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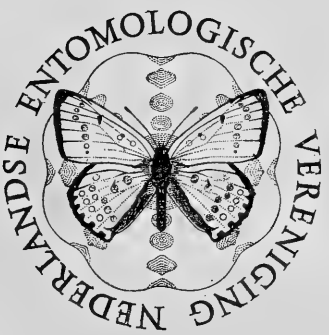

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THE GENUS LIPARA MEIGEN (DIPTERA, CHLOROPIDAE), SYSTEMATICS, MORPHOLOGY, BEHAVIOUR, AND ECOLOGY

by

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Abstract

Four species of the genus *Lipara,* viz.: *L. lucens, similis, rufitarsis* and *pullitarsis,* occur in Europe, where they cause galls in Common Reed (*Phragmites communis*). The specific differences of eggs, larval, and adult stages are described, and a general account is given of the life cycle, gall formation, precopulatory and ovipositional behaviour, habitat relations, and influence of parasites and predators with emphasis on the known differences between the species.

Contents

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1. INTRODUCTION

The galls on Common Reed (*Phragmites communis* Trin.), caused by flies of the genus *Lipara,* have attracted the attention of many generations of entomologists in Europe. During more than one hundred years, after several entomologists in Vienna had collected reed galls and studied their inhabitants (Schiner 1854, Heeger 1856, Loew 1858, Giraud 1863), three species were recognized: *L. lucens, rufitarsis,* and *similis.*

In 1957 Ruppolt mentioned the occurrence of two types of larvae of *L. rufitarsis,* one in typical galls and the other in galls indentical to those of *L. lucens.* He supposed that these might be two different species.

From 1967 to 1970, Pokorný took up the problem again in Czechoslavakia, and found that the two types of *L. rufitarsis* make distinctive galls. The differences he observed also in the life cycle and the behaviour of the larvae were such that he expected the insects to belong to two different species. He submitted the adults, bred from the galls, to Doskočil and Chvála who indeed recognized them as two different species, one being *L. rufitarsis* and the other, a previously undescribed species which they named *L. pullitarsis* (Doskočil and Chvála, 1971).

In recent years Mook studied the ecology of *Lipara lucens* in the Netherlands (Mook, 1961, 1967) and also collected data on the ecology of *L. rufitarsis* and *pullitarsis* (*L. similis* does not occur in the Netherlands). In co-operation with Miss C. G. Bruggemann he studied the behaviour of the adult of *L. lucens* (Mook and Bruggemann, 1968, 1971) and also collected data on the behaviour of the other species. These data corroborate the view that four different species are involved.

It seemed worth while to collect both the published and the unpublished data in order to give a survey of the similarities and differences in the biology of the four species. The results are presented here. The authors have each treated those aspects of the biology with which they are most familiar, and they remain responsible for the relevant section: Chvála and Doskočil for section 2, Pokorný, for section 3 and Mook, for sections 4 and 5. It should be kept in mind that the different geographical localities where the authors collected their data may have influenced their findings.

2. SYSTEMATICS AND MORPHOLOGY

a. Adults

Genus Lipara Meigen, 1830

Lipara Meigen, 1830: 1. Type species, *Lipara lucens* Meigen, 1830 (monobasic).

Homalura Wiedemann, 1830: 573 (nec Meigen, 1826), junior homonym. Type species, *Homalura grisea* Wiedemann, 1830 (monobasic).

? *Gymnopoda* Macquart, 1835: 503, subjective synonym. Type species, *Gymnopoda tomentosa* Macquart, 1835 (monobasic).

The genus *Lipara* Meigen belongs to the family Chloropidae, subfamily Oscinellinae, and comprises medium-sized to large blackish species, 3.3—7.3 mm, with dense pale pubescence on mesonotum. Arista thin, not pubescent, antennae broadly separated at base by a wide pollinose facial keel, very prominent in lateral aspect. Eyes rather small and finely pubescent, face very deep, almost as long as one half of the eye-height; vibrissal angles absent.

The genus nearest related to *Lipara* is *Calamoncosis* Enderlein wich comprises distinctly smaller species, 2-3 mm, with equally oval head in profile, with facial "keel" only indistinctly developed. In *Lipara* the facial keel is prominent and very broad over the whole length, as far as the mouth cavity, or, if it is narrowed in the middle between the antennae, again widening out below; viewed from the side, the keel is strongly prominent above the antennae, as is the lower part of the frons, so that the head in profile ist strongly prominent anteriorly.

The larvae of all *Lipara* species cause more or less distinct galls on stems of the Common Reed (*Phragmites communis* Trin.).

The genus has been recently revised by Doskočil and Chvála (1971) and as a result four Palaearctic species (viz., *lucens, similis, rufitarsis,* and *pullitarsis*) were introduced as essentially European species. Two of them, *lucens* and *similis,* have been found separately as immigrants in North America.

The four Palaearctic *Lipara* species may be keyed as follows:

1 Thoracic pubescence long, arranged in longitudinal stripes, producing a ridged appearance. Large or smaller species 2
— Thoracic pubescence shorter, uniformly spread, not arranged in stripes. Smaller species 3
2 Thoracic pubescence brassy-yellow. Large species, 5.3—7.3 mm, facial keel very broad . . . . . *lucens*
— Thoracic pubescence whitish. Smaller species, 3.3—4.6 mm, facial keel narrower . . . . . *similis*
3 Facial keel broad, with almost parallel sides, about as broad as one-half of antennal segment 3. Male genitalia with fused cerci. Length 3.3—5.0 mm *pullitarsis*
— Facial keel narrowed in the middle, widening above and below, less broad than one-third of antennal segment 3. Male genitalia with paired cerci. Length 3.5—5.3 mm . . . . . *rufitarsis*

Lipara lucens Meigen, 1830

Lipara lucens Meigen, 1830, Syst. Beschr. 6: 1.
Homalura grisea Wiedemann, 1830, Aussereurop. zweifl. Ins., 2: 573.
? *Gymnopoda tomentosa* Macquart, 1835, Hist. nat. Ins. Dipt., 2: 502.

Diagnosis. A conspicuously large and robust species, 5.3—7.3 mm, the largest species of the genus and family in the Palaearctic region. Thorax with long, brassy-yellow pubescence on mesonotum which is arranged in distinct longitudinal stripes, producing a ridged appearance. Antennae yellowish on basal segments, segment 3 mostly blackish. Facial keel conspicuously broad and with almost parallel sides. Legs extensively darkened. Male genitalia (Fig. 2) large, with small but rather widely separated, apically pointed cerci.

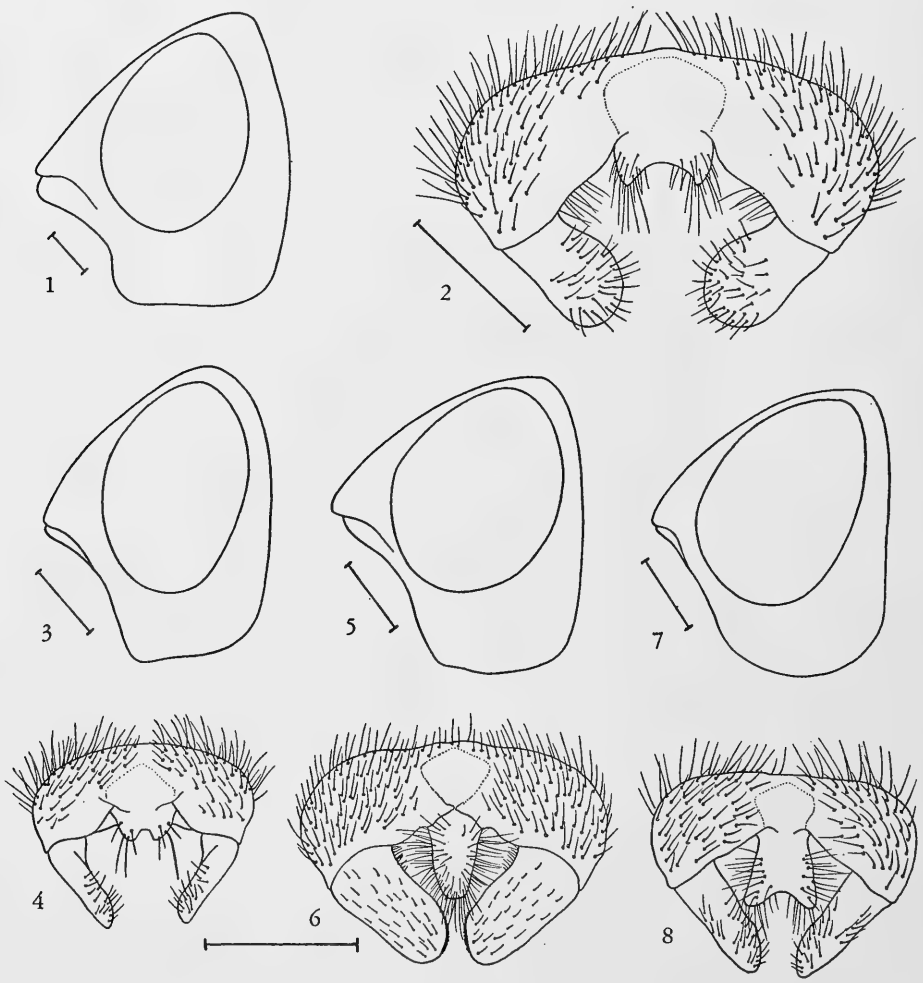
Distribution. A widely distributed and everywhere common species in Europe, ranging in the North from England through the Netherlands, Denmark, and southern Sweden, eastward as far as the northern regions of the European part of the USSR, a very common species in central and southern Europe, immigrant in North America (Connecticut).

Lipara similis Schiner, 1854

Lipara similis Schiner, 1854, Verh. zool.-bot. Ges. Wien, 4: 172.

Diagnosis. Closely related to *lucens,* having the same type of long pubescence on thoracic disc which is arranged in distinct longitudinal stripes, producing a ridged appearance. In contrast to *lucens,* the thoracic pubescence is distincly whitish to silvery-grey; *similis* is a much smaller species, 3.3—4.6 mm. Facial keel rather broad, slightly widened above and below. Antennae and palpi yellowish. Legs mostly yellow on tibiae and tarsi, but in some specimens tarsi extensively darkened. Male gentitalia (Fig. 4) small, cerci not very wide apart, small, and apically distinctly rounded.

Distribution. The species is rather common and widely distributed in Central Europe (Poland, Germany, Czechoslovakia, Austria, and Hungary), and has also been recorded from England, France, and the western regions of the European part of the USSR.



Figs. 1—8. Head in profile and male genitalia (caudal view) of *Lipara:* 1, 2, *lucens* Meig.; 3, 4, *similis* Schin.; 5, 6, *L. pullitarsis* Dosk. et Chv.; 7, 8, *L. rufitarsis* Loew. Scale = 0.3 mm

According to Sabrosky (1958), the species was intercepted in the USA (Hoboken) in *Phragmites* packing from a ship from the Netherlands. It was also mentioned for the Netherlands by Docters van Leeuwen (1957), but his description and illustration of the gall do not fit. The species has not been reared from Dutch galls (de Meijere, 1949). Dr. Th. van Leeuwen, Dr. W. J. Kabos, Dr. G. Kruseman (Amsterdam) and Dr. S. J. van Ooststroom (Leiden), who were so kind as to inform us of their experiences, also did not find the species in the Netherlands.

Lipara pullitarsis Doskočil et Chvála, 1971

Lipara pullitarsis Doskočil et Chvála, 1971, Acta ent. bohemoslov., 68: 102.

Diagnosis. A smaller species, 3.3—5.0 mm, with mesonotum densely covered with mostly brassy-yellow short pubescence, not arranged in longitudinal ridges. Facial keel very broad, the narrowest part in the middle about as broad as half the width of antennal segment 3. Antennae mostly black, only basal segments sometimes very dark brown; palpi black. Legs mostly black, extreme tips of femora and extreme bases of tibiae slightly brownish; fore tarsi black, posterior four tarsi yellowish-brown on basal segments, apical segments extensively darkened. Male genitalia (Fig. 6) rather large, with broad parameres and entirely fused long cerci. The Central European and southern Scandinavian populations have extremely darkened antennae and legs, but we have seen paler specimens from the Netherlands that superficially resemble *rufitarsis,* differing from the latter by a much broader facial keel and quite distinct male genitalia.

Distribution. This species has long been confused with *rufitarsis,* and it is highly probable that many records on the distribution of *rufitarsis* refer, in fact, to *pullitarsis.* The species was described very recently from Czechoslovakia but we have also seen documentary material from the Netherlands, Denmark, and Sweden.

Lipara rufitarsis Loew, 1858

Lipara rufitarsis Loew, 1858, Wien. Ent. Monatschr., 2: 57.

Diagnosis. A smaller species, 3.5—5.3 mm, resembling *pullitarsis* in having the same type of pubescence on thoracic disc; the hairs are short and not arranged in longitudinal ridges but, in contrast to *pullitarsis,* the pubescence is distinctly silvery-grey and the hairs on the hind part of mesonotum and on the scutellum are distinctly longer. Facial keel is much narrower than in *pullitarsis,* widening above and below, the narrowest part in the middle being hardly as broad as one-third the width of antennal segment 3. Antennae reddish-brown except for outer side of segment 3 and arista which are extensively darkened or almost black; palpi black. Femora and tibiae predominantly black, the apical tips of femora, both rather broader tips of tibiae and whole tarsi yellowish- to reddish-brown. Wings with cubital and discal veins almost straight, not curved as in *pullitarsis.* Male genitalia (Fig. 8) rather large, with narrower parameres, long cerci apically distinctly separated.

Distribution. *L. rufitarsis* is recorded in the literature as a common species throughout Europe, but at least some of these records must concern *pullitarsis.* We have seen the documentary material from the Netherlands, Czechoslovakia, Austria, and Italy, and

according to Dr. Hackman (letter of 24.8.1971), the material from southwestern Finland also belongs to *rufitarsis*. On the other hand, having revised in Copenhagen and Lund all of the accessible *rufitarsis* material from Denmark and southern Sweden, one of the authors (Chvála) comes to the conclusion that all of it belongs to *pullitarsis*.

b. Immature stages

There are few older data on immature stages of *Lipara;* a summary of all the records up to 1950 is given by Hennig (1952). He found only four records of larva and puparium of *lucens* in the literature, but the record of larva by Vimmer (1925), must, in fact, refer to *rufitarsis* judging from the Czech description and figures. Ruppolt (1957) described eggs and larval stages of *lucens*. The most complete treatment of the morphology of immature stages of *lucens* is by Waitzbauer (1969). No other records are available.

Most of the eggs, larvae, and puparia used for the study discussed in this section, belong to material collected and bred by J. H. Mook and V. Pokorný.

Eggs

The eggs of the four Palaearctic *Lipara* species are very distinctive. In general, they may easily be separated into two different groups, viz., (1) the *lucens* type and (2) the *rufitarsis* type. The former type (*lucens* and *similis*) is characteristically rather broader, more oval, and light yellow in colour. The differences between the eggs of *lucens* (Plate 2b) and *similis* (Plate 2d) are very slight; the egg of *similis* is almost as long and as wide as that of *lucens,* but the latter has more distinct sculpture, consisting of rather deep longitudinal furrows (Plate 2a). The measurements of the eggs of these two species are as follows: *lucens*: (N = 40) length 1.37—1.69 mm (M = 1.57 mm), width 0.25—0.36 mm (M = 0.32 mm); *similis:* (N = 20) length 1.35—1.46 mm (M = 1.42 mm), width 0.23—0.32 mm (M = 0.27 mm). The ratio of length to width is about 5 : 1 in both *lucens* and *similis*.

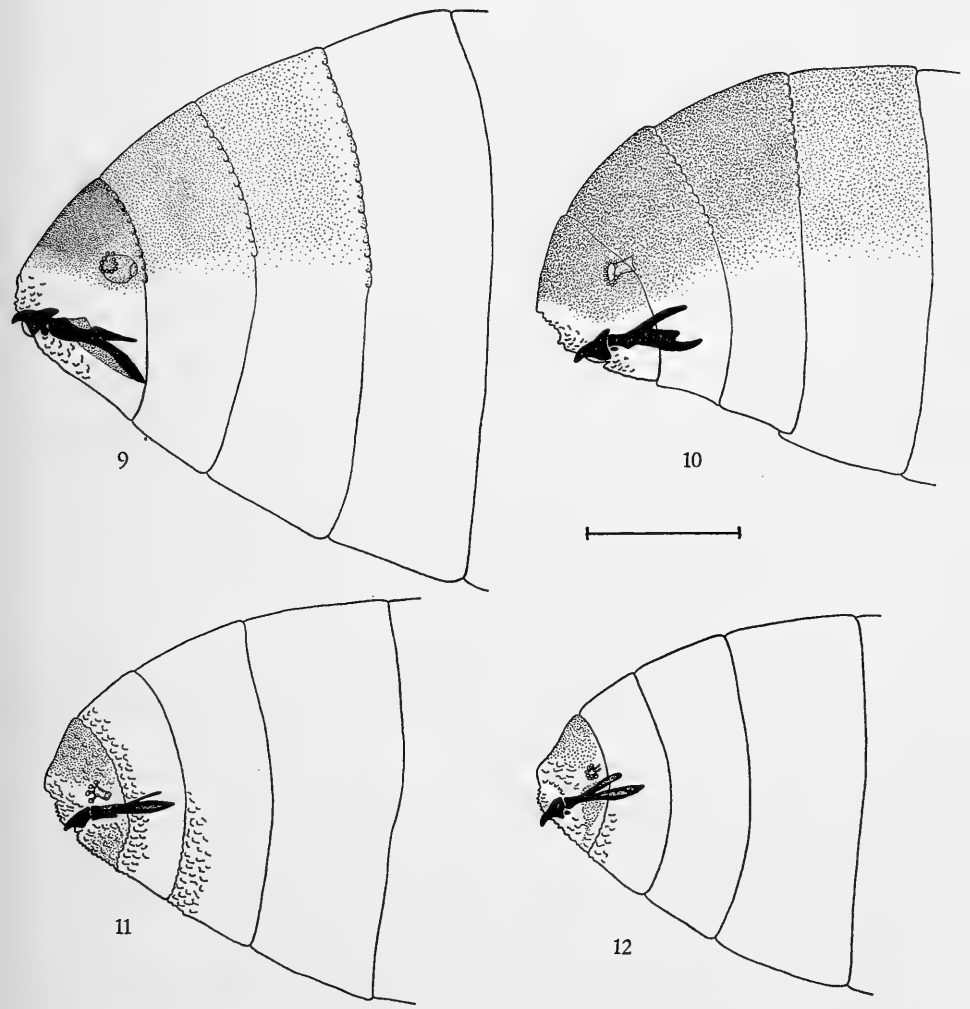
The second type of egg (*rufitarsis* and *pullitarsis*) is characteristically long and narrow, and distinctly blackish in colour. The egg of *pullitarsis* (Plate 3b) is distinctly narrower, slightly shorter, rather circular in cross-section, and the longitudinal furrows (Plate 3a) are quite distinct. The eggs of *rufitarsis* (Plate 3d) is less slender but slightly longer, somewhat triangular in cross-section (rounded above, flattened below), and the longitudinal furrows are less numerous and barely visible; the whole egg is therefore rather smooth. The measurements of these two eggs are: *pullitarsis:* (N = 30) length 1.13—1.26 mm (M = 1.21 mm), width 0.07—0.11 mm (M = 0.09 mm); *rufitarsis:* (N = 40) length 1.39—1.53 mm (M = 1.50 mm), width 0.15—0.20 mm (M = 0.18 mm). The ratio of length to width in *rufitarsis* is 8 : 1, in *pullitarsis* 13 : 1.

Larvae

Larvae are elongate, light yellowish, with one or both tips more or less sclerotized; the length of mature larvae varies from 5.5 to 12 mm; all measurements were taken from larvae collected in the winter or early spring. The whole body is rather smooth, integument exclusively with regularly spaced flower-like not sclerotized papillae and sometimes with striae, especially on anterior segments. The sclerotization of anterior and posterior segments, including the number of buds on anterior spiracle, seem to be

the best specific characters. Posterior spiracle consists of three simple radiating slits, interstigmatal processes are branched (? absent in *rufitarsis*).

The mature larva of *lucens* (Plate 6a) is conspicuously large and stout, 8—12 mm in length and 2—3 mm in width. Only anterior segments dorsally sclerotized (Fig. 9), more heavily on segment 1 as far as the anterior spiracle, a slight sclerotization continues over anterior spiracle on dorsum of segment 2 and anterior half of segment 3. Segment 1 sometimes also slightly sclerotized ventrally. Posterior margin of anterior three segments on dorsum with small sclerotized papillae in a row; on venter also present but hardly visible (not sclerotized). Anterior spiracle (Fig. 13) with 11 to 12 (exceptionally up to 14) buds, their number not constant on each side; the usual combinations are 11—11, 11—12, or 12—12, in rare cases, 12—13 or 12—14.



Figs. 9—12. Four anterior segments of mature larva of *Lipara* (lateral view). 9, *L. lucens* Meig.; 10, *L. similis* Schin.; 11, *L. pullitarsis* Dosk. et Chv., 12, *L. rufitarsis* Loew. Scale = 1 mm

The mature larva of *similis* (Plate 6b) generally is smaller and especially more slender, 5.5—10 mm in length and 1—2 mm in width; it is the only species of the genus with distinct sclerotization of both tips. Segment 1 (Fig. 10) heavily sclerotized dorsally, except for a narrow anterior strip, segments 2 and 3 heavily sclerotized dorsally, almost blackish, as is segment 1. Segment 4 dorsally with a slight sclerotization, venter of four anterior segments pale, membraneous. Segments 5 to 10 membraneous, segment 11 slightly sclerotized dorsally and ventrally, almost membraneous laterally. Segment 12 heavily sclerotized throughout, having the same blackish colour as anterior three segments dorsally. Posterior margins of segments 2, 3, and 10 dorsally with a row of slightly sclerotized papillae, these membraneous only on venter. Anterior spiracle (Fig. 14) with 9 tot 11 buds with usual combinations 9—9, 9—11, 10—11, 11—11, or 9—10.

The mature larva of *pullitarsis* (Plate 6c) is 6.5—9 mm long and 1.5—2 mm wide, with sclerotization on segment 1 similar to that in *rufitarsis*. Dorsum of segment 1 (Fig. 11) more or less heavily sclerotized, lateral area almost membraneous, and venter evenly and slightly sclerotized, without any distinct pattern. Slight sclerotization also visible on the anterior ridge. No rows of membraneous papillae have been found on posterior margins, but distinct papillae are visible on anterior ridge and among the striation on segment 1 ventrally; this segment distinctly striated both ventrally and dorsally, segment 2 on anterior half dorsally and ventrally, segment 3 on anterior half ventrally only. Otherwise the integument is smooth, except for regularly spaced, small, flower-like papillae. Anterior spiracle (Fig. 15) with 4 to 5 buds, the number on each side often differing.

The mature larva of *rufitarsis* (Plate 6d) has in general much in common with *pullitarsis;* it is rather smaller, 6—8.5 mm long and 1.5—2.5 mm wide, more or less sclerotized only on segment 1. The dorsal sclerotization (Fig. 12) is not very distinct (light brown in colour), almost interrupted laterally near anterior spiracle and again more distinct on a triangular patch ventrally. Papillae on posterior margins always membraneous and therefore inconspicuous. Whole of segment 1 distinctly striated except for the anterior ridge, which bears very small, not sclerotized papillae. Segment 2 with fine striae on anterior half ventrally, otherwise segments smooth. Anterior spiracle (Fig. 16) with 6 to 9 buds in combinations 7—8, 8—9, 7—7, 6—7, or 6—6.

The mature *Lipara* larvae may be keyed as follows:

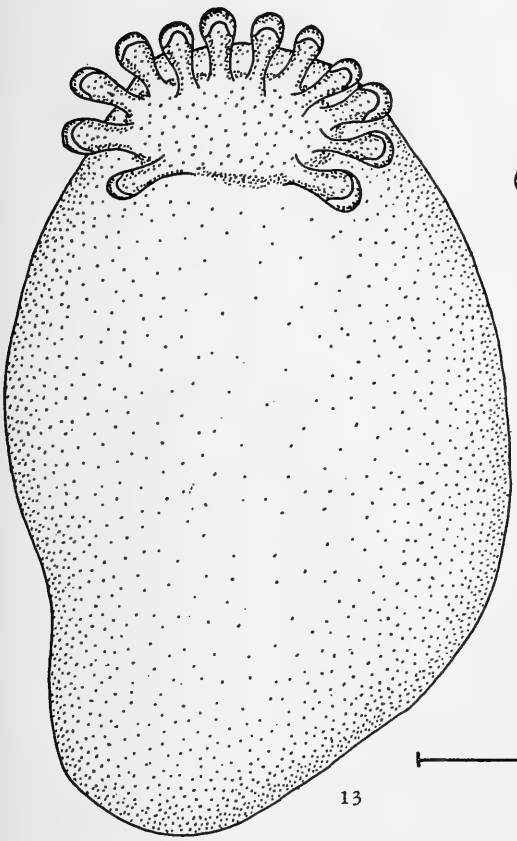
1 Larva heavily sclerotized (blackish-brown in colour) on both tips, anteriorly on 4, posteriorly on 2 segments. Anterior spiracle with 9 to 11 buds. Larva about 8 mm long . . . . . *similis*

— Larva less heavily sclerotized (brownish in colour), only anteriorly, at most on the three anterior segments. Posterior segments pale, membraneous . . . 2

2 Three anterior segments slightly sclerotized on dorsum. All thoracic segments with a row of heavily sclerotized papillae on posterior margin, segment 1 without a ridge on anterior margin. Anterior spiracle with 11 to 12 (or rarely up to 14) buds. Larva about 10 mm long and very stout . . . . . *lucens*

— Only segment 1 slightly sclerotized. Sclerotized papillae on posterior margins of thoracic segments absent, segment 1 with a distinct ridge on anterior margin.

Fig. 13—16. Anterior spiracle of mature larva of *Lipara*. 13, *L. lucens* Meig.; 14, *L. similis* Schin.; 15, *L. pullitarsis* Dosk. et Chv.; 16; *L. rufitarsis* Loew. Scale = 0.1 mm



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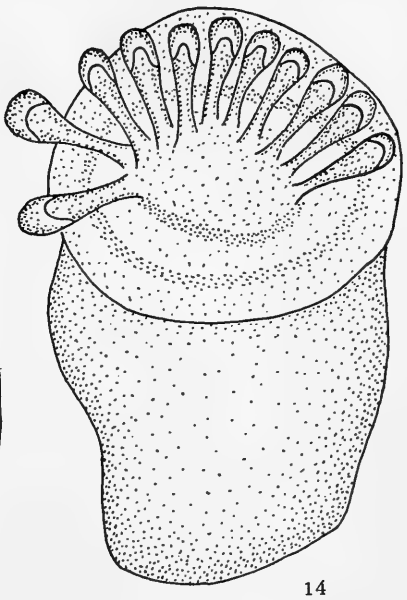

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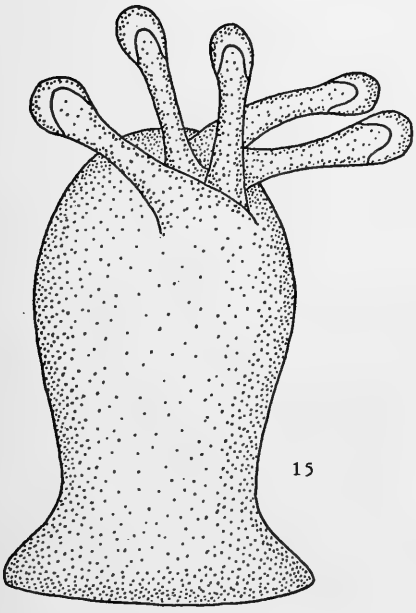

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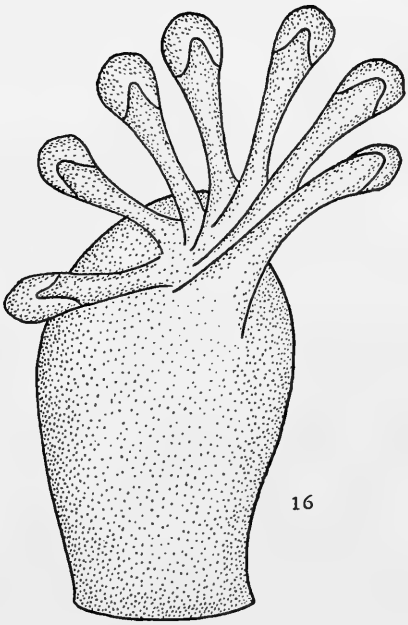

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Anterior spiracle with at most 9 buds. Larvae generally smaller, about 8 mm long, and slender 3

3 Anterior spiracle with 6 to 9 buds. Segment 1 usually slightly sclerotized, also ventrally, distinctly striated on the whole surface, except the smooth anterior ridge; segment 2 with slight striae on anterior half ventrally; segment 3 smooth, without striae . . . . . *rufitarsis*

— Anterior spiracle with 4 to 5 buds. Segment 1 usually membraneous beneath, at most quite indistinctly sclerotized, but with distinct striae throughout, also on anterior ridge; segment 2 with striae on anterior half both ventrally and dorsally; segment 3 with striae on anterior half ventrally . . . . . *pullitarsis*

Puparia

The puparia are brown to reddish-brown, with the same specific characters as in mature larvae, i.e. of the same size, different colour of tips, and the same number of buds on the anterior spiracle. *L. lucens* has a large and stout puparium, 8 to 12 mm long, the anterior two segments distinctly darkened dorsally, anterior spiracle with 11 to 14 buds; puparium of *similis* slightly smaller on average, distinctly blackish over three anterior and two posterior segments, anterior spiracle with 9 to 11 buds; *rufitarsis* and *pullitarsis* have smaller puparia, about 6 to 9 mm long, slightly darkened on segment 1 only, anterior spiracle with 6 to 9 buds in *rufitarsis* and 4 to 5 buds in *pullitarsis*.

3. Life cycle and influence on the reed stems

a. Life cycle and gall formation

By their action in the larval stage, all four *Lipara* species induce the formation of a terminal gall on the infested shoot, thus altering the length of the stem, the number and dimensions of internodes and the formation of a panicle. Each gall is ultimately inhabited by a single larva, even when shoots are infected by more than one egg.

The formation of the gall is principally the same in all four species, and is closely related to the behaviour of the larvae. The egg-laying behaviour of the fly is described in section 4. Several days after the eggs are laid the larvae hatch. In *L. lucens* the larvae hatch after about 9 days. Hatching takes place virtually only during the night. This is probably important for survival, because in order to escape drying out the larvae require a very high humidity (Ruppolt, 1957, Mook, 1967). The young larva crawls upward on the surface of the shoot untill it reaches the top part, and then crawls under the edge of a leaf sheath into the roll of young leaves. There it feeds on the young leaf parenchyma and bores downward toward the growing point. Just above this point it continues to feed on the newly-formed leaves. Here the larva molts twice. The growing point is affected by the feeding of the larva and probably also by its metabolic products. Internodes formed subsequently remain shorter than the internodes of a healthy stem.

The shortening of the internodes leads to the formation of the terminal gall in the stem. The gall itself is formed (except in the case of *L. lucens*) by the leaves growing from the agglomerated nodes. The leaf-sheaths do not have sufficient room to grow parallel with the stem axis and are pushed off at an angle to it; in this way the typical cigar- or spike-like inflation develops.

Up to this point the life cycle is basically the same for all the four species. The

differences become apparent at a later stage, and therefore the rest of the life cycle will be described for each species separately.

During July or August the larva of *L. lucens* (Plate 6a) bites through the growing point and lives in the shortened internodes where it feeds on the soft parenchyma filling these internodes. In due time it gnaws a chamber passing into the 6th to 8th internode from above. At the end of the summer and in the beginning of the autumn the larva turns 180° in the chamber, so that its head is pointing upward. This turn is very important (and takes place in the other species, too), because it enables the adult to leave the gall. After turning, the larva shifts its position 2 to 3 cm higher, living without nutrition approximately 1 to 2 cm under the remnants of the growing point; at that time it is 8—12 mm long, thick, and ivory white. In this position it also hibernates and pupates in the spring. In Czechoslovakia and in the Netherlands, depending on the climatic conditions, the adults emerge as the second *Lipara* species at the end of May or beginning of June (Fig. 17).

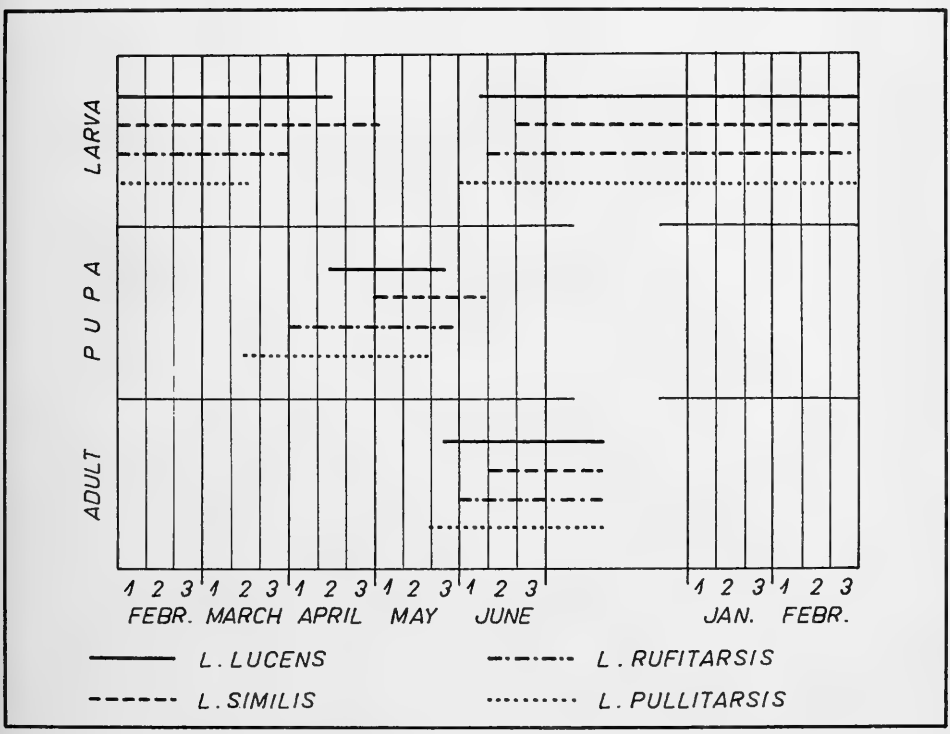


Fig. 17. Life cycle of *Lipara* species in Czechoslovakia

The growing point of the reed is also perforated by the larva of *L. rufitarsis* (Plate 6d), but in this species the chamber reaches only to the 3rd or 4th (shortened) internode from the top. The walls of the shortened internodes are not thickened and their width is the same as that of the adjacent not shortened ones. Once arrived below the growing point the larva feeds until some time around August, after which it turns and rests until spring, when it pupates. At that time it is 6—8.5 cm long, slightly yellowish, and more flattened than the larvae of the other species. The adult emerges as the third *Lipara* species at the beginning of June.

These two species are characterized by a common behaviour pattern viz., biting through the growing point and life in the chamber in the shortened internodes. The other two species leave the growing point intact, living throughout their whole lifespan between the leaves above this.

In the beginning, the larva of *L. pullitarsis* (Plate 6c) feeds on young rolled leaves in which it "chops" its chamber. Later on, when the panicle is beginning to be formed, it feeds on this rudiment often completely destroying the panicle. Sometimes, probably when infestation occurs later, a panicle large enough to survive is formed in the gall, only to have the larva gnaw through it, too, to maintain its chamber. Such panicles never develop fully. Before turning, the larva usually reaches the growing point, but after having turned, it shifts itself 3 to 5 cm above the growing point and hibernates there. At that time it is 6.5—9 mm long and white. In the spring, as soon as the days become warmer, the larva pupates as the first of the *Lipara* species and the adults emerge also as the first, in the second half of May.

Similarly, the larva of *L. similis* (Plate 6b) lives in the tube of leaf sheaths. In the beginning it feeds on the rolled leaves, which later becomes completely severed from the growing point, so that they can be pulled out by the tips. The space between the leaves is relatively narrow and the adult larva fills it completely. As soon as the panicle begins to develop the larva starts to feed on the rudiments, thus destroying the panicle completely. Even in the narrow cleft in the tube the larva turns and shifts itself upward. During the winter and early spring, the two sheaths become hard, thus protecting the hibernating larva, which at that time lies 5 to 7 cm above the remnants of the growing point. In this period it reaches a length of 5.5 to 10 mm, and is slim, milky white, and glossy, with both ends black. In the same position, the larva pupates in spring as the last of the *Lipara* species. The adults emerge, also as the last, in the middle of June.

b. Description of the galls

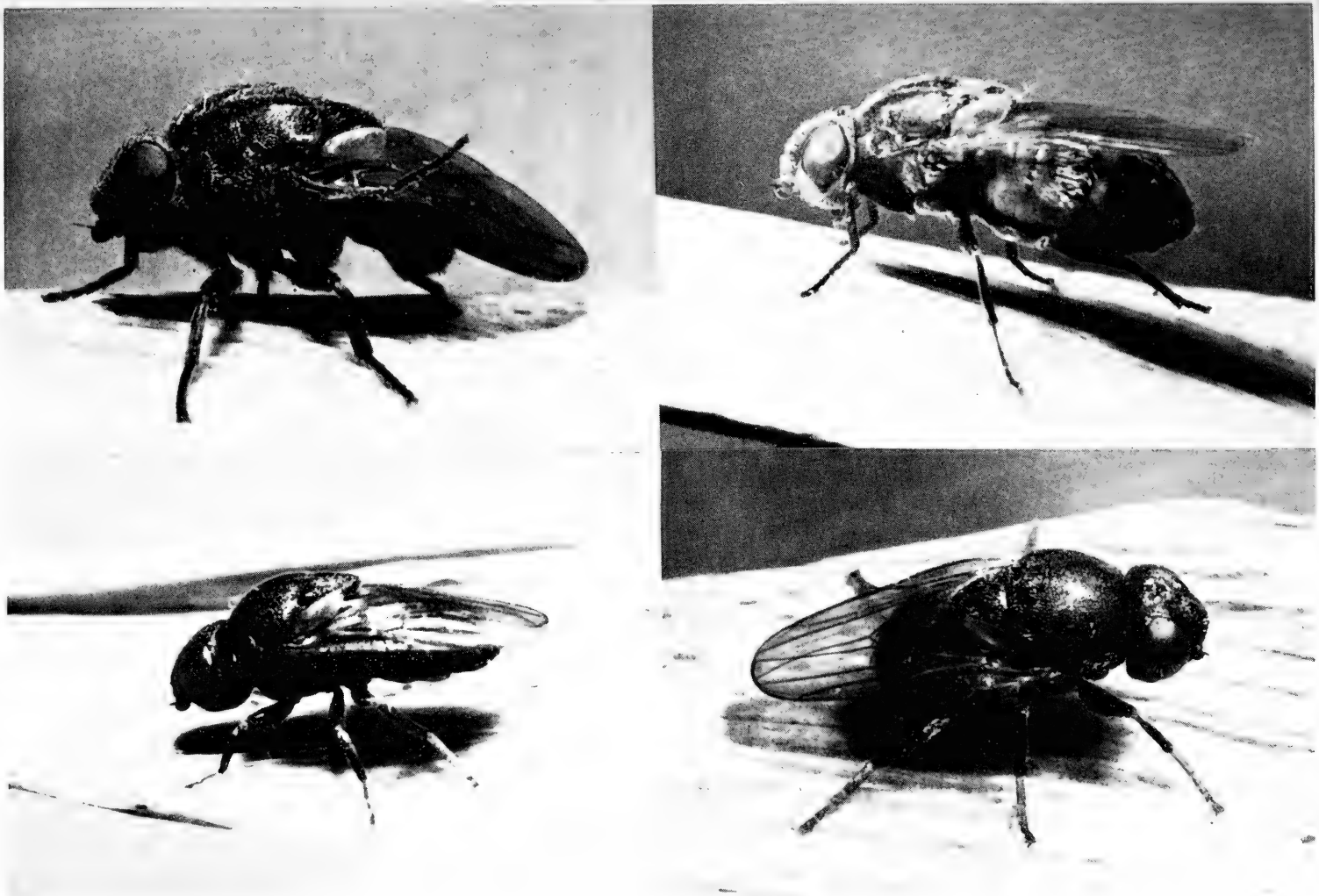
The number of shortened internodes is more or less characteristic for the species and thus also for the shape of the gall (Fig. 18 and Plate 4). The most massive and prominent galls result from the influence of the larva of *L. lucens* (Plate 5a), and this corresponds with the greatest number of shortened internodes, usually 10—13. The shortened internodes are 2 to 3 times wider than the adjacent normal ones, and their walls are thickened and strongly lignified (Plate 4a). All of the 6 to 8 uppermost shortened internodes are brownish and covered with a continuous hairy layer. The agglomerated nodes are also provided with a wreath of hairs, and the leaves growing from them have short broad sheaths and weaker short blades. The highest leaves are relatively broad and short, again covered with a continuous hairy layer; these leaves do not differentiate into sheath and blade.

Due to the activity of the larvae of *L. rufitarsis* or *L. pullitarsis,* only 5 to 6 internodia are manifestly shortened (Plate 4c). The galls (Plate 5c, d) in these two species are usually similar, and can only be conclusively differentiated by a longitudinal section through the gall. The galls are medium-sized to large, the *pullitarsis* galls being usually larger, since *pullitarsis* occurs on wider shoots. This is why its galls are sometimes larger than those of *lucens*. But if the galls of *lucens* and *pullitarsis* appear simultaneously on equally wide shoots, those of *lucens* are always larger (Fig. 20).

The stem infested by *L. similis* has the smallest number of shortened internodes, i.e.

a

b



c

Plate 1. Adults of *Lipara*. a, *L. lucens* Meig.: b, *L. similis* Schin.; c, *L. pullitarsis* Dosk. et Chv.; d, *L. rufitarsis* Loew (Phot. V. Pokorný).

d

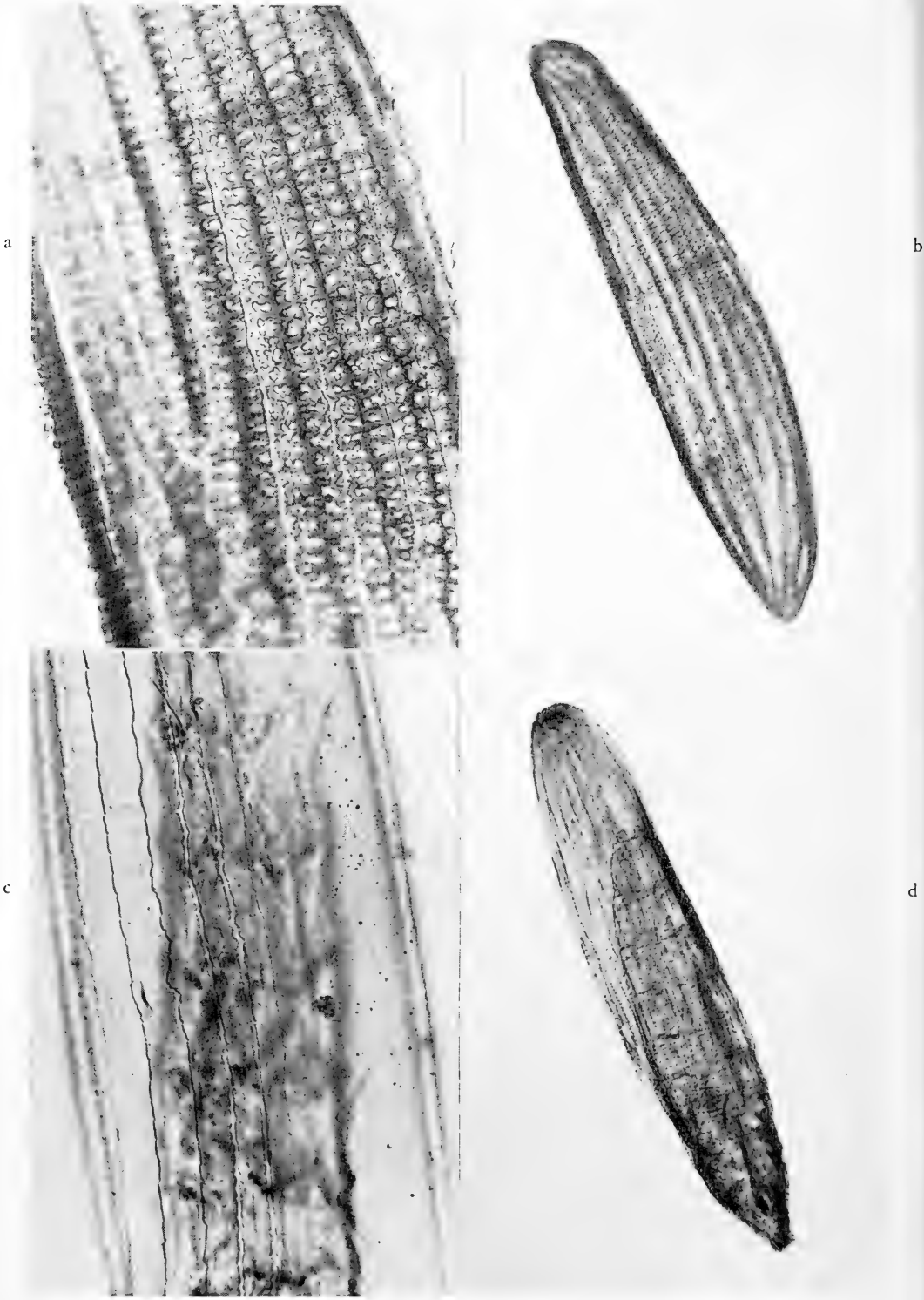


Plate 2. *Lipara* eggs with detail. a, b, *L. lucens;* c, d, *L. similis* Egg: × 70, detail: × 160 (Phot. J. Chalupský)

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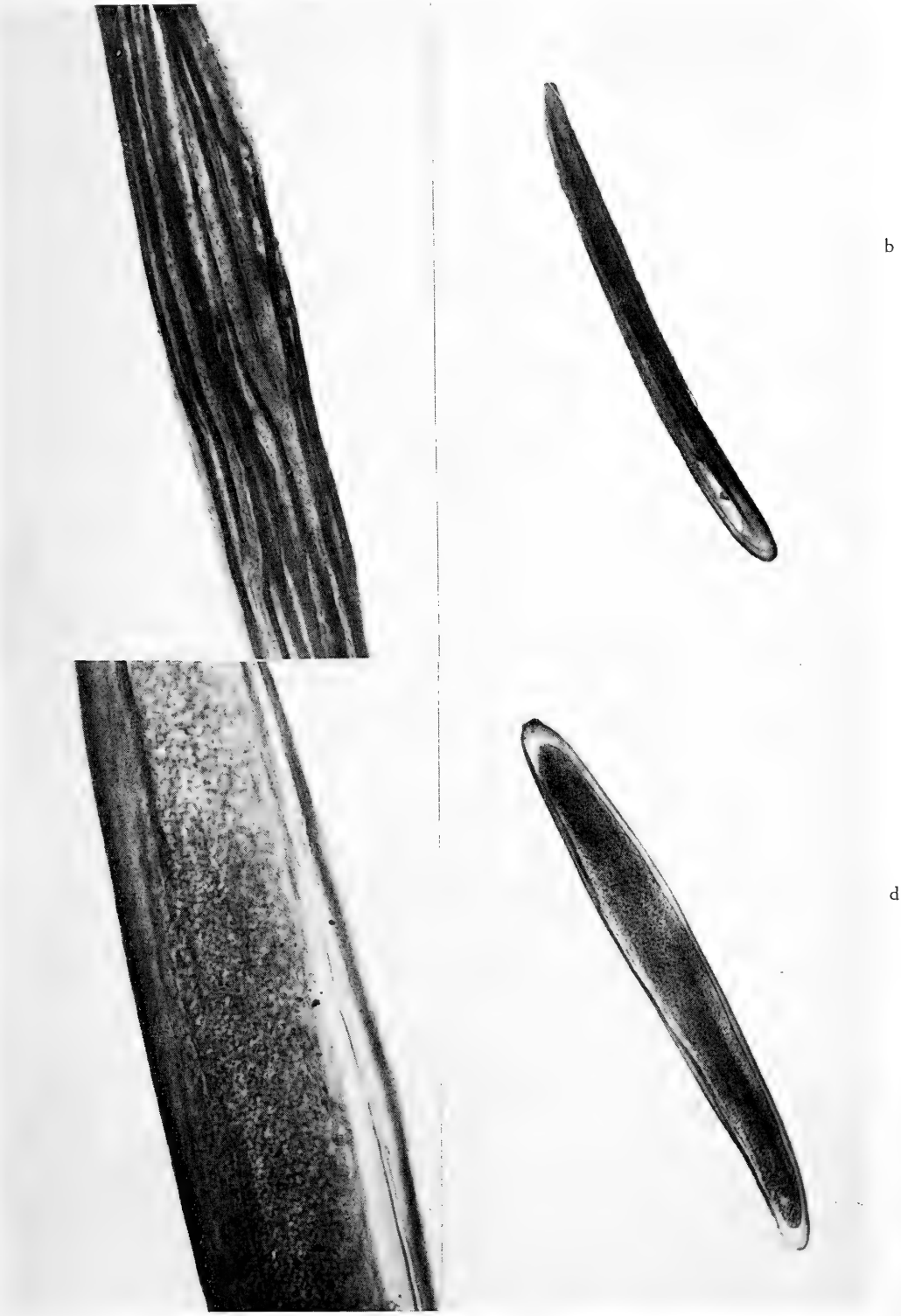


Plate 3. *Lipara* eggs with detail. a ,b, *L. pullitarsis;* c, d, *L. rufitarsis.* Egg: × 70, detail × 160 (Phot. J. Chalupský)

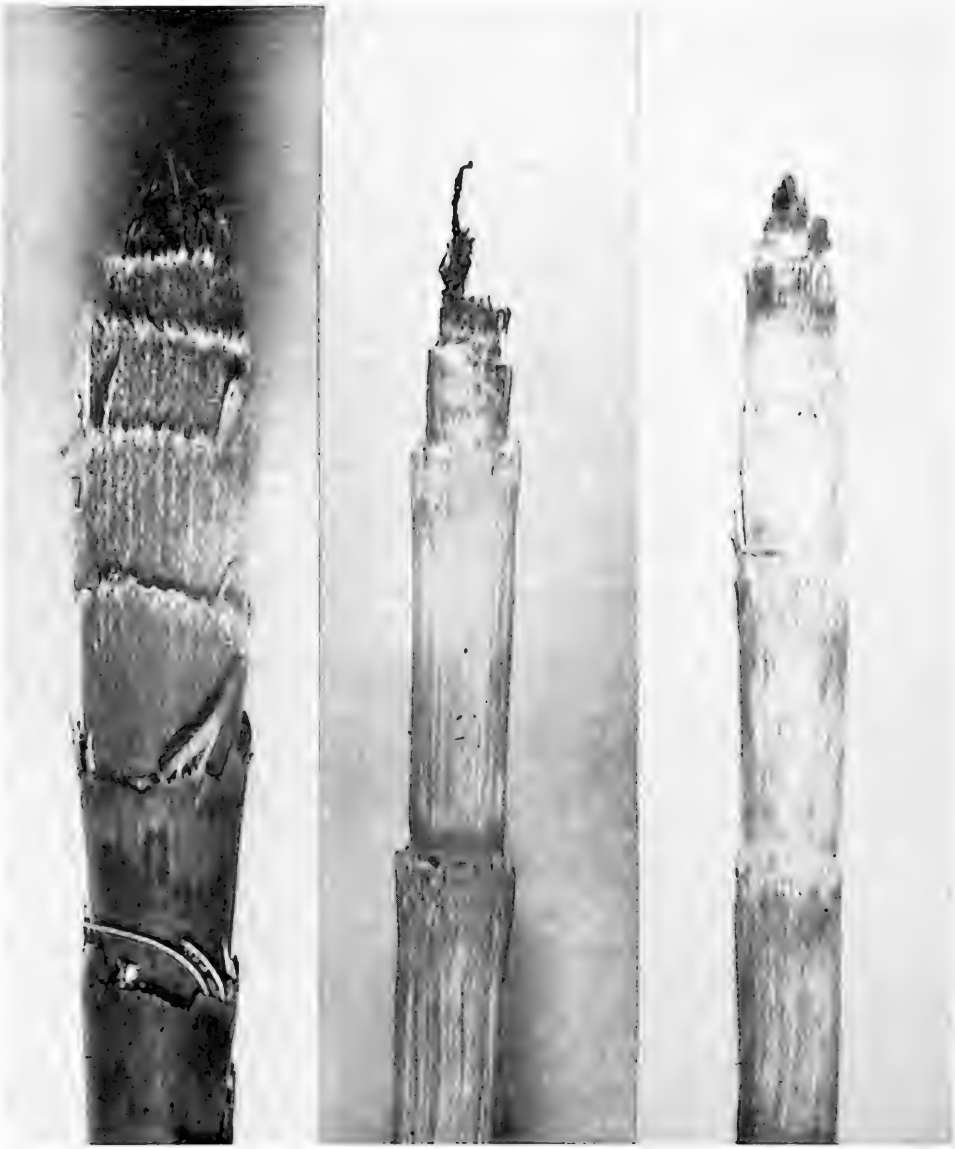


Plate 4. The highest internodes of reed stems with a gall of *Lipara*. a, *L. lucens;* b, *L. similis;* c, *L. pullitarsis* (Phot. V. Pokorný)

Plate 5. Galls typical of the individual species of *Lipara*. a, *L. lucens;* b, *L. similis;* c, *L. pullitarsis;* d, *L. rufitarsis*. The size relations are maintened (Phot. V. Pokorný)

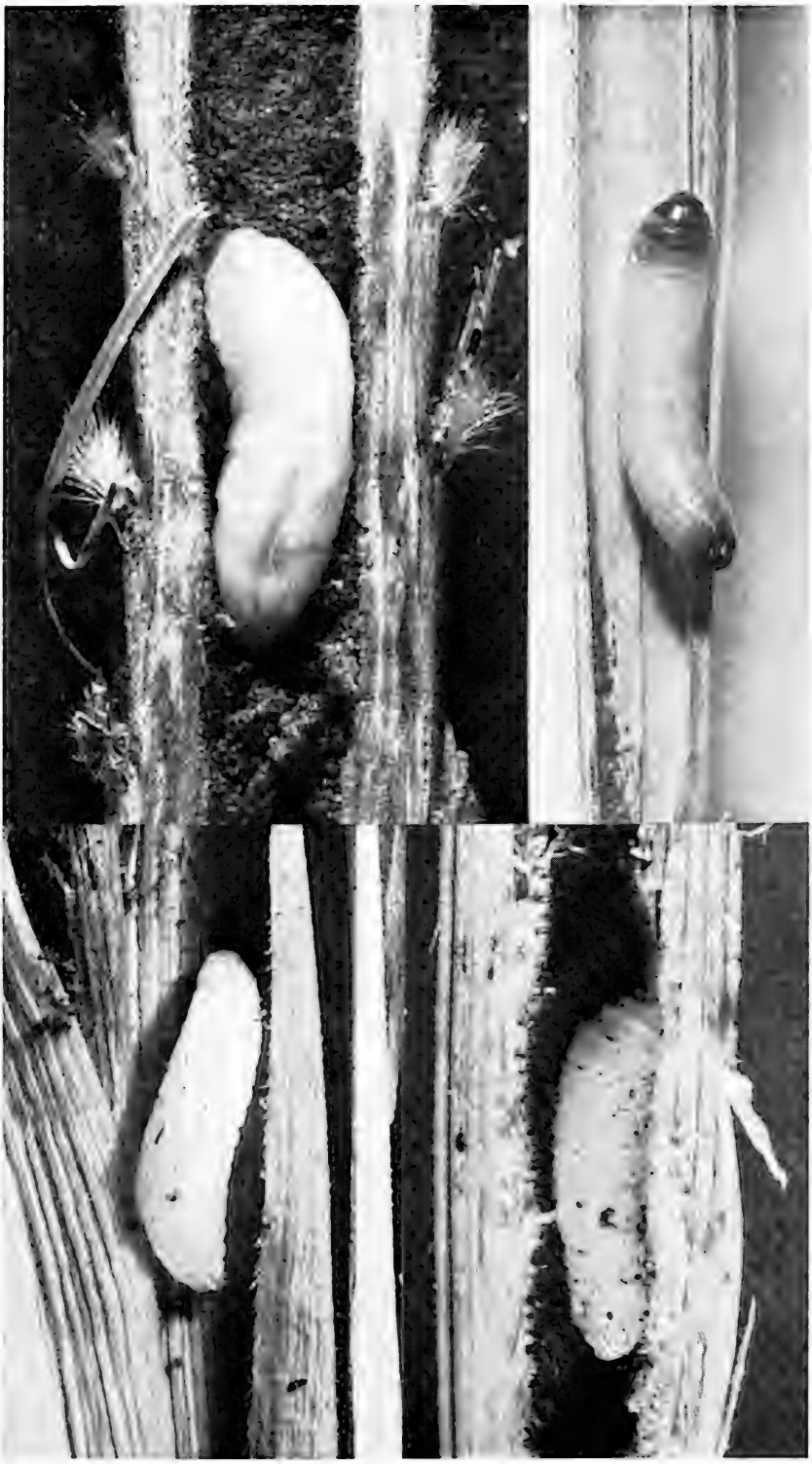


Plate 6. Larva of *Lipara*. a, *L. lucens*; b, *L. similis;* c, *L. pullitarsis;* d, *L. rufitarsis* (Phot. V. Pokorný)

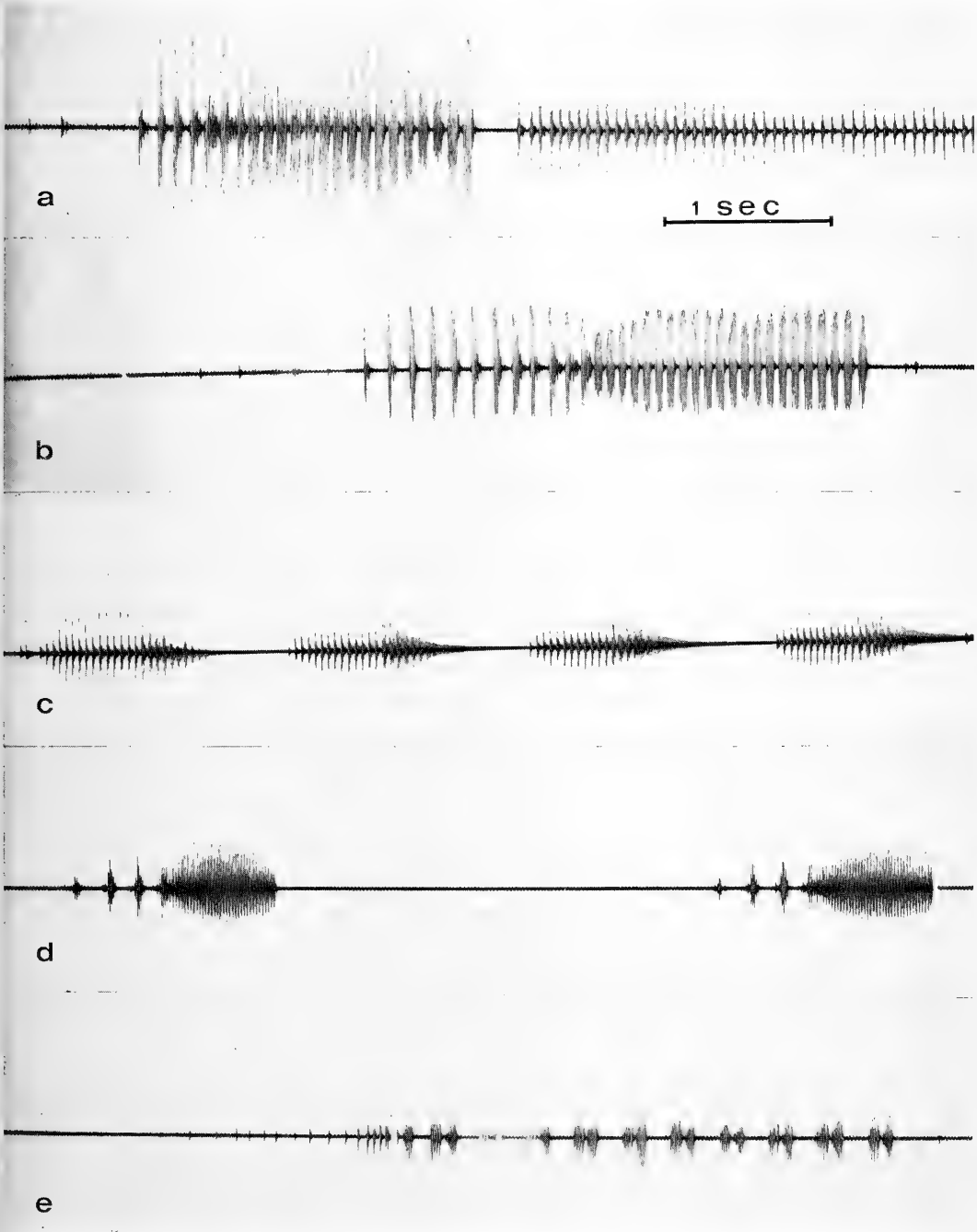


Plate 7. Signals of *Lipara* species registered with an UV recorder. a, signal of male *L. lucens* with part of answering signal of female; b-e signals of males of different species: b, *L. lucens;* c, *L. similis;* d, *L. pullitarsis;* e, *L. rufitarsis*

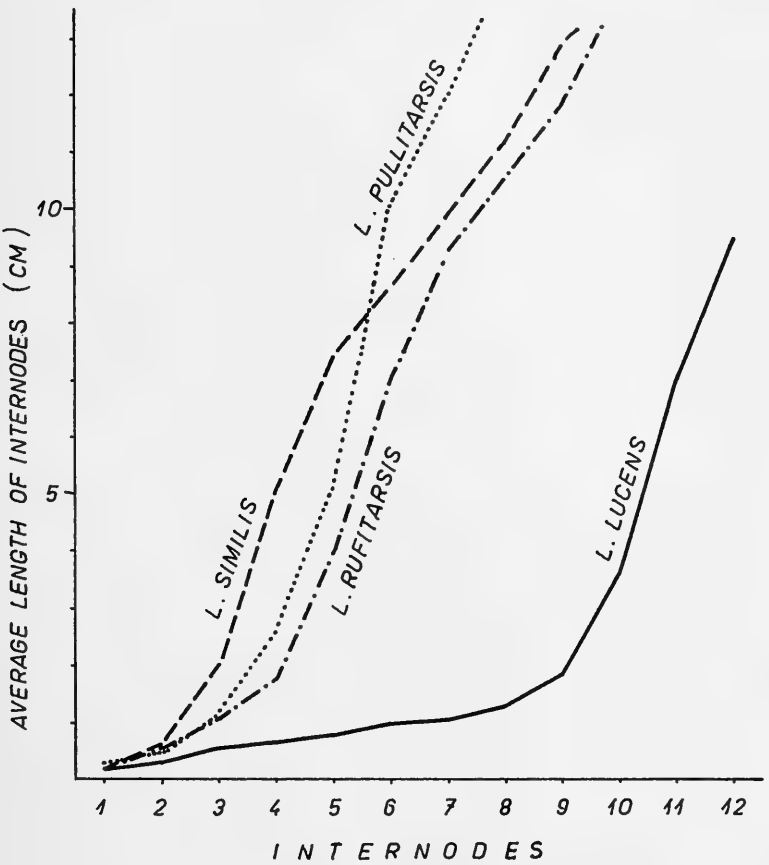


Fig. 18. Length of the highest internodes (counted from above) of reed stems attacked by larvae of *Lipara* species. (average of 30 stems per species)

3 to 4. This is why the gall is the smallest and least noticeable (Plate 5b). Due to this small number of shortened internodes and also to the fact that the shortened internodes are narrower than the adjacent normal ones but rather telescopic (Plate 4b), the sheaths have enough room and embrace the stem closely. The gall itself is formed only by the leaf sheaths growing from the two highest visible nodes which form an approximately 9 cm long tube concealing the remnants of the rolled leaves, the larva and the remainders of the panicle and the growing point. This is why the gall is not inflated and resembles the top of a sterile shoot, from which it differs only by the fact that the sheaths of the two uppermost leaves covering the gall are almost equally long.

By summarizing these descriptions we arrive to the following key to the galls:

1 There is a terminal inflation on the stem: a cigar- or spike-shaped gall . . . 2

— There is no terminal inflation of the stem, it looks like the top of sterile shoot. In the tube formed by the leaf sheaths growing from the two highest visible nodes there is a slim, milky white, glossy larva with both ends black (or brown pupa with both ends black) . . . . . *similis*

2 In a longitudinal section through the gall a chamber cutting through the young rolled

leaves can be seen. In the chamber there is a big white larva (or brown pupa). The chamber never passes through the growing point to the shortened internodes . . . . . *pullitarsis*

— The chamber passing through the rest of the growing point in order to reach the shortened internodes. Its inner walls black 3

3 Walls of the shortened internodes thickened, their width two or three times that of adjacent not shortened ones. The chamber passing through 6 to 9 shortened internodes, containing a big, thick, ivory white larva (or a brown pupa). The shortened internodes brown . . . . . *lucens*

— Walls of shortened internodes neither thickened nor brown, their width equal to that of the adjacent not shortened ones. The chamber passing through 2 tot 4 shortened internodes only and containing a big, yellowish, and somewhat dorsoventrally flattened larva (or brown pupa) . . . . . *rufitarsis*

4. Behaviour of adults

The discussion of behaviour and ecology will be somewhat one-sided, because *Lipara lucens* is by far the best known species of the four and the outline of its biology will therefore be the largest. The fragmentary information concerning the biology of the other species will be compared with that of *lucens*.

a. Precopulatory behaviour

The adults of *Lipara lucens* force themselves upward between the leaf sheaths and emerge from tip of the gall during the early morning hours. In this process an important role is played by the ptilinum, a large sac of the head, which can be expanded, so pushing aside any obstacle in front of the head. It is also useful for bursting the puparium, and in other species of higher flies, for forcing a way up through the soil (Oldroyd, 1964). In the hardening process after emergence, the ptilinum is retracted inside the head.

The flies emerge over a period of two or three weeks in the end of May or the beginning of June. Our observations do not indicate that the female flies emerge a few days before the males, as is stated by Waitzbauer (1969).

The female flies are probably very sedentary before copulation, but detailed observations on the behaviour in the field are not yet available. In laboratory experiments, where the flies are observed in small cages provided with some old reed stems, the females remain in the same place for a long time unless the temperature becomes high (above about 25° C), when they become restless. The males move about much more, and it is often obvious that they are in search of a female. They fly from reed stem to reed stem, on each stem giving a signal by vibrating. A virgin female fly sitting on the same substrate as the male perceives this signal as a vibration of the substrate and immediately answer by vibrating in its turn (Plate 7a). This in turn induces in the male increased searching on the reed stem. It starts to walk over the stem, stops after a few seconds to give a signal again, and when this is answered, begins to walk again. In this way the male finally finds the female, and copulation often takes place without obvious further display.

When a male gives its signal on a stem and does not receive an answer, it soon leaves the stem and flies to another. Therefore the function of this behaviour seems obvious. This procedure requires much less time than the male would need for searching the whole reed stem.

The signals of both the male and the female fly cannot normally be heard by the human ear, but the male's signal is perceived when seated on a reverberating substrate. Both signals can be made audible by placing a crystal gramophone pick-up element in contact with the substrate, for instance a reed stem, and by connecting this element to a tape recorder. The tape recordings can then be converted to visual signals with the help of an oscilloscope or an UV recorder (Plate 7).

This description is based primarily on observations of *L. lucens* (Mook and Bruggemann, 1968, 1971), but behaviour of other species is known to be similar. Important differences between species were found in the signals of the males, characteristic examples of which are given in Plate 7b-d. The main pitch of these sounds is about the same (a few hundred Hz.), but there are wide differences in the rhythm making it easy to recognize the different species by their signals. There are no great differences between the signals of the females. They all have a pattern similar to the one shown in Plate 7a; only the duration varies, that of *L. pullitarsis* being characteristically short (one or two seconds) while that of the other species is usually longer (up to over 10 seconds). No differences were found between the signals of flies collected in Czechoslovakia and the Netherlands.

Because such marked differences were found between the signals of the males, an experiment was set up in order to investigate whether these differences play a role in reproductive isolation. In this experiment, sounds of three species of *Lipara* and two species of *Haplegis* (small Chloropid flies, the larvae of which occur as inquilines in *Lipara* galls) were played back to females of the three *Lipara* species. The female flies rested on a strip of paper in contact with a small loudspeaker (output 0,5 watt). The tape gave each of the signals ten times in a random sequence, with a 30 second interval between signals. The tape was played back twice to each of five females of the three different species, so that each female was subjected to each signal twenty times, and their response was observed with a binocular microscope. The number of responses (Table I) was high only for the own species, which makes it probable that the signals do indeed play a role in reproductive isolation.

Table I. Reactions of 5 females of 3 *Lipara* species to 20 male signals of 5 different Chloropidae

♂ *signal*	Reactions of ♀														
	lucens					*pullitarsis*					*rufitarsis*				
L. lucens	18	16	18	19	18	—	—	—	—	—	—	—	—	—	—
L. pullitarsis	—	—	—	2	—	19	19	13	16	16	—	—	—	—	—
L. rufitarsis	2	1	—	1	—	—	—	—	—	—	19	19	20	17	17
Haplegis spec. A	—	1	—	2	—	—	3	1	—	—	—	—	—	—	—
Haplegis spec. B	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—

b. Egg-laying behaviour

The egg-laying behaviour of *Lipara lucens* has been investigated extensively (Mook, 1967). The species is autogenic: it does not need food to lay eggs. At emergence the ovaries contain almost mature eggs, and egg-laying can start two or three days later. The number of eggs in the ovaries of *L. lucens* lies between 64 and 96, with a mean of 84 (data from 40 Dutch specimens). However, egg production is not limited to this

number. In laboratory experiments the flies were often observed laying eggs in two or three periods of one or two days, each period separated by two or three days in which no eggs were laid. The number of eggs laid during the first of these periods corresponded to the number of mature eggs in the ovaries at emergence. In the later periods a smaller number of eggs was laid, so that the total production of eggs often attained twice the number of eggs originally present in the ovaries. Under favourable circumstances (the flies were provided daily with fresh drinking water and pieces of fresh reed shoot of the preferred diameter; light and a temperature of 20° C were maintened for 7 hours each day) the number of eggs laid was between 0 and 199, with a mean of 133.6 (median 147).

Comparable data for the other species are lacking. At emergence they too have almost mature eggs in the ovaries. For *L. pullitarsis* the number of eggs in the ovaries lies between 98 and 157 in 20 Dutch specimens and for *L. rufitarsis* between 54 to 83 in 17 Dutch specimens. No data are available for *L. similis*.

Lipara lucens lays its eggs during the warmest hours of the day. The female flies to a reed shoot and walks on it, first upward. After reaching the top of the shoot it often turns and walks down again. During this walking the ovipositor may be slightly extended, but does not touch the shoot. After a while the female begins to walk on a more restricted part of the shoot, a few centimeters' distance. By this time the ovipositor is fully extended and its tip now and then touches the surface of the shoot. The fly then pauses for about 60 seconds with its head pointing upward, after which the egg emerges from the tip of the ovipositor and is pressed against the surface of the shoot. After the egg has been laid the female walks upwards and usually flies away to another shoot.

The eggs are usually laid on the stem, sometimes but not always on or under the hairy ligules, but in an outdoor cage an appreciable proportion of the eggs was found on the reed blades. The flies show a marked preference for ovipositing on shoots of a certain diameter; nonpreferred shoots are generally deserted during the walking stage of this ovipositional behaviour. Because this preference influences the habitat relationships, it will be treated in the next section.

5. Ecology

a. Habitat relations

In the literature it is often stated that the galls of *Lipara lucens* are most numerous in reed stands located in dry places (Wagner, 1907; Docters van Leeuwen, 1957; Ruppolt, 1957), but this does not necessarily imply that the water level itself influences the species. Together with the water level, characteristics of the vegetation vary considerably. The number of shoots per square metre, for instance, tends to be higher in drier places (but is lower again where the soil becomes very dry). The dimensions of the reed shoots are also influenced by the water level, the shoots being shorter and thinner in dry than in wet places.

A partial regression analysis of samples of three different vegetations showed that the variation in gall density is not primarily due to variations in water level or shoot density, but to variations in the dimensions of the shoots. In this analysis and in the subsequent experimental work the basal diameter of the shoots was chosen as the most characteristic shoot dimension, because this is the most constant measure throughout the year and is not influenced by gall formation. The basal diameter does not alter during

the growing season and when the reed dries in the autumn it diminishes only by about 10 per cent.

Experimental work in the field and in the laboratory showed that the diameter of the reed shoots plays an important role in the biology of *Lipara lucens,* in some cases directly affecting the behaviour of the fly or its parasites, in other cases correlated only with the real operating factor. The correlation of life functions of *Lipara lucens* with the diameter of the reed shoots has been treated elswhere (Mook, 1967); only a short survey will be given here.

The female flies lay their eggs preferentially on shoots with a width of 4 and 5 mm at the base. In Fig. 19a oviposition is expressed as the mean number of eggs per shoot, thus eliminating the influence of the number of shoots available in each class. Waitzbauer (1969) found a distribution of eggs in the field with an optimum on shoots with a diameter of 4—4.5 mm, but he did not take into account the distribution of shoot

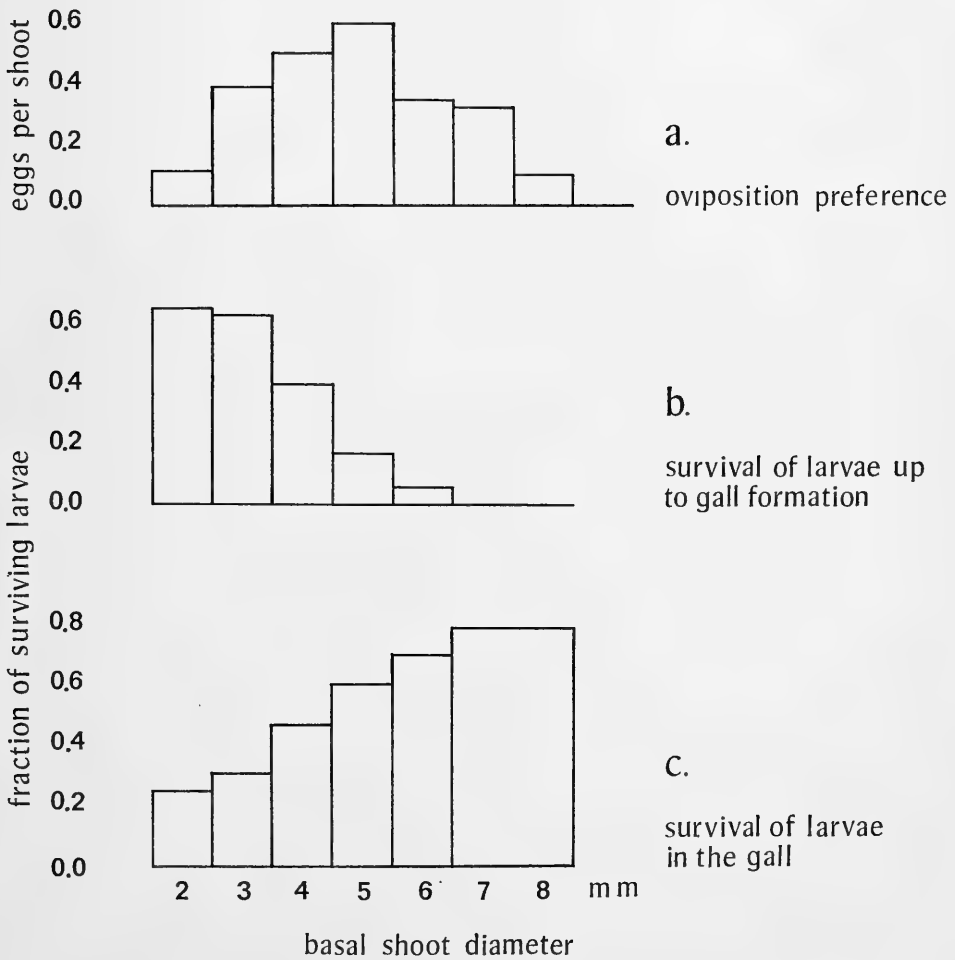
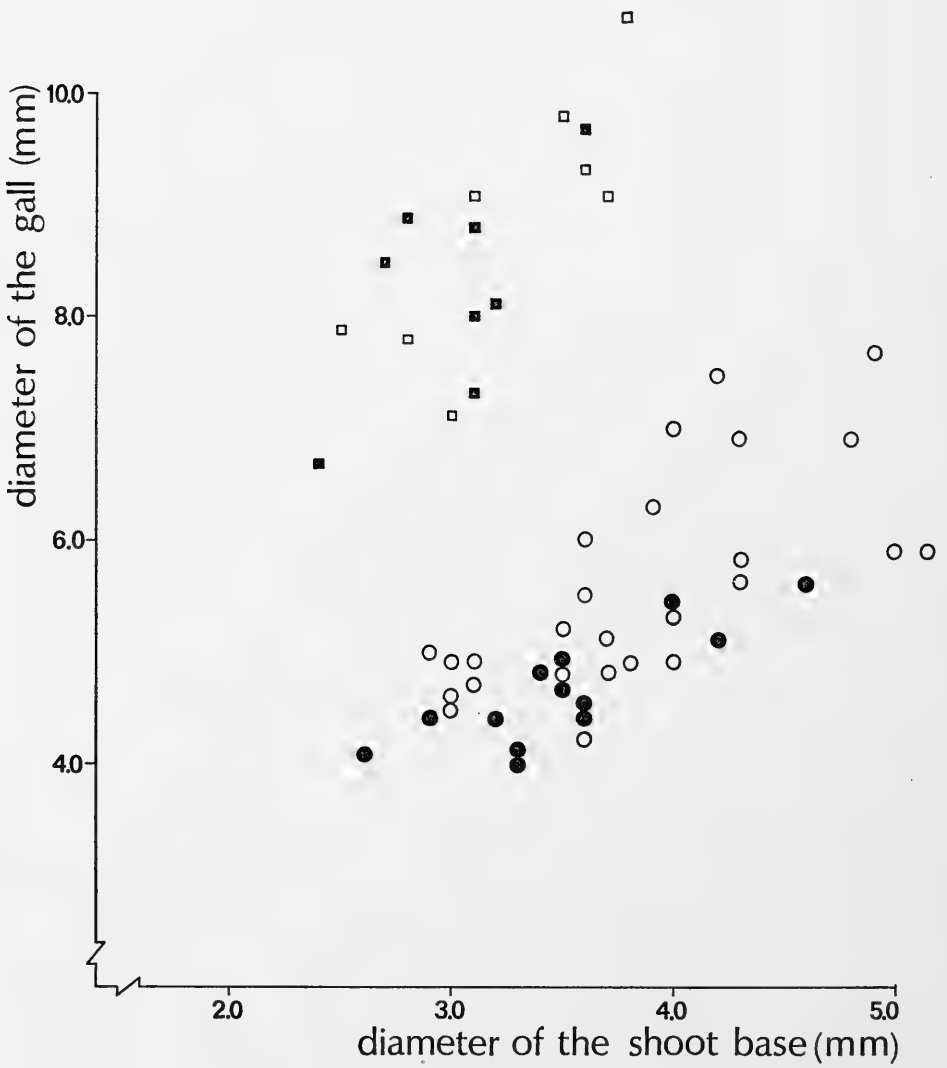


Fig. 19. *Lipara lucens* Meig. Correlation of oviposition and survival of larvae with diameter of reed shoots

diameter in the vegetation. He states that Mook (1967) found a preference for shoots with a diameter of 2.5—2.9 mm, but this is derived from a laboratory experiment in which the diameter of the shoot top was used. This value corresponds to a basal diameter of about 4 mm.

Once a shoot has received an egg, the probability that a gall will be formed is also correlated with shoot width (Fig. 19b). It is in the shoots with a diameter of about 2 and 3 mm that the young larvae have the greatest chance to induce a gall and thus the greatest chance to survive. The differences in survival of larvae in the gall (fig. 19c) are due to a heavier parasitism by *Stenomalina* and more predation by birds on the thinner shoots.

Multiplication of the estimates of oviposition preference and survival up to gall



formation in one diameter class gives the probability that a shoot in that class will develop a gall. This appears to be highest on shoots with a diameter of 3 and 4 mm, and this estimate agrees with the fractions of galled shoots in each class found in the field. In the field a low number of galls is also found on shoots with a diameter of 7 or 8 mm and sometimes even more, so that the chance of gall formation cannot be zero as in the experiment of Fig. 19b. The experiments were of course, all carried out with a limited number of shoots, so that chance variation can be important.

This analytical approach explains why the highest density of galls can be found in

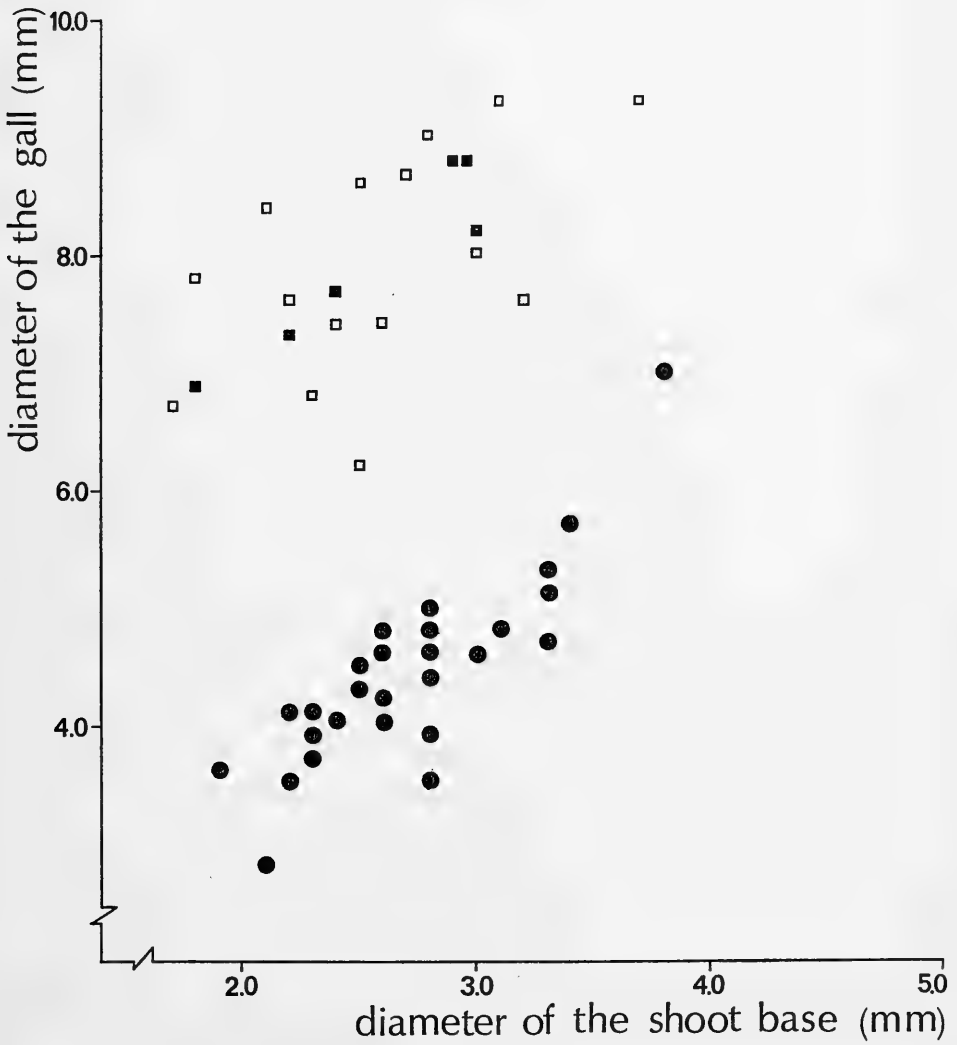


Fig. 20—21. Correlation between basal diameter of reed shoot and diameter of gall occurring on that shoot, for different types of galls: lignified galls containing larvae of *L. lucens* (□) and *L. rufitarsis* (■), and soft walled galls with larvae of *L. rufitarsis* (•) and *L. pullitarsis* (○). Galls collected in Voorsterbos (Fig. 20: parcel T 35, Fig. 21 parcel S 18), N.O. Polder, The Netherlands 11-1-1963

places where a large proportion of the reed shoots have a width of about 3 or 4 mm.

It may be concluded that most galls of *Lipara lucens* are found in reed with suboptimal growth, but not in reed with the worst growth. Although the water level has no direct influence, it can be said that reed with suboptimal growth is found mainly in dry places. On the basis of experience with a wide variety of reed vegetations in the Netherlands it can be said that there is no predilection for reed growing in extensive vegetations, as compared to reed in smaller patches, for instance in small bogs, along ditches, etc.

Lipara rufitarsis and especially *L. pullitarsis* are not as abundant in the Netherlands as *L. lucens*. Only superficial observations on their habitat are available, but comparison with *L. lucens* is possible. In reed vegetations where two or three species are present the galls of *L. rufitarsis* and *L. lucens* occur on shoots with about the same diameter, but th shoots with galls of *L. pullitarsis* on the average have a larger diameter. This can be seen, for instance, in Fig. 20, but has also been found in many other vegetations.

Galls of *L. rufitarsis* are sometimes present in low numbers in closed reed vegetations on dry soil, together with *L. lucens,* but occur much more abundantly in smaller reed vegetations in dry places at the edge of woods or along roadsides or other somewhat shaded places. In such places they are often more numerous than *L. lucens.*

Galls of *L. pullitarsis* were found in small reed stands with a low shoot density (often located between trees or bushes) in wetter, marshier places than those where *L. rufitarsis* has its optimum. In the Netherlands no galls of *pullitarsis* were found in large closed reed vegetations. This shows clearly that shoot dimension is not the only important factor determining the habitat of *Lipara* species.

In places where *L. rufitarsis* and *L. lucens* occur together, the larvae of the former species are sometimes found in galls that are indistinguishable from those of the latter species. This peculiar phenomenon has already been reported by Ruppolt (1957), but he did not describe *L. rufitarsis* in its typical galls. The thin galls with larvae he describes under the name of *L. rufitarsis,* undoubtedly refer to *L. pullitarsis.*

The two types of galls in which *rufitarsis* is found are quite different. That no intermediate forms occur is evident, e.g. in Figs. 20 and 21, showing two distinct groups of dots. The upper group corresponds with the wide galls with thickened internodes and lignified walls, the lower group, with narrow galls of which the internodes are not thickened. For both types of gall there is a strong positive correlation between shoot and gall width illustrating that the diameter and other dimensions of a gall are significant only in relation to shoot diameter.

Analysis of the morphology of the larvae and adults and also of the acoustical signals of the male flies, proved that the same species (*rufitarsis*) occurs in both types of gall. A few galls of the *lucens* type have also been found in which only a *pullitarsis* larva was present (above the growing point).

It is difficult to believe that one species can induce different galls on the same food plant. We know that when a shoot is infected by more than one egg, never more than one larva will survive. When these eggs are of different species, it cannot be said beforehand which species will survive. In the case of multiple infection by *lucens* and by one of the smaller species, if the *lucens* larva dies the result will be a typical *lucens* gall with a surviving *rufitarsis* or *pullitarsis* larva. This only holds, however, if the *lucens* larva does not die before the gall reaches maturity, since otherwise we would find a gall of intermediate size. We know that gall growth stops when a *lucens* larva dies before

gall maturation, because we find rudiments of galls above which the shoot has resumed normal growth. This does not imply, however, that *lucens* will always succumb to the smaller species. Without extensive breeding experiments, it will be impossible to judge the outcome of interspecific competition.

b. Parasites

Hymenopterous parasites belonging to four families attack the different species of *Lipara*. We have not tried to give a comprehensive list of these parasites. Only the common species with which we are acquainted will be treated here, because the records of occasional parasites are difficult to check. It is important to rear from material found in opened galls, to be sure that the parasites originate from *Lipara* larvae and not from the numerous species of inquilines that are also present in the galls.

The occurence of parasites differs widely between the types of galls. Table II shows the numbers of hosts and parasites found in galls collected in a number of localities in the central and eastern part of the Netherlands. The *lucens* galls included here originate exclusively from places where this species occurred together with one or both of the other fly species. More figures on parasitism of *L. lucens* have been given elswhere (Mook, 1967).

The findings of Table II cannot be generalized for other regions. The relative importance of the parasites in different regions is indicated below under the different species.

Table II. Distribution of host and parasite larvae over 3 types of galls collected in various places in the Netherlands

Species of larvae	Type of gall *lucens*	*rufitarsis*	*pullitarsis*
Lipara lucens	191	—	—
Lipara rufitarsis	31	240	—
Lipara pullitarsis	9	—	119
Polemon liparae	83	—	—
Stenomalina liparae	58	8	13
Scambus phragmitidis	1	113	4
Total	373	361	136

Ichneumonidae: From Table II it is apparent that *Scambus phragmitidis* Perk. is primarily a parasite of *L. rufitarsis*. Waitzbauer (1969) reared one specimen from *lucens* in Austria (Neusiedler See). In the Netherlands we have found a few in galls of *lucens*, but always in places where *rufitarsis* also occurred in *lucens* galls. This parasite was erroneously named *Pimpla arundinator* F. var. *similis* Bridgm. in Mook (1967). The new identification was made by Mr. K. W. R. Zwart, Wageningen, who compared specimens with paratypes from the British Museum (Natural History), London.

The distribution is difficult to assess. Pokorný did not find *Scambus* in Czechoslovakia. Other species of the same genus have been mentioned in the literature: Giraud (1863) reared *Scambus* (= *Pimpla*) *arundinator* F. as a parasite of *L. rufitarsis* or *L. pullitarsis* in Austria, while Wagner (1907) in Germany (Hamburg) and Blair (1944b) in England mention *Scambus* (= *Pimpla*) *detritus* Holmgr. from galls of *L. lucens*.

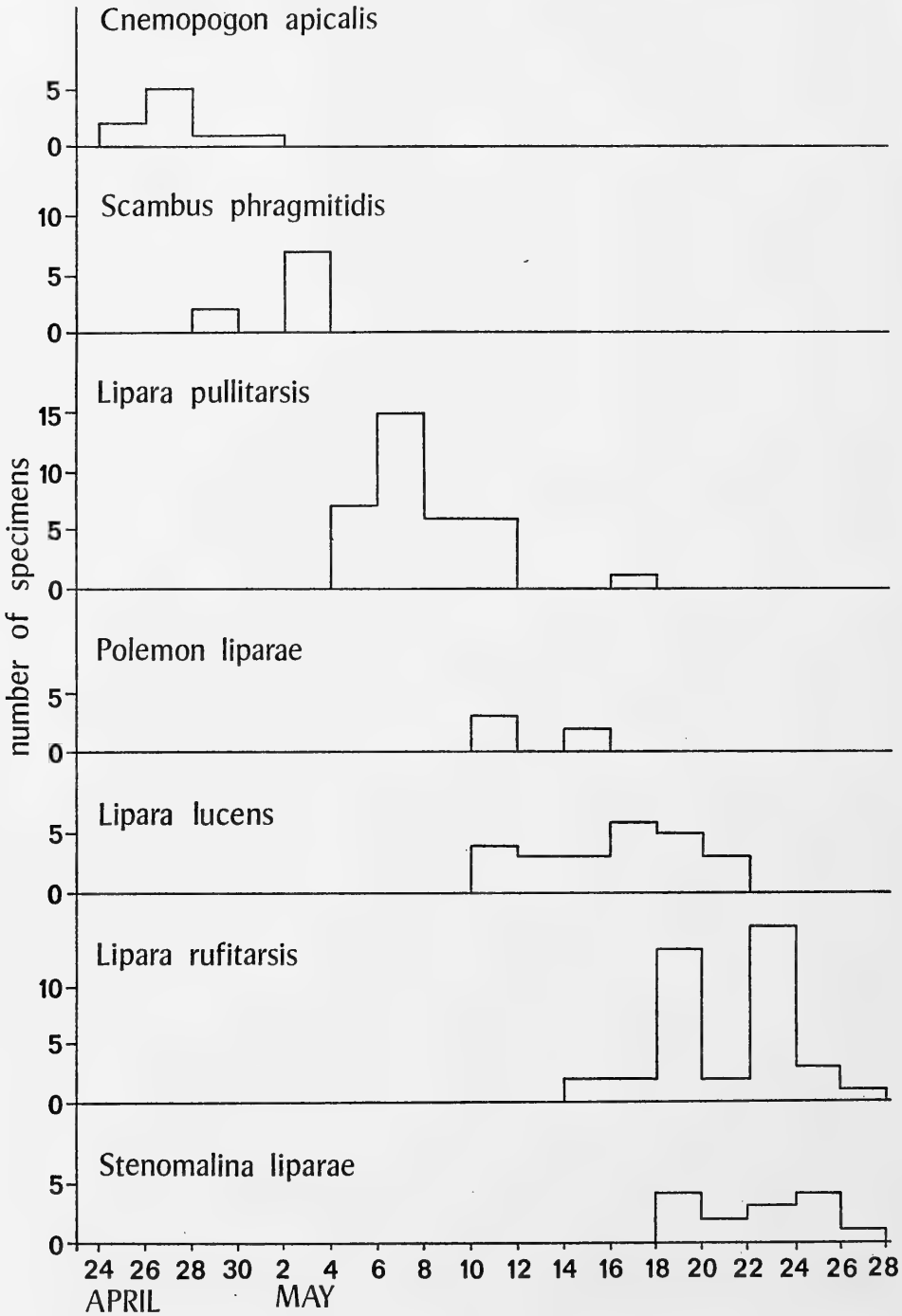


Fig. 22. Emergence in the laboratory of adult flies, predators and parasites from galls collected in N.O. Polder and near Dalfsen, The Netherlands, 20-IV-1962

Of the life history of *Scambus phragmitidis* nothing more is known than that it emerges early in the season (see Fig. 22), long before *L. rufitarsis*. The oviposition behaviour has not been studied.

Braconidae: Two species of *Polemon* have been described: *P. liparae* Gir. and *P. melas* Gir. In the Netherlands *P. liparae* is primarily a parasite of *L. lucens*. In Austria (Waitzbauer, 1969) and Czechoslovakia (Pokorný) it is by far the most important parasite of *L. lucens*, while in Hungary it was the only parasite found in this host (Erdös, 1961). Giraud (1863) mentions this species as the only parasite of *Lipara similis*.

Polemon melas is the most important parasite of *L. rufitarsis* in Czechoslovakia (Pokorný). Giraud (1863) found it in Austria. It was reared occasionally in the Netherlands (Reynvaan and Docters van Leeuwen, 1906).

Polemon liparae emerges from the tip of the gall just as its host and at the same time as *L. lucens*. It oviposits in the eggs of *lucens* (Mook, 1961). Larvae of *lucens* parasitized by *Polemon* form a puparium in September instead of in the spring, as they normally do. A puparium containing a parasite can be distinguished from the normal by being reddish-brown and slightly more slender. Varley and Butler (1933, see also Askew, 1971) have suggested that the premature pupation might be caused by wounding by the ovipositing parasite. This is improbable because of the long time lying between infection and pupation.

Pteromalidae. *Stenomalina* (= *Pteromalus*) *liparae* Gir. was found in the Netherlands in galls of *lucens*, *rufitarsis* and *pullitarsis* (see Table II), but most commonly in *lucens*. In England (Blair, 1932) and western Germany (Hamburg, Wagner, 1907) it is the most common parasite of *lucens*. In Czechoslovakia it is not common (Pokorný); it was not found in eastern Austria (Neusiedler See) by Waitzbauer (1969) and in Hungary by Erdös (1961). Giraud (1863) has described it from material collected near Vienna and indicates that it was rather common there.

The adults of *Stenomalina liparae* leave the gall by biting a small round hole in the leaf sheaths just above the gall chamber. They begin to emerge about 8—10 days later than *L. lucens*. They parasitize the young larvae living above the growing point, by boring through the leaf sheaths. In view of the circumstance that the first larvae of *lucens* arrive above the growing point in the period that *Stenomalina* starts to emerge and that this species does not need much time between emergence and oviposition, it seems that its life cycle is primarily synchronized to that of *L. lucens*.

Eulophidae. *Tetrastichus legionarius* Gir. is mentioned as a parasite of *L. lucens* in Czechoslovakia (Pokorný), Austria (Giraud, 1863), and the DDR (Greifswald, Ruppolt, 1957), but seems nowhere to be common. Erdös (1961) mentions the species from Hungary as a parasite of *Haplegis flavitarsis* Mg., a small chloropid fly that is an inquiline in *Lipara* galls. In the Netherlands *T. legionarius* is rare in *lucens*. We have found only recently two parasitized puparia, after having opened more than 10.000 galls from various places, although mainly from the eastern part of the country. Mr. M. J. Gijswijt ('s-Graveland), who kindly identified our specimen, informed us that the species has also been reared from *lucens* galls from three localities in the central and southern parts of the Netherlands. It is a gregarious parasite: our puparia contained 25 and 28 larvae respectively.

c. Predators

Birds attack the galls of *L. rufitarsis* in particular and also the smaller galls of *L. lucens* occurring on narrow shoots and, less often, the galls of *L. pullitarsis*. The intensity of this predation differs widely between winters. Blue Tits (*Parus caeruleus* L.) are known to predate in winter on all kinds of insects in reed stems (Tischler, 1943). Actual observations of predating tits are scarce, but they are at least known to be able to open the galls (Mook, 1967). Kramer (1917) observed a Great Spotted Woodpecker (*Dryobatus major* L.), opening a gall of *L. lucens*.

Puparia of *Cnemopogon apicalis* Wiedemann (Diptera, Scatophagidae) are found in the winter in small numbers between the top blades of all three types of galls. The host larvae are always absent, presumably having been consumed by the *Cnemopogon* larvae (Wagner, 1907; Theowald, 1961).

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PYRALIDAE OF THE THIRD ARCHBOLD EXPEDITION. 1. SUBFAMILY ODONTIINAE (LEPIDOPTERA)

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ABSTRACT

Nine species in six genera are recorded from the material of the Third Archbold Expedition to Western New Guinea and are figured. The following taxa are described as new: *Trigonoorda* gen. nov., type-species *T. triangularis* spec. nov., also includiing *T. iebelealis* spec. nov.; *Pseudonoorda* gen. nov., type-species *P. minor* spec. nov., also including *P. brunneiflava* spec. nov. and the previously described *P. nigropunctalis* (Hampson) comb. nov., *P. distigmalis* (Hampson) comb. nov. and *P. metalloma* (Lower) comb. nov., ex *Noorda,* and *P. noordimimalis* (Hampson) comb. nov., *P. brunneifusalis* (Hampson) comb. nov., *P. photina* (Tams) comb. nov. and *P. lampra* (Tams) comb. nov., ex *Clupeosoma; Hyalinarcha* gen. nov., type-species *H. hyalina* (Hampson) comb. nov., ex *Boeotarcha. Thesaurica notodontalis* (Hampson) comb. nov. and *T. accensalis* (Swinhoe) comb. nov. are transferred from *Sameodes* and *Noorda,* respectively.

INTRODUCTION

The rich material of Pyralidae collected by the Netherlands Indian — American Expedition to the interior of Dutch New Guinea (now West Irian), better known as the Third Archbold Expedition, has been lent to me for study for a number of years, thanks to the generosity and sorely tried patience of the Rijksmuseum van Natuurlijke Historie, Leiden. During this time the whole of this material has been prepared and sorted to species and the problems of identity and relationship have for the most part been solved. I now propose to give lists of the material, subfamily by subfamily, with remarks on relationships and with descriptions of new taxa where required. A general faunistic analysis will be deferred until after the taxonomic treatment is complete, but the following statements will serve for introduction.

The collection was made mostly in relatively undisturbed habitats at a variety of elevations from near sea level to 3800 m. The localities are described in detail by Brass (1941), Archbold, Rand & Brass (1942) and Toxopeus (1940). The most intensive collecting was done at middle and higher altitudes, from which the species representation is good. Many species were collected at lower levels also, but they probably represent a considerably smaller fraction of the fauna there. The fauna shows pronounced altitudinal zonation. In a general way this corresponds well to what is known from eastern New Guinea. The same groups: Scopariinae, certain Nymphulinae, etc., are well developed at high altitudes, with such groups as Epipaschiinae and certain Phycitinae and Pyraustinae becoming important in the 1500—2500 m zone. At both levels some species are known from eastern New Guinea, whereas others are known only from the

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present collections. At the lower levels, especially Araucaria Camp at 800 m, at which a large collection was made, the fauna is generally similar to that in other parts of New Guinea.

The high-altitude material is the most extensive so far collected in New Guinea, but the whole collection is of very great interest. In the main it reflects the hard and careful work of the late L. J. Toxopeus, whose untimely death in 1951 interrupted a brilliant entomological career.

This first paper deals with the subfamily Odontiinae. Although the subfamily has a number of genera and species in New Guinea, the representation in the present collection is poor. I can only speculate as to the reasons, but there are probably relatively few species at high altitudes, while at moderate and low altitudes they may have been eclipsed by the many more conspicuous and exciting species of other groups.

SUBFAMILY ODONTIINAE

Clupeosoma Snellen

Clupeosoma Snellen, 1880: 203.

Type-species *C. pellucidalis* [recte, *pellucidale*] Snellen, 1880, Celebes, by monotypy.

This genus was used by Hampson, 1897: 216, for a rather mixed assemblage of odontiine and pyraustine species, which he placed in the Hydrocampinae (= Nymphulinae) because of the stalking of R_2 with R_{3+4}. In my "Synopsis of the North American Odontiinae" (Munroe, 1961: 5) I referred *Clupeosoma* to the Odontiinae without discussion. As will be seen from the figure, the genitalia are typically odontiine, with bilobed setose uncus, with gnathos arms fused basally with tegumen, with strong coremata associated with the juxta, and with rounded, radially fluted valves.

I restrict the genus to a series of species closely related to *C. pellucidale,* including *C. astrigale* Hampson, emend., from Queensland; *C. subrufale* (Rothschild), emend., comb. nov., from Ceram, described in *Noorda; C. atristriatum* Hampson, emend., from Rook[e] Island; *C. rufistriatum* Hampson, emend., from the Oetakwa River, Snow Mountains, New Guinea; *C. glaucinale* Hampson, emend., from Sumbawa; and *C. laniferale* Hampson, emend., from St. Aignan, as well as a number of undescribed species. Snellen's characterization of the genus is good, and will serve to distinguish it from the discordant elements placed in it by Hampson. The maculation is characteristic and is shared only by the closely related genus *Neogenesis* Hampson, discussed below.

Clupeosoma rufistriatum Hampson

Figs. 1, 10

Clupeosoma rufistriatum [sic] Hampson, 1917: 277.

The single specimen of the genus in the present collection appears to belong to Hampson's species, described from the Oetakwa River at 3.000 ft [ca. 900 m].

1 ♂, Araucaria Camp, 800 m, 24 March 1939, L. J. Toxopeus.

Neogenesis Hampson

Neogenesis Hampson, 1907: 19.

Type-species *N. flaviplagialis* Hampson, from New Guinea, by monotypy.

As Hampson noted, this genus has clearly arisen from *Clupeosoma* by exaggeration

of the secondary sexual characters and by stalking and fusion of veins in both sexes. The single known species is widely distributed in New Guinea.

Neogenesis flaviplagialis Hampson
Figs. 2, 11, 19

Neogenesis flaviplagialis Hampson, 1907: 19.

The species should not be mistaken for anything else. It was described from material from Milne Bay (type locality) and Moroka, British New Guinea [now Papua]. Meek collected it in the Snow Mountains and George Holland and I found it at several localities in eastern New Guinea. I can see no significant geographical variation.

1 ♂, Hollandia, 1938, Brinkmann; 1 ♂, Araucaria Camp, 800 m, 22 March 1939, L. J. Toxopeus; 1 ♂, Mist Camp, 1800 m, 15 Jan. 1939, L. J. Toxopeus.

Trigonoorda gen. nov.

Type-species *Trigonoorda triangularis* spec. nov.

External characters. Frons slightly prominent, either rounded or flat, smoothly scaled. Vertex short, with rough, erect scaling. Labial palpus porrect, exceeding frons by about length of head, scaling flattened, blade-like, third segment largely hidden in scaling of second. Maxillary palpus prominent, with an expanded distal tuft of scales. Proboscis well developed, scaled at base. Eye large. Ocellus present but small. Antenna filiform, in male with feathery ciliations, several times as long as diameter of shaft; in female with short even ciliations; in both sexes smoothly scaled dorsally. Body short but not especially robust. Praecinctorium prominent, with transversely rounded distal tuft. Legs slender, without unusual specializations.

Forewing broadly triangular; costa and termen somewhat convex; apex acute; posterior margin sub-basally convex and with a weak scale tuft. Cell rather narrow, a little over half of length of wing. R_1 from cell basad of anterior angle. R_2 stalked with R_{3+4}, the latter long-stalked. R_5 from anterior angle of cell, weakly curved and approximated to R_{3+4} at base. Discocellular straight, somewhat oblique. M_1 from somewhat behind anterior angle of cell, diverging from R_5. M_2 and M_3 from posterior angle of cell, their origins close but slightly separated, their basal parts not or scarcely curved and approximated. Cu_1 from well basad of posterior angle. Cu_2 from cell at two-thirds to three-fifths from base. Anal loop large, very weak distally.

Hind wing of moderate width, termen rounded. Sc and R_s anastomosed. R_s and M_1 stalked for some distance. Cell about half length of wing. Discocellular concave, posterior limb strongly oblique distad. M_2 and M_3 from posterior angle of cell, their basal parts usually weakly curved and approximated. Cu_2 from cell at two-thirds to three-fifths. Cubital and anal area with slender, weakly spatulate, hairlike scales.

Male genitalia. Uncus rather narrowly subtriangular, tip rounded, sides rolled down and weakly setose. Gnathos Y-shaped. Transtilla narrow, arched. Juxta large and pyriform. Vinculum ventrally rounded and expanded, bearing moderately developed submedial and lateral paired coremata. Valve of moderate width, ovoidal, with a sinuate ridge well below costa and with inflated sacculus; distal and costal parts radially fluted; a variably developed group of short spines on ventrodistal curvature at end of sacculus. Penis slender and curved, with fairly long basal caecum; armature of vesica weak or absent.

Female genitalia. Ovipositor with high narrow lobes bearing relatively few, variably developed setae. Apophyses moderate to long. Eighth tergite rectangular or with anterior margin medially produced, with scattered setae. Ductus bursae membranous, evenly narrow, of moderate length, with a sclerotized collar at junction with bursa. Bursa round or pyriform, membranous, with a small signum near junction of ductus bursae.

Remarks. This genus would key to *Zebronia* Hübner in Hampson's Nymphulinae, but it has only certain superficial characters in common with that pyraustine genus. It is related in a general way to *Clupeosoma* and *Autocharis*. It differs from the former in the shorter palpi, broadly triangular wings and in characters of the wing venation, maculation and genitalia. From the latter it differs, inter alia, in the stalking of R_2 with R_{3+4}.

In addition to the two species described here there are several smaller undescribed species from New Guinea and the Sunda Archipelago, which will be dealt with elsewhere.

Trigonoorda triangularis spec. nov.
Figs. 3, 12, 20

External characters. Frons somewhat rounded, dark reddish brown. Vertex contrastingly light buff. Maxillary palpus reddish brown. Basal scaling of proboscis buff. Eye and ocellus brownish fuscous. Antenna buff; dorsal scaling with fuscous segmental bands. Thorax above anteriorly reddish brown, posteriorly light buff. Abdomen above buff. Body beneath light buff. Legs whitish buff, with femora reddish brown and outer surfaces of front tibiae and tarsi broadly banded with reddish brown.

Forewing above somewhat thinly scaled, light, weakly pinkish buff with fine fulvous-buff dusting. Costa and termen narrowly dark reddish brown. Antemedial line narrow weak, almost straight; oblique distad from costa at one-third from base to posterior margin at two-fifths. Discocellular bar fine, fuscous, connected anteriorly with costal line. Postmedial line narrow, weak, slightly dentate, tending to be interrupted at veins, dark reddish brown or brownish fuscous; oblique distad from costa at four-fifths from base as far as middle of cell M_2, there angled and curved increasingly basad to just in front of Cu_2, there obtusely angled and erect to posterior margin at three-fourths from base. Fringe light buff basally, white distally.

Hind wing above translucent pale yellowish buff. Fringe whitish buff.

Forewing beneath light pinkish buff, with silky lustre. Costal line as above. Terminal line more diffuse. Discocellular bar strong. Transverse lines visible only by transparency. Fringe as above.

Hind wing beneath as above.

Expanse 21 to 24 mm.

Male genitalia. Uncus less than three times as long as wide. Gnathos with median element tapering to a point distally. Dorsal part of juxta narrow. Patch of spines at ventrodistal curvature of valve strong.

Female genitalia. Ovipositor lobe high and narrow, with long setae. Apophyses short. Eighth tergite rectangular, with few fine setae, most numerous posterolaterally. Ostium membranous. Ductus bursae short but slender and of even width. Bursa round, signum near junction of ductus bursae.

Life history. Unknown.

Types. Holotype, ♂, allotype, ♀, and 4 paratypes, Moss Forest Camp, 2600—2800

m, 11—24 Oct. 1939, L. J. Toxopeus. Holotype, allotype, and two paratypes in Leiden Museum; one male and one female paratype in Canadian National Collection, Type No. 12.861.

Remarks. This species closely resembles *T. iebelealis* but is slightly smaller, with forewings sharper and less warmly coloured and with finer, sharper markings; the hindwings are paler and less strongly yellowish in the present species. The genitalia differ in the two species in a number of characters as noted in the descriptions.

Trigonoorda iebelealis spec. nov.
Figs. 4, 13, 21

External characters. Frons flat and oblique, dark brown medially, lighter towards sides but with a dark border. Vertex reddish brown anteriorly, yellowish buff posteriorly. A whitish-buff line between eye and antenna. Labial palpus with mixed fuscous and ferrugineous scales, its base beneath narrowly but contrastingly white. Maxillary palpus fuscous; base of proboscis buff. Antenna light buff with segmental fuscous bands dorsally. Thorax above reddish brown anteriorly, shading to warm buff posteriorly. Abdomen above light greyish buff. Body beneath and legs whitish buff; outer surface of front legs broadly banded with purplish fuscous.

Forewing broadly triangular; costa and termen somewhat convex; apex subrectangular; termen slightly oblique, tornus rounded. Ground colour above warm yellowish buff, finely dusted with ferrugineous. Costa ferrugineous. Antemedial line weak, narrow, somewhat sinuated, ferrugineous; oblique distad from costa at one-third from base to posterior margin at three-fifths. A weak fuscous discocellular bar.

Postmedial line slightly oblique distad from costa at five-sixths to vein M_3, there weakly retracted to an obtuse angulation on Cu_2 and erect to termen near tornus. Termen with a narrow, somewhat diffuse, ferrugineous band. Fringe yellowish at base, whitish distally.

Hind wing above translucent yellowish buff, a little darker terminally. Faint traces of a reddish-brown postmedial line in cubito-anal area. Fringe as on forewing.

Wings beneath much as above. Forewing a little darker, with transverse lines lost and other dark markings reduced. Hind wing as above.

Expanse 23 to 25 mm.

Male genitalia. Uncus more than three times as long as wide. Gnathos with median element finger-like and not tapering. Dorsal part of juxta wider than in *T. triangularis*. Patch of spines at ventrodistal curvature of valve very weak.

Female genitalia. Ovipositor lobe high and narrow, but somewhat reduced and with few setae. Apophyses long and strong. Eighth tergite elongate and heavily sclerotized, produced forward medially and at anterolateral angles, its surface with scattered, fairly strong setae. Ductus bursae wider than in *T. triangularis*, pyriform and with signum far from junction of ductus bursae.

Life history. Unknown.

Types. Holotype, ♂, allotype, ♀, and 1 ♀ paratype, Iebele Camp, 2250 m, 7 and 26 Nov. 1938, L. J. Toxopeus. 1 ♀ paratype, Sigi Camp, 1500 m, 23 Feb. 1939, L. J. Toxopeus. Holotype, allotype and one paratype in Leiden Museum; one paratype in Canadian National Collection, Type No. 12.862.

Remarks. This species is very similar in appearance to *T. triangularis*, but is a little

larger; the forewing is more orange and the hind wing is yellower; the transverse lines of the forewing are a little more diffuse; the antemedial line is more oblique and less regular. There are obvious differences in the male genitalia, especially the much weaker development in the present species of the spinose patch on the ventrodistal curvature of the valve.

Pseudonoorda gen. nov.

Type-species: *Pseudonoorda minor* spec. nov.

External characters. Frons flat and oblique, smoothly scaled. Vertex with rather smooth vestiture of raised and often broad scales, arising laterally and curving anteromesad. Labial palpus long and porrect, with flattened, blade-like, triangular scaling; third segment wholly or partly hidden in scaling of second. Maxillary palpus prominent, with triangular distal scale-tuft. Proboscis well developed, scaled at base. Eye large. Ocellus present. Antenna filiform, ventrally short-pilose in both sexes, dorsally scaled. Body robust, abdomen slightly exceeding anal angle of hind wing. Praecinctorium with transverse, rounded, distal fan of scales. Legs slender, outer tibial spurs somewhat shorter than inner.

Forewing triangular, costa and termen weakly convex, posterior margin almost straight. Cell about half as long as wing, of moderate width. Discocellular erect anteriorly, curved increasingly distad, posterior angle of cell moderately acute. R_1 from near end of cell, closely apposed to R_{2-4}. R_2 stalked for a considerable distance with R_{3+4}. R_3 and R_4 stalked to near apex. R_5 from anterior angle of cell, its basal part curved and approximated to R_{3+4}. M_1 from anterior angle of cell, but straight and diverging from base of R_5. M_2, M_3, and Cu_1 from posterior angle of cell, their basal parts curved and approximated. Cu_2 from cell somewhat basad of end. 1st A absent. 2nd A strong. Anal loop large and complete.

Hind wing with Sc and R_s anastomosed for some distance. Sc and M_1 separate or short-stalked. Cell less than half length of wing. Discocellular weak, its anterior part concave, its posterior limb strongly oblique. M_2, M_3 and Cu_1 from posterior angle of cell; M_2 and M_3 with basal parts curved and strongly approximated; basal part of Cu_1 weakly curved and slightly approximated to that of M_3. Cu_2 from cell at about two-thirds from base. Three anals present.

Male genitalia. Uncus subtriangular, bilobed, not or weakly setose. Gnathos with lateral arms arising from tegumen, median element spike-like, with weak terminal denticles. Transtilla angled dorsad medially. Juxta large and weakly sclerotized, flanked by coremata bearing strong, specialized scales. Vinculum ventrally broadly rounded, medially expanded. Valve oval, with complex basal sclerotization and strong subcostal ridge; distal part fluted and sometimes with somewhat specialized terminal setae.

Female genitalia. Ovipositor with elongate sparsely setose lobes. Posterior apophysis with cross-bar set at a shallow angle to shaft but not expanded; shaft long and slender, but strong. Eighth segment long, slender, cylindrical; tergite more or less rectangular, its anterior margin slightly excised and strengthened. Anterior apophysis as long as posterior, with triangular sub-basal flange. Ostium unarmed. Ductus bursae slender, membranous, with a sclerotized collar near bursa. Bursa globular or oval, membranous, with unevenly distributed spinules.

Life history. Unknown, but the ovipositor appears adapted to inserting eggs into plant tissues or crevices. The larva of the closely related *Decelia terrosalis* Snellen bores in mango seeds.

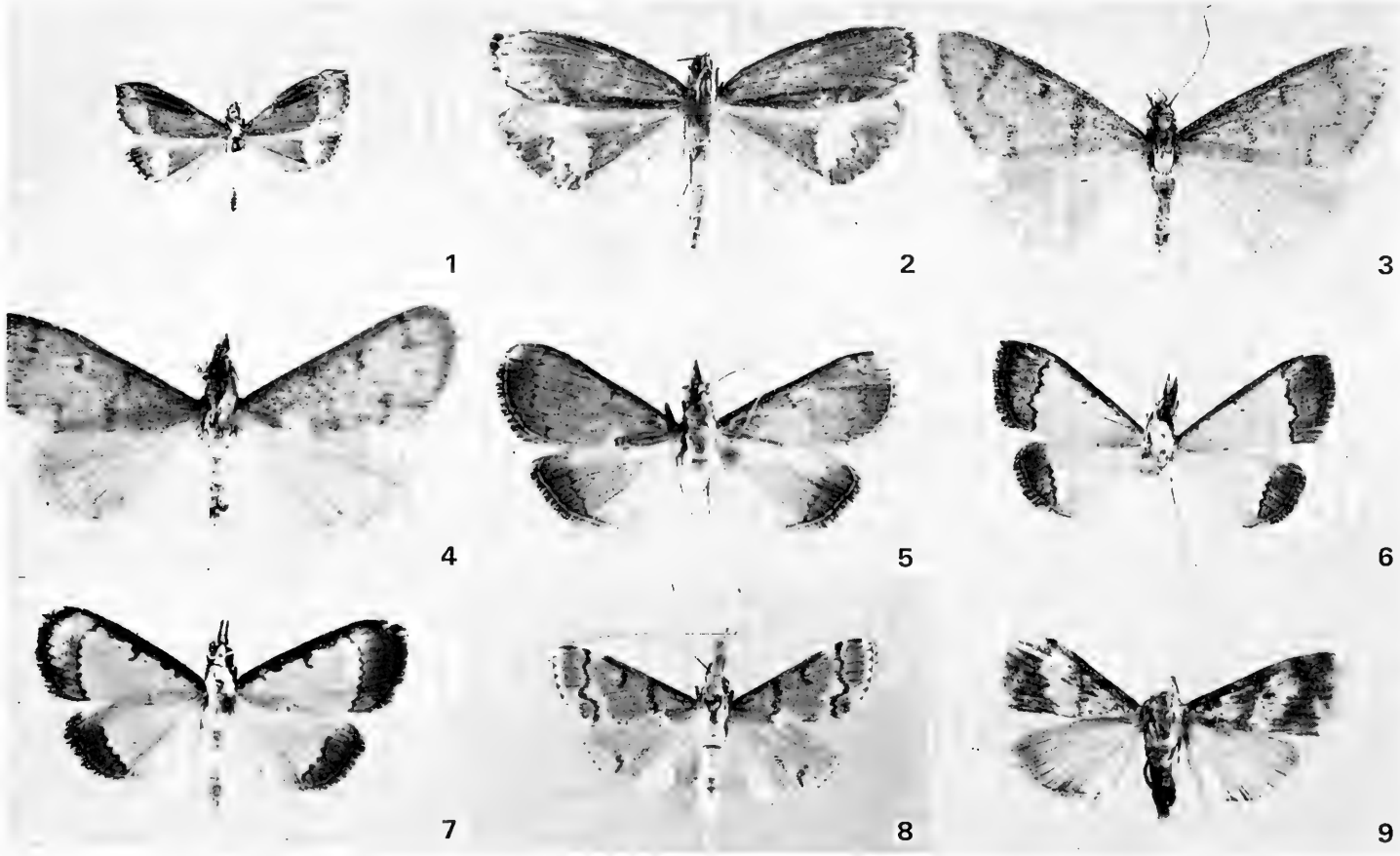

Plate 1. Fig. 1—9. New Guinea Odontiinae. 1, *Clupeosoma rufistriatum* Hampson, ♂; 2, *Neogenesis flaviplagialis* Hampson, ♂; 3, *Trigonoorda triangularis* spec. nov., holotype, ♂; 4, *Trigonoorda iebelealis* spec. nov., paratype, ♂; 5, *Pseudonoorda minor* spec. nov., holotype, ♂; 6, *Pseudonoorda nigropunctalis* (Hampson), ♂; 7, *Pseudonoorda brunneiflava* spec. nov., holotype, ♂; 8, *Hyalinarcha hyalina* (Hampson), ♂; 9, *Thesaurica notodontalis* (Hampson), ♂

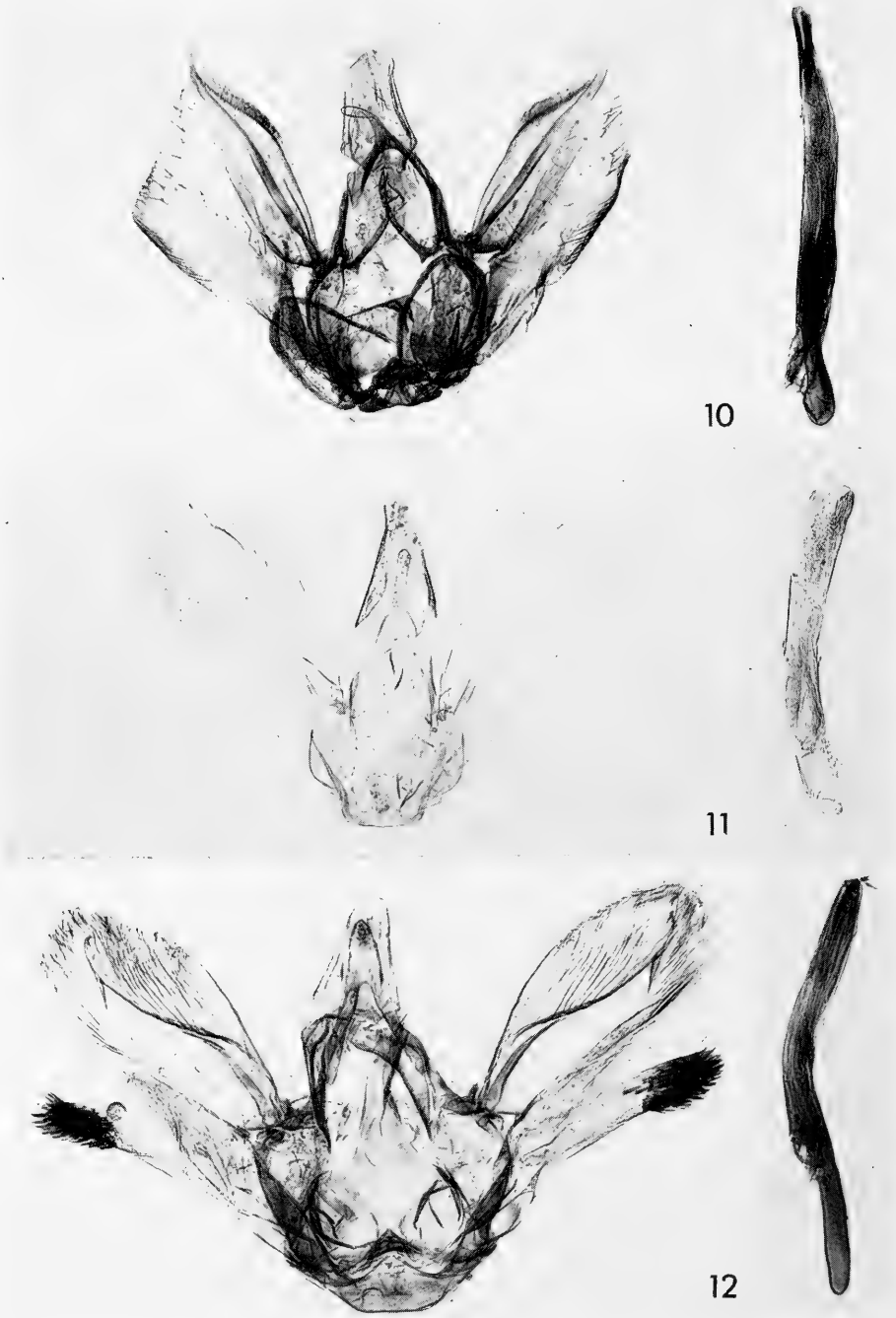

Plate 2.

Fig. 10—12. New Guinea Odontiinae, ♂ genitalia. 10, *Clupeosoma rufistriatum* Hampson; 11, *Neogenesis flaviplagialis* Hampson; 12, *Trigonoorda triangularis* spec. nov.

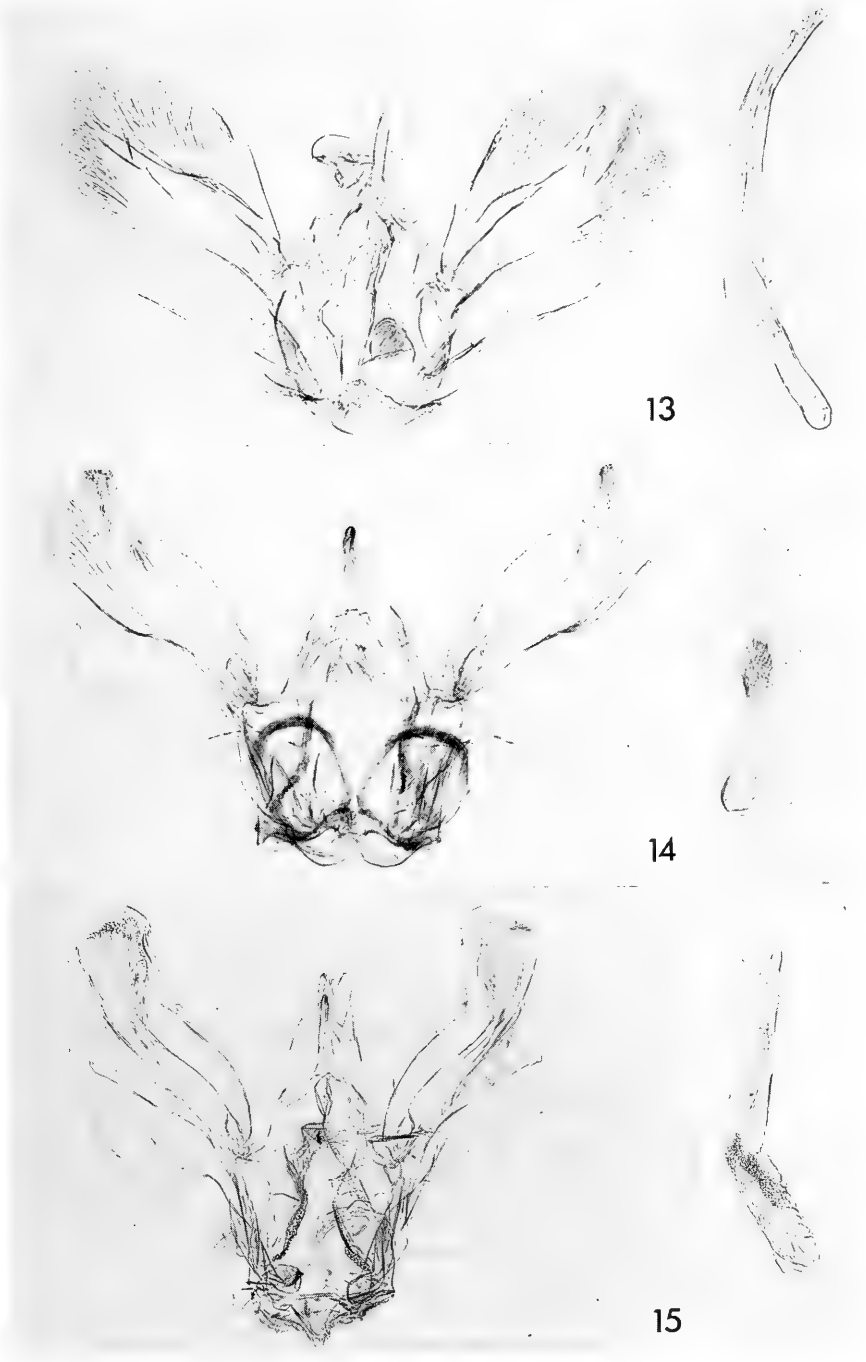

Plate 3.

Fig. 13—15. New Guinea Odontiinae, ♂ genitalia 13, *Trigonoorda iebelealis* spec, nov.; 14. *Pseudonoorda minor* spec. nov.; 15, *Pseudonoorda nigropunctalis* (Hampson)

E. MUNROE: *Pyralidae of the 3rd Archbold Expedition. 1*

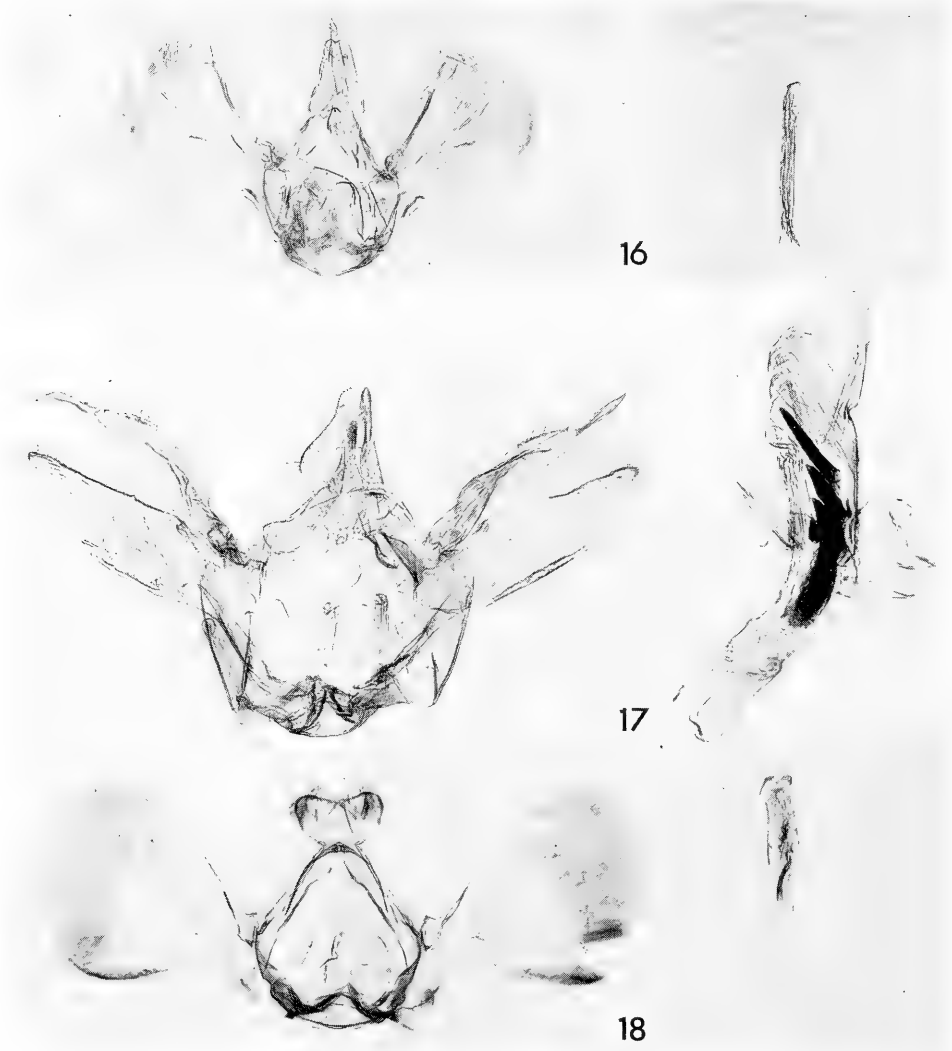

Plate 4.

Fig. 16—18. New Guinea Odontiinae, ♂ genitalia. 16, *Pseudonoorda brunneiflava* spec. nov.; 17, *Hyalinarcha hyalina* (Hampson); 18, *Thesaurica notodontalis* (Hampson)

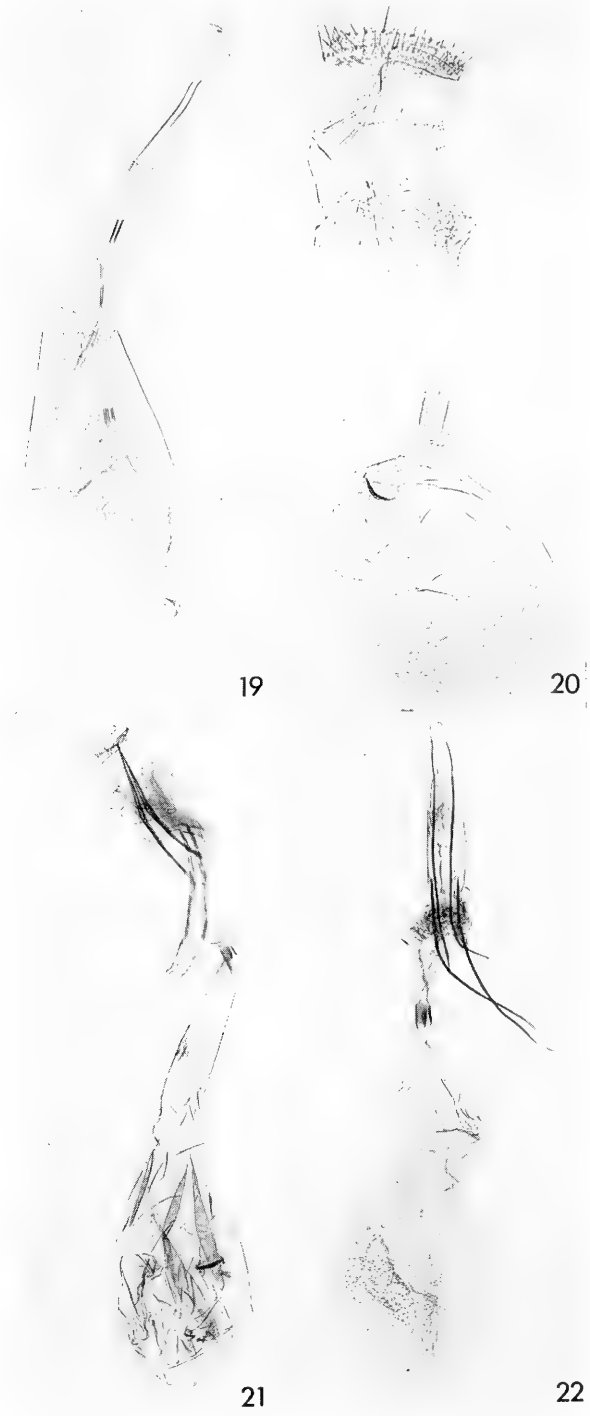

Plate 5.

Fig. 19—22. New Guinea Odontiinae, ♀ genitalia. 19, *Neogenesis flaviplagialis* Hampson; 20, *Trigonoorda triangularis* spec. nov.; 21, *Trigonoorda iebelealis* spec. nov.; 22, *Pseudonoorda minor* spec. nov.

Remarks. This genus contains a number of species which collectively range from Samoa through tropical Asia to Africa. They have been put in *Clupeosoma* in the Nymphulinae when authors noticed the stalking of R_2 with R_{3+4} or in *Noorda* when they did not. The most closely related named genera are: *Decelia* Snellen, unplaced by Hampson, though he put one of the nominal species in *Noorda; Autocharis* Swinhoe (see Amsel, 1965, 1970), whose species were also included by Hampson in *Noorda;* and *Noordodes* Hampson, placed by him in Endotrichinae. *Decelia* differs in having the third segment of the labial palpus clearly marked off from the second, not hidden in its scales, in having the tip of the forewing curved downward, in having the abdomen produced some distance beyond the anal angle of the hind wing, in having specialized scale-tufts on the front and middle legs of the male, in having the ovipositor lobes and eighth tergite of the females less elongate and in having the bursa copulatrix coiled. *Autocharis* has vein R_2 of the forewing free, not stalked with R_{3+4}; the cell of the forewing is long and the discocellular is only weakly curved; in the hind wing veins M_2 and M_3 are stalked.

In addition to the type-species at least the following described species belong to this genus: *Noorda distigmalis* Hampson, from Africa, *Clupeosoma noordimimalis* Hampson, from Africa, *Noorda nigropunctalis* Hampson, from Perak; *Clupeosoma brunneifusalis* Hampson, from New Guinea, *Clupeosoma photina* Tams and *C. lampra* Tams, from Samoa; and *Noorda metalloma* Lower, from Australia and New Guinea, if the last species is correctly identified at the British Museum. All these become new combinations in *Pseudonoorda.*

Pseudonoorda minor spec. nov.
Figs. 5, 14, 22

External characters. Frons fuscous, with a sharply defined, clay-coloured, postero-median triangle. Vertex ferrugineous. Labial palpus fuscous; base beneath contrastingly light grey. Eye and ocellus fuscous. Antenna dull buff. Thorax above ferrugineous anteriorly, shading to clay-colour posteriorly. Abdomen above brownish clay-colour, with posterior margins of segments light grey. Body beneath and legs grey, coxae, femora and front tibia infuscated.

Forewing above translucent greyish fuscous to postmedial line, brown-tinged beyond. Costa narrowly dark fuscous. Weak traces of an outwardly oblique, diffuse, dark-fuscous antemedial line. A weak fuscous streak on discocellular, strongest at anterior and posterior angles of cell. Postmedial line fine, fuscous, somewhat irregular, denticulate basad on veins, the denticulations somewhat accentuated. A diffuse, inconspicuous, dark terminal line, with faint dark rays extending a short distance basad on and between veins. Fringe fuscous, with a yellowish-buff line at extreme base, followed by a darker line.

Hind wing with a wedge from M to anal fold coloured like forewing; costal and anal areas pale translucent yellowish grey. No antemedial or discal markings. Postmedial line obsolescent anteriorly, generally straight but slightly denticulate from M_1 to 1st A, there nearly touching termen and ending abruptly. Fringe as on forewing.

Wings beneath as on upperside but shinier, less strongly marked and with terminal area hardly differentiated in colour.

Expanse 18 mm.

Male genitalia. Uncus about 2½ times as long as wide. Gnathos with median element rod-like, somewhat decurved and spinose at tip. Marginal scales of corema flanking juxta rather slender, in strong bunches. Valve irregular in shape, both dorsal and ventral

margins somewhat incised before tip; subcostal ridge sinuous, rather weak; fluting strong. Penis rather thick, with an imbricated group of small spine-like cornuti.

Female genitalia. As described for the genus.

Life history. Unknown.

Types. Holotype, ♂, and 1 ♂ paratype, Mist Camp, 1600 m, 18 Jan. 1939, L. J. Toxopeus. Allotype, ♀, same locality and collector, 11 Jan. 1939. 1 ♂ paratype, Bernhard Camp B, 100 m, 10 April 1939, L. J. Toxopeus. Holotype, allotype and one paratype in Rijksmuseum van Natuurlijke Historie, Leiden; one paratype in Canadian National Collection, Type No. 12.863.

Remarks. This species closely resembles *P. brunneifusalis* (Hampson), from the Oetakwa River, Snow Mountains, but is appreciably smaller (18 as against 22 mm) and much paler than the holotype of *N. brunneifusalis*. I think it better to classify the present series as a distinct species.

Pseudonoorda nigropunctalis (Hampson) comb. nov.
Figs. 6, 15

Noorda nigropunctalis Hampson, 1899: 222.

The present collection contains two specimens and the Canadian National Collection has one from Aiyura, Eastern Highlands, New Guinea, ca. 1850 m, which agree well with Hampson's types in spite of the different provenance of the latter.

1 ♀ (without abdomen), Araucaria Camp, 800 m, 21 March 1939, L. J. Toxopeus; 1 ♂, Iebele Camp, 2250 m, 28 Nov. 1938, L. J. Toxopeus.

Pseudonoorda brunneiflava spec. nov.
Figs. 7, 16

External characters. Frons yellow to yellowish buff, with black anterolateral wedges. Vertex yellow or yellowish buff. Labial palpus black, white at base beneath. Maxillary palpus black. Basal scaling of proboscis white. Eye and ocellus fuscous. Antenna buff, dorsally with dark-brown segmental stripes. A fuscous stripe from eye to wing-base. Thorax above yellow.

Abdomen above light orange-buff, with posterior margins of segments yellow. Body beneath and legs whitish buff; front and middle tibiae with weak fuscous bands.

Forewing above yellow. Costa to cell contrastingly fuscous with blue metallic lustre. Black antemedial dot, orbicular dash and comma-shaped discocellular bar, all adjoining costal stripe. Postmedial line faint, fuscous, denticulate inward with black accentuation on veins, oblique distad from costal stripe to cell R_5, thence regularly convex to termen before tornus. Whole area beyond postmedial line evenly copper brown with purple lustre, except slightly paler just beyond postmedial line anteriorly. A row of fuscous terminal dots between veins. Fringe shining fuscous with a slightly darker line just basad of middle.

Hind wing above coloured like forewing, but with costal area whitish and its maculation obsolescent. No markings basad of postmedial line. The latter almost straight from M_1 to 1st A, there ending, but succeeded by a weak dark terminal smudge in anal area. Fringe as on forewing, but becoming paler toward anal area.

Wings beneath as above but somewhat suffused with brownish and with dark areas considerably less contrasting.

Expanse 15 to 17 mm.

Male genitalia. Uncus about twice as long as wide. Gnathos with median element tapering somewhat irregularly from base to narrowly rounded tip. Scale tufts of corema flanking juxta narrow. Valve broadly and rather evenly rounded; subcostal ridge straight; fluting weak. Penis straight and weakly sclerotized.

Female genitalia. Unknown.

Life history. Unknown.

Types. Holotype, ♂, and 1 ♂ paratype, Araucaria Camp, 800 m, 17 and 19 March 1939, L. J. Toxopeus. Holotype in Rijksmuseum van Natuurlijke Historie, Leiden; paratype in Canadian National Collection, type no. 12.864.

Remarks. As will be seen from the figures, the genitalia of this species differ considerably from those of *P. nigropunctalis,* especially in the shape of the valve. A species identified as *P. metalloma* (Lower) in the British Museum (Natural History) and represented in the Canadian National Collection from Padwe, Sepik District, New Guinea, is somewhat similar, but has the terminal area purplish fuscous and the postmedial line of the forewing evenly curved. Another, apparently undescribed, species from Papua and New Guinea has the postmedial line differently shaped but otherwise is very close to *P. brunneiflava.*

Hyalinarcha gen. nov.

Type-species *Boeotarcha hyalina* Hampson.

External characters. Frons flat and oblique, smoothly scaled, somewhat produced, but not conical. Vertex short, with rather small erect scales. Behind occiput a collar of large, wide, smooth scales, probably arising from neck. Labial palpus weakly decumbent, with broad, compressed, distally pointed scaling, exceeding frons by somewhat more than length of cranium, the segments with their scaling not visibly divided. Maxillary palpus prominent, with triangularly dilated distal tuft of scales. Proboscis moderately well developed, scaled at base. Eye large. Ocellus well developed, separated by a considerable distance from eye. Chaetosema marked by a tuft of slender scales. Antenna of male filiform, dorsally scaled, ventrally fasciculate. Body rather short and thick. Legs moderately slender, outer tibial spurs of male about half length of inner. Praecinctorium with simple, transverse, rounded distal scale tuft.

Male genitalia. Uncus flattened, pyriform, the sides downcurved and more heavily setose than the median part. Gnathos with wide lateral arms and heavy, somewhat trough-shaped median piece, the latter shorter than uncus and with rows of spines on dorsal surface distally. Juxta large, pyriform, dorsally rounded. Vinculum shallow, ventrally broadly flattened, bearing a moderately developed scale-like structure on each side, flanked mesally and ectally by narrower striated sclerites. Valve of moderate size, weakly fluted; a very strong subcostal sclerotized bar, ending in a prominent, free, spine-like process extending beyond body of valve; dorsad of this a weak zone of setae on distal part of costa; sacculus broadly sclerotized, bounded dorsally by a weak ridge. Penis thick, curved, with spirally pleated vesica and with a group of very heavily sclerotized spine-like cornuti, large, few and in a single row distally, becoming small, numerous and multiserial basally.

Female genitalia. Unknown.

Life history. Unknown.

Remarks. Although at present I propose this genus for the type-species only, there are additional closely related species, which may have to be placed here when the group

has been studied more comprehensively. The type-species is recorded only from West Irian, but its relatives range through the Indo-Papuan region.

Hyalinarcha hyalina (Hampson) comb. nov.
Figs. 8, 17

Boeotarcha hyalina Hampson, 1913: 527.

This species is represented in the present collection by a single male, which exactly matches the type male from the Mimika River in the British Museum (Natural History). Though Hampson may have meant to designate a holotype, his citation is ambiguous, reading "2 ♂ type". I therefore designate as lectotype the specimen in the British Museum (Natural History) with the label "Boeotarcha hyalina type ♂. Hmpsn".

1 ♂, Hollandia, Brinkmann.

Thesaurica Turner

Thesaurica Turner, 1915: 49.

Type-species *Sameodes argentifera* Hampson, 1913, from Queensland, by monotypy and original designation.

This genus was erected for a single Australian species, but Hampson correctly associated with this in the British Museum collection the additional species *Sameodes notodontalis* Hampson, from Sandakan, Borneo, and *Noorda accensalis* Swinhoe, from Thailand. The generic transfers appear not to have been published, and these species accordingly become *Thesaurica notodontalis* (Hampson) comb. nov., and *Thesaurica accensalis* (Swinhoe) comb. nov. One of these is represented in the present collection.

Thesaurica notodontalis (Hampson)
Figs. 9, 18

Sameodes notodontalis Hampson, 1899: 175.
Epipagis notodontalis: Klima, 1939: 316.

The exact identity of this species is uncertain, as topotypical material is not available at the time of writing and there are at least three superficially very similar species in New Guinea. The species represented in the present collection is at least closely similar to *T. notodontalis*. There are three specimens in the collection.

2 ♂, Bernhard Camp, 100 m, 10 and 12 April 1939, L. J. Toxopeus; 1 ♂ Araucaria Camp, 800 m, 28 March 1939, L. J. Toxopeus.

ACKNOWLEDGEMENTS

My thanks are due to Dr. A. Diakonoff and to the authorities of the Rijksmuseum van Natuurlijke Historie, Leiden, for their patience in allowing me to retain this material for study for a very long period of time. It would have been impossible to work out the taxonomy without the continued support of the British Museum (Natural History) and especially the active help of Messrs. P. E. S. Whalley and Michael Shaffer. The photographs were made by Messrs. Orin Hanright and Tom Stovell of the Bio-Graphic Unit, Research Branch, Canada Department of Agriculture, with the help of Mr. D. H. Kritsch. Mr. Kritsch also made preparations of genitalia and rendered other technical assistance.

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UITGEGEVEN DOOR

DE NEDERLANDSE ENTOMOLOGISCHE VERENIGING

INHOUD

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REVISION OF THE PSENINI OF THE ETHIOPIAN REGION, INCLUDING MALAGASY (HYMENOPTERA, SPHECIDAE, PEMPHREDONINAE)

by

J. P. VAN LITH
Rotterdam

ABSTRACT

The following new forms are described and illustrated: *Psen* (*Psen*) *leclercqi* (♀); *Psen* (*Mimesa*) *empeyi* (♂); *Psenulus alveolatus* (♂), *P. aurifasciatus* (♀), *P. bidentatus pallidus* (♀ and ♂), *P. freetownensis* (♀ and ♂), *P. jacoti* (♀ and ♂), *P. leoninus* (♀), *P. oweni* (♀ and ♂), *P. rugifrons* (♀), *P. sapobaensis* (♀), *P. uelleburgi* (♀). A supplementary description of earlier named species is given and males of some of these species are described for the first time. The subgeneric position of the species of *Psen* and the relationships of the species of *Psenulus* are discussed. Provisional keys and a list of Ethiopian species are presented.

A few years ago Dr. H. Townes, Ann Arbor, kindly sent me about sixty African Psenini, mainly from Sierra Leone, for identification. Usually material of this group is not found in great numbers. This relatively large collection therefore stimulated the undertaking of a new revision of the Ethiopian Psenini.

In 1961 Prof. J. Leclercq published his catalogue of the species of the Ethiopian region including Malagasy. In that paper of fundamental importance, he recorded four species of the subgenus *Psen* and twenty species of *Psenulus*, of which ten were newly described. A description of *Psenulus garambae* (Leclercq, 1961b) followed soon afterwards.

The study of nearly all types or paratypes of known species, along with some small fresh collections, enabled me to give supplementary descriptions, where necessary. Furthermore, eleven new species and one subspecies have been added and the systematic status of a few forms, regarded as subspecies by Leclercq, has been reconsidered. At present 41 species and subspecies of Psenini are known from the Ethiopian region.

In all about 450 specimens have now been recorded, the majority of which I had at my disposal. The material not seen by me includes a few large series of the commoner species, like a series of over sixty *Psenulus capensis* from Garamba. It is evident that the above total is far from being representative for this large area. Nevertheless we have obtained a somewhat better idea of its Psenine fauna. Some species have dispersed over large areas, consisting of savanna as well as forest regions. *Psenulus capensis* Brauns, for instance, is found from the extreme South of Africa to as far north as Sierra Leone and Ethiopia, with very little variation in structure or colour. Of *Psenulus bidentatus* (Cameron) at least three subspecies can be distinguished. The nominate form occurs mainly in the savanna region, *pallidus* subsp. nov. in the forest region and the subspecies *rubrocaudatus* Turner in South Africa.

The subgenus *Mimesa* was already known from North Africa; the first representative of this subgenus of *Psen* south of the Sahara has now been found in Transvaal. The

subgeneric status of a few species, thus far thought to belong to *Psen* s.str., is discussed at the end of the present paper, where also an attempt is made to recognize some higher groups of *Psenulus*.

The few data we have concerning the bionomics of the Ethiopian Psenini, their prey (cf. *Psen silvaticus* Arnold, *Psen madecassus* Arnold, *Psenulus stevensoni* Arnold and *Psenulus capensis* Brauns) or their nesting (cf. *Psenulus patei* Arnold and *Psenulus capensis*) agree with our present knowledge of the bionomics of their Palaearctic or Indo-Australian relatives.

For generously sending me their material I am much indebted to the authorities and staff of the institutions as well as to the private entomologists mentioned below, preceded by abbreviations used in the following text:

AMG — Albany Museum, Grahamstown, Cape Province, South Africa; Dr. F. W. Gess
AMNH — The American Museum of Natural History, New York, U.S.A.; Dr. J. G. Rozen and Mrs. M. Favreau
BM — British Museum (Natural History), London, United Kingdom; Dr. I. H. H. Yarrow and Mr. C. R. Vardy
CNC — Canadian National Collection of Insects, Ottawa, Canada; Dr. C. M. Yoshimoto
EC — Collection H. N. Empey, Highlands North, Transvaal, South Africa
FAG — Faculté des Sciences Agronomiques de l'Etat, Gembloux, Belgium; Prof. J. Leclercq
HT — Collection H. Townes, Ann Arbor, U.S.A.
IRSNB — Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium; Dr. P. Dessart
MRAC — Musée Royal de l'Afrique Centrale, Tervuren, Belgium; Dr. J. Decelle
MS — Naturhistoriska Riksmuseet, Stockholm, Sweden; Dr. P. I. Persson
NMB — Naturhistorisches Museum, Basle, Switzerland; Dr. C. Baroni Urbani
OSUM — Oregon State University, Entomological Museum, Corvallis, U.S.A.; Dr. G. R. Ferguson
PMFV — Collection P. M. F. Verhoeff, Utrecht, The Netherlands
RM — National Museum of Rhodesia, Bulawayo, Rhodesia; Mr. F. C. de Moor
SAM — South African Museum, Cape Town, South Africa; Dr. A. J. Hesse
TM — The Transvaal Museum, Pretoria, Transvaal, South Africa; Dr. J. A. van Reenen
USNM — National Museum of Natural History, Smithsonian Institution, Washington D.C., U.S.A.; Dr. K. V. Krombein, Dr. P. D. Hurd and Dr. A. S. Menke
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KEY TO THE SPECIES OF *Psen* S.L.

(the females of *P. empeyi*, *P. patellatus*, and the males of *P. leclercqi* and *P. silvaticus* are still unknown)

1. Females 2
— Males 5
2. Mesopleura including hypo-epimeral area coarsely striato-punctate. Scutum densely, coarsely punctate, interstices narrower than punctures. Petiole dorsally smooth . 3
— Mesopleura much finer and more sparsely punctate. Scutum coarsely punctate . 4
3. Propodeum finely reticulato-carinate, enclosed area ill-defined, more coarsely reticulato-carinate. Frons medially rugoso-punctate. Thorax black, pronotal tubercles and parts of pronotum red. Length 12 mm. Male unknown. Rhodesia . . . . . *Psen* (*Psen*) *silvaticus* Arnold
— Propodeum coarsely reticulato-carinate, enclosed area well-defined. Frons densely coarsely punctate, partly striato-punctate. Thorax largely black, pronotum, pronotal tubercles, anterior corners and narrow lateral margin of scutum, and upper two-thirds of anterior plate of mesepisternum reddish. Length 11.5 mm. Male unknown. Malagasy . . . . . *Psen* (*Psen*) *leclercqi* sp. nov.
4. Frons coarsely striato-punctate. Mesopleura more distinctly and more densely punctate, interstices 3 or 4 times diameter of puncture. Petiole dorsally smooth. Pygidial area finely coriaceous with a few irregular punctures along sides. Thorax and gaster completely black, legs dark. Length 14 mm. Zaire . . . . . *Psen* (*Psen*) *congolus* Leclercq
— Frons finely superficially punctate. Mesopleura finely and very sparsely, indistinctly, punctate. Scutum coarsely punctate, interstices usually at most as large as punctures. Petiole with fine latero-dorsal groove, in which a row of punctures, each with erect long hair. Pygidial area shining, with a few punctures along sides. Thorax including mesopleura largely dark reddish, gaster including petiole reddish-brown, tibiae reddish. Length 10—11 mm. Malagasy . . *Psen* (subgenus?) *madecassus* Arnold
5. Apical margins of third and fourth gastral sternites with fasciculate hairs. Scutum striato-punctate. Mesopleura distinctly punctate. Black, fore and mid tibiae brownish. Length 12—13 mm. Zaire . . . . . *Psen* (*Psen*) *congolus* Leclercq
— Apical margins of third and fourth sternites without fasciculate hairs. Thorax largely dark reddish, or gaster partly reddish, or tarsi whitish 6
6. Frontal carina distinct. Mesopleura including hypo-epimeral area finely, very sparsely, punctate. Petiole with fine latero-dorsal groove, in which row of punctures, each with erect long hair. Thorax including mesopleura largely dark reddish, tibiae reddish, gaster including petiole reddish-brown. Length 8.5—9.5 mm. Malagasy . . . . . *Psen* (subgenus?) *madecassus* Arnold
— Frontal carina indistinct. Mesopleura densely punctate. Thorax black 7
7. Hypo-epimeral area dull, coarsely coriaceous. Mesopleura densely punctate, with narrow interstices. Scutum shining, densely punctate, interstices mostly larger than punctures. Antennae normal, gradually broadening towards apex. Legs normal. Ventral plate of petiole, first gastral tergite and base of second tergite reddish. Length 6.5 mm. Female unknown. South Africa . *Psen* (*Mimesa*) *empeyi* sp. nov.
— Hypo-epimeral area shining, with distinct, separate, punctures. Mesopleura densely

finely punctate, narrow interstices. Scutum shining, densely somewhat irregularly punctate, interstices sometimes larger than punctures. Apical half of flagellum broadened, segments much concave below. Fore femora, fore tibiae and especially fore basitarsi broadened. Gaster black, all basitarsi whitish. Length 7 mm. Female unknown. South Africa . . . . . *Psen* (subgenus?) *patellatus* Arnold

KEY TO THE FEMALES OF *Psenulus*
(the females of *P. alveolatus*, *P. avernus* and *P. trevirus* are still unknown)

1. Tempora with coarse sculpture. Interantennal carina much broadened. Transverse carina below antennae. Prescutal sutures long, on apical half at least slightly indicated. Propodeal enclosure with wide central area. Petiole usually short, cylindrical, base flattened. No distinct pygidial area. Apical margins of sternites 4—5 with dense fringe of long pale hairs . . . . . (Group of *Psenulus turneri*) 2
— Tempora with much finer sculpture, in some species finely striate. Sternites 4—5 on apical margin with short pubescence, or with fringes of medium length (see *leoninus*, *reticulosus* and *sapobaensis*) 10
2. Second submarginal cell of fore wings petiolate 3
— Second submarginal cell of fore wings not petiolate, if triangular, see also *turneri* or *paulisae* 5
3. Apical part of fourth tergite and/or tergites 5—6 reddish, rarely also whole fourth tergite. Fore legs reddish, mid legs more or less brown, hind legs black. Antennae dorsally reddish-brown. Frons obliquely striato-punctate, vertex punctate with faint striae. Scutum rather coarsely punctate with traces of transverse striae. Propodeum behind enclosure irregularly striate. Mesopleura strongly punctate with tendency to striation. South Africa . . . . . *turneri* Arnold
— Tergites 1—6 or 2—6 reddish. Antennae blackish dorsally. At least base of hind tibiae reddish. Upper part of propodeum obliquely striate 4
4. Frons below ocelli distinctly obliquely striato-punctate. Vertex shining, finely punctate. Clypeus distinctly bidentate. Mesopleura and scutum distinctly densely punctate with tendency to transverse striation. Fore femora yellowish-red, sometimes with brown streak behind; mid femora brown behind; hind femora black, hind tibiae dorsally brown with pale reddish base. Zaire, Sierra Leone . *paulisae* Leclercq
— Frons finely densely punctate, slightly striate near median carina. Vertex shining, very finely punctate. Clypeal margin slightly emarginate, teeth less distinct. Scutum and mesopleura much finer and more sparsely punctate. Fore and mid legs and also hind tibiae yellowish-red; hind femora partly brown. Male unknown. Zaire, Sierra Leone . . . . . *erusus* Leclercq
5. Second submarginal cell of fore wings triangular or nearly so (see also *turneri* and *paulisae*); if slightly open, at least mid basitarsi pale yellowish. Upper part of propodeum striate. Frons more or less obliquely striato-punctate, or distinctly punctate. Tergites 1—2 or 1—3 black 6
— Second submarginal cell distinctly open dorsally (see also *patei* and *saltitans*). Frons striato-punctate or finely punctate. Gaster completely black or tergites 1—6 red, or upper part of propodeum coarsely reticulate 8
6. Apical margin of second tergite and tergites 3—6 completely reddish. Legs reddish, greater part of all femora dark brown, also back of mid tibiae and hind tibiae; mid

basitarsi yellowish-brown; hind tibiae with yellowish basal ring. Antennae slightly darkened dorsally. Mandibles yellowish-red. Vertex shining. Scutum shining, finely punctate, anteriorly somewhat striato-punctate. Mesopleura distinctly punctate, more sparsely than in *paulisae*, interstices smaller than punctures. Male unknown. Zaire . . . . . *garambae* Leclercq

— Tergites 4—6 reddish (at most also margin of third tergite) 7

7. Second submarginal cell usually triangular or nearly so. Scutum shining, finely punctate, laterally with tendency to transverse striation. Tergites 4—6 reddish. Fore legs yellowish-red, underside of femora and trochanters brown; mid femora dark brown, underside of mid tibiae pale reddish-brown, basal fifth yellowish; hind femora and tibiae brownish-black, basal fourth of hind tibiae straw-yellow; all basitarsi pale yellowish, apex of hind basitarsi more or less darkened. Antennae dorsally slightly brownish. Male unknown. Rhodesia . . . . . *patei* Arnold

— Second submarginal cell not completely closed. Scutum shining, slightly stronger, but still finely punctate, with very little tendency to transverse striation. Apical margin of third tergite and whole tergites 4—6 reddish. Fore femora almost completely brown, fore tibiae yellowish-red, fore tarsi yellowish; mid femora and tibiae brown, mid basitarsus pale yellowish; hind legs brown, tibiae without distinct basal ring. Antennae brownish dorsally. Male unknown. Rhodesia . . . . *saltitans* Arnold

8. Gaster black, last tergite brownish. Legs black, fore tibiae, apex of fore femora and back of mid tibiae reddish-brown. Frons on either side of median carina convex, shining, very finely and sparsely punctate. Scutum shining, finely sparsely punctate. Prescutal sutures indistinct on posterior three-quarters part of scutum, indicated only by a line of punctures. Mesopleura distinctly punctate, interstices mostly larger than punctures. Upper part of back of propodeum finely obliquely striate. Larger species, length 8 mm. Petiole about one and one-quarter times as long as first tergite, in dorsal aspect. Male unknown. Sierra Leone . . . . . *aurifasciatus* sp. nov.

— At least tergites 5—6 reddish 9

9. Tergites 1—6 reddish. All legs including trochanters completely reddish. Antennae dark brown above; scape, last segment completely and rest of segments below yellowish-brown. Frons, scutum and mesopleura finely punctate. Upper part of propodeum smooth and shining. Petiole shorter than first tergite, in dorsal aspect. Sierra Leone, Equatorial Guinea . . . . . *freetownensis* sp. nov.

— Only tergites 4—6 or 5—6 completely reddish. At least mid and hind femora brown, fore tibiae and foreside of mid tibiae reddish, hind tibiae brown with yellowish-grey base. Antennae dorsally blackish-brown, scape and antennae below brownish. Frons above antennal sockets obliquely striato-rugose. Scutum and mesopleura striato-punctate. Upper part of propodeum coarsely reticulate, laterally somewhat obliquely striate. Petiole about as long as first tergite. Zaire, Sierra Leone . . *ealae* Leclercq

10. First gastral tergite not distinctly nodose; or thorax with yellowish marking and gaster reddish or partly reddish-brown 11

— First gastral tergite nodose. Frontal carina narrow between antennae. No sharp transverse carina below antennae, at most a low ridge. Anterior margin of clypeus blunt. Prescutal sutures short. Thorax and gaster black. (Group of *Psenulus latiannulatus*) 30

11. Raised part of interantennal carina more or less broadened, sometimes not excavate.

Prescutal sutures long (except in *reticulosus*), sometimes partly indistinct. Some species with reddish petiole and gaster 12

— Raised part of interantennal carina narrow (very slightly broadened in *dilectus*) between antennae. Prescutal sutures short. Never gaster including petiole reddish 27

12. Gaster and petiole reddish. Fore and mid legs whitish or yellowish. Distinct transverse carina below antennae 13

— At least petiole black, if petiole and first gastral tergite reddish-brown, legs not whitish or yellowish 15

13. Raised part of carina between antennae much broadened, ratio width-length about 1 : 1.5. Prescutal sutures long but not sharply defined. Scutum shining, distinct, irregular punctation, sometimes with tendency to rugosity. Upper part of back of propodeum smooth. Petiole about one and one-third times as long as first tergite, in dorsal aspect. Pygidial area distinct, narrow. Pronotal dorsum, pronotal tubercles, hind margin of scutellum and metanotum ivory-white. Fore and mid legs including coxae ivory-white; hind legs yellowish-red, hind trochanters more or less yellowish-white. Malagasy . . . . . *fulgidus* Arnold

— Carina between antennae slightly broadened, sometimes almost sharp. Petiole over one and a half times as long as first tergite, in dorsal aspect 14

14. Prescutal sutures distinct only on anterior third of scutum. Scutum with distinct separate punctures. Propodeum behind enclosure smooth, back reticulate, above with oblique striae. Pygidial area narrow, with parallel unsharp lateral carinae. Pronotum yellow dorsally, in var. *alboscutellatus* Arnold also scutellum and metanotum yellow. Fore and mid legs including trochanters yellowish, hind legs reddish. Antennae reddish, base dorsally slightly darkened. Malagasy . . . . . *reticulosus* Arnold

— Prescutal sutures distinct on about two-fifths part of scutum, continued by a row of punctures. Scutum with variable, distinct separate punctures. Behind propodeal enclosure narrow smooth margin, back-side obliquely striate. No pygidial area. Mid tibiae on outer apex with longitudinal groove. Pronotum medially and metanotum somewhat brownish (discoloured?). Fore and mid legs including trochanters and mid coxae straw-yellow, hind legs including coxae reddish. Antennae dorsally dark brown, last segment above and flagellum below reddish-brown. Male unknown. Nigeria . . . . . *sapobaensis* sp. nov.

15. Apex of pygidium with single sharp and long median longitudinal carina. Frontal carina between antennae only slightly broadened. Frons finely punctate. Distinct transverse carina below antennae. Prescutal sutures long. Back of propodeum smooth. Petiole about one and a half times as long as first tergite, in dorsal aspect. Petiole except ventral plate black, gaster reddish. Pronotal tubercles and tegulae yellowish-red. Fore and mid legs except back of femora and base of hind tibiae yellowish, hind femora and apex of hind tibiae brown. Zaire . . . . . *benoiti* Leclercq

— Pygidium without single longitudinal carina 16

16. No transverse carina below antennae. Broadened part of raised interantennal carina indistinctly closed below. Protruding median part of clypeal margin slightly emarginate, almost blunt. Frons and vertex densely finely punctate. Scutum densely finely punctate, slightly transversely rugose, prescutal sutures with short transverse striae and deep alveoles. Petiole at least one and a half times as long as first gastral tergite, in dorsal aspect. Pygidial area elongate-triangular. Gaster black. All tibiae and tarsi

whitish; fore and mid tibiae below and apical half of tibiae, except a narrow line above, brownish. Male unknown. Rhodesia . . . . . *kohli* Arnold

— Distinct transverse carina below antennae, sometimes fine and only visible in ventral aspect. At least tergites 5—6 reddish or hind tibiae dark 17

17. Petiole little longer than first tergite. Apical margins of fourth and fifth sternites with fringe of yellowish-golden hairs, at least as long as width of base of hind basitarsi, but shorter than in group of *turneri*. Frontal carina ending normally as single carina in transverse carina below antennae, transverse carina almost rectangular in frontal aspect. Scutum partly transversely striato-punctate and also with some very large punctures. Prescutal sutures ill-defined. Apical half of pygidial area narrow with parallel carinae. Apical margin of first tergite and tergites 2—6 completely reddish. Legs reddish, back of mid femora and hind femora except underside dark brown. Fore and mid basitarsi yellowish. Length about 6 mm. Male unknown. Sierra Leone . . . . . *leoninus* sp. nov.

— Petiole much longer. Apical margins of fourth and fifth sternites without fringes of long hairs 18

18. Raised part of frontal carina much broadened between antennae, broadened part usually not closed below but ending with two parallel carinae in transverse carina below antennae. Upper part of propodeum finely obliquely striate. Pygidial area distinct. Fore and mid legs not whitish, at most mid basitarsi 19

— Carina between antennae much less broadened, or broadened part short and inter-antennal carina ending as a single carina in transverse carina. Lateral carinae of pygidial area not well-defined, if more distinct, fore and mid legs extensively whitish. Petiole about twice as long as first tergite, in dorsal aspect 23

19. Gaster black, at most last tergite brownish, or petiole completely and first tergite partly reddish-brown 20

— Gaster partly reddish 21

20. Frons very finely obliquely striate, vertex with weak sculpture. Scutum dull, superficially transversely striate and with some larger punctures. Petiole more than twice as long as first tergite, in dorsal aspect. Antennae reddish, apical half darkened. Fore and mid legs reddish-brown; at least mid basitarsi yellowish-white; hind legs entirely brown. Pronotal tubercles blackish; gaster black. Length 7 mm. Rhodesia . . . . . *stevensoni* Arnold

— Frons shining, finely punctate, vertex almost impunctate. Scutum shining, anterior two-thirds sparsely punctate. Petiole less than twice as long as first tergite. Antennae reddish-brown, segments 7—11 more or less darkened dorsally. Fore and mid legs including mid basitarsi and base of hind tibiae reddish-brown; fore and mid femora partly darkened, hind femora black, hind tibiae dark brown. Pronotal tubercles reddish-brown. Gaster black, petiole at least ventrally and laterally partly reddish-brown, also first tergite more or less brown, apex of last segment yellowish-red. Length 7 mm. South Africa . . . . . *jacoti* sp. nov.

21. Apical margin of fourth tergite and tergites 5—6 completely reddish. Mid basitarsi brown. Scutum dull, finely punctate. Petiole over twice as long as first tergite, in dorsal view. Pygidial area broader, lateral carinae slightly converging towards apex. Length 8 mm. Male unknown. Rhodesia . . . . . *luctuosus* Arnold

— Gastral tergites 1—6 reddish. Pygidial area narrow 22

22. Frons very finely punctate, vertex almost impunctate. Petiole over twice as long as

first tergite, in dorsal aspect. Antennal segment 1—12 reddish below. Greater part of mandibles reddish-brown. Legs brown, fore tibiae and tarsi reddish, mid basitarsi testaceous. Length 7.75 mm. Male unknown. Zaire . . . . . *lusingae* Leclercq

— Frons finely densely striato-punctate, vertex indistinctly striate. Petiole slightly over one and three-quarters times as long as first tergite, in dorsal aspect. Antennae black, only small central part of segments 5—12 below reddish-brown. Mandibles darker. Legs black, last tarsal segments, underside of fore tibiae and base of hind tibiae brownish. Length 7 mm. Male unknown. Ethiopia . . . . . *rugifrons* sp. nov.

23. Tergites 1—6 or 2—6 reddish 24

— At least tergites 1—3 black or very dark brown. Fore and mid basitarsi reddish-brown 26

24. Pronotal tubercles at most partly reddish or reddish-brown (very rarely yellowish; if so cf. *bidentatus pallidus*). Fore and mid legs reddish, underside femora brownish, base of fore tibiae often somewhat yellowish, rarely a narrow yellowish streak on foreside, fore and mid basitarsi yellowish or yellowish-red; hind legs reddish on inner side, dark brown on outer side, base of hind tibiae usually dark. Mandibles reddish. Antennae reddish, apical half dorsally brown. First gastral tergite mostly dark brown (reddish in female from Angola). Punctation of scutum superficial, interstices larger than punctures, slight tendency to transverse striation. Propodeum with narrow smooth margin behind enclosed area, back dorsally obliquely striate, below irregularly carinate. Pygidial area dull, lateral carinae not sharp, parallel. Length 8.5—9.5 mm. Tanzania, Kenya, Rhodesia, Angola, Zaire . . . . . *bidentatus bidentatus* (Cameron)

— At least posterior half of pronotal tubercles and foreside of fore tibiae distinctly yellowish. Tergites 1—6 or apex of first tergite and tergites 2—6 completely reddish. Length 7.5—8 mm 25

25. Only pronotal tubercles, foreside of fore tibiae, base of mid tibiae, and fore and mid basitarsi yellowish or whitish. Base of hind tibiae paler than rest of hind tibiae. Punctation of scutum coarser than in *bidentatus bidentatus*, more striato-punctate with interstices larger than punctures and more strongly transversely striate. Sculpture on back of propodeum reaching enclosed area, except laterally. Pygidial area as in nominate subspecies. Length 7.5 mm. Zaire, Rhodesia, Malawi, Equatorial Guinea . . . . . *bidentatus pallidus* subsp. nov.

— Pronotum partly, pronotal tubercles and metanotum yellow. Fore and mid legs yellowish-white, femora with light brown streak behind; greater part of hind legs brown. Scutum finely punctate, slight tendency to transverse striation. Propodeum behind enclosed area smooth, back with oblique striae above and irregular carination below. Pygidial area dull, more distinctly defined, almost rectangular and with two rows of fine punctures. Length 8 mm. Male unknown. Nigeria, Sierra Leone . . . . . *nigeriae* Leclercq

26. At least tergites 5—6 as well as apical half of fourth tergite reddish. Thorax black, pronotal tubercles partly dark brown. Fore legs except trochanters reddish-brown, underside of fore femora darker; mid legs reddish-brown, underside of femora and tibiae dark brown; hind legs dark brown or black. Mandibles reddish. Scutum with large, somewhat superficial punctures and distinct transverse rugae especially on outer side of prescutal sutures. Narrow smooth margin behind enclosed area of propodeum, back with fine oblique striae, medially sometimes reaching enclosed area.

Pygidial area as in *bidentatus bidentatus*. Length 8.75 mm. Male unknown. South Africa . . . . . *bidentatus rubrocaudatus* Turner

— Tergites 4—6 reddish-brown. Thorax black including pronotal tubercles. Legs somewhat darker reddish-brown, except fore basitarsi. Mandibles reddish. Scutum finer punctate, very little tendency to transverse striation. Narrow smooth margin behind enclosed area, back side dorsally with distinct fine oblique striae. Length 9.5 mm. Male unknown. Ethiopia . . . . . *bidentatus* subsp. nov.?

27. No well-defined pygidial area. Scutum transversely rugoso-punctate. Petiole less than twice as long as first tergite. This tergite of usual shape. Upper part of propodeum laterally with oblique striae, on either side of median sulcus a smooth area. Back of propodeum with coarse reticulate carination. Distinct transverse carina below antennae. Median part of pronotum, and whole metanotum, yellowish. Petiole black, tergites 1—6 reddish. Fore and mid legs yellow, fore and mid femora brown below, hind femora completely brown. Antennae dorsally dark brown. Length 7.5 mm. Male unknown. Zaire, Uganda . . . . . *ghesquierei* Leclercq

— Distinct narrow pygidial area. Scutum shining, finely punctate. First gastral tergite slightly nodose 28

28. Hind legs and tergites 1—6 reddish. Pronotum dorsally, pronotal tubercles, small marks on scutum, scutellum, metanotum, large part of back of propodeum and a mark on anterior plate of mesepisternum pale yellow, also fore and mid legs. Petiole black with yellowish base. Transverse carina below antennae lacking or indistinct. Back of propodeum almost completely smooth. Length 8—9 mm. Sierra Leone . . . . . *oweni* sp. nov.

— Hind legs mostly brown, gaster brownish or base of segments dark brown and only apical margins dark reddish 29

29. Pronotum, pronotal tubercles, four marks on scutum, scutellum, metanotum, back of propodeum and parts of sides of thorax yellow. Base of petiole yellow, remainder dark brown, gaster brownish. Fore legs mostly yellow; foreside mid legs yellowish, back-side brownish-red; hind legs brown but back of femora partly yellow. Fine transverse carina below antennae. Upper part of propodeum smooth, lower two-thirds of back-side with fine reticulate carination. Petiole about twice as long as first tergite. Length about 10.5 mm. Male unknown. Equatorial Guinea . . . . . *uelleburgi* sp. nov.

— Pronotum dorsally, pronotal tubercles, scutellum and metanotum yellowish-red. Petiole reddish-brown or darker brown, base of tergites dark brown, apical margins dark reddish. Fore and mid legs including trochanters reddish, mid femora brownish behind, hind legs brown, base of tibiae reddish. Transverse carina below antennae fine or indistinct, vertical carinae downwards from outer side of antennal sockets distinct. Propodeum behind enclosed area smooth, back-side finely punctate, apex finely reticulate. Petiole slightly longer than first tergite. Length 8 mm. Male unknown. Malagasy . . . . . *dilectus* Saussure

30. Lateral corners of pronotum obtuse. No sharp transverse carina below antennae, at most an indistinct ridge, but below outer side of each antennal socket a short vertical carina, in dorsal aspect protruding like a tooth. Punctation of scutum variable, sometimes very coarse. Upper part of back of propodeum usually distinctly obliquely striate. Pygidial area indistinct. Foreside of fore and mid tibiae yellow, also

fore and mid basitarsi and base of hind tibiae. Length about 7 mm. South Africa, Mozambique, Malawi, Zambia, Tanzania, Uganda, Zaire, Sierra Leone. The subspecies *laevior* Arnold, Ethiopia, female unknown, is distinguished by the brown femora and weaker sculpture of scutum and propodeum . *capensis capensis* Brauns

— Lateral corners of pronotum sharp. No distinct transverse or vertical carinae below antennae, sometimes a small low shining tubercle below antennae. Punctation of scutum variable but usually finer than in *capensis*. Propodeum behind enclosed area usually smooth. At least foreside of fore and mid tibiae more or less yellowish. Larger 31

31. Fore tarsi, a part of mid basitarsi, and base of hind tibiae yellowish-white. Punctation of scutum variable, usually fine and sparse. Pygidium with two indistinct, close, parallel carinae at apex. Length 8—9 mm. Tanzania, Rhodesia, Uganda, Zaire, Nigeria, Sierra Leone . . . . . *latiannulatus latiannulatus* (Cameron)

— Mid basitarsi and base of hind tibiae black or dark brown. Punctation of scutum stronger. Distinct narrow pygidial area, with very close, parallel carinae. Length 7.75 mm. Zaire, Rwanda, Cameroon . . . . . *latiannulatus basilewskyi* Leclercq

KEY TO THE MALES OF *Psenulus*

(the males of *P. aurifasciatus, P. dilectus, P. erusus, P. garambae, P. ghesquierei, P. kohli, P. leoninus, P. luctuosus, P. lusingae, P. nigeriae, P. patei, P. rugifrons, P. saltitans, P. sapobaensis*, and *P. uelleburgi* are still unknown)

1. Tempora coarsely, mostly longitudinally, striato-reticulate. Raised part of carina between antennae more or less broadened. Antennae with tyloidea. Anterior margin of pronotum alveolate. Prescutal sutures long, almost reaching hind margin of scutum. At least thorax and petiole black . . . (Group of *Psenulus turneri*) 2

— Tempora much less coarsely sculptured, sometimes finely striate (see *benoiti*) . 6

2. Upper part of back of propodeum smooth. Frons shining, finely punctate. Antennal segments long, segments 3 (or 4)—8 with distinct tyloidea. Scutum shining, finely punctate. Second submarginal cell of fore wings open dorsally. Tergites 1—6 reddish, only last sternites slightly brownish, all legs reddish. Sierra Leone, Equatorial Guinea . . . . . *freetownensis* sp. nov.

— Upper part of back of propodeum coarsely sculptured. At least first tergite completely black 3

3. Second submarginal cell not petiolate or triangular, dorsally open. Frons obliquely striate. Antennal segments 8—12 at least one and a half times as long as broad at apex, third segment with very small tyloidea, segments 4—10 with distinct long tyloidea, on third and 11th segment at most a small point. Scutum strongly transversely striate. Petiole about one and a half times as long as first tergite, in dorsal aspect. Tergites 1—3 black or dark brown. Fore and mid tibiae and tarsi and foreside of fore and mid femora reddish; back of fore and mid femora, as well as hind legs completely, brown except pale yellowish base of hind tibiae. Zaire, Sierra Leone . . . . . *ealae* Leclercq

— Second submarginal cell petiolate (rarely triangular in *turneri* or *paulisae*). Base of hind tibiae dark 4

4. Petiole nearly one and one-third times as long as first tergite, in dorsal aspect. Frons obliquely striate. Antennae moniliform, segments 8—12 little longer than broad, segments 3—10 with distinct tyloidea, small on tenth segment. Scutum distinctly punctate, slight tendency to transverse striation. Prescutal sutures with large alveoles. First tergite, basal two-thirds of second tergite and sides of tergites 3—5 partly black. Fore and mid legs including trochanters reddish, also hind tibiae and tarsi, hind femora brown. Zaire, Sierra Leone (description based on male from Sierra Leone) . . . . . *paulisae* Leclercq
— Petiole usually distinctly longer, about one and a half × or twice as long as first tergite, in dorsal aspect, or scutum more coarsely sculptured 5
5. Petiole about one and a half times as long as first tergite, in dorsal aspect. At least tergites 1—3 fully black, fourth tergite more or less darkened. Fore legs including trochanters reddish-brown, femora brown below, mid legs reddish-brown, darkened below, trochanters brown; hind legs for greater part dark brown. Antennal segments 3—8 about one and a half times as long as wide at apex, segments 4—8 with distinct small tyloidea, 9—10 with indistinct tyloidea. Frons obliquely striate, vertex more superficially striato-punctate. Scutum more coarsely punctate than in *paulisae*, with some transverse rugae, especially across the prescutal sutures, and large alveoles. South Africa . . . . . *turneri* Arnold
— Petiole nearly twice as long as first tergite. First tergite and two-thirds of second tergite black, greater part of sternites 2—4 blackish-brown. Fore legs including trochanters reddish-brown, mid legs slightly darker brown, hind legs dark brown. Antennal segments 3—8 about one and a half times as long as wide at apex, segment 3 with small tyloidea, segments 4—8 with longer, distinct, tyloidea. Frons and interocellar area coarsely, frons obliquely, striato-punctate, vertex between ocelli and oculi more finely striato-punctate. Anterior half of pronotal dorsum with stronger longitudinal short carinae, alveolate. Scutum distinctly punctate, tendency to transverse striation, rugae across prescutal sutures very coarse, alveoles larger than in *turneri*. Female unknown. Rhodesia . . . . . *alveolatus* sp. nov.
6. First gastral tergite not distinctly nodose, or tergites 1—6 or 2—6 reddish . . 7
— First gastral tergite distinctly nodose. Prescutal sutures short. Raised part of frontal carina between antennae sharp. Gaster black, fore and mid tibiae at least partly yellowish or yellowish-white . . . . . (Group of *Psenulus latiannulatus*) 16
7. Petiole and gaster reddish. Interantennal carina not distinctly broadened between antennae, as it is in female. Upper part of back of propodeum smooth behind enclosed area. Petiole about one and a half times as long as first tergite . . . 8
— Petiole black, at most base yellowish, or sides dark reddish-brown 9
8. Scutum coarsely transversely striato-punctate. Mesopleura coarsely punctate, hypoepimeral area more finely. No tyloidea on antennal segments. Scape of antennae yellow, rest of antennae yellowish-brown, brownish above. Pronotum, pronotal tubercles, tegulae, hind margin of scutellum and metanotum yellow. Fore and mid legs including trochanters yellow; hind legs including coxae yellowish-red. Length 6 mm. Malagasy . . . . . *fulgidus* Arnold
— Scutum shining, with punctures of variable size, interstices mostly larger than punctures. Mesopleura finely punctate. Antennal segments 3 (or 4)—13 with distinct oblique tyloidea. Scape of antennae yellow, rest of antennae reddish. Two marks on pronotum, and pronotal tubercles, yellow or yellowish-white. In var.

alboscutellatus Arnold also scutellum with yellowish-white mark. Fore and mid legs including trochanters whitish, femora brownish below and last tarsal segments reddish; hind legs including coxae reddish. Length 8.5 mm. Malagasy . . . . . *reticulosus* Arnold

9. Thorax and gaster black, at most pronotal tubercles and sides of petiole reddish-brown. Interantennal carina broadened. Median part of propodeal enclosure rather broad. Upper part of back of propodeum finely obliquely striate. Petiole long . 10
— Gaster more or less reddish 11
10. Petiole at least twice as long as first gastral tergite, in dorsal aspect. Frons with superficial oblique striae. Antennal segments 10—12 about as long as broad; segments 3—13 with tyloidea. Scutum transversely striato-punctate, prescutal sutures almost reaching hind margin. Pronotal tubercles dark brown. Legs and veins of fore wings reddish-brown. Petiole completely black. Gaster with somewhat appressed silvery pubescence. Length 6 mm. Rhodesia . . . . . *stevensoni* Arnold
— Petiole little more than one and a half times as long as first tergite. Frons shining, finely punctate. Antennal segments 10—12 about one and a half times as long as broad; segments 4—11 with tyloidea, indistinct tyloidea on segment 12. Scutum shining, scarcely finely punctate, prescutal sutures posteriorly slightly indicated. Pronotal tubercles reddish-brown, sides of petiole somewhat reddish-brown. Legs black, fore tibiae and tarsi and underside of mid and hind tibiae yellowish-brown. Veins of wings black. No appressed silvery pubescence on gaster. Length nearly 7 mm. South Africa . . . . . *jacoti* sp. nov.
11. Scutum distinctly or indistinctly transversely rugoso-punctate. Propodeum black. Petiole at least twice as long as first tergite. Antennae very strongly moniliform, with tyloidea. Interantennal carina slightly or not broadened 12
— Scutum smooth, finely punctate, or coarsely punctate and back of propodeum with yellow marking. Antennae not strongly moniliform 13
12. Pronotal tubercles dark brown. Fore and mid legs reddish-brown, basitarsi paler, femora below dark brown, hind legs dark brown. Mandibles reddish. Base of petiole dark brown or black. Gastral tergites 2—6 reddish. Pronotum and metanotum black. Scutum with coarse punctures and light transverse rugae. Narrow smooth margin behind propodeal enclosure, sometimes lacking. Length 8 mm. Tanzania, Rhodesia, Kenya, Angola, Zaire . . . . . *bidentatus bidentatus* (Cameron)
— Pronotal tubercles yellowish or yellowish-red. Fore and mid tibiae yellow, basitarsi whitish. Mandibles yellowish. Base of petiole somewhat yellowish-red (not in female). Gastral tergites 1—6 or 2—6 reddish. Pronotum partly and metanotum more or less yellow, rarely black. Scutum with distinct punctures and feeble transverse rugae. Broader smooth margin behind enclosed area of propodeum. Length 7 mm. Zaire, Equatorial Guinea, Rhodesia and Malawi . *bidentatus pallidus* subsp. nov.
13. Thorax black. Prescutal sutures long. Frontal carina more or less broadened between antennae. Scutum finely punctate 14
— Thorax and propodeum with yellow marking. Prescutal sutures short, one-third or one-half of length of scutum. Raised part of frontal carina narrow between antennae. First gastral tergite slightly nodose. No tyloidea 15
14. Upper part of propodeum smooth, back-side coarsely reticulate. Petiole about one and one-third times as long as first gastral tergite, in dorsal aspect. Antennal segments slightly rounded below, no distinct tyloidea. Pronotal tubercles yellowish-brown.

Tergites 1—6 reddish. Fore and mid legs reddish, hind legs brown. Zaire . . . . . *benoiti* Leclercq

— Upper part of propodeum shining, indistinctly obliquely striate, back with coarse reticulate carination. Petiole about two and one-third times as long as first tergite. Antennal segments more cylindrical, less rounded below, segments 3—12 with very fine narrow shining tyloidea, indistinct on twelfth segment. Pronotal tubercles dark brown. First gastral tergite brownish, 2—6 reddish. All femora blackish-brown, fore and mid tibiae brown. Female unknown. Zaire . . . . . *avernus* Leclercq

15. Anterior lateral corners of pronotum obtuse. Scutum coarsely punctate, scutellum and metanotum almost impunctate. Upper part of propodeum behind enclosed area smooth, rest coarsely reticulate. Sides of propodeum with narrow smooth anterior margin. Mesopleura distinctly punctate, interstices about three or four times as wide as punctures. Petiole about one and one-third times as long as first tergite, in dorsal aspect. Pronotum, pronotal tubercles, two square marks on scutellum, metanotum, two marks on back of propodeum and small spot on anterior plate of mesepisternum, brownish-yellow. Base of petiole yellowish-white, tergites 2—6 reddish, base of second tergite black. Fore and mid legs including trochanters brownish-yellow, back of femora brown; hind trochanters and femora brown, median part of hind tibiae brownish, rest of hind legs reddish. Female unknown. Zaire . . *trevirus* Leclercq

— Anterior lateral corners of pronotum sharp. Scutum shining, very finely punctate. Upper part of propodeum smooth, back coarsely reticulate, sides of propodeum with broad smooth anterior margin. Mesopleura finely punctate, interstices larger. Petiole about one and a half times as long as first gastral tergite. Pronotum, pronotal tubercles, two or four small longitudinal marks on scutum, scutellum, metanotum, four marks, connected below, on back of propodeum and a small spot on anterior plate of mesepisternum, whitish-yellow. Base of petiole yellowish-red, tergites 1—6 reddish, first tergite more or less darkened. Fore and mid legs including trochanters pale yellow, femora brown below; hind legs including trochanters dark brown, underside femora and basal half of tibiae more reddish. Sierra Leone . . . *oweni* sp. nov.

16. Anterior lateral corners of pronotum with obtuse angle. Antennal segments 4—12 behind, on line between dark brown upper side and yellowish-brown underside, with low but distinct tyloidea. Scutum with coarse variable punctation, apically finer but more densely punctate. Upper part of propodeum behind enclosed area completely rugoso-striate. Black; fore and mid tibiae, except brown mark below, and tarsi yellow, base of hind tibiae whitish. Length about 7 mm. South Africa, Mozambique, Malawi, Zambia, Tanzania, Uganda, Zaire, Sierra Leone, Ethiopia (subspecies *laevior* Arnold, distinguished by brown femora and weaker sculpture of scutum and propodeum) . . . . . *capensis capensis* Brauns

— Anterior lateral corners of pronotum more or less sharp, never obtuse. Antennae without distinct tyloidea. Upper part of propodeum behind enclosed area usually at least partly smooth, or base of hind tibiae dark. Length 7.5—8 mm . . . 17

17. Mid basitarsi and base of hind tibiae whitish, apart from other yellowish-white parts of fore and mid legs. Antennae dorsally black, reddish-brown below. Punctation of scutum distinct, interstices large, punctures usually small, rarely larger. Upper part of propodeum behind enclosed area near median sulcus usually smooth. Anterior lateral corners of pronotum more or less sharp. Length 8 mm. Tanzania, Rhodesia, Uganda, Zaire, Nigeria, Sierra Leone . . *latiannulatus latiannulatus* (Cameron)

— Mid basitarsi and base of hind tibiae dark brown. Antennae dorsally blackish-brown, below on basal half reddish-brown, on apical half brown. Punctation of scutum coarser. Upper part of propodeum behind enclosed area obliquely striate or rugose. Anterior lateral corners of pronotum sharp. Length 7.5 mm. Zaire, Rwanda, Cameroon . . . . . *latiannulatus basilewskyi* Leclercq

Psen (Psen) silvaticus Arnold

Arnold, 1924: 38—39, ♀ (*Psen silvaticus*; Rhodesia).
Leclercq, 1961a: 15, ♀ (*Psen* (*Psen*) *silvaticus*; Rhodesia).

Material studied: Rhodesia: 1 ♀ (holotype), "Cloudlands, 6000 ft, Vumba Mts, 6—17 April, 1923", 1 ♀, Vumba Mts, Umtali dist., 7 March, 1930, coll. R. H. R. Stevenson, 1 ♀, Vumba Mts, March, 1930, coll. R. H. R. Stevenson, 2 ♀, Vumba, March, 1930, coll. R. H. R. Stevenson, 1 ♀, Vumba Mts, 1 March, 1938, coll. G. Arnold (RM); 1 ♀, Vumba, March, 1930, coll. R. H. R. Stevenson (SAM).

Arnold (1924) recorded the holotype as follows: "Mt. Chinzewa, 6200 ft, Vumba Range, near Umtali, S.R. One female taken flying round a species of wild raspberry in the hollow stems of which it probably nests. Type in R.M. coll." Mr. F. C. de Moor kindly checked his topocadasteral map of the Vumba Mountains area because of the discrepancy between the locality label under the type and Arnold's record. In his letter, 10 May, 1973, he writes: "Cloudlands is a Private Game reserve, the highest point on this farm is an unnamed mountain with a beacon "Castle Beacon 6245 feet". I can find no reference to Mt. Chinzewa however".

Mr. de Moor also reported to me that in March, 1930 in total ten specimens were collected in the Vumba Mts., with the following note written by Arnold: "Nesting in cracks in old rotten tree stump (prone). All ten specimens taken from same spot in dull weather."

Under one of these specimens the prey has been pinned, an adult Homopteron belonging to the Cercopidae, about 7 mm long. Cercopidae have been recorded earlier as the prey of Palaearctic and Indo-Australian species of *Psen*.

Supplementary description. — Frontal carina distinct on lower half of frons, on upper half almost absorbed by the coarse close punctation. Arnold's figure of the head wrongly gives the impression that there is a transverse carina below the antennae. In reality two very fine carinae connect the interantennal tooth with the inner side of the antennal sclerites (Fig. 1). Propodeal enclosure ill-defined, with irregular reticulate carination, back very finely reticulato-carinate. Hypo-epimeral area striato-punctate, like adjacent part of mesopleura. Outer epicnemial carinae below hardly receding backwards. No acetabular carina. Mesosternum dull, finely densely superficially punctate, fine median longitudinal carina. Mesopleura on lower part shining, with large punctures and tendency to striation. Upper longitudinal half of hind femora smooth, separated from normally pubescent lower part by a narrow longitudinal area of dense fine punctation and fine short hairs, somewhat broadened near apex, not distinctly depressed there. Petiole cylindrical with long lateral hairs, directed obliquely downwards, sometimes worn off.

This species much resembles *P. leclercqi* sp. nov. from Malagasy.

Psen (Psen) congolus Leclercq

Leclercq, 1961a: 15—16, ♀ and ♂ (Zaire).

I have examined one of the paratypes (a male) from Lubumbashi (Elisabethville), Dec., 1933, coll. M. Bequaert (FAG). The structure of the epicnemial area and of the mesosternum agrees with that of the Indo-Australian representatives of the subgenus *Psen*. The acetabular carina is short. Hind margins of third and fourth sternites with tufts of long brownish hairs.

Psen (Psen) leclercqi spec. nov.

Female. — Head black; mandibles reddish-brown except dark tips, labrum reddish-brown, palpi yellowish-brown, antennae black but underside of scape, of second, third and 12th segment reddish-brown. Thorax black, with following parts reddish-brown: pronotum dorsally and upper part of foreside, pronotal tubercles, anterior corners of scutum and a narrow margin along tegulae, upper two-thirds of anterior plate of mesepisternum and tegulae. Legs black with following parts reddish-brown: fore tibiae and tarsi, underside of mid and hind tibiae, and tarsi. Calcaria yellowish-brown. Petiole reddish, gaster black but greater part of first and second gastral tergites, apex of last segment and greater part of sternites reddish-brown. Veins of wings black but basal part and stigma reddish-brown.

Clypeus feebly convex, like supra-clypeal area densely but superficially punctate, protruding median part slightly emarginate (Fig. 2, 3). Frontal carina reaching groove around median ocellus but almost absorbed by sculpture of frons. Carina ending below antennae in low triangular tooth, connected with inner side of antennal sclerites by fine carinae. Frons flat, up to ocelli densely striato-punctate, interstices shining, very narrow margin along oculi finer and sparsely punctate. Punctation between ocelli fine, interstices about as wide as punctures. Vertex behind ocelli with close and large punctures, laterally coarser and somewhat striato-punctate, with only a few smooth places about as large as punctures. Postocellar region not distinctly raised. Temples finely but distinctly punctate, interstices about as wide as punctures or slightly more. Occipital carina ending in hypostomal carina, both narrow and high, but lower than in *P. madecassus* Arnold. Scape of antennae long, at least three times as long as wide, third segment nearly four times, fourth segment more than twice, segments 5—7 about one and a half times, eighth segment about one and a third times as long as wide at apex, segments 9—11 slightly longer than wide, 12th segment about twice as long as broad at base.

Pronotal corners obtuse. Scutum densely and coarsely rugoso-punctate (Fig. 4), interstices shining, medially not more than a narrow line. Prescutal sutures indicated by a row of much finer punctures. Scutellum somewhat striato-punctate, interstices larger than punctures, metanotum with irregular longitudinal carinae. Propodeal enclosure depressed, lateral parts with oblique longitudinal carinae, central part with irregular carination; back of propodeum with coarse irregular reticulate carination reaching enclosed area. Sides of propodeum with oblique carinae and fine punctures between. Mesopleura coarsely striato-punctate, striae posteriorly more striking, lower part finer sculptured, hypo-epimeral area coarsely densely punctate. Epicnemial areas almost smooth, inter-epicnemial area finely punctate, mesosternum depressed behind short acetabular carina, antero-laterally obliquely striato-punctate, medially with strong transverse carinae. Meta-

pleura shining, with some low longitudinal rugae on posterior half. Anterior plate of mesepisternum with irregular long, partly vertical, striae; anterior oblique suture foveolate, widened upper part with transverse striae, continuing on hypo-epimeral area. Epicnemial carina below normally curved backwards. Metasternum with deep triangular emargination.

Femora heavy, hind tibiae dorsally with row of short thick thorns and thin long white spines. Base of second submarginal cell of fore wings about one and a half times as long as upper side, receiving first recurrent vein at about one-third from inner side; second recurrent vein ending in this cell very near outer side.

Petiole as long as first two tergites and half third tergite, dorsally completely smooth, impunctate, apically somewhat flattened, sides longitudinally slightly depressed, only lower keel distinct, ventrally an indistinct blunt median longitudinal keel. Tergites basally very finely punctate, on third tergite deeper than on second tergite; interstices about as wide as punctures, on apical two-thirds interstices a few times as wide as punctures. Margin of fourth tergite narrowly, of fifth broadly impunctate. Pygidial area elongate-triangular, defined by distinct carina, apex rounded, surface shining but extreme apex dull, laterally a few small punctures, each bearing a short stiff hair (Fig. 5). Sternites sparsely punctate, somewhat more densely at base, especially antero-laterally on second sternite.

Clypeus with appressed golden pubescence and long erect hairs. Supra-clypeal area and lower part of frons with less appressed golden pubescence; upper part of head with longer, brownish pubescence. Temples with erect greyish pubescence, pronotum with appressed greyish-white pubescence, thorax with long and dense pubescence, brownish on scutum, whitish on rest of thorax, denser on mesosternum. Legs with greyish hairs, base and apex of hind tibiae on inner side and underside of hind basitarsus with very dense and short, yellowish-golden pubescence. Upper half of back of hind femora smooth and shining, separated from normally pubescent lower half by a dorsally sharply defined narrow line of fine dense punctation and short pubescence. Petiole below lower lateral longitudinal carina with row of fine punctures, each bearing a long obliquely downwards directed hair and also with a row of dense short hairs, densest apically. Tergites sparsely reddish-brown pubescent, dense on lateral parts of hind margin. Apex of fifth tergite before smooth hind margin with a few long stiff hairs, also sixth segment with long stiff hairs. Base of second sternite with dense pale pubescence, on disk and on hind margins of following sternites a few long stiff hairs.

Length about 11.5 mm.

Male unknown.

Malagasy: 1 ♀ (holotype), "Madagascar, Rogez, II.44" (FAG).

This is the second species of *Psen* known from Malagasy. It is easily distinguished from *P. madecassus* Arnold, which is smaller, more reddish, and much more finely, very sparsely, punctate, especially on front, vertex, scutum and sides of thorax.

P. leclercqi is very similar to *P. silvaticus* Arnold from Rhodesia but it differs not only in the reddish anterior corners of the scutum, but especially in the sculpture of the propodeum. In *P. silvaticus* the enclosed area is hardly distinguishable, with irregular reticulate carination; back-side of propodeum very finely reticulato-carinate. In *P. leclercqi* the propodeal enclosure is well-defined, lateral parts of enclosure shining, with oblique distinct carinae, median part with coarse irregular sculpture, back of propodeum coarsely irregularly reticulato-carinate.

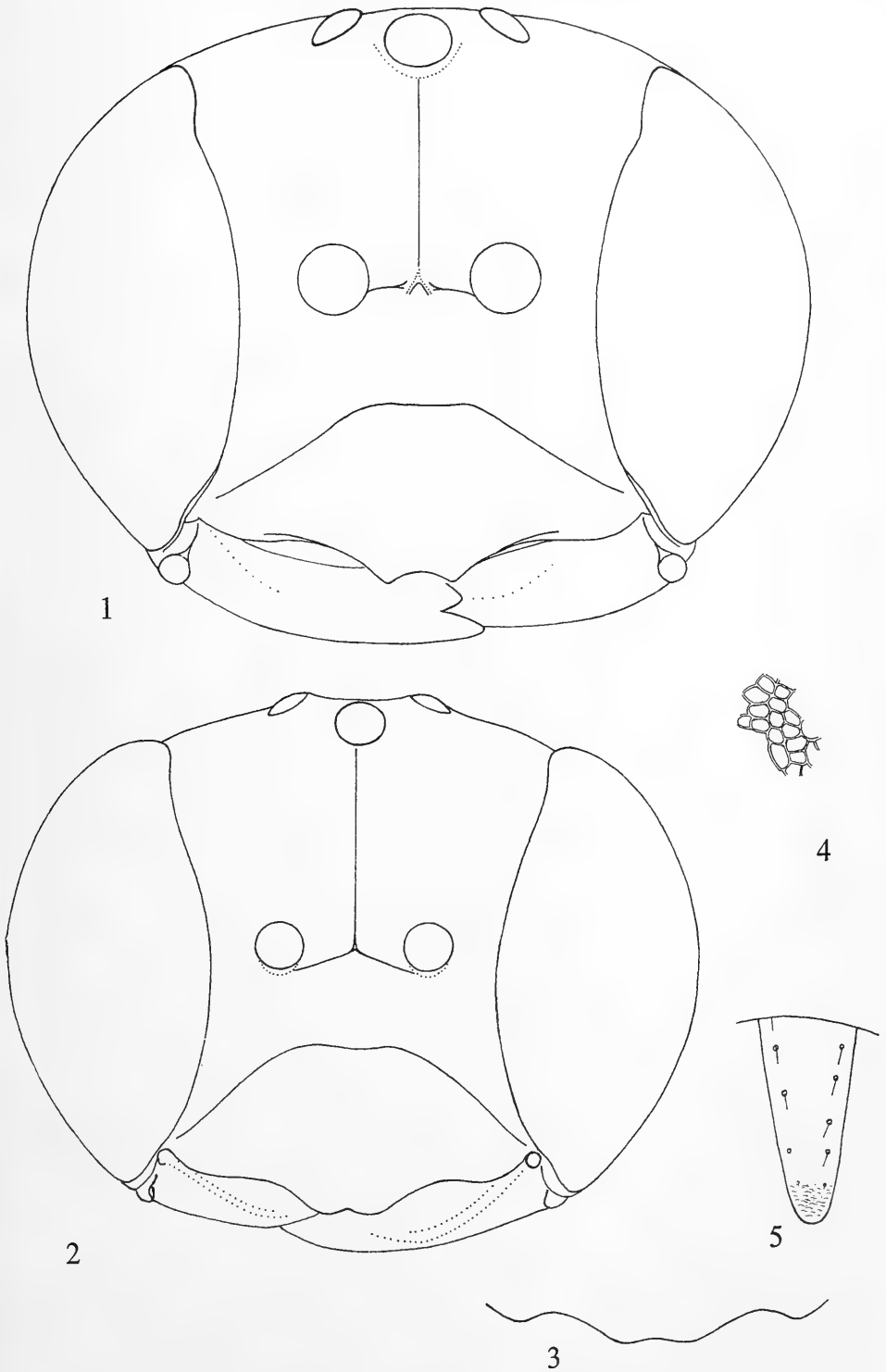

Fig. 1. *Psen* (*Psen*) *silvaticus* Arnold, ♀. Face. Fig. 2—5. *Psen* (*Psen*) *leclercqi* sp. nov., ♀, holotype. 2, face; 3, clypeal margin; 4, punctation median part of scutum; 5, pygidial area

Psen (subgenus?) madecassus Arnold

Arnold, 1945: 152—153, ♀ and ♂ (*Psen madecassus*; Malagasy: Bekily, Ranomafana, Ivondro).
Leclercq, 1961a: 15, ♀ and ♂ (*Psen (Psen) madecassus*; Malagasy: Bekily, Rogez).
Leclercq, 1961c: 117, ♀ (Malagasy: Mandraka).

Material studied: Malagasy: 1 ♀, paratype and 1 ♂, paratype, both labelled "in cop. B.", Bekily, Febr., 1937, coll. A. Seyrig, 2 ♂, Bekily, Jan., 1937, coll. A. Seyrig, 1 ♀, Perinet, "Forêt côte est", Febr., 1939, coll. A. Seyrig (RM); 1 ♀, Bekily, Jan., 1942 (BM); 1 ♂, Bekily, Jan., 1937, coll. A. Seyrig (author's collection); 1 ♂, Rogez, June, 1944, coll. A. Seyrig (MRAC); 1 ♀, Madagascar Est, Mandraka (Tamatave), 4 April, 1958, coll. F. Keiser (NMB).

The excellent description by Arnold may be supplemented with the following characters. — Frontal carina fine, reaching anterior ocellus, slightly widening at lower end and ending in a low small tubercle. Lateral parts of frons with large low tubercle. In both sexes occipital carina narrow and high, especially lower part, ending normally in hypostomal carina. Apical margin of clypeus thick, slightly emarginate.

Scutum coarsely punctate, interstices as large as, sometimes larger than punctures. Mesopleura not closely and finely punctate, as stated by Arnold, but finely and sparsely, including hypo-epimeral area, interstices many times larger than punctures. Mesosternum depressed and smooth behind interepicnemial area, with high median longitudinal carina, anteriorly defined by a distinct short acetabular carina. Metasternum deeply emarginate. Petiole dorsally smooth, latero-dorsally with shallow narrow groove, sides of petiole with distinct groove, also ventro-laterally a distinct longitudinal groove; in all these grooves a row of fine punctures, each with a long erect fine hair. Hind coxae with sharp inner longitudinal carinae. Upper third of hind femora smooth, medially a broad, densely finely punctate and pubescent, longitudinal line, lower part of femora sparsely longer pubescent. Pygidial area of female (Fig. 13) elongate-triangular, apex emarginate, lateral carinae high. Antennae of male without distinct tyloidea. No fasciculate hairs on apical margins of third and fourth gastral sternites, but margins of second and following sternites with fine pale, obliquely inwards directed, long erect hairs. Genitalia of male: Fig. 6, 7, 8, 9. Seventh sternite: Fig. 10. Eighth sternite: Fig. 11, 12.

P. madecassus does not belong to the subgenus *Psen* because of the somewhat different shape of the sternum, the fine, punctate, latero-dorsal sutures of the petiole and the absence of fasciculate hairs on the apical margins of the third and fourth gastral sternites of the male. Probably it should best be placed into the subgenus *Punctipsen*, of which representatives are known from the Palaearctic region, Ryukyu Islands, Formosa and S India. The characters they have in common are the punctation of the petiole, the almost vertical foreside of the first tergite, the continued longitudinal rugae on the back of the propodeum, behind the enclosed area, the thick apical margin of the clypeus, the absence of fasciculate hairs on the sternites of the male and to some extent also the shape of the male genitalia.

Fig. 6—12. *Psen madecassus* Arnold, ♂. 6, outer valve of genitalia, dorsal aspect; 7, the same, lateral aspect; 8, the same, inner aspect, with volsella; 9, right penis valve, outer side; 10, 7th sternite, ventral aspect; 11—12, 8th sternite, lateral and ventral aspect. Fig. 13. *Psen madecassus* Arnold, ♀, pygidial area. Fig. 14—18. *Psen patellatus* Arnold, ♂, paratype. 14, face; 15, 6th, 7th and 8th sternites, ventral aspect; 16—18, genitalia, ventral, lateral and posterior aspect

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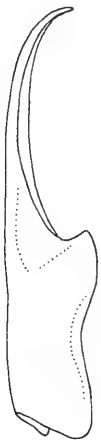

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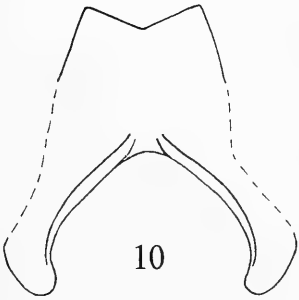

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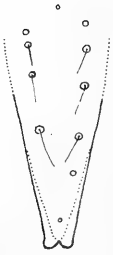

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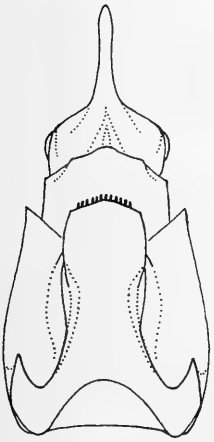

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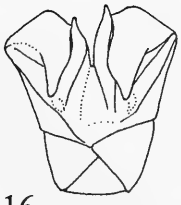

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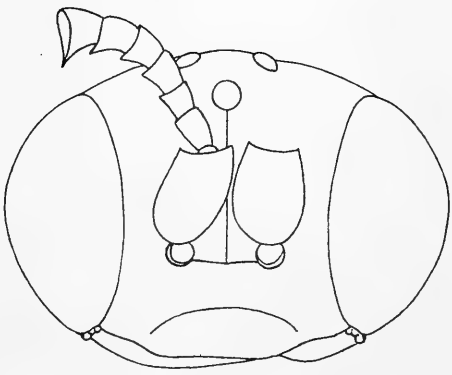

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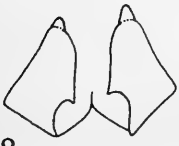

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P. madecassus differs from the earlier described species belonging to *Punctipsen* in the reduced punctation of the dorsal side of the petiole and in having no tooth on mandibles or mid basitarsi of the males, but I think that these characters do not have any subgeneric value.

The hind coxae have a sharp inner carina as in the subgenus *Pseneo*, but there is no oval patch on the posterior apex of the hind femora, the clypeus is bidentate and the petiole has latero-dorsal grooves with fine punctures and long erect lateral and ventral hairs.

Arnold (1945) records one specimen with prey, a small adult Cercopid.

Psen (subgenus?) **patellatus** Arnold

Arnold, 1924: 39—40, ♂ (*Psen patellatus*; SW Africa: Onoolonga and Mafa).
Leclercq, 1961a: 15 (*Psen* (*Psen*) *patellatus*)).

Material studied: South-West Africa: 1 ♂ (holotype), Mafa, Febr., 1923, 1 ♂, Onoolonga, Febr., 1923, det. Arnold (SAM); 1 ♂, Onoolonga, Febr., 1923, with green paratype label (RM).

Dr. Hesse of the South African Museum informed me that there are two more males in his collection, respectively one from Mafa and one from Onoolonga. Arnold (1924) recorded in total three males from Onoolonga and Mafa, he did not mention which was the holotype.

Little can be added to the detailed original description. — Face broad (Fig. 14), hypostomal carina ending normally in occipital carina. Mandibles unidentate at apex. Sternum very densely punctate, no acetabular carina, lateral epicnemial carinae not curved backwards as in subgenus *Psen*. Petiole short, not only dorsally, but also laterally with irregular longitudinal carinae; similar carinae on ventral side which are converging backwards; ventral plate with fine longitudinal rugae. Fourth and fifth gastral sternites without fasciculate hairs. Sternites 6—8: Fig. 15, ventral aspect. Apical spine short. Genitalia short, base and apex dark brown, median part and penis valves testaceous (Fig. 16, 17 and 18).

Arnold already doubted whether this species belongs to the subgenus *Psen*. The structure of the epicnemial areas and of the petiole, the depressed posterior side of the propodeum, the absence of fasciculate hairs on the apical margins of the fourth and fifth sternites, and the short genitalia make it very unlikely that *P. patellatus* should be placed in the subgenus *Psen*. As it does not fit in any of the other subgenera, perhaps a new subgenus has to be erected to receive this species.

Psen (Mimesa) empeyi spec. nov.

Male. — Head and thorax black; anterior margin of lower part of pronotum somewhat thicker and yellowish-white; apices of mandibles reddish, palpi very dark brown, antennal segments 5—12 below, last two segments completely, orange-reddish, segments 5—11 brownish dorsally. Tarsi brownish, tibial spurs of hind legs whitish. Veins of wings brown, base of veins and base of stigmata of fore wings paler brown. Petiole black, ventral plate red, also first tergite and base of second tergite, following tergites black.

No distinct frontal carina, small low tubercle between antennae. Frons and vertex densely punctate, interstices on vertex larger, at least as wide as diameter of punctures,

shining. Temples rather densely punctate, surface with fine striae. Underside of head shining, occipital carina distinctly ending in hypostomal carina. Face below antennae, including clypeus, dull, finely very densely punctate, protruding median part of clypeus with small triangular emargination and slight depression (Fig. 19). Mandibles narrow. Third antennal segment nearly three times, fourth segment about twice, fifth segment about one and a half times, segments 6—8 about one and a quarter times as long as broad at apex, segments 9—12 about as long as broad at apex, last segment about one and three-quarter times as long as wide at base. Interocellar area almost impunctate, distance between posterior ocelli longer than distance between ocelli and oculi.

Sides of pronotum converging roundly backwards (Fig. 20). Scutum shining, densely punctate, interstices mostly larger than diameter of punctures, prescutal sutures indistinct, scutellum punctate as scutum, posteriorly somewhat longitudinally striate. Metanotum dull, with coarse and very close reticulate carination. Propodeum also dull, with coarser reticulate carination, coarsest on lower half. Propodeal enclosure ill-defined, propodeal longitudinal groove deep, coarsely reticulato-carinate. Sides of propodeum dull, finely closely reticulato-carinate, more striate on anterior half. Upper part of metapleura dull, lower part almost shining. Mesopleura, anterior plate of mesepisternum, greater part of epicnemial areas and mesosternum densely punctate, with narrow shining interstices; hypo-epimeral area dull, finely closely reticulato-carinate or coarsely coriaceous, epimeral suture ill-defined. First recurrent vein of fore wings interstitial, second recurrent vein ending near end of second submarginal cell. Legs slender. Petiole about one and a half times as long as first tergite, thin, cylindrical, slightly widened at base and apex, with small pit dorsally at apex. Gaster slender, finely alutaceous, last tergite dorsally flattened, broad-triangular with rounded apex (Fig. 21, 22), densely punctate with short appressed hairs.

Sixth sternite dentate apically (Fig. 23). Seventh sternite whitish transparent, tip dark brown with triangular emargination (Fig. 24). Eighth sternite whitish transparent, apical margin dark brown, spine short and dark brown (Fig. 25, 26). Genitalia dark brown: Fig. 27, 28.

Pubescence silvery-whitish, dense and appressed below antennae.

Length about 6.5 mm.

Female unknown.

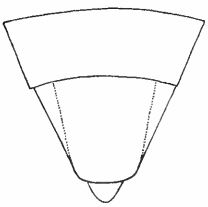
South Africa: 3 ♂ (holotype and paratypes), Ellisras, N. Transvaal, 19 June, 1962, 1 ♂ (paratype), 22 June, 1963, coll. H. N. Empey (holotype deposited by Mr. Empey in the Transvaal Museum, paratypes EC, PMFV and in the author's collection).

P. empeyi is the first known Ethiopian species of the subgenus *Mimesa*, a subgenus well represented in the arctic and Mediterranean regions. It is distinguished by the remarkable female-like pygidial area which resembles that of the Nearctic *Psen* (*Mimesa*) *pygidialis* Malloch (1933).

Psenulus turneri Arnold

Arnold, 1927: 121, ♀ (South Africa: Cape Province).
Leclercq, 1961a: 26.

Supplementary description of female. — Outer half of mandibles reddish. Fourth tergite varying from completely reddish to basally or almost completely black. All of the eleven females from Grahamstown and Kenton-on-Sea, mentioned below, have darker



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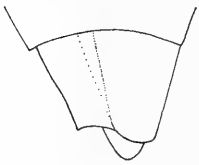

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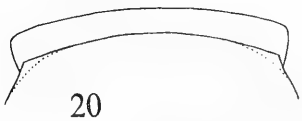

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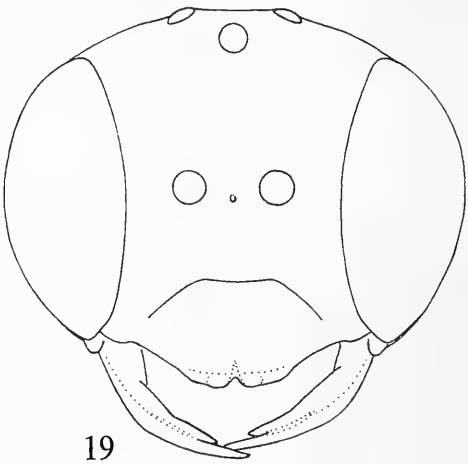

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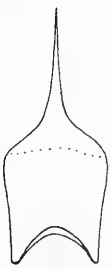

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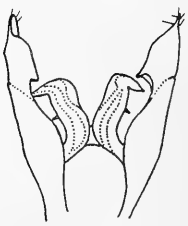

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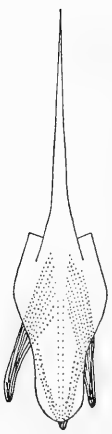

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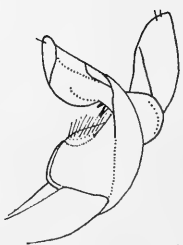

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legs than the holotype, the hind legs are completely black. The holotype has a completely black fourth tergite and all legs are reddish.

Frontal carina raised and much broadened between antennae, connected with high transverse carina below antennae by two closely parallel or confluent carinae. Prescutal sutures long, on anterior three quarters of scutum with short transverse carinae (alveoles). Petiole cylindrical, little longer than first tergite in dorsal aspect. No distinct pygidial area. One of the six females from Howison's Poort, Grahamstown, has a triangular, instead of petiolate, second submarginal cell, in both wings.

Apical margin of fourth and fifth gastral sternites with dense fringe of long whitish hairs.

First description of male. — Resembling female. Mandibles almost completely reddish. Basal half of fourth tergite black in all three specimens. Hind legs partly brownish. Antennal segments 3—13 brown above; scape, second segment and underside of flagellum reddish.

Antennae moniliform, segments 3—8 about one and a half times, segments 9—12 about one and a third times as long as broad at apex, last segment about one and three quarters times as long as broad at base, segments 4—8 with small narrow tyloidea, segments 9—10 with indistinct tyloidea. Petiole of second submarginal cell shorter than in female. Back of propodeum coarsely reticulate, more or less striate behind enclosed area. Petiole slightly shorter than in female, below with distinct lateral keel. No conspicuous fringes on apical margins of fourth and fifth gastral sternites.

Apex of seventh sternite with triangular emargination (Fig. 31) and fringe of long fine hairs. Eighth sternite: Fig. 29, 30. Genital apparatus (Fig. 32, 33) short, broad, pale yellowish-brown, stipes broad and rounded at apex.

The holotype is a female from South Africa, Cape Province, Mossel Bay, 18—30 Nov., 1921, coll. R. E. Turner (BM).

New records from South Africa, Cape Province: 6 ♀, Howison's Poort, Grahamstown, 19—30 Nov. and 14—20 Dec., 1971, 2 ♀, Belmont Valley, Grahamstown, 28—31 Oct. and 5—9 Nov., 1971, all collected by F. W. Gess, 3 ♀, Kenton-on-Sea, 1—9 Nov., 1971, 26—31 Nov., 1971 and 1—14 March, 1972, coll. R. A. Jubb; 1 ♂, Howison's Poort, Grahamstown, 24—26 Nov., 1971, coll. F. W. Gess, 3 ♂, Kenton-on-Sea, 23—29 Oct., 1970, 14—21 Oct., 1971, 21—26 Oct., 1971, coll. R. A. Jubb, all collected in Malaise traps (AMG).

Leclercq (1961a) rightly assumed that *P. turneri* and *P. paulisae* Leclercq are very closely related, but they are still distinctly different.

Psenulus paulisae Leclercq

Leclercq, 1961a: 23—26, ♀ and ♂ (Zaire).

New records from Sierra Leone: 1 ♀, Njala, Dec., 1934, coll. E. Hargreaves, pres. by Com. Inst. Ent. B.M. 1973—1 (BM); Freetown, 4 ♀, March, May, July, 1967, 3 ♂, Febr., April, 1968, coll. D. F. Owen (HT).

Fig. 19—28. *Psen* (*Mimesa*) *empeyi* sp. nov., ♂, 19, holotype, 20—28, paratype. 19, face; 20, pronotum; 21—22, 7th segment, dorsal and latero-dorsal aspect; 23, apex 6th sternite, dorsal aspect; 24, 7th sternite, latero-ventral aspect; 25—26, 8th sternite, ventral and lateral aspect; 27, genitalia, dorsal aspect; 28, apex penis valve, lateral aspect. Fig. 29—33. *Psenulus turneri* Arnold, ♂. 29—30, 8th sternite, with part of musculature, ventral and lateral aspect; 31, 7th sternite, lateral aspect; 32—33, genitalia, right stipes bent, dorsal and lateral aspect

I have compared these specimens with a paratype (female) from the type-locality Paulis (FAG). In the females the transverse striae on the sides of the scutum are less distinct, but in one of the males they are distinct. Leclercq has given a very good and detailed description but I would like to mention the following additional characteristics.

Female. — Anterior oblique suture of mesopleura foveolate, widened upper part with transverse carinae. Stiff hairs of fringes on apical margins of fourth and fifth sternites about as long as fourth segment of posterior tarsus.

Supplementary description of male based on the males from Sierra Leone. — Antennal segments moniliform. Scape, second segment and underside of following segments yellowish-red, dorsal side of flagellum dark brown, third, 12th and 13th segment somewhat paler. Third antennal segment about one and a half times as long as broad at apex, length of segments then gradually decreasing, segments 11—12 about as long as broad at apex, last segment about one and a half times as long as broad at base. Segments 3—9 with distinct, narrow and oblique, pale tyloidea, on tenth segment much smaller. Raised part of carina between antennae somewhat narrower than in female.

There is some variation in the colour of the gaster. One of the females from Sierra Leone, collected March, 1967, has also the first tergite completely reddish, and the apex of the ventral plate of the petiole. In one of the males from Sierra Leone not only the first tergite and at least the base of the second tergite are deep black, but the following tergites also are somewhat darkened on the sides. Apical margins of sternites 2—6 brownish. Also the sculpture of scutum and propodeum may vary somewhat.

Psenulus erusus Leclercq

Leclercq, 1961a: 26—27, ♀ (Zaire).

New records: Sierra Leone: Freetown, 1 ♀, July, 1967, 2 ♀, Jan., 1968, coll. D. F. Owen (HT).

These specimens are identical with the holotype from Zaire (Congo), Eala, Nov., 1936 (MRAC), but they are slightly smaller and the upper part of the back of the propodeum is less densely striate.

Length about 6.5 mm.

There are fringes of long hairs on the apical margins of the fourth and fifth sternites like in the other species belonging to the group of *P. turneri.*

Psenulus garambae Leclercq

Leclercq, 1961b: 57—58, ♀ (Zaire).

In the holotype the dilated raised part of the interantennal carina is wide, ratio width-length being about 1 : 2.5, carina ending below antennae in a distinct transverse carina. Tempora coarsely striato-reticulate. Petiole about one and one-third times as long as first gastral tergite.

Apical margins of fourth and fifth sternites with fringe of long, yellowish golden hairs.

Length about 6 mm.

Leclercq recorded this specimen from the National Park of Garamba, in wooded savanna surrounding the camp of Bagbele, 20 March, 1950, coll. H. de Saeger (MRAC). There are no further records. He has already recognized the close relationships of *P. garambae* with *P. saltitans* Arnold, as well as with *P. turneri*, *P. paulisae*, and *P. erusus.*

Psenulus patei Arnold

Arnold, 1940: 132—133, ♀ (Rhodesia: Bulawayo and Khami).
Leclercq, 1961a: 29, ♀ (Rhodesia: Matopos).

Arnold based his description of this species on 6 females from Bulawayo and Khami. The holotype, which Mr. F. C. de Moor of the National Museum at Bulawayo kindly sent me on loan, is labelled: "Khami, S. Rhodesia, 30.10.1938, Nat. Museum S. Rhodesia" and also bears a red type-label of G. Arnold.

The remaining five females recorded by Arnold are undoubtedly included in the following material from the type localities: 2 ♀, Bulawayo "Kh" (= Khami?), 16 Sept., 1928, 1 ♀, Bulawayo, 25 Dec., 1929, 1 ♀, Khami Dam, 14 Sept., 1938, 2 ♀, Khami, 1 Nov., 1938, all collected by R. H. R. Stevenson (RM).

I could also study the female recorded by Leclercq (1961a) from Rhodesia: Matopos, 20 Nov., 1938, leg. et det. G. Arnold (BM).

New records from Rhodesia: 1 ♀, Murampara, 9 Sept., 1927, 1 ♀, Umguza Valley, Bulawayo dist., 1 Febr., 1930, both coll. R. H. R. Stevenson (RM).

Supplementary description, based on holotype. — Mandibles dark reddish except blackish tips. Labrum dark reddish. Palpi pale brown. Fore legs yellowish-red, trochanters completely and base of femora below brown, basitarsi yellowish-white. Mid trochanters and femora brown, apex of mid femora yellowish-red below, base of mid tibiae yellowish, underside pale reddish-brown. Hind trochanters, femora and tibiae brownish-black, basal fourth of tibiae straw-yellow, base of hind basitarsi pale yellowish. Pronotal tubercles dark brown, tegulae yellowish-transparent. Veins of wings dark brown.

Frons below antennae with tendency to transverse striation. Vertex shining, very finely punctate. Labrum not distinctly tridentate. Antennae short, third segment about one and a half times as long as broad at apex, segments 4—6 little longer than broad, segments 7—11 shorter than broad at apex, last segment about one and a half times as long as broad at base.

Prescutal sutures almost reaching hind margin of scutum, indicated only by a row of irregular short transverse grooves. No pygidial area. Apical margins of fourth and fifth sternites with fringes of long yellowish-golden hairs, sixth sternite densely yellowish-golden pubescent. Epicnemial areas below with patch of dense short whitish pubescence.

The female from Umguza Valley has darker mandibles, reddish fore tarsi, light brown mid tibiae, straw-yellowish mid basitarsi, rest of mid tarsi pale reddish, brownish-black hind legs and yellowish-brown base of hind tibiae.

P. patei is recognized by the triangular (rarely slightly open) second submarginal cell of the fore wings, striate upper part of propodeum and reddish tergites 4—6. It is closely related to *P. saltitans* Arnold, which also belongs to the group of *P. turneri* Arnold but *P. saltitans* has no distinct pale base of hind tibiae.

According to Arnold (1940) this species was found nesting in a decayed tree trunk.

Psenulus saltitans Arnold

Arnold, 1958: 135, ♀ (Rhodesia).
Leclercq, 1961a: 29.

Material studied: 1 ♀, "Cashel, S. Rhodesia", 30 Dec., 1947, with green paratype-label (RM).

Supplementary description. — Middle part of mandibles dark reddish. Fore trochanters

and at least outer side of fore femora brown, not reddish-brown. Mid basitarsi straw-yellow. Veins of wings brown.

Frons shining, oblique rugae superficial. Antennae short, third segment about one and one-quarter times as long as broad at apex, segments 4–6 little longer than broad, segments 7—11 wider than long, last segment about one and three-quarter times as long as broad at base. Interantennal carina raised and broadened between antennae, lateral edges of widened part converging below and ending as two very close parallel carinae in the transverse carina below antennae. Transverse carina more angular than figured by Arnold (1958: 134). Lower half of clypeus shining, impunctate.

Prescutal sutures as in *P. patei* Arnold. Anterior oblique suture foveolate, widened upper part with transverse carinae reaching upper anterior corner of episternal area. No pygidial area. Petiole about one and a half times as long as first tergite in dorsal aspect, cylindrical, base flattened dorsally.

Petiole dorsally with lateral row of very short hairs, ventro-laterally a few long outstanding hairs. Apical margins of fourth and fifth sternites with fringe of long yellowish-golden hairs, sixth sternite yellowish-golden pubescent.

P. saltitans belongs to the group of *P. turneri* Arnold, but differs from latter species in the non-petiolate but triangular second submarginal cell of the fore wings. It differs from *P. patei* in the dark bases of mid and hind tibiae.

According to Arnold this species was caught "jumping about on the leaves of a shrub, probably in search of aphids".

Psenulus ealae Leclercq

Leclercq, 1961a: 27—29, ♀ (Zaire).

New records: Sierra Leone: Freetown, 1 ♀, May, 1967, 1 ♂, April, 1968, coll. D. F. Owen (HT).

A series of seven females is known from Eala; through the kind intermediary of Prof. J. Leclercq I could study three paratypes (FAG).

Supplementary description of female based on these paratypes. — All legs brown, apex of fore femora, fore tibiae, and underside of mid tibiae more yellowish-brown, base of hind tibiae yellowish-grey. Veins of fore wings dark brown.

Transverse carina below antennae not long, reversed-V-shaped with an angle of about 100 degrees. Foreside of pronotum with transverse striae. Anterior oblique suture broad, foveolate, widened upper part with transverse carinae. Base of second sternite with semicircular depression. No pygidial area. Apical margins of fourth and fifth sternites with fringe of long yellowish-golden hairs.

Length about 6.5 mm.

First description of male (Sierra Leone). — Resembling female. Base of fourth tergite also brown. Raised and broadened part of interantennal carina narrower, ratio width-length about 1 : 4. Antennal segments convex below, third segment about one and three-quarter times, segments 4—12 about one and a half times as long as broad at apex, last segment nearly two and a half times as long as broad at base. Segments 4—10 behind with distinct narrow oblique tyloidea, on segments 5—6 about half as long as segment, all reddish like underside of flagellum, on segments 3 and 11 at most a small point.

Second submarginal cell of fore wings sessile, but its upper width shorter than in

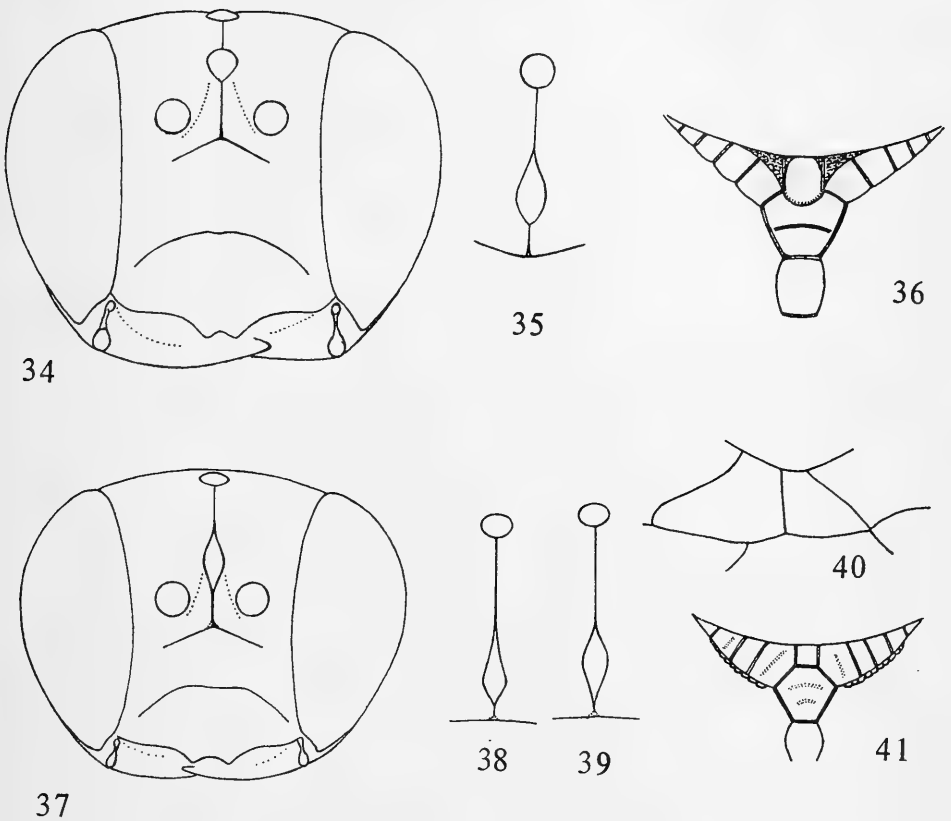


Fig. 34—36. *Psenulus aurifasciatus* sp. nov., ♀, holotype. 34, face; 35, frontal (interantennal) carina, dorsal aspect; 36, propodeal enclosure. Fig. 37—41. *Psenulus freetownensis* sp. nov., ♀, holotype. 37, face; 38, frontal carina, dorsal aspect (39, the same, paratype); 40, 2nd and 3rd submarginal cell of left fore wing; 41, propodeal enclosure

female. Petiole about one and a half times as long as first tergite. This is much longer than in the female, in which the petiole is about equal in length. However, this may be a sexual difference.

The female from Sierra Leone is somewhat smaller than the paratypes from Eala, the scutum is slightly less strongly sculptured and the fore femora are more reddish.

P. ealae is closely related to *P. turneri* Arnold, but is distinguished easily by the open second submarginal cell.

Psenulus aurifasciatus spec. nov.

Female. — Head and thorax black; mandibles partly brownish, palpi yellowish-brown. Underside of antennae reddish-brown. Apex of fore femora, fore tibiae completely and tarsi reddish; back-side of mid tibiae and tarsi reddish, rest of mid legs and hind legs completely black or very dark brown. Gaster black, apical margins of tergites 2—5 brownish transparent laterally; last tergite, greater part of fifth and whole of sixth sternite brown. Veins of wings dark brown, tegulae reddish-brown.

Frontal carina (Fig. 35) raised and broadened between antennae, ratio width-length about 1 : 2.5, lower narrow part of carina about as long as broadened part and ending below in a transverse carina, its length about half the distance between the eyes, obtusely angular in the middle (Fig. 34). Basal half of clypeus dull, apical half shining, median part much protruding with low triangular emargination, forming two triangular teeth. Mandibles normal. Occipital carina ending in hypostomal carina. Frons near oculi with large convex, shining and very finely punctate areas, below anterior ocellus on both sides of carina very densely finely punctate. Vertex shining, very finely punctate, punctures between ocelli coarser. Tempora with coarse, striato-reticulate longitudinal carination, especially along the eyes. Antennae short, third segment about one and a half times, segments 4—5 about one and one-third times as long as broad at apex, segments 6—10 almost square, 11th segment about one and one-quarter times as long as broad at apex, last segment about twice as long as broad at base.

Pronotal corners rounded, foreside above with fine longitudinal striation. Scutum shining, finely punctate, prescutal sutures linear on anterior fourth, on posterior part until near hind margin of scutum indicated by a line of punctures larger than those on rest of scutum. Scutellum and metanotum very finely punctate, interspaces a few times as large as punctures. Lateral parts of propodeal enclosure medially separated from metanotum by two triangular, dull areas; median part broad, almost heart-shaped and connected with anterior margin by a small separate area (Fig. 36). Back of propodeum shining, dorsally with superficial oblique striae, followed by a more coarsely and somewhat irregularly striate area, lower third with fine irregular reticulation and a few stronger carinae. Median longitudinal groove broad. Posterior half of sides of propodeum reticulate, separated from back-side by a broad, dorsolateral, irregularly foveolate groove; anterior part of sides dull. Metapleura dull over greater part. Mesopleura and mesosternum shining, distinctly punctate, interstices mostly larger than punctures, punctures very fine on hypo-epimeral area, a foveolate groove along metapleura. Anterior oblique suture broad and foveolate, widened upper part with transverse carinae. Legs normal, stoutly built, a row of four small teeth on apical two-fifths of mid tibiae, hind tibiae with two very small thorns on apical half. Second submarginal cell of fore wings sessile, upper side about one-fifth of length of lower side, first recurrent vein ending in second submarginal cell. Petiole about one and one-quarter times as long as first tergite, cylindrical, base above distinctly, and sides only slightly, flattened, apex above with a small pit. Gaster very finely punctate. No pygidial area. Second sternite at base with a rounded-triangular depression.

Face with appressed silvery pubescence, sparse on anterior third; also with long whitish hairs. Head, thorax and legs whitish pubescent, more yellowish-grey and longer on vertex, dense and somewhat yellowish-grey on lower part of epicnemial areas and on mesosternum. Gaster with yellowish-brown pubescence. Pygidium with many long stiff hairs, apical margins of fourth and fifth gastral sternites with fringe of long, yellowish-golden hairs.

Length 8 mm.

Male unknown.

Sierra Leone: 1 ♀ (holotype), Freetown, April, 1967, coll. D. F. Owen (HT).

This species belongs to the group of *P. turneri* and is easily distinguished by its dark gaster.

Psenulus freetownensis spec. nov.

Female. — Head and thorax black; mandibles reddish, palpi testaceous. Scape of antennae and underside of flagellum yellowish-brown, flagellum above dark-brown. Pronotal tubercles and tegulae yellowish-brown. Veins of wings dark-brown. Legs including trochanters reddish, fore and mid legs slightly paler than hind legs. Petiole, except ventral plate, black, following segments of gaster reddish.

Frontal carina (Fig. 38, 39) raised and widened between antennae, length of widened part about 3.5 times width, carina ending below antennae in transverse carina, which has the shape of a reversed V with an angle of about 120 degrees (Fig. 37). Clypeus very finely and densely punctate, lower margin less densely punctate and more shining; protruding median part with two distinct small teeth, distance between apices of teeth about one sixth of total distance there between eyes. Frons and vertex shining, distinctly punctate. Tempora with coarse reticulato-striate sculpture behind eyes. Occipital carina ending normally in hypostomal carina. Mandibles normal. Third antennal segment at least one and a half times, segments 4—5 about one and a third times as long as broad at apex, segments 6—7 slightly longer than broad, segments 8—11 about as long as broad at apex, last segment about one and three quarters times as long as broad at base.

Lateral corners of pronotum obtuse. Scutum densely finely punctate, prescutal sutures not sharp, almost reaching hind margin, parapsidal sutures distinct. Scutellum and metanotum very finely and densely punctate. Propodeal enclosure triangular, central part broad, separated from metanotum by a small square area (Fig. 41), lateral areas with at least three oblique carinae. Median longitudinal groove broad, oval, with narrow deeper groove. Upper half of back of propodeum smooth and shining, lower half with fine reticulate carination. Posterior half of sides of propodeum with reticulate carination, anterior half opaque, propodeum postero-laterally with a broad foveolate groove. Metapleura opaque, somewhat coriaceous, mesopleura and mesosternum shining, very finely punctate. Anterior oblique suture broad, foveolate, broadened upper part with transverse carinae. Upper side of second submarginal cell about one third length of lower side of cell, first recurrent vein ending just in second submarginal cell, second recurrent vein ending well in third submarginal cell (Fig. 40). Legs normal, mid tibiae at apex behind with 3—5 short reddish thorns, on back of hind tibiae in the middle two or three short reddish thorns.

Petiole about two-thirds of length of first tergite (in dorsal view), almost cylindrical, base flattened and with lateral carina, apex with small pit. Gaster very finely punctate. No pygidial area. Second sternite at base with semi-circular depression.

Face with silvery appressed pubescence and also with long erect silvery hairs. Pubescence of head and thorax whitish, epicnemial areas below with round patch of dense appressed pubescence. Petiole with long lateral hairs and dorsally with two backwardly convergent rows of very short hairs. Pubescence of legs and gaster yellowish-golden, apical margins of fourth and fifth sternites with fringe of long, yellowish-golden hairs, sixth sternite with short dense yellowish-golden pubescence.

Length about 6.5—7 mm.

Male. — As female, but underside of antennae paler, transverse carina below antennae longer and less angular in frontal aspect, segments 3—12 about one and a half times as long as broad at apex, last segment about two and a half times as long as broad at base, underside of segments convex, segments 4—8 on back with indistinct, oblique, reddish

tyloidea. Circular patches of appressed pubescence at lower side of epicnemial areas less conspicuous and sternites 4—5 without fringes of long hairs. Upper, horizontal part of propodeum smooth and shining, back and sides of propodeum more coarsely sculptured than in female. Petiole on apical half below with distinct ridge, sides of petiole slightly depressed.

Length about 5.5 mm.

Sierra Leone: Freetown, 1 ♀ (holotype), Aug., 1967, 1 ♂ (allotype), July, 1967, 1 ♂ (paratype), Jan., 1968, all collected by D. F. Owen (HT, paratype in author's collection).

Equatorial Guinea (Spanish Guinea): 1 ♀ (paratype), "Uelleburg", June—Aug., 1908, coll. Tessmann (ZMB).

In the allotype the second submarginal cell of the left wing is almost triangular. On the contrary this cell is more open above in the male paratype than in the holotype.

The petiole of the female from Equatorial Guinea is brownish, its apex reddish dorsally. The interantennal carina is slightly broader and the upper side of the second submarginal cell is about one fourth of the length of the lower side.

P. freetownensis is in both sexes easily recognized by the completely red gaster and legs, and the broad smooth upper part of the propodeum behind the enclosed area. It evidently belongs to the group of *P. turneri*, of which some species normally have triangular or even petiolate second submarginal cells.

Psenulus alveolatus spec. nov.

Male. — Head and thorax black; antennae brown, underside and scape completely reddish-brown. Palpi pale brown. Tegulae dark reddish-brown. Labium and apical half of mandibles reddish-brown. Fore legs including trochanters reddish-brown, mid and hind legs brown. Tibial spurs of mid and hind legs yellowish-white. Petiole including ventral plate deep black, also first tergite and basal two-thirds of second tergite, rest of dorsal side of gaster reddish; sternites 2—4 very dark brown, nearly black, following sternites reddish; apical spine dark reddish. Veins of wings dark brown.

Frontal carina raised and much broadened between antennae, ending below antennae in high transverse carina. Clypeal margin medially with two low triangular teeth. Frons with coarse oblique rugae, interocellar area with transverse rugae, vertex more shining, striato-punctate, striae weak. Tempora coarsely striato-reticulate with a few strong longitudinal carinae. Occipital carina ending in hypostomal carina, high, alveolate along fore-side. Antennal segments 3—8 about one and a half times, segments 9—12, about one and a quarter times width at apex, last segment one and three quarters times width at base; third segment with small tyloidea, segments 4—8 with longer and distinct, narrow tyloidea.

Anterior margin of pronotum alveolate; scutum shining, with irregular rather dense punctation, and centrally with weak transverse rugae; prescutal sutures with deep and large alveoles and strong transverse rugae, reaching posterior margin which shows many short longitudinal rugae; parapsidal sutures distinct; lateral margins of scutum alveolate. Scutellum shining, sparsely finely punctate. Metanotum somewhat more densely punctate. Enclosed area of propodeum shining, with rather short oblique carina on lateral parts, wide central area; back coarsely reticulate, median longitudinal carina deep and wide but irregular. Sides of propodeum less coarsely reticulate. Metapleura smooth. Mesopleura

and mesosternum shining, densely coarsely punctate, partly somewhat rugose. Anterior plate of mesepisternum shining, less densely punctate, not rugose. Anterior oblique suture broad, foveolate, widened upper part with transverse carinae.

Legs slender. Second submarginal cell distinctly petiolate, first recurrent vein ending in second submarginal cell, second recurrent vein ending well in third submarginal cell. Petiole long, nearly twice length first tergite; sides slightly depressed, with distinct lower keel, dorsally convex, but base and apex somewhat flattened, narrow triangular pit at apex.

Face with appressed silvery pubescence and erect longer hairs, rest of head, and thorax, with whitish hairs, gaster yellowish-grey pubescent, apical margins of sternites with thin fringe of short, backwards directed stiff hairs, disk of sixth sternite with dense, backwards directed, golden pubescence.

Length about 7 mm.

Female unknown.

Rhodesia: 1 ♂ (holotype), Bulawayo, 25 Dec., 1929, coll. R. H. R. Stevenson (RM).

P. alveolatus is certainly closely related to *P. turneri* Arnold, differing however by having a longer petiole, a more coarsely sculptured scutum, and by the fact that more gastral segments are reddish.

A male from Angola (A30), 7 miles W. of Gabela, 16—18 March, 1972, Southern African Exp. B.M. 1972—1 (BM) is very similar and certainly belongs to the group of *P. turneri*. It has also a long petiole and tergites 2—6 are completely reddish, but it differs from *alveolatus* in being somewhat smaller, with the scutum less coarsely sculptured and the second submarginal cell being open dorsally. As the antennae are missing I prefer to wait for additional material before describing this form as a new species.

Psenulus fulgidus Arnold

Arnold, 1945: 156—157, ♀ and ♂ (Malagasy: Bekily, Behara and Ranomafana).
Leclercq, 1961a: 35, ♀ (Malagasy: Fort-Dauphin).

Material studied: 2 ♀, Bekily, Dec., 1932, Febr., 1940, 1 ♂, Bekily, May, 1934, (FAG); 1 ♀, Bekily, March, 1937, coll. A. Seyrig, det. Arnold (?) (author's collection).

The material from the collections of the Faculty of Agricultural Sciences at Gembloux was kindly sent to me by Prof. J. Leclercq; it forms part of the material collected by Seyrig and was mounted after Arnold's study (1945) and identified by Leclercq (1960).

P. fulgidus and *P. reticulosus* Arnold are much alike as regards their colour patterns, but they differ in a few important characteristics. *P. fulgidus* is smaller (female 6.3—8.5 mm, male 6—6.5 mm, cf. Arnold, 1945, who based his description on 16 females and 9 males). In the female of *P. fulgidus* the broadened raised part of the interantennal carina is lozenge-shaped, petiole about one and one-third times as long as first tergite, apex of petiole about twice as wide as base, pygidial area with distinct lateral carinae, parallel on apical half, gradually diverging towards base. I have seen one male, recorded above, from Bekily (det. J. Leclercq). This differs from the male of *P. reticulosus,* apart from being smaller, in having no tyloidea. Raised part of interantennal carina hardly broadened. Arnold described the punctation of the scutum as being denser than in the female, interspaces between larger punctures about twice as wide as punctures themselves and some specimens with a trace of transverse rugosity. He did not mention the interantennal carina.

The above male has a strongly transversely rugose scutum, apical margin of scutellum yellow, remaining part brown and yellowish-brown. Petiole about one and a half times as long as first tergite.

Psenulus reticulosus Arnold

Arnold, 1945: 154—156, ♀ and ♂ (*Psenulus reticulosus* and *Psenulus reticulosus* var. *alboscutellatus*; Malagasy: Rogez, Perinet, Ivondro, Ranomafana).
Leclercq, 1961a: 35, ♀ (Malagasy: Mandraka, Rogez, Analandraraka).
Leclercq, 1961c: 117, ♀ (Malagasy: Ranomafana, Perinet, Joffre-ville).

Material studied: Rogez, 1 ♀, Jan., 1931, 1 ♀, 1932, 1 ♂, April, 1931 (FAG); 1 ♀, Rogez, "forêt côte est", Febr., 1934, coll. A. Seyrig (author's collection); Rogez, 1 ♀, Dec., 1931, 1 ♀, 1932, 1 ♂, May, 1932 (FAG). The last mentioned three specimens belong to the var. *alboscutellatus* Arnold.

Petiole over one and a half times as long as first tergite, in dorsal aspect. Prescutal sutures distinct only on basal third of scutum. Raised part of interantennal carina slightly broadened in female, hardly or not broadened in male.

Pygidial area of female narrow with indistinct, parallel, carinae.

Underside of fore and mid femora pale brown in male, in female fore and mid legs completely pale yellow. Antennal segments 3 (or 4)—13 with distinct tyloidea, which are reddish like flagellum.

Psenulus sapobaensis spec. nov.

Female. — Head and thorax black; mandibles yellowish with brown tips, labrum reddish-brown, palpi testaceous. Scape of antennae yellowish, following segments dark brown above, last segment reddish-brown above, underside of antennae yellowish-red. Pronotal dorsum medially, and metanotum, blackish-brown. Posterior part of pronotal tubercles yellowish, tegulae yellowish-red. Fore and mid legs including trochanters and mid coxae pale yellowish-red or straw-yellow; hind legs including coxae darker yellowish-red. Veins of wings dark brown. Gaster including petiole yellowish-red.

Frontal carina distinct, raised part between antennae very slightly broadened (Fig. 43), ending below antennae in a distinct transverse carina. Supraclypeal area and basal half of clypeus superficially densely punctate, apical half of clypeal disk not very shining but without distinct sculpture or punctation. Protruding median part of clypeal margin distinctly bidentate, distance between apices of teeth about one-ninth of total distance there between the eyes (Fig. 42). Frons below anterior ocellus with distinct separate punctures, near oculi almost smooth. Vertex shining, sparsely and minutely punctate. Tempora with fine longitudinal striae. Occipital carina ending normally in hypostomal carina. Mandibles normal. Third antennal segment about two and one-third times, fourth segment about twice, fifth segment about one and three-quarter times, segments 6—8 about one and a half times, segments 9—11 about one and one-third times as long as broad at apex, last segment at least twice as long as broad at base (all in frontal view).

Pronotal corners sharp. Scutum fairly strongly punctate, finer on anterior part between prescutal sutures. Prescutal sutures distinct on anterior two-fifths of scutum, continued until near apical margin by a row of relatively large punctures. Scutellum and metanotum scarcely finely punctate. Propodeal enclosure triangular, well-defined, median part rather

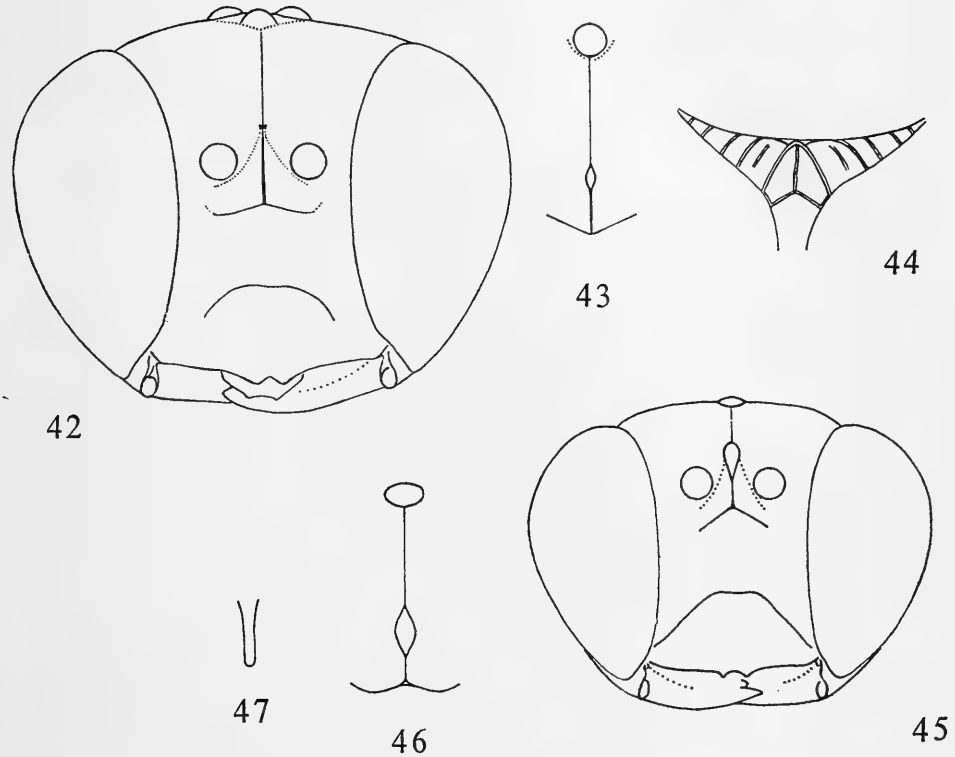


Fig. 42—44. *Psenulus sapobaensis* sp. nov., ♀, holotype. 42, face; 43, frontal carina, dorsal aspect; 44, propodeal enclosure. Fig. 45—47. *Psenulus leoninus* sp. nov., ♀, holotype. 45, face; 46, frontal carina, dorsal aspect; 47, pygidial area

wide with median longitudinal carina (Fig. 44), lateral parts with few oblique carinae. Upper part of propodeum with narrow smooth and shining area, back with fine oblique striae, transverse on lower part. Dorso-lateral edge of propodeum more coarsely reticulate, posterior part of sides finely reticulate, anterior part smooth. Metapleura shining, somewhat striate below, mesosternum and mesopleura smooth, with scattered punctures. Anterior oblique suture foveolate, widened upper part smooth. Legs stout, fore and mid femora and tibiae rather heavily built, apex of mid tibiae on outer side with narrow longitudinal depression, margined anteriorly by a reddish oblique low carina and behind by four short reddish spines. Hind tibiae on outer side with three (left tibia) or two (right tibia) longer spines. Second submarginal cell above about half as wide as lower side. First recurrent vein ending just in second submarginal cell, second recurrent vein ending well in third submarginal cell, about one-fifth of base of third submarginal cell. Petiole long, slightly more than one and a half times length of first tergite, cylindrical, apex dorsally with small triangular pit. Gaster minutely punctate, no well-defined pygidial area, just a narrow smooth and shining area bordered by a few long hairs. Base of second sternite somewhat depressed.

Pubescence of face and tempora silvery, appressed, leaving structure of clypeus well visible, face also with a number of long erect hairs. Vertex with long greyish pubescence.

Pubescence of thorax whitish, long on propodeum, dense on mesosternum. Epicnemial areas below with round patch of dense appressed silvery pubescence. Legs and gaster with yellowish-grey pubescence, denser and rather long on apical margins of fourth and fifth sternites but not fringe-like, sixth sternite densely yellowish-golden pubescent. Petiole with a few long, obliquely directed downwards, hairs, dorsum bare.

Length about 9 mm.

Male unknown.

Nigeria: 1 ♀ (holotype), Sapoba, 16 Aug., 1962, coll. D. C. Eidt, in Malaise trap (CNC).

This species is probably closely related to *P. reticulosus*.

Psenulus leoninus spec. nov.

Female. — Head and thorax black; mid part of mandibles brownish, palpi testaceous, antennae dark-brown, scape and underside of following segments reddish-brown. Pronotal tubercles slightly brownish, tegulae reddish. Fore and mid legs reddish, including trochanters, mid femora brown below, fore and mid basitarsi yellowish; hind trochanters brown, hind femora brown, apical two-thirds reddish below, rest of hind legs also reddish. Veins of wings dark-brown. Petiole including ventral plate black; gaster reddish, first tergite with large black mark almost reaching hind margin.

Frontal carina raised and widened between antennae, about two and a half times as long as broad (Fig. 46), ending below antennae in a short transverse carina, in the shape of a reversed V with obtuse angle. Face below transverse carina dull, finely aciculate; clypeal margin ending in two distinct small teeth, distance between these teeth about one eighth of total distance there between eyes (Fig. 45). Mandibles normal. Occipital carina ending in hypostomal carina. Frons densely punctate, vertex between eyes with more widespread punctures. Tempora aciculate, partly finely striate. Antennae short, third segment about one and a half times, segments 4—6 about one time, segments 7—9 about two-third times, segments 10—11 about half as long as broad at apex; last segment about one and a third times as long as broad at base.

Pronotal lateral corners with sharp anterior angle. Scutum finely densely punctate, relatively few very large punctures and on sides of anterior half transversely striate. Prescutal sutures almost reaching hind margin of scutum, rather ill-defined. Scutellum and metanotum with sparse fine punctures. Propodeal enclosure narrow, lateral parts with a few oblique carinae. Median longitudinal groove wide, with transverse carinae. Upper part of back of propodeum immediately behind enclosed area finely obliquely striate, lower half and posterior two-thirds of sides of propodeum with irregular reticulate carination; anterior part of sides dull. Metapleura shining. Mesopleura and mesosternum with few fine punctures. Anterior oblique suture coarsely foveolate, widened upper part with a few transverse carinae. Legs normal, flattened apical outer side of mid tibiae with short row of three small reddish teeth. First recurrent vein of fore wings interstitial, upper side of second submarginal cell about half length of lower side. Petiole little longer than first tergite, cylindrical, apex dorsally with long triangular emargination and small pit, anterior third dorsally flattened and medially with slight groove. Gaster very finely punctate, pygidial area narrow-triangular, lateral carinae parallel on apical half (Fig. 47).

Face below antennae with appressed silvery pubescence and erect silvery hairs. Vertex with long yellowish-grey pubescence, not dense, rest of head and thorax with whitish

pubescence, pubescence on mesosternum dense and short, also with long hairs; hairs on scutellum, metanotum and propodeum long. Epicnemial areas below with round patch of dense yellowish-white pubescence. Petiole with a few long laterally outstanding hairs. Gaster yellowish-grey pubescent, hind margins of fourth and fifth sternites with dense fringe of yellowish-golden hairs, at least as long as width of base of hind basitarsus. Sixth sternite densely yellowish-golden pubescent.

Length about 6 mm.

Sierra Leone: 1 ♀ (holotype), Freetown, August, 1967, coll. D. F. Owen (HT).

P. leoninus may be closely allied to *P. lusingae* Leclercq, described from Zaire, but it is easily distinguished by the smaller size, the shape of the lower part of the frontal carina, the shorter petiole, the coarser sculpture of the scutum, the paler legs and the darkened first gastral tergite.

Psenulus benoiti Leclercq

Leclercq, 1961a: 29—30, ♀ and ♂ (Zaire).

The female of *P. benoiti* has a remarkable sharp median longitudinal carina on the sixth tergite, as if the lateral carinae of the pygidial area have joined into one single carina. This characteristic is not found in any of the other Old World Psenini, only in the female of the Philippine *P. luteopictus* the sixth tergite is very slightly keeled. *P. mayorum* Bohart & Grissell (1969) from Mexico, shows a similar structure of the sixth tergite, but it certainly belongs to a different group of species.

A more extensive description of *P. benoiti* is given here.

Female. — Head and thorax black; antennae yellowish-brown below, brown above, mandibles reddish-brown, palpi testaceous. Pronotal tubercles and tegulae yellowish-red. Fore and mid legs including trochanters yellowish, back of femora brownish. Hind trochanters yellowish, femora brown, base of hind tibiae and tarsi yellowish-brown, apex of hind tibiae brownish. Petiole black except ventral plate, gastral tergites 1—6 reddish. Veins of wings brown.

Frontal carina between antennae hardly broadened, but with distinct narrow groove. Distinct transverse carina below antennae. Narrow protruding median part of clypeal margin not distinctly emarginate. Frons shining, finely punctate, vertex more shining, almost impunctate. Tempora finely alutaceous, almost smooth. Occipital carina ending in hypostomal carina. Third antennal segment about twice as long as broad at apex, following segments gradually shorter, segments 9—11 much broader than long, twelfth segment about one and three-quarters times as long as wide at base. Mandibles normal.

Punctation of scutum variable, on median part of scutum large impunctate areas. Prescutal sutures almost reaching hind margin, on fore part with some transverse striae, parapsidal sutures long. Enclosed area of propodeum short, deep, median area broad but much less than in the group of *P. turneri*. Longitudinal propodeal suture widened on back-side. Back of propodeum smooth and shining, apex with some irregular carination; sides of propodeum on posterior part coarsely reticulate, almost smooth on fore part. Metapleura shining; anterior plate of mesepisternum, mesopleura and mesosternum sparsely finely punctate. Anterior oblique suture foveolate, widened upper part indistinct. Legs normal. Second submarginal cell above about two-thirds of length of lower side. Petiole long, in dorsal view about one and a half times as long as first tergite, cylindrical,

base dorsally somewhat flattened, apex with deep triangular pit. Gaster finely punctate. No normal pygidial area, but sixth tergite with sharp narrow median carina, which ends in an indistinct very small elongate and flattened part. Second gastral sternite with semicircular depression.

Pubescence of face silvery, appressed, leaving sculpture visible. Head and thorax whitish pubescent, dense on mesosternum, petiole with long, laterally and ventrally outstanding yellowish-grey hairs, gaster with yellowish pubescence. Epicnemial areas below with circular densely whitish pubescent spot, last sternite with dense yellowish-golden pubescence, apical margins of fourth and fifth sternites with short dense pubescence, not conspicuous.

Length about 6.5 mm.

Male. — Resembling female. Fore and mid legs including trochanters more reddish, hind trochanters, femora, and tibiae dorsally, brown.

Frons on both sides of median carina somewhat convex. Frons with fine distinct punctation. Frontal carina between antennae raised and broadened, ratio width-length about 1 : 3. Antennal segments 3—8 about one and a half times, segments 9—12 about one and one-third times as long as broad at apex, last segment about twice as long as broad at base. No distinct tyloidea, lower side of antennal segments distinctly convex. Median part of clypeal margin with two distinct small teeth. Prescutal sutures without distinct transverse striae, almost reaching hind margin and ending in a widened depression. Upper part of propodeum shining with a few indistinct punctures, back coarsely reticulate, posterior part of sides of propodeum also coarsely reticulate, fore part densely punctate. Petiole about one and one-third times as long as first gastral tergite, sides with lower carina on apical half and distinct longitudinal depression, dorsal side rounded, flattened at base and with triangular pit at apex.

Length about 6.5 mm.

Material studied: ♀ (holotype) and ♂ (allotype), Zaire, Upper Uele, Isiro (Paulis), May and July, 1947, coll. P.L.G. Benoit (MRAC).

No further material seems to have been collected thus far.

Psenulus kohli Arnold

Arnold, 1923: 50—51, ♀ (Rhodesia: Bulawayo).
Leclercq, 1961a: 30.

After study of the holotype (RM) a few remarks should be made. — Femora brown, tibiae and tarsi whitish, almost whole underside of fore tibiae light brown, mid tibiae light brown below except apices, apical half of hind tibiae brown, except a narrow yellowish-white line on outer side. Greater part of mandibles reddish.

Raised part of carina between antennae much broadened, with distinct lateral carinae, broadened part closed below by indistinct converging carinae on lower part. This does not appear from Arnold's figure (1923, Fig. 77, p. 51). Tempora broad. Upper side of second submarginal cell about two-fifths of length of lower side of cell. Propodeal enclosure very short, behind this area very fine oblique striation. Petiole cylindrical, at least one and a half times as long as first tergite, in dorsal aspect. Pygidial area very narrow elongate-triangular, lateral carinae distinct.

Also broadened part of interantennal carina silvery pubescent. Apical margins of fourth and fifth sternites with short pubescence.

This species is not closely allied to *P. capensis* and *P. latiannulatus*, as Arnold suggested, but it takes an isolated position. The gaster is not slender and the first tergite is hardly nodose. *P. kohli* is easily distinguished from other Ethiopian species by the absence of a transverse carina below the antennae and the shape of the densely silvery pubescent interantennal carina.

Psenulus luctuosus Arnold

Arnold, 1929: 405—406, ♀ (Rhodesia).
Leclercq, 1961a: 30.

Supplementary description of holotype: ♀, Vumba Mts., Umtali, Rhodesia, Febr., 1928, coll. G. Arnold (RM). — Pronotal tubercles dark brown. Interantennal carina not quite closed below, as Arnold's figure No. 37 (1929, p. 406) suggests, but slightly open and the two lateral carinae ending close together in transverse carina (cf. Fig. 48: *P. jacoti*). Anterior oblique suture strongly foveolate, widened upper part with transverse carinae. Petiole more than twice as long as first gastral tergite. Pygidial area elongate-triangular, lateral carinae slightly diverging towards base, surface irregularly finely punctate.

Petiole with long erect lateral hairs.

No further captures have come to my knowledge.

This species is closely allied to *P. jacoti* sp. nov., from which it differs in the reddish fifth and sixth tergites, the longer petiole and the slightly wider pygidial area.

Psenulus stevensoni Arnold

Arnold, 1940: 133—134, ♀ and ♂ (Rhodesia: Bulawayo).
Leclercq, 1961a: 30.

Material studied: 1 ♀, Rhodesia, Bulawayo, Hillside, 29 April, 1927 (with red type-label); 1 ♂, Bulawayo, 9 Nov., 1924 (with red type-label); 1 ♂, Bulawayo, Hillside, 29 April, 1927, all coll. R. H. R. Stevenson (RM). I have selected the female as the lectotype and the male of 9 Nov., 1924, as the paralectotype. Arnold apparently has not seen the male which was collected at the same time and locality as the female.

Supplementary description of female. — Not only basitarsi of mid legs yellowish-white, but also basitarsi of fore legs more or less yellowish. Hind legs more brown than brownish-red. Scape of antennae, following four segments completely and segments 6—9 below reddish, rest of flagellum dark brown.

Broadened part of interantennal carina open below, lateral carinae ending in transverse carina (see Fig. 48: *P. jacoti*, and Leclercq, 1961a). Scutum dull, superficially transversely striate and also with some rather large punctures. Petiole about two and a half times as long as first tergite. Pygidial area distinct, elongate-triangular.

Apical margins of fourth and fifth sternites with fringe of short white hairs.

Supplementary description of male. — Basitarsi of fore and mid legs reddish. Broadened part of interantennal carina narrower than in female, closed below and ending as a narrow single carina in transverse carina below antennae. Antennal segments 3—13 with narrow oblique tyloidea. Scutum more strongly transversely rugose. Parapsidal

sutures deep, as in female. Petiole more than twice as long as first tergite, in dorsal aspect.

For further characteristics may be referred to Arnold (1940).

Arnold considered *P. stevensoni* closely allied to *P. kohli*, but in differs from the latter species in having a distinct transverse carina below the antennae in the female, the head is much swollen behind the eyes, the propodeal enclosure is longer, and the petiole is much longer. There are much closer relationships with *P. luctuosus* Arnold, *P. jacoti* sp. nov., and perhaps also with *P. lusingae* Leclercq and *P. rugifrons* sp. nov.

On the label of the female its prey is glued, probably an adult Psyllid which is somewhat damaged.

Psenulus lusingae Leclercq

Leclercq, 1961a: 33, ♀ (Zaire).

The characteristics given by Leclercq in his key (1961a) are sufficient to recognize this species. However, a redescription including some not yet mentioned details may be useful for future study.

Female. — Head and thorax black; mandibles dark reddish except tips, palpi testaceous, scapes of antennae and underside of flagellum reddish-brown, dorsally almost black. Tegulae reddish-brown. Veins of wings brown. Legs brown, fore side of fore femora, tibiae and whole tarsi yellowish-red, mid basitarsi and second tarsal segment testaceous. Petiole including ventral plate black, rest of gaster reddish.

Raised part of frontal carina between antennae broadened, ratio width-length about 1 : 3, lateral carinae of broadened part ending separately, parallel, in transverse carina below antennae, this transverse carina almost rectangular in frontal view. Frons below ocelli finely punctate, vertex nearly impunctate. Mandibles normal. Protruding median part of clypeal margin with two distinct teeth, distance between apices about one-seventh of total distance there between eyes. Tempora very finely longitudinally striate. Antennae short, somewhat clavate, third segment about one and three-quarters times, segments 4—5 about one and one-third times, segments 6—8 about as long as wide at apex, segments 9—10 about two-thirds times, eleventh segment about half as long as wide at apex, last segment about one and a half times as long as wide at base.

Scutum opaque, very finely punctate, interspaces a few times larger than punctures. Prescutal sutures nearly reaching hind margin of scutum, not well-defined, parapsidal sutures much deeper. Scutellum and metanotum shining, sparsely punctate. Propodeal enclosure triangular, central area normal, lateral areas each with about six oblique carinae, propodeum behind enclosed area very finely and densely obliquely striate, median longitudinal sulcus gradually narrowing towards centre, followed by a few narrower alveoles. Also greater part of back-side of propodeum with very fine oblique striae, dorsolaterally a coarsely reticulate-carinate ridge, sides of propodeum on posterior half with fine reticulation, on fore part almost smooth, with fine punctures. Metapleura shining, mesopleura and anterior plate of mesepisternum extremely finely punctate. Anterior oblique suture coarsely alveolate, widened upper part with a few transverse carinae. Upper side of second submarginal cell about one-quarter of length of base. Legs normal, outer apex of mid tibiae flattened, this area defined posteriorly by about six small thorns. Petiole slender, cylindrical, over twice as long as first tergite, in dorsal aspect, dorsally rounded with small pit at apex. Pygidial area narrow, distinct. Second gastral sternite with indistinct basal depression.

Face with appressed silvery pubescence, head, thorax and legs whitish pubescent, back of propodeum below with longer hairs. Petiole laterally with long erect hairs. Gaster with short yellowish-grey pubescence, apical margins of fourth and fifth sternites with dense and short pale pubescence, sixth sternite densely yellowish-golden pubescent.

Length about 7.75 mm.

Material studied: ♀ (holotype), Zaire, Parc National de l'Upemba, Lusinga, 1.760 m, 3 July, 1947, coll. Mission G. F. de Witte, no. 542a (MRAC).

No further specimens are known at present.

Psenulus avernus Leclercq

Leclercq, 1961a: 30, ♂ (Zaire).

Supplementary description of holotype, from Rutshuru (IRSNB). — Frons shining, finely densely punctate, vertex almost impunctate. Tempora finely striate below. Antennal segments 3—11 with distinct narrow tyloidea, small and indistinct on twelfth segment.

Prescutal sutures long, almost reaching hind margin of scutum. Upper part of propodeum shining behind enclosed area, with irregular oblique striation. Back-side of propodeum with coarse reticulate carination. First recurrent vein ending just in second submarginal cell, second recurrent vein well in third submarginal cell, this cell above about half as wide as lower side of cell. Petiole long and slender, about two and one-third times as long as first tergite in dorsal aspect, laterally somewhat depressed, on apical two-thirds with indistinct upper and distinct lower keel.

Estimated length — the gaster has been glued to the pin — 7 mm.

P. avernus is probably closely related to *P. lusingae* Leclercq, of which only the female holotype, from Lusingae, Zaire, is known. However, this female has a very densely and finely striate upper part of the propodeum; its scutum is rather dull, this part being shining in *P. avernus*.

Psenulus jacoti spec. nov.

Female. — Head and thorax black; following parts reddish-brown: Mandibles except dark tips, antennae including scape, but segments 7—11 dorsally somewhat darkened, pronotal tubercles and tegulae. Palpi brown. Fore legs reddish-brown, greater part of femora below and back of trochanters black; mid trochanters and basal half of mid femora black, rest of mid legs reddish-brown; hind trochanters and femora except apex ventrally, black, hind tibiae and tarsi reddish-brown, partly blackish. Veins of wings almost black, upper half of radial cell infuscate. Gaster black, petiole ventrally and laterally, at least partly, reddish-brown, also first tergite somewhat on sides of apical part, apex of last segment reddish-brown or yellowish-red.

Frontal carina raised and much broadened between antennae (Fig. 49), narrowed below antennae into two carinae which are closely parallel or just touching, and ending in a very fine, almost indistinct, angular transverse carina (Fig. 48). Protruding median part of clypeus with two distinct triangular teeth, distance between apices of teeth about one seventh or one eighth of total distance there between eyes. Frons shining, finely and closely punctate, between oculi and ocelli much sparser punctate, behind ocelli almost impunctate. Tempora, especially lower part, with dense fine oblique striation. Apex of mandibles normally bidentate. Antennae widening towards apex, third segment about

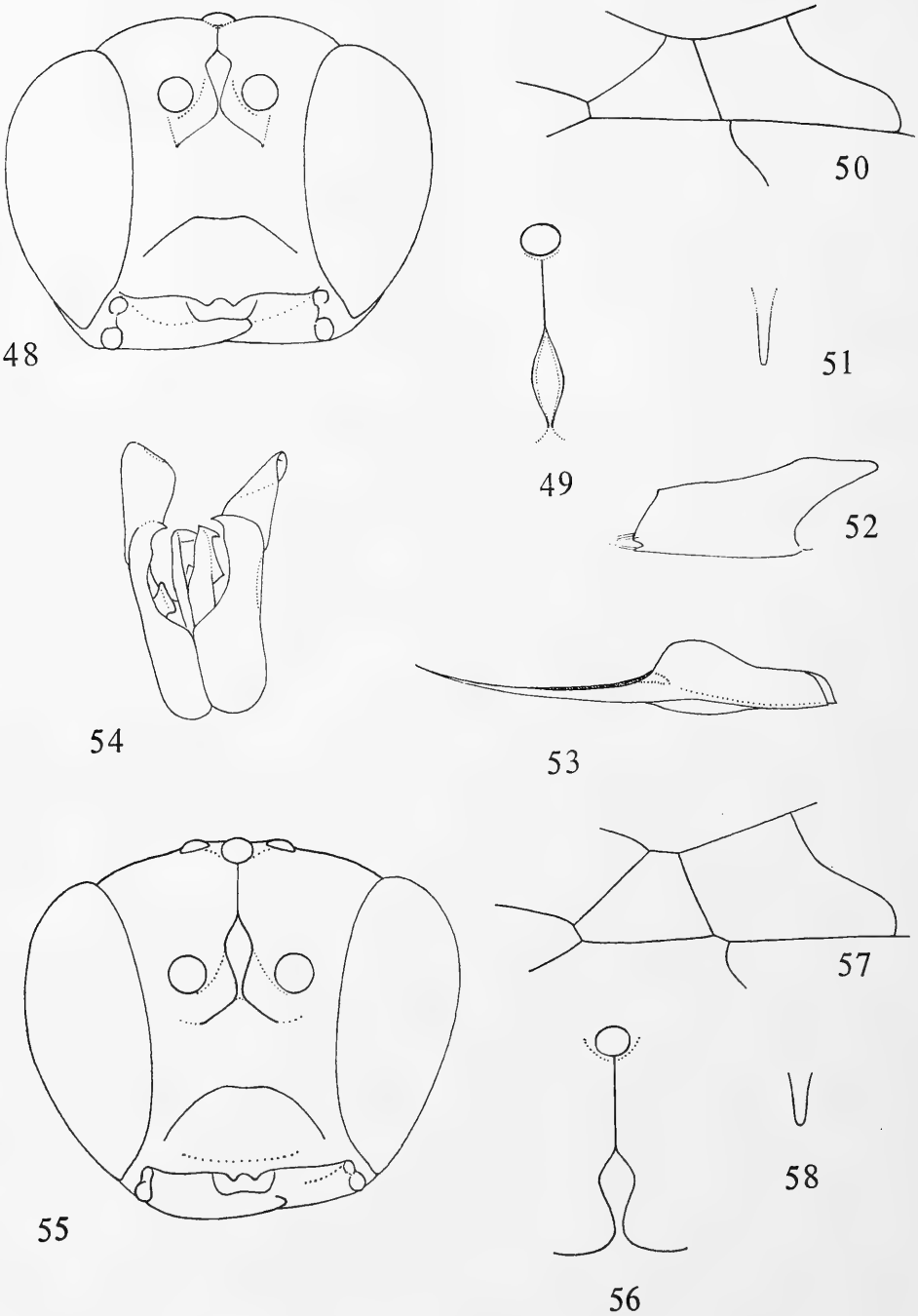


Fig. 48—51. *Psenulus jacoti* sp. nov., ♀, paratype. 48, face; 49, frontal carina, dorsal aspect; 50, 2nd and 3rd submarginal cell of right fore wing; 51, pygidial area. Fig. 52—54. *Psenulus jacoti* sp. nov., ♂, paratype. 52, 7th sternite, lateral aspect; 53, 8th sternite, lateral aspect; 54, genitalia, dorsal aspect. Fig. 55—58. *Psenulus rugifrons* sp. nov., ♀, holotype. 55, face; 56, frontal carina, dorsal aspect; 57, 2nd and 3rd submarginal cell of right fore wing; 58, pygidial area

twice, segments 4—5 about one and a half times, segments 6—7 about one and a fourth times as long as broad at apex, segments 8—11 nearly quadrate, last segment about one and three-quarters times as long as broad at base.

Lateral corners of pronotum obtuse. Scutum shining, sparsely punctate, prescutal sutures long, on posterior margin lost in the denser punctation. Scutellum and metanotum almost impunctate. Enclosed area of propodeum rather short, shining, with oblique carinae. Dorsal half of back of propodeum finely and densely obliquely striate, striae reaching enclosed area, lower part of propodeum with fine sculpture and punctures. Median longitudinal carina broad above, narrowing towards apex, upper part with transverse carinae. Sides of propodeum with fine oblique striae. Metapleura and mesopleura shining, sparsely punctate, mesosternum somewhat more densely punctate. Anterior oblique suture foveolate, widened upper part with transverse carinae. Legs rather stoutly built, mid tibiae flattened on outer side of apex, with a few dark red spines at posterior margin, hind tibiae with a row of short reddish spines on outer side. Second submarginal cell pentagonal (Fig. 50), first recurrent vein ending in second submarginal cell, second recurrent vein ending just in third submarginal cell, in some specimens interstitial. Petiole almost cylindrical, about one and a half times as long as first tergite (in dorsal view), dorsally slightly flattened, with small pit at apex. Gaster very finely punctate, segments 2—6 finely aciculate. Pygidial area narrow (Fig. 51), lateral carinae distinct, almost parallel, medially a line of fine punctures.

Face with appressed silvery pubescence and long, erect, silvery hairs; rest of body greyish-yellow pubescent. Epicnemial areas below with round patch of dense, yellowish-grey pubescence, appressed, apical margins of sternites 4—5 with dense, short, whitish pubescence, sixth sternite with long and dense, directed backwards, pale golden pubescence. Pubescence on mesosternum rather long and dense.

Length about 7 mm.

Male. — Similar to female but reddish-brown parts more or less darkened. In two of the three males antennal segments 3—13 black above, in one of the two males from Belmont pronotal tubercles and mid and hind legs almost completely black. In the allotype the antennae are almost completely reddish.

Transverse carina below antennae more distinct. Raised carina between antennae less broadened. Antennal segments 3—12 about one and a half times as long as broad at apex, last segment twice as long as broad at base; segments 3—11 with narrow longitudinal tyloidea, 12th segment with small, indistinct, tyloidea. Seventh sternite with small triangular emargination at apex (Fig. 52). Eighth sternite: Fig. 53. Genital apparatus (Fig. 54) short, pale brown, lateral valves with inner tooth, apices with rounded outer margin.

No conspicuous pubescence on epicnemial areas and on margins of fourth and fifth gastral sternites.

Length about 6.5—7 mm.

South Africa, Cape Province: 1 ♀ (holotype), Hilton, Grahamstown, 21 Oct., 1970, coll. C. Jacot-Guillarmod; 1 ♂ (allotype), Howison's Poort, Grahamstown, 19—22 Nov., 1971, coll. F. W. Gess; paratypes: 3 ♀, Hilton, Grahamstown, 5—9 Nov., 1970, coll. F. W. Gess, 1 ♀, Hilton, Grahamstown, 19—31 Dec., 1970, C. Jacot-Guillarmod, 1 ♀, Howison's Poort, Grahamstown, 12—14 Nov., 1971, F. W. Gess, 1 ♀, Kenton-on-Sea, Dec. 1971, R. A. Jubb, 2 ♂, Belmont Valley, Grahamstown, 28—31 Oct., 1971, coll. F. W. Gess, all in Malaise traps (AMG, one ♀ and one ♂ in author's collection).

South Africa, Transkei: 1 ♀, Port St. John, 12 Nov., 1961, coll. H. N. Empey (EC).

There is some variation in this species. In one of the females from Hilton the frontal carina is not bicarinate below the antennae, but single. In the female from Kenton-on-Sea the petiole is abnormally broadened towards the apex. The female from Transkei is paler coloured: antennae dorsally hardly darkened; fore and mid femora and trochanters brown instead of black; hind trochanters dark-brown, femora brown, hind tibiae and tarsi reddish-brown; complete petiole and great part of first tergite dark reddish; veins of wings brownish.

P. jacoti seems to be closely related to *P. stevensoni* Arnold from which it can be distinguished, e.g. by the non-striate vertex. There is also a great similarity to *P. luctuosus* Arnold, *P. lusingae* Leclercq, and *P. rugifrons* Van Lith, which all have at least the fifth and sixth tergites reddish.

Psenulus rugifrons spec. nov.

Female. — Head and thorax deep black; apices of mandibles dark reddish, labrum and palpi dark brown, underside of antennal segments 5—12 with orange-brown spot. Legs black; tarsi, underside of fore tibiae and base of hind tibiae brown, apical spine of fore tibiae yellowish-brown, of mid legs whitish, inner apical spine of hind legs whitish, outer spine of hind tibiae brown. Petiole black, extreme apex dorsally, ventral plate completely and whole gaster reddish.

Frontal carina raised and broadened between antennae (Fig. 56), broadened area tapering to two parallel carinae which end in a transverse carina, reversed V-shaped (Fig. 55). Face below antennae, and clypeus, dull, finely punctate, median part of clypeus protruding, with two small teeth close together. Frons finely obliquely punctato-rugose, between eyes and ocelli finely and sparsely punctate, vertex finely rugose. Tempora finely striate. Third antennal segment about twice, segments 4—5 about one and one-third, sixth segment about one and one-fourth times as long as broad at apex, segments 7—9 about as long as broad, segments 10—11 broader than long, last segment at least one and a half times as long as broad at base. Mandibles normal.

Anterior lateral corners of pronotum obtuse. Scutum finely punctate, prescutal sutures almost reaching hind margin, not distinctly alveolate, parapsidal sutures distinct, broad. Lateral margin of scutum along tegulae strongly alveolate. Scutellum finely punctate, metanotum almost impunctate. Propodeal enclosure shining, with distinct oblique carinae on lateral parts, median part of usual width. Upper part of propodeal longitudinal sulcus broad, with a few transverse carinae, sulcus on back side of propodeum broad but not deep, dull. Fine oblique striation behind propodeal enclosure, lower part finely reticulate; propodeum postero-laterally coarsely reticulate, sides of propodeum posteriorly finely reticulate, anteriorly very finely striate. Metapleura somewhat shining, mesopleura and mesosternum shining, finely punctate. Anterior oblique suture foveolate, upper part with transverse striae. Legs normal. First recurrent vein of fore wings ending well in second submarginal cell, second recurrent vein in third submarginal cell; upper side of second submarginal cell about one-fourth of length of lower side (Fig. 57). Petiole cylindrical, nearly twice as long as first gastral tergite, apex dorsally with long triangular depression. Pygidial area distinct, narrow with almost parallel carinae (Fig. 58).

Face with short and long, silvery, appressed pubescence. Head and thorax greyish-

white pubescent, on mesosternum longer and denser. Petiole dorsally along sides with row of short hairs, laterally with long outstanding hairs. Gaster yellowish-golden pubescent, longer on last segment. Apical margins of fourth and fifth gastral sternites with dense fringe of short pale hairs, sixth sternite with long, backwards directed, yellowish-white hairs.

Length about 7 mm.

Male unknown.

Ethiopia: 1 ♀ (holotype), Jimma, 29 June—3 July, 1965, coll. A. B. Gurney (USNM).

P. rugifrons probably belongs to the group of *P. luctuosus* Arnold.

Psenulus bidentatus (Cameron)

Cameron, 1910: 282, ♀ (*Psen bidentatus*; Tanzania: Kilimanjaro).
Turner, 1912: 412—413, ♀ (*Psenulus rubrocaudatus*; South Africa: Natal).
Arnold, 1923: 48—50, ♀ (Zaire: "Elizabethville" (Bequaert)).
Leclercq, 1961a: 33—34, ♀ and ♂ (Zaire).
Leclercq, 1961b: 58, ♀ and ♂ (Zaire).

P. bidentatus is recognized by the bidentate clypeus, slightly broadened raised part of interantennal carina, distinct transverse carina below antennae, finely striate tempora and long petiole. The pygidial area of the female is indistinct, the male has very strongly moniliform antennae and the raised part of the interantennal carina is narrow in most cases.

A study of the holotype (female) from the Kilimanjaro, which is in the Natural History Museum at Stockholm, revealed that most of the specimens from Zaire (recorded as *P. bidentatus* Cameron by Leclercq), part of the material from Rhodesia, and specimens from Malawi and Equatorial Guinea belong to a different form. There are distinct differences in structure as well as in colour and size and I believe that they represent at least a distinct subspecies. Future studies may lead to the conclusion that *pallidus* has specific rank.

Leclercq (1961a) pointed out that *P. rubrocaudatus* Turner is a geographical form of *P. bidentatus* in South Africa.

Psenulus bidentatus bidentatus (Cameron)

Cameron, 1910: 282, ♀ (*Psen bidentatus*; Tanzania: Kilimanjaro).
Arnold, 1923: 48—50, ♀ (*Psenulus bidentatus*; Rhodesia: Salisbury).
Arnold, 1929: 406 (Fig. 38: head of ♀).
Leclercq, 1961a: 33—34, ♀ partim (Zaire).

Most of the specimens recorded by Leclercq from Zaire (1961a, b) belong to the subspecies *pallidus*. The following female from Lubumbashi (Elisabethville) is a representative of the nominate form: Lubumbashi, Oct., 1934, coll. P. Quarré (MRAC).

New records: Rhodesia: 4 ♀, Salisbury, Sept., 1916, coll. G. Arnold, 26 Sept., 1919, 14 May, 1941 (2 specimens); 2 ♀, Bulawayo "Kh" (Khami?), 21 Oct. 1938, coll. R. H. R. Stevenson (RM).

Kenya: 2 ♂, Nairobi, July and Aug., 1930, coll. V. G. L. van Someren (BM, 1972-2, pres. by Com. Inst. Ent., and BM 1959-468).

Angola: 1 ♀ and 1 ♂, 30 km N of Quiculungo, Sept.—Oct., 1957, George R. Ferguson Collection 1972 (OSUM).

Probably the first-mentioned female from Salisbury, labelled "*Psenulus Bequaerti* Brauns comp. with type, G.A.", was the one recorded by Arnold (1923). He compared it with the type of *P. bequaerti* Brauns (nomen in litt.) from Lubumbashi and stated that they differ only in minor details of colour. I presume Brauns' specimen was a female of *pallidus* subsp. nov.

The authorities of the Naturhistoriska Riksmuseet at Stockholm kindly allowed me to study the holotype (female), labelled "Kilimandj., Sjöstedt, Kibonoto Kulturz., 4 maj" (printed) and "*Psen bidentatus* Cam. type" (in Cameron's handwriting).

Supplementary description of female. — Labrum reddish. Fore and mid trochanters brown, fore and mid legs reddish but lower side of femora brown, sometimes foreside of fore tibiae and extreme base of mid tibiae yellowish, outer side of mid tibiae pale brown and basal two-thirds of mid basitarsi, sometimes also fore basitarsi, yellowish. Hind legs brown, femora almost black. Tegulae reddish, very rarely somewhat yellowish. First gastral tergite except apical margin and base of second gastral tergite dark brown; in the female from Angola also first tergite reddish.

Raised part of interantennal carina slightly broadened, lateral ridges of broadened part shining, interantennal carina ending below antennae in a distinct transverse carina. Frons densely finely punctate, almost smooth near eyes. Vertex finely punctate. Apical third of clypeus sparsely punctate. Tempora very finely striate on lower part. Third antennal segment about two and a half times, fourth segment about one and three-quarters times, fifth segment about one and a half times as long as broad at apex, segments 6—7 about as long as wide, segments 8—11 shorter than wide, last segment about one and a half times as long as broad at base.

Pronotal corners obtuse. Punctures of anterior plate of mesepisternum somewhat elongate, mesopleura strongly punctato-striate, apex below finer and more sparsely punctate. Punctation of scutum finer, interstices mostly larger than punctures, very light tendency to transverse striation. Prescutal sutures almost reaching hind margin, fore part more linear, posterior half more foveolate. Anterior oblique suture foveolate, widened upper part with a few transverse carinae. Oblique carinae of propodeal enclosure weak. Propodeum behind enclosed area with narrow smooth margin, upper part of back of propodeum obliquely, lower part more irregularly striate. Petiole about twice as long as first tergite. Pygidial area not sharply defined, dull, indicated by two almost parallel low ridges, apex blunt, as in *P. nigeriae* Leclercq.

Length about 8.5—9.5 mm.

First description of male of nominate form. — Resembling female in colour and structure. Fore and mid basitarsi reddish or yellowish-red. First tergite except apical margin dark brown. Scape and following segments of antennae reddish, flagellum dark brown above, apical half of last segment above reddish-brown, underside of flagellum reddish.

Raised part of interantennal carina very slightly or not broadened. Antennae strongly moniliform, "en forme de toupies" (Leclercq, 1961a), segments 3—13 with narrow oblique tyloidea on back-side, segments 3—9 about one and one quarter times as long as greatest width, segments 10—11 about as long as greatest width, last segment over twice as long as greatest width. Scutum slightly more coarsely sculptured. Propodeum

behind enclosed area with fine superficial oblique striae which reach enclosed area; in the male from Angola a very narrow smooth margin behind enclosure.

Length about 7.75—8 mm.

Psenulus bidentatus (Cameron) var. or subsp. ?

Ethiopia: 1 ♀, Adola, "S. Abyssinia", Nov., 1941, 7000 ft, "*Psenulus bidentatus* Cam. var. n., det. G. Arnold" (RM).

In this dark form of *P. bidentatus* (Cameron) the second and third gastral tergites are also largely blackish and the legs are slightly darker reddish-brown than in the nominate subspecies. More material is needed to decide whether it belongs to a different subspecies or is merely a variety.

Psenulus bidentatus pallidus subsp. nov.

Leclercq, 1961a: 33—34, ♀ and ♂ partim (*Psenulus bidentatus*; Zaire).
Leclercq, 1961b: 58, ♀ and ♂ (*Psenulus bidentatus*; Zaire).

Female. — Mandibles yellowish. Antennae brown above, reddish-brown below. All trochanters brown. Fore femora brown, apex and foreside yellowish-red, sometimes apex pale yellow, fore tibiae yellowish, brown below, fore basitarsi yellowish-white, rest of fore tarsi yellowish-brown. Mid femora brown, apex yellowish, base and foreside of tibiae yellowish, back-side brown, mid basitarsi yellowish-white, following segments reddish-brown. Hind legs dark brown, base of femora below and base of tibiae paler. Petiole black, apex of ventral plate reddish. First gastral tergite brown except a reddish margin in the females from Lubumbashi (Elisabethville), in females from Rhodesia and Malawi all tergites reddish. Pronotal tubercles yellowish, or yellowish-red, at least on posterior half. Metanotum in one of the females from Malawi partly brownish.

Scutum coarsely striato-punctate, with irregular transverse rugae. Oblique striation on upper part of propodeum medially reaching propodeal enclosure, laterally a large smooth area.

Length about 7.5 mm.

Other characters as in nominate subspecies.

Male. — Mandibles yellow. Scape yellowish, following segments brown above, brownish-yellow below. Fore and mid trochanters yellowish-brown, hind trochanters brown. Fore legs yellowish, base, apex and foreside of tibiae and tarsi whitish, fore femora slightly darkened below in two of the three specimens studied. Mid femora brown, apex below more yellowish, mid tibiae and tarsi yellowish, foreside of tibiae and basitarsi whitish. Hind legs brown, base of tibiae paler brown.

Pronotum mostly with two yellowish-brown or brownish marks, metanotum yellowish-brown, reddish or brownish, rarely black, scutellum often somewhat brownish on posterior margin. Petiole dorsally blackish-brown, base somewhat paler, apex of ventral plate reddish. Tergites 1—6 or tergites 2—6 and apical margin of first tergite reddish.

Sculpture of scutum as in female, but interantennal carina hardly broadened, in most of the males even narrow. Behind enclosed area of propodeum a rather broad smooth margin, back-side of propodeum with irregular reticulate carination, coarser on lower half. Mesopleura more finely and sparsely punctate than in female, interstices larger than punctures, punctation denser below, in the male from Nkolentangan mesopleura on lower

half also somewhat striate. Hypo-epimeral area shining, almost impunctate.

Length about 6.5 mm.

The male differs from the female in the yellowish or brownish marked pronotum and metanotum (rarely dark) as well as in the distinct smooth margin behind the propodeal enclosure.

Zaire (Congo): 1 ♀ (holotype), Lubumbashi, 10 Nov., 1923, coll. Ch. Seydel (MRAC). Paratypes: 1 ♀, Lubumbashi, 1932, coll. De Loose (FAG); 1 ♂, Lubumbashi, 1933, coll. De Loose, 1 ♂, Parc National Albert, Rwindi, 1000 m, 22—24 Nov., 1934, coll. G. F. de Witte, no. 793, 1 ♂, Parc National de l'Upemba, Munoï, bifurcation Lupiala, 890 m, 15—24 June, 1948 (MRAC); 1 ♂, Mabwe, Lake Upemba, 585 m, 21—28 Aug., 1947, Miss. G. F. de Witte, no. 719a (FAG); 1 ♂, Parc National de la Garamba, I/a/3, 8 May, 1950, coll. H. de Saeger, no. 497 (MRAC); 1 ♂, Parc National de la Garamba, Nagero, 10 May, 1952, coll. H. de Saeger, no. 3503 (IRSNB); 1 ♂, Haut-Uele, Abimva, 1925, coll. L. Burgeon (MRAC); 1 ♂, Haut-Uele, Isiro (Paulis), July, 1947, coll. P. L. G. Benoit (FAG); 1 ♂, Rutshuru, North Kivu, Nov., 1937, coll. J. Ghesquière, 1 ♂, Yangambi, 19 June, 1948, coll. P. L. G. Benoit (MRAC).

Malawi (Nyasaland): 1 ♀, Zamba, 18 Nov., 1943, 1 ♀, Mlanje, 2000 ft, 17 Dec., 1944 (RM).

Rhodesia: 1 ♀, "Halfway Hotel Vic. Falls Rd" (about 140 miles on the main road from Bulawayo to the Victoria Falls), Sept. 1957; 2 ♀, Selukwe, 9 Sept. and 7 Okt., 1942 (RM).

Equatorial Guinea (Spanish Guinea): 1 ♂, Nkolentangan, coll. Tessmann (ZMB).

This form, especially the male, strongly resembles *P. nigeriae* Leclercq, of which only the female sex is known, and perhaps they are closely related. It differs from the nominate subspecies not only in being more yellowish marked and in having a coarser sculptured scutum but it is also distinctly and constantly smaller. As suggested above *pallidus* may be a distinct species.

Psenulus bidentatus rubrocaudatus Turner

Turner, 1912: 412—413, ♀ (Natal).
Arnold, 1923: 48—50.
Leclercq, 1961a: 33—34.

Arnold (1923) placed *P. bidentatus* (Cameron) and *P. rubrocaudatus* Turner in synonymy, but I share Leclercq's opinion (1961) that *P. rubrocaudatus* should be considered a subspecies of *P. bidentatus*, at least as long as there is no proof that they are specifically different. *P. rubrocaudatus* is known only from South Africa: Natal (Durban) and Cape Province (Grahamstown).

It differs distinctly from *P. bidentatus* s.str., collected in Rhodesia and northward, in the much darker gaster and hind femora. Turner did not mention that the raised carina between the antennae is slightly broadened. A pygidial area is defined by two rather weak almost parallel carinae. Petiole about twice as long as first gastral tergite. Scutum distinctly punctate, with slight tendency to transverse striation. In one of the paratypes the fine oblique striae on the upper part of the propodeum reach the propodeal enclosure, on either side of the longitudinal sulcus, whilst in the fresh specimens there is a narrow smooth margin behind the enclosed area, followed by fine oblique striae, the back-side being coarsely reticulate.

Mandibles almost completely reddish, also labrum. Narrow apical margin of fourth gastral tergite reddish, in the female from Durban this margin much broader. Fore and mid femora only blackish below.

Male still unknown.

New records: South Africa, Natal: 1 ♀, Durban, June, 1959 (RM); Cape Province: 3 ♀, Howinson's Poort, Grahamstown, 22—24 Nov., 24—26 Nov. and 8—14 Dec., 1971, coll. F. W. Gess, Malaise traps (AMG).

I had the opportunity to compare these specimens with the holotype and two paratypes (all females) from Natal (BM).

Psenulus nigeriae Leclercq

Leclercq, 1961a: 34, ♀ (Sierra Leone: Njala; Nigeria).

New records from Sierra Leone: 1 ♀, Njala, Dec., 1935, coll. E. Hargreaves, pres. by Com. Inst. Ent. BM 1973—1 (BM); 1 ♀, Freetown, May, 1967, coll. D. F. Owen (HT).

The yellow marking of the female from Freetown is slightly paler than in the holotype from Njala, 21 Aug., 1929, coll. E. Hargreaves (BM). I have also seen the paratype, a female from S. Nigeria, Oshogbo, Dr. T. F. G. Mayer (BM).

Supplementary description. — Antennae dorsally dark brown, reddish below, scape pale yellow. Pronotum with two vague yellowish-brown marks, pronotal tubercles and metanotum, except narrow lateral parts, pale yellow, fore and mid legs including trochanters yellowish-white with vague brown streak on back; hind legs brown, trochanters, underside of femora and base of tibiae paler. Petiole black, ventral plate of petiole and gaster reddish.

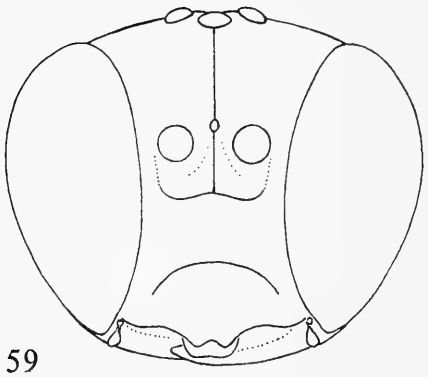
Median part of clypeal margin distinctly bidentate, distance between apices of teeth about one-sixth or one-seventh of total distance there between the eyes. Frons very finely punctate. Raised part of frontal carina between antennae with small broadened part, medially depressed (Fig. 60). Distinct transverse carina below antennae (Fig. 59). Tempora finely aciculate. Third antennal segment about two and a half times, fourth about twice, segments 5—6 about one and three-quarter times, seventh segment about one and a half times as long as broad at apex, segments 8—9 about as wide as long, twelfth segment slightly more than twice as long as broad at base.

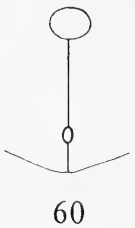
Pronotal corners sharp (Fig. 61). Scutum with distinct punctures of variable size and very slight tendency to transverse striation. Prescutal sutures long, almost reaching hind margin, posterior two-thirds consisting of a row of larger punctures. Behind propodeal enclosure a narrow smooth area, upper part of back-side of propodeum finely obliquely striate, lower part rather finely irregularly reticulate. Apex of mid tibiae on outer side with small bare area, raised and shining in the middle and margined posteriorly and at apex by a few short reddish spines. Petiole nearly twice as long as first tergite, in dorsal aspect. Pygidial area distinct, almost rectangular, apex blunt (Fig. 62), parallel carinae not sharp, surface dull and medially with two parallel rows of very fine punctures, each with a long erect fine hair.

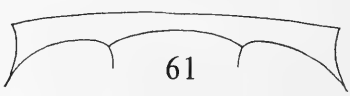
Apical margins of fifth and sixth sternites with dense short pale pubescence.

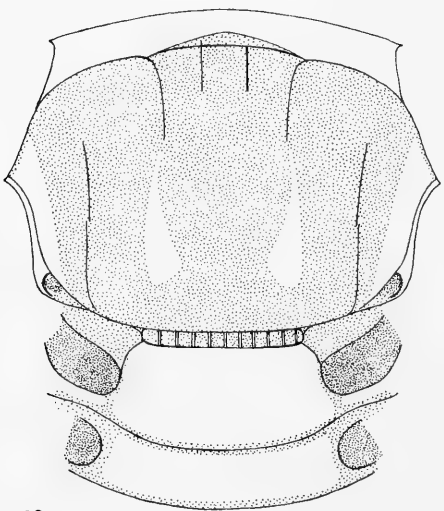
Length about 8 mm.

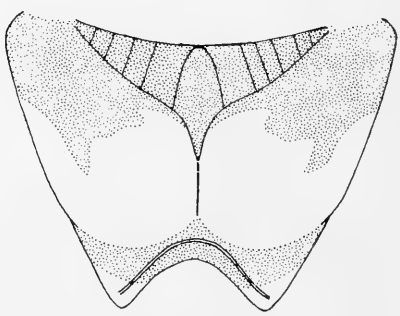
Male unknown.











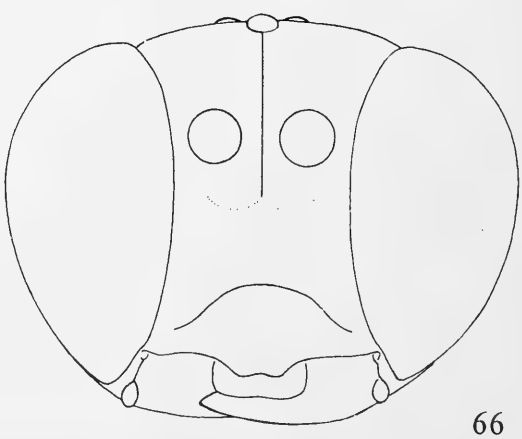


Fig. 59—62. *Psenulus nigeriae* Leclercq, ♀, Sierra Leone. 59, face; 60, frontal carina, dorsal aspect; 61, pronotum; 62, pygidial area. Fig. 63—66. *Psenulus oweni* sp. nov., ♀, holotype. 63, thorax, dorsal aspect; 64, propodeum, anterior aspect; 65, pygidial area; 66, face. Fig. 67—68. *Psenulus oweni* sp. nov., ♂, paratype. 67, genitalia, dorsal aspect; 68, apex lateral valves

P. nigeriae is closely related to *P. bidentatus* (Cameron) and most resembles the form provisionally considered to be the male of *P. bidentatus pallidus*, which is paler than the female of *P. bidentatus pallidus* but still somewhat darker than *P. nigeriae*.

Psenulus ghesquierei Leclercq

Leclercq, 1961a: 34, ♀ (Zaire).

New record: Uganda: 1 ♀, Bwamba, Hakitengya, Febr.—March, 1949, Fan trap, coll. W. H. R. Lumsden (BM).

I have compared this specimen with the holotype from Eala (Zaire), June, 1935 (MRAC) and consider them to be completely identical. As Leclercq has only given a short characteristic of *P. ghesquierei* in his key (1961a: 19), a detailed redescription of the holotype follows.

Female. — Head and thorax black; mandibles yellow with reddish-brown tips, palpi testaceous, scapes yellow, second segment yellow with brown mark above, following segments reddish-brown below, segments 3—9 brownish at apices, dorsally dark brown. Median part of pronotum yellow dorsally, lateral corners black. Pronotal tubercles yellow. Metanotum yellow, laterally reddish-brown. Tegulae yellowish, transparent. Veins of wings dark brown, paler at base. Fore and mid legs including trochanters yellow, femora darkened below, especially mid femora. Hind trochanters yellowish, hind femora brown, hind tibiae reddish above, brown below, tarsi brownish. Petiole black, ventral plate of petiole and gaster yellowish-red.

Frontal carina sharp, raised part between antennae not broadened, ending below in a distinct transverse, bilobed, carina. Frons below anterior ocellus obliquely striato-punctate, rest of frons and vertex sparsely finely punctate. Face and clypeus dull, protruding median part of clypeus with two distinct teeth, distance between tips of teeth about one-seventh of total distance there between the eyes. Tempora with fine longitudinal striation. Mandibles normal. Third antennal segment about two and a half times, segments 4—5 about twice, sixth segment about one and a half times, segments 7—8 about one and one-third times as long as broad at apex, segments 9—11 about as long as broad at apex, last segment about twice as long as broad at base.

Scutum transversely rugoso-punctate, not very coarsely, punctures fine with shining interspaces. Prescutal sutures indistinct, about as long as anterior third, parapsidal sutures distinct. Scutellum and metanotum with sparse punctation. Propodeal enclosure triangular, lateral parts with about six oblique carinae, central part with indistinct median line, upper part of propodeum laterally with oblique striae, on both sides of median sulcus a small smooth area. Sulcus broad. Back-side of propodeum coarsely reticulate, sides less coarsely sculptured, dull anteriorly. Metapleura smooth on fore part, posterior triangular part with a few oblique carinae. Mesopleura and mesosternum with superficial irregular punctation. Anterior oblique suture gradually widening upwards, with long transverse carinae. Anterior plate of mesepisternum with some irregular reticulation. Legs normal; mid tibiae somewhat thicker at apex, outer side flattened and bordered behind by a bent row of five short yellowish-red thorns. First recurrent vein of fore wings ending in second submarginal cell, second recurrent vein ending in third submarginal cell. Upper side of second submarginal cell about half as long as lower side. Petiole cylindrical, about one and a half times as long as first tergite, rounded above, small depression at apex. Gaster

very finely punctate, no distinct pygidial area. Base of second sternite without well-defined depression.

Face with appressed silvery pubescence, head and thorax whitish pubescent, rather dense and long on propodeum, yellowish on legs and gaster, apical margins of fourth and fifth sternites with fringe of very short pale hairs, sixth sternite with dense yellowish-golden pubescence.

Length at least 7.5 mm.

Male unknown.

Psenulus trevirus Leclercq

Leclercq, 1961a: 34, ♂ (Zaire).

Redescription. Male. — Head and thorax black, with following yellow marking: mandibles except reddish tips, palpi, pronotum dorsally and pronotal tubercles, two square marks on scutellum, extreme upper corner of anterior plate of mesepisternum, metanotum, with a narrow interruption, two marks on back of propodeum close to longitudinal sulcus, as long as apical half of propodeum and each about one-fourth of width of back of propodeum. Yellow colour on thorax somewhat whitish. Underside of antennae yellowish-red. Fore and mid legs including trochanters yellowish, base and back of fore femora and back of mid femora brown, hind trochanters and femora dark brown, rest of hind legs reddish with median part of tibiae somewhat brownish. Petiole including ventral plate black but extreme base of petiole below yellowish-white; first and base of second tergite black, rest of gaster dark reddish, apex more brown. Sternites partly darkened. Veins of wings brown.

Raised part of frontal carina not broadened between antennae, transverse carina below antennae much protruding. Frons and vertex finely sparsely punctate. Clypeal margin distinctly bidentate. Tempora smooth. Antennae long, filiform, third segment about two and one-third times, segments 4—12 about twice as long as broad at apex, last segment about two and a half times as long as broad at base, segments slightly convex below; no tyloidea.

Anterior lateral corners of pronotum obtuse. Scutum coarsely punctate, interstices irregular, prescutal sutures about one-third of length of scutum, indistinct, indicated by transverse short grooves. Scutellum and metanotum almost impunctate. Enclosed area of propodeum concave, triangular, with a few indistinct oblique carinae. Back of propodeum with coarse reticulation, a smooth area behind lateral parts of enclosed area. Median longitudinal sulcus neither broad nor narrow. Sides of propodeum except narrow anterior part with coarse reticulation. Mesopleura distinctly punctate, interstices about three or four times size of punctures, hypo-epimeral area almost impunctate. Anterior oblique suture foveolate, widened upper part smooth. Legs normal. Base of second submarginal cell about one and a half times as long as upper side. Petiole long and cylindrical, about one and one-third times as long as first tergite in dorsal view, first tergite about one and a half times as long as wide at apex, slightly nodose. Petiole dorsally rounded, with small apical pit. Apex of gaster laterally depressed.

Face with appressed yellowish-silvery pubescence. Pubescence of thorax greyish, of gaster yellowish, petiole with long erect lateral hairs.

Length about 8 mm.

Female unknown.

Material studied: Zaire, "Equateur: Bokuma, II—1952, R. P. Lootens", 1 ♂ (holotype) (MRAC).

The systematic place of this species is still unclear. The shape of the antennae does not point to a close relationship to *P. bidentatus* (Cameron), as Leclercq suggested (1961a). It may be more closely allied to *P. oweni* sp. nov., from Sierra Leone.

Psenulus oweni spec. nov.

Female. — Head black; mandibles pale yellow with reddish-brown tips, labrum brown, palpi pale yellow. Scape of antennae pale yellow, extreme tip brown, following antennal segments dark brown, almost black dorsally, underside reddish-yellow, tip of last segment brownish below. Thorax black with following yellow parts (Fig. 63): dorsum and upper margin of foreside of pronotum, pronotal tubercles, longitudinal mark along tegulae, two narrow marks on scutum, widened towards apex, commencing at end of prescutal sutures and ending well before apical margin of scutum — marks on scutum, especially the two median ones, may be more or less reduced, rarely lacking — a small mark on axillae — often missing — scutellum including lateral margin behind depressed lateral part, posterior margin sometimes darkened medially, metanotum with sometimes medially darkened posterior margin, back of propodeum, except two black triangular incisions projecting from the black base (Fig. 64) and black apical margin, upper third of anterior plate of mesepisternum, and a small mark on hypo-epimeral area, which may be lacking. Fore and mid legs including trochanters and tip of coxae yellowish-white, back of mid tibiae and mid tarsi somewhat orange; hind coxae pale yellow with black base, rest of hind legs reddish-orange, back of trochanters brownish, femora sometimes with brown streak behind, tarsi light-brown. Tegulae yellowish-red, veins of wings blackish-brown. Petiole black, basal third yellowish, gaster including ventral plate of petiole reddish.

Protruding median part of clypeal margin weakly emarginate (Fig. 66). Frontal carina distinct, raised part between antennae narrow, slightly flattened, ending below antennae in a small shining point; no distinct transverse carina, at most slightly indicated. Frons, vertex and tempora shining, almost impunctate. Occipital carina ending in hypostomal carina. Mandibles normal. Third antennal segment just over two and a half times, fourth segment over twice, fifth segment about twice, segments 6—9 about one and a half times, tenth segment about one and a third times and eleventh segment about one and a quarter times as long as broad at apex, last segment about one and a half times as long as broad at base. Pronotal corners with sharp angle; scutum densely, extremely finely punctate with a few larger punctures. Prescutal sutures about half as long as scutum. Scutellum and metanotum very finely punctate. Propodeal enclosure triangular, hind margin not sharply defined, median two longitudinal carinae slightly bent inwards at base, lateral parts with oblique carinae (Fig. 64). Median longitudinal suture on back of propodeum very narrow, ending in a shallow depressed triangular area at apex of propodeum. Back of propodeum smooth, dorso-laterally with weak parallel striae, sides of propodeum and metapleura smooth. Mesopleura and anterior plate of mesepisternum and mesosternum with fine hair-bearing punctures. Anterior oblique suture narrow, with a few transverse carinae, widened upper part smooth. Epicnemial areas shining. Legs normal, mid tibiae postero-dorsally with three or four reddish spines, base of hind tibiae on outer side with short flattened area, margined basally by a semi-circular area of small and short reddish

spines. Upper side of second submarginal cell nearly two-thirds of length of lower side, first recurrent vein ending distinctly in first submarginal cell, second recurrent vein ending well in third submarginal cell. Petiole in dorsal view about one and one-third times as long as first tergite, cylindrical, apex dorsally with small triangular pit. Gaster slender, almost impunctate, first tergite somewhat nodose, pygidial area distinct, narrow elongate-triangular (Fig. 65). Base of second sternite somewhat depressed.

Lower part of frons and face with appressed silvery pubescence, clypeus also with long erect hairs. Vertex and tempora with short silvery pubescence, vertex also with long hairs. Thorax with whitish pubescence, on scutum short, intermixed with long hairs. Pubescence long and denser on scutellum, metanotum and propodeum, very dense on mesosternum. Epicnemial areas below with patch of dense appressed yellowish pubescence. Pubescence of legs and gaster yellowish, hind margins of fourth and fifth sternites with dense and short yellowish-white pubescence, sixth sternite with large patch of yellowish-golden pubescence, petiole with long outstanding hairs in two lateral rows on dorsum and on sides.

Length about 8—9 mm.

Male. — Similar to female, with following differences. Small yellow mark on hypoepimeral area lacking, yellow markings on scutum completely lacking in the allotype, lateral hind margin of scutellum behind depressed lateral area sometimes black. Yellow marking on back of propodeum reduced to four marks, more or less united below. Fore and mid coxae brown, hind coxae black at base, posterior half reddish; fore and mid tibiae with brown streak on back, hind femora dark brown, underside reddish, hind tibiae dark brown on inner side, base reddish-brown. First gastral tergite somewhat brown at base and sternites 3—4 and 6 more or less dark brown.

Face with distinct transverse carina below antennae. Antennae long, segments distinctly convex below, segments 3—12 slightly more than twice as long as broad at apex, last segment nearly three times as long as broad at base. Genitalia: Fig. 67,68.

Length about 8—9 mm.

Sierra Leone: Freetown, 1 ♀ (holotype), Febr., 1968, 1 ♂ (allotype), Jan., 1968; 1 ♀, Jan., 1967, 1 ♀, March, 1967, 1 ♀, April, 1967, 6 ♀, May, 1967, 2 ♀, May, 1968, 1 ♂, March, 1967, 1 ♂, Dec., 1967 (all paratypes), coll. D. F. Owen (HT, a few paratypes in author's collection).

Only in the holotype and in the allotype the marks are fully yellow, in the paratypes the colour is more whitish, the chitin being also partly transparent there.

P. oweni is easily distinguished from *P. nigeriae* by the lacking transverse carina below the antennae of the females and the richer yellow marking. It shows some relationships with the group of *P. capensis*. The male much resembles *P. trevirus* from Zaire.

Psenulus dilectus (Saussure)

Saussure, 1892: 571—572, ♀ (*Psen dilectus*; Malagasy: province of Imerina).
Schulz, 1911: 141—142 (*Psenulus dilectus* (Saussure) = *Stenomellinus dilectus* Saussure in litt.).
Arnold, 1945: 154, ♀ (Malagasy: Bekily).
Leclercq, 1961a: 35.
Leclercq, 1961c: 117, ♀ (Malagasy: Sakavondro, Ranomafana).

Material studied: 1 ♀, "Madagascar", det. J. Leclercq (FAG); 1 ♀, "Madagascar, Bekily, Rég. sud de l'île", Oct., 1936, coll. A. Seyrig (RM).

This species resembles those placed in the group of *P. capensis* Brauns in many respects; especially the vertical carinae below the antennal sclerites and the nodose first gastral tergite are striking features. However, *P. dilectus* is less slender, the transverse carina below the antennae is distinct, though very fine, and it has a distinct, narrow, pygidial area; the colour is also different. The male has not yet been found.

A few characters should be added to earlier descriptions. — Median part of clypeal anterior margin protruding, weakly emarginate. Occipital carina ending normally in hypostomal carina. Pronotal corners obtuse. Prescutal sutures distinct only on basal third of scutum. Propodeum behind enclosed area smooth and shining, backside sparsely finely punctate, apex with some reticulate carination. Petiole cylindrical, apex dorsally with small triangular pit, petiole slightly longer than first tergite, which is about twice as long as wide at apex and distinctly nodose. Apical margins of fourth and fifth gastral sternites with dense short pubescence.

Psenulus uelleburgi spec. nov.

Female. — Head black; mandibles yellow with dark tips, labrum yellowish-red, palpi straw-yellow, scape of antennae yellowish with reddish tip, following segments yellowish-red below, dorsally dark brown, last segment dorsally reddish-brown. Thorax black, with following parts (Fig. 69) yellow: dorsal side and upper half of foreside of pronotum, pronotal tubercles, large yellow mark on sides of scutum reaching fore margin, two narrow lines along prescutal sutures, about half as long as scutum, posterior half of axillae, scutellum and metanotum including posterior lateral margins, propodeum except upper lateral corners and apex, round yellow mark on anterior half of hypo-epimeral area, anterior plate of mesepisternum. Lower half of foreside of pronotum and greater part of mesopleura reddish. Fore legs including coxae yellow, foreside of mid legs yellow, back side of mid legs mostly brownish-red, hind legs reddish-brown including tibial spurs, apical half of hind femora yellowish below. Basal third of petiole yellow, rest dark brown above, ventral plate yellowish. Gaster brown, darkening towards apex. Veins of wings dark brown. Tegulae yellowish-red.

Raised part of frontal carina between antennae narrow, carina ending below antennae in a fine transverse carina, which is about half as long as distance between eyes. Supraclypeal area and upper half of clypeus dull, very finely punctate, anterior half shining, protruding median part of clypeus slightly emarginate, frons and vertex shining. Tempora smooth and shining. Occipital carina ending normally in hypostomal carina. Apex of mandibles normal. Antennae long and slender, third segment about three times, segments 4—5 about two and a half times, sixth segment about twice, segments 7—8 about one and three quarters, segments 9—11 about one and a half times as long as broad at apex, last segment about two and a half times as long as broad at base.

Pronotal corners with obtuse angle. Scutum shining, sparsely distinctly punctate. Prescutal sutures fine, about one-third of length of scutum. Parapsidal sutures sharp, linear. Enclosed area of propodeum triangular with oblique carinae on lateral parts, these parts not sharply separated from rest of propodeum, median part with irregular fine median carina. Upper third of back of propodeum smooth, finely obliquely striate below, lower two-thirds and sides of propodeum finely reticulate, fore part of sides smooth. Median longitudinal groove on back of propodeum narrow. Metapleura smooth and shining, mesopleura and mesosternum smooth with fine punctures. Anterior oblique

suture narrow, indistinctly foveolate, widened upper part smooth. Foreside of fore femora much flattened; apical two-fifths of mid tibiae with row of four dark red thorns; hind legs slender, base with small smooth depressed area, margined at base by semicircular row of thin reddish teeth. First recurrent vein of fore wings interstitial, second recurrent vein ending just in third submarginal cell. Upper side of second submarginal cell about two-thirds of length of lower side. Petiole about twice as long as first tergite, cylindrical, apex with relatively large triangular pit. Gaster elongate, first tergite much convex, pygidial area narrow and shining, with long parallel lateral carinae (Fig. 70).

Pubescence of head silvery, on face below antennae mostly appressed, yellowish on thorax, dense and silvery on mesosternum, epicnemial areas below with round patch of dense yellowish pubescence, last sternite densely yellowish-golden pubescent. Petiole with few long, obliquely downwards directed hairs.

Length about 10.5 mm.

Male unknown.

Equatorial Guinea (Spanish Guinea): 1 ♀ (holotype), "Westafrika, Uelleburg", June—Aug., 1908, coll. Tessmann (ZMB).

P. uelleburgi seems to be rather closely related to *P. dilectus* from Malagasy.

Psenulus capensis capensis Brauns

Brauns, 1899: 391—392, ♀ and ♂ (Cape Province near Port Elizabeth).
Arnold, 1923: 47—48, ♂ (Rhodesia: Matopos).
Arnold, 1947: 159—160, ♀ and ♂ (*Psenulus pauxillus* sp. nov.; Zambia: Abercorn).
Leclercq, 1961a: 30—32 (Zaire; S. Africa: Natal, S. Zululand; Cape Province).
Leclercq, 1961b: 56—57 (Zaire).
Arnold, 1962: 851—852, ♀ (*Psenulus stuckenbergi* sp. nov.; Mozambique: Marromeu).

New records: South Africa: Natal: "Mfongosi, Zululand" (Mfongozi, near Kranskop), 1 ♂, Febr., 1914, 1 ♀, May, 1916, coll. W. E. Jones (SAM); 1 ♂, Durban, no. 4457 (AMNH).

South Africa, Transvaal: Ellisras, N. Transvaal, 2 ♀, 6 April and 19 June, 1962, 3 ♀, 22 June, 1963, 1 ♀, 13 May, 1972, 3 ♂, 19 June, 1962, 2 ♂, 22 June, 1963; 1 ♂, Schoemanville, H-B Dam, 8 Aug., 1965, all coll. H. N. Empey (EC, one ♀ and one ♂ PMFV); 1 ♀, 5 miles N of Warmbad, 24 Febr., 1968, coll. Krombein and Spangler (USNM).

Zaire (Congo): 2 ♀, Kasongo, Aug., 1959, coll. P. L. G. Benoit, 2 ♂, Kivu: Uvira, Sept., 1958, coll. J. Pasteels (MRAC); 1 ♀, Tshibinda, Aug., 1931, coll. J. Ogilvie, 1 ♂, Lubumbashi (Elisabethville), Sept., 1931, coll. L. Ogilvie (BM).

Mozambique: 1 ♂, Beira, Dec., 1960 (RM).

Tanzania: 1 ♂, "Tanganyika, Kilosa", 25 Aug., 1948, at flowers of *Solanum incanum*, coll. G. Salt, BM 1971—85 (BM).

Malawi: "Nyassa-See Langenburg", 1 ♂, 31 Oct.—14 Nov., 1898, 1 ♂, end Dec., 1898—end Jan., 1899, 3 ♀, 17 Aug., 1899, all coll. Fülleborn (ZMB).

Uganda: 1 ♀, "Buunga" (?), 29 May, 1924, coll. G. L. R. Hancock, pres. by Com. Inst. Ent. BM 1973—1 (BM); 1 ♀, Ankole, Kichwamba, 23—29 April, 1968, coll. P. J. Spangler (USNM).

Sierra Leone: Freetown, 1 ♀, July, 1967, 4 ♂, March and July, 1967, Jan. and Febr.,

1968, coll. D. F. Owen (HT); 1 ♀, "Rokupr." (?), Febr., 1965, CIE 612 (241), pres. by Com. Inst. Ent. BM 1967—3 (BM).

In one of the two females from Kasongo (Zaire) the fore tibiae are completely yellowish-white, the females from Malawi have a brownish streak on the back of the fore tibiae.

P. capensis Brauns and *P. latiannulatus* (Cameron) are distinctly different species, the former having a pronotum with obtuse lateral corners (Fig. 74), whilst in *P. latiannulatus* the lateral corners always have a more or less sharp angle (Fig. 71 and 72). Moreover *P. capensis* is smaller, length in both sexes being about 7 mm (in *P. latiannulatus* about 8—9 mm), and the sculpture on frons, scutum and propodeum is generally much coarser.

The female of *P. capensis* is easily recognized by the traces of a transverse carina below the antennae, consisting of a short vertical carina downwards from each of the antennal sclerites, best visible in dorsal view, when it looks like a tooth. They are connected by a more or less distinct transverse low ridge, never forming a sharp carina. There is no distinct pygidial area but sometimes two very close parallel carinae are indistinctly indicated. Upper part of back of propodeum usually distinctly obliquely striate.

The antennae of the male have low but distinct narrow-elliptic tyloidea, small on fourth segment, on segments 5—10 about half as long as segments, smaller on segments 11—12, sometimes very indistinct on twelfth segment. Dorsal side of flagellum blackish-brown, lower side yellowish-brown; tyloidea situated on back-side of segments just in the dark part but they are somewhat paler brown. *P. latiannulatus* has no tyloidea.

I did not see Braun's types but his excellent description allows to recognize his species without any doubt. He labelled the female and the male from "Algoa Bay, Capland", as "♀ type" and "♂ type"; I have designated the female as the lectotype.

I have seen the type of *P. stuckenbergi* Arnold (1962), a female without gaster, and consider this a true *P. capensis capensis*. Arnold's figure No. 6 of the face of *P. stuckenbergi* is not exact.

P. capensis is one of the very few Ethiopian Psenini, of which we know some particulars in regard to its biology. Brauns found his couple in the month of August in stems of a species of *Phragmites* in which he thought this *Psenulus* should be nesting. Mr. Empey (letter of 23 Nov., 1972) collected his specimens about the middle of June — in the South African winter — in the subtropical area of North Transvaal (Ellisras), hovering about the reeds on the banks of the river. Finally, the female from "Rokupr.", Sierra Leone, caught in February, bears on its pin the remains of its cocoon. This cocoon very much resembles that of the Palaearctic *P. schencki* Tournier. It has a solid, flat, upper side, smooth and creamy-white on its lower surface, with remains of the inner wall of the stem solidly fastened to its circumference. The sides and bottom of the cocoon are made of a fine whitish tissue, probably covering the whole length of the cell, but keeping free from its wall.

This specimen from Sierra Leone also bears the following note on its pin: "pred. on *Hecalus* on wild rice". *Hecalus* is a Homopteron belonging to the Cicadelloidea (or Jassoidea), Hecalidae. Jassids as well as Delphacids are known as the prey of Indo-Australian *Psenulus*. The food of *Psenulus sogatophagus* Pagden consists of the Delphacid *Sogata furcifera* Horv. and the Jassid *Nephotettix bipunctata* F., both Homoptera being pests of rice (Pagden, 1933).

Psenulus capensis laevior Arnold

Arnold, 1951: 163, ♂ (*Psenulus pauxillus laevior*; Ethiopia).
Leclercq, 1961a: 30—31 (*Psenulus capensis*).

Arnold distinguishes this form from *P. pauxillus* Arnold (= *P. capensis* Brauns) by the brown colour of the femora which are black in *P. capensis*, the somewhat wider scutum, the lacking feeble transverse ridges between punctures of scutum and the finer sculpture of dorsum of propodeum (epinotum). Because of the variation in the sculpture of *P. capensis* series of both sexes of the Ethiopian form should be studied to place it with more certainty.

Psenulus latiannulatus latiannulatus (Cameron)

Cameron, 1910: 281—282, "♀" (= ♂) (*Psen latiannulatus*; Tanzania: Kilimanjaro)
Turner, 1912: 413, ♂ (Nigeria).
Arnold, 1923: 50.
Leclercq, 1961a: 30—32, ♀ and ♂ (Zaire).
Leclercq, 1961b: 57 (Zaire).

New records: Uganda: 1 ♂, Ankole, Kichwamba, 23—29 April, 1968, coll. P. J. Spangler (USNM).

Rhodesia: 1 ♀, Cashel, 6 Dec., 1945 (RM).

Zaire (Congo); 1 ♂, Boma, 13°0′ E, 6°0′ S, 14 June, 1915, coll. Lang and Chapin (AMNH); 1 ♀, Kasongo, Sept., 1959, coll. P. L. G. Benoit (MRAC), 1 ♂, Lubumbashi (Elisabethville), 25 Sept., 1962, coll. M. and A. and J. Bourgeois (HT).

Nigeria: 1 ♂, Aba, May, 1967, coll. Jean Townes (HT).

Sierra Leone: Freetown, 8 ♀, March, May, July, Oct., Dec., 1967, Febr., April, 1968, 12 ♂, Jan., July, Aug., Sept., Oct., Dec., 1967, Jan., 1968, all coll. D. F. Owen (HT).

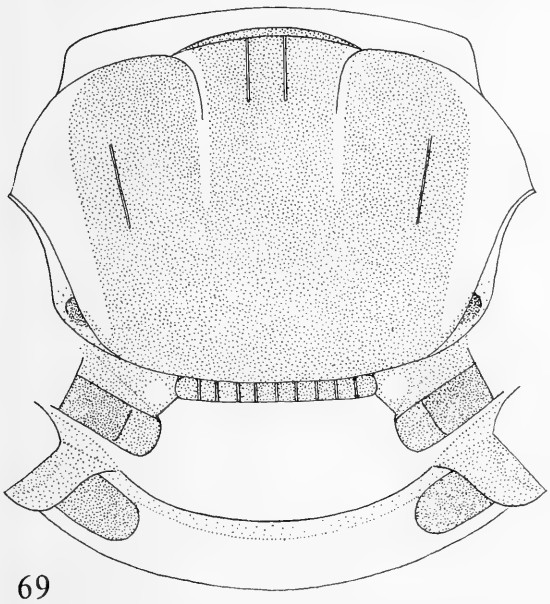
Dr. Per Inge Persson of the Naturhistoriska Riksmuseet at Stockholm kindly sent me the holotype, which is labelled: "Kilimandjaro, Sjöstedt. 1905—6, Kibonoto, 1300—1900 m, 4 maj, Typus, *Psen latiannulatus* Cam. Type (in Cameron's writing). 307.3". From Cameron's description of the face of his type it is evident that he had a male before him. This has been proved by examination of the holotype, so Cameron has again been misled by the long apical spine of the males of the Psenini.

The anterior corners of the pronotum are almost rectangular in the type (Fig. 72), not as sharp as in other *P. latiannulatus* studied (Fig. 71, male from Sierra Leone), but certainly not as obtuse as in *P. capensis*. Upper side of antennae dark brown, underside paler brown, more reddish at base. Although the antennae are somewhat dirty, it is sufficiently clear that there are no tyloidea. Upper part of propodeum behind enclosed area close to median longitudinal suture almost smooth, behind this smooth part a few superficial oblique rugae, back coarsely reticulate.

Fig. 75 shows sternites 5—8 of a male from Sierra Leone, somewhat extracted and bent upwards, in lateral view. Apical margin of seventh sternite (Fig. 76) not emarginate. Genital apparatus slender (Fig. 77, 78).

Pygidial area of female indistinct, in some specimens last tergite with two very superficial, very close and parallel ridges. Apical margins of fourth and fifth sternites with dense short pale pubescence.

There is some variability in the angle of the pronotal corners as well as in the puncta-



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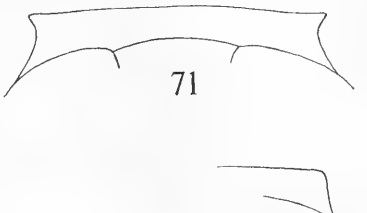

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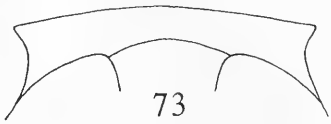

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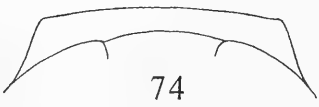

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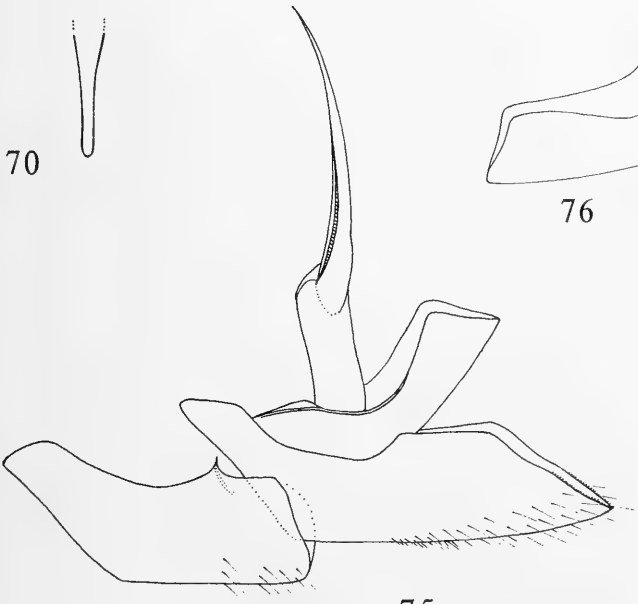

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Fig. 69—70. *Psenulus uelleburgi* sp. nov., ♀, holotype. 69, thorax; 70, pygidial area. Fig. 71. *Psenulus latiannulatus latiannulatus* (Cameron), ♂, Sierra Leone. Pronotum. Fig. 72. *Psenulus latiannulatus latiannulatus* (Cameron), ♂, holotype. Right part pronotum. Fig. 73. *Psenulus latiannulatus basilewskyi* Leclercq, ♂. Pronotum. Fig. 74. *Psenulus capensis capensis* Brauns, ♂, North Transvaal. Pronotum. Fig. 75—78. *Psenulus latiannulatus latiannulatus* (Cameron), ♂, Sierra Leone. 75, 5th, 6th, 7th and 8th sternites, lateral aspect, 7th and 8th sternites bent upwards; 76, 7th sternite, lateral aspect; 77—78, genitalia, dorsal and ventral aspect

tion of the thorax. The legs of the specimens from Sierra Leone are usually more whitish than in specimens from other regions. The female from Cashel, Rhodesia, bears the following note, probably in Arnold's handwriting: "very near *Psenulus latiannulatus*, but 2nd abs. radius differs".

Length of female about 8—9 mm, of male about 8 mm.

P. latiannulatus belongs to a small group which is easily recognized by the slender form and the nodose first gastral tergite. *P. latiannulatus* and its nearest relative, *P. capensis*, have a wide area of dispersal over the Ethiopian region. *P. dilectus* Saussure may be a representative of the group in Malagasy, but the female of this species has a distinct narrow pygidial area.

Psenulus latiannulatus basilewskyi Leclercq

Leclercq, 1955: 420—421, ♂ (*Psenulus basilewskyi*; Rwanda).
Leclercq, 1961a: 32—33, ♀ and ♂ (*Psenulus capensis basilewskyi*; Zaire).

New records: Cameroon: 1 ♀, Yaoundé "Amt Jaunde, Buschwald", 19—23 Oct., 1914, coll. Tessmann (ZMB). Length, sting not included, about 7.5 mm.

Zaire (Congo): 1 ♀, Kasongo, Sept., 1959, coll. P. L. G. Benoit (MRAC).

Further material studied from Zaire: 1 ♀ (allotype), Kiamokoto-Kiwakishi, Parc de l'Upemba, 1070 m, 4—16 Oct., 1948 (MRAC); 1 ♂ (paratype), Eala (Equateur), Nov., 1931, det. J. Leclercq (FAG).

In the allotype (♀) only the basal half of the antenna is yellowish-red, rest of underside dark brown, dorsal side black. Apex of fore femora on foreside, base and foreside of fore tibiae yellow, basitarsi yellowish, following segments of tarsi brownish. Base of mid tibiae yellow on foreside, tarsi including basal segment dark brown. The female from Cameroon has also foreside of mid tibiae somewhat brownish. In the female from Kasongo apical half of fore femora, fore tibiae completely, and basal two-thirds of foreside of mid tibiae yellowish-white. Antennal segments 4—12 in this specimen with reddish-brown mark below.

Propodeum behind enclosed area and back of propodeum of female smooth, with very fine dorso-lateral striae.

Male without distinct tyloidea.

Length of female about 7.75 mm, of male about 7.5 mm.

The sharp anterior corners of the pronotum (Fig. 73) are an indication of the close relationships between *P. basilewskyi* and the nominate form of *P. latiannulatus* (Cameron). *P. basilewskyi* is easily distinguished in both sexes by the dark base of the hind tibiae. The apex of the mid tibia is more or less brownish. The superficial close, parallel carinae on the pygidium of the female are slightly more distinct than in *P. latiannulatus* s.str.

REMARKS ON RELATIONSHIPS

Psen Latreille

Psen silvaticus Arnold (Rhodesia) and *Psen leclercqi* sp. nov. (Malagasy) probably belong to the subgenus *Psen*. Both species are remarkable because of the coarse and dense sculpture of their mesopleura. The males, still unknown, would be welcome to

confirm the subgeneric status. *Psen congolus* Leclercq (Zaire) certainly belongs to *Psen* s.str. as is also proved by the sternal tufts of hair in the male.

Psen madecassus Arnold (Malagasy) differs from *Psen* s.str. in the sculpture of the petiole and the absence of fasciculate hairs on the sternites of the male. It may belong to the subgenus *Punctipsen*, known from the palaearctic and oriental regions.

Psen patellatus Arnold (South-West Africa) is another species difficult to place. Although the antennae resemble those of *Psen ater* F., it differs in many respects so much from other *Psen* s.l. that the erection of a new subgenus seems to be justified. We hope, however, that soon the female will be discovered (the males date from half a century ago!).

Psen empeyi sp. nov. (South Africa) is a distinct representative of the subgenus *Mimesa.*

Psenulus Kohl

Most of the Ethiopian species of *Psenulus* closely resemble their Indo-Australian relatives. In the majority of species the interantennal carina is broadened (primitive character?) as in all but one of the palaearctic species and about one third of the oriental forms. On the other hand the petiole is cylindrical or nearly so, which means that it is more evolved. The dorsal groove of the petiole is lacking, the sides of the first sternite, out of which the petiole has developed, being completely merged. It is already possible to distinguish one large group and a few smaller groups of closely allied species.

The group of *Psenulus turneri* Arnold is characterized by the coarse sculpture of the tempora and in the females by the fringes of long hairs on the fourth and fifth gastral sternites. It has this combination of characters in common with the group of *Psenulus rugosus* from the Philippines and Borneo. Also the triangular second submarginal cell of the oriental species is found in some of the African forms, where in some cases the cell is even petiolate. The Ethiopian group comprises *turneri* Arnold (South Africa), *paulisae* Leclercq, *erusus* Leclercq and *ealae* Leclercq (Zaire and Sierra Leone), *garambae* Leclercq (Zaire), *aurifasciatus* sp. nov. (Sierra Leone), *freetownensis* sp. nov. (Sierra Leone and Equatorial Guinea), *patei* Arnold and *saltitans* Arnold (Rhodesia), probably also *alveolatus* sp. nov. (Rhodesia) and a related, still unnamed male from Angola.

Psenulus reticulosus Arnold (Malagasy) and *sapobaensis* sp. nov. (Nigeria), with rather long petiole, oblique striae on the back of the propodeum and indistinct or absent pygidial area in the female may be closely related.

Group of *Psenulus luctuosus* Arnold. This seems to be a group distinguished by the broadened part of the interantennal carina which usually ends with two parallel carinae in the transverse carina. The pygidial area of the female is distinct. The following species should be included: *luctuosus* Arnold and *stevensoni* Arnold (Rhodesia), *jacoti* sp. nov. (South Africa), *lusingae* Leclercq (Zaire) and *rugifrons* sp. nov. (Ethiopia), probably also *avernus* Leclercq (Zaire).

In the group of *Psenulus bidentatus* (Cameron) not only the nominate form from Tanzania, Kenya, Rhodesia, Zaire and Angola, the subspecies *rubrocaudatus* Turner (South Africa) and *pallidus* subsp. nov. (Zaire, Rhodesia, Malawi and Equatorial Guinea) can be placed, but also *nigeriae* Leclercq (Nigeria, Sierra Leone).

A peculiar group is formed by the widely distributed *Psenulus capensis* Brauns and its near relatives *latiannulatus* (Cameron) with a somewhat more restricted area, *latiannula-*

tus basilewskyi Leclercq (Zaire, Rwanda, Cameroon), *dilectus* (Saussure) (Malagasy) and perhaps also *uelleburgi* sp. nov. (Equatorial Guinea) and *oweni* sp. nov. (Sierra Leone). They all have a strongly or slightly nodose first gastral tergite, the raised part of the carina between the antennae is narrow, the transverse carina below the antennae is fine or indistinct in the female; the pygidial area of the female is indistinct in *capensis* and *latiannulatus*, distinct elongate-triangular in the other forms which probably belong to this group. The Indo-Australian group of *Psenulus pulcherrimus*, especially its subgroup of *carinatus*, has the following characters in common: more or less nodose first gastral tergite, narrow interantennal carina and indistinct transverse carina below antennae in the female, but in that group the thorax is yellow marked and the pygidial area of the female is distinct.

Psenulus benoiti Leclercq (Zaire) is very remarkable, the pygidial area of the female being reduced to a single sharp and long median longitudinal carina. So far this character was only known of a few Mexican species.

The relationships of the remaining species are not clear at the moment. For this reason the species have been listed hereafter in alphabetical order.

PROVISIONAL LIST OF PSENINI OF THE ETHIOPIAN REGION INCLUDING MALAGASY

Genus **Psen** Latreille

Subgenus **Psen** Latreille

P. silvaticus Arnold, 1924, ♀ — Rhodesia
P. leclercqi sp. nov., ♀ — Malagasy
P. congolus Leclercq, ♀ and ♂ — Zaire

Subgenus ?

P. madecassus Arnold, 1945, ♀ and ♂ — Malagasy

Subgenus ?

P. patellatus Arnold, 1924, ♂ — South-West Africa

Subgenus **Mimesa** Shuckard

P. empeyi sp. nov., ♂ — South Africa (Transvaal)

Genus **Psenulus** Kohl

P. alveolatus sp. nov., ♂ — Rhodesia
P. aurifasciatus sp. nov., ♀ — Sierra Leone
P. avernus Leclercq, 1961, ♂ — Zaire
P. benoiti Leclercq, 1961, ♀ and ♂ — Zaire
P. bidentatus bidentatus (Cameron), 1910, ♀ and ♂ — Tanzania, Kenya, Rhodesia, Angola, Zaire
P. bidentatus pallidus subsp. nov., ♀ and ♂ — Zaire, Rhodesia, Malawi, Equatorial Guinea
P. bidentatus rubrocaudatus Turner, 1912, ♀ — South Africa (Natal)
P. bidentatus subsp. ♀ — Ethiopia

P. capensis capensis Brauns, 1899, ♀ and ♂	— South Africa (Cape Province, Natal, Transvaal), Mozambique, Rhodesia, Malawi, Zambia, Tanzania, Uganda, Zaire, Sierra Leone
P. capensis laevior Arnold, 1951, ♂	— Ethiopia
P. dilectus (Saussure), 1892, ♀	— Malagasy
P. ealae Leclercq, 1961, ♀ and ♂	— Zaire, Sierra Leone
P. erusus Leclercq, 1961, ♀	— Zaire, Sierra Leone
P. freetownensis sp. nov., ♀ and ♂	— Sierra Leone, Equatorial Guinea
P. fulgidus Arnold, 1945, ♀ and ♂	— Malagasy
P. garambae Leclercq, 1961, ♀	— Zaire
P. ghesquierei Leclercq, 1961, ♀	— Zaire, Uganda
P. jacoti sp. nov., ♀ and ♂	— South Africa (Cape Province, Transkei)
P. kohli Arnold, 1923, ♀	— Rhodesia
P. latiannulatus latiannulatus (Cameron), 1910, ♀ and ♂	— Tanzania, Rhodesia, Uganda, Zaire, Nigeria, Sierra Leone
P. latiannulatus basilewskyi Leclercq, 1955, ♀ and ♂	— Zaire, Rwanda, Cameroon
P. leoninus sp. nov., ♀	— Sierra Leone
P. luctuosus Arnold, 1929, ♀	— Rhodesia
P. lusingae Leclercq, 1961, ♀	— Zaire
P. nigeriae Leclercq, 1961, ♀	— Nigeria, Sierra Leone
P. oweni sp. nov., ♀ and ♂	— Sierra Leone
P. patei Arnold, 1940, ♀	— Rhodesia
P. paulisae Leclercq, 1961, ♀ and ♂	— Zaire, Sierra Leone
P. reticulosus Arnold, 1945, ♀ and ♂	— Malagasy
P. rugifrons sp. nov., ♀	— Ethiopia
P. saltitans Arnold, 1958, ♀	— Rhodesia
P. sapobaensis sp. nov., ♀	— Nigeria
P. stevensoni Arnold, 1940, ♀ and ♂	— Rhodesia
P. trevirus Leclercq, 1961, ♂	— Zaire
P. turneri Arnold, 1927, ♀ and ♂	— South Africa (Cape Province)
P. uelleburgi sp. nov., ♀	— Equatorial Guinea

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The names of new species and subspecies are marked with an asterisk

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ON AMERICAN APHIDS, WITH DESCRIPTIONS OF A NEW GENUS AND SOME NEW SPECIES (HOMOPTERA, APHIDIDAE)

by

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ABSTRACT

The following new taxa are described: *Acyrthosiphon pentatrichopus* spec. nov., from *Rosa fendleri* and *Rosa* sp., Utah and Colorado, U.S.A.; *Acyrthosiphon vandenboschi* spec. nov., from *Potentilla glandulosa,* California, U.S.A.; *Aphis agastachyos* spec. nov., from *Agastache urticifolia,* Utah and Idaho, U.S.A.; *Aphis astragalina* spec. nov., from *Astragalus* sp., Montana, U.S.A. and Alberta, Canada; *Aphis atromaculata* spec. nov., allegedly from *Ribes* sp., Oregon, U.S.A.; *Aphis baccharicola* spec. nov., from *Baccharis pilularis,* California, U.S.A.; *Aphis mulini* spec. nov., and *Aphis mulinicola* spec. nov., from *Mulinum* sp., Patagonia, Argentine; *Masonaphis magna* spec. nov., from Composites, Alberta and British Columbia, Canada; *Megourina* gen. nov., type-species *Megourina lagacei* spec. nov., from *Aquilegia formosa,* California, U.S.A.; *Pentamyzus falklandicus* spec. nov., from *Poa flabellata,* Falkland Isles; *Thripsaphis* (*Trichocallis*) *californica* spec. nov., from *Carex* near *C. comosa,* California, U.S.A.; *Thripsaphis* (*Trichocallis*) *hybrida* spec. nov., from *Carex* sp., California, U.S.A.; *Thripsaphis* (*Trichocallis*) *ossiannilssoni pacifica* subspec. nov., from *Carex* sp., California, U.S.A.; *Thripsaphis* (*Trichocallis*) *scabra* spec. nov., from *Carex* sp., California and Idaho, U.S.A.; *Thripsaphis verrucosa nodulosa* subspec. nov., from *Carex* sp., Alaska, U.S.A., and Labrador, Canada; *Thripsaphis verrucosa subverrucosa* subspec. nov., from *Carex* sp., California, U.S.A.; *Uroleucon sijpkensi* spec. nov., from *Solidago macrophylla,* Quebec, Canada. The following new synonymies are proposed: *Hyperomyzus boerneri* Prevost, 1959, and *Hyperomyzus sobrinus* F. P. Müller, 1966, of *Neonasonovia zirnitsi* Hille Ris Lambers, 1952; *Dactynotus pieloui* Richards, 1972, of *Uroleucon hieracicola* (Hille Ris Lambers, 1962) comb. nov., transferred from *Dactynotus; Thripsaphis gelrica* Hille Ris Lambers, 1956, of *Allaphis caricicola* (Mordvilko, 1914); *Callaphis* Mordvilko, 1909, type species *Callaphis caricicola* Mordvilko, 1914, and *Allaphis* Mordvilko, 1921 nom. nov. pro *Callaphis* Mordvilko, 1909 nec Walker, 1870, of *Thripsaphis* Gillette, 1917, type species *Brachycolus ballii* Gillette, 1908; *Thripsaphis thripsoides* Hille Ris Lambers, 1939, of *Allaphis caricis* Mordvilko, 1921. New combinations are: *Nearctaphis argentinaeradicis* (Gillette & Palmer, 1932), from *Aphis; Neonasonovia inflata* (Richards, 1962), from *Hyperomyzus; Neonasonovia fronki* (Knowlton, 1945), from *Amphorophora; Neonasonovia nabali* (Oestlund, 1886), from *Rhopalosiphum; Neonasonovia nigra* (J. McVicar Baker, 1934) (with a redescription of apterae), from *Amphorophora*; *Neonasonovia thorsteinni* (Stroyan, 1960), from *Hyperomyzus; Pentamyzus acaenae* (Schouteden, 1904), from *Rhopalosiphum; Neobacillaphis striata* (Bozhko, 1961), from *Thripsaphis; Uroleucon nigrotuberculatum* (Olive, 1965), from *Dactynotus; Uroleucon sonchellum* (Monell, 1879), from *Siphonophora.* The apterous viviparous female of *Masonaphis corylina* (Davidson, 1914), is described; *Aphis mimuli* Oestlund, 1887, is redescribed; and the host alternations of *Neonasonovia nabali* (Oestlund) and *Aphis ribiensis* Gillette & Palmer, 1929 are discussed. *Thripsaphis* (*Trichocallis*) *caricis* (Mordvilko, 1921), *Thripsaphis* (*Trichocallis*) *foxtonensis* Cottier, 1953, and *Thripsaphis* (*Trichocallis*) *producta* (Gillette, 1917) are distinguished as separate taxa. A key to the American members of *Thripsaphis* (*Trichocallis*), and to the subspecies of *Thripsaphis* (*Trichocallis*) *verrucosa* (Gillette, 1917) is given.

Acyrthosiphon pentatrichopus spec. nov.

Fundatrix.

Colour in life not known. In mounted specimen body rather broadly spindle-shaped. Tergum faintly sclerotic, not smooth, but wrinkled to irregularly reticulated, the head pale brownish yellow, the rest not pigmented. Distinct semiglobular marginal tubercles present on all thoracic segments and on abd. segments II—IV or V, and besides, spinal tubercles on tergite VIII; the marginal tubercles elevated, on pronotum to 0.030 mm in diameter, elsewhere smaller. Dorsal hairs not numerous, about 10—14 on each of abd. tergites I—II, inverted bottle-shaped, on tergites I—III about 0.008 mm long, the 4 hairs on tergite VIII about 0.016—0.020 mm long. Frontal tubercles rather low, much diverging, quite smooth, with 4—6 hairs each; median process hardly developed.

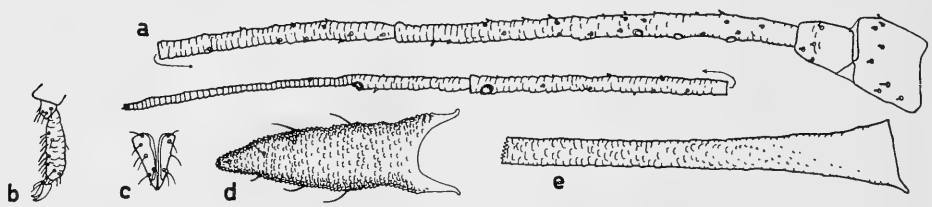

Fig. 1. *Acyrthosiphon pentatrichopus* spec. nov. Fundatrix: a, antenna; b, hind tarsus; c, last rostral segment; d, cauda; e, siphunculus with probably broken apex. All × 72

Antennae much shorter than body, pale, very gradually darker to the brown processus terminalis, without noticeably darker tips to the segments; flagellum gradually more distinctly imbricated from base of segment III to apex; rhinaria on segment III rather small and inconspicuous, not elevated or protruding, rather far apart up to nearly halfway the segment; segment III with 22—24 very inconspicuous hairs of 0.006—0.008 mm long, 1/6—1/4 of basal diameter of the segment; processus terminalis short, with one hair besides the apical ones. Rostrum just reaching the middle coxae; last segment 0.10 mm long, about 5/7 of second joint of hind tarsi, with 9 hairs besides the 3 subapical pairs. Legs pigmented like the antennae, apices of tibiae slightly darker, tarsi dark brown; femora ventrally with many small scales towards apex; first tarsal joints with 5,5,5 or 5,5,4 hairs, the median one half as long as the others; second tarsal joints imbricated, with about 4 pairs of ventral hairs. Siphunculi cylindrical with wide base, pale without darker apex, gradually more distinctly imbricated from base to apex, halfway about as thick as middle portion of hind tibiae; apical part missing. Cauda elongated triangular with a very faint constriction, pale, with 8 hairs of which only the most basal ones are acute, the others stunted and partly very short (e.g., 0.013 mm). Subgenital plate with 8 hairs near posterior margin, 2 hairs on anterior half.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Siph.	Cau.	Rhin. on III
1	3.20	2.49	0.75	0.43	0.47	0.21 + 0.41	0.72	0.44	1 & 3

(from *Rosa fendleri,* Helper, Utah, U.S.A., 17.V.'58, leg. G. F. Knowlton).

Apterous viviparous female.

In mounted specimens body slenderly spindle-shaped. Rather like fundatrix, but tergum much thinner, indistinctly wrinkled, not reticulated. Spinal and marginal tubercles distinct, but slightly flatter. Dorsal hairs about 1½—2 times as long as in fundatrix, tergite VIII with 5—8 hairs. Frontal tubercles better developed. Antennae much longer than body, and segments of flagellum with faintly darker tips; segment III with 3—12 rhinaria irregularly spaced in mostly single file over basal 1/3—6/11 part of segment. Last rostral segment 0.105—0.11 mm, only about 5/9 of second joint of hind tarsi, with 9—11 hairs besides the 3 subapical pairs. Legs much longer; second tarsal joints ventrally with several more hairs. Siphunculi about 2/7—1/3 of length of body, about as long as ant. segment III, with small flange. Cauda less than half as long as siphunculi, more acute and not or hardly constricted, with 7—9 hairs of which the 3—5 stunted dorso-apical hairs are longer. Otherwise as in fundatrix.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Rhin. on III	Siph.	Cau.
1	3.29	3.86	0.95	0.77	0.67	0.20 + 1.03	7 & 8	1.02	0.43
2	3.11	3.97	0.97	0.74	0.71	0.20 + 1.10	4 & 5	0.95	0.41
3	2.99	4.16	0.99	0.78	0.75	0.20 + 1.18	3 & 5	0.99	0.43
4	3.36	3.98	1.04	0.79	0.74	0.18 + 1.00	5 & 5	1.01	0.44

(1—4, from *Rosa* sp., Mud Springs, Colorado, U.S.A., 9.VII.'66, leg. F. C. Hottes & H. L. G. Stroyan no. U.S.A. 281).

Discussion. The first available specimen, a fundatrix, rather strongly resembles fundatrices of *Acyrthosiphon wasintae* (Hottes) as to general shape, length of processus terminalis, etc., but it differs by the chaetotaxy of the first tarsal joints, the length and chaetotaxy of the last rostral segment, the caudal hairs, etc. It is very surprising that Palmer (1952, p. 330, fig. 396) draws the processus terminalis of the male of *A. wasintae* as in the fundatrix of our new species, but writes that it is 0.90 mm long. It is clear that our first *A. pentatrichopus* is a fundatrix, because an embryo inside has a comparatively very much longer processus terminalis. Dr. Stroyan kindly allowed me to add a description of his material, which consisted of apterous viviparae of probably the third generation.

The species can be separated from all known species of *Acyrthosiphon* by the combination of its first tarsal chaetotaxy with siphunculi twice or more times as long as the cauda. In the number of hairs on the first tarsal joints the aphid agrees with *Acyrthosiphon cyparissiae* (Koch), but that species has short siphunculi.

Types. Holotype: fundatrix, from *Rosa fendleri,* Helper, Utah, U.S.A., 17.V.'58, leg. G. F. Knowlton, in the author's collection. Paratypes: apterous viviparous female, from *Rosa* sp., Mud Springs, Colorado, U.S.A., 9.VII.'66, leg. F. C. Hottes & H. L. G. Stroyan no. U.S.A. 281, in the collection of Dr. Stroyan, Harpenden, Herts.

Acyrthosiphon vandenboschi spec. nov.

Apterous viviparous female.

Colour in life not known. In mounted specimens body elongate spindle-shaped, 3.75—4.35 mm long. Tergum membranous, smooth. No marginal or spinal tubercles present. Dorsal hairs stiff, rather thick, blunt or with faintly incrassate, colourless apices, the longest spinal and marginal ones on tergite III 0.052 mm long, the shortest 0.026 mm; tergites I—III each with about 14—20 hairs of which 6—12 are marginal ones; tergite VIII with 10—12 hairs of which the longest are 0.055 mm long. Frontal tubercles large, diverging, quite smooth, with 8—10 hairs of about 0.050 mm long; median process hardly developed. Antennae about 1 1/5 times as long as body, pale, with the very tips of segment III, IV and V, and the part around the rhinaria on VI dark brown; flagellum, except the very base of segment III, evenly and lightly imbricated; segment I with 11—14 hairs; segment III without rhinaria, with some 30 rather spreading, stiff hairs of up to 0.035 mm long, i.e., about 2/3 of basal diameter of segment; processus terminalis with about 10—19 small hairs besides those at apex. Last rostral segment about 0.22—0.25 mm long, 1 1/2—1 4/7 times as long as second joint of hind tarsi, not pointed, with about 40 hairs besides the 3 subapical pairs. Legs long, pale, with only the apices of the tibiae brown, and the tarsi blackish brown, with rather spiny hairs, the femora very slightly imbricated; first tarsal joints with 3, 3, 3 spiny hairs of similar shape, the middle one little shorter than the others; second tarsal joints slightly imbricated, with numerous ventral hairs. Stigmal pori oval, not or only very faintly reniform, about 0.026 × 0.016 mm. Siphunculi pale with the very apices brown, evenly, basad almost denticulately imbricated from base to apex, nearly cylindrical with widened base, very slender, at mid-length thinner than middle portion of hind tibiae, very long, about 2/7—3/8 of length of body, without a trace of reticulation below the well developed, thin, flange. Cauda pale, not constricted, with almost cylindrical basal half, and evenly tapering distal half, just not acute, 3/8—2/5 of the siphunculi, with 16—19 subacute to acute hairs. Subgenital plate with 12—16 hairs along posterior margin and 2—4 on anterior half.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Siph.	Cau.
1	3.84	4.53	0.98	0.85	0.75	0.18 + 1.46	1.36	0.52
2	4.04	—	1.04	0.91	0.75	0.17 + ?	1.25	0.48
3	4.35	—	1.04	0.96	0.80	0.19 + ?	1.43	0.52
4	4.34	4.75	1.12	0.93	0.70	0.17 + 1.48	1.36	0.49
5	4.28	4.52	1.07	0.83	0.75	0.18 + 1.36	1.38	0.48
6	4.36	4.77	1.08	0.98	0.76	0.20 + 1.39	1.46	0.51

(1—6, from *Potentilla glandulosa,* Willow Creek (Monterey Co.), California, U.S.A., 4.IV.'66, leg. R. van den Bosch no. 66-IV-4i and 66-IV-4m).

Alate viviparous female.

Colour in life unknown. Mounted specimens with faintly brownish yellow head, fuscous around the ocelli, similarly pale mesothorax, minute pale brownish marginal

sclerites on abdomen. Shape similar to apterous viviparous female. Antennae 1¼ times as long as body; basal segments brown, very base of segment III almost colourless but rest of segment black, the other segments from rather dark brown to blackish, but paler than segment III; segment III from base to near apex with about 42—60 small to medium-sized, hardly elevated or protruding, broad-rimmed rhinaria scattered over half the circumference. Femora brownish yellow, blackish brown dorsally near apex; tibiae with middle portion brownish yellow, at the very base pale, in between mottled dark brown, apically black like the small tarsi. Wings with dark, blackish brown, very faintly bordered veins; stigma pale smoky with dark posterior border. Marginal sclerites each with some 6—10 closely packed nodules. Siphunculi at apex just wider than near middle, with pale bases, blackish brown basal 1/2—2/3 part and similar apex, but between the dark apex and the lower portion mostly paler and more transparent. Cauda elongated triangular, dusky. Subgenital plate very slightly pigmented. Other characters very much like those in apterous viviparous female.

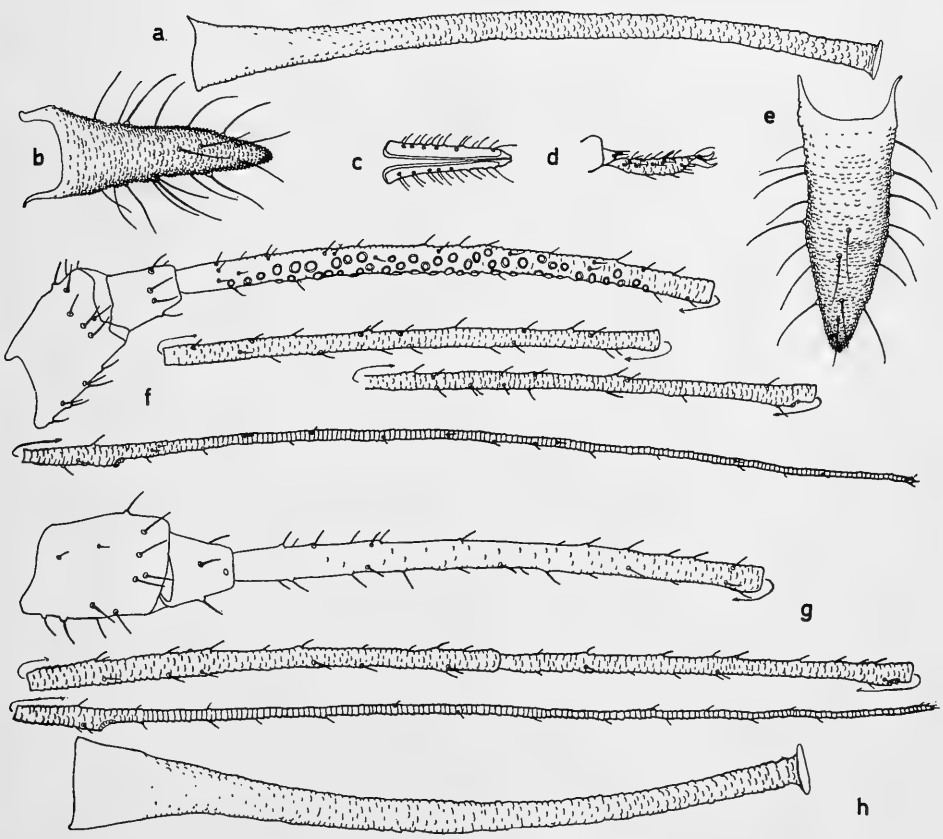

Fig. 2. *Acyrthosiphon vandenboschi* spec. nov. Al. viv. fem: a, siphunculus; b, cauda; c, last rostral segment; d, hind tarsus; f, antenna. Apt. viv. fem.; e, cauda; g, antenna; h, siphunculus. All × 72

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Rhin. on III	Siph.	Cau.
1	3.78	4.76	0.99	0.93	0.82	0.19 + 1.45	51 & 54	1.34	0.47
2	4.00	5.08	1.02	0.99	0.86	0.19 + 1.61	53 & 56	1.47	0.49
3	4.03	5.02	1.03	0.98	0.82	0.20 + 1.57	47 & ?	1.47	0.50
4	3.74	4.62	0.95	0.90	0.77	0.18 + 1.52	48 & 53	1.32	0.43
5	3.96	4.86	1.03	0.95	0.83	0.18 + 1.52	52 & 60	1.40	0.49
6	3.88	4.89	1.09	0.91	0.79	0.19 + 1.56	42 & 50	1.32	0.53

(1—6, with apterous viviparous females no. 1—3).

Discussion. This species with its very long and slender siphunculi immediately reminds one of *A. macrosiphum* (Wilson) and *A. gossypii* Mordv., but it is at once distinguished by the very hairy last rostral segment, and by the absence of secondary rhinaria in apterae viviparae.

The species is named for my friend and colleague Dr. R. van den Bosch, of the University of California, Berkeley, who in his hunt for aphid parasites produces a steady stream of unknown aphids.

Types. Holotype: apterous viviparous female (no. 1 of measurements) from *Potentilla glandulosa,* Willow Creek (Highway no. 1, Monterey Co.), California, U.S.A., 4.IV.'66, leg. R. van den Bosch no. 66-IV-4i. In the authors collection. Paratypes: apterous and alate viviparous female with collecting data as for holotype, in the collections of the Biol. Control Dept., Univ. of California, Berkeley, and in the author's collection.

Aphis agastachyos spec. nov.

Apterous viviparous female.

Colour in life dark green (Stroyan). In mounted specimens either quite pale or, in slightly alatiform apterae, head infuscated, siphunculi gradually darker towards apex, cauda quite dark like the apices of tibiae and the tarsi. Body about 1.50—2.00 mm long, broadly oval, with only on the mesothoracic pleura and caudad each siphunculus more or less pigmented sclerites. Tergum often distinctly reticulated. Dorsal hairs variable in number, often pleural or duplicated spinal hairs present; hairs stiff, with fine, not flexuose apices, long, on tergite III spinally up to 0.055 mm long; tergite VIII with 4—8, mostly 6, hairs of similar shape up to 0.070 mm long. Marginal tubercles only on abdominal tergites I and VII, bluntly conical, about as tall as their basal width (e.g., 0.020—0.030 mm). Front not much sinuated, with the hairs as long as, but stouter than hairs more ventrally. Antennae evenly pale or with darker apices, 1/2—5/9 of length of body; flagellum ventrally markedly imbricated from the very base of segment III, but segment III dorsally nearly smooth, in true apterae without rhinaria or in specimens with dark head with 1—5 small rhinaria; processus terminalis 1 1/2—1 4/5 times as long as base of segment VI, mostly somewhat bent near the primary rhinaria; hairs on segment III stiff, variable, from blunt with faintly incrassate apices, to very acute, the longest about 1 1/2—2 times as long as basal diameter of the segment. Rostrum when extended reaching a little past middle coxae; last segment about 0.105—0.125 mm long, about

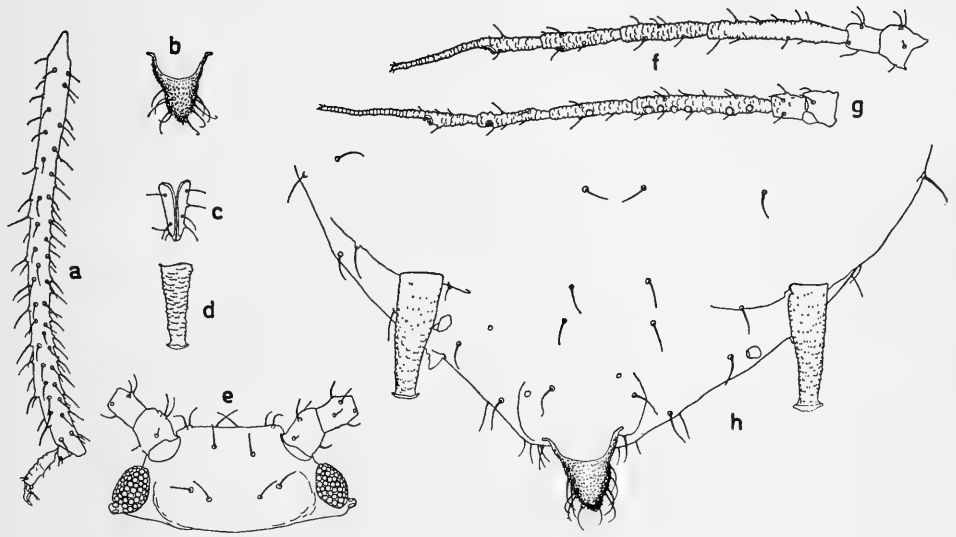

Fig. 3. *Aphis agastachyos* spec. nov. Apt. viv. fem.: a, tibia + hind tarsus; c, last rostral segment; e, head; f, antenna; h, posterior part of abdomen. Al. viv. fem.: b, cauda; d, siphunculus; g, antenna. All × 72

1¼ times the very small second joints of hind tarsi, with 4—8 hairs besides the 3 subapical pairs. Legs pale, or, in specimens with pigmented head, with dark apices to the tibiae; longest ventral femoral hair 0.060—0.075 mm long; dorsal hairs halfway hind tibia spreading and longer than local diameter of tibia; tarsi small, second joint twice apical diameter of hind tibia. Siphunculi pale or in alatiforms infuscated towards apex, rather thick, evenly tapering to near apex, or there just perceptibly constricted, about 1/9—1/7 of length of body, imbricated but apical 1/5—1/4 part at least dorsally nearly smooth, with a very wide (for an *Aphis*) flange, about 1 1/3 times as wide as the part just basad. Cauda thick, more or less bluntly triangular, about as long as its basal width, darker than siphunculi and 1/2—2/3 of their length, with 7—12 acute, strongly curved hairs, some of which are placed dorso-apically. Subgenital plate with 10—12 hairs along posterior margin and 6—10 on anterior half.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Siph.	Cau.
1	1.54	0.83	0.21	0.12	0.12	0.10 + 0.17	0.15	0.11
2	1.97	0.99	0.28	0.15	0.15	0.11 + 0.18	0.22	0.15
3	1.96	1.03	0.26	0.15	0.16	0.13 + 0.20	0.23	0.15
4	1.80	0.94	0.27	0.14	0.14	0.10 + 0.18	0.19	0.13
5	1.81	1.04	0.26	0.16	0.16	0.12 + 0.21	0.22	0.16
6	1.87	1.02	0.27	0.14	0.15	0.13 + 0.21	0.22	0.15
7	1.51	0.84	0.20	0.12	0.13	0.11 + 0.17	0.17	0.15

(All from *Agastache urticifolia*, U.S.A.; 1—2, 5—6, Cub River Canyon Idaho, 13.VIII.

'65, leg. G. F. Knowlton; 3, Monte Christo, Utah, 7.VII.'66, leg. H. L. G. Stroyan; 4, Wellsville Mountains, Utah, 15.VII.'65, leg. G. F. Knowlton; 7, Logan Canyon, Utah, 20.VII.'71, leg. G. F. Knowlton).

Alate viviparous female.

Colour. Head, thorax, siphunculi, cauda, antennae, large marginal sclerites dark to blackish, rest as in apterae. In mounted specimens body 1.60—1.90 mm long, with blackish head and thorax; large marginal and postsiphuncular sclerites, long bars across tergites VII and VIII, a broad spinal sclerite on tergite VI and often small, paired spinal sclerites on tergite V darkish. Antennae dark with the very base of segment III pale, 4/7—3/5 of length of body; segment III with 7—16 very unequally-sized, faintly protruding rhinaria irregularly arranged along one side; segment IV with 1—4 rhinaria; segment V sometimes with a secondary rhinarium; processus terminalis at most twice as long as base of segment VI. Legs faintly brownish to brown with femora distad, and tibiae apically blackish. Venation normal, greyish brown, not bordered. Siphunculi blackish, cylindrical to slightly tapering, with the large flange to 1½ times as wide as the smooth part just below. Cauda narrower than in apterae, with the "hard portion" less than half the total length, with up to 14 hairs. Tergite VIII with 4—8 hairs.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Siph.	Cau.	Rhin. on III	IV
1	1.77	0.94	0.24	0.15	0.14	0.11+0.19	0.15	0.13	7 & 8	1 & 2
2	1.63	0.92	0.24	0.13	0.14	0.11+0.19	0.14	0.12	10 & 11	2 & 2
3	1.84	1.01	0.27	0.15	0.16	0.11+0.20	0.18	0.13	10 & 13	3 & 1
4	1.66	0.90	0.26	0.13	0.13	0.10+0.18	0.14	0.12	9 & 11	4 & 2
5	1.78	0.93	0.24	0.14	0.14	0.10+0.19	0.17	0.13	9 & 12	3 & 4
6	1.72	0.97	0.26	0.15	0.14	0.11+0.20	0.15	0.12	14 & 9	1 & 2

(1—2, with apt. viv. 1—2; 3, with apt. viv. 3; 4—6, with apt. viv. 4—6).

Oviparous female.

Colour in life not known. In mounted specimens much like apterous viviparous female, but body more slender. Antennae with 5 or 6 segments. Abdominal tergite VIII with 16—20 hairs. Hind tibiae not or hardly incrassate, with 3—12 pseudosensoria, pigmented like other tibiae. Siphunculi pale with infuscated apex, flange smaller than in apterae viviparae. Cauda bluntly conical, with 12—14 hairs. Subgenital plate with middle 1/3 part unpigmented, rather evenly hairy.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Siph.	Cau.
1	1.52	0.69	0.14	0.10	0.12	0.10+0.15	0.14	0.13
2	1.36	0.57	0.17	0.10	0.06+0.16		0.11	0.10
3	1.39	0.58	0.17	0.10	0.07+0.15		0.11	0.11

(1, with apt. viv. fem. no. 3; 2—3, with apt. viv. fem. no. 7).

Apterous male.

Colour in life not known. In mounted specimens head and part of the pro- and mesothorax as well as marginal sclerites, small sclerites on which the spinal hairs from mesonotum to abd. tergite VI are placed, small postsiphuncular sclerites, and bars across tergites VII and VIII dark sclerotic. Antennae dark like head, rather thick, with conspicuously imbricated flagellum; rhinaria flat, small, over nearly half the circumference of segments III—V; hairs on segment III over twice as long as diameter of segment at its constricted base. Siphunculi dark with the very base pale, slightly tapering, imbricated, with normal flange. Cauda dark, small, slightly constricted, with 6 hairs. Remainder more or less as is apt. viv. fem.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Rhin. on segment III	IV	V	Siph.	Cau.
1	1.35	0.72	0.17	0.12	0.11	0.07+0.14	12&14	7&8	4&4	0.09	0.09

(1, with apt. viv. fem. no. 7).

Discussion. This species seems to curl the leaves of *Agastache urticifolia.* Several samples were received from Dr. G. F. Knowlton, and seven slides from Dr. H. L. G. Stroyan, who provided his colour notes.

The aphid was first identified as *Aphis ramona* Swain, known from *Salvia mellifera* (syn. *Ramona stachyoides*) from California. But *A. ramona* differs by having all the antennal and dorsal hairs blunt and shorter; by having in apterae viviparae 2, rarely 3 hairs on abdominal tergite VIII; and by the flange of the siphunculi being much narrower, about 1 1/5—1 2/9 times as wide as the smooth part basad in apterae viviparae, about 1 1/3 times as wide as the thinnest part basad in alatae. Sensoriation of antennae, rostrum, tarsi, etc., are very much the same, but the cauda has fewer hairs and the subgenital plate has mostly 2 hairs on anterior half.

Because of the several hairs on the basal half of the last rostral segment, the pale siphunculi and mostly darker cauda in apterae viviparae, and the sensoriation of the alatae, *Aphis ramona* Swain and *A. agastachyos* spec. nov. strongly resemble the *Aphis oenotherae* group of *Aphis* (*A. oenotherae* Oestl., *A. neomexicana* Cock., *A. sanborni* Patch, *A. varians* Patch, etc.). They differ from this group by the conspicuous flange to the siphunculi.

The occurrence of sexuals in early summer is rare in aphids and exceptional in *Aphis* L. The oviparous females contained no eggs, and therefore perhaps later the production of oviparae might be larger. On the other hand it is possible that eggs are laid very early, and that may be a reason why this conspicuous species was not found by the specialists working over Utah and Idaho.

Types. Holotype: apterous viviparous female (measurements no. 1), from *Agastache urticifolia,* Cub River Canyon, Idaho, U.S.A., 13.VII.'65, leg. G. F. Knowlton, Paratypes: apterous and alate viviparae with data as for holotype, and all others mentioned under the measurements.

Aphis astragalina spec. nov.

Apterous viviparous female.

Colour in life not known. In mounted specimens body broadly oval, about 2.50 mm long. Sclerotisation of dorsum variable, from largely membranous with scattered spinal sclerites, a broken, very irregular spino-pleural bar on tergite IV, a broad, very irregular and perforated, thick spino-pleural bar across tergite V partly fused with a more regular, longer bar across tergite VI, to almost completely fused thick spino-pleural bars across tergites I—IV with the sclerotic bar across tergite IV solidly fused with that across V and partly with that across VI; marginal sclerites small or large, free; tergites VII and VIII with free bars, the one on VIII encircling the segment to nearly the subgenital plate; tergum cephalad siphunculi also on the membranous parts distinctly reticulated (Montana specimens) or not. Dorsal hairs scarce, spinally on tergite III 0.035—0.052 mm long, the 12 hairs on the sclerite on tergite VIII to 0.065 mm long. Marginal tubercles on tergites I and VII, bluntly conical to cylindrical with rounded tops, on tergite VII more or less distinctly complex, with a basal diameter of 0.030—0.035 mm. Head blackish; front sinuate; frontal hairs long and fine, to 0.060 mm long, dorsal cephalic hairs from 0.040—0.060 mm long. Antennae about 4/7 length of body, with blackish basal segments, remainder pale with brownish apices to segments (III), IV and V; VI brown; segment III without scaliness on one side, along the other side markedly im-

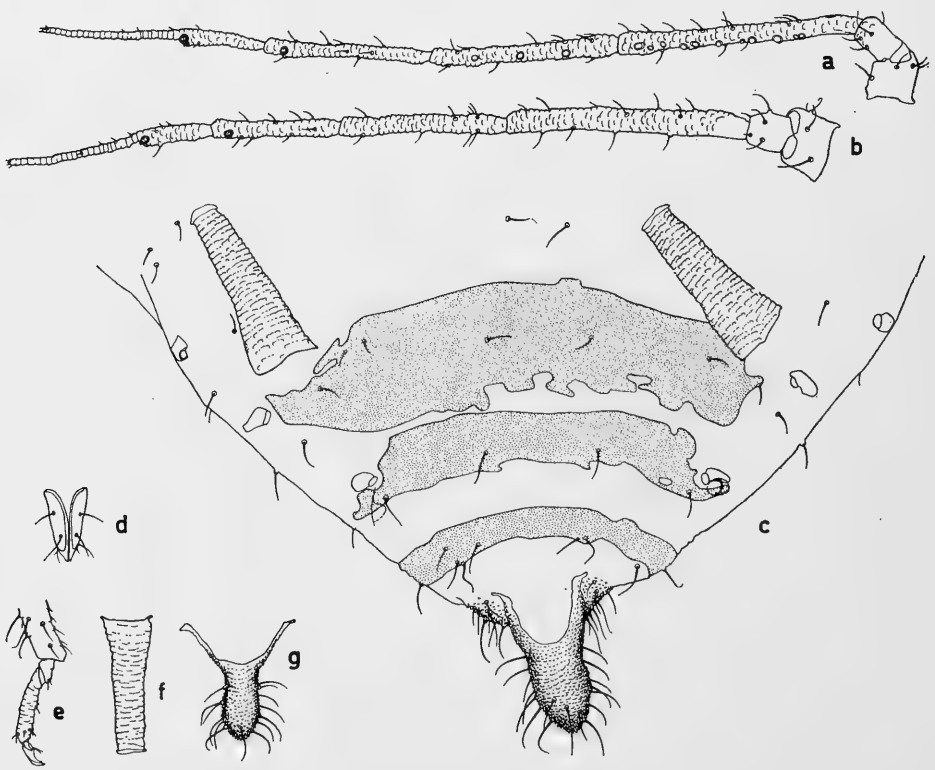

Fig. 4. *Aphis astragalina* spec. nov. Apt. viv. fem.: b, antenna; c, abdomen; d, last rostral segment; e, tip tibia + hind tarsus. Al. viv. fem.: a, antenna; f, siphunculus; g, cauda. All × 72

bricated; processus terminalis short, 1½ times base of segment VI; hairs on segment III rather numerous (8—12), spreading to erect, up to 0.052 mm long, to twice diameter of segment at its constricted base; segment VI on base with 2—3 hairs of 0.025—0.035 mm, but besides with 1—3 short (0.0085 mm) spiny hairs similar to the 3—4 occurring on basal 2/3 part of the processus terminalis which besides has 4 on the top. Rostrum reaching to middle coxae; last segment rather blunt, 0.12—0.13 mm long, 4/5—1 times as long as second joint of hind tarsi, with 2 hairs besides the 3 subapical pairs. Legs rather short and thick; femora blackish brown with pale base; tibiae pale with the very base infuscated and distal 1/4—1/3 blackish brown, conspicuously tapering from near base to apex; femoral hairs fine, longest ventral one up to 0.070 mm; tibial hairs dorsally fine and erect, to 0.065 mm long, halfway tibiae just shorter than local diameter of tibia, but ventral hairs more spiny and on basal part some only 0.022 mm long; first tarsal joints with 3, 3, 2 hairs; second joints with distal dorsal pair not longer than middle dorsal pair of fore and mid legs. Siphunculi black, thick, tapering, 1/9—1/8 of length of body, strongly but rather bluntly imbricated, with just indicated flange. Cauda black, thick, fingertip-shaped with a faint constriction, just shorter than siphunculi, with 17 normal, long, curved hairs. Subgenital plate with 10—12 long hairs on anterior half.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Siph.	Cau.
1	2.40	1.28	0.36	0.23	0.20	0.13 + 0.19	0.28	0.26
2	2.52	1.44	0.42	0.28	0.24	0.14 + 0.21	0.30	0.27

(1, from white flowered Leguminosa, 4 mi. E. of Elliston, Montana, U.S.A., 20.VII.'66, leg. F.G.A.—A.P.G. no. G66—VII—20f; 2, from *Astragalus,* 2 mi. E. of Conmore, Alberta, Canada, 17.VII.'66, leg. F.G.A.—A.P.G. no. F66—7—17h).

Alate viviparous female.

Colour in life not known. In mounted specimens head and thorax black sclerotic, abdomen on tergites I—IV with scattered, transverse spinal and pleural sclerites, and with very large marginal sclerites; on tergite V with an irregular transverse bar, on tergites VI—VIII with bars as in apterae. Hairs shaped as in apterae, but tergite VIII with 8 hairs though in view of the irregular arrangement other numbers probably occur. Antennae with black basal segments, flagellum with the very base pale, rest brown, very gradually blackish brown towards apex; segment III with the rhinaria very unequal in size, more or less in a line; the rhinaria evenly spaced over length of segment IV; hairs on segment III shorter, to 0.030 mm, but on segment VI as in apterae. Wings probably with normal venation (damaged), veins brownish grey, not bordered. Siphunculi thinner and less tapering. Cauda with triangular base and cylindrical or even very elongate oval distal half, very blunt, with 14 hairs. Other characters as in apterae.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Rhin. on III	IV	Siph.	Cau.
1	2.48	1.61	0.44	0.34	0.30	0.15+0.22	11 & ?	3 & ?	0.23	0.20

(1, with aptera no. 1).

Discussion. Few *Aphis* spp. have been described from North America after they were cleared, and therefore it is not possible to discover from published descriptions what kind of sclerotisation occurs in apterae viviparae of Nearctic *Aphis*. There appears to be a small group of Nearctic species that are comparable to the *craccivora* group of *Aphis*, originally Palaearctic. The Nearctic ones I saw, differ by three characters: the presence of a sclerotic band encircling abd. segment VIII to near the subgenital plate, and bearing some 3—12 hairs, marginal tubercles on abdomen with a rather wide sclerotic basal part, and a rather high number of spiny hairs on the processus terminalis and often the basal part of antennal segment VI. In this sense also *Aphis lupini* Gill. & Palmer, according to a specimen identified by Prof. Palmer that I remounted, without a sclerotic dorsum, comes near this group. None of the species so far known to me has such long antennal hairs as *A. astragalina* spec. nov., or so many caudal hairs.

Types. Holotype: Apterous viviparous female (no. 1 of measurements), from white flowered Leguminosa, 4 mi. E. of Elliston, Montana, U.S.A., 20.VII.'66, leg. F.G.A. —A.P.G. no. G 66—VII—20 f. Paratypes: one alate vivipara with collecting data as for holotype, and one aptera vivipara from *Astragalus* sp., 2 mi. E. of Conmore, Alberta, Canada, 17.VII.'66, leg. F.G.A.—A.P.G. no. F66—VII—17h.

Aphis atromaculata spec. nov.

Apterous viviparous female.

Colour in life not known. In mounted specimens body about 2.10—2.40 mm long, very broadly oval. Head and thorax black sclerotic; over abd. tergites I—VII thick, nearly solid, black sclerotic bars, often more or less completely fused on tergites II—VI, the bars on tergites I, VII and VIII always free; sclerotisation laterally reaching to near the stigmata, and rather distinctly reticulated. Tall (to 0.045 mm), large (basal diameter 0.035 mm), often constricted, on the basal portion sclerotic, marginal tubercles on abd. tergites I and VII, in one out of 11 specimens with a smaller one on tergite II. Dorsal hairs scarce, rather stiff, pointed, on abd. tergites I—II spinally about 0.035—0.045 mm long, the 3—6 hairs on tergite VIII with fine apices, to 0.070 mm long. Front slightly sinuated, antennae about 4/7—2/3 of length of body; basal segments black, segments III and IV pale with brown apices, V and VI dark brown; segment III from base imbricated by smallish scales, without rhinaria, processus terminalis 1 1/2—1 2/3 times base of last segment, with 1—2 small spines like the 4 on apex; hairs on flagellum rather acute and spreading, longest ones on segment III to 0.035—0.040 mm and slightly longer than diameter of segment at its slightly constricted base. Rostrum according to stylet length reaching to hind coxae; last segment about 0.14—0.15 mm long, normal, with 2 hairs besides the 3 pairs near apex. Mid and hind femora blackish with only the very bases pale, fore femora paler; all femoral hairs except some dorso-apical ones long and fine, largest ventral hair 0.050—0.060 mm long; tibiae brownish yellow with the very apex, and distal 1/4—1/3 part blackish; dorsal tibial hairs, excepting 1—4 blunt ones near base, long and fine, spreading, on basal half to 0.055 mm long, not quite as long as local diameter of tibia; first tarsal joints with 3, 3, 3, or (perhaps) sometimes 3, 3, 2 hairs; second joints about 0.10 mm long, only 1½ times as long as apical diameter of tibiae. Siphunculi quite black, more or less cylindrical with widened base, 1/7—1/6 of length of body, evenly imbricated, with very small flange. Tergite VIII with a long blackish sclerotic bar reaching nearly to the subgenital plate. Cauda black, rather thick,

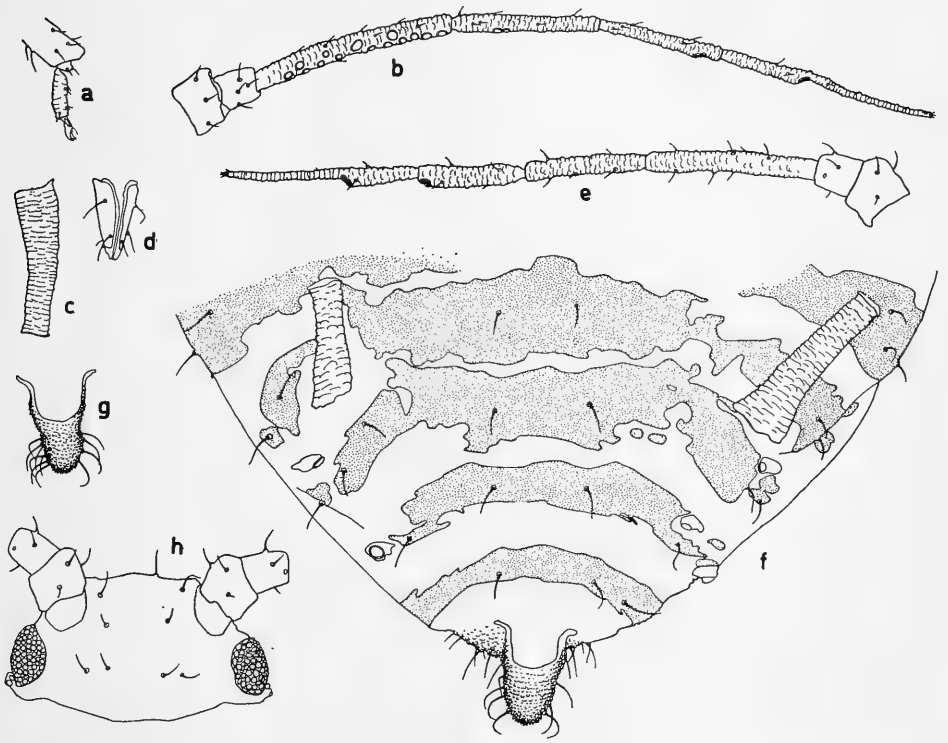

Fig. 5. *Aphis atromaculata* spec. nov. Apt. viv. fem.: a, tip tibia + hind tarsus; d, last rostral segment; e, antenna; f, posterior part of abdomen; h, head. Al. viv. fem.: b, antenna; c, siphunculus; g, cauda. All × 72

fingertip-shaped, perhaps sometimes constricted, 2/5—3/5 of length of siphunculi, with 7—9 almost hooked hairs. Subgenital plate with 5—9 hairs on disc and anterior half.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Siph.	Cau.
1	2.15	1.22	0.32	0.21	0.19	0.14 + 0.21	0.30	0.18
2	2.14	1.28	0.35	0.21	0.21	0.14 + 0.21	0.38	0.18
3	2.28	1.28	0.36	0.22	0.22	0.13 + 0.19	0.36	0.19
4	2.36	1.54	0.45	0.30	0.24	0.15 + 0.24	0.33	0.18

(1—4, "*Ribes* or?", Zigzag, Oregon, U.S.A., 28.VI.'57, leg. G. F. Knowlton & D. W. Davis).

Alate viviparous female.

Colour in life not known. In mounted specimens body 2.05—2.45 mm long. Head and thorax black sclerotic; abdomen on all tergites with completely free, blackish, spinopleural transverse bars sometimes fused with intersegmental sclerites but not with the

conspicuous marginal sclerites. Antennae black with only the very base of segment III brown; segment III with 22—29 medium-sized, nearly flat, not bulging, scattered rhinaria; segment IV with 0—4 inconspicuous rhinaria in file; segment V only on one antenna (with 4 rhinaria on IV) with a secondary rhinarium; processus terminalis as in apterae 1 1/2—1 2/3 times as long as base of segment VI. Wings with normal venation, veins rather dark brown, stigma about as dark as dorsal abdominal sclerites, darker than subcosta. Tibiae with more black at base and apex, in old specimens nearly wholly dark; dorsal tibial hairs more adpressed than in apterae, shorter, and a larger basal portion with blunt hairs. Siphunculi rather shorter than in apterae. Cauda distinctly constricted, with 8—12 hairs. Other characters rather as in apterae.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Rhin. on III	IV	Siph.	Cau.
1	2.36	1.40	0.37	0.26	0.22	0.16+0.23	25 & 26	1 & 2	0.27	0.18
2	2.31	1.43	0.38	0.24	0.23	0.16+0.26	23 & 27	3 & 0	0.27	0.16
3	2.11	1.37	0.37	0.23	0.22	0.15+0.25	22 & 22	3 & 3	0.28	0.17
4	2.21	1.34	0.35	0.22	0.22	0.15+0.25	24 & 29	1 & 1	0.27	0.18

(1—4, with the preceding morph).

Discussion. This *Aphis* belongs morphologically to the long-haired section of the *Aphis craccivora* Koch group, which has very few members in Europe, all on Leguminosae. In America, native long-haired *Aphis* with extensive black abdominal sclerotisation so far are known from only one Leguminosa, *Astragalus* spp. *Aphis cercocarpi* Gill. & Palmer from *Cercocarpus* spp. seems to be the only earlier described species. It can easily be recognized by the absence of rhinaria on ant. segment IV in alatae, by the shape of its cauda, and the pigmentation of the antennae. Apterae have scattered areas of sclerotisation on the abdomen, as specimens remounted from slides received from Professor Palmer showed. The present species can easily be distinguished from *astragalina* by the much larger number of rhinaria in alatae, and the shorter tarsi in all known morphs. Similar *Aphis* species from *Spiraea,* as yet undescribed, has (or have) also longer tarsi. The South American *A. mulini*, described on p. 121 of this paper, differs by possessing marginal tubercles also on abd. segments II—IV, while in the other American species they are only present on segments I and VII.

Unfortunately the host plant is not known, but the species can so easily be recognized that I venture to describe it from the sample. *Ribes* is the most unlikely host plant.

Types. Holotype: apterous viviparous female (no. 1 of measurements), from "*Ribes* or ?", Zigzag, Oregon, U.S.A., 28.VI.'57, leg. G. F. Knowlton & D. W. Davis no. 367. Paratypes: the measured apterae viviparae and 7 alatae viviparae.

Aphis baccharicola spec. nov.

Apterous viviparous female.

Colour in life not known. In mounted specimens head and parts of thorax quite dark to blackish; abdomen with rather short spinal to spino-pleural dark sclerotic bars across

tergites VII and VIII, and often a short, thicker spinal sclerite on tergite VI; small marginal sclerites and large post-siphuncular sclerites on tergites I—VI but these paler than the blackish intersegmental sclerites; sometimes small fragments of spinal sclerites on more anterior tergites. Tergum more or less distinctly reticulated. Dorsal hairs sparse, fine, with wavy apices, the spinal ones on abdominal tergite III about 0.050—0.060 mm long, the 2—4 hairs on tergite VIII to 0.070 mm long. Marginal tubercles on abdomen only on tergites I and VII, large, less than half as long as their basal width (e.g., 0.045—0.060 mm). Front sinuated, the frontal and dorsal hairs in length similar to the ventral ones. Antennae with basal segments slightly paler than head, flagellum pale with dark apex; length of antennae 5/8—2/3 of length of body; segment III without rhinaria, rather sharply imbricated from near base; processus terminalis 1 8/11—2 3/10 times base of segment VI, usually with 2—3 spines besides those at apex; hairs on segment III conspicuously erect, fine, the longest ones just over twice as long as diameter of the segment at its only slightly constricted base. Rostrum when extended reaching to hind coxae; last segment rather slender, 0.11—0.12 mm long, subequal to second joints of hind tarsi, with 2 long hairs besides the 3 subapical pairs. Femora blackish brown with shorter or longer pale basal part; longest ventral femoral hair about 0.060 mm; tibiae with the very base and distal 1/5 part dark brown, the rest yellowish to brownish yellow; dorsal hairs on hind tibiae spreading, all long and fine, halfway tibia about 0.060 mm long, 1 1/2—1 3/5 times as long as local diameter of tibia; hairs on ventral side of tibia more variable, all shorter, and mostly more spiny. Siphunculi black, rather thick, evenly densely imbricated, tapering to the middle with distal half cylindrical or tapering to the top, with the apex often faintly attenuated, in the middle about 1 3/8—1 1/2 times as thick as halfway diameter of hind tibiae, about 1/6—2/11 of length of body, rather often with up to 2 hairs of the type of the dorsal body hairs but shorter; flange small, about 1 1/10 times as wide as the part just basad. Cauda as dark as siphunculi, very strongly tapering on basal 1/3 part, less tapering on distal part, quite blunt, 1/2—2/3 of length of siphunculi, with 8—9 very strongly curved hairs, one of which is dorso-apical. Subgenital plate with 2 hairs on anterior half.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Siph.	Cau.
1	1.58	1.09	0.31	0.17	0.15	0.11 + 0.23	0.27	0.15
2	1.72	0.98	0.28	0.15	0.14	0.11 + 0.19	0.31	0.15
3	1.45	0.96	0.22	0.15	0.14	0.11 + 0.21	0.23	0.14
4	1.63	0.96	0.28	0.14	0.14	0.10 + 0.19	0.27	0.11
5	1.45	0.98	0.26	0.14	0.14	0.10 + 0.23	0.25	0.14
6	1.63	0.98	0.26	0.16	0.14	0.10 + 0.21	0.27	0.14
7	1.60	1.00	0.27	0.15	0.14	0.10 + 0.23	0.26	0.13

(1, from *Baccharis pilularis,* Patrick Point State Park (Humboldt Co.), California, U.S.A., 19.VIII.'66, leg. C. Lagace and D. Calvert no. G 66—VII—19 g; 2—7, from *Baccharis* sp., Clam Beach, Highway 101 (Humboldt Co.), California, U.S.A., 19.VIII. '66, leg. C. Lagace, no. L 66—VIII—19 e).

Alate viviparous female.

Colour in life not known. In mounted specimens head and thorax black, abdomen with similar sclerotic pattern as in apterae, but spinal sclerotisation much more extensive, though marginal sclerites still very little developed. Antennae blackish with base of segment III brown to pale brown, about 3/5—2/3 of length of body; segment III with about 14—22 rather equally sized, slightly protruding, rather small rhinaria along one side not in line; segment IV without rhinaria, processus terminalis to 2½ times base segment VI. Legs more slender and darker than in apterae. Venation of wings normal, with second fork of media sometimes rather near apex; veins thick and brownish, not bordered, siphunculi less thick than in apterae, with or without hairs. Cauda more evenly tapering. Tergite VIII with 3—6 hairs. Other characters as in apterae viviparae.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Siph.	Cau.	Rhin. on III
1	1.71	1.17	0.35	0.18	0.16	0.11 + 0.25	0.26	0.14	19 & 22
2	1.93	1.17	0.34	0.19	0.16	0.11 + 0.25	0.30	0.15	16 & 20
3	1.56	1.14	0.31	0.17	0.16	0.11 + 0.27	0.23	0.12	14 & 17

(1—3, with aptera no. 1; 3, intermediate with wing pads).

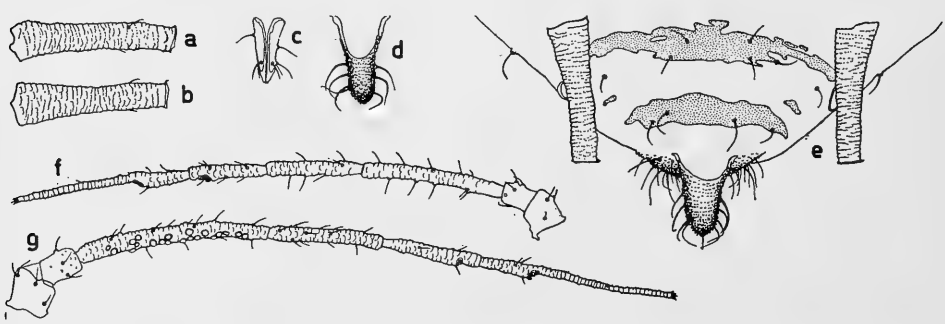

Fig. 6. *Aphis baccharicola* spec. nov. Apt. viv. fem.: a, siphunculus; c, last rostral segment; e, posterior part of abdomen; f, antenna. Al. viv. fem.: b, siphunculus; d, cauda; g, antenna. All × 72

Discussion. Every detail of the morphology of this species suggests that it belongs to the *Aphis helianthi* Monell group of the genus. Also *A. ceanothi* Clarke belongs to this group, which is characterized by a comparatively long third antennal segment with numerous irregularly arranged rhinaria in alatae, no rhinaria on segment IV, a rather short processus terminalis, moderately short antennal hairs; long and fine dorsal body hairs; thick, dark siphunculi and an almost equally dark cauda with 7—10 hairs; 2 hairs on the anterior part of the subgenital plate; on abdomen marginal tubercles only on segment I and VII; 2 hairs besides the 3 subapical pairs on the last rostral segment. Within this group *Aphis baccharicola* can immediately be recognized by its very long and fine antennal hairs, large marginal tubercles, and the not infrequent occurrence of long hairs on the siphunculi.

The new species seems to be widely spread on *Baccharis pilularis,* together with its

subspec. *consanguinea* a common shrub in the California coastal area..

Types. Holotype: apterous viviparous female (without hairs on siphunculi, measurements no. 1), from *Baccharis pilularis,* Patrick Point State Park (Humboldt Co.), California, U.S.A., 19.VIII.'66, leg. C. Lagace & D. Calvert no. G 66—VIII—19 g. Paratypes: alate viviparae (with hairs on siphunculi) with collecting data as for holotype; apterae viviparae (some with hair on siphunculi), from *Baccharis* sp., Clam Beach, Highway 101 (Humboldt Co.), California, U.S.A., 19.VIII.'66, leg. C. Lagace no. L 66—VIII —19 e.

Aphis mimuli Oestlund, 1887

Apterous viviparous female.

Colour in life not known. In mounted specimens quite pale with only the apices of antennae and tibiae brown and the cauda rather dark. Body about 1.55—1.75 mm long, rather broadly oval, without sclerotic pigmented spots. Reticulation of tergum faintly visible. Dorsal hairs sparse, stiff, blunt, on abdominal tergite III spinally about 0.015 —0.026 mm long, caudad much longer, the two hairs on tergite VIII very acute and up to 0.060 mm long. Marginal tubercles only on abdominal tergites I and VII, conical, about half as long as their basal width of about 0.026 mm. Front rather sinuated, with the hairs 0.025—0.035 mm long. Antennae pale with the apex from basal one-third part of segment V more or less dark brown, 4/9—5/9 of length of body; flagellum on basal 1/3—1/2 of segment III ventrally with some small dispersed scaly imbrications, more distally strongly but not densely imbricated, without secondary rhinaria; processus terminalis 1 4/5—2 1/9 times as long as base of segment VI; segment III with about 5—8 stiff, blunt hairs, the longest of which is just shorter than basal diameter of the segment. Rostrum nearly reaching hind coxae; last segment about 0.13—0.14 mm long, with about 6—9 hairs besides the 3 subapical pairs. Legs pale with apices of tibiae brown; femora hairy, longest ventral hair about 0.025 mm long; hind tibiae with rather erect, stiff hairs with mostly spear-shaped apices, halfway the tibiae about 0.019—0.020 mm long, just shorter than local diameter of the tibia. Siphunculi pale with sometimes the apex faintly dusky, rather thick, tapering to distal one-fourth part or to apex, just attenuated, 2/15 —2/11 of length of body, on basal half almost smooth, on distal half superficially imbricated. Cauda dark, slightly constricted, with fingertip-shaped distal part, 3/5—2/3 of the siphunculi, with some 12—16 curved, normal hairs. Subgenital plate with some 16—20 hairs along posterior margin, 6—10 long hairs on anterior half.

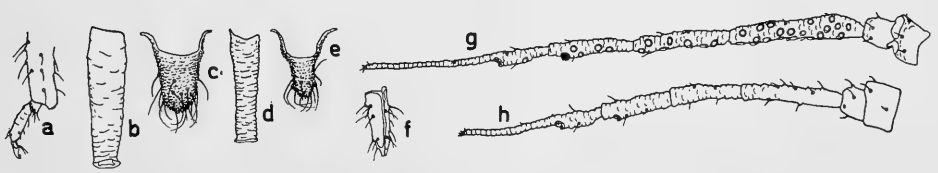

Fig. 7. *Aphis mimuli* Oestlund. Apt. viv. fem.: a, tip tibia + hind tarsus; b, siphunculus; c, cauda; h, antenna. Al. viv. fem.: d, siphunculus; e, cauda; f, last rostral segment; g, antenna. All × 72

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Siph.	Cau.
1	1.65	0.84	0.17	0.14	0.14	0.10 + 0.18	0.22	0.15
2	1.57	0.87	0.17	0.16	0.14	0.10 + 0.19	0.28	0.16
3	1.66	0.81	0.17	0.13	0.12	0.10 + 0.18	0.25	0.14
4	1.73	0.84	0.17	0.14	0.13	0.09 + 0.19	0.23	?

(1—3, from *Mimulus aurantiacus,* Union Landing (Mendocino Co.), California, U.S.A., 18.VIII.'66, leg. D. Calvert no. C 66—VIII—18 b; 4, from *Mimulus guttatus,* Plaskett Creek (Monterey Co.), California, U.S.A., 5.IV.'66, leg. R. van den Bosch no. 66—IV —5 p).

Alate viviparous female.

Coulour in life not known. In mounted specimens head and thorax black; on the abdomen rather large marginal and postsiphuncular sclerites, a thin spinal bar on tergite VIII, a thicker spinal bar on tergite VII, a very thick rectangular spinal bar on tergite VI, a complete to rudimentary spinal bar on tergite V and some small irregular sclerites on more anterior tergites dark, but paler than the conspicuous intersegmental sclerites. Antennae blackish with thick, imbricated flagellum, 5/9—3/5 of length of body; segment III up to twice as thick as its basal width, with 17—21 rather equally sized, broad-rimmed rhinaria over most of its circumference; segment IV with 7—11 rhinaria; segment V with 0—4 secondary rhinaria, and even basal part of segment VI sometimes with a secondary rhinarium; processus terminalis 2—2 1/5 times as long as base of segment VI. Legs dark, with the basal part of the femora and the larger part of the tibiae only in immature specimens pale, but then still the very base of the tibiae dark. Venation of wings normal; veins dark, rather heavy but not distinctly bordered; stigma blackish grey. Siphunculi blackish, nearly cylindrical, imbricated from near base, shorter than in apterae, with the distinct flange nearly 1 1/5 times as wide as the part just below. Cauda rather slender, dark with paler tip, with only 9—11 hairs. Anterior part of subgenital plate with (3)4—8 hairs. Other characters as in apterae.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Siph.	Cau.	Rhinaria on segments III	IV	V	VI
1	1.87	1.04	0.27	0.17	0.16	0.11+0.23	0.22	0.15	18&21	10&6	3&4	0&0
2	1.89	1.00	0.25	0.17	0.16	0.10+0.21	0.19	0.13	17&17	7&9	4&3	1&0
3	1.65	1.00	0.26	0.15	0.15	0.10+0.23	0.19	0.11	19&20	8&11	2&3	1&0
4	1.74	1.09	0.29	0.17	0.17	0.11+0.23	0.21	0.14	17&21	10&8	1&2	0&0
5	1.63	0.92	0.23	0.15	0.13	0.09+0.21	0.17	0.11	18&21	8&8	2&0	0&0

(1—5, with apterae 1—3).

Discussion. This is a typical member of the *Aphis oenotherae* group of species, which so far was only known to occur on *Ribes* spp. and on Onagraceae (*Oenothera, Epilobium, Chamaenerium*). If one sample from *Mimulus* were available, it would not have been

described here, but there are two, from different species of *Mimulus*. If both apterous and alate viviparae are available, samples can be identified. Apterae look like *Aphis oenotherae* Oestl. or *A. neomexicana* Cock., but alatae have too many rhinaria. Palmer (1952) mentions 11—22 rhinaria in alate *A. oenotherae* but the high numbers almost certainly relate to *Aphis varians* Patch, which goes from *Ribes* to *Chamaenerium angustifolium*, also in Colorado. The latter species has a longer last rostral segment, more hairs on the antennae, and as a typical character 4—8 hairs on abdominal tergite VIII, besides considerably longer antennal hairs. Therefore the chaetotaxy distinguishes *Aphis mimuli* from *A. varians* Patch, the number of rhinaria separates it from the species described as *A. sanborni* Patch, *A. ribiensis* Gill. & Palmer, *A. ribigillettei* Allen & Knowlton and *A. oenotherae* Oestl.

It seemed desirable to publish a redescription of the species which was very insufficiently described in 1887 and briefly mentioned in Oestlund (1922). I did not find any further descriptive notes.

Aphis mulini spec. nov.

Apterous viviparous female.

Colour in life not known. In mounted specimens body broadly oval, about 1.75—2.00 mm long. Sclerotisation of body variable, consisting of thick, very variable, conspicuously reticulated, blackish spino-pleural transverse bars on body from metanotum to abd. tergite VIII; in very sclerotized specimens these bars tend to fuse on tergites I—V, maybe only two of them; in little sclerotized specimens the bars show perforations and a median split on tergites I—III, and as a limit are reduced to paired, very irregular and fragmented spino-pleural sclerites; marginal sclerites on abd. tergites II—IV absent, but traces present on tergite V; spino-pleural bar on tergite VIII short, thin or absent; pleural intersegmental sclerites on abdomen darker than other sclerotic parts, sharply bordered, and looking like groups of black yeast cells. Dorsal hairs on abdomen on tergites I—IV both pleurally and spinally present, but on nearly all of these tergites one or more spinal or pleural hairs absent; longest spinal hairs on tergite III to 0.039 mm long, acute or with a fine almost invisible apex; the 2—4 hairs on tergite VIII up to 0.060 mm long. Marginal tubercles darkish, cylindrical with rounded tops to bluntly conical, besides on tergites I and VII (basal diameter 0.030—0.040 mm) also regularly on tergites II—IV and VI on which they are about half that wide. Head blackish; front sinuate; frontal hairs fine, to 0.048 mm long; dorsal cephalic hairs at least as long. Antennae about 3/5 of length of body, with blackish basal segments and pale flagellum, apparently without darker apices to segments III—V; segment III without rhinaria, ventrally imbricated, dorsally apparently smooth, though other segments on both sides imbricated, with fine, erect hairs of up to 0.035 mm, about 1 1/3 times as long as diameter of segment at its somewhat constricted base; segment VI about as long as III, with short processus terminalis. Rostrum not quite reaching hind coxae; last segment about 0.115—0.125 mm long, subequal in length to 2nd joint of hind tarsi, with 2 hairs besides the 3 subapical pairs. Legs pale with dark apices especially the hind femora, and tibiae; longest hair on trochanter 1 1/5 times as long as suture between trochanter and femur; dorsal hairs on tibiae long and fine, inclined, on basal half to 0.055 mm long, distinctly longer than the more spiny ventral hairs, and longer than local diameter of tibiae; first tarsal joints with 3, 3, 2 hairs; second joint of hind tarsi to 3 times as long as apical diameter of

hind tibiae. Siphunculi evenly black, with dense, rather long, subacute imbrications over whole length, about 1/6 of length of body, rather evenly tapering from base to the small flange. Cauda blackish, fingertip-shaped, about 2/3 of length of siphunculi, with 10—14 long, curved hairs with fine apices. Subgenital plate with 10—12 hairs on posterior part, and 2—3 on anterior half.

Measurement in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Cau.	Siph.
1	1.78	1.08	0.28	0.19	0.19	0.11 + 0.17	0.28	0.20
2	1.77	1.11	0.26	0.20	0.18	0.12 + 0.21	0.28	0.20
3	1.94	1.10	0.28	0.19	0.17	0.12 + 0.20	0.32	0.22
4	1.92	1.13	0.29	0.20	0.18	0.12 + 0.20	0.31	0.23

(1—4, from *Mulinum* sp., Bariloche, Neuquen, Argentine, 15.I.'64, leg. D. C. Lloyd).

Discussion. The four specimens were in very good condition in an excellent balsam slide received from Dr. R. C. Dickson, Riverside. I received no reply to a letter with a request for further information about the material. Because the slide contained two very similar *Aphis* spp., it had to be remounted. During the process specimens came in contact with a rubbery glue used for fixing labels, and they were badly damaged. Fortunately the measurements and description were made before remounting.

Because abdominal tergite VIII has only a very short transverse sclerotic bar, and only 2 hairs, this species is not affiliated to North American *Aphis* with a markedly sclerotized dorsum in apterae viviparae. It has all the characters of the European *craccivora,* or rather *medicaginis* group, for abd. tergites II—IV show consistently marginal tubercles. In that group only one species is known with long antennal, tibial and dorsal body-hairs: *Aphis comosa* Börner. But that species has only 6—9 caudal hairs, and a solid sclerotic dorsal shield that does not tend to be divided into separate bars, but is merely becoming reduced on its anterior part in specimens that are starved. All other species with rather long siphunculi have much shorter hairs.

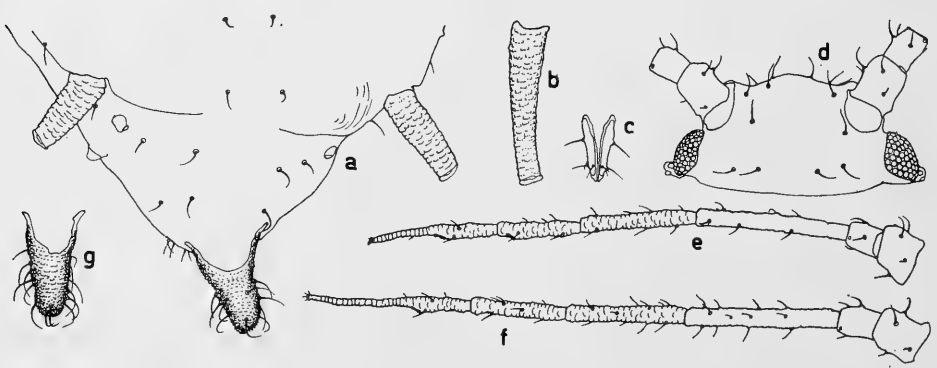

Fig. 8. *Aphis mulinicola* spec. nov. Apt. viv. fem.: a, posterior part of abdomen; e, antenna. *Aphis mulini* spec. nov. Apt. viv. fem.: b, siphunculus; c, last rostral segment; d, head; f, antenna; g, cauda. All × 72

Types. Holotype: apterous viviparous female (measurements no. 1), from *Mulinum* sp., Bariloche (Patagonia), Argentine, 15.I.'64, leg. D. C. Lloyd. Paratypes: apterae viviparae with collecting data as for holotype.

Aphis mulinicola spec. nov.

Apterous viviparous female.

Colour unknown. Strikingly like the preceding species. Differing in the following characters: dorsal sclerotisation much more extensive, consisting of a large spino-pleural, intersegmentally hardly perforated patch which on tergite V is linked to the marginal sclerites; marginal sclerites present, and bearing the marginal tubercles; tergite VIII with a rather long sclerotic transverse bar bearing 2—4 hairs. Marginal tubercles lower, but similar as to size and arrangement. Antennae with segments I—V similar in length to those in *A. mulini,* but processus terminalis not longer than basal part of segment VI. Last rostral segment 0.14 mm long, just longer than second joint of hind tarsi. Siphunculi only 1/10 of length of body, almost without a flange, thick, slightly curved outwards. Cauda thick, as long as or longer than siphunculi, with 8—10 normal, curved hairs. In all other respects like *Aphis mulini.*

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Siph.	Cau.
1	1.81	0.99	0.26	0.19	0.16	0.13 + 0.12	0.17	0.20
2	1.84	1.06	0.28	0.20	0.18	0.13 + 0.13	0.17	0.17

(1—2, from *Mulinum* sp., Bariloche, Neuqen, Argentine, 15.I.'64, leg. D. C. Lloyd).

Discussion. The two available specimens were in a slide with the preceding species, but survived the remounting process slightly better. They were first mistaken for fundatrices of *Aphis mulini* spec. nov. I then compared a great number of fundatrices with apterae of later generations of similar members of the genus *Aphis.* It became evident, that, if they were fundatrices, there probably would have been either 5 antennal segments, or also ant. segments III—V should have been distinctly shorter than they were in *Aphis mulini* spec. nov. The date of collecting 15.I.'64 at Bariloche, which is about 41° S. of the equator, would be comparable with 15 July at New York on the Northern Hemisphere, at which date one could expect fundatrices only as far north as Greenland, or near a glacier.

Also this species belongs in the *craccivora* group because of its dorsal sclerotisation, but species with such long hairs, marginal tubercles on tergites II—IV, and siphunculi not longer than the cauda, were not previously found in that section of *Aphis* L.

Types. Holotype: apterous viviparous female (measurements no. 2), from *Mulinum* sp., Bariloche (Patagonia), Argentine, 15.I.'64, leg. D. C. Lloyd. Paratype: apterous viviparous female with collecting data as for holotype.

Aphis ribiensis Gillette & Palmer, 1929

Syn.: *Aphis nasturtii* Palmer, 1936, 1952 nec Kaltenbach, 1843.

On 17-IX-1956 the late Dr. F. C. Hottes and I found at Carson's Hole near Grand Junction, Colo., U.S.A., a small *Aphis* on stems and leaves of *Veronica americana* var. *crassata.* In a plastic bag with some water the larvae developed into alate females, males, and one ovipara. This suggested that the *Aphis,* which in life strongly resembled *Aphis nasturtii* Kltb., had host alternation.

The mounted aphids fitted the description of Palmer (1936, 1952) of *Aphis nasturtii,* but they differed from the real *nasturtii* Kltb. by having much shorter siphunculi and processus terminalis. Palmer described her *A. nasturtii* from various *Rorippa* species, some of which are also hosts of *Aphis nasturtii* Kltb.

Through the kindness of Dr. Fronk it became possible to examine most of the samples to which Palmer (1952) refers. Undoubtedly the *Aphis* from *Veronica* is the same as Palmer's *A. nasturtii.* But in her slide from *Rorippa,* Ft. Collins, Colo., 21-VIII-1918, leg. L.C.B(ragg) there is also an aptera and an alate of the real *A. nasturtii* Kltb. And in one from Twin Lake, Pingree Park, Colo., from *Rorippa obtusa,* 15-VIII-1932, leg. M.A.P(almer) there is also one aptera of *A. nasturtii* Kltb. The latter aphid is described by Palmer (1952) as *A. abbreviata* Patch from *Rhamnus cathartica,* Ft. Collins, a synonym of *A. nasturtii* Kltb. and the identification appears to be correct.

Palmer (1952) wrote under *Aphis ribiensis* Gillette & Palmer: "this species seems to show no distinguishing characters from *Aphis nasturtii;* however, since no host transfers have been done the two species will be held distinct for the present". To European aphid workers the identity looks improbable, but this is not the case when one knows what Palmer meant by *Aphis nasturtii.* Type material of *A. ribiensis* was received, with the kind permission to remount, from the U.S. National Museum and from the Colorado A. & M. College, Ft. Collins, Colo. I have no doubt that *Aphis ribiensis* Gill. & Palmer is the aphid from *Rorippa* spp. and *Veronica americana.* Apterae, alatae and oviparae fully agree. Typical are the protected spiracles on the abdomen, of a type often found in aphids living in very wet surroundings.

A. ribiensis is the only American *Aphis* from *Ribes* with only two accessory hairs on the last rostral segment as correctly figured by Palmer (1936, 1952). However, specimens identified by Prof. Palmer as *Aphis ribiensis,* from *Ribes aureum,* Nibley, Utah, leg. G. F. Knowlton, show 5—7 accessory hairs on the last rostral segment which is 0.12 mm long. The latter specimens agree best with *Aphis ribigillettei* Knowlton & Allen which is virtually indistinguishable from *Aphis oenotherae* Oestlund.

I should like to point out the similarity in structure and life cycle between *Aphis ribiensis* and the European *Aphis triglochinis* Theob., both with only two accessory hairs on the last rostral segment, and having host alternation between *Ribes* and aquatic or semiaquatic plants.

Masonaphis (Ericobium) corylina (Davidson, 1914)?

Apterous viviparous female.

Colour in life not known. In mounted specimens body broadly spindle-shaped, about 2.50—2.70 mm long. Tergum not distinctly sclerotic, locally with fine, long, irregular,

transverse ridges, especially on the anterior abd. tergites. Small spinal tubercles on vertex and abd. tergite VIII. Marginal tubercles small and low, irregularly present on some of tergites II—IV. Dorsal hairs rather thick and stiff, with spear-shaped apices, spinally on tergites I—III about 0.025 mm long; tergite VIII with 4 hairs 0.048—0.052 mm long. Frontal tubercles smooth, well developed, with slightly diverging inner sides, at their inner apices with 2 hairs of about 0.035 mm long, ventrally with 1—3 more hairs; sinus frontalis conspicuously wide and with nearly flat bottom. Antennae about 1 1/15 times as long as body; basal segments brownish, slightly darker than the head; flagellum evenly darker to blackish brown from near base to apex; segment III finely imbricated from base to apex, near base with 2—3 hardly elevated, flattish rhinaria; processus terminalis nearly 6 times as long as base of segment VI, with some 9—12 spiny hairs besides the 4 on apex; segment III with about 22—28 hairs the longest of which is up to 2/3 basal diameter of segment. Rostrum just reaching hind coxae as measured by stylets; last segment with 14—16 hairs besides the 3 pairs near apex, 0.154—0.161 mm long, nearly 1½ times as long as second joint of hind tarsi. Legs about as pale as basal half of ant. segment III, with the conspicuously bent apical 1/6—1/5 part of tibiae blackish brown; femora on distal half ventrally, and near apex dorsally, slightly scabrous; dorsal hairs at mid-length of tibiae 0.035—0.045 mm long, to as long as local diameter of tibiae; first tarsal joints with 5, 5, 5 or 5, 5, 4 hairs, second joints ventrally hairy, rather bluntly imbricated, and without spinules on imbrications. Siphunculi pale, apicad gradually darker to brownish, distal 1/8 part rather dark brown; imbricated evenly and superficially from base to near apex, with distal 1/9—1/8 reticulated; smallest diameter on basal half about 0.050 mm, largest width in swollen part 0.061—0.065 mm, in the reticulated area about 0.078 mm wide; flange thin, distinct. Cauda pale, elongated bluntly triangular, not constricted, about 3/7 of length of siphunculi, with 7 hairs. Subgenital plate with about 10—12 hairs along posterior margin, and 2 much longer ones on anterior half.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Rhin.	Siph.	Cau.
1	2.66	2.80	0.68	0.46	0.44	0.15 + 0.87	3 & 3	0.71	0.32
2	2.54	?	0.77	0.45	0.47	0.15 + > 0.72			

(1—2, from *Aquilegia formosa,* Tioga Pass (3300 m.), Calif., U.S.A., 17.VII.'73, leg. D. Voegtlin no. 75).

Discussion. *Masonaphis* (*Ericobium*) *corylina* (Davidson, 1914) was only known as alatae, from *Corylus* sp., but Mason (1925) writes that according to Davidson the aphid is common on *Physocarpus capitatus.* That is a most unusual host combination for a *Masonaphis.* It is not clear whether the alatae developed on *Corylus* or had landed there. Notwithstanding much searching no *Masonaphis* could later be found on *Corylus* or *Physocarpus.*

At my request Mr. David Voegtlin searched *Aquilegia formosa* for more specimens of *Megourina lagacei* spec. nov. He collected some larvae of that species, and some larvae of *Kakimia aquilegiae* (Essig), but also two adult, slightly damaged apterae and two

larvae of a *Masonaphis* (*Ericobium*). With the key in MacGillivray (1958) one arrives at or near *Masonaphis* (*Ericobium*) *corylina* and my Voegtlin specimens may well belong to that species. This can only be decided when alatae have been collected from *Aquilegia,* or apterae viviparae from *Corylus.*

Masonaphis magna spec. nov.

Apterous viviparous female.

Colour in life not known. In mounted specimens body elongate oval, about 4.00—4.50 mm long. Tergum somewhat sclerotic but evenly faintly yellowish pigmented, not quite smooth. Marginal tubercles usually present on tergites II—IV, inconspicuous, 0.007—0.013 mm in diameter, rather flat; spinal tubercles of the same size common on the head and tergite VIII. Dorsal hairs stiff, blunt, spinally on tergites I—III about 0.035 mm

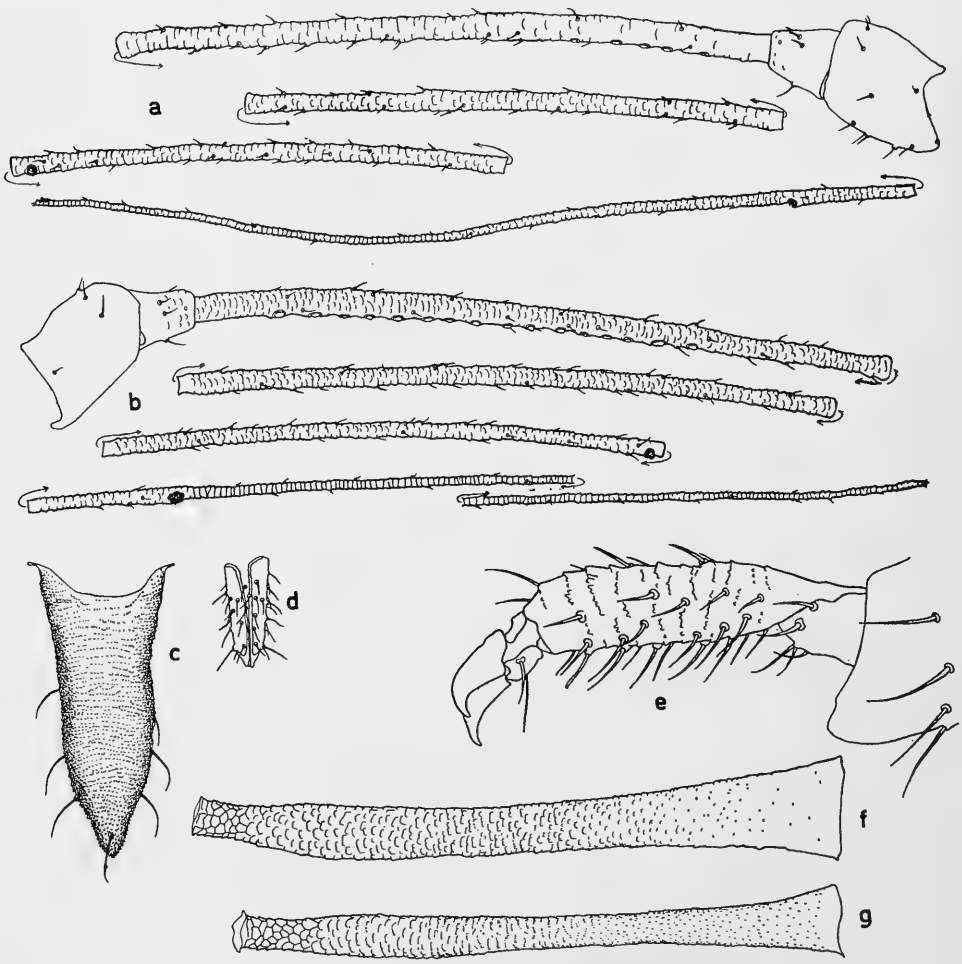

Fig. 9. *Masonaphis magna* spec. nov. Apt. viv. fem.: a, antenna; d, last rostral segment; e, tip tibia + hind tarsus; f, siphunculus. Al. viv. fem.: b, antenna; c, cauda; g, siphunculus. a, b, c, d, f and g, × 72; e, × 362

long, about 12 per segment; tergite VIII with 6—8 hairs up to 0.065 mm long. Frontal tubercles with a few spinules on underside, diverging, with rather straight inner sides, with 3—4 hairs; sinus frontalis bluntly V-shaped; median frontal process not developed; antennae very long, to over 1 1/3 times length of body, pale brownish yellow, with the very junctions between segments III/IV and IV/V dark brown, distal part of segment V and all of VI dark brown; segment III evenly imbricated from base to tip, with in the available specimens 5—8 rather evenly spread, hardly elevated, not bulging rhinaria in a line on basal 1/3—2/5 part; processus terminalis 5—6 1/4 times as long as base of segment VI, with no less than 12—20 spiny hairs besides the 4 on apex; segment III with some 30 blunt hairs, up to 0.022 mm long, about half basal diameter of the segment. Rostrum short, reaching to middle coxae as measured by stylets; last segment very hairy, with 26—30 hairs besides the 3 subapical pairs, 0.190—0.205 mm long, to 1 2/3 times as long as the small second tarsal joints of hind legs. Legs long, slender, pale, with the conspicuously bent apices of the tibiae blackish brown; femora dorso-apically and laterally somewhat imbricated; longest ventral femoral hair 0.045 mm long; dorsal hairs halfway hind tibiae about 0.045 mm, about 2/3 of local diameter of tibiae; apices of all tibiae conspicuously hairy, with quite acute hairs; first tarsal joints with 5, 5, 5 hairs, second joints hairy, sharply imbricated with rather distinct spinules on the imbrications. Siphunculi pale with conspicuously blackish apical 1/12—1/10 part, about ¼ of length of body, imbricated from near base with apical 1/10 part distinctly reticulated, at base about 0.13 mm, from there gently tapering to halfway their length, to 0.075—0.080 mm, increasing in diameter to a maximum of 0.088—0.092 mm, with the dark, reticulated apex about cylindrical, much attenuated, only 0.050—0.055 mm wide; flange small. Cauda pale, about half the siphunculi, with 8 hairs, one of which is dorso-apical; shape not describable in available specimens. Subgenital plate with 16—20 hairs along posterior margin, two longer ones near anterior margin and 1—4 hairs on the disc.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Rhin. on III	Siph.	Cau.
1	4.22	4.75	1.13	0.92	0.85	0.25 + 1.32	5 & 6	1.09	0.48
2	4.19	5.78	1.19	1.20	1.05	0.28 + 1.77	8 & 8	1.19	0.64

(1, from Composite, 4 mi. E. of Sturgeon Heights, Alberta, Canada, 14.VI.'66, leg. A.P.G. no. F 66—7—14 a; 2, from Composite, Mobley Lake, British Columbia, Canada, 12.VII.'66, leg. F.G.A.—A.P.G. no. F 66—7—12 b).

Alate viviparous female.

Colour in life unknown. In mounted specimens body even larger than in apterae, 4.30—4.55 mm long; head and pronotum quite pale with some brown on the medial side of the ocelli, mesonotum light brown, abdomen not pigmented. Antennae very long, with segment I vaguely brownish, segment II and base of segment III basad rhinaria pale, rest dark brown to brownish black, but segment IV on basal half lighter than segment III; segment III with 17—19 rhinaria similar to those in apterae, very nearly all in line, on basal ¾ part. Legs as in apterae but femora dorso-apically brownish. Wings with normal venation, veins brown, not bordered, but posterior margin of pterostigma

with a brown border contrasting to the much paler stigma. Siphunculi much thinner than in apterae, on basal half down to 0.050 mm, in the swollen portion up to 0.075 mm, and in the reticulated 2/15 part down to 0.055 mm. Cauda with 7—9 hairs, flattened in the slides. Other characters as in apterae viviparae.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Rhin. on III	Siph.	Cau.
1	4.34	5.56	1.26	1.18	1.00	0.30 + 1.54	18 & 19	1.05	0.51
2	4.53	5.58	1.14	1.03	1.00	0.37 + 1.64	17 & 18	1.05	0.56

(1, with aptera no. 1; 2, from Composite, Lac La Hache, British Columbia, Canada, 6.VII.'66, leg. F.G.A. no. F 66—7—6 t).

Discussion. From the fact that this aphid was collected on one trip at three different localities, it would seem to be fairly common. Unfortunately the Composite on which all specimens were found was not identified.

It is very difficult to decide to which subgenus of *Masonaphis* H.R.L. this species belongs. The imbrications on its second tarsal joints are about as spinulose as they are in *M. lambersi* MacGillivray which one would classify as a *Masonaphis* sensu stricto. No such aphid has been recorded from Compositae before. It is certainly not a member of subgen. *Oestlundia* H.R.L. (pale head and thorax, no ornamentation in wings) or *Amphorophorina* MacGillivray (arrangement of rhinaria). This leaves *Masonaphis* sensu stricto and *Ericobium* MacGillivray. With MacGillivray's (1958) key to *Masonaphis* sensu stricto one could arrive at *M. rhokalaza* (Tissot & Pepper), but that species has dark siphunculi, and fewer hairs on the last rostral segment. In her key to subgen. *Ericobium* one arrives at *M. phacelia* Essig, but that species has much less reticulation to the siphunculi, long dorsal hairs, and a virtually smooth antennal flagellum. The tarsi are very small. The hind tibiae are about 28 times as long as the second tarsal joints (0.122 mm).

Because of its very large size, hairy last rostral segment, small tarsi and clear wings this aphid should be easily recognizable.

Types. Holotype: alate viviparous female (measurements no. 1) from Composite, 4 mi. E. of Sturgeon Heights, Alberta, Canada, 14.VII.'66, leg. A.P.G. no. F. 66—7—14 d. Paratypes: aptera vivipara with data as for holotype; alate viviparous female, from Composite, Lac La Hache, British Columbia, Canada, 6.VII.'66, leg. F.G.A. no. F 66—7—6 i; apterous viviparous female, from Composite, Mobley Lake, British Columbia, Canada, 12.VII.'66, leg. F.G.A.—A.P.G. no. F 66—7-12 b.

Megourina gen. nov.

Type-species: *Megourina lagacei* spec. nov. Very similar to *Megourella* H.R.L., 1949, but differing by: 5 or 4 hairs on the first tarsal joints instead of 3 hairs; median frontal process distinct; sclerites in alatae obsolete on anterior abdominal tergites (always?); yellow instead of black tibiae; marginal hairs on processus-like sclerites, like other dorsal hairs with slightly capitate, very transparent tips.

Discussion. The type and single species was first considered to belong to a subgenus of *Megourella,* but there is no conceivable phylogenetic connection with that genus. Therefore the strong resemblance of *M. lagacei* to the two *Megourella* species must be considered convergence. The hairy rostrum, the structure of the dorsal hairs and the shape of the front suggest relationship to the Nearctic *Kakimia*'s, associated with Saxifragaceae, Scrophulariaceae and also *Aquilegia.*

Megourina lagacei spec. nov.

Apterous viviparous female.

Colour in life not known. In mounted specimens body oval, about 2.50—2.95 mm long, about 1.40 mm wide. Tergum membranous, with dark brown scleroites about 0.016—0.050 mm in diameter at the bases of the spinal and pleural hairs, with very strongly convex, processus-like, dark brown marginal sclerites, well developed antesiphuncular and rather smaller postsiphuncular sclerites, and a narrow, lighter brown spinal bar across tergite VIII. Distinct semiglobular marginal tubercles, 0.006—0.013 mm in diameter, singly, or sometimes in pairs or complex, regularly present on each marginal sclerite on tergites II—V. No spinal tubercles present. Dorsal hairs on strong bases, thick, stiff, dark, with seemingly finely furcated apex, but actually with a colourless thin knob, spinally on abdominal tergite III about 0.035—0.055 mm long, the 4 hairs on tergite VIII thinner and up to 0.065 mm long; marginal sclerites with 2—4 hairs each; about 14—16 hairs on each of abdominal tergites I—IV, of which the innermost pairs have much smaller scleroites at their bases than the others. Head pale brown, smooth, with only on the upper apex of the large, parallel, frontal tubercles a few nodules or spinules; median frontal process seemingly absent, somewhat downwards. Antennae about as long as body; first segment distinctly darker than head; segment III slightly imbricated, blackish brown with pale basal portion and often also with a part distad the rhinaria lighter, with 24—40 small, and sometimes some very small, slightly elevated, bulging rhinaria irregularly arranged along 2/3—4/5 part of the segment, about twice as long as segment IV; the latter on basal part mostly lighter than apical part of segment III, distally brownish black like the more distal segments, without rhinaria; processus terminalis 5—5½ times base of segment VI, with 7—10 small spiny hairs besides the 4 at the top; hairs on segment III about 14—18 in number, stiff, the longest one as long as basal diameter of the segment. Rostrum (according to stylets) reaching beyond middle coxae; last segment about 0.150—0.160 mm long, about 1 2/5 times as long as second joint of hind tarsi, conspicuously hairy, with some 16—20 hairs besides the much longer 3 subapical pairs. Legs rather long; femora with blackish brown distal part, gradually paler from there to base; tibiae pale to brownish yellow with blackish brown apices; first tarsal joints mostly with 5 hairs, the slightly stouter middle one the shortest, but apparently sometimes on one or two legs with 4 hairs, one of the lateral ones missing; tarsal joints rather small, imbricated. Siphunculi blackish, about 1/5 of length of body, on basal part with a few single spinules, remainder smooth, with a slender cylindrical basal 1/3 part about 0.055 mm wide, distad gently increasing in diameter to a maximum of about 0.070—0.075 mm, and evenly decreasing to a tip which is almost exactly as wide as the thinnest part on basal half; flange small, about 1 1/7 times as wide as the slightly incised part just below. Cauda dark, about 3/5 of the siphunculi, rather thick, slightly tapering over 4/5 part, then rather suddenly tapering to the blunt apex, with

probably 5—7 normal hairs (sometimes one hair of the lateral 3 pairs, sometimes the dorsal-apical hair absent). Subgenital plate with 8—12 hairs along posterior margin, 2 longer hairs on anterior part, but also 8—10 hairs on the middle portion.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Rhin. on III	Siph.	Cau.
1	2.89	2.96	0.92	0.44	0.43	0.15 + 0.81	32 & 38	0.57	0.31
2	2.69	2.61	0.82	0.38	0.38	0.15 + 0.77	24 & 27	0.52	0.29
3	2.68	2.66	0.79	0.39	0.36	0.15 + 0.73	26 & 27	0.52	0.27
4	2.63	2.83	0.86	0.42	0.39	0.15 + 0.80	26 & 30	0.53	0.30
5	2.80	3.03	0.95	0.43	0.44	0.17 + 0.82	32 & 32	0.53	0.30
6	2.81	2.73	0.85	0.40	0.37	0.15 + 0.73	25 & 27	0.48	0.29

(1—6, from *Aquilegia formosa,* Plaskett Creek, Highway no. 1, Monterey Co., California, U.S.A., 5.IV.'61, leg. C. Lagace no. 66—IV—5 a).

Alate viviparous female.

Colour in life unknown. In mounted specimens head and thorax blackish brown; abdomen almost without scleroites except at bases of spinal hairs of tergites V—VIII, but with larger marginal sclerotic processes than in apterae. Antennae very dark with only base of segment III pale; rhinaria on segment III except at the very base larger than in apterae, and covering most of the circumference of the segment up to its top. Legs much darker than in apterae. Wings with normal venation, the veins dark, not bordered. Other characteristics much as in apterae, but siphunculi and cauda slightly more slender.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Rhin. on III	Siph.	Cau.
1	2.95	2.99	0.92	0.44	0.44	0.15 + 0.82	49 & 55	0.53	0.27
2	2.64	2.80	0.85	0.43	0.39	0.15 + 0.77	47 & 47	0.46	0.24

(with apterae nos. 1—6).

Discussion. This aphid, according to specimens in the Essig collection, has been collected several times before in California, from *Aquilegia formosa,* which host plant it shares with *Kakimia aquilegiae* (Essig). Since it greatly differs from all other Nearctic aphids, and its resemblance to the European *Megourella* spp. was discussed and p. 27, no further discussion is necessary.

The species is dedicated to the late Mr. C. Lagace, who collected this and many other fascinating aphids.

Types. Holotype: apterous viviparous female (measurements no. 1), from *Aquilegia formosa,* Plaskett Creek, Highway no. 1 (Monterey Co.) California, U.S.A., 5.IV.'66, leg. C. Lagace no. 66—IV—5 a. Paratypes: apterae viviparae and two alatae with collecting data as for holotype. Some paratypes in the Lagace collection, Albany, California, U.S.A.

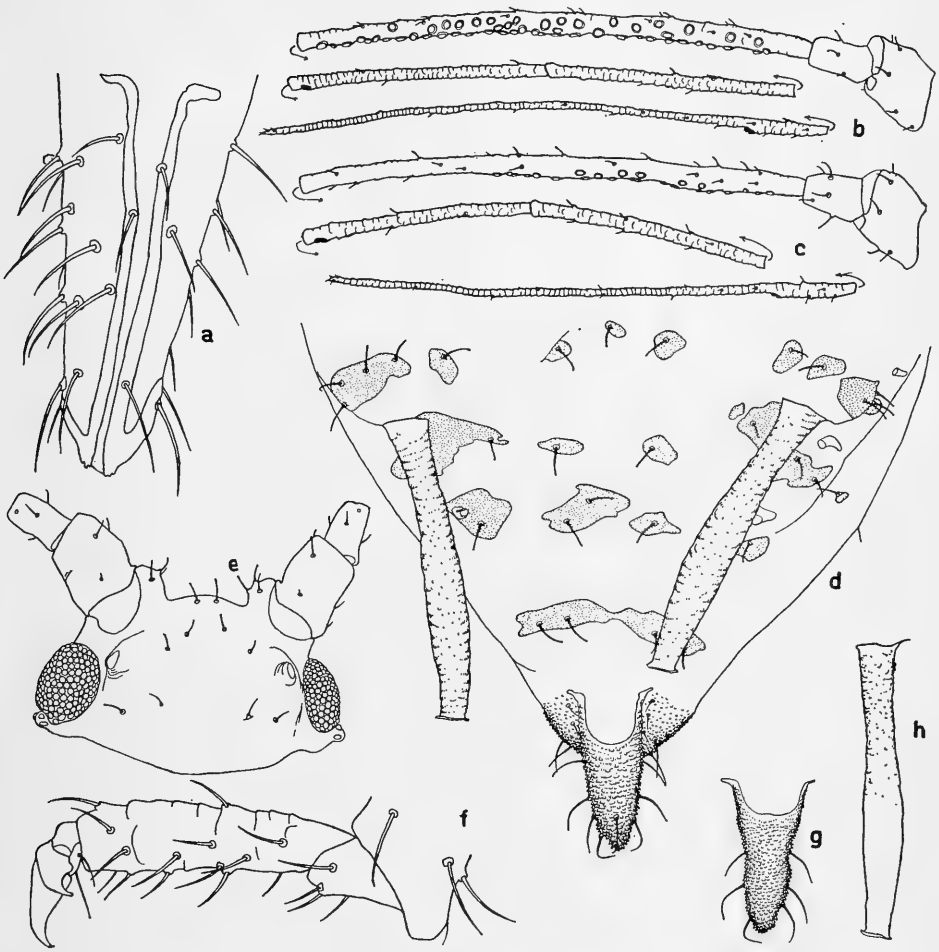

Fig. 10. *Megourina lagacei* spec. nov. Apt. viv. fem.: a, last rostral segment; c, antenna; d, posterior part of abdomen; f, tip tibia + hind tarsus. Al. viv. fem.: b, antenna; e, head; g, cauda; h, siphunculus. a and f, × 342; b, c, d, e, g and h, × 75

Nearctaphis argentinaeradicis (Gillette & Palmer, 1932)

According to the type material this apparently very rare aphid belongs in *Nearctaphis* Shaposhnikov, and not in *Aphis* L. in which it was described.

The following items supplement the descriptions and figures by Gillette & Palmer (1932) and Palmer (1952).

Apterous viviparous female. Head dorsally with about 24—30 hairs besides the 6—8 on the front, covered with blunt spinules or nodules. Last rostral segment to 0.18 mm, with 4—6 hairs besides the 3 subapical pairs, 1½ times as long as second joints of hind tarsi. Dorsum of thorax and abdomen covered with little scleroites, bearing hairs, but many hairs not on scleroites; tergite IV with 40—55 hairs, about 0.065 mm long, with

extremely fine apices; tergite VIII with 12—16 hairs. Marginal tubercles present on abd. segments I—V, not on VI or VII, irregular in shape, and those on segment V larger than all the others and composite, in dorsal view looking like an *Eriosoma* wax gland. First tarsal joints with 4 hairs, 2 short and thick, 2 long and thin. Siphunculi with transverse rows of bluntish spinules, with a rather wide flange.

With the kind permission of Dr. D. Fronk several paratypes collected 23.VIII.1930 and bearing the number 4830 were remounted and for the greater part returned to the Palmer collection at Fort Collins, Colorado.

Neonasonovia inflata (Richards, 1962)

The species was described as a *Hyperomyzus.* But old apterae develop a vague brown central sclerotic patch on the abdomen in combination with black siphunculi, while alatae have an equally vague abdominal sclerotic pattern not at all like that in the four real *Hyperomyzus.* Therefore I transfer *Hyperomyzus inflatus* Richards, 1962, to *Neonasonovia.* Miss E. M. Patch recognized the species as new and gave a manuscript name to specimens collected on 30.VII.'26 near Portland, Maine, U.S.A. on *Hieracium,* by Mrs. I. M. Knight, and it was found in several localities in North Carolina by C. F. Smith, J. O. Pepper and myself in 1963 and 1964. In the latter state it evidently overwinters on *Hieracium,* for apterae, alatoid nymphs and alatae were found on 24.IV.'64 in two localities.

Neonasonovia nabali (Oestlund, 1886)

This species, described as *Rhopalosiphum nabali* from *Nabalus albus,* now *Prenanthes alba,* is mostly treated as an *Amphorophora* Buckton in North American papers. Its sexuals have not been recorded or described but I found them in very large numbers on 28.VIII.'56 in the Laurentide Park, Prov. Quebec, Canada, on the undersides of the leaves of *Ribes glandulosum.* Alate males are brownish red, first instar oviparae greenish yellow, after their first moult brilliant brownish red. Eggs at first very pale transparent green, later black, on the branches.

In my hotel at Fredericton, N.Br., Canada, I transferred alatae from *Prenanthes* sp. to leaves of *Ribes nigrum* and very soon obtained similar larval oviparae, and it would seem that *Ribes* spp., at least *R. glandulosum,* are primary host plants of this species which I transfer to *Neonasonovia* H.R.L.

Amphorophora fronki Knowlton, 1945, described from "Wild Currant" (= *Ribes* sp.) is extremely nearly related to *Neonasonovia nabali* and congeneric. I could remount some apterae from the type sample, one of which, though full of embryos, has a few pseudosensoria on one atrophied hind tibia. I found up to 23 rhinaria on antennal segment III, much fewer than in *nabali,* in which species the apterae from *Prenanthes alba* have mostly about twice that number of rhinaria, which are smaller in size, in addition to several on segment IV and sometimes V. But such a difference in number of rhinaria is, in *Neonasonovia* and related genera, common between spring forms on the primary host plant and summer forms from the secondary host plants. The swelling of the siphunculi is similar, and rostrum, cauda, chaetotaxy, etc., do not show differences. Only the large pigmented spinal scleroites of *N. nabali* from *Prenanthes* cannot be found in remounted *N. fronki,* a case refound in *N. picridis* (Börner & Blunck), the type-species.

However, the number of rhinaria in alate *N. fronki* is certainly much lower than that in gynoparae of *N. nabali.* Besides, an ovipara was found on *Ribes* in July. Therefore *nabali* Oestl. and *fronki* Knowlton must be considered different taxa as long as no authentic spring forms from the primary host, *Ribes glandulosum,* of *Neonasonovia nabali* are known.

Probably *Amphorophora petiolaris* Knowlton & Allen, 1945, described as spring alatae from *Ribes petiolaris,* Washington, also belongs to this group. I have not seen authentic material. The host plant occurs in Utah. The name *petiolaris* may have priority over *fronki.*

Neonasonovia nigra (J. McVicar Baker, 1934)

Julia McVicar Baker's aphids have received very little attention. Therefore it seems useful to publish a more modern description of one of her species, originally described as an *Amphorophora* from *Stevia pubescens,* from Mexico. She mentioned about 30 rhinaria on ant. segment III, 18 on IV, 4—5 on V, some more than in my material.

Apterous viviparous female.

Colour in life, according to Baker's description, very shiny black. In mounted specimens body oval, about 1.30—1.55 mm long, about 0.60 mm wide, strongly convex. Tergum with a solid, black, smooth shield extending from the suture-less fused tergites of metathorax to abdominal segment V, and reaching down laterally to between the stigmal pori; tergites VI—VIII with free sclerotic bars. No marginal or spinal tubercles present. Dorsal hairs inconspicuous, blunt, only 0.004—0.008 mm long spinally on abdominal tergites I—III; the 4—6 hairs on tergite VIII very little longer, to 0.010 mm, about half as long as basal diameter of antennal segment III. Head frontally as dark as abdominal dorsum, caudad paler; frontal tubercles not much developed, diverging, with rounded inner sides, smooth, with 2 short hairs; median frontal process rounded, very prominent, nearly half as high as the frontal tubercles. Antennae about as long as body or slightly longer, blackish with only the very base of segment III pale; segment III near base distinctly imbricated, more distally very lightly imbricated, along one side over its whole length with 16—26 slightly elevated, a little bulging rhinaria, not in line but nearly so; segment IV with 0—10 rhinaria; processus terminalis 3½—5 times as long as base of segment VI, with 2—4 small spines besides the 4 at apex; hairs on segment III inconspicuous, to about 0.005 mm long, only 1/5—1/4 of basal diameter of the segment. Rostrum reaching halfway between middle and hind coxae, last segment about 0.105—0.115 mm long, about 1 1/3 times as long as second joint of hind tarsi, with some 7—9 thin hairs of 0.013—0.021 mm besides the 3 pairs near apex. Legs in more pigmented specimens most conspicuous because basal 1/3 part of tibiae is pitch black, much darker than any other part of body or appendages; femora blackish brown, paler brown towards base; longest ventral femoral hair about 0.09 mm long; tibiae with middle 1/3 part pale to yellowish brown, at apex paler than on basal part; dorsal hairs halfway hind tibia inconspicuous, to 0.009 mm long; first tarsal joints with 3, 3, 3 hairs; second joints distinctly imbricated. Stigmal pori of abdominal segments I—V open, nearly circular. Siphunculi blackish, smooth except for distinct striation in the annular incision below the flange, 2/9—1/4 of length of body, strongly swollen; at base about 0.070 mm wide, just above 0.050 mm, then widening to about 0.090 mm halfway their length and gradually decreasing in width to 0.028 mm in the incision below the flange of about

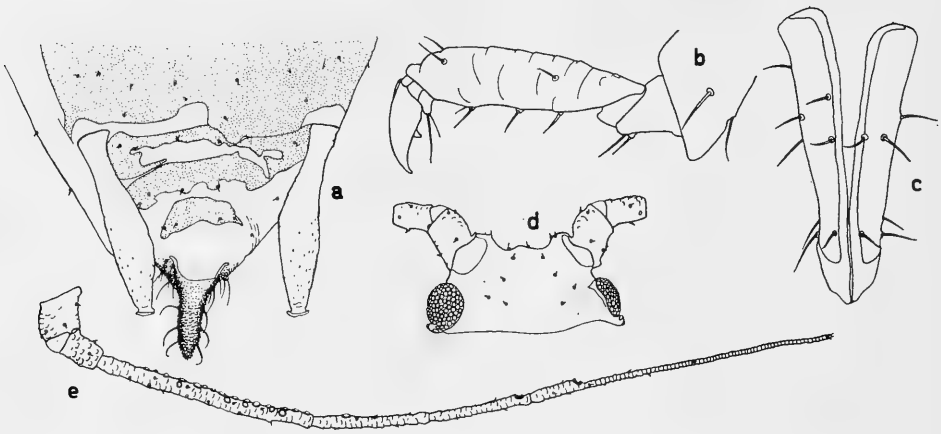

Fig. 11. *Neonasonovia nigra* (J. M. Baker). Apt. viv. fem.: a, posterior part of abdomen; b, tip tibia + hind tarsus; c, last rostral segment; d, head; e, antenna. a, d and e, × 72; b, and c, × 342

0.037 mm. Cauda pale, slender, narrow-conical with a mostly distinct constriction, 6/11—2/3 of the length of the siphunculi, with 5—6 normal hairs (mostly with a dorso-apical one). Subgenital plate with 8—10 short, blunt hairs along posterior margin, with 2 hairs of up to 0.020 mm near anterior margin.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	IV	Rhin. on III	IV	Siph.	Cau.
1	1.32	1.48	0.40	0.20	0.19	0.09+0.46	19&20	0&1	0.33	0.18
2	1.46	1.40	0.38	0.23	0.20	0.10+0.35	16&19	2&3	0.34	0.20
3	1.43	1.41	0.39	0.21	0.20	0.10+0.36	18&21	7&3	0.34	0.18
4	1.52	1.55	0.45	0.23	0.22	0.10+0.40	22&26	8&10	0.36	0.20

(1—4, from *Stevia glandulosa,* 62 mi. E. of Villa Union, Sinaloa, Mexico, 1.II.'64, leg. R. van den Bosch no. 64—2—1 f).

Discussion. Four adult apterae without larvae were collected by Dr. van den Bosch. They are classified with some reluctance as *Neonasonovia* although they have short hairs. However, the shape of the front, antennae including their sensoriation, round, not covered stigmal pori, siphunculi with annular incision below the flange are so typical that on these characters a decision is easy. Besides, the hairs in *N. inflata* (Richards) are not much longer, and *N. hieracii* (Börner) has a position more or less intermediate between *inflata* and the type species, *picridis* Börner & Blunck, as to dorsal hairs.

Because of its extensive black sclerotisation recognition of this aphid is very simple.

Neonasonovia zirnitsi Hille Ris Lambers, 1952

The author (1952) described this species from *Ribes alpinum* and *Euphrasia* sp. from Sweden. At that time the life cycle had not yet been confirmed by transfer experiments.

However, in 1967 I received living specimens on *Ribes alpinum*, found near Denekamp, Netherlands, by the Phytopathological Service, and emigrants successfully colonized potted *Euphrasia nemorosa* on which several generations developed. At my request Mr. van der Schaaf then searched *Euphrasia* in the Denekamp area and he found several specimens on this plant on 28.VII.'67. Therefore *Ribes alpinum* indeed is the primary host plant of *N. zirnitsi* H.R.L. and *Euphrasia* spp. are secondary hosts.

Prevost (1959) described *Hyperomyzus boerneri* from *Euphrasia rostkoviana* and *Euphrasia* sp. from Austria and Switzerland. Morphologically her type material cannot be distinguished from *zirnitsi* developed on *Euphrasia.* Because the type material contained several oviparae and two males (and also an alate oviparous female), it was supposed that *boerneri* was a good species. However, further searching by the present author in Switzerland and Austria revealed that this aphid, which is very common on *Euphrasia* in the Alps, in September produces masses of alatae, settling on *Ribes alpinum* and producing larvae, and some males. I now suppose that colonies remain on the secondary host and that some oviparae are produced there when the temperature has become too low for flight initiation, as in, e.g., *Myzus cerasi* (F.). Therefore *Hyperomyzus boerneri* Prevost, 1959, is considered a synonym of *Neonasonovia zirnitsi* H.R.L., 1952.

Müller (1960) described *Hyperomyzus sobrinus* as host alternating between *Ribes alpinum* and *Euphrasia officinalis.* Nothing distinguishes the paratypes he most kindly gave me from *Neonasonovia zirnitsi* H.R.L., of which *Hyperomyzus sobrinus* Müller, 1966 is considered to be a synonym.

From Iceland Stroyan (1960) described *Hyperomyzus boerneri* subspec. *thorsteinni* from *Euphrasia frigida.* This aphid very strongly resembles *zirnitsi,* but apterae collected in August have the processus terminalis only about 4 times as long as the base of segment VI, instead of 6 or more times as long as in true *zirnitsi.* Since *Ribes alpinum* is not mentioned in the Iceland Flora, *thorsteinni* has apparently been split off the dioecious *zirnitsi,* and has evolved far enough to be considered a species, as I do, transferring it to *Neonasonovia* H.R.L.

Pentamyzus acaenae (Schouteden, 1904)

Through the kindness of Dr. H. Weidner, Hamburg, Germany, I could mount the pickled material of *Rhopalosiphum acaenae* Schouteden, 1904. This appears to be a *Pentamyzus* H.R.L., easily separable from the type-species, *P. graminis* H.R.L., by the wide flange to the siphunculi (0.048—0.052 mm) and the thin part (0.030—0.035 mm)

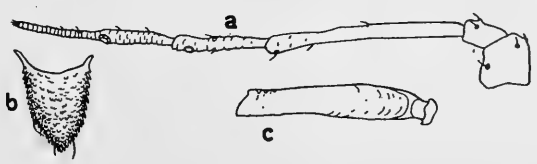

Fig. 12. *Pentamyzus acaenae* (Schouteden). Apt. viv. fem.: a, antenna; b, cauda; c, siphunculus. All × 72

just below, where some transverse striae are present, and by antennal segment III being twice as long as segment IV. Since the original slides seem to have been destroyed, a lectotype, partly from *Acaena splendens,* Uschuaia, Tierra del Fuego, Argentine,

14.XI.'92, leg. H. Michaelsen no. 147, was selected and returned to the Hamburg Museum. Some of the lecto-paratypes, with collecting data as for lectotype, are in the author's collection.

Pentamyzus falklandicus spec. nov.

Apterous viviparous female.

Colour in life not known. In mounted specimens integumentum faintly yellowish. Body elongated oval, 2.40—3.00 mm long, just over twice as long as its greatest width (rather flattened specimens). Thoracic tergites free, tortoise shell-like sclerotic, or rather with elevated, very low flattish warts, but along the median line apparently membranous; abdominal tergites I—VIII similarly sclerotic and mutually free, but the membranous median divide ending at anterior margin of tergite V or perhaps sometimes VI. Very inconspicuous marginal tubercles, probably flat, about 0.005—0.008 in diameter, very irregularly present on abdominal segments II—IV; spinal tubercles regularly present on vertex, irregularly on abdominal tergites VII and VIII where they are more elevated and larger than the marginal tubercles. Dorsal hairs scarce, on tergites I—IV spinally in a very flat trapezoid, about 14—16 per segment, spinally on tergite III to 0.022 mm long, stiff and blunt; tergite VIII with 8—12 mostly slightly longer hairs, to 0.030 mm long, sometimes in a double row. Head broad; frontal tubercles just indicated, slightly protruding beyond the convex front, wrinkled but not spinulose, nodulose or scaly, with 1—2 hairs each. Antennae of 5 segments, pale, with segment V brown, 2/5—3/7 of length of body; segment I on inner side bulging; segment III without rhinaria, superficially bluntly imbricated, more than twice as long as segment IV; processus terminalis 1 1/2—1 6/7 times as long as base of last segment, with mostly 2 spiny hairs besides the 4 near apex of which one is always placed more than its own length below the tip; antennal hairs scarce, only 5—7 on segment III and these half as long as basal diameter of the segment. Eyes normal. Rostrum thick, reaching the middle coxae; last segment acute, almost rostrate, about 0.14 mm long, about 8/9 of second joint of hind tarsi, with 4—6 hairs of about 0.040 mm besides the 3 subapical pairs. Legs rather short and thick, pale with perhaps the tarsi darker; longest ventral femoral hair about 0.030 mm, stiff, bluntish, dorsal hairs on hind tibiae more acute, halfway tibiae about 0.30 mm long, about 2/3 of local diameter of tibiae; first tarsal joints with 3, 3, 2 or 3, 3, 3 hairs; second joints hardly imbricated; empodial hairs about 1/2—3/5 of length of claws.

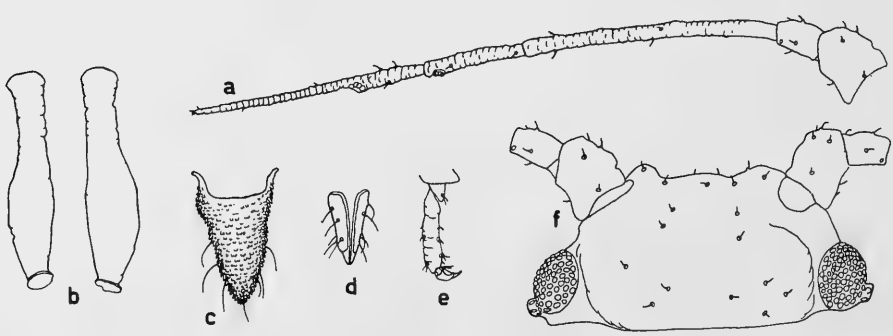

Fig. 13. *Pentamyzus falklandicus* spec. nov. Apt. viv. fem.: a, antenna; b, siphunculi; c, cauda; d, last rostral segment; e, hind tarsus; f, head. All × 72

Siphunculi pigmented like the legs, nearly smooth with some wrinkles near base and some striae near apex, about 1/7—1/6 of length of body, with basal 1/3 part about cylindrical and there about 0.05 mm thick, suddenly strongly swelling to a maximum width of about 0.09 mm and from there tapering to the thinnest part, about 0.045 mm, just below the rather thick flange of about 0.055 mm. Cauda thickly elongated triangular with convex sides, less than half as long as siphunculi and similarly pigmented, with 6—10 normal, acute hairs in irregular arrangement. The three rudimentary gonapophyses unusually large, with spiny hairs of up to 0.030 mm. Subgenital plate with 14—18 bluntish hairs along posterior margin and 2—4 much longer and more acute ones on anterior part.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	Siph.	Cau.
1	2.72	1.19	0.44	0.17	0.15 + 0.25	0.39	0.25
2	3.00	1.27	0.47	0.18	0.16 + 0.25	0.43	0.25
3	2.60	1.24	0.45	0.19	0.15 + 0.27	0.37	0.22
4	2.75	1.26	0.44	0.19	0.15 + 0.28	0.39	0.23
5	2.81	1.37	0.49	0.21	0.18 + 0.29	0.46	0.26
6	2.93	1.26	0.44	0.19	0.15 + 0.28	0.39	0.23
7	2.47	1.18	0.42	0.18	0.14 + 0.26	0.37	0.23

(1—7, from *Poa flabellata,* Falkland Isles, 21.VI.'37, leg. A. G. Bennett no. 8246).

Discussion. The closest relative of this aphid is *P. acaenae* (Schouteden) supposedly living on *Acaena splendens,* but there was also a piece of a blade of grass in tube no. 147. In *P. acaenae* the processus terminalis is shorter, 1—1 1/3 times as long as base of segment V; the siphunculi swell gradually from 0.048 near base to a maximum of 0.065 mm, from where they gradually narrow to 0.035 mm just below the thin flange. The body in *acaenae* is very different in shape, e.g., 1.94 mm long with a greatest width of 1.21 mm.

The sample consisted of 13 apterae and one larva. The latter has smooth hind tibiae. In one aptera the embryos can easily be examined. They have 5 antennal segments, segment III being hairless. The last rostral segment has 4 hairs besides the 3 subapical pairs, and it is distinctly rostrate. The chaetotaxy of the dorsum is not visible.

Types. Holotype: apterous viviparous female (measurements no. 2), from *Poa flabellata,* Falkland Islands, 21.IV.'37, leg. A. G. Bennett. Paratypes: apterae viviparae with collecting data as for holotype. Holotype and most paratypes returned to the British Museum (Natural History); some paratypes in the author's collection.

Thripsaphis Gillette, 1917

Börner (1930, 1952), Quednau (1954), Eastop (1966), and Richards (1971) use a subdivision of what Palmer (1952) has under *Thripsaphis* Gillette. This, in its most recent form by Richards, is as follows:

a. *Thripsaphis* Gillette, 1917, type species *Brachycolus ballii* Gillette, 1908. Empodial hairs spatulate.

b. *Allaphis* Mordvilko, 1921, type species *Callaphis caricicola* Mordvilko, 1914 [1]). Empodial hairs setiform, apterae viviparae without wax glands ("cribriform discs" of Richards, 1971) or with wax glands not visible (Quednau, 1954).

c. *Trichocallis* Börner, 1930, type species *Allaphis caricis* Mordvilko, 1921. Empodial hairs setiform, apterae viviparae with dorsal wax glands.

Eastop (1966) uses *Allaphis* and *Trichocallis* as subgenera of *Thripsaphis*. The subdivision looks clear enough, but there are some objections. The case of *Thripsaphis utahensis* Knowlton & Hall, discussed on p. 149, suggests that the presence or absence of wax glands is not a very good character. But besides, a very close examination of those species the four authors thought to have no wax glands, revealed that these are present, though often only caudo-laterally on abd. tergite VIII, and in dorsal view hardly visible. A more serious objection arises from the accumulation of misidentifications of the type species of *Allaphis* and *Trichocallis*.

Through the kind help of Dr. G. Shaposhnikov, Leningrad, I could remount and examine original material of *"Callaphis" caricis* and *"C." caricola* Mordv., *collected* from Carex in 1907 and labelled by Mordvilko. The results are:

a. *Callaphis caricicola* Mordvilko, 1914, later renamed *Allaphis caricicola* (Mordvilko, 1914) by Mordvilko (1921). Börner (1952) synonymized *Thripsaphis thripsoides* Hille Ris Lambers, 1939 with *caricicola* Mordv. However, this is quite wrong. Actually *Thripsaphis gelrica* Hille Ris Lambers, 1956 is a synonym of *Callaphis caricicola* Mordvilko, 1914, and that is a species with markedly spatulate empodial hairs. Therefore *Callaphis* Mordvilko, 1909, type species *Callaphis caricicola* Mordvilko, 1914, and *Allaphis* Mordvilko. 1921, nomen novum pro *Callaphis* Mordvilko, 1909 nec Walker, 1870, become synonyms of *Thripsaphis* Gillette.

b. *Allaphis caricis* Mordvilko, 1921, the type species of *Trichocallis* Börner. *Thripsaphis thripsoides* Hille Ris Lambers, 1939 is a synonym of *Allaphis caricis* Mordvilko, 1921, and not of *Callaphis caricicola* Mordv., as Börner and later authors thought. *Allaphis caricis* Mordv. is a species with setiform empodial hairs, and, as *Thripsaphis thripsoides* H.R.L. according to Richards (1971), *without* dorsal wax glands in apterae viviparae.

As the presence or absence of wax glands is hardly a sensible character, I recognize only two subgenera, *Thripsaphis* Gilette, 1917, and *Trichocallis* Börner. The fact that Börner (1930, 1952) misidentified *Aphis cyperi* Walker, 1848 with *Allaphis caricis* Mordv., and (1930, p. 165) erroneously synonymized his genus *Trichocallis* erected on p. 127 of the same paper with *Phyllaphoides* Takahashi, fortunately has no consequences. Also *cyperi* Walker has setiform empodial hairs, even if it has very many wax pores on the dorsum.

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[1]) The years of publication of the genus *Callaphis* Mordv. and the species *caricis* Mordv. and *caricicola* Mordv. were dubious. Mordvilko (1921, p. 58) writes *"caricicola* Mordv. (1908)". Börner (1952, p. 282) could not find a reference to the species in Mordvilko's papers of 1908. Neither could I. Börner then writes that Mordvilko (1914, p. 27) first turns up with *Callaphis,* with as single species *C. caricicola* Mordv., in a key to genera. But as Mordvilko treats both genus and species as if they were described earlier by him, I continued the search, and found in a footnote in Mordvilko's (1909) paper on aphid biology on p. 102: "In die Gruppe *Callipterina* bewohnt nur die Gattung *Sipha* Pass. Kräuter und namentlich Gramineen, sowie die Gattung *Callaphis* Mordw. (*caricicola* Mordw. und *caricis* Mordw.) die Blätter von Carex;". Consequently *Callaphis* Mordv. should have 1909 as year of publication; *caricicola* Mordv. remains a nomen nudum till 1914; and *caricis* Mordv. till 1921, when it was described as an *Allaphis.*

In Richards' revision (1971) of the sedge aphids of the world a few species and one genus have not been discussed. He lists *Thripsaphis striata* Bozhko, 1961 as a synonym of *Subsaltusaphis ornata* (Theob.) which is not suggested by the photograph accompanying the description. Dr. Maria Bozhko most kindly made a type available for examination. It appears that *Thripsaphis striata* Bozhko, 1961 belongs in *Neobacillaphis* Huculak, 1968, type species *Neobacillaphis szelegiewiczi* Huculak, 1968, a species and genus not mentioned by Richards. *N. striata* (Bozhko) differs from *N. szelegiewiczi* Huculak by a shorter and broader body with paired, dark, spino-pleural sclerites; an evenly rounded abd. tergite VIII (as in *T. ossiannilssoni* H.R.L.) which has a number of small hairs on its disc as in *N. szelegiewiczi;* by shorter antennae without secondary rhinaria in apterae, with a processus terminalis only half as long as the base of ant. segment VI, with conspicuous, dense transverse rows of spinules from segment III—VI, and with long hairs, mostly longer than the largest diameter of ant. segment III; by having no umbrella-shaped, but inverted-wedge shaped dorsal hairs.

Also *Thripsaphis caricicola* Swain, 1918 is not mentioned by Richards (1971). The type material of this California sedge aphid can not be found. At any rate the name is not available, because it is a junior secondary homonym of *Callaphis caricicola* Mordvilko, 1914.

A number of new members of the subgenus *Trichocallis* are described hereafter. The North American species key as follows:

Key to the North American species of the subgenus *Trichocallis*

Apterous viviparous females.

1 (2) Median process on front as long as ant. segments I and II together. *Carex trichocarpa.* Canada.
T. daviaulti Quednau

2 (1) Median frontal process shorter than ant. segments I and II together.

3 (4) Abd. tergite VIII with its caudal margin triangular with slightly convex sides or with a faint process bearing two hairs. Resembles strongly *caricis* Mordv., but differs in pattern of dorsal nodules. Colorado, Quebec.
T. producta Gill.

4 (3) Abd. tergite VIII with caudal margin in the middle rounded or straight or indented.

5 (16) Hind margin of tergite VIII, posterior corners of tergite VII, and often various other places, e.g. around spinal and pleural hairs, and distal parts of antennal segments, with stippled wax pores.

6 (11) Distance between the two middle hairs on posterior margin of abd. tergite VIII only about 9/10—1¼ times as large as the distance from either of those hairs to the nearest marginal hair more basad. Tergite VIII always very evenly rounded, more or less semicircular, often with a number of tiny hairs on its disc. Group of *T. ossiannilssoni* H.R.L.

7 (10) Ant. segment III only about 3½—6½ times as long as its greatest width. Dorsal ornamentation of abdomen consisting of long, wavy, here and there coalescing, rows of very small semi-acute spinules.

8 (9) Disc of abd. tergite VIII with 6—15 mostly very inconspicuous, thin hairs besides the single or partly double row of much larger marginal hairs. Only Europe to Japan.

T. ossiannilssoni H.R.L. sensu stricto

9 (8) Disc of abd. tergite VIII without hairs. California.

T. ossiannilssoni subsp. *pacifica* subsp. nov.

10 (7) Ant. segment III at least 8, mostly 10 or more times as long as its greatest width. Dorsal ornamentation consisting of short rows of 2—4 blunt nodules mixed with half-fused single large nodules up to 0.009 mm in diameter. Probably *T. ossiannilssoni* × *T. subverrucosa,* found with the potential parents. California.

T. hybrida spec. nov.

11 (6) Distance between the two middle hairs on posterior margin of abd. tergite VIII more than 1¼ time as large as the distance from either of those hairs to the nearest marginal hair more basad. Tergite VIII mostly not evenly rounded, either with a blunt angle between sides and rounded apex (or, not as a result of mounting, posterior marginal hairs far from posterior margin of tergite), or with a straight or slightly concave part between the middle hairs on posterior margin.

12 (13) Distance between middle posterior hairs on margin of abd. tergite VIII 2½—3¼ times as large as distance from either of these hairs to the nearest marginal hair more basad. Only posterior angles of tergite VIII with stippled wax glands, none in the middle of posterior margin. Antennae long, up to 3 times as long as width of head across and including the compound eyes. Front with very pronounced median process of 0.065 mm long. California.

T. californica spec. nov.

13 (12) Distance between middle posterior hairs on margin of abd. tergite VIII less than 2 times distance from either of these hairs to nearest marginal hair more basad. A broad zone of stippled wax glands along the margin of tergite VIII, also in the middle. Median frontal process not exceeding 0.055 mm.

14 (15) Row of hairs along posterior margin of abd. tergite VIII placed up to their length inwards from posterior margin of that tergite. Dorsal ornamentation virtually absent. More than posterior half of tergite VIII covered with stippled wax glands. Large fields of stippled wax glands around the marginal, pleural and spinal hairs of thorax and abd. tergites I—VII. Many States in North America; Europe.

T. cyperi (Wlk.) sensu latiore

15 (14) Row of hairs along posterior margin of abd. tergite VIII arranged on, or very nearly on, that margin. Dorsal ornamentation very conspicuous, consisting of short rows of 2—4 subacute spinules suggesting imbrication. Along the the median line stippled wax glands on abd. tergite VIII only on posterior 1/4—1/3 of the segment. Fields around spinal hairs on abd. tergites I—VI consisting of 0—10 glands. Utah.

T. utahensis Knowlton & Hall

16 (5) No wax glands visible or only a few on abd. tergite VIII.

17 (18) The 10—16 hairs on abd. tergite VIII thin, only about 0.015—0.030 mm

long. Dorsal ornamentation on abd. tergites II—V consisting of rather sharp, small spinules, often in short rows of 2—5, but distance between rows, or between isolated spinules at least 3 times diameter of spinule. Tergite at posterior margin not indented in the middle. Idaho, California.

T. scabra spec nov.

18 (17) The 6—10, mostly 8, hairs on abd. tergite VIII stout and stiff, the longest of the set 0.050—0.085 mm long, when rather short often somewhat blunted. Dorsal ornamentation on abd. tergites I—III mostly consisting of more or less flat, partly strongly transversely oval warts which may measure 0.010 mm in one direction, and which are not farther apart than their greatest length. Tergite VIII on posterior margin somewhat depressed or indented in the middle. Many North American States, also Europe.

T. verrucosa Gill. sensu latiore

Thripsaphis (Trichocallis) californica spec. nov.

Apterous viviparous female.

In life very pale yellowish white with glassy, transparent margins, more or less shiny; antennae dark; legs glassy. In mounted specimens body about 2.20—2.70 mm long, maximum width about 0.37 of length, pale with in the darkest specimens a faint browning along the very margin of abdomen, especially on abd. tergites VII and VIII, and with more distinct very thin, brownish intersegmental transverse lines. Spinal hairs on abd. tergite III 0.008—0.010 mm long; marginal hairs to 0.016 mm long; the 8—10 marginal, medium-thin, hairs on tergite VIII to 0.040 mm long, with middle posterior pair about 2½—3¼ times as far apart as distance to nearest more lateral hair. Stippled poriform wax glands clearly visible in the darkest specimens on their marginal pigmented areas, from tergites III to VIII; on the more anterior of these tergites around the marginal hairs; in quite pale specimens at most visible on tergite VIII, but rather frequently not visible, also because they may be on the edge of the body; legs and antennae apparently without wax glands. Integumentum on mid-dorsum with irregularly arranged, rather pointed nodules, shorter than their basal width of about 0.002 mm, in transverse direction about 3—4 times their own width apart, but in longitudinal direction much further apart; marginally these nodules are nearly absent, but where present they appear to be inclined caudad; from tergite VI caudad the nodules change to very short spinules in transverse rows of 2—3 on tergite VI, 2—7 on tergite VIII which looks spinulosely imbricated. Head with a median band of small blunt nodules which, more laterally, are much flatter, blunt, more disperse, and hardly visible. Front strongly, downwards, protruding with a rounded median process as long as ant. segment II with 2 pairs of hairs of about 0.035 mm long. Antennae 3/5—2/3 of length of body, with segments I, II, and about basal 1/3—1/2 of III pale, rest dark brown; flagellum with spinules on the straight, fine, imbrications; segment III without rhinaria, much longer than segment VI, with some 12—16 straight, acute hairs up to 3/5 as long as diameter of segment at its constricted base, about 14—17 times as long as its largest width. Rostrum reaching to half-way middle coxae; last segment half as long as second joint of hind tarsi, with 2 hairs besides the 3 subapical pairs. Legs as pale as body with only the second tarsal joints infuscated; tibiae to near base inconspicuously spinulose except ventrally, hind tibiae between 2/7 and 1/3 of length of body; apical tibial hairs not differentiated; first tarsal joints very spinulose, with 5 ventral hairs; second tarsal joints 1/5 of length of

hind tibia; empodial hairs fine. Porus of siphunculi about 0.035 mm in diameter, hardly raised. Tergite VIII roughly in the shape of a rectangle with sides of 0.065 and 0.035 mm of which the upper corners are replaced by quarter circles with a radius of half the short side; sides slightly convex, posterior margin faintly convex; disc without hairs. Cauda knobbed, the knob distinctly longer than wide, with 13—16 short hairs.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Cau.
1	2.66	1.72	0.52	0.34	0.33	0.18 + 0.19	0.15
2	2.34	1.60	0.48	0.31	0.31	0.18 + 0.16	0.12
3	2.63	1.74	0.53	0.36	0.32	0.18 + 0.18	0.13
4	2.67	1.77	0.53	0.35	0.33	0.19 + 0.18	0.13
5	2.55	1.57	0.47	0.31	0.30	0.17 + 0.16	0.12
6	2.63	1.65	0.48	0.34	0.32	0.18 + 0.17	0.14

(1—6, from *Carex* sp., Inverness, Point Reyes, California, U.S.A., 22.II.'64, leg. D.H.R.L. no. 148).

Discussion. The species might easily be mistaken for *Thripsaphis verrucosa* Gill. without rhinaria on ant. segment III, but the structure of abd. tergite VIII is quite different. In only a few specimens, the more pigmented ones, the wax glands are quite distinct.

Because the presence or absence of wax glands is such an unreliable character, I have made an effort to find other discriminants, such as chaetotaxy and the fine sculpture of the integumentum, for species of this genus. Quite good slides are needed for studying the sculpture of the integumentum.

The *Carex* on which this species occurred was a tall species with leaves of over 10 mm wide, growing in a ditch. It was thought to be *C. comosa,* but inflorescences were not available.

Types. Holotype: apterous viviparous female (measurements no. 6) from *Carex? comosa,* Inverness, Point Reyes peninsula, California, U.S.A., 22.II.'64, leg. D.H.R.L. no. 148. Paratypes: apterae viviparae with collecting data as for holotype.

Thripsaphis (Trichocallis) cyperi (Walker, 1848)

The most characteristic features of this species are the following: the marginal hairs on abd. tergite VIII stand far inwards from the posterior margin of that tergite, there are no hairs on the disc of this tergite, the antennae in adult apterae have secondary rhinaria, and the empodial hairs are not spatulate but setaceous. *T. caricicola* (Mordv.) is very similar, has the same exceptional arrangement of marginal hairs on abd. tergite VIII, but has, in all specimens studied, some extra hairs on the disc of that tergite, has no secondary rhinaria on the antennae in apterae, and spatulate empodial hairs. *T. cyperi* is widely distributed in the Nearctic and Palaearctic, but *T. caricicola* is only known from the Palaearctic Region.

T. vibei H.R.L., 1952, which has the hairs on abd. tergite VIII arranged as in

T. cyperi, was described from Greenland, where also a form with longer antennae occurs. Richards (1971) has listed *T. vibei* as a synonym of *T. cyperi,* but does not mention for which reason. Because *T. vibei* does not show the very elongate shape of *T. cyperi,* and has rather shorter antennae, it can easily be distinguished. In *T. vibei* the flagellum of the antennae in apterae is 0.9—1.0 times the greatest width of the body. In *T. cyperi* the flagellum is 1.4—1.8 times as long as the greatest width of the much more elongate body, depending on the degree of flattening of the body through mounting. *T. cyperi* subsp. *arctica* H.R.L., 1955, agrees with *T. cyperi* as to shape of body, but the absolutely shorter antennae are more like those of *T. vibei,* and therefore I (1960) treated it as a subspec. of *T. vibei.* In this subspecies the flagellum of the antennae in apterae is 1.15—1.25 times as long as the greatest width of the body.

As yet *T. vibei* is only known from two good samples from Greenland, *T. vibei* subspec. *arctica* H.R.L. from one sample from Greenland, and seven samples from Iceland; it produces sexuals in Greenland at the end of July, in Iceland in the beginning of August. *T. cyperi* is known from the more northern States of U.S.A., e.g., Minnesota, and in a broad belt across Canada at least as far north as Labrador, in Europe from west to east reaching to the north as far as Northern Sweden, and to the south into the Alps; as far as known its sexuals are produced in the autumn.

Thripsaphis (Trichocallis) hybrida spec. nov.

Apterous viviparous female.

Colour in life not known. In mounted specimens body 2.20—2.45 mm long, about 3 times as long as its largest width; seemingly evenly pale, with abd. tergite VII posteriolaterally, and tergite VIII marginally and caudally smoky brown, but actually colourless intersegmental lines between segments posteriorly bordered by pale brown visible on abdomen. Tergum densely covered with flat-topped, small, oval warts of up to 0.006 mm in the longest, transverse axis, and these warts very often divided in two equal parts; laterally warts much smaller and even pointed, and on tergites VII and VIII also medially passing into spinulose imbrications; the ornamentation much as in *T. verrucosa* Gill., but warts smaller. Dorsal hairs on tergite III about as long as the width of the nearest wart, cephalad of the siphunculi marginally not longer, but tergite VII (and mostly VI, sometimes V) marginally with stout, sharp hairs of 0.030—0.055 mm; tergite VIII, only marginally, with 8—11 slightly longer, stout hairs of which the middle posterior pair stands not or hardly farther apart than the other hairs; no hairs on the disc of tergite VIII. Wax glands indistinctly present on posterior margin of tergite VIII. Head with small, blunt nodules; front strongly protruding but not quite as far as the length of ant. segment II, with 2 stoutish sharp or blunt hairs 0.040—0.045 mm long; more laterally and caudad two shorter hairs on low processes. Antennae with segments I, II and basal part of III pale, rest dark brownish; flagellum imbricated with very short spinules on the imbrications; segment III about 9—12 times as long as its largest width, without rhinaria and glands, just longer than segment VI, with 6—9 hairs up to half as long as diameter of segment at its constricted base. Rostrum not nearly reaching middle coxae; apical segment about half as long as second joint of hind tarsi, with 2 short hairs besides the 3 subapical pairs. Legs pale, with tarsi distad brownish; tibiae especially dorsally spinulose from base to apex; hind tibiae ¼ of length of body; apical tibial hairs not differentiated; first tarsal joints with 5 ventral hairs; second joints less than ¼ of

length of hind tibiae; empodial hairs setaceous. Siphunculi slightly elevated, on the margin of tergite VI which is densely covered with small, just blunt, nodules. Tergite VIII semicircular to semioval, evenly rounded also on posterior margin, about 4/7 times as long as its basal width, with anterior middle portion pale, rest dark smoky brown. Cauda pale, the knob trapezoid, as long as wide, with 14—16 short hairs.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Cau.
1	2.44	1.14	0.32	0.19	0.19	0.13 + 0.14	0.12
2	2.21	0.97	0.27	0.16	0.15	0.12 + 0.12	0.11

(1—2, from *Carex* sp., Wheeler Springs (Ventura Co.), California, U.S.A., 19.V.'61, leg. R. van den Bosch, no. 61—V—19 r).

Discussion. The two specimens of *T. hybrida* were part of a rather large sample, no. 61—V—19 r, collected by Dr. R. van den Bosch. In the sample the following different apterous forms could be distinguished.

1. *T. ossiannilssoni pacifica,* described on p. 145.
2. *T. verrucosa* Gill., one quite typical specimen with rather large, flat warts from pronotum to abd. tergite VI, a distinct flat furrow between two scabrous protuberances on the posterior margin of abd. tergite VIII, and some rhinaria on segment III of the long antennae.
3. *T. hybrida,* two specimens with small warts mostly in pairs suggesting small transversely oval warts, an evenly rounded tergite VIII with traces of stippled wax glands on N.E. and N.W. part near the margin, and short antennae without secondary rhinaria.
4. Specimens with the dorsal ornamentation exactly as in *T. hybrida,* but with abdominal tergite VIII rather as in *T. verrucosa,* with the flat furrow in the middle of posterior margin, and the two stout hairs beside it on a scabrous, very little pronounced, elevation; antennae without secondary rhinaria.
5. Specimens much like no. 4, but covered with very small nodules in transverse rows, seemingly without a trace of warts, except on the middle of mesonotum where they appear to be subdivided. Antennae without secondary rhinaria.

I should add that in nos. 2—5 the hairs on tergite VIII are all stout as in typical *T. verrucosa.*

One wonders what happened on this plant. Are these various types the products of hybridization? With that in mind I proposed the name *T. hybrida* for no. 3. They are like an intermediate hybrid between *T. ossiannilssoni,* and nos. 4 and 5, which I describe on p. 151 as *T. verrucosa subverrucosa* subspec. nov.

It should be emphasized that the differences in the structure of abd. tergite VIII are not artifacts. All the specimens were remounted and regained their shape completely in water, and kept it subsequently in rather thick slides.

Types. Holotype: apterous viviparous female (measurements no. 1), from *Carex* sp., Wheeler Springs (Ventura Co.), California, U.S.A., 19.V.'61, leg. R. van den Bosch no. 61—V—19 r. Paratype: aptera vivipara with collecting data as for holotype.

Thripsaphis (Trichocallis) ossiannilssoni pacifica subsp. nov.

Apterous viviparous female (from one specimen).

Colour in life not known. In mounted specimen body about 3 times as long as its greatest width; head pale; thorax laterally with smoky, sclerotic areas; abdomen with caudad larger and darker marginal sclerites on each segment, and with very vague, paired, widely separated, short, spino-pleural sclerotic bars which on tergite VII are fused to one bar, and very nearly so on tergites V and VI; sclerotisation slightly more distinctly pigmented on posterior tergites; tergite VIII about as dark as marginal sclerites on tergite VII. Hairs on dorsum very short, spinally on tergite III about 0.004 mm long, marginally about 0.009 mm; tergite VIII only along its margin with 12 much stouter, acute hairs 0.030—0.065 mm long, but no hairs on its disc. Wax glands of the stippled pore variety only visible around the marginal hairs of abd. tergites I—VI, over most of the marginal sclerites of tergite VII and on most of tergite VIII except the middle anterior part; I cannot find them on antennae or legs. Dorsum only distinctly spinulose where it is pigmented, the spinules very small, not longer than wide at base, and rather blunt, in rather short rows, rather far apart. Head seemingly smooth because it is pale; front protruding about as far as ant. segment II is long. Antennae darker than head; segment III about 6½ times as long as its maximum width, without rhinaria; segment VI considerably longer than III; flagellum faintly imbricated with rather inconspicuous and widely spaced spinules on the imbrications; longest of the very few hairs on segment III half as long as diameter of segment at its much constricted base. Rostrum reaching the middle coxae; last segment with 2 hairs besides the 3 subapical pairs, about 4/7 of second joint of hind tarsi. Legs rather short, pale with bases of tibiae slightly darker than apices; tibiae on distal half slightly spinulose, very faintly so dorsally on basal half; hind tibiae about ¼ length of body; apical tibial hairs not differentiated; first tarsal joints with 5 ventral hairs; second joints about ¼ the length of the corresponding tibiae; empodial hairs fine, setaceous. Siphunculi nearly poriform, not measurably elevated, on the marginal sclerite of abd. tergite VI. Tergite VIII semicircular, caudally hardly flattened. Cauda with strongly transverse knob, with 13 rather short hairs.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Cau.
1	1.74	0.76	0.17	0.12	0.13	0.12 + 0.11	0.08

(1, from *Carex,* Wheeler Springs (Ventura Co.), California, U.S.A., 19.V.'61, leg. R. van den Bosch 61—V—19 r).

Discussion. *Thripsaphis ossiannilssoni* H.R.L. is now known from the Netherlands to Japan (Higuchi, 1972), and specimens from various European countries hardly differ from Japanese material. All have a number of often very inconspicuous hairs on the disc of abd. tergite VIII besides the much longer and thicker hairs along the margin. Mostly one sees only the bases of these hairs as perforations in the dark tergite. However, in the Californian specimen there is no trace of such hairs.

T. ossiannilssoni can easily be recognized with the key on p. 139—141.

Type. Holotype: apterous viviparous female, from *Carex* sp., Wheeler Springs (Ventura Co.), California, U.S.A., 19.V.'61, leg. R. van den Bosch no. 61—V—19 r.

Thripsaphis (Trichocallis) producta Gillette, 1917

Under this name Gillette (1917) and Palmer (1952) very clearly described, or figured part of, the species which Richards (1971) described as *Allaphis thripsoides* Hille Ris Lambers. Under *Allaphis thripsoides,* Richards writes that *Thripsaphis foxtonensis* Cottier, 1953, is a synonym and he quotes also Eastop (1966) in this context. Eastop, however, separated the two species. They are closely related but totally different. The types Dr. Cottier gave me show in the apterae antennae of 1.80 mm long, fully twice as long as in average *thripsoides* = *caricis* Mordv., and nearly reaching to abd. tergite VI. Also the alatae are very different, by having broad, black sclerotic, quite free bars across the abdomen instead of a solid sclerite like *T. caricis* Mordv. This is clearly shown in Cottier's figures.

The confusion about *T. producta* appears to be that the type-specimen in the U.S. National Museum does not agree with the original and Palmer's (1952) description. [1]) This is not very surprising. Not until 1932 did Gillette and Palmer mention types for their species, and the unfortunate mix-up with *T. ballii* is clearly shown in Gillette & Palmer (1931) where the VIIIth abdominal tergite of *ballii* is drawn over the caption *T. producta.*

American *T. producta* is not the same as European *T. caricis,* though the two are extremely alike. There is a consistent difference in the pattern of the nodules on the abdominal tergum. In *T. caricis* they are small on the middle of the body, often subacute, and invariably arranged in somewhat wavy, often coalescing, very long transverse rows. In *T. producta* from America the nodules are larger and if there are rows, they consist of 2—3 nodules.

T. thripsoides = *caricis,* and *T. producta* are said by Eastop (1966), and consequently Richards (1971), to have no wax glands, or cribriform discs. They are clearly visible in specimens, especially near-adult larvae and apterae viviparae, with a dark eighth abd. tergite, along its sides, and in larvae also on the marginal sclerites. In pale adults they are invisible.

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[1]) The type slide, borrowed from the U.S. National Museum, Washington, D.C., (Cat. no. 41948) contains an alate and an aptera vivipara both indicated as type, and an alate indicated as paratype. All are indeed *Thripsaphis ballii* (Gillette) as stated by Richards (1971) and confirmed by Quednau. It has very clearly been relabelled in the handwriting of ? C. P. Gillette. Under the right - hand label is another label on which the original name, which I could not read, is obliterated by a narrow strip of paper on which the name "T. producta n. sp." is written. The specimens were found "on Carex sp. / 6-3-1915 / Ft. Collins, Colo. / Coll. L. C. Bragg / Colo. Agr. Exp. Sta. /Ac. 1005". Another slide labelled metatype, with one label "Thripsaphis / producta n. sp. / on Carex / 8.17.07 / Ft. Collins, Colo / C. P. G. Coll", contains 6 apterae viviparae and two larvae which are in excellent condition and agree with the original description. It is quite clear that an error in labelling has been made when about 1932 types were indicated by C. P. Gillette and/or M. A. Palmer.

I made a formal proposal to the International Commission on Zoological Nomenclature to approve the designation of a lectotype of *Thripsaphis producta* Gill. that agrees with the original description.

It is the lowest specimen on the right, on slide: U.S. Nat. Museum no. 73040, labelled on the left: "Thripsaphis / producta / Gilette, 1917 / lectotype (at arrow) / and paratypes / D. Hille Ris Lambers, 1973". On the right labelled as mentioned above for the metatype.

Thripsaphis (Trichocallis) scabra spec. nov.

Apterous viviparous female.

Colour in life not known. In mounted specimens body evenly yellowish, 2.40—2.90 mm long, about 2½ times as long as its maximum width which is on the posterior third of the body. Spinal hairs on abd. segment III thick, inconspicuous, about 0.007 mm long, marginal hairs 0.009 mm, all sharply curved backwards; the 11—16 hairs on tergite VIII mostly strongly curved near the middle, the longest (median posterior pair) 0.022—0.034 mm long, the shortest 0.013 mm long; often a few hairs on tergite VIII far from its margin; distance between the median posterior pair about 0.065—0.070 mm, to the nearest hair 0.040—0.065 mm. No traces of wax glands visible on any part of the body. Integumentum densely covered with mostly rather blunt nodules, on middle of mesonotum with basal width of about 0.004 mm, at mutual distances of 0.007—0.010 mm; more caudad these nodules smaller, subdivided and more acute, in rows of 2—3; on tergite VI acute and in rows of 2—4; on tergite VIII very small, in long wavy transverse lines of 10—30 spinules, but larger and in short rows on the margins of that segment. Head with a very broad median band of small nodules, and more inconspicuous, scattered ones more laterally. Front with a large median bulge, which protrudes about as much as the length of ant. segment II; this bulge not a marked process, in the middle with 2 pairs of hairs of about 0.030—0.035 mm, one above the other, but sometimes below the upper pair an extra pair of hairs half as long. Antennae 3/5—7/10 of length of body, with segments I, II and basal 1/2—2/3 part of segment III pale, the rest dark brown to black; flagellum faintly imbricated and imbrication more or less denticulate, not spinulose on segments III—V, but on VI very indistinctly spinulose; in specimens from Idaho with 0—1 rhinarium (5 segments with together 1 rhinarium), in specimens from California with 1—3 always quite small and inconspicuous rhinaria on III, half-way or past middle of segment; segment 14—18 times as long as its largest width, with 16—20 small hairs up to 2/5 of diameter at its constricted base. Rostrum unusually short, not reaching mesosternum, last segment triangular with slightly convex sides, acute, only 1/3—3/8 of length of second joint of hind tarsi, with 2 hairs besides the 3 subapical pairs. Legs faintly tinged; tibiae over about ¾ of their length only somewhat spinulose on dorsal surface and also near apex with rather few spinules; hind tibiae about ¼ of

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Rhin. on III	Cau.
1	2.62	1.54	0.50	0.27	0.27	0.16 + 0.17	1 & 2	0.12
2	2.57	1.88	0.57	0.37	0.34	0.20 + 0.19	1 & 1	0.12
3	2.47	1.68	0.55	0.31	0.29	0.18 + 0.18	1 & 2	0.12
4	2.79	1.57	0.52	0.31	0.26	0.15 + 0.17	2 & 3	0.13
5	2.68	1.58	0.52	0.30	0.27	0.16 + 0.17	1 & 1	?
6	2.55	1.54	0.51	0.29	0.26	0.16 + 0.16	0 & 0	0.12

(1—5, from *Carex* sp., U. C. Sagehen Creek (Sierra Co.), California, U.S.A., 18.VII.'67, leg. D. Calvert no. C 67—7—18 a; 6, from "grass", Cascade, Idaho, U.S.A., 18.VI.'54, leg. G. F. Knowlton no. 495).

length of body, their apical hairs not differentiated; first tarsal joints normally spinulose, with 5 ventral hairs; second tarsal joints of hind legs ¼ of length of hind tibiae; empodial hairs setaceous. Porus of siphunculi about 0.040 mm wide, hardly raised. Tergite VIII in the shape of a rectangular triangle with hardly convex sides the top of which is replaced by a circle with the length of the segment as radius; length 0.45 times base; posterior margin evenly curved, not indented in the middle. Cauda with the knob 1.1 times as wide as long, rather evenly rounded, with 12—14 hairs.

Alate viviparous female.

Colour in life not known. In mounted specimen body about 2.15—2.50 mm long, elongate; head laterally blackish brown with a pale median stripe and a pale brownish area mesad of each eye; thorax unevenly dark, abdomen with large, dark brown marginal sclerites and with broad, paler brownish spino-pleural cross-bars on each tergite; the bars are narrower laterally, tend to fade or disappear in the middle on tergites I—III, are fused with marginal sclerites only on tergites VI and VII, sometimes V, and may be fragmentary on tergites I—III; tergite VIII evenly dark brown. Mesonotum with small, very elongated nodules, but sclerites on abdomen only with long, wavy lines of small, blunt spinules. Bulge on front lower than in apterae. Antennae 3/4—4/5 of length of body, blackish, with the very base of segment III paler, with only processus terminalis very indistinctly spinulose; segment III with 9—11 ciliate, larger and smaller rhinaria more or less in one row, larger ones transversely oval, distal 1/6—1/5 part without rhinaria. Fore wings long and narrow, with thick brown veins; sector radii very short, sometimes hardly developed, very little curved; radial cell not or hardly wider than stigma. Legs brown to dark brown, rather slender. Knob of cauda brownish black. Other characters as in apterous viviparous females.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Rhin. on III	Cau.
1	2.15	1.56	0.52	0.33	0.27	0.14 + 0.16	9 & ?	0.12
2	2.47	1.91	0.65	0.36	0.33	0.18 + 0.21	10 & 11	0.12
3	2.30	1.88	0.64	0.36	0.33	0.19 + 0.18	10 & 10	0.12

(1—3, from *Carex* sp., U. C. Sagehen Creek (Sierra Co.), California, U.S.A., 18.VII.'67, leg. D. Calvert no. C 67—7—18 a).

Embryos. Marginal hairs spiny, from 0.016 mm on abd. segment III to 0.030 mm on segment VII. Spinal and pleural hairs smaller, from 0.006, to 0.012 on tergite VII; hairs on tergite VIII about 0.040 mm long.

Discussion. One sample of 5 good apterae and 4 alatae, one without head, is available from California, and a sample of 4 much damaged apterae from Idaho. The samples differ very little except in the number of rhinaria in the apterae. The California sample was mixed with *Thripsaphis verrucosa* Gill., of which one aptera and one alata was present. This made it possible to decide that the differences between the two highly similar species were not caused bij eco-factors. But something else may cause confusion. In the bodies of these aphids one may find larvae of hymenopterous parasites with a very

warty skin similar to that of *T. verrucosa,* but with the warts more closely packed. Such a larva in *T. scabra* might lead to misidentification. Then the different shape of abd. tergite VIII or the much less reliable shape of the front could help.

Alatae of both species have more pronounced differences in frontal structures, but also the sculpture on the sclerotic parts of the abdomen is very different. On tergites II—V this consists pleurally in *verrucosa* of transversely oval warts with 2—4 blunt, dark spinules on their posterior margin but in *T. scabra* there are only rows of 3—7 spinules.

It is doubtful whether the curious shape of the sector radii is a good discriminant. The veins in this sample show often some extra forks, and therefore the shape of the sector radii might be teratological.

Types. Holotype: apterous viviparous female (no. 1 of measurements), from *Carex* sp., Univ. of Calif. Sagehen Creek (Sierra Co.), California, U.S.A., 18.VII.'67, leg. D. Calvert, no. C 67—7—18 a. Paratypes: apterous and alate viviparous females with collecting data as for holotype; apterae viviparae (damaged), from "grass", Cascade, Idaho, U.S.A., 18.VI.'54, leg. G. F. Knowlton.

Thripsaphis (Trichocallis) utahensis Knowlton & Hall, 1950

Richards (1971) classifies this species as an *Allaphis* Mordvilko, which in Richards' sense is "without clusters of wax pores". Through the kindness of Dr. Louise M. Russell I could borrow the type slide from the U.S. National Museum, Washington, D.C. This contains three remounted specimens: one adult apterous viviparous female, one alatoid nymph, and one alate viviparous female. The aptera, which I choose as lectotype, and the alatoid nymph have large fields of wax glands on abd. tergite VIII, around the posterior spinal hairs and marginally on abdomen. A slide marked "Paratypes IV", from: grass sweeps, Logan, Utah, 15.V.'43, borrowed from the U.S. Nat. Museum, contains two apterae viviparae in which the wax glands are also quite distinct although these specimens are still in balsam.

Thripsaphis (Trichocallis) verrucosa Gillette, 1917

The published descriptions seem to cover three taxa which are treated as subspecies. They key as follows:

1 (2) In apterae legs and antennae dark to blackish brown, and also body conspicuously brown with a pale median stripe, and dark brown intersegmental transverse lines. Tergum evenly covered with semiglobular or slightly transverse nodules, little larger than the socket of a dorsal hair, but taller. Ant. segment III with rhinaria. In alate mesonotal lobes with randomly arranged, nearly round nodules. On *Carex.* Labrador and Alaska. *T. verrucosa nodulosa* subspec. nov.

2 (1) In apterae legs pale, antennae with at least segments I and II and a basal portion of segment III pale. Ornamentation of tergum of a different kind. Ant. segment III with or without rhinaria.

3 (4) In apterae ant. segment III without rhinaria in all available samples. Antennae about half as long as body or shorter. Integumentum on mesonotum to abd. tergite III sometimes with large, quite flat, transversely oval or eye-shaped warts

but mostly subdivided into 1—3 nodules on their posterior half, caudally and medially soon splitting into pairs or triplets of small warts; undivided larger warts at least in one direction farther apart than their own longest axis; on margin of body warts rather acute and all inclined caudad. Sclerotic bars on abdomen of alate ornamented with rows of tiny, acute spinules not on the posterior margin of flat scales. S.W. California.

T. verrucosa subverrucosa subspec. nov.

4 (3) In available material at least one ant. segment III with one or more rhinaria on distal half. Antennae rarely half as long as body, usually considerably longer. Integumentum from pronotum to about abd. tergite VI in the middle covered with eye-shaped or strongly transversely oval, never subdivided, very flat warts, which stand at most as far apart as their shortest axis, while their longest axis is about as long as the dorsal hairs on these tergites. On more posterior tergites spinules appear on the posterior margin of the warts. Alatae on mesonotal lobes with oblique rows of strongly oval nodules, on the sclerotic bars of abdomen with transverse oval warts bearing small spinules on posterior half (Photograph 10 b, p. 14 in Richards, 1971). All European material, and samples from Colorado, Utah, California and Quebec. May occur mixed with the preceding subspecies. (*T. leporinae* Börner).

T. verrucosa verrucosa Gill.

Thripsaphis verrucosa **nodulosa** subsp. nov.

Apterous viviparous female.

Colour in life not known. In mounted specimens body 2.45—2.85 mm long, spindle-shaped, with largest width at abd. segment I at about the middle of the body, conspicuously brown with a pale median stripe from head to tergite VI, VII or VIII, with interrupted, pale, membraneous, intersegmental lines, bordered caudad by narrow, dark brown lines across the abdomen. For dorsal ornamentation see key to subspecies. Median depression on posterior margin of abd. tergite VIII distinct, but the scabrous processes on both sides very low. In those specimens in which tergite VIII is slightly elevated, distinct wax glands or cribriform discs visible at the level of the marginal hairs, especially distinct in no. 4 in the table below. Antennae dark brown to black with only the very base of segment III pale; segment III with many more rhinaria than in the main species. Legs dark brown to brownish black, only seemingly not much spinulose. Other characters more or less as in *T. verrucosa* sensu stricto.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Rhin. on III	Cau.
1	2.60	1.43	0.47	0.27	0.21	0.15 + 0.13	5 & 7	0.15
2	2.63	1.47	0.46	0.28	0.23	0.16 + 0.15	6 & 6	0.15
3	2.64	1.40	0.47	0.26	0.19	0.17 + 0.15	4 & 6	0.15
4	2.54	1.39	0.47	0.27	0.21	0.15 + 0.13	7 & 7	0.15
5	2.69	1.67	0.57	0.33	0.29	0.16 + 0.15	6 & 7	0.15
6	2.78	1.66	0.56	0.30	0.29	0.18 + 0.15	5 & 6	0.15

(1—4, "Emergent vegetation", S. Carter Basin (Labrador), Canada, 5.VIII.'58, leg. B.S.E.S., British Museum no. 1958—490; 5—6, from *Carex* sp., Juneau, Alaska, U.S.A., 26.VII.'61, leg. F. C. Hottes no. 10).

Alate viviparous female.

Colour in life not known. Material in very poor condition, but clearly as dark as apterae. Ant. segment III with 13—17 rhinaria.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Rhin. on III	Cau.
1	2.90	?	0.77	0.38	0.32	0.18 + ?	17 & ?	0.16

(from *Carex* sp., Juneau, Alaska, U.S.A., 26.VII.'61, leg. F. C. Hottes no. 10).

Discussion. The two samples of the subspecies are very much alike, but differ considerably from all other material of *T. verrucosa*. Both come from rather far north, and they could be modifications by low temperature. Yet they grew up during the hottest part of the year, and they are much darker than samples that grew up early at high altitude. The Alaska sample, from July, has one apterous male. This suggests that production of this sex is not induced by short day and low temperature in this subspecies. In European and Colorado populations of the main species sexuals are produced in late autumn.

The discovery of wax glands on abd. tergite VIII in viviparae of this subspecies with its dark tergites suggest that these glands may well be present in the other, pale subspecies. Even in dark forms they are very inconspicuous because in "good" preparations, with a quite horizontal tergite VIII, they are in the plane of the optical axis.

Types. Holotype: apterous viviparous female (measurements no. 1), in "emergent vegetation", S. Carter Basin, Labrador, Canada, 5.VIII.'58, leg. B.S.E.S., British Museum no. 1958—490; paratypes: apterous viviparous females with collecting data as for holotype; apterae viviparae, two damaged alate viviparae and one apterous male, from *Carex* sp., Juneau, Alaska, U.S.A., 26.VII.'61, leg. F. C. Hottes no. 10. Holotype deposited in British Museum (Nat. Hist.) where also most paratypes from the same sample are.

Thripsaphis verrucosa subverrucosa subsp. nov.

Apterous viviparous female.

Colour in life not known. Mounted specimens 1.90—2.50 mm long, elongate spindle-shaped with largest width mostly at metanotum, faintly brownish-yellow with narrow, light brown, pleural intersegmental transverse lines, marginally slightly darker because of the nodules in profile. For dorsal ornamentation see key to subspecies. Median furrow on posterior margin of tergite VIII not very distinct. Antennae with at least segments I, II and basal half of III pale, the rest brownish black. Legs coloured like the body; tibiae conspicuously spinulose till base, except on the caudal side of the base. Other characters as in *T. verrucosa* sensu stricto.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Cau.
1	2.44	1.24	0.38	0.23	0.20	0.15 + 0.14	0.11
2	1.97	0.99	0.27	0.17	0.17	0.14 + 0.13	0.10
3	2.00	1.00	0.30	0.16	0.17	0.13 + 0.13	0.10
4	2.27	1.15	0.34	0.21	0.18	0.14 + 0.15	0.11
5	2.01	1.09	0.32	0.19	0.17	0.14 + 0.14	0.10
6	2.37	1.13	0.33	0.20	0.17	0.16 + 0.13	0.11
7	2.36	1.13	0.33	0.20	0.18	0.15 + 0.13	0.11
8	2.45	1.04	0.32	0.17	0.16	0.15 + 0.12	0.11

(All from *Carex* sp., California, U.S.A., 19.V.'61, leg. R. van den Bosch; 1—2, Wheeler Springs (Ventura Co.), no. 61—V—19 r; 3—4 Matilija (Ventura Co.), no. 61—V—19 s; 5—8, Gorman (Los Angeles Co.), no. 61—V—19 t).

Alate viviparous female.

Colour in life not known. For ornamentation of abdomen see key. Lobes of mesonotum not well visible but with oblique rows of rather dispersed spinules besides an indistinct pattern of broad oblique striae. Other characters as in *T. verrucosa* sensu stricto.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Rhin. on III	Cau.
1	2.19	1.53	0.49	0.31	0.25	0.17 + 0.17	8 & 11	0.11

(with apt. viv. fem. nos. 1—2).

Discussion. Dr. van den Bosch was after hymenopterous parasites of *Carex* aphids, and in one trip collected in three places, probably on the same *Carex*. The Wheeler Springs sample was a mixture of *T. verrucosa* sensu stricto, the subspecies described above, a species described in this paper as *T. hybrida,* and one *T. ossiannilssoni*. The other samples are quite homogeneous.

The absence of rhinaria in all the apterae made me think that perhaps the specimens were fundatrices of *T. verrucosa* sensu stricto. That, however, is not so likely because there was also an alate, which clearly belongs with the apterae.

The subspecies is not a typical California form of *verrucosa* in as much that also quite normal *verrucosa* from several other localities, and even from Wheeler Springs, are available.

Types. Holotype: apterous viviparous female (measurements no. 6) from *Carex* sp., 3 miles S.E. of Gorman (Los Angeles Co.), California, U.S.A., 19.V.'61, leg. R. van den Bosch no. 61—V—19 t. Paratypes: apterae viviparae with collecting data as for holotype; apterous viviparae and one alate viviparous female with collecting data as mentioned under measurements 1—4.

Uroleucon sijpkensi spec. nov.

Apterous viviparous female.

Colour in life brown, with black siphunculi, pale cauda, pale legs, and pale antennae with dark apices. In mounted specimens body 2.80—3.35 mm long, broadly spindle-shaped. Dorsal hairs stiff, with spear-shaped apices, spinally on abd. tergite III to 0.065 mm long, on tergite VIII slightly longer, nearly all placed on brown scleroites up to 0.050 mm in diameter; no trace of an antesiphuncular sclerite present, but postsiphuncular sclerites well developed; tergite VIII with 4 hairs. Marginal tubercles on abd. tergites II—IV mostly present, dark, and smaller and flatter than the socket of a dorsal hair, hardly visible on a small sclerite between two marginal hairs. Head light brown, smooth. Frontal tubercles strongly diverging; depth of frontal furrow just over ¼ of distance between antennal bases. Antennae considerably longer than body; segment I slightly darker than head; segment II as dark as head; segment III with part bearing rhinaria darker to very much darker than head, basal and apical part conspicuously paler, the very apex dark brown to blackish, with 17—36 faintly protruding rhinaria of very variable size, with bulging membranes, mainly along one side over basal 4/7—2/3 part of segment; segment IV basally about as pale or dark as distal part of segment III, apicad darker, to brownish black like the rest of flagellum; proc. terminalis longer than segment III, 5½—6 times as long as basal part of segment VI; longest hairs on segment III slightly longer than basal diameter of segment. Rostrum (stylets) reaching to hind coxae; last segment about 0.18—0.20 mm long, about 1 1/3 times second joint of hind tarsi, with 7—10 accessory hairs. Legs evenly yellowish, to slightly brownish yellow, with the femora dorso-apically on distal 1/4—1/5 (hind legs) to distal 1/3 (fore legs) suddenly brown to blackish brown, tibiae similarly dark at the articulation, and on distal ¼ part; first tarsal joints with 5 or often, on some legs, with 4 hairs. Siphunculi evenly black, rather variable in length, from 2/9—3/11 of length of body, tapering from the thick base, with distal 1/3—1/4 part cylindrical and there 1 1/5 times as thick as mid portion of hind tibiae, with distal 1/4—2/7 reticulated, the rest to the very base slightly and inconspicuously imbricated. Cauda pale, ensiform and nearly 3 times as long as width at its very base, slightly blunt, with 12—18 hairs of two conspicuously different sizes, all with fine apices.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Rhin. on III	Siph.	Cau.
1	3.23	3.69	0.93	0.69	0.59	0.19 + 1.06	20 & 21	0.77	0.53
2	3.31	3.69	0.93	0.71	0.59	0.18 + 1.04	30 & 34	0.88	0.57
3	3.06	3.53	0.86	0.65	0.55	0.18 + 1.05	19 & 19	0.68	0.51
4	3.26	3.66	0.91	0.73	0.57	0.17 + 1.02	30 & 36	0.87	0.55
5	2.89	3.58	0.87	0.68	0.57	0.17 + 1.03	25 & 26	0.68	0.47
6	3.13	3.58	0.88	0.68	0.57	0.18 + 1.04	21 & 22	0.71	0.48
7	3.14	3.53	0.86	0.66	0.55	0.18 + 1.03	18 & 22	0.72	0.53
8	2.97	3.40	0.85	0.63	0.54	0.18 + 0.97	17 & 19	0.70	0.47

(1—8, from *Solidago macrophylla,* Gaspé Nat. Park, Quebec, Canada, 16.VIII.'65, leg. J. P. Sijpkens no. 94).

Oviparous female.

Like apterous viviparous female, but abd. tergite VIII with up to 8 hairs; hind tibiae quite yellow with short black socks, considerably swollen to up to 2½ times maximum width of other tibiae, with a great many pseudosensoria. Siphunculi thinner, from a thick base rapidly tapering to the cylindrical distal 2/3—3/4 part, rather scabrously imbricated from base to reticulated area. Cauda much shorter and also thicker.

Measurements in mm.

No.	Length body	Ant.	Ant. segments III	IV	V	VI	Rhin. on III	Siph.	Cau.
1	3.04	?	0.96	0.80	0.64	0.19 + ?	29 & 31	0.80	0.45
2	3.11	3.66	0.92	0.75	0.66	0.20 + 0.87	29 & 33	0.99	0.45

(1—2, with the apterae viviparae).

Discussion. The principal character of this species is the paleness of the legs. In quite a number of brown North American *Uroleucon* (formerly *Dactynotus*) the tibiae are partly pale and transparent on the basal half, at least in apterae viviparae. But then the hind tibiae in oviparae (as far as known) are evenly black. In *U. sijpkensi* the hind tibiae are yellow also in oviparae with only a small part at the apex blackish.

Dr. A. T. Olive, to whom I sent a slide, identified this as *U. nigrotuberculatum* (Olive). Biometrically it agrees with that species, also in the tiny dark marginal tubercles, but not in the pigmentation of the flagellum and of the hind tibiae which are blackish in paratypes, in other material identified by Dr. Olive, and in several Canadian samples. The siphunculi in viviparae of *U. nigrotuberculatum* are, with the exception of few often invisible imbrications on the underside very near the base, completely smooth to near the reticulated area. In *U. sijpkensi* they are very lightly imbricated in apterae viviparae, but conspicuously imbricated in oviparae.

Two apterae from *Solidago* sp. in Canada were sent to Dr. W. R. Richards in Ottawa who confirmed my suspicion that they were his *U. pieloui*. The apterae in that sample have a considerable part of the tibiae pale, but about halfway they become dark towards the apex. The oviparae have evenly black hind tibiae. The flagellum is black with only the very base of segment III paler. I have not succeeded in finding a difference between *pieloui* and the earlier described *U. hieracicola* (H.R.L.), of which *pieloui* may well be a synonym.

U. sonchellum (Monell) strongly resembles *U. sijpkensi* spec. nov. in the pigmentation of tibiae, but the femora are more extensively black at the tips, and the short siphunculi, and the extremely long ant. segment III with its many rhinaria exclude confusion with *U. sijpkensi.*

According to Dr. Sijpkens the aphids infested the inflorescences of their host. It is remarkable that oviparae, one teneral, the other old, were collected as early as the middle of August, together with the apterae viviparae.

The species is named after my compatriot and friend, the late Dr. J. P. Sijpkens, who made very carefully documented collections of aphids in many parts of the world.

Types. Holotype: apterous viviparous female (measurements no. 6, in one slide with an ovipara), from *Solidago macrophylla,* Gaspé Nat. Park, Quebec, Canada, 16.VIII.'65, leg. J. P. Sijpkens no. 94. Paratypes: apterous viviparous females, larvae and oviparae with collecting data as for holotype. Some paratypes in the collection of Dr. A. T. Olive, Winston-Salem, North Carolina, U.S.A.

TYPES

Unless otherwisely stated, types of new species and subspecies described in this paper are in the author's collection.

Acknowledgements

The ready cooperation of the following colleagues, who sent valuable material as gifts or on loan, or established the identity, of species mentioned in this paper is gratefully acknowledged: Drs. R. van den Bosch; Maria P. Bozhko; R. C. Dickson; V. F. Eastop; W. D. Fronk; G. F. Knowlton; the late C. F. Lagace; A. T. Olive; Miriam A. Palmer; W. R. Richards; Louise M. Russell; the late J. P. Sijpkens; H. L.G. Stroyan; D. J. Voegtlin; H. Weidner; and especially G. Ch. Shaposhnikov who refound and made available Mordvilko material of crucial importance.

Mrs. M. Hielkema-Visser made the drawings in this paper.

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REVIEW OF CENTRAL AND EAST ASIATIC HABROPODA F. SMITH, WITH HABROPHORULA, A NEW GENUS FROM CHINA (HYMENOPTERA, ANTHOPHORIDAE)

by

M. A. LIEFTINCK
"Kalliste", Rhenen U., Netherlands

With 1 table and 100 text-figures

Contents

INTRODUCTION

The object of the present paper is to round off, as far as possible, my investigations of the general morphology and specific characters of the anthophorine genus *Habropoda*, the emphasis being laid on the members inhabiting Central and East Asia. In a former paper (Lieftinck, 1966) I have treated this genus in a more general way in connection with allied genera, pointing out and illustrating the characters of the type species, *Habropoda tarsata* (Spin.) and five of its immediate allies which occur in the western part of its range, i.e. the Mediterranean region and western Asia. A sixth species of the same group, *H. pekinensis* Ckll. from East Asia, which I had not yet seen, is included in the present article.

In my previous account brief comments were already given on the remaining taxa, ten in number and all from Asia, but as these had not been studied in any detail, all were left as species requiring further investigation. It must be said at the outset, that of the species just mentioned one, *nubilipennis* Cockerell, originally described from a single female, deviates so much from all others that it has to be segregated and redefined as the first member of a distinct new genus, *Habrophorula.* The re-characterization of this bee is based mainly on the hitherto unknown male, whose structures are fully described and illustrated at the end of this paper.

CENSUS OF MATERIAL AND ACKNOWLEDGEMENTS

This study is based on the examination of many hundred specimens pertaining to 22 taxa, including nine which are new and one previously described species mentioned above, which requires a new generic name. Besides these, redescriptions and figures are given of 12 earlier named forms (including the types of five), the generic status of only one still remaining uncertain.

Most of the material originates from the province of Fukien, in south-east China, and the island of Taiwan [1]). Thanks to the activities of Dr. T. C. Maa, who investigated the insect fauna of several Chinese provinces for about seven years in succession, no fewer than eight species of *Habropoda* and the undescribed male of *nubilipennis* Ckll., the type species of *Habrophorula* gen. nov., were collected by him in China, Taiwan and Thailand. Other important material was accumulated by members of the British Museum East Nepal Expedition 1961—62.

Below the names are listed of the institutions and private collections from which valuable material was obtained for the purpose of this study, preceded by the usual symbols denoting the ultimate location of specimens borrowed. These data are followed by the names of persons who generously gave me access to the collections under their care and who provided many other facilities. To all these I wish to extend my grateful thanks for the loan of types and other indispensable material necessary for the preparation of the present article. I am particularly thankful to my colleague T. C. Maa, who supplied important information on the biology of certain Chinese species and details concerning the localities and distribution of these. Paratypes and duplicate specimens have been distributed as much as possible among the institutions mentioned.

[1]) For details concerning H. Sauter's localities in the island of Taiwan (Formosa), see p. 201—202.

BISH — B. P. Bishop Museum, Honolulu (J. L. Gressitt)
BM — British Museum (Natural History), London (R. W. Crosskey, I. H. H. Yarrow and G. R. Else)
ML — Rijksmuseum van Natuurlijke Historie, Leiden
MNB — Museum für Naturkunde an der Humboldt Universität, Berlin (E. Königsmann)
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SMF — Forschungsinstitut Senckenberg, Natur-Museum, Frankfurt a.M. (D. S. Peters)
TCM — Tsing-chao Maa collection, Neihu
UKL — Department of Entomology, University of Kansas, Lawrence (C. D. Michener)
USNM — National Museum of Natural History, Washington, D.C. (P. D. Hurd, Jr. and K. V. Krombein)
ZIL — Zoological Institute, Acad. Sci. USSR, Leningrad (M. N. Nikolskaja and V. I. Tobias)

General remarks on classification and relationships

The main problem that confronted me was that of the natural relationships of the species involved and the question as to whether even *Habropoda* — after the segregation of *Elaphropoda* (see Lieftinck, 1966) and *Habrophorula* (of this paper) — should be further subdivided. It was suggested earlier that some at least of those left in *Habropoda* could be linked to *Emphoropsis*, a nearly allied genus occurring in the Western Hemisphere. It will be seen that further investigations proved the impossibility of doing so and that a definite generic or subgeneric assignment of the group must still be left in abeyance.

As with *Anthophora*, one of the difficulties in defining sections or subgenera is the fact that practically all characters available to establish these are unisexual and found in the hidden sternal plates and genital organs of the male. In studying these, much was learned of the various forms of their structure; giving particular attention to the internal sternites, for example, these proved to be surprisingly differentiated, most species exhibiting peculiarities and specializations of their own. It goes without saying that an attempt was made to correlate these varying structures with variations in other organs, such as the antennal and leg structure, the shape of the facial sclerites with their colour marks, and the nature and colour of the vestiture. However, these features proved to be allotted differently, so much so in fact that they greatly impeded the separation of well-defined groups. Although it was fairly easy to pick out pairs, or even minor sections of more closely associated species, there were too many strays that seemed to stand apart from the others. Taking all characters together, and seeing that so many of them are shared out indiscriminately, it soon became evident that it was impossible to arrange them in a harmonious system.

Turning our attention again to the New World genus *Emphoropsis*. Though some of the Asiatic species were temporarily attributed to this genus by Michener (1944) and myself, I must confess that my own suggestions to that effect were rather premature. In point of fact nearly all taxonomic characters of the present composite section of *Habro-*

poda seem to meet (and intergrade with) those of *Emphoropsis*, which obviously constitutes an equally diversified group. The existing definitions of *Emphoropsis* are meagre, Cockerell's review (1905) being not exactly "according to Cocker", neither do they do justice to the interspecific variation observed in this genus (see in particular *E. excellens* Timberlake, 1962). Hence it is now *Emphoropsis* which is in need of a revised definition as a genus, while its members require a thorough analysis of their finer structures. Unfortunately, only the type species, *E. laboriosa* (F.), appears to have been investigated upon the male copulatory organs. True, the genital capsule with its appendages does not reveal differences of any great importance as compared with that seen in *Habropoda*. Nevertheless the chief claim to generic rank of *Emphoropsis* (i.e. the type species) would appear to be the complete absence of a pair of heavily scleroid transverse ridges at the base of the disks of the seventh and eighth gastral sternites. These strong raised transitional carinae are conspicuously present in practically all *Habropoda*, inclusive of the species presently discussed. On balance, for the present this peculiarity supplies the strongest motive to leave the genus as it now stands, with all Old World members included. Future investigations on a broader scale and on the basis of a great many characters may necessitate subgeneric divisions of both *Habropoda* and *Emphoropsis*, and it is not unlikely that the taxa here treated will have to participate in this.

GEOGRAPHICAL AND SEASONAL DISTRIBUTION

In the accompanying Table I have summarized the available data relating to the geographical distribution of the species here treated, with as many particulars on seasonal and altitudinal occurrences as could be accumulated from the literature, the locality labels of museum specimens, and from information supplied to me by field workers.

It seems that throughout the Himalayan range the most favourable reproduction period for these bees is from August to October, as it also appears to be in the mountains of Shillong, in Assam. Similarly, at the higher levels of Nepal, most *Habropoda* were collected just after the summer rains, which characterize the monsoon season, i.e. in the period between July and November, the monsoons in Nepal occurring regularly between June and September. In this connection the re-appearance of *H. radoszkowskii* again in April and May, is hard to explain, two generations being not likely to be effected at these high altitudes.

Interesting differences in the flight seasons can be observed in some of the Chinese *Habropoda* occurring south of the Yangtze River (about lat. 30° N). One of these, *H. sinensis*, is widely distributed in the submontane countries; but whereas this, and four others in south-east China and Viet Nam, were all assembled in a period between June and late autumn, the somewhat isolated *tainanicola*, from Taiwan, as well as its subspecies *maiella* from the opposite continent, appeared much earlier in the year, viz. from March till May. Morphologically this taxon stands rather apart from the others, which may or may not have something to do with the fact that both races afford good examples of early spring bees restricted to hill-country at lower altitudes. Dr. T. C. Maa regularly kept me informed about his efforts in Taiwan to find *tainanicola* during the autumn months, from August onward, but he never once came across a single individual until the emergence of the next spring generation. For notes on the nesting habits, see under that species. A second Taiwanese member of the group, *bucconis*, was recorded by other collectors as having been captured from October to January, but this species was not yet

TABLE I. REGIONAL AND SEASONAL DISTRIBUTION OF CENTRAL AND EAST ASIATIC *Habropoda* ET AL.

Name	Region (W to E)	Altitude (in metres)	Months of the year 1	2	3	4	5	6	7	8	9	10	11	12	Unknown
hookeri	W Himalaya	2300								+	+	+			
deiopea	W Himalaya	2300—2500									+	+			
apostasia	Nepal	2000									+	+			
pelmata	Nepal	2000											+		
krishna	E Himalaya	2300													+
apatelia	Nepal; E Himalaya	2000—2300										+	+		
radoszkowskii	Nepal; E Himal.; Assam	1465—2450				+	+				+	+	+		
plantifera	Assam	1400—1500										+			
turneri	Assam	1460								+	+				
rowlandi	Assam	1460								+	+				
sutepensis	Thailand	1650 ca.		+											
orbifrons	Thailand	1500					+								
tumidifrons	S Viet Nam	1400—1500						+	+						
disconota	N Viet Nam	low level													+
sinensis	SE China	350—2000						+	+	+	+	+			
mimetica	SE China	300—500									+	+			
imitatrix	SE China	500—1500								+	+	+	+		
t. maiella	SE China	400—1000				+	+								
t. tainanicola	Taiwan	250			+	+	+								
bucconis	Taiwan	0—500 ca.	+									+		+	
pekinensis	N China	500—1000				+									
Habrophorula nubilipennis	SE China	1000								+					

encountered by Dr. Maa, who suggests that it may occur in other parts of the island in a different season. It is, perhaps, significant that *imitatrix*, the nearest ally of *bucconis* from continental China, was found abundantly each year by the same collector from August to November.

DESCRIPTIVE KEYS AND ILLUSTRATIONS

Having in mind an adequate valuation of characters, I tried to construct suitable keys for both sexes, whereby I had to choose between two possibilities, (1) to identify species merely on some characters apt to vary (such as the presence or absence of yellow clypeal

marks, or a spot on the antennal scape); or (2) by trying to give an impression of the whole insect by sorting out the various taxa in a descriptive key by a combination of as many salient particulars as could be detected. The second course has been followed as the most satisfactory one: first to prevent misidentifications liable to happen when too few and superficial distinctives are used, and further, to avoid unnecessary repetitions in the specific descriptions. Females of closely allied species being notorious by their homogeneity, the characters will be found to differ widely from those given for the males. The difficulties engaged with defining clear-cut group characters for the males are fully expressed in the keys and especially brought out by the illustrations. These only partly reflect true relationships, but I do hope that they show how the characters are shared by each. The sequence in the text that follows will be found more in accordance with a certain phylogenetic continuity. Additional information on peculiarities of structure is given under each species.

Concerning the illustrative methods followed it can be said that all illustrations are original camera lucida drawings, except Fig. 7—10, of the face markings of some species, which are semi-diagrammatic and on the same scale. The hind legs are shown in full profile view; though most of the pile covering the tibio-tarsal surfaces is omitted, it was necessary for each species to indicate clearly the contour of the strong marginal hairs of these segments, so as to show the length and density of the vestiture: a very important aid in species recognition. The compact bristly hairs covering and fringing the exposed part of the apical tergite of the males are omitted from all figures. As customary, the separate parts of the invaginated sclerites and genital organs were dissected out, cleaned, and depicted from glycerin slide preparations under cover glass, hollow slides having been used for the genital capsule to prevent pressure and to keep the ventral surfaces in horizontal position. For ultimate preservation all terminalia were transferred, without excess glycerin, to cellophane capsules glued to a card on the pin with the specimen. It should be noted that corresponding organs have not in every instance been drawn on the same scale.

KEY TO THE SPECIES, MALES

N.B. — The males of *H. disconota, hookeri, orbifrons* and *tumidifrons* are still unknown

1. Legs robust and strongly modified: fore coxae armed with a long process, fore tibiae with an apical tooth, and conspicuous tooth-like projections also at the inside of the first two protarsal segments; hind basitarsus with great flattened antero-apical lamina. Mid and hind femora posteriorly with distinct longitudinal keel. Tarsal arolia well developed. Ocelli arranged in a broad triangle; interocellar (IOD) and ocellorbital (OOD) distances equal (hence IOD : OOD = 100 : 100); ocelloccipital distance not longer than diameter of nearest ocellus. Labrum dark, only slightly broader than long, its apex a little protuberant; disk clothed thickly with long tuft of decumbent pale hairs directed anterad. Face, including paraclypeal areas and a band along epistomal suture on supraclypeal area, bright chrome; clypeus not unusually broad and bare, its surface convex, but not very shining, superficially finely punctate; colour bright chrome, with pair of black marks, constricted at middle. Antenna of great length, scape naked, anterior face broad, flattened and conspicuously yellow; flagellum black. Eyes convergent below, inner orbits nearly straight. Light dorsal pubescence of thorax long and dense, unicolorous. Marginal cell of fore wing a little shorter than distance from its apex to wing tip. Integument

of gastral tergites 1—6 black, evenly closely punctate; 1 clothed abundantly with long, erect light hairs, which become shorter, decumbent, more condensed and band-like apicad; most of 2—6 with mixture of erect black hairs varying in length, but apical, margins of all with complete, sharply contrasting light bands made up of compact, appressed hairs entirely concealing surface. Apical margins of sternites lacking continuous hair-bands, but sides of 2—6 with long pale fringes. Tergite 7 broad, flattened dorsally, apex narrower and rounded. Apical sternal plates and genital organs not studied. See description. Body length 15.0 mm approx. Hab.: W and NE China . . . . . **pekinensis**

1¹. Legs more slender: fore legs unarmed, femora not distinctly keeled posteriorly, only apical portion of hind basitarsus occasionally expanded and/or modified. Remaining characters combined not as above 2

2. Integument of tergites 1—6 brownish black or black, faintly lustrous, evenly closely and deeply punctate, punctures equal to or larger than interspaces; 1 clothed with longish, raised light hairs, which become depressed, more condensed and band-like apicad; most of 2—6 covered sparsely with short black hairs, but apical margins of all with complete, rather broad and compact, sharply contrasting, light ochraceous-buff to pale orange-yellow bands occupying at least one-fifth of the exposed surface of each, these bands composed of thick, appressed and finely branched, curled hairs entirely hiding the surface. Free border of sternites 2—5 straight, surfaces dark brown, margins narrowly paler, each with continuous fringe of rather long yellowish white hairs of almost equal length, less compact than on tergites. Apex of sternite 6 obtuse-angulate, with dense fringe of short pale marginal hairs. Labrum dark, almost two times as long as broad, widest basally; anterior border gently convex, with tiny median emargination, a pale hair tuft in the depth of incision, and a pair of minute subapical tubercles at the end of a low arched ridge that runs almost parallel to apical margin; disk flat, closely, coarsely and rather deeply punctate; pubescence short, pale, not concealing surface. Face broad, clypeus convex but only little protuberant, almost totally hairless, its surface smooth and shining, covered with large, widely spaced, rather superficial punctures, except basally, where punctures are smaller and crowded; colour mainly bright chrome, only sides with dark stripe along paraclypeal suture, widest and somewhat angulated at level of obscured tentorial pits. Mandible bases and a low, triangular or trapezoidal stripe, tapering at either end, bordering the almost straight epistomal suture on supraclypeal area, likewise bright chrome; paraclypeal areas unmarked, with short appressed silvery hairs (Fig. 7). Malar space distinct, but narrower than pedicel of antenna. Antenna slender, scape slightly curved, long and cylindrical, uniform red- to dark brown, anterior face clothed with long hairs; 3 much shorter than 4 + 5, ratio of length to width 100 : 70.4; length ratios of 3, 4 and 5 = 100 : 86.5 : 90. Ocelli forming an almost equilateral triangle; IOD : OOD = 70 : 100; ocelloccipital distance very short, subequal to diameter of nearest ocellus. Eyes parallel or nearly so, inner orbits somewhat convex mesially and a little diverging at either end. Legs slender, pubescence rather short, hind tibia and basitarsus, Fig. 7; tarsal arolia well developed. Marginal cell of fore wing longer than distance from its apex to wing tip (ratio 100 : 74.6). Pubescence in front of head and dorsum of thorax ochraceous to brownish yellow, rather dense though not very long; hairs finely plumose and more distinctly brown at sides of face, upon vertex and occipital

area; laterally all hairs palest yellow on genal area and thoracic sides. Tergite 7 closely punctate, apex slightly upturned, truncated, whole surface black-haired. Sternites 7—8 and genitalia, Fig. 2—3; 7 strongly constricted about halfway length, at which level transverse ridges are non-apparent and hardly sclerotised, apical portion diamond-shaped (Fig. 2). Body length 11.0—12.0 mm. Hab.: E China . . . . . **sinensis**

2¹. Integument of tergites yellowish brown to black, but apical margins invariably broadly pale, frequently semitransparent, thus accentuating the light hair bands, when present; if so, then the latter are less sharply defined anteriorly: basal portions of 1—6 usually at least with admixture of much longer, partly raised hairs, hence never very short and quite black; if the first three or more segments are dark-haired, then there are no well defined, compact, light apical bands 3

3. Eyes very large and bulging: shortest interorbital distance (across antennal sockets) only about one-half length of eye; inner orbits in frontal view subparallel but distinctly convex mesially, diverging gradually at either end. Labrum much broader than long (about 100 : 60), disk flat, shining, coarsely rugosely punctate, with smooth median line or low ridge, and clothed sparsely with short pubescence; anterior border with broad and deep crescentic emargination carrying a tuft of stiff pale hairs in the depth of the incision (Fig. 16). Ocelli in almost equilateral triangle; IOD : OOD = 71.4 : 100. Head, including mandibles, labrum and paraclypeal areas, black; clypeus entirely chrome, except a narrow lateral black stripe, equal in width to the narrow paraclypeal area at its upper end; also a transverse chrome bar, broadest at middle, along the slightly arched epistomal suture, on supraclypeal area. Malar space nil. Antennal scape black; ratio of length to width of segment 3 = 100 : 35.5; length ratios of 3, 4 and 5 = 100 : 35.5 : 44.4. Legs brownish black, unmodified; hind basitarsus long, slender, laterally compressed, slightly curved, parallel-sided, lacking a naked area on lower surface; coxae and femora with mixture of light and dark pubescence, hind tibia and basitarsus clothed throughout with rather long and dense black hairs, the dorsal fringe at hind basitarsus longer than greatest width of the latter (Fig. 4). Tarsal arolia vestigial. Marginal cell of fore wing longer than distance from its apex to wing tip (ratio almost 4 : 3). Thorax and abdomen thickly and evenly clothed with rather short, erect pale pubescence, without admixture of black, except a broad, ill-defined, transverse dark band between the fore wings; pale hair on remainder of thorax and tergite 1 light yellow (straw yellow, Ridgway), shorter, decumbent and deeper in tint (ochraceous-buff) on 2—5, on which it forms very compact bands, ill-defined anteriorly; tergites 6—7 black-haired. Apex of tergite 7 truncated. Sternites 2—5 unmodified, straight-bordered, each with apical fringe of long, wavy, partly recurved and mostly pure white, hairs, longest at sides; 6 bluntly triangular, with dense fringe of short stiff marginal hairs; 7—8 and genitalia, Fig. 5—6. Sternite 7 constricted beyond halfway length, at which level the lateral ridges are small; distal portion greatly expanded, but apex abruptly narrowed and ending in a slender, rod-like median process. Body length 14.0—15.0 mm. Hab.: SE China (Fukien) . . . . . **mimetica**

3¹. Eyes not unusually enlarged, less prominent and more widely separated above: shortest interorbital distance always greater than one-half length of eye. Other characters combined not as above. Generally smaller-sized species 4

4. Mid and hind tibiae and basitarsi black-haired, or almost so. Dorsal pubescent pattern varicoloured: summit of head, anterior portion of thorax to behind tegulae, as well as ends of tergite 2 and most of 3, black; remaining parts of thorax, tergite 1 and proximal portion of 2, canary yellow; distal portion of 3 and all succeeding tergites orange to orange-rufous, the broad pale brown hind margins of 3—7 shining through the pubescence. Long silky hairs on genal area, sides and ventral parts of thorax, the femora, and those fringing apical margins of sternites, almost pure white. Labrum dark brown, much broader than long (100 : 75), its anterior border evenly convex, apex slightly impressed medially but not excised; surface flat, coarsely rugosely punctate, disk bounded by a low, wide, arc-like ridge running subparallel to anterior border. Mandibles yellowish brown. Malar area black, narrower than pedicel of antenna. Clypeus and paraclypeal areas almost entirely bright yellow, their surface superficially punctate; also a narrow, transverse bar of yellow, widest at middle, along the straight epistomal suture, on supraclypeal area; clypeus marked with black laterally much as in *sinensis*, but black stripe gradually broadened below. Inner orbits subparallel. IOD : OOD = 66 : 100. Ocelli in isosceles triangle. Antennal scape yellow anteriorly and clothed densely with long, soft, white pubescence; ratio of length to width of segment 3 = 100 : 42.5; length ratios of 3, 4 and 5 = 100 : 52.5 : 57.5. Legs dark brown; hind basitarsus simple, slightly curved but parallel-sided, much longer than broad (4 : 1); outer face sulcate for its entire length, but no naked area on lower surface; hair fringing upper and lower ridges shorter than greatest width of basitarsus (Fig. 17). Tarsal arolia present, though of minute size. Marginal cell of fore wing longer than distance from its apex to wing tip (ratio 100 : 81). Apex of tergite 7 shaped as in Fig. 18. Sternites 2—5 straight-bordered, marginal hair-fringes more condensed and silky, longest at sides of 3—5, whole surface of 6 clothed with short and dense, pale rufous hairs. Sternites 7—8 and genitalia, Fig. 19—20. Body length 13.0 mm approx. Hab.: Assam . . . . . **turneri**

4¹. Mid and hind tibiae and tarsi at least partly light-haired. Dorsal pubescent body pattern more uniform, never tricoloured. Tarsal arolia well developed and conspicuous 5

5. Pubescence uniform buff yellow, except that some long raised hairs upon head and thorax are tipped with brown, and that there is an ill-defined but conspicuously blackish brown transverse band of long raised hairs upon middle of tergite 2; sides of segments clothed with still longer, finely branched light hairs. Labrum dark brown, much broader than long (100 : 80), its anterior border a little projecting and upturned, slightly crenulated medially, but not emarginate; disk somewhat concave, not bounded by a ridge, coarsely rugosely punctate, well visible under the long pale pubescence. Mandibles obscurely brownish yellow at middle. Malar space black, somewhat broader than pedicel of antenna. Clypeus and paraclypeal areas almost entirely pale yellow, a black paraclypeal stripe only bordering inner orbits, and a minute brownish dot, or streak, to the inside of the obscured tentorial pits; surface superficially punctate; also a pale yellow stripe, usually interrupted at middle and occasionally absent, along epistomal suture on supraclypeal area. Inner orbits subparallel but distinctly convex medially and diverging gradually below. IOD : OOD = 80 : 100. Ocelli in isosceles triangle. Antennal scape dark brown, unmarked with yellow in front, and clothed with long pale hair; ratio of length to

width of segment 3 = 100 : 51; length ratios of 3, 4 and 5 = 100 : 60.6 : 72.7. Hind basitarsus simple, scarcely curved and subparallel-sided, much longer than broad (3 : 1); outer face slightly concave, not sulcate, and no naked area on lower surface; dorsal ridge with thin fringe of raised hairs, which are almost as long as greatest width of basitarsus, especially the basal ones, those along ventral ridge much shorter (Fig. 22). Marginal cell of fore wing distinctly longer than distance from its apex to wing tip (100 : 71 approx.). Long silky pubescence on genal area, sides and ventral parts of thorax, the femora, and at anteapical margin of sternites, pale yellow. Apex of tergite 7 truncated, but hind margin with shallow crescentic emargination (Fig. 23). Sternites 2—5 straight-bordered, marginal hairs at sides much shorter and less compact than in *turneri*, especially at middle; 6 slightly projecting, whole surface clothed densely with short rufous hairs. Sternites 7—8 and genitalia, Fig. 24—26. Body length 11.0—12.0 mm. Hab.: Assam . **rowlandi**

5¹. Pubescence variable, but not as above; no poorly defined dark hair band restricted to the middle of tergite 2 6

6. Apical portion of sternite 7, beyond the two heavily sclerotised transverse ridges, at first parallel-sided, then much expanded and terminating in a pair of divergent flaps separated by a shallow median emargination (Fig. 30, 36). Hind basitarsus comparatively broad and thin, 3.5 to almost 3.7 times as long as broad, parallel-sided and strongly laterally compressed; both dorsal and ventral ridges subacute and hairy, the erect basal hairs of the dense fringe at upper ridge and apex longest, exceeding greatest width of basitarsus; outer face not sulcate, smooth and shining, very finely superficially and sparsely punctate, with few short decumbent hairs; inner face divided lengthwise into a thickly pubescent upper part and a narrower strip bordering the ventral ridge, which is clothed sparsely with much shorter hairs, this almost bare lower part being placed at an oblique angle to the dorsal crest (Fig. 27, 33). Supraclypeal area with thick, transverse, yellow bar along epistomal suture; clypeus and paraclypeal areas almost wholly yellow. Labrum light brown, little broader than long, anterior border not emarginate, but disk with small midapical depression, bounded by a tiny crescentic or ∧-shaped ridge carrying a small tubercle on either side; surface rugosely punctate, with tuft of longish hairs not quite concealing the surface; also a tuft in the antemedian depression. Mandibles dirty yellow, base and apex obscured. Malar space distinct, not broader than pedicel of antenna. Ocelli placed in equilateral triangle. IOD : OOD = 77 : 100. Antennal segment 3 distinctly shorter than 4 + 5; ratio of length to width 100 : 51.5; length ratios of 3, 4 and 5 = 100 : 75—80 : 75—80. Colour of body vestiture very variable. Postgradular areas of sternites 4—5 smooth, shallowly impressed, lateral areas of 4 clothed with long hairs but apical fringe at middle very short; free border of 5 broadly emarginate, surface with pair of conspicuous diverging patches of minute, extremely condensed, golden brown decumbent hairs; apex of 6 little prominent, fringed all round with short radiating hairs (Fig. 29, 35). Body length 13.0—14.0 mm. Hab.: Taiwan and SE China . . . . . **tainanicola**

6¹. Apical portion of sternite 7, on either side of the two transverse ridges (if present), at first very broad with strongly projecting side-angles, but soon much narrowed and tapering towards a variously shaped apex. Hind basitarsus varying in length, the dorsal ridge sharp, but lower portion gradually swollen from above down and ventral surface rather convex; outer face whether or not sulcate, inner

face normal, undivided, covered densely all over with uniform setiferous punctures or minute warts. Supraclypeal area dark brown or black, unmarked. Sternites 2—5 straight-bordered, texture and vestiture of 4—5 not as above 7

7. Hind basitarsus comparatively narrow in profile, from almost 4 to 4.3 times as long as broad; its ventral surface either covered all over with bristle-like hairs, or the naked part is restricted to a linear strip placed at right angles to the opposite dorsal crest, tapering away and disappearing at some distance from apex. Anterior face of antennal scape conspicuously yellow 8

7¹. Hind basitarsus varying in length; its ventral surface, between the rounded side-edges, with a completely bare, convex central area placed at right angles to the opposite dorsal ridge, this hairless area variable in width, but extending from base to apex 10

8. Outer face of hind basitarsus whether or not sulcate, but ventral surface without any indication of a slightly broadened, convex and naked area. Clypeus, paraclypeal area and mandibles almost wholly bright yellow. Antennal segment 3 little shorter than 4 + 5 9

8¹. Outer face of hind basitarsus shallowly longitudinally sulcate and somewhat shining, covered rather sparsely with longish decumbent hairs; ventral surface of its swollen lower portion slightly convex, bare, and covered with setiferous warts towards apex, the impunctate area being reduced to a narrow strip that tapers away and disappears slightly beyond halfway its length from base (Fig. 46). Mandible bases, paraclypeal areas, and a thick more or less T- (mushroom-) shaped median spot on clypeus, bright yellow. Antennal segment 3 a little longer than 4 + 5. Labrum dark reddish brown, base including the large tubercles lighter brown; slightly broader than long, anterior border with minute crescentic emargination and a pair of low, converging anteapical ridges running parallel to the apical border, each ending in a small tubercle; disk slightly concave, irregularly rugosely punctate, with long tuft of pale hairs, and a smaller tuft also in the depth of the emargination. Body pubescence throughout orange-buff, except some dark-tipped hairs sparsely intermixed above, mostly palest yellow or white on ventral surfaces. Legs slender; hair fringing dorsal ridge of hind basitarsus much shorter than greatest width of the latter. IOD : OOD = 53 : 100. Ratio of length to width of antennal segment 3 = 100 : 40; length ratios of 3, 4 and 5 = 100 : 42.2 : 48.8. Tergite 7 truncated, margin feebly emarginate. Posterior sternal hair fringes pure white, of great length, dense and partly wavy, directed inward and with recurved apices, marginal hairs of 4—5 of almost equal length, those of 5 only little shorter medially than at sides; 6 bluntly triangular, clothed apically with short, stiff radiating hairs. Sternites 7—8 and genitalia, Fig. 47—48. Body length 12.0 mm approx. Hab.: Taiwan . . . . . **bucconis**

9. Legs brown, thin and slender, tibiae and tarsi clothed sparsely with relatively short and pale hairs. Hind basitarsus narrow, parallel-sided, outer face hardly noticeably concave, not definitely sulcate, surface dull, finely tessellate, clothed with short, evenly distributed depressed hairs, those fringing dorsal ridge also short (Fig. 38). Labrum black, somewhat broader than long (100 : 76), widest basally; disk bounded antero-laterally by a pair of swollen, smooth and shining ridges, close to the almost straight anterior margin, each of these curving mesiad and ending in a small tubercle placed on either side of a mid-apical depression; surface flat, coarsely

rugosely punctate, well visible under rather short, semi-erect pale hairs; apex also with small tuft in the depression. Malar area distinct, though narrower than length of pedicel of antenna. Face relatively narrow, less than twice as broad as greatest transverse diameter of eye at level of supraclypeal suture (100 : 55). Clypeus with thick, deep black stripe along paraclypeal suture, separating the yellow areas on each side of it; further down this stripe curves outward, meeting the eye-margin, so as to fill out the lower edge of the paraclypeal area. Ratio of length to width of antennal segment 3 = 100 : 44.4; length ratios of 3, 4 and 5 = 100 : 51.4 : 53.0. IOD : OOD = 54 : 100. Apical light hair bands of tergites 1—5 narrower, more contrasting and condensed than in other pale-coloured species, leaving more of the dark basal portions which are only sparsely clothed with a mixture of long, raised, brown and yellowish hairs, not at all concealing the somewhat shining integument; the latter, as in *sutepensis,* sparsely punctate and finely reticulated. Apex of tergite 7 shallowly emarginate with rounded side-edges (Fig. 39); upper surface clothed with dense orangish pubescence. Posterior sternal hair fringes relatively short, palest yellow; sternite 5 shallowly emarginate, apical portion, between the lateral fringes, with transverse brushy patch of minute, slightly recurved ferruginous hairs; 6 as described for *bucconis.* Sternites 7—8 and genitalia, Fig. 40—41. Body length 11.2 mm approx. Female unknown. Hab.: Nepal . . . . . **apostasia**

9[1] Legs darker brown and not so slender, tibiae and tarsi with long, partly dark hairs: outer face of hind basitarsus shining, shallowly sulcate, sparsely punctate, clothed with short depressed hairs; dorsal ridge with compact, very long, black fringe; expanded ventral ridge strewn with strong, bristle-bearing warts. Hind tibia brown-haired, but inner and outer faces apically also with long black tufts (Fig. 42). Labrum reddish brown, growing darker apically, shaped as in *apostasia,* disk not ridged laterally, but anterior border with small, almost circular, mid-apical depression bounded by a low ridge, which on either side ends in a minute tubercle; surface flat, rugose, rather shining, clothed with short pale pubescence not concealing the ground; a small tuft also in the mid-apical depression. Malar space parallel-sided, distinctly broader than length of pedicel of antenna, surface shining, chestnut-coloured. Face much broader, more than twice as broad as greatest transverse diameter of eye at level of supraclypeal suture (100 : 44). Clypeus and paraclypeal area unmarked, save for a small brownish spot (or streak) directed obliquely inward from the obscured tentorial pit; no dark line bordering paraclypeal suture. Ratio of length to width of antennal segment 3 = 100 : 42; length ratios of 3, 4 and 5 = 100 : 58 : 60.5. IOD : OOD = 44 : 100. Body pubescence longer and denser, throughout orange-buff to orange, with brown-tipped hairs sparsely intermixed upon vertex and occipital area, the abdominal banding broader and indistinctly limited towards base of tergites. Apex of tergite 7 long and narrow, tip bituberculate (Fig. 43), upper surface clothed with long, brownish-black hairs. Posterior sternal hair fringes palest yellow, considerably longer and denser than in *apostasia,* especially the lateral tufts of 3—6, which are very conspicuous, the vestiture of 5 and 6 very nearly like *bucconis,* but hair covering 5 more compact at middle and also distinctly shorter than at sides. Sternites 7—8 and genitalia, Fig. 44—45. Small species, body length 10.0 mm approx. Hab.: Thailand . . . . . **sutepensis**

10. Hind basitarsus strong, less than three times as long as its breadth at apex, at least slightly broadened towards apex in profile; hairless area on ventral surface lanceolate (*pelmata*), or much broader, definitely sole-shaped. Posterior sternal hair fringes pale yellow, very long and dense, especially at sides, much as described for *bucconis*, but hairs covering sternite 5 much shorter and also more compact than those of 4, most noticeably so in the middle along margin. Anterior face of antennal scape conspicuously yellow 11

10¹. Hind basitarsus slenderer, at least three times as long as its greatest breadth near apex in profile and more nearly parallel-sided; hairless area on ventral surface lanceolate. Posterior sternal hair fringes yellowish or white, as before, but hairs covering sternite 5 not much shorter and more condensed than those of 4 . . 13

11. Hind basitarsus in profile slightly broadened towards apex, its lanceolate (torpedo-shaped) naked ventral area light brown, the slightly swollen apex of this not projecting below and evenly rounded in side view. Legs brown, mainly palely pubescent, except small apical tufts of dark hair at dorsal ridges of mid and hind tibiae, and suberect deep black fringe along whole dorsal ridge of hind basitarsus; dense decumbent pubescence covering inner faces of hind basitarsi pale golden brown. Hind tibia rather slender, widest beyond halfway length and gradually expanded towards apex; inner face lacking apical tuft of long hairs (Fig. 68). Mandible bases, paraclypeal area, antennal scape anteriorly, and a very thick, mushroom-shaped spot, similar to that of *bucconis*, upon middle of clypeus, all pale yellow; supraclypeal area unmarked, or with pair of tiny transverse yellow streaks. IOD : OOD = 50 : 100. Antennal scape with external fringe of long pale hairs (rest of both antennae missing). Apex of tergite 7 truncated (Fig. 69). Sternites 7—8 and genitalia, Fig. 70—71. Size small, body length 11.0 mm approx. Female unknown. Hab.: Nepal . . . . . **pelmata**

11¹. Hind basitarsus in profile distinctly broadened towards apex, which is produced below into a bluntly rounded process (Fig. 56); naked ventral area yellow-brown, conspicuous and well defined, surface undulated, forming a convex sole-shaped plate (Fig. 57). Legs robust, femora and tibiae rather swollen, clothed with long, mostly pale, pubescence. Hind tibia more expanded, its greatest breadth at about midway length, inner face with conspicuous tuft of very long, wavy dark hairs. Anterior face of antennal scape conspicuously yellow, clothed with longish pale pubescence anteriorly; segment 3 shorter than 4 + 5 12

12. Clypeus predominantly black: yellow median spot strongly constricted at middle, rather I-shaped, the transverse anterior bar tapering at either end. Labrum dark brown, blackened apically, anterior border with distinct crescentic median emargination. Legs, including basitarsi, dark brown, tarsal distalia lighter; inner faces of hind tibia and basitarsus, including dense fringe at dorsal crest, black, the sole almost four times as long as broad, chestnut-coloured, strongly swollen apically. Dorsal pubescence of thorax and abdomen orange-buff to deep chrome, with dark hairs sparsely intermixed on thorax, the tergal "banding" fairly distinct, progressively broader and more distinctly orange posteriorly. IOD : OOD = 52.5 : 100. Ratio of length to width of antennal segment 3 = 100 : 46.5; length ratios of 3, 4 and 5 = 100 : 58.1 : 62.8. Apex of tergite 7 subtruncated, the sides usually obtuse-angulate (Fig. 58). Sternites 7—8 and genitalia, Fig. 59—61. Body length 13.8—14.0 mm. Hab.: E Himalaya; Nepal; Assam . . . . . **radoszkowskii**

12¹. Clypeus predominantly yellow: median spot thick, less constricted, rather diabolo-shaped; dark lateral marks brownish and not sharply outlined mesially. Labrum light brown, anterior border slightly crenulated at middle, not emarginate. Legs, including basitarsi, orange-buff, the femora and tibiae slightly darker; pubescence throughout warm orange, except the long inferior apical tuft at hind tibia, which is black, and a thin fringe at dorsal crest of hind basitarsus, brown; sole a little over four times as long as broad, light brown, slightly less expanded and swollen apically than in *radoszkowskii*. Dorsal pubescence of thorax and abdomen longer, more condensed and more brightly orange, the tergal "bands" deepest in tint posteriorly. IOD : OOD = 60 : 100. Ratio of length to width of antennal segment 3 = 100 : 51; length ratios of 3, 4 and 5 = 100 : 65.7 : 71.4. Apex of tergite 7 narrower (Fig. 64, unique male). Sternites 7—8 and genitalia, Fig. 65—67. Body length 12.0 mm approx. Hab.: Assam . . . . . **plantifera**

13. Clypeus predominantly brownish black, yellow median band more or less I-shaped, strongly constricted and considerably narrower than dark lateral parts, clothed abundantly with very long, suberect dark bristles and decumbent pale converging hairs. Legs dark brown; pubescence pale, except conspicuous fringes alongside lower surface of hind tibia and a dorsal tuft at apex of same, these hairs long, raised, and predominantly or wholly black. Hind basitarsus brownish black, not at all broadened towards apex in profile; outer face shining, longitudinally sulcate, sparsely hairy; hairless ventral area dark brown, strongly convex, surface dullish, with few superficial punctures; a dense hair fringe along full length of dorsal ridge, jet black. IOD : OOD = 57.5 : 100. Anterior face of antennal scape conspicuously yellow, with external fringe of long pale hairs; 3 a little shorter than 4 + 5, ratio of length to width 100 : 38; length ratios of 3, 4 and 5 = 100 : 50.5 : 60. Tergite 7 somewhat attenuated, but apex truncated (Fig. 51). Sternites 7—8 and genitalia, Fig. 52—53. Body length variable, 13.0—14.5 mm. Hab.: SE China (Fukien) . . . . . **imitatrix**

13¹. Clypeus predominantly yellow: an irregular brown stripe, widest below, but slightly narrower than greatest width of paraclypeal area, at either side of clypeus, and a pair of more or less isolated brown discal spots, placed a little more inward, slightly beyond halfway length from base. Anterior face of antennal scape entirely dark brown, unmarked with yellow; 3 subequal to, or a little longer than, 4 + 5. Legs light to dark brown, pubescence not quite as described above, mainly pale; raised hair covering lower surface of hind tibia short, sparsely distributed and pale-coloured. Hind basitarsus more slender, subparallel-sided; outer face sulcate, rather shining, sparsely pubescent and punctate; hairless area narrowly lanceolate, light brown, otherwise as in *pelmata* (Fig. 72, 78, 85). Legs throughout palely pubescent, lacking black hairs 14

14. Head large and face relatively broad: distance separating inner orbits and diameter of eye at level of supraclypeal suture in the ratio of 100 : 50. Protruding median portion of clypeus broadest well beyond halfway its length from base; length : breadth ratio of clypeus in frontal view about 90 : 100. Clypeus with yellow lateral streak bordering anterior end of paraclypeal suture. IOD : OOD = 51 : 100. Ratio of length to width of antennal segment 3 = 100 : 40; length ratios of 3, 4 and 5 = 100 : 46.5 : 51.2. Second submarginal cell markedly longer than high, receiving recurrent nervure well before its apex. Apex of tergite 7 narrow,

hind margin very shallowly concave. Sternites 7—8 and genitalia, Fig. 73—76. Size a little larger and stature more robust. Body length 13.0—13.5 mm. Hab.: West Himalaya . . . . . **deiopea**

14¹. Head comparatively small and face narrower: distance separating inner orbits and diameter of eye at level of supraclypeal suture in the ratio of 100 : 56—57. Protruding median portion of clypeus broadest at or a little beyond halfway its length from base; length : breadth ratio of clypeus in frontal view about 110 : 100. Yellow lateral streak on clypeus bordering anterior end of paraclypeal suture present (Nepal), or wanting (Darjeeling). IOD : OOD = 60 : 100. Ratio of length to width of antennal segment 3 = 100 : 40—42; length ratios of 3, 4 and 5 = 100 : 42 : 47.4 (Nepal), or 100 : 44.4 : 55.5 (Darjeeling). Second submarginal cell almost square, recurrent nervure entering cell a little before its apex. Apex of tergite 7 narrow, truncated (Fig. 79, Darjeeling), or as in Fig. 86 (Nepal). Sternites 7—8 and genitalia, Fig. 80—83 (Darjeeling) and Fig. 87—89 (Nepal). Averages smaller in size, stature more slender. Body length 11.0—12.5 mm. Hab.: East Himalaya and ? Nepal . . . . . **apatelia**

Key to the species, females

N.B. — The females of *H. apostasia, pelmata* and *plantifera* are still unknown

1. At least tergites (1) 2—4 with complete, well defined, pale (sub)apical pubescent bands or lines, which are about equally broad, consisting of closely-set decumbent hairs entirely concealing the marginal surface. Outer hind tibial and/or basitarsal scopal hairs never quite black 2

1¹. Tergite (1) 2—4 diffusely pubescent, frequently varicoloured, but lacking contrasting, clearly defined, apical hair bands of one colour; hind margins of integument often broadly pale, membranous and seemingly "banded" . . . 5

2. Eyes not enlarged, converging below, only little shorter than upper interorbital distance (100 : 106); inner orbits nearly straight, vertex at summit a little broader than lower interorbital distance. Ocelli placed in a broad, isosceles triangle; distance separating lateral ocelli two or more times their own diameter; interocellar (IOD) and ocellorbital (OOD) distances equal (hence IOD : OOD = 100 : 100). Mouth parts, face and antennae all black, except basal tubercles of labrum and mid portion of mandibles diffusely brownish. Labrum slightly broader than long, disk with conspicuous dense tuft of decumbent pale hairs. Malar space shorter than pedicel of antenna; antennal scape lacking anterior fringe of long hairs; segment 3 subequal to 4 + 5. Front of head moderately protuberant. Clypeus rather convex, protruding anteriorly beyond eye in profile by as much as width of latter; surface rather closely, irregularly punctate and hairy, especially at sides; epistomal suture in frontal view straight. Inner ramus of mid and hind tarsal claws almost half as long as outer; arolia well developed. Abdominal tergites closely reticulate-punctate; light apical bands fairly broad, occupying at least one-fourth of the exposed surface; much longer raised pale hairs present on rest of tergite 1, but very short, sparsely distributed, more or less appressed and mostly black, on the exposed basal portions of remaining tergites. Sternites 2—5 with dense subapical fringes of suberect pale hairs, not much longer laterally than at middle. Pygidial plate broadly tongue-shaped, much as in *rowlandi* (Fig. 26), but even broader, more gradually tapered,

almost flat, lacking depressed margins; surface finely transversely striated, the striae convex posteriorly. Large species, body length 15—16 mm approx. Hab.: W and NE China . . . . . **pekinensis**

2¹. Eyes larger and more bulging, parallel or nearly so, inner orbits straight, vertex at summit subequal in width to lower interorbital distance. Ocelli placed in an almost equilateral triangle; IOD much shorter than OOD. Labrum dark, fully twice broader than long, widest basally, surface rugose; pale hairs on disk shorter and less dense, not concealing surface. Malar space broadest anteriorly, about as long as pedicel of antenna. Front of head broad, "pug-nosed", conspicuously bulging, but clypeus evenly convex, protruding anteriorly beyond eye in profile by at most ¾ (usually less) the width of eye, its surface smooth, shining, almost bare, strongly punctate and with conspicuous yellow marks (Fig. 8—10); epistomal suture distinctly arched in frontal view. Antennal scape lacking anterior fringe of long hairs, unmarked with yellow. Claws slender, inner ramus of mid and hind pairs at least half as long as outer; arolia well developed, of large size. All abdominal segments closely punctate; light apical tergal hair bands variable; pile on disk of tergite 1 raised and considerably longer than on following segments, though not concealing the surface. Pale suberect hairs fringing apical margins of sternites 2—4 not noticeably long and wavy, though longest at sides of 3—4. Pygidial plate brown, very broad at extreme base (exceeding total length), then tapering rapidly to a narrow and almost pointed tip, the sides distinctly incurved, margins a little upturned; surface slightly convex, rather shining, finely tessellated. Smaller-sized species 3

3. Apical tergal hair bands rather broad and compact, occupying about one-third or more of the exposed surface of each tergite, colour pale orange-yellow, hairs curled and almost as crowded as in male; apical band of tergite 5 cinnamon brown, projecting broadly and triangularly basad at middle, the long hairs at sides pale; integument of tergites almost black, surface dull, faintly lustrous, evenly, extremely closely and rather deeply punctate, diameter of punctures exceeding interspaces; punctation equally dense on pregradular areas of sternites, but more sparse and superficial on postgradular portions, except along hind margins. Outer hind tibial scopal hairs pale orange-yellow, not quite concealing surface, outer faces of hind basitarsi much more sparsely hairy and darker; penicillus brown. Anterior border of labrum but little convex, median emargination very small; disk lacking dense hair tuft, but apex with longish, pale golden fringe. Clypeus chrome, marked with pair of large, diverging, subrectangular brown patches, closely approximated or even fused together at extreme base and extending to about ⅔ to ¾ length from base; these marks are obliquely cut off anteriorly, longest at each side of the median line, so as to save a tripartite yellow mark bordering the clypeus anteriorly (Fig. 8). Paraclypeal area black, clothed densely with appressed yellowish white hairs. Supraclypeal area frequently also with trace of yellow bordering epistomal suture. IOD : OOD = 37.5 : 100; distance separating lateral ocelli subequal to their own diameter. Eyes longer than upper interorbital distance (100 : 78). Antennal segment 3 almost twice as long as thick and equal in length to 4 + 5 (length ratios of 3, 4 and 5 = 100 : 45.5 : 54.5). Marginal cell of fore wing longer than distance from its apex to wing tip. Pygidial plate (Fig. 11) reddish brown, abruptly changing to blackish brown at the constriction, basal portion strongly convex, surface shining,

finely transversely reticulate-striate, except apically. Body length variable, 12.3—14.0 mm. Hab.: E China . . . . . **sinensis**

3¹. Apical tergal hair bands linear and less compact, occupying much less than one-fifth of the exposed surface of each tergite, colour pale chrome; integument of tergites glossy black, almost bare, evenly finely punctate, diameter of punctures smaller than interspaces. Outer hind tibial scopal hairs bright orange-rufous, entirely concealing surface; outer faces of hind basitarsi, including penicillus, mainly dark-haired, the inner ones black. Marginal cell of fore wing only slightly longer than distance from its apex to wing tip (100 : 91.6—92.3). Males unknown . . . 4

4. Supraclypeal area wholly brownish black; clypeus with inverted T-shaped, chrome-yellow mark, Fig. 9, whole surface shining, distinctly uneven (rather rugose), irregularly and scatteredly punctate, except basally, where punctures are more crowded and wider than the interspaces; supraclypeal area more densely and deeply punctate, most punctures confluent at sides, those on summit of head smaller and more widely spaced. Pale posterior bands of tergites 1—4 linear, about 0.2 mm broad, composed of finely plumose hairs. Outer hind tibial scopal hairs throughout orange-rufous, those of basitarsus relatively long, dark brown only along dorsal ridge, and of penicillus, the discal hairs mainly light orangish. Pygidial plate, Fig. 12. Body length 13.0 mm approx. Hab.: Indochina (South Viet Nam) . . . . . **tumidifrons**

4¹. Supraclypeal area with broad, slightly angulated, yellow crescent bordering the suture; clypeus with conspicuous anchor-shaped chrome-yellow mark (Fig. 10); whole surface smooth and shining, but with fewer punctures than in *tumidifrons*, even at base smaller and more widely spaced. Pale posterior bands of tergites 1—4 all a little broader, about 0.3 mm or more, otherwise as described above. Outer hind tibial scopal hairs generally shorter, mainly orange-rufous, but becoming more brownish towards ventral ridge, those covering basitarsus distinctly shorter and more numerous than in *tumidifons*, very dark brown, almost black. Pygidial plate, Fig. 13. Body length 13.0 mm approx. Hab.: Thailand . . . . . **orbifrons**

5. Body pubescence dense, varicoloured: alternately yellow, black and orange, these coloured areas transverse, broad and sharply delimited; if tergites are predominantly black-haired, then pubescence on dorsum of thorax also mainly black. Integument of abdominal tergites not pallid and membranous apically. Outer faces of femora and tibiae black-haired; tarsal arolia vestigial. Labrum much broader than long. Disk of clypeus only slightly convex, closely punctate, almost bare. Front of head mainly black and dark-haired. Ocelli placed in equilateral triangle, distance separating lateral ocelli less than twice their own diameter 6

5¹. Body pubescence usually less dense and not coloured as above: if tergites are varicoloured, then the coloured areas are not sharply delimited. Hind margins of abdominal tergites mostly broadly pallid. At least outer faces of hind tibiae and/or basitarsi light-haired; tarsal arolia well developed 8

6. Eyes large and globular, longer than upper interorbital distance, inner orbits subparallel, but distinctly convex in frontal view. Clypeus much less protruding anteriorly beyond eyes in profile than half diameter of eye (100 : 37). Labrum subrectangular, ratio of length to width = 60 : 100, not projecting anterad, border almost straight but considerably thickened medially, with deep U-shaped notch and tuft of ferruginous bristles in the depth of the emargination, apex not preceded by

a subparallel ridge. Dorsum and sides of thorax clothed evenly with rather short, pale yellow to orange pubescence; mesonotum with a thick, transverse, black median band or patch between the wings. Abdominal pubescence also comparatively short, on tergite 2 (save for a narrow light apical fringe) black, on 1 orange-yellow and black, on succeeding tergites variable. Pygidial plate (Fig. 14—15) broadly triangular, tapering gradually towards apex, which is bluntly rounded; sides slightly concave, margins a little thickened and raised; surface dull, markedly convex, finely transversely striate; colour reddish-brown, apex obscured. Robust, short-legged, compactly built species 7

6¹. Eyes much smaller and less prominent, only slightly longer than upper interorbital distance (100 : 88), inner orbits subparallel and almost straight in frontal view. Clypeus protruding anteriorly beyond eyes in profile for almost half diameter of eye (100 : 46). Labrum broad, ratio of length to width = 68 : 100, projecting more markedly anterad than in male, apex obtuse-angulate, anterior border only slightly thickened medially, but preceded by a low arched ridge, narrowly interrupted in the median line, which runs subparallel with free margin. IOD : OOD = 70 : 100. Antennae, including scape anteriorly, dark brown; segment 3 much longer than 4 + 5, length ratios of 3, 4 and 5 = 100 : 30 : 40. Head dark brownish black or black, except that basal tubercles of labrum are light brown and mid portion of mandibles chestnut. Legs blackish brown, black-haired, the tarsi lighter brown; hair on outer faces of basitarsi reddish brown to black, on the inner golden brown to ferruginous; dorsal fringe of mid and hind basitarsi black; penicillus brassy. Dorsal pubescence longer than in the two preceding species, pattern much as in male, except that the long dense canary yellow hairs (raised on 1, decumbent on 2) occupy almost whole surface of 2 and are tipped with black; 3 entirely black, 4—5 orange-rufous, the fringe at apex of 5 very brightly so. Sides and ventral surfaces mainly dark brown, except long white-tipped hairs at base of fore femora, and long dense tufts covering most of the genal area and thoracic pleurae below wings, which are silvery white. Pygidial plate (Fig. 21) broadly triangular, tapering towards apex, which is bluntly rounded; sides almost straight, margins a little upturned; surface dull, evenly and but slightly convex; colour reddish-brown, growing darker apically. Body length 15.5—16.0 mm. Hab.: Assam . . . . . **turneri**

7. Black pubescent band between fore wings about as broad as the yellow mesonotal area in front of it and only little broader than the yellow patch covering posterior portion of thoracic dorsum; colour of light thoracic pubescence bright yellowish tawny, on tergite 1 slightly more orangish, except at posterior margin of the latter, where it is occasionally black; 2 totally black-haired, save for a well-defined apical fringe of orange; 3—4 wholly bright orange, the hairs on basal portion raised, those along posterior margins longer, dense and decumbent; 5 dark-haired at base, the broad apical fringe of long dense hairs ferruginous. Long semi-erect hairs fringing hind margins of sternites 2—4 light yellow, those at 5 pale ferruginous. Black plumose hind tibial scopal hairs relatively short, not exceeding greatest breadth of tibia. Front of head brownish black or black, supraclypeal area with crescentic or triangular yellow spot bordering frontoclypeal suture. Pygidial plate, Fig. 15. Body length 15.5—16.5 mm. Hab.: SE China (Fukien) . . . . . **mimetica**

7¹. Black pubescent band between fore wings about twice as broad as the orange mesothoracic collar in front of it and at least 1½ times as broad as the orange band

covering posterior portion of thoracic dorsum; scutellum and upper part of sides below wings brightest orange, the pubescence lower down acquiring gradually a yellowish tint. Only basal half of tergite 1 orange, for the rest black-haired; 2—4 entirely black, except narrow fringes of orange at sides of 1 and along full length at posterior margins of 2—4, the consistence of pilosity as in *mimetica*; 5 black-haired at base, the broad apical fringe of long dense hair bright golden-brown. Long raised hairs fringing hind margin of sternites all black. Black plumose hind tibial scopal hairs conspicuous, much denser, and longer than greatest breadth of tibia. Front of head as in *mimetica*, but supraclypeal area with well defined creamy-yellow crescent bordering the suture. Pygidial plate, Fig. 14. Body length 15.5 mm Hab.: Indochina (North Viet Nam) . . . . . **disconota**

8. Vestiture of thorax, abdomen and genal area buff yellow, consistence much as in *turneri*; hair covering mouthparts, face, antennae and summit of head mainly dark brown. Dorsum of abdominal tergite 2 with transverse, ill-defined, but conspicuously blackish brown band of light-tipped hairs; dense appressed pubescence covering tergite 5 and sides of 6 ferruginous to ochraceous-orange; outer faces of mid and hind tibiae and tarsi, including penicillus, similarly coloured. Head, including labrum, clypeus and antennae, throughout brownish-black to black, otherwise much as in male, mandibles dark chestnut at middle; clypeal disk somewhat shining, covered densely with partly coalescent punctures. Labrum longer than in *turneri*, anterior border scarcely ridged before margin, with minute crescentic median emargination. Clypeus protruding anteriorly beyond eyes in profile for more than half diameter of eye (100 : 80); surface rather shining, closely striato-punctate, there being few isolated punctures. Ocelli placed in isosceles triangle, distance separating lateral ocelli exactly twice their own diameter; IOD : OOD = 75.6 : 100. Antennal segment 3 only little longer than 4 + 5, length ratios of 3, 4 and 5 = 100 : 40.5 : 45.2. Pygidial plate (Fig. 26) chestnut-colour, very broad, the converging sides almost straight; surface smooth, disk very slightly convex, microscopically tessellate, margins broad, thin, and a little upturned; apex bluntly rounded. Body length 13.0—13.5 mm. Hab.: Assam . . . . . **rowlandi**

8¹. Vestiture of thorax and abdomen very variable, but there is no poorly defined dark hair-band restricted to the middle of tergite 2. Clypeus and supraclypeal area more strongly protruding from face than in *disconota*, *mimetica*, *rowlandi* and *turneri*, arising abruptly in a short step from the deeply recessed antennal sockets and flat upper portions of the paraclypeal areas. Pygidial plate not as above . . 9

9. "Similar to male, but larger and more robust. Dense hair of abdomen very red. Clypeus convex, the upper third in middle with a shining keel, from the lower end of which starts a creamy-white vertical band, rapidly broadening below to form a broadly triangular pale area; labrum reddish; mandibles with more than the basal half pale rufous; malar space well developed; outer side of hind tibiae with rich copper-red hairs; hind basitarsi with black hair. The cheeks below have long pure white hair." (Taken from original description). Other features not known. Hab.: Thailand . . . . . **sutepensis**

9¹. Combined characters not as above. Clypeus not, or only feebly, keeled basally. Dense hair covering abdomen, if at all partly reddish, then only so on posterior tergites. Outer faces of hind basitarsus with few dark hairs interspersed . . 10

10. Pygidial plate (Fig. 32) elongate, tongue-shaped, distinctly longer than its

greatest width at base, downcurved and gradually narrowed towards the end; sides almost straight and apex simply rounded; surface even, not at all keeled or ridged, finely, superficially and transversely striated from base to apex; colour black, turning to red-brown towards base. Vestiture of thorax and abdomen nearly always partly obscured (or even black) dorsally, but apical segment(s) of abdomen invariably orangish or rufous. Outer faces of hind tibia and basitarsus clothed with long, bright orange-chrome to vivid orange-rufous scopal hairs. Integument of head above and clypeal areas unicoloured brownish black or black, clypeus occasionally with ill-defined rusty brown median dot at some distance from apex; disk shining and for the greater part almost bare, the sides only clothed with soft decumbent pubescence interspersed with long, erect, dark bristles; whole surface evenly, superficially (though rather closely) punctate, all punctures isolated and smaller than the microscopically reticulate interspaces; occasionally a narrow, almost polished and impunctate, median area. Labrum and most of the mandibles red brown to chestnut; labrum broader than long, much as in male: with pair of closely approximated, sub-triangular tubercles placed behind anterior border, which itself is scarcely excised medially. IOD : OOD = 66.6—72 : 100. Antennal segment 3 much longer than 4 + 5. Body length 14.0—15.5 mm. Hab.: Taiwan and SE China . . **tainanicola**

10[1]. Pygidial plate shorter, more nearly triangular, only little longer than its greatest width at base, where it is very broad, but then tapers rapidly, the sides frequently curving inward and converging to a narrow and pointed tip. Vestiture of thorax and abdomen of uniform colour, never obscured, varying from pale ochraceous to deep chrome, the long erect or suberect dorsal hairs often tipped with brown. Scopal hairs on outer face of hind tibia and basitarsus less brightly coloured (occasionally silvery yellow). Clypeus usually more dullish, whole surface densely, rugosely striato-punctate, there being no isolated punctures; colour variable, but nearly always with yellow median spot before the apex. Labrum shaped much as in *tainanicola*, but anteapical tubercles larger, less approximated and forming together a wide V-shaped arc, hence upper anterior border distinctly emarginate; mandibles for the greater part pale yellowish. Antennal segment 3 longer than 4 + 5 11

11. Clypeus and supraclypeal area dull, uniformly, rather closely, rugosely punctate, all punctures confluent; whole clypeal surface clothed evenly with longish, decumbent, pale silvery yellow hairs concealing part of the surface; ground colour brown, except a transverse, ivory yellow band, broadest at middle, just before the apex. Labrum only little broader than long, brown, becoming almost black apically, the basal tubercles lighter; subapical teeth black, triangular and flattened, separated from each other by a crescentic emargination. Mandibles for the greater part ivory yellow, the distal portion becoming brown. First three antennal segments brown, rest missing. Vestiture generally pale (discoloured ?), uniform pale ochraceous, lacking black hairs; legs brown, the external scopal hairs pale silvery-yellow, almost white. Abdomen blackish-brown, all segments feebly "banded" posteriorly, these bands composed of pale appressed pubescence, the disks moreover with abundant, somewhat darker, erect hairs; dense patch covering tergite 5 pale ochreous, the fringe of stiff lateral bristles surrounding the pygidial plate of 6 still darker, ferruginous-brown. Long posterior sternal hair-fringes palest yellow, almost white. IOD : OOD = 60 : 100; distance separating lateral ocelli slightly less than twice their own diameter. Pygidial plate (Fig. 55), chestnut-coloured (only partly

exposed), feebly convex, its median portion raised into a distinct, broad, longitudinal ridge, whole surface finely transversely reticulated. Body length 13.0 mm. Male unknown. Hab.: West Himalaya . . . . . **hookeri**

11¹. Clypeus and supraclypeal area rather shining, clypeus coarsely and irregularly striato-punctate, the elevated and finely tessellated rugae on the basal portion more closely set than the smooth and broader ridges on the distal area, the latter glossy, slightly sloping and feebly triangular in outline, with faint indication of an impunctate median ridge; central area of clypeus bare or sparsely hairy; ground colour light to dark brown, frequently with yellow median spot, but lacking a transverse yellow bar just before the apex. Vestiture generally deeper in tint and brighter, especially the scopal hairs and abdominal segments posteriorly; long erect or suberect hairs generally darker than the closely appressed pubescence, which spreads in a diffuse pattern over the surface of all tergites, this tomentum becoming progressively more dense, compact and vividly coloured (orange-buff to deep chrome) towards the end of abdomen. Similarly-looking species of small to medium size 12

12. Larger species, body length 13.0—16.0 mm. Hind basitarsus with admixture of dark hairs at least basally and along upper and lower margins. Pygidial plate (Fig. 49, 54, 62) gently downcurved, reddish, the apex obscured, surface finely transversely striated. Pale tufts of soft, finely branched hair at postero-lateral margins of sternites 3—5 much longer than the postero-median fringes, which are also of a darker yellow tint 13

12¹. Smaller species, body length 12.0—13.0 mm. No admixture of black hairs on outer face and margins of hind basitarsus. Pale tufts of soft, finely branched hair at postero-lateral margins of sternites 3—5 longer than the postero-median fringes, but all are of the same light colour 15

13. Clypeus and supraclypeal area dark blackish brown with a reddish tinge, clypeus shining, with well-defined ivory spot placed upon middle of distal half, just before anterior border, this spot shaped like an isosceles triangle, the base of which is shortest and a little convex, the sides concave, the apex acuminate and pointing basad. Malar space as long as pedicel of antenna. Raised and appressed hairs covering dorsum of thoracic segments and abdomen moderately long and dense, neither quite concealing the black ground of thoracic dorsum, nor the disks of tergites 1—4; dorsal pubescence of thorax sallower (greyish-ochraceous) than that of abdomen. Dense hair covering tergite 5, as well as the scopal hairs of hind basitarsal penicillus, golden yellow; upper and lower borders of hind basitarsus with distinct basal admixture of almost black hairs. Pile upon tergite 5, on either side of pygidial plate, golden brown; plate with feebly indicated median ridge. IOD : OOD = 50 : 100; distance separating lateral ocelli less than twice their own diameter. Length ratios of antennal segments 3, 4 and 5 = 100 : 30 : 40. Pygidial plate (Fig. 62). Slightly smaller, 14.0—15.0 mm. Hab.: East Himalaya; Nepal; Assam . . . . . **radoszkowskii**

13¹. Clypeus and supraclypeal area not so dark, clypeus dullish and more closely striato-punctate, yellow median spot before anterior border variable. Malar area a little longer than pedicel of antenna. Raised and appressed hairs covering dorsum of thoracic segments and abdomen longer, uniformly more dense and brightly coloured, all tergal hairs concealing most of the surface, even of tergites 1 and 2.

Dense hair covering tergite 5, as well as the scopal hairs of hind tibia, more vividly orange; hair on outer face of hind basitarsus somewhat darker than on tibial scopa, but not blackish at base; penicillus golden orange. Pilosity of tergite 6, on either side of pygidial plate, as in *radoszkowskii*. Length ratios of antennal segments 3, 4 and 5 = 100 : 28—30 : 40—40.3. Slightly more robust and larger, 14.5—17.0 mm 14

14. Clypeal spot triangular, shaped much as in *radoszkowskii*, but less sharply defined, the apex bluntly pointed. Pygidial plate (Fig. 49), with well pronounced median ridge. Ocelli larger, more closely approximated, distance separating lateral ocelli scarcely greater than their own diameter; IOD : OOD = 54.3 : 100. Body length 15.0 mm approx. Hab.: Taiwan . . . . . **bucconis**

14[1]. Clypeal spot still smaller, diffuse, usually elongate-oval, and occasionally vestigial, but rarely absent altogether. Pygidial plate (Fig. 54), with median ridge unapparent. Ocelli smaller, more widely apart, distance separating lateral ocelli less than twice their own diameter; IOD : OOD = 70 : 100. Size variable, 14.5—16.0 mm. Hab.: SE China . . . . . **imitatrix**

15. Mussoorie: Pygidial plate (Fig. 77) chestnut, growing dark brown apically, shaped much as in *radoszkowskii*, the median ridge broad but rather low, and fine transverse striation effaced (worn ?). Protruding median part of clypeus distinctly longer than broad in frontal view. Front of head, including labrum and clypeus, very dark brown, almost black, clypeus without any indication of a yellow mid-apical spot, surface coarsely, rugosely punctate, basal three-fourths with low, ill-pronounced, irregular median ridge. Labrum with base of converging ante-apical ridges impunctate. Mandibles dirty ochreous tipped with black; malar area slightly longer than pedicel of antenna. Galea of proboscis short, 2.2 mm. IOD : OOD = 64 : 100. Antenna brownish black, the flagellar segments 5—12 distinctly light brown anteriorly; length ratios of 3, 4 and 5 = 100 : 30 : 37.5. Wing margin somewhat lacerated; second submarginal cell markedly longer than high, receiving recurrent nervure shortly before apex. Raised hairs covering dorsal thoracic segments and first two gastral tergites greyish yellow, many hairs on mesoscutum anteriorly, and on distal parts of tergites 1—2, more or less obscured. Scopal hairs orange-buff to orange; penicillus golden brown. Hab.: West Himalaya . . . . . **deiopea**

15[1]. Darjeeling: Pygidial plate (Fig. 84) with convex median ridge occupying most of the surface, apex attenuated and almost pointed. Protruding median part of clypeus a trifle broader than long, almost square in frontal view. Front of head, including labrum, proboscis and clypeus yellowish brown (ochraceous-buff), clypeus moreover with tiny, ill-defined, roundish yellow dot upon middle of distal half before anterior border, its surface less coarsely punctate; ante-apical ridge and free margin of labrum black. Mandibles yellow, apices obscured; malar area as before. Galea of proboscis longer, 2.7 mm. IOD : OOD = 53.5 : 100. First three segments of antenna dark brown, rest of flagellum ochraceous anteriorly, dark brown posteriorly; length ratios of 3, 4 and 5 = 100 : 32.2 : 40. Wing margin entire; second submarginal cell almost square, recurrent nervure interstitial. Pubescence more vividly coloured, distinctly more orangish, similar to fresh males, many hairs dark-tipped, but abdominal pile brighter; hair at sides of thorax and of body parts underneath palest yellow, not pure white. Scopal hairs much as in *deiopea*, but more yellow-orange with distinct golden shine; penicillus slightly darker. Hab.: East Himalaya . . . . . **apatelia**

Discussion of species and subspecies

Habropoda pekinensis Cockerell

Habropoda pekinensis Cockerell, 1911, Proc. U.S. Nat. Mus., 39: 642—643 (♂ ♀ Pekin, China, 1901, M. L. Robb) — Lieftinck, 1966, Tijdschr. v. Ent., 109: 144 (full references; addit. notes).

Material examined. — North China: 1 ♀, labelled "Tjinen Cho [Tshan Chan?] (2) Apr. 13, '29", in Cockerell's hand, and "H. pekinensis, det. T. D. A. Cockerell, pres. by Imp. Bur. Ent. Brit. Mus. 1929-570" (print) (general coll., BM).

For the synonymy of this bee, see my previous remarks (1966). Since briefly reporting on *pekinensis*, I could examine a series of both sexes in the late V. B. Popov's collection at Leningrad; these are from eastern USSR provinces and bear locality labels in Russian characters. Though none of them were identified with *alashanica* Gussakowskij, the females agreed with Cockerell's specimen of that sex in the Brit. Mus. (Nat. Hist.) collection. One of the males from "Pekin" in the National Museum of Natural History (USNM) was selected by Cockerell as the type of *H. pekinensis*.

As the salient male characters of *pekinensis* can not be described or illustrated at present, I am merely quoting the original description of both sexes.

Original description. — "Male. Closely related to *H. zonatula* Smith; on comparison with a *zonatula* from Smith's collection (Nicopolis, May, 1836) the following differences are found: A little less robust; abdomen narrower, less triangular, more as in *Anthophora*; pubescence paler, not so red; flagellum longer and more slender, fourth antennal joint much longer; first *r.n.* not quite reaching apex of second *s.m.*; black on clypeus reduced, the middle broadly yellow to top, the large black markings variable, but constricted in middle; pygidial plate much broader; anterior femora strongly keeled beneath at base; hind tarsi red. The anterior coxae have the characteristic long backwardly-directed spines, and the hind basitarsi the great flattened lamina. The male is the type. — Female. About 16 mm. long, with the same ochreous hair covering thorax, the same black abdomen with light hair-bands; face, mandibles, and antennae entirely dark; fifth abdominal segment with the hair clear fox-red in middle, cream-colored at sides; scopa of hind legs light golden-ferruginous; eyes pale green, stained with red. — Habitat. Pekin, China, 1901 (M. L. Robb). Four males; April 19 (2), April 20, April 21. Twenty-three females; April 19 (12), April 20 (5), April 21 (5), April 22 (1). — Type. Cat. no. 13426, U.S.N.M." — Follows a comparison with a number of unrelated species.

This robust species clearly belongs to a group of six closely interrelated western Palaearctic *Habropoda* ranging from the Mediterranean far into continental Asia. It is the only member that occurs so far north-eastward. *H. pekinensis* is treated here only to demonstrate some differential characters over against all other Asiatic species having a more south-eastern distribution; it will be seen that this section comprises a much less homogeneous assemblage of forms. It comes nearest the Mediterranean *H. zonatula* Smith and a few other species inhabiting central West Asia, sharing with these the more distinctive features of *Habropoda* in its restricted sense. The male is, indeed, closely similar to *zonatula*, but I noted a difference in the lobes at the hind basitarsi, which in *pekinensis* are considerably larger, broader, and also lighter in colour. The male internal structures could not be examined. For some further details of the female, see the descriptive key; the pygidial plate is shaped similarly to that of *zonatula*.

Habropoda sinensis Alfken
Fig. 1—3, 7—8, 11

Habropoda sinensis Alfken, 1937, Ent. & Phytopath., 5 no. 20: 404—405 (♀ ♂ Chekiang, Tien-Mu-Shan, 24.viii.1936, T. C. Maa) — Woo, 1965, Chinese Ins. Econ. Importance (83 pp., 7 col. pls.), 9 Hym. Apoidea: 66 (♂ ♀ Chekiang, Kiangsi and Szechuan) — Lieftinck, 1966, Tijdschr. v. Ent., 109: 147 (note).

Type material examined. — China: 1 ♀ (holotype, no. 204), 1 ♂ (allotype), West Chekiang, Tien-Mu-Shan, 24.8.36, Tsing-chao Maa; 1 ♂ 1 ♀ (paratypes), with same locality information and all bearing red Typus-, Allotypus- and Paratypus-labels, in J. D. Alfken's handwriting (MNB).

Further material examined. — China: 1 ♂ 1 ♀, Kuling, Musée Heude, 7.7.35, O. Piel, identified with "? Habropoda sinensis Alf. ♀ ♂" (unknown hand), under drawer-label of V. B. Popov: "Emphoropsis sinensis Alf." (ZIL). Long series of both sexes (33 ♂, 51 ♀) from various localities in Fukien Prov., as follows: Shaowu distr.: Tachulan, 1000 m and Wuku, 350 m; Chungan distr.: Bohea Hills, 600 m; Kuatun, 1600-2000 m; Sanchiang, 600 m; Kienyang distr.: Hwangkeng, 500 m; various dates, from vi-x.1942-1945, all T. C. Maa (ML and various other collections).

With the two new species, *H. tumidifrons* and *orbifrons*, defined hereafter and in the descriptive key, *sinensis* forms a fairly distinctive section of the genus. The key characters will suffice to recognize them from all other *Habropoda*; for additional information on colour and pubescence, see also the original description. The bees of this little group are mainly distinctive by their more compact build, short antennae, bare and shiny abdomen, and also by the narrowly banded tergites and much shorter pubescence, recalling *Amegilla* in general appearance. The group is characterized further by the large head, broad, "pug-nosed" face and striking body punctation. These features, shared alike by all three, point to close interrelationship. As to the male terminal appendages, *sinensis* differs from most other *Habropoda* by the lateral shifting and reduction of the transverse ridges at the constriction of the 7th gastral sternite, whose diamond-shaped apical plate is covered with very fine, short setulae; in other details of male genitalia, the species is a true *Habropoda* (Fig. 2—3). Although Popov did not mention *sinensis* in his revision, he was apparently inclined to place it in *Emphoropsis* (see above), a genus whose characters, so far known, are hardly in accordance with those of the present species.

In a letter dated March 1, 1968, Dr. T. C. Maa called my attention to a recent publication by (Miss) Yen-Joo Woo (loc. cit., 1965), in which the author deals with the more common Anthophorine species occurring in China. This account, which I have not been able to consult, is provided with keys to genera and species, with brief descriptions of nine species, including *H. sinensis* Alfken. According to Dr. Maa, it is of interest to note that Miss Woo's article is based mainly on the collections of the Musée Heude, in Shanghai (now known as Shanghai Station, Entomological Institute of the Academia Sinica). The specimens of *H. sinensis* are topotypical and were labelled as such many years previously by Dr. Maa himself, who therefore assumes that they were correctly identified. He states that this bee is evidently widely distributed in the submontane areas of China south of the Yangtze River.

In the province of Fukien, the flight season of *sinensis* is given by Maa as lasting from June till October. It was repeatedly found in situations similar to those of *H. imitatrix* spec. nov., and apparently during the same time of the year.

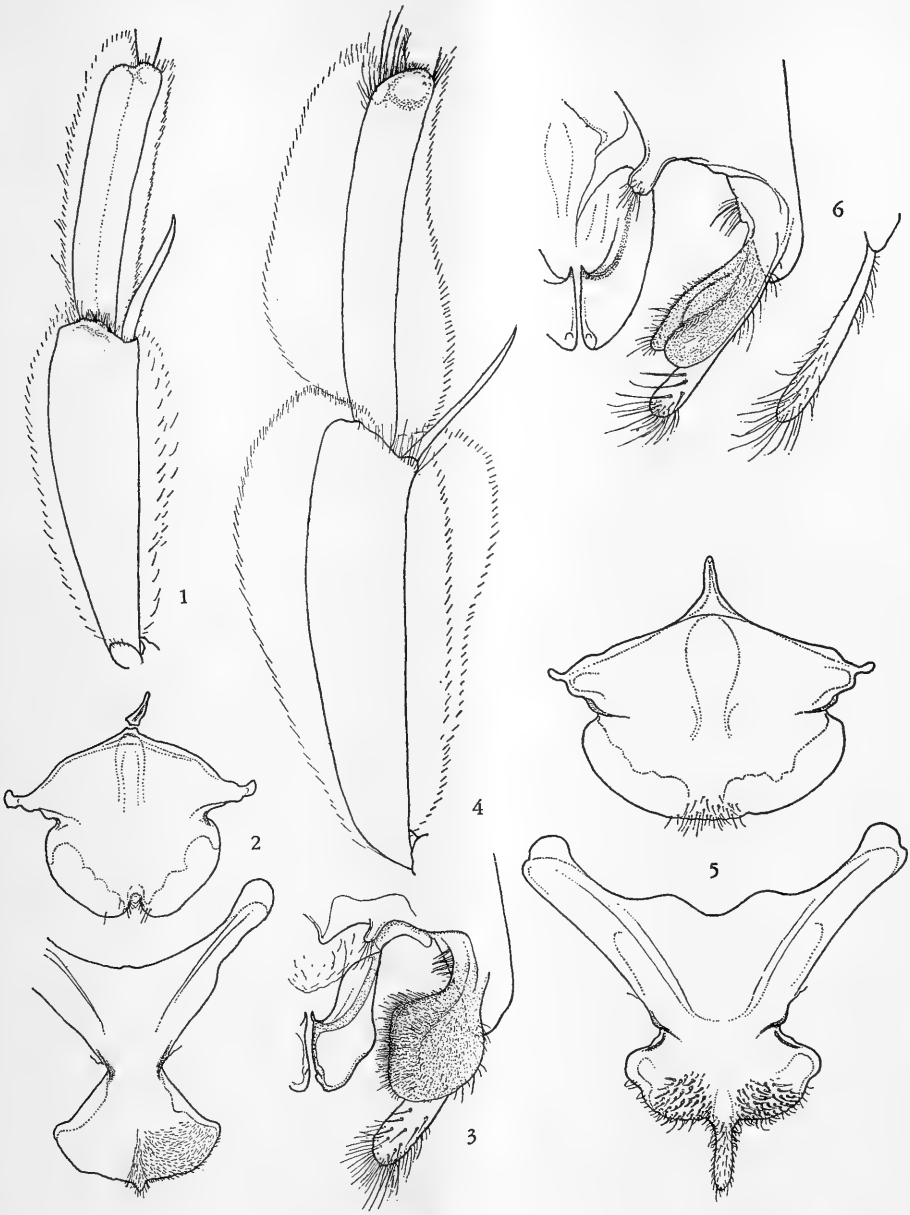

Fig. 1—3. *Habropoda sinensis* Alfk., ♂ structures, Fukien; Fig. 1, exterior view of left hind tibia-basitarsus; Fig. 2, eighth and seventh sternites, exterior view; Fig. 3, right gonoforceps and penis valves, partial ventral view, showing appendages: intero-ventral lamella and gonostylus. — Fig. 4—7. *H. mimetica* Ckll., ♂ structures, Fukien; Fig. 4, exterior view of left hind tibia-basitarsus; Fig. 5, eighth and seventh sternites, exterior view; Fig. 6, right gonoforceps with appendages and penis valves, partial ventral view, with detached right gonostylus, dorsal view

Habropoda tumidifrons spec. nov.
Fig. 9, 12

Material examined. — Indochina: 1 ♀, South Viet Nam, 6 km south of Dalat, 14—1500 m, 9.vi-7.vii.1961, N. R. Spencer coll. The specimen is the holotype (BISH).

Female. — A more colourful species than *H. sinensis*, with linearly banded abdomen.

Labrum subrectangular, almost two times broader than long, widest basally (ratio 100 : 52); dark brown, basal tubercles small, smooth, rest of surface coarsely punctate, all punctures coalescent and of large size, disk covered sparsely with light brown semierect hairs, densest and tufty mid-apically; anterior border slightly convex, median emargination unapparent, disk with pair of feebly raised, transverse, anteapical ridges. Basal half of mandibles yellowish brown, for the rest black. Face evenly convex in profile, protruding anteriorly by less than two-thirds greatest diameter of eye (63 : 100), projecting portion of clypeus (frontal view!) distinctly broader than long (ratio 66 : 50); almost hairless, but paraclypeal and parorbital areas covered with short appressed whitish tomentum; raised plumose hairs on vertex and ocellar area dark brown, the long occipital fringes and genal hairs again lighter. IOD : OOD = 60 : 100. Antenna brown, the anterior faces from end of segment 4 as far as the apex, red-brown; 3 exactly twice as long as broad at apex, length ratios of 3, 4 and 5 = 100 : 44 : 60.

Tegulae light brown, smooth, with few, very fine, superficial punctures. Punctures covering mesonotum and scutellum more crowded and deeply impressed than those on summit of head; gastral tergites again finer and more superficially punctate, the interspaces hardly exceeding one puncture width. Basitibial plate forming an isosceles triangle with broadly rounded apex, surface flat, finely tessellate, margins distinctly raised and rim-like. Pubescence on dorsum and upper part of sides, as well as base of tergite 1, rather short, moderately dense (not quite concealing surface), much as in *sinensis*, but deeper in tint, ochraceous-orange, the hairs becoming paler ventrally. Broad, compact hair-band at apex of tergite 5 and sides of 6 dark brown; posterior fringes at sternites 2—4 pale yellowish, longest at sides of 4.

Habropoda orbifrons spec. nov.
Fig. 10, 13

Material examined. — Thailand: 1 ♀, NW Thailand, Chiangmai, Doi Pui, 1500 m, 2.v.1958, T. C. Maa coll. The specimen is the holotype (BISH).

Very similar to *H. tumidifrons*. In addition to the characters given in the key, a minor difference is found in the punctation of the abdominal tergites, the punctures being more numerous and a little smaller than in *tumidifrons*. Face a little more protruding anteriorly in proportion to greatest diameter of eye (ratio 73 : 100), and clypeus in frontal view a trifle broader (ratio of length to breadth 50 : 70), than in *tumidifrons*. Antennae as in that species, 3 a trifle longer (length: breadth = 33 : 15), length ratios of segments 3, 4 and 5 = 100 : 51 : 66. IOD : OOD = 70 : 100.

In both species the second submarginal cell of the fore wing is almost square, very little broadened distally (in *sinensis* more markedly so). First recurrent nervure entering second submarginal a little before distal side of the latter (in *sinensis* variable and frequently interstitial).

Undoubtedly intimately allied to *tumidifrons* and easily recognized by a combination of characters enumerated under *sinensis*. The male of the present species being still unknown, nothing can be said about its internal structures, yet we may expect a form of apical abdominal sternites and genitalia resembling those of *tumidifrons* and *sinensis*, these organs being known only from the last-mentioned one.

Habropoda mimetica Cockerell
Fig. 4—7, 15—16

Habropoda mimetica Cockerell, 1927, Amer. Mus. Novit., 274: 15 (♀ Yen-ping [Fukien], China, Sept. 11, 1920, H. R. Caldwell) — Lieftinck, 1966, Tijdschr. v. Ent., 109: 146 (notes).

Material examined. — S E C h i n a, Fukien Prov.: 7 ♂ (one diss., Fig. 2—6), 10 ♀, Shaowu distr., Kuhsienkai, 300 m, no dates, 1944 (4 ♂ 6 ♀), Shaowu City, 300 m, 18.x.1941 (1 ♀), no date, 1942 (3 ♂ 3 ♀); Kienyang distr., Hwangkeng, ca. 500 m, 11.x.1943 (1 ♀); all T. C. Maa (ML and various other collections).

Original description. — "Female.— Length about 15 mm; robust, black, the legs dark red, and the abdomen reddened at base below; clypeus entirely black, but a broadly triangular cream-colored supraclypeal mark; antennae black, slightly stained with reddish, the flagellum dusky ferruginous beneath; labrum with pale golden hair; face, front and vertex with thin black hair; cheeks with white hair; thorax with bright yellowish-tawny hair, except a very broad dark brown or nearly black band between the wings; tegulae very dark; wings very brown; second cubital cell broad and quadrate, receiving recurrent nervure some distance before its end; marginal cell long, not much less than half its length beyond the third cubital cell; legs with black or brown-black hair, dark reddish on inner side of tarsi, long and yellowish-white on under side of anterior femora, also pale on middle legs beneath basally, anterior and middle tibiae with a little red tuft on outer side at apex; spurs dark; abdomen densely hairy, first segment with long fulvous hair, except at apex, where it is black; second with black, but a fulvous fringe at apex; third and fourth very bright orange-fulvous; apex with pale chocolate hair; hair of venter long and mainly pale chocolate. — Yen-ping, China, Sept. 11, 1920. Collected by the Rev. H. R. Caldwell. Allied to *H. turneri* Ckll. (Assam) by the long marginal cell and general appearance, but *H. turneri* has the black band on third abdominal segment, and the thorax anteriorly all black. *H. rowlandi* Meade-Waldo (Assam) has the black band on second segment, but no black band between the wings. *Anthophora pseudobomboides* Meade-Waldo (Assam) looks superficially like *H. turneri*, but has the second cubital cell narrowed above, short appressed felt-like tomentum on second abdominal segment, which is black at sides, etc. These insects present an extraordinary resemblance to the species of *Bombus*; the present species (*H. mimetica*) recalling such species as *B. bizonatus* Smith and *B. mendax* subsp. *defector* Skorikov."

A conspicuous, sturdily built species of large size, unlike any of its congeners, and superficially resembling a short-haired bumblebee, hence the name.

Female. — Though complying with the above description, some additional peculiarities are worth mentioning. Proboscis relatively short, reaching fore coxae in repose: galea not longer than clypeus and labrum united. Last segment of labial palpus shorter than penultimate joint. Labrum brownish black, all punctures large, coarse and coalescent, disk bounded on either side by a low, slightly outcurved ridge placed in the long axis; thickened semicircular border of emargination obliquely cut off, the brushy median

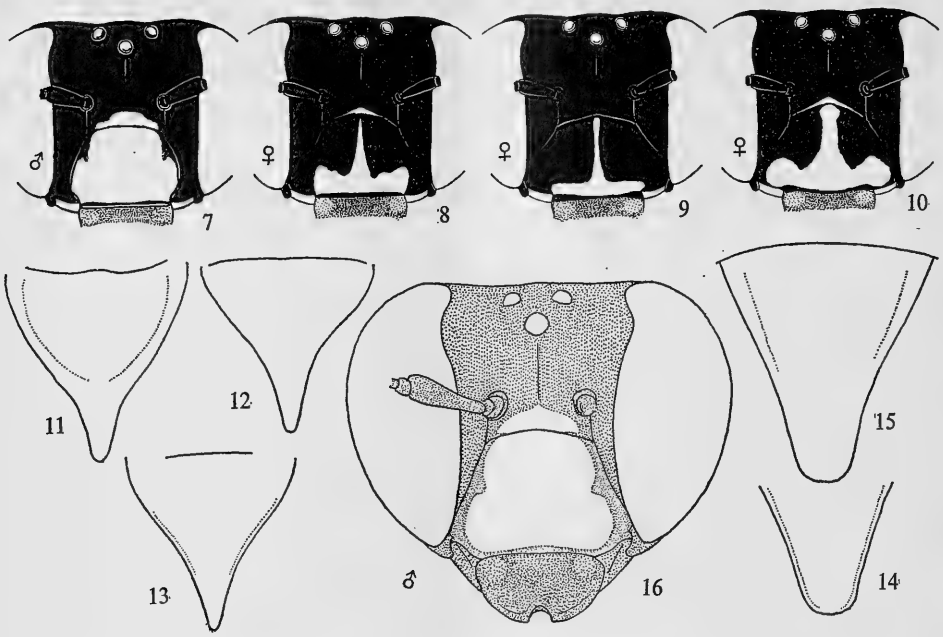

Fig. 7—10. Frontal view of heads of *Habropoda*, semi-diagrammatic; Fig. 7—8, *H. sinensis* Alfk., Fukien; Fig. 9, *H. tumidifrons* spec. nov., holotype, S. Viet Nam; Fig. 10, *H. orbifrons* spec. nov., holotype, Thailand. — Fig. 11—15. Pygidial plates of ♀ *Habropoda*, dorsal view; Fig. 11, *H. sinensis* Alfk., Fukien; Fig. 12, *H. tumidifrons* spec. nov., holotype, S. Viet Nam; Fig. 13, *H. orbifrons* spec. nov., holotype, Thailand; Fig. 14, *H. disconota* spec. nov. (apical portion, more enlarged), N. Viet Nam; Fig. 15, *H. mimetica* Ckll., Fukien. — Fig. 16. Frontal view of head of ♂ *H. mimetica* Ckll., Fukien

tuft golden brown. Tufts of long, raised and mostly dark hairs before and behind anterior ocellus, and all along upper occipital border, the fringe behind the latter and on genal area, pale yellowish to white. IOD : OOD = 69 : 100. Antennal scape slender, subcylindrical, not flattened anteriorly, shortly pilose, only little longer than segment 3, which is almost as long as its width at apex (100 : 34.6), and equalling in length the next three (4—6) combined; ratio of 3, 4 and 5 = 100 : 25 : 30.8; colour blackish brown, 4—12 ochraceous anteriorly. Body punctation extremely dense, except smooth and glossy mid-propodeal triangle. Raised silky hairs covering thoracic segments completely hiding integument. Tegulae brownish black, very shiny, with few minute superficial punctures. Wing membrane light smoky yellow, apical border hardly obscured. Venation as described for *sinensis*, the second recurrent nervure never quite interstitial. Basitibial plate broadly oval, with slightly raised margin and overlaid basally with golden, matted hairs originating from apex of femur. Tarsal arolia absent, or, when vestigial, then flat, subcordate.

Male (hitherto undescribed). — Mouth parts retracted, galea reddish brown, shorter than in female, not reaching fore coxae. Mandibles black, only the mid portion chestnut. Labrum jet-black, the broad polished median line variable in breadth, complete or confined to its distal half. Face even less protuberant than in female. Chrome patch occupying most of clypeus trapezoidal in shape, the tentorial pits vestigial, not or only

slightly obscured. Antenna brownish black, flagellar segments as in female; scape somewhat flattened and broader, its antero-lateral face fringed with long, raised yellowish hairs; segment 3 markedly shorter than scape. Eyes considerably larger and more convex than in female, their shortest distance (at level of antennae) and own diameter, in frontal view, in the ratio of 30 : 25. Body sculpture as in the opposite sex, pubescence of the same length, but much paler and showing a different pattern: dark band across mesonotum as broad as in female, but not at all defined, most fine plumose hairs between the wings tipped with grey-brown at the transition into the pale orange-yellow hairs covering remaining parts of the dorsum; thorax greyish white underneath. Wing membrane as in the female; second submarginal cell frequently almost square, and position of second recurrent nervure also variable, either interstitial, or (more often) entering the cell just before distal side of the latter. Abdominal pubescence as described in the key, the black band on tergite 2, so conspicuous in the female, replaced by yellow, disk in very fresh examples only more distinctly brown, or with admixture of darkish hairs, when looked at from the side.

Habropoda disconota spec. nov.
Fig. 14

Material examined. — Indochina: 1 ♀, North Viet Nam [Tonkin], environs of Hanoi, no dates, Thank leg., ex coll. B. Tkalcu. The specimen is the holotype (ML).

For a characterization of this bee, see the key to the females. Undoubtedly intimately related to *mimetica*, approaching the latter so closely in general appearance and major external features that no further description is needed. Originally I thought this to be only a geographical subspecies of *mimetica*, but, apart from the dissimilar colour design noted, I am now convinced that the remaining characters of this unique specimen are sufficiently distinctive to warrant specific recognition. One of the really noteworthy features common to both is found in the clypeus, which does not protrude strongly from the face, but arises gradually from the plane of supraclypeal and paraclypeal areas. Unfortunately, the male of *disconota* still remains unknown.

Habropoda turneri Cockerell

Habropoda turneri Cockerell, 1909, Entomologist, 42: 308 (♀ Shillong, Assam) — Lieftinck, 1966, Tijdschr. v. Ent., 109: 145—146 (notes on ♀); 1972, Tijdschr. v. Ent., 115: 281 (host-parasite relationship).

Type material examined. — NE India: 1 ♀ (holotype), "Assam, Shillong, 9.03" (written), labelled "type" and "Habropoda turneri Ckll. Type", in Cockerell's handwriting (general coll., BM).

Further material examined. — NE India: 1 ♀ (topotypical), same labels as holotype (BM); 1 ♂ (diss., Fig. 17—20, first described ♂), "Shillong, 9.03" (written), "Assam, R. Turner 1905—125" (print) (BM); 1 ♂, "Shillong, 8.03" (written), "Assam, R. Turner 1910—225" (print) (ML); 1 ♀, "Shillong, 8.03" (written) (ML). 1 ♂ (head and proboscis detached, abdomen partly missing), "Coll. Friese" (print), "Khasi Hills, 1.9.95" (written, blue disk), "Anthophora bremoides Fr." [nom. nud.], det. Friese 1913 (MNB).

A rather large, handsomely coloured species, easily distinguished from others by the

conspicuous variegated colour-pattern, dark legs and fuliginous wings. For the sake of completeness, the original description is here quoted in full:

"♀. Length about 17 mm., anterior wing 11; robust, but with the abdomen much longer in proportion to its breadth than in *H. zonatula*, Sm.; black, with the pubescence of the head, and thorax above as far back as the level of the hind wings, black; posterior to this, beginning abruptly, the pubescence is sulphur-yellow, and the same, very dense, covers the first two segments of the abdomen; the third segment has the hair short, dense and coal-black; the fourth and fifth have it reddish, more or less black at sides; there is a little pale tomentum at sides of face, and the lower part of the cheeks is covered with long white hair; a peculiar feature is a small patch of appressed white hair just above (a little mesad of) each antenna, surrounded on all sides by erect long black hair; the pleura is covered with long white hair; hair of legs mainly black, but some long white hair on anterior femora beneath; brush at end of hind basitarsus orange-fulvous. Clypeus prominently densely punctured, but the punctures irregular and largely in grooves; antennae black, third joint a little longer than 4 + 5; tegulae black; wings fuliginous, third s.m. broader than second; marginal cell long; hind tibiae broad and flat, not produced at end, the scopa coarse and dense.

Hab. Shillong, Assam.

A very distinct species, not closely resembling any of the four (*H. montana*, Rad., *H. magrettii*, Bingh., *H. moelleri*, Bingh., *H. fulvipes*, Cam.) known from India. There is a certain general resemblance to *H. tarsata*, but that has the hair of the thorax entirely orange-fulvous above."

(It may be noted in passing, that all species compared by Cockerell with *turneri*, except *montana* (= *radoszkowskii*), have since been transferred to *Elaphropoda* Lieft.).

Female. — Maxillary palpi slender, 1st segment short, only twice as long as broad, the 2nd longest, and from 3 on gradually diminishing in length, the whole palpus shaped rather like *Elaphropoda* (see Lieftinck, 1966 : 126 fig. 18). Proboscis light brown, much longer than in *H. mimetica*, measuring 10 mm when fully extended, galea reaching end of hind coxae in repose. Dark pubescence covering anterior portion of thorax extending below wings about as far down as the scrobal groove, the large patch below this silvery white; coxae and femora predominantly dark-haired, as also the abdominal sternal fringes, which are of moderate length, most conspicuous at sides of 4 and 5. Basitibial plate blackish, broadly oval, surface dull, quite flat and not rimmed, the apex rather protuberant. Tibial spurs light brown. Inner ramus of mid and hind tarsal claws only half as long as outer and more strongly curved than the latter. Wing membrane light brown; marginal cell of fore wing long and attenuated, relatively a little longer than in male (ratio 100 : 75.5); second submarginal cell of the usual, almost square, shape, the recurrent vein entering the cell a little before its distal side. Pygidial plate, Fig. 21.

Male (hitherto undescribed). — Unidentified specimens of this sex in the British Museum (Nat. Hist.) collection turned up unexpectedly in drawers containing various other anthophorines, after publication of my 1966 paper (loc. cit.).

The principal characters are those given in the descriptive key. Very similar to the female, but size a little smaller and all colours less bright, the dark band on gastral tergites 2—3 less definite, anteriorly as well as posteriorly. Proboscis of the same great length (9 mm approx., small specimen), exceeding length of abdomen. White pubescent patch of finely plumose hairs behind antennae directed anterad, occupying the depressed

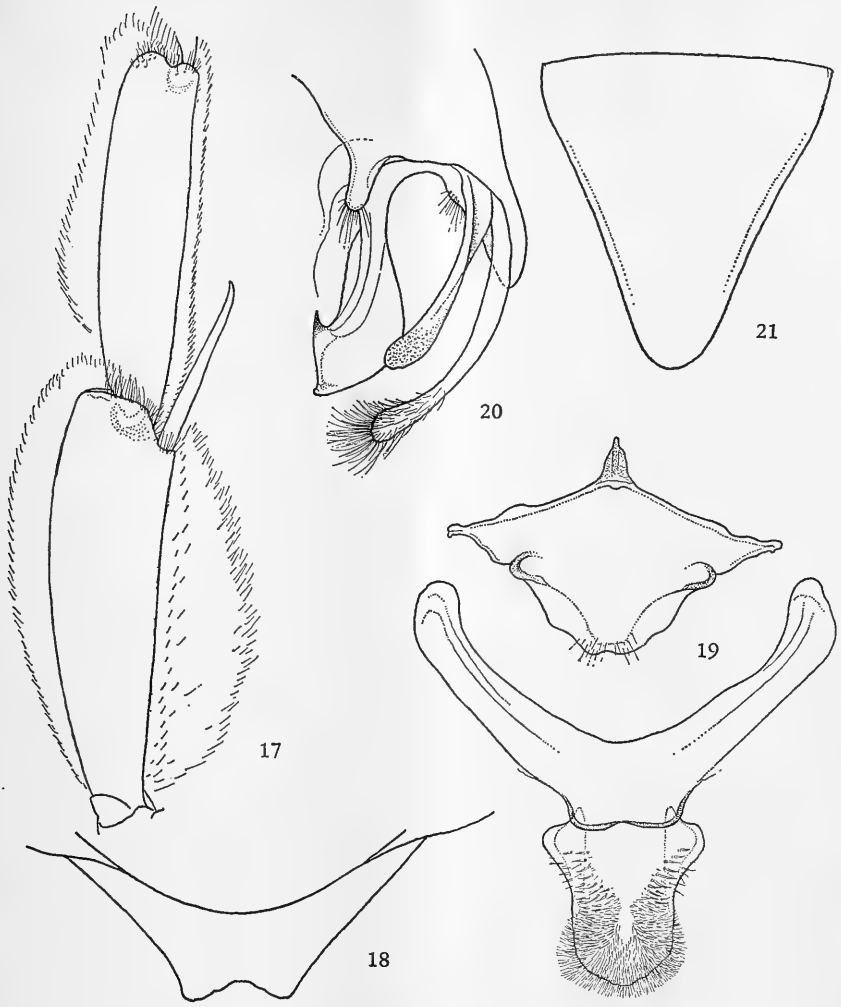

Fig. 17—21. *Habropoda turneri* Ckll., structures, Shillong; Fig. 17, exterior view of ♂ left hind tibia-basitarsus; Fig. 18, ventral view of ♂ seventh tergite; Fig. 19, eighth and seventh sternites of ♂, exterior view; Fig. 20, right gonoforceps with appendages and penis valves of ♂, partial ventral view; Fig. 21, pygidial plate of ♀, dorsal view

facial foveae on either side and confluent with longer white hairs in the middle of the supraclypeal area. Tegulae brown, surface shining, clothed with longish, darker brown hairs hiding most of the surface. Hair on outer face of hind tibia and basitarsus all black, much less condensed than in female, not hiding the surface, which is rather shining and evenly punctate; tarsal distalia brown, with yellowish brown hairs, last segment and claws basally, ferruginous tipped with black. Apex of tergite 7 excised, dorsal surface clothed densely with long, bristle-like hairs (Fig. 18). Sternites 7 and 8 of characteristic shape (Fig. 19—20). Intero-ventral process at apex of gonocoxite placed in a vertical plane: when viewed from behind in the form of a broad, bluntly rounded,

almost bare, oval plate, which is directed inward and hollowed out externally; owing to its transverse position, the plate in ventral view appears to be slenderly lanceolate (Fig. 20); gonostylus much longer, base slender, ribbon-like, the flattened distal portion gradually distended, its apex fringed with long, stiff bristles.

With the discovery of the males of both *mimetica* and *turneri*, it became quite evident that the two are not at all nearly allied, as had been held previously by Cockerell and myself. These statements were based on the long marginal cell and reduced tarsal arolia, characters common to both. In point of fact the resemblance between them is merely superficial, due to a somewhat similar pubescent colour-design. The pronounced sexual dimorphism of *mimetica* is non-apparent in *turneri*, which is more slenderly built and has a differently shaped head, the legs and hidden sternites of the male being also very unlike those of *mimetica*. In general appearance, and on comparing the structural features of the males, *turneri* approaches *rowlandi*, discussed hereafter, much more closely, all facts suggesting real relationship.

In a recent publication (Lieftinck, 1972), I suggested the Indian melectine *Protomelissa tricolor* m., also from Shillong, as a possible parasite of *H. turneri*.

Habropoda rowlandi Meade-Waldo

Anthophora (*Habropoda*) *rowlandi* Meade-Waldo, 1914, Ann. Mag. Nat. Hist. (8) 13: 45 (key), 50—51 (♀ ♂ Shillong, Assam, viii.1903, R. E. Turner).

Habropoda rowlandi: Lieftinck, 1966, Tijdschr. v. Ent., 109: 146 (brief notes on both sexes).

Type material examined — NE India: 1 ♀ (holotype, no. 637, selected by Meade-Waldo), "Assam, Shillong, 9.03, R. E. Turner, 1910—225" (BM).

Further material examined. — NE India: 3 ♂, 3 ♀ (first described ♂, diss., Fig. 23—25, BM), "Assam, Shillong, 8.03" (written), "Assam R. E. Turner, 1910—225", and "Turner Coll. 1912—111" (print), ♀ with additional label "Habropoda ♀" (general coll., BM and ML); 3 ♂, 1 ♀, "Shillong, 8.03, Assam" (written), R. Turner 1905—125, one with label "Habropoda ♀" (BM).

Apparently based on several specimens of either sex, but with the exception of the holotype and one male standing over a drawer label *rowlandi*, all were unidentified.

Note. — A number of "*rowlandi*" in the Brit. Mus. (Nat. Hist.) collection with typewritten labels "Simla, 8.98" and "9.98 Bingham coll.", and placed as *rowlandi* by Meade-Waldo, are not that species but a mixture of *apatelia* spec. nov., *apostasia* spec. nov., and *deiopea* Cam., discussed hereafter.

My statement (1966 : 146) that the type of this species is not a true *Habropoda*, is incorrect, in so far as it was based on characters which I now consider are of no generic importance. *H. rowlandi* is, I think, most closely related to *turneri*, a species whose male had not been recognized at the time, but which is described in the previous pages.

So far known only from Meade-Waldo's nondescript diagnosis. The specimens now before me form a homogeneous series showing little or no variation.

The two sexes are characterized anew in the keys, which can be supplemented as follows. Stature slenderer and of smaller size than *turneri*, from which it is at once distinguished, among other characters, by the more uniformly coloured body pubescence,

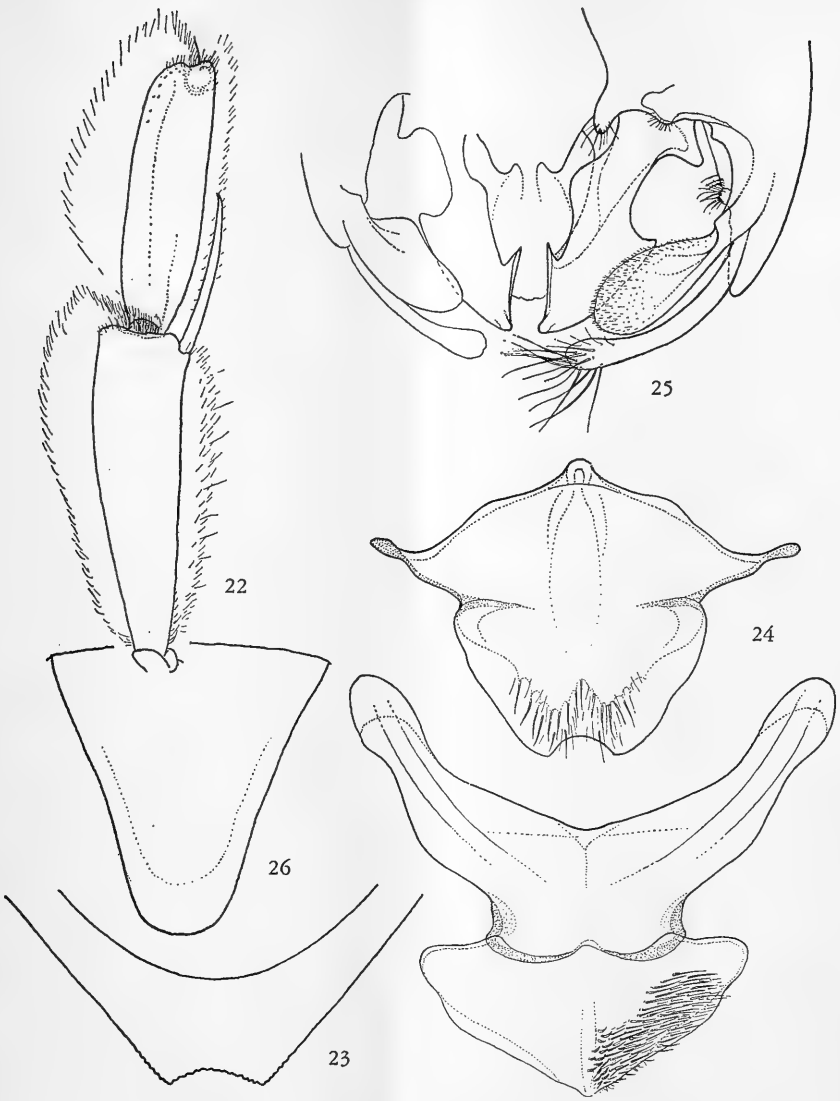

Fig. 22—26. *Habropoda rowlandi* Meade-Waldo, structures, Shillong; Fig. 22, exterior view of ♂ left hind tibia-basitarsus; Fig. 23, ventral view of ♂ seventh tergite; Fig. 24, eighth and seventh sternites of ♂, exterior view; Fig. 25, apical portion of genital capsule, showing gonoforceps with appendages and penis valves of ♂, ventral view; Fig. 26, pygidial plate of ♀, dorsal view

lighter brown and palely pubescent legs, and also by the presence of a well-developed tarsal arolia and much lighter wings.

Male and female. — Proboscis of the same great length as *turneri*, galea reaching as far back in repose as the mid coxae. Labrum broader and more angulated laterally, lacking the dark crescentic ante-apical ridge of *turneri*, and with the discal hairs (as well as the mid-apical and lateral fringes) much longer than in that species; sides of clypeus with light marginal hairs also more conspicuous and longer, especially so in male. Malar

area distinctly longer than in *turneri*. Legs much lighter, the tibiae and tarsi more reddish brown, clothed all over with brown hairs, those covering mid and hind tibiae and basitarsi light golden brown. Tibial spurs golden yellow; tarsal claws with distinct, slender, laterally compressed, arolia, otherwise shaped as in *turneri*. Wing membrane pale smoky yellow. Vestiture of abdomen composed of a matted layer of plumose pubescence covering the tergites posteriorly, and much longer, raised and finely branched hairs more sparsely disseminated over the whole surface, all discal hairs shorter than in *turneri*.

Male. — Apical fringes of tergites 6—7 and sternite 6 with distinct golden gloss. Hidden sternites 7—8 (Fig. 24) considerably more expanded than in *turneri*, but strong transverse ridges at base of apical plate and abundant short microsetae similarly arranged. Structure of genitalia likewise resembling that of *turneri*, the intero-ventral lamella at apex of gonocoxite and gonostylus both broader than in that species (Fig. 25).

Female. — Basitibial plate dark brown, shaped similarly to *mimetica*, with the same golden brown femoral tuft overlying its base, thus differing from *turneri*. Apical fringes of tergites 5—6 with golden shine, as in the male. Pygidial plate, Fig. 26.

A peculiarity of the venation not mentioned earlier, is found in the shape of the submarginal cells of the fore wing. Considerable variation exists in the proportional sizes of the second and third submarginal cells, the latter frequently being scarcely broader than the second. In *turneri* and most other species, the third *s.m.* is much larger than the second, the costal and anal sides of the latter being markedly shorter than those of the third cell. In most *rowlandi*, on the other hand, the third is only little larger than the second, in several males the reverse condition existing as to the lengths of the costal and anal sides of these cells.

Habropoda tainanicola Strand
Fig. 27—37

Anthophora (*Habropoda*) *tainanicola* Strand, 1913, Suppl. Ent., 2: 51—52 (♀ Tainan & Hoozan, Formosa).

Anthophora bucconis Friese: Strand, 1913, Suppl. Ent., 2: 51 (♂♀ Formosa, addit. descr., partim!).

Emphoropsis spec.: Michener, 1944, Bull. Amer. Mus. Nat. Hist., 82: 286 (♂ Formosa).

Habropoda tainanicola: Lieftinck, 1966, Tijdschr. v. Ent., 109: 146 (notes).

Type material examined. — T a i w a n (Formosa): 1 ♀, "Cotype" (print on yellow disk), "Tainan, Formosa, 1911, H. Sauter/7.IV" (print), "Anthophora tainanicola m.", in H. Strand's writing/"Cotype" (print on dark red), "H. tainanicola Strand", det. M. A. Lieftinck 1967 (BM).

Further material examined. — T a i w a n (Formosa): 1 ♀, "Formosa, Takao, 3. 1908, Sauter/Anthophora pyropyga Friese 1915 [nom. nud.] Type" (print on dark red), "tainanicola Str., det. H. Hedicke 1942, cpd. with cotype by M. A. Lieftinck 1970" (MNB). 3 ♂ (first ♂, one diss., Fig. 28—31), 6 ♀ (2 ♀ light, 4 ♀ dark form), Taiwan, Neihu nr. Taipei, 250 m, iv-v.1972, at nesting site; 15 ♂ (1 diss.), 10 ♀ (4 ♀ light, 3 ♀ dark, 3 ♀ intermed. form), same locality, 20—25.iii.1973, 1—2.iv. 1973; all T. C. Maa (ML, etc.). 1 ♂ (diss.), Formosa, Urai, i.iv.1932, J. L. Gressitt, "Habropoda spec.", det. C. D. Michener (UKL).

This remarkable species stands rather apart from its Asiatic congeners Although both

sexes bear a striking superficial resemblance to *H. bucconis* and the nearly related *imitatrix* spec. nov., *tainanicola* can be distinguished from these by a number of structural peculiarities described in the key. The most striking differences are found in the abdominal sternites of the male and pygidial plate of the female; *H. tainanicola* also deviates from the two regional species just mentioned by the colour and sculpture of the face, the male moreover by the placement of the ocelli, the length ratios of the proximal antennal segments, and the long hairs fringing the outer ridges of the hind legs. When good series are available for comparison, it will be seen that *tainanicola* averages a little smaller in size, the insect at the same time appearing somewhat more slenderly built, than *bucconis* and *imitatrix*.

There appear to be two distinct geographical subspecies: one, the nominotypical *tainanicola*, described from the island of Taiwan (Formosa), and a second, *maiella* subspec. nov., from the opposite Chinese continent. In respect of size, general morphology and sculpture, the two races are practically identical, males in addition being inseparable as regards shape and armature of the hidden sternal plates and genital organs. In spite of this, males can be recognized fairly easily by a different pubescent colour pattern, which appears to be constant in both. The females are dichromatic, there being two colour forms of either subspecies, one (isochromatic) resembling the male, and a second (heterochromatic), almost black-haired, form with a "red-tipped" abdomen. The latter is the one described by Strand as *tainanicola*. Specimens intermediate in colour do occur in populations of both subspecies.

H. tainanicola tainanicola Strand
Fig. 27—32

Here follows first the original description:

"9 ♀ ♀: Tainan 7. April, Hoozan April.

Die Art muss wohl für eine Habropoda gehalten werden, wenn auch das Geäder nicht konstant wie bei dieser Gattung oder Untergattung ist: bei dem einen Exemplar ist die erste rekurrente Ader interstitial, bei den übrigen mündet sie in die zweite Cubitalzelle ein, aber allerdings ganz nahe der zweiten Cubitalquerader. Labrum mit hellem langen Haarschopf. Die Art ähnelt *H. Radoszkowskii* D.T. (= *montana* Rad.), aber Clypeus ist einfarbig schwarz, die Behaarung des Thorax und der Basalhälfte des Abdomens ist schwarz usw.

Tegument schwarz, an den Fühlern ist die Spitze des Schaftes und die Unterseite des Flagellums, abgesehen vom Endglied, gerötet, an den Beinen sind die Spitze der Femoren, die ganzen Tarsen und wenigstens die Spitze der Tibien, am II. und III. Paar die ganzen Tibien gerötet. Behaarung schwarz, rotgelb (feuerrot) aber an den Segmenten 4—6, wenigstens der Hälfte des Segmentes 3, an allen Metatarsen und Tarsen, an den ganzen Tibien 3 und an der Spitze der Tibien 1—2; letztere beiden haben auch oben mehr oder weniger rotgelbe, mit schwarz gemischte Behaarung, und blass rötlichgelbe Behaarung findet sich an der Unterseite des Körpers, den Schläfen und an den Femoren, hell rötlichgelbe auf den Hinterrändern der Bauchsegmente, dem Labrum und (mit schwarz gemischt) auf dem Clypeus. Tegulae schwarz. Die Flügel sind gelblich angeraucht, stark schimmernd, mit braunschwarzem Geäder, das Saumfeld (bis an die Zellen) am dunkelsten. Clypeus stark vorstehend, vorn in der unteren Hälfte flach, der dieser Fläche entsprechende Teil des Vorderrandes gerade und ganz schwach erhöht,

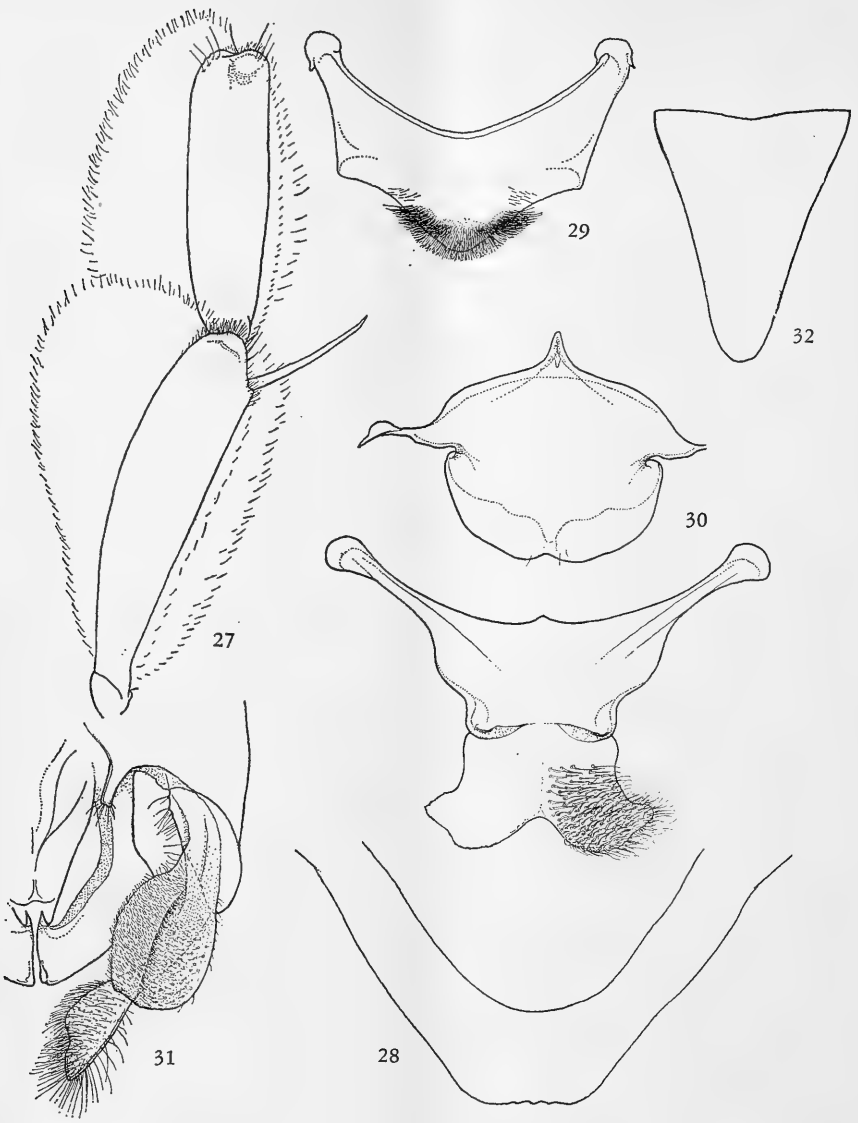

Fig. 27—32. *Habropoda t. tainanicola* Strand, structures, Taiwan; Fig. 27, exterior view of ♂ left hind tibia-basitarsus; Fig. 28, ventral view of ♂ seventh tergite; Fig. 29, exterior view of ♂ sixth sternite; Fig. 30, eighth and seventh sternites of ♂, exterior view; Fig. 31, left gonoforceps and penis valves of ♂, partial ventral view; Fig. 32, pygidial plate of ♀, dorsal view

der ganze Clypeus etwas glänzend, und zwar vorn mitten am deutlichsten, mit ganz seichten und nicht dichtstehenden kleinen Grübchen. Der Scheitel stärker glänzend, zwischen Ozellen und Augen seicht ausgehöhlt, glatt, das Ozellenfeld matt. Die Wangen schmal, glänzend, glatt, jedoch mit einzelnen ganz feinen Pünktchen. Mesonotum, soweit durch die ziemlich dichte Behaarung erkennbar, ist etwas glänzend, fein und spärlich punktiert. Das zweite Geisselglied ist jedenfalls nicht länger als die drei folgen-

den zusammen. Die dritte Cubitalquerader ist gleichmässig saumwärts stark konvex gekrümmt, die erste ist umgekehrt und zwar ungleichmässig und fast unmerklich gebogen. — Körperlänge 14 mm. Flügellänge 10,5 mm. Breite des Abdomens ca. 6 mm."

This good description complements the female characters given in the specific key and the more detailed racial distinctions given below.

Male. — Vestiture of body throughout bright orange-chrome to orange-rufous, the long pubescence on supraclypeal area, mandibles, genal area, ventral surface of body and bases of fore legs, lighter, pale orange-yellow; dark brown raised hairs only on paraclypeal area, but erect tufts on summit of head in front of ocelli and at occipital border also obscured; occasionally some brown-tipped hairs interspersed on mesonotum anteriorly. Broad membranous posterior margins of tergites 1—6 yellowish, well visible beneath the pubescence. Wing membrane stained with pale orange-yellow, outer borders of both fore and hind wing broadly and distinctly obscured.

Female. — (a), typical (dark) colour form: see original description. Apart from the "cotype", four out of our series of nine dark females have the abdomen as described by Strand, whereas in five others tergites 3 and part of 2 are likewise red. (b), light colour form: the remaining seven females are isochromatic, coloured similarly to the male though having more grey-brown hairs intermixed on the thoracic dorsum; the other three are intermediate, differing from the rest by having most of the thorax clothed with dark rufous-brown hairs and a vivid orange-rufous abdomen, more deeply so in tint than in the male. The legs have retained the same bright colour throughout our series of females.

The proboscis is almost as long as in *H. turneri* and *rowlandi*, the galea measures 4.2—4.6 mm, and the tongue when fully extended, reaches as far as the apex of the trochanters of hind legs. The basitibial plate of the female is rimmed, shaped similarly to that described for *mimetica* and *rowlandi*, with the same conspicuously golden basal tuft at apex of femur as seen in *rowlandi*. Venation light brown; shape of submarginal cells variable, costal side of the 2nd always a little shorter than anal side, the 3rd cell distinctly longer than 2nd; recurrent nervure either interstitial, or received a little before distal side of 2nd submarginal.

Strand only described the female, from "Sauter's Formosa Ausbeute", a number of females —and possibly also light-coloured males — having been confounded by him with *H. bucconis* in the same publication; see under that species.

H. tainanicola maiella subspec. nov.
Fig. 33—37

Habropoda tainanicola: Cockerell, 1931, Amer. Mus. Novit., 480: 7 (♀ Foochow distr.).

Material examined. — S E China, Fukien Prov.: 11 ♂ (2 diss.), 52 ♀, Shaowu distr., Tachulan, 1000 m, iv-v.1934, 1942—43 (♂ diss., 21—27.iv.1943 and 11.iv.1943, on white labiate); 3 ♂, 14 ♀, Chungan distr., Tsilichao, 1000 m, 4.iv.1943 (2 ♂), Sanchiang, 600 m, 30.iv.1928 (♂) and iv.1942; 12 ♀, Chungan distr., Bohea Hills, 600 m, iv.1940; 3 ♀, Kienyang distr., Hwangkeng, 22.iv.1943; 1 ♀, Central Fukien, Changting, 27.iv.1943, at *Citrus*; all T. C. Maa (ML, etc.). 3 ♀, Fukien, Kushan below Foochow, 400 m, 8.iv.1935, and Buang Kri, north of Foochow, 26.iv.1935 (intermediate colour form), E. Suenson (BISH). Holotype ♂ and first described ♀: Shaowu,

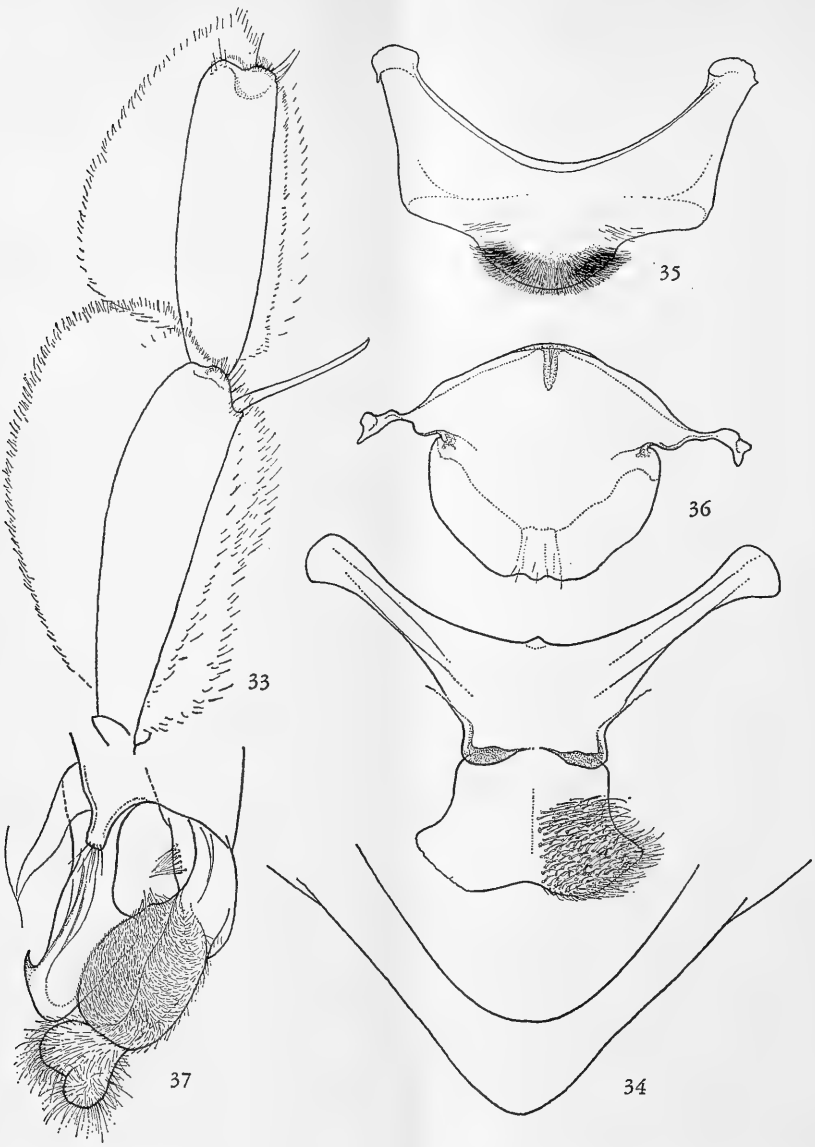

Fig. 33—37. *Habropoda tainanicola maiella* subspec. nov., ♂ structures, Fukien; Fig. 33, exterior view of left hind tibia-basitarsus; Fig. 34, ventral view of seventh tergite; Fig. 35, exterior view of sixth sternite; Fig. 36, eighth and seventh sternites, exterior view; Fig. 37, left gonoforceps and penis valves, partial ventral view

Tachulan, 21—27.iv.1943 (♂ diss.), and same loc., 2.vi.1942 (♀) (ML); paratypes in various other collections.

This is obviously the same bee as the one which Cockerell characterized briefly as follows: "The single female sent is in very bad condition, but it appears to belong to Strand's species, described from Formosa. It is very distinct by the entirely black face; the dark reddish labrum keeled down the middle and sharply bidentate at end; the large

red area on basal part of mandibles; brownish black hair of head and thorax (but cheeks below with long gray hair); dark tegulae; yellowish-hyaline wings; hind tibiae and tarsi covered with very bright ferruginous hair; apex of abdomen with red hair. If this is at all different from the Formosan insect, the fact can only be ascertained by direct comparison of good specimens."

Male. — Vestiture more sallow and generally darker than in *t. tainanicola*; long pubescence on labrum, supraclypeal area, genal surface and fore femora almost pure silvery white; summit of head, mesonotum and scutellum a mixture of grey-brown, sides below wings dark brown, pleurae pale brownish fading to almost white ventrally. Legs light to dark brown, the dorsal fringes of hind tibia and basitarsus variable, frequently almost black. Wing membrane much as in the insular race but outer border of wings less obscured. Broad membranous posterior margins of tergites 1—6 pale ochraceous; pubescence of 1 greyish yellow to pale orangish gradually darkening to grey-brown on succeeding segments, 4—5 again lighter with orangish hue, 6 and 7 progressively more vividly orange-yellow, the lateral tufts at tergites 4—6, tomentum of sternites 5—6, as well as the dense apical fringe of 7, light golden yellow in fresh specimens.

Female. — (a), typical (dark) colour form: very similar to nominotypical examples, but differing constantly in that the dark hair covering thorax and abdomen, besides being dark brownish black instead of deep black, is thinner, leaving visible more of the underlying surface, especially that of the abdomen. It differs further by the reduction of light colour on the abdomen, the black extending as far as a little before the apex of tergite 4, the posterior fringe of which is light orange-yellow instead of rufous, only the dense hair covering tergite 5 acquiring a golden-rufous tint. Long bristles fringing tergite 6, on either side of the pygidial plate, glistening golden brown. (b), light colour form: much lighter and less uniformly coloured than the lightest individuals of *t. tainanicola.* Eight females (about 10% of the total) are isochromatic, though differing from the male in that they are more densely hairy, the pelage on the whole being less sallow, brownish yellow, lightest on the scutellum, the first and penultimate abdominal segments, the intermediate ones acquiring a more greyish brown tint, while 5 and 6 are again orange-rufous, these colours on all parts shading one into the other. About 15% of the total number of females are more or less intermediate in this respect.

Attention should be drawn to the accompanying Fig. 27—32 and 33—37, of the two races of *tainanicola*, which were prepared only from a single individual of each taken at random. The apparent differences brought about in these drawings give no answer to the amount of variation which may be observed when good series are compared. So much is certain, that the form of tergite 7 as well as that of the hidden sternites seems to vary somewhat in both subspecies, these structures being, in fact, nearly identical in shape.

As pointed out above, the matching of the sexes has long remained a matter of uncertainty and, until recently, led to wrong conclusions (see below). The discovery of a very similar subspecies in Fukien and simultaneous occurrence of its sexes in various places on the Chinese continent, has removed all doubt about the correctness of their association. The fact that the two races were collected in the same season already indicated a close relationship. However, conclusive evidence could be obtained from a continued investigation of the nesting habits of typical *tainanicola* in Taiwan, described hereafter. A few years ago (Lieftinck, 1972 : 277) I have reported already on these biological observations, which were carried out by T. C. Maa. In the spring of 1970, and again

in 1971, two small colonies were discovered, clusters of cells being established in sandy soil under overhanging rocks on a road-side slope, near the observer's residence at Neihu (near Taipei). At that time individuals of two kinds of differently coloured females were observed, which occurred together with a single kind of male. The dark females and pale brown males were identified as *H. tainanicola*, a species then still known only from the female. The light colour form of the latter — though closely resembling *bucconis* — was supposed to represent an undescribed species of which the male had still to be discovered. The fact that the female forms inhabiting the "bee village" were so utterly unlike, led to the erroneous assumption that a mixed colony existed of two species, and that the male's flight season of one of the occupants had already been over at the start of the observations. In order to throw more light upon this question, Dr. Maa continued his investigations the next year, re-visiting the colonies almost daily, from the 10th of March onward till the end of April, with about one week's interruption. One of the nesting sites had been destroyed the year before, but the second was still left intact. On the 10th of March, the first humming sound of a *Habropoda* male was heard near the exposed entrance holes of the cell-cluster. Two days after, about 10 males (but no females!) were seen at the site, while a small series of both sexes could be procured from the 12th March until the 4th April, when the last male was captured, females of all colour forms then being still on the wing. This evidently indicated that the flight season had almost come to an end.

A careful examination of the entire series of specimens revealed beyond doubt that all occupants of the nesting site belonged to a single species. The females are variable, exhibiting a marked polychromatic colour design, whereas all males are of the same uniform yellow-brown colour.

The species was found by Dr. Maa nowhere else in Taiwan, nor did he come across *H. bucconis* in any part of the island. This is probably a much scarcer bee, which has a different flight season (see under that species). The only flowers visited by *tainanicola* were two species of native *Rhododendron* and an introduced species of *Passiflora.*

Habropoda apostasia spec. nov.
Fig. 38—41

Material examined. — N e p a l : 1 ♂ (holotype, diss.), E Nepal, Taplejung [Taplang Jong] Distr., Sangu, ca. 6200′, mixed vegetation by stream in gully, ix-x.1961, R. L. Coe coll., Brit. Mus. East Nepal Exp. 1961-62 (BM).

A more easily recognized species than the other inconspicuous and small-sized members occurring in the Himalayan region.

The present male is unique and best characterized by the slender, unmodified form of its legs, more especially of the posterior pair. As described in the key, the outer face of the hind basitarsus is almost flat and lustreless, very finely tessellate and evenly covered with short, decumbent pale hairs, the pile fringing the dorsal and ventral ridges being only little longer than the rest and, like these, of a pale yellow colour; the inner face is closely punctate and clothed with the usual dense brush of much longer, stiff, golden-brown hairs, which are directed apicad. It follows, that the hind basitarsus of this species shows no expansion of its lower part, and hence entirely lacks the hairless area, or "sole", which is so conspicuously present in several similarly-looking species.

Proboscis retracted, but galea relatively long, almost 3.5 mm, reaching well beyond fore coxae. Labrum, the brown basal tubercles excepted, black, the converging ante-

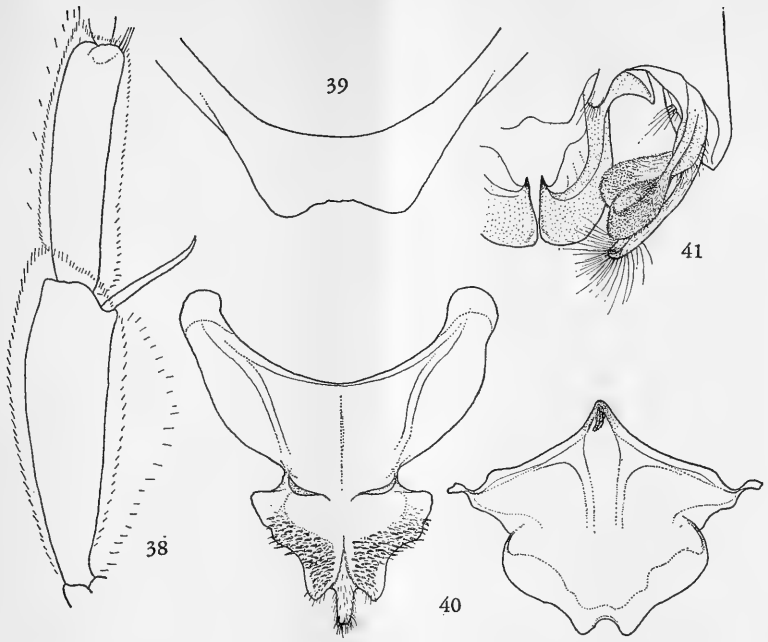

Fig. 38—41. *Habropoda apostasia* spec. nov., ♂ structures, holotype Nepal; Fig. 38, exterior view of left hind tibia-basitarsus; Fig. 39, ventral view of seventh tergite; Fig. 40, seventh and eighth sternites, exterior view; Fig. 41, left gonoforceps and penis valves, partial ventral view

apical ridges smooth, somewhat upturned, each ending in a low tubercle just before and above the front margin, which is almost straight; disk as described, the pale hairs covering it not very long, free border with short dense fringe of ferruginous hairs, the median tuft longest. Clypeus for the greater part light yellow, surface evenly convex, dullish, superficially, rather irregularly punctate, more shining only at apex. Antenna dark brown, anterior face of segment 3 only with vestigial basal and apical orangish spots, but remaining segments all brownish orange anteriorly. Long pubescence of genal area, ventral parts of thorax and basal segments of legs, white. Other characters as described in the key. Hidden sternal plates (Fig. 40) resembling those of *sutepensis* most closely; basal portion of sternite 7 relatively broad, and transverse sclerotised ridges reduced in size. Intero-ventral lamella at apex of gonocoxite placed transversely (Fig. 41), considerably expanded, broadest about halfway length, outer margin — when viewed from the inside — straight, but much swollen and folded in distally, the marginal rim thus formed bituberculate (not shown in Fig. 41). Gonostylus slightly exceeding lamella, narrow and almost straight, the apex slenderly club-shaped in side view.

Female unknown.

This little species was collected in Nepal along with individuals of *radoszkowskii*, *pelmata* and *apatelia*, all members of one group. By the clypeal marks and the yellow-spotted antennal scape, it resembles the two first mentioned species. However, the very different shape of the hind leg as well as the configuration of the hidden sternal plates, are unique features which preclude the possibility of a close affinity with these. In fact, *apostasia* is probably most nearly related with *H. sutepensis*, described below.

Habropoda sutepensis Cockerell

Fig. 42—45

Habropoda sutepensis Cockerell, 1929, Ann. Mag. Nat. Hist. (10) 4: 132—133 (♂ Siam, Doi Sutep, Feb. 9, 1928); Cockerell, 1930, Ann. Mag. Nat. Hist. (10) 5: 163 (♀ Siam, same loc.). — Lieftinck, 1966, Tijdschr. v. Ent., 109: 146 (note on types); 1972, Tijdschr. v. Ent., 115: 257 & 281 (generic assignment and host-parasite relationship).

Type material examined. — Thailand (Siam): 1 ♂ (holotype), "Doi Sutep, Siam, on summit, Feb. 9, 1928, T. D. A. Cockerell" (BM, no. 652).

Further material examined. — Thailand (Siam): 2 ♀, "Doi Sutep, Siam, Feb. 1928 T. D. A. Cockerell" (BM); 1 ♂, "Doi Sutep, Siam, Feb. 1928, H. sutepensis Ckll.", det. T. D. A. Cockerell (MNB); 2 ♂ (one diss., Fig. 43—45), "Doi Sutep, Siam, Feb. 1928" (written), "T. D. A. Cockerell coll." (print), "W. P. Cockerell & A. Mackie collrs." (written), "Pres. by Imp. Bur. Ent. Brit. Mus. 1929—570" (print), "Habropoda sutepensis Ckll." (in Cockerell's handwriting) (BM & ML).

I believe to have shown in the key that, here again, we meet with a species showing characters departing from those used for establishing the generic diagnosis.

Since briefly reporting on *H. sutepensis*, I have studied (1966, 1972) the morphology of the male more carefully and arrived at the conclusion that it can best remain merged in *Habropoda* along with all other species here treated. The present conception, which holds good for a number of other aberrant members as well, is briefly explained in the introduction.

Male *sutepensis* runs out in the key to near *H. apostasia* spec. nov., from which it is, however, immediately distinguished by the totally different shape of the hind legs and much longer abdominal pubescence. The hidden sternites are rather similar in the two, but here the resemblance ends. In fact, the long malar area, unmodified — yet conspicuously hairy — hind basitarsus, in combination with the elongate form of the 7th abdominal tergite, are characters peculiar to *sutepensis*. On the other hand, the non-specialized long hair dress of the exposed sternites, as well as the face marks and body punctation, definitely link the species with *bucconis*, so that I assume the latter to be its nearest ally.

The key characters of the male can be supplemented briefly by the next few particulars.

Male. — Proboscis retracted, galea of moderate length, 3.5 mm approx., reaching to end of fore coxae in repose. Clypeus ivory, basal portion with feebly indicated median ridge, this part of the surface dull, finely, superficially and sparsely punctate, the anterior portion slightly declivous and triangular in outline, its surface impunctate and shining; whole disk of clypeus almost hairless, raised bristles only laterally and on paraclypeal area. Antennal scape and pedicel reddish-brown, the former with thick yellow mark anteriorly, segment 3 entirely black, except two minute anterolateral spots, one at base, the second at apex; succeeding segments brown, their anterior faces ochraceous. Long pubescence on genal area, lower parts of thorax and basal segments of legs, white. Intero-ventral lamella at apex of gonocoxite placed transversely (Fig. 45), forming an undulated plate, hollowed out within; when viewed from the inside, expanded basally, projecting inward with strongly convex margin, distal portion tapering rapidly to a blunt apex, the straight outer border of the lamella narrowly folded in almost for its whole length. Gonostylus slightly surpassing lamella, at first slenderly lanceolate, then

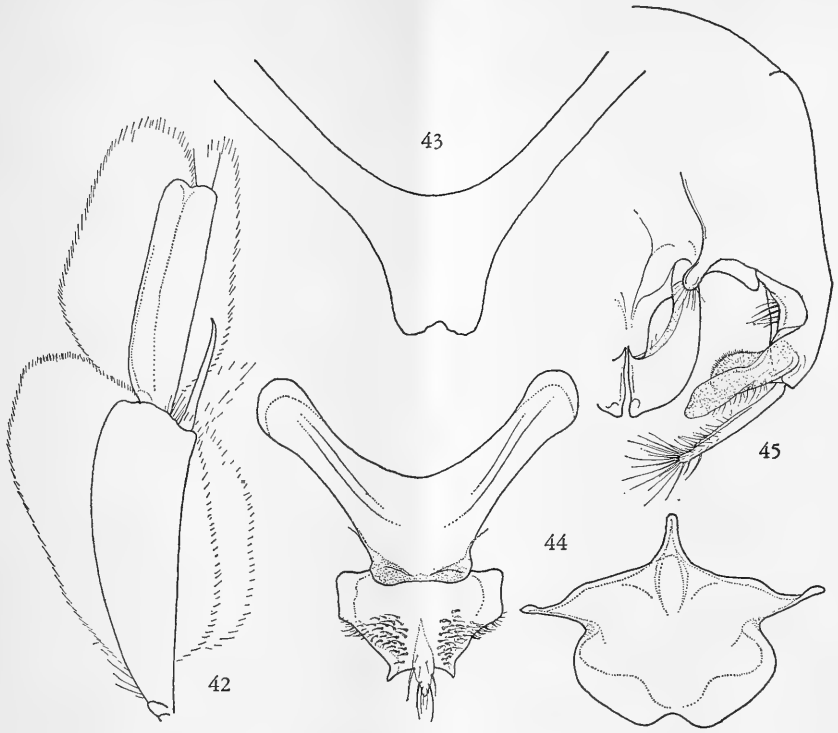

Fig. 42—45. *Habropoda sutepensis* Ckll., ♂ structures, Thailand; Fig. 42, exterior view of left hind tibia-basitarsus; Fig. 43, ventral view of seventh tergite; Fig. 44, seventh and eighth sternites, exterior view; Fig. 45, left gonoforceps and penis valves, partial ventral view

broadening gradually, spatulate, the apex suddenly narrowing again and ending in a blunt point (not shown in Fig. 45).

Female. — The brief diagnosis of this sex has been copied in the specific key. I am unfortunately unable to give a more detailed description. The two topotypical specimens which I had formerly registered — but failed to consider — in the Hymenoptera department of the British Museum, could not be retraced when last inspecting the collections, in October 1973.

This little species is known only from the type locality. Cockerell (1929) made the interesting observation that the melectine *Protomelissa habropodae* (Ckll.), which it greatly resembles, occurred together with many *Habropoda sutepensis*, stating that the former is doubtless its parasite (see also Lieftinck, 1972 : 257, 281).

Habropoda hookeri Cockerell
Fig. 55

Habropoda hookeri Cockerell, 1920, Ann. Mag. Nat. Hist. (9) 6: 202—203 (♀ Simla, 7000 ft., Oct. 1907 (H.M.L.), Fletcher; and Mussoorie, 7000 ft., Aug. 1906, Fletcher). — Lieftinck, 1966, Tijdschr. v. Ent. 109: 146 (notes).

Material examined. — North India, Uttar Pradesh: 1 ♀, with typewritten label

"Simla 9.98", and "P. Cameron Coll. 1914—110" (print), unidentified (BM).

Male unknown.

It is of interest to reproduce the original description of this bee, which runs as follows: "♀. — Length about 13 mm.

Robust, with abundant pale ochraceous-tinted pubescence, not mixed with black; clypeus strongly rugose, very prominent, faintly keeled on apical half, with a transverse yellow band, broadest in middle, just before the apex; first r.n. joining second s.m. before the end.

This nearly agrees with *H. montana* Rad., as described by Bingham, but must certainly be distinct, as the hind tibiae are not specially broadened or modified (their spurs are ferruginous and very long), and their inner side, instead of being bare and smooth, is densely covered with brownish hair. Other salient characters are: — Labrum with ferruginous spot on each side of base; greater part of mandibles pale yellowish or cream-colour; tegulae pale rufo-testaceous; hair on outer side of middle and hind tibiae yellowish white (not bright ferruginous), some black hair near base of tibiae; hair on inner side of hind basitarsi dark chocolate; wings brownish; nervures dark fuscous (not testaceous); hind margins of abdominal segments broadly pallid; fifth segment with a pale reddish fringe.

Simla, 7000 ft., Oct. 1907 (H.M.L.), Fletcher, 2 = type. Mussoorie, 7000 ft., Aug. 1906, also Fletcher, 2.

Dedicated to the memory of Sir Joseph Hooker."

As pointed out earlier (Lieftinck, 1966), the characters distinguishing *hookeri* from *radoszkowskii*, as given by Cockerell, apply to the leg structure of the males, and since Cockerell had no male of *hookeri*, he was, of course, all abroad. Cockerell's females, including the type from Simla, could not be recovered in the British Museum (Nat. Hist.) collection. However, the unexpected discovery of a single unidentified female from Simla, mixed with various other *Habropoda*, enables me to give a better impression of this bee. As it tallies the original description in almost every respect, the latter is here copied verbatim.

The most important features of the present female are mentioned in the key. Chiefly characterized by the almost white scopal hairs, the lustreless face, and the transverse ivory mark bordering the clypeus anteriorly. Proboscis retracted, galea short, measuring a little over 2 mm, not quite reaching base of fore coxae in repose. Long hairs covering genal area, occipital region (mostly), the thorax ventrally, and the marginal fringes of the abdominal sternites, almost white. Hair fringing posterior ridges of femora likewise whitish, those at trochanter and femur of hind leg very short. Basitibial plate brown, broadly rounded, surface flat with narrow upturned margin, its base covered with dense yellowish tuft from apex of femur. Tibial scopa with short, linear stripe of brownish hairs restricted to base of dorsal ridge, otherwise whitish. Penicillus of hind basitarsus and most of the distitarsi ferruginous; claws tipped with dark brown. Wing membrane lightly tinged with greyish yellow; 2nd submarginal cell almost square.

The "faint keel" on apical half of clypeus, mentioned by Cockerell, is unapparent in the present specimen, there being only two short and low parallel ridges in the median line, before the apex. Pygidial plate, Fig. 55.

The affinities of *H. hookeri* are obscure and must remain so until the male becomes known.

Habropoda bucconis (Friese)
Fig. 46—49

Anthophora bucconis Friese, 1911, Verh. zool.-bot. Ges. Wien, 61: 127 (♀ ♂ Tainan, Formosa). Strand, 1913, Suppl. Ent., 2: 51 (♂ ♀ Formosa, addit. descr., partim!).

Type material examined. — T a i w a n (Formosa): 1 ♂ (lectotype by present selection), "Tainan, Formosa/Anth. bucconis Fr., det. H. Friese 1910/Type" (print on dark red), "Habr. bucconis, det. H. Hedicke 1942" (MNB).

Further material examined. — T a i w a n (Formosa): 2 ♀, "Tainan, Formosa, Type" (print on orange), det. H. Friese & H. Hedicke, evidently syntypes (MNB); 1 ♂ (diss., Fig. 46—48), "Taihorin, Formosa, H. Sauter 1911/7.xii, Anthophora bucconis Fr., det. E. Strand/Dr. E. Strand 1913—249", cpd. with lectotype, M. A. Lieftinck (BM); 1 ♂ 1 ♀, both labelled "Tainan, Formosa, Type" (print on orange), "Anth. bucconis, ex coll. H. Friese", evidently syntypes (SMF); 1 ♂ 2 ♀, "Hoozan, Formosa, xii.1909 & i.1910, H. Sauter, A. bucconis, det. Friese & Hedicke" (MNB); 1 ♂, "Pilam, Formosa, i.1908, H. Sauter" (MNB); 1 ♀, "Polisha, x.1909, A. bucconis", det. Friese (MNB); 1 ♀, "Formosa, Takao, xii.1908, Sauter" (print, ML).

When Strand (1913) writes: "Bei den meisten ♂ ♂ ist das ganze Untergesicht gelb . . . .", he is certainly wrong, inasmuch as the genuine *bucconis* was mixed up with the similarly pubescent — but unrelated — *tainanicola*, a species that was also before him at that time. This confusion is evident from his further remark: "Clypeus hat an der Basis jederseits einen kleinen schwarzen Längsstrich". In the male of *bucconis* the clypeus is brownish-black marked with a thick, yellow, T-shaped spot, the transverse bar on top of the T being narrower than the stem, which is distinctly broadened anteriorly. The females also can be distinguished by the clypeal marks (Strand: "Der helle Clypeusfleck der ♀ ♀ kann fehlen"). True *bucconis*, however, has a more protuberant face and the clypeus bears a triangular yellow median spot in front of the anterior border, whereas in *tainanicola* the clypeus is invariably unicoloured black, or dark brown.

Though very similar superficially, these two Taiwanese species are altogether different structurally, belonging to two different species groups.

For a description of this bee, see the keys to both sexes and the comparative notes as contained in the diagnosis of its nearest relative, *imitatrix*, in the next pages. Indeed, were it not for the different structure and pubescence of the hind legs, and the slightly dissimilar form of the hidden sternites and genitalia of the male, the evidence for considering these two taxa specifically rather than subspecifically distinct, would seem to be less strong than, for example, in the case of *bucconis* and the previously described *tainanicola*. Unfortunately, these features are unisexual, the recognition of females being more difficult, necessitating a careful comparison of all characters.

As far as our locality records show, *bucconis* and *tainanicola* are probably completely allopatric in Taiwan, as suggested above, at the end of the discussion of the latter. Another fact separating them, is the difference in flight dates, *bucconis* being principally a late season bee, collected from October till January, whereas *tainanicola*, as we have seen, is an early spring species. In respect of seasonal occurrence, *bucconis* thus appears to be neatly affiliated with its ally of the Chinese continent, *imitatrix*, of which all specimens were collected in the autumn, between August and November.

Note. — Dr. Maa tells me (in litt.) that all old Taiwanese (Formosan) localities as found in the literature are situated in low hilly country or near the coast; the names

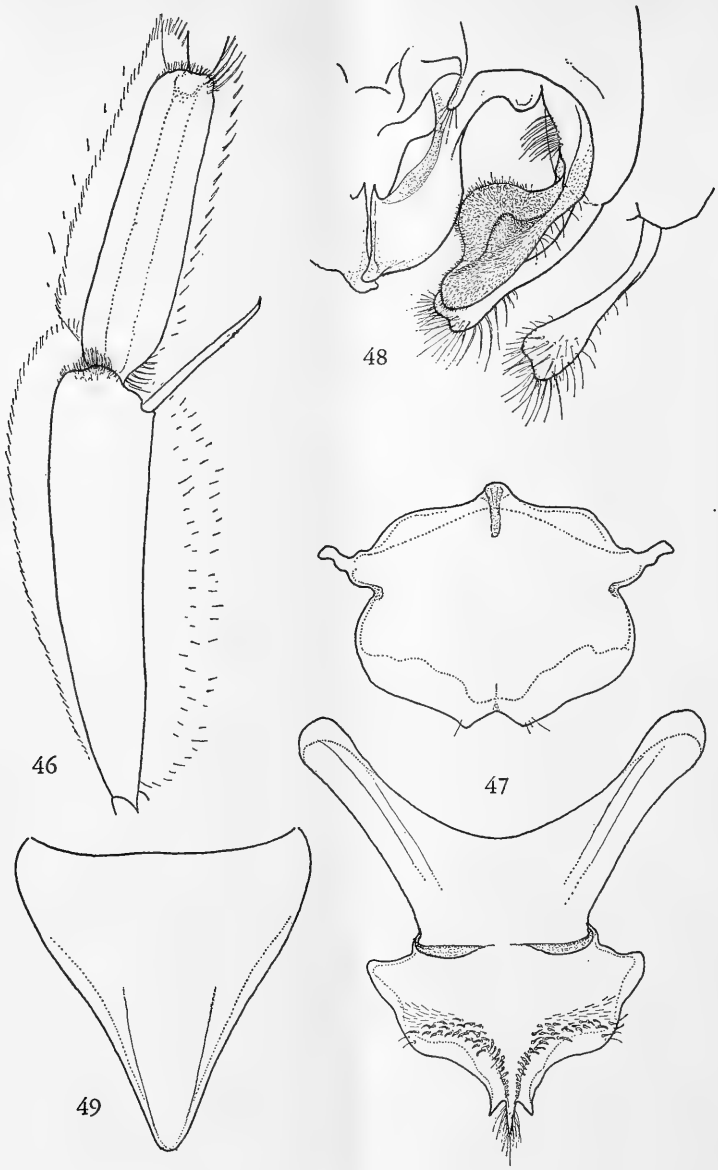

Fig. 46—49. *Habropoda bucconis* (Friese), structures, Taiwan; Fig. 46, exterior view of ♂ left hind tibia-basitarsus; Fig. 47, eighth and seventh sternites of ♂, exterior view; Fig. 48, left gonoforceps and penis valves, partial ventral view, with detached right gonostylus, dorsal view; Fig. 49, pygidial plate of ♀, dorsal view

of several of these places have since been changed, as follows. Hoozan = Fengshan (low hills); Pilam = Taitung (sea level); Polisha = Puli (450 m, but up to 1000 m alt. further inland); Tainan = unchanged (low country); Taihoku = Taipei (low country); Taihorin = Tailin (low country); Takao = Kaohsiung (low hills). Owing to serious deforestation and other drastic changes through human agency, the natural surroundings of south Taiwan are nowadays very different compared to Sauter's time.

Habropoda imitatrix spec. nov.
Fig. 50—54

Material examined. — S E C h i n a, Fukien prov.: 78 ♂ (2 diss.), 75 ♀, Shaowu distr., Tachulan, 1000—1200 m, ix-x.1942—43 (♂ diss., 8.ix.1943, Fig. 50—53); 4 ♂ 2 ♀, Shaowu distr., Outou, 16.x.1943; 2 ♂ 1 ♀, Shaowu distr., Lichiatun & Tengchiatun, 16—18.x.1943; 2 ♂ 7 ♀, Chungan distr., Sanchiang, 1000 m, 17.x.1941 & 24—31.x.1942; 1 ♀, Chungan distr., Kuatun, 1200—1500 m, 28.x.1942; 8 ♂ 1 ♀, Kienyang distr., Hwangkeng, 500—800 m, 18.x.1941, 4.xi.1942 and 15—17.x.1943; all T. C. Maa. SE China, Kiangsi prov.: 1 ♂ 2 ♀, Kwantseh, Kwanmentshih, viii. 1943, T. C. Maa. Holotype ♂ and first described ♀: Shaowu, Tachulan, 8.iv.1943 (♂ diss.), and same loc., 1—15.x.1943 (♀) (ML); paratypes in various other collections.

A homogeneous series of both sexes, which show little or no variation, except in size. Males average slightly smaller than females, but exhibit the same uniform colour design.

Stature of *H. bucconis* and *radoszkowskii*, and only superficially resembling *tainanicola* cum subsp., described before.

Male. — Proboscis of moderate length, galea reaching back in repose to as far as middle of fore coxae. Labrum dark brown, with lighter brown basal tubercles; only a trifle broader than long, disk shining, irregularly, rugosely punctate, anterior border somewhat raised and swollen on either side of a tiny, shallowly crescentic emargination, the edges of which are prominent, almost rectangulate; pile long, silky silvery white, all hairs directed forward, as are the long, stiff marginal bristles emerging from the emargination. Mandibles ivory, a brown line at base as well as the apices, black. Malar area light brown, a little longer than pedicel of antenna and almost 1½ times as long as in *bucconis*. Antenna dark brown, apex of segment 3 with orange spot and 3—13 ochraceous anteriorly; scape broadly striped with yellow in front, scarcely longer than 3. Ocelli placed in equilateral triangle, the laterals more distant than in *bucconis*. Vertex and mesonotum rather shining, surface of the former finely chagreened, impunctate, centre of mesonotum sparsely, superficially punctate, the sides much more closely so. Tegulae light brown, shining, basal half clothed with longish decumbent hairs, directed toward centre and not quite concealing surface. Clypeus dark reddish brown, the cream-coloured median bar halter- or I-shaped, much narrower than in *bucconis*, transverse basal portion of this spot occasionally reduced and tapering basad to a mere stripe; long, silvery decumbent pile at sides converging, directed obliquely cephalad, the tips of hairs meeting in the median line and hiding most of the surface, sides moreover with sparsely distributed, long erect hairs, longest at side-angles; yellow paraclypeal areas clothed densely with fine, pale pubescence. Occiput and genal area white-haired, the former in addition fringed with much longer, raised dark hairs. Legs dark brown, hind basitarsus darkest, mediotarsi lighter brown, last segment ferruginous; pubescence predominantly pale brown, long, raised and almost white at all femora, the outer fringes of fore and mid tibiae also white, but long hairs fringing lower face of hind tibiae darker; fringes at dorsal ridge of hind tibia light orange, increasing in length from base to apex, the distal hairs much longer than in *bucconis* and tipped with black. Spurs pale. Hind basitarsus almost parallel-sided, surface shining, sulcate, scatteredly punctate (similar to *bucconis*); fringe at dorsal crest longer and denser than in that species, brownish black or black instead of short and pale-coloured. Wing membrane yellowish, venation as variable as in *bucconis* and *radoszkowskii*; 2nd submarginal cell frequently almost square,

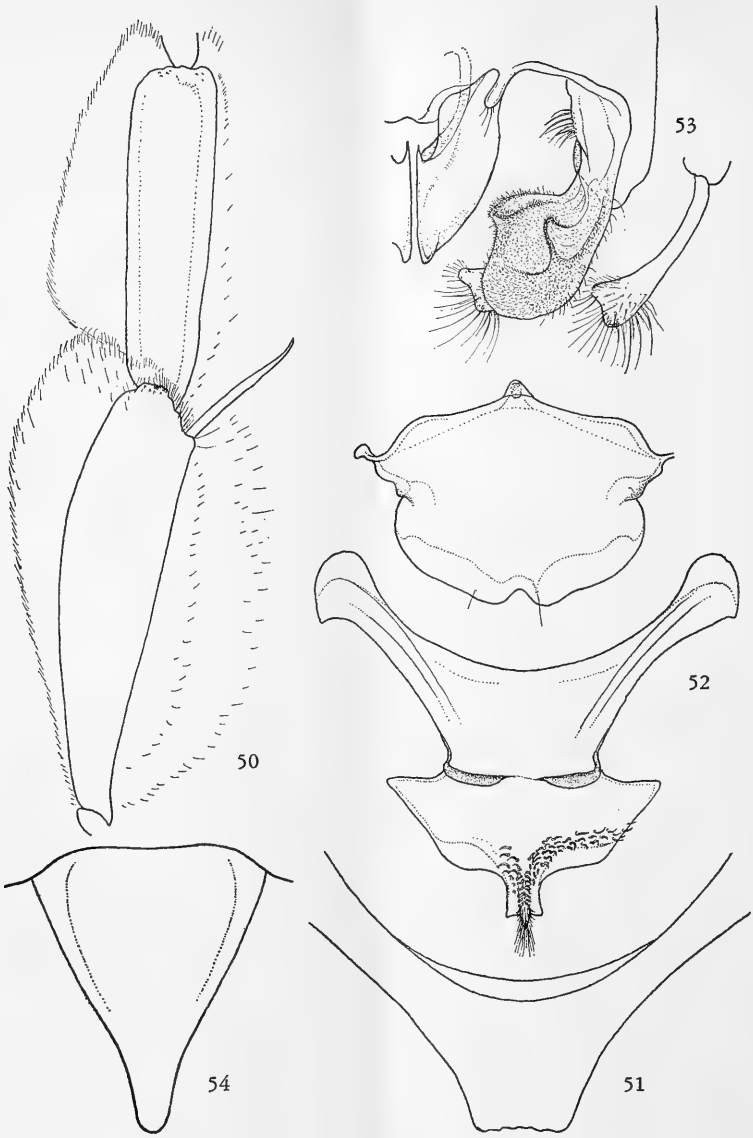

Fig. 50—54. *Habropoda imitatrix* spec. nov., structures, Fukien; Fig. 50, exterior view of ♂ left hind tibia-basitarsus; Fig. 51, ventral view of ♂ seventh tergite; Fig. 52, eighth and seventh sternites of ♂, exterior view; Fig. 53, left gonoforceps and penis valves of ♂, partial ventral view, with detached right gonostylus, dorsal view; Fig. 54, pygidial plate of ♀, dorsal view

receiving recurrent nervure at, or (more often) a little before, its distal side. Punctation, colour and pubescence of abdominal tergites and sternites as in *bucconis*; hind margins of sternites 2—5 straight, the conspicuous, long and dense, apical hairs pure white, similar in the two species. Sternites 7 and 8 as in Fig. 52, the microsetae covering ventral face of 7 strongly curved, rather similar in arrangement to *bucconis*. Intero-ventral process at apex ot gonocoxite, in full ventral view, broader and more plate-shaped than

shown in Fig. 53, a little hollowed out dorsally, subrectangular in outline, but widest and broadly rounded mesially at base, the apex folded in and carrying a strong recurved ridge, which does not reach the base of plate; whole ventral surface covered with microsetae. Gonostylus subequal in length to plate (Fig. 53).

Female. — Labrum similar to *bucconis*: distinctly broader than long (hence shorter than in male); apex of the slightly projecting anterior border divided transversely into a thin lower plate and the proper margin immediately above it, the latter being distinctly swollen and upturned on each side of the middle, forming a pair of black tubercles, the median tuft of bristly hair emerging from the sulcus between the two plates. Clypeus and supraclypeal area invariably darker brown than in *bucconis*, the ivory spot, though varying in size, less sharply defined than in that species. Antennae also darker, and of uniform colour. Body punctation and vestiture, as well as shape and pubescence of legs, practically identical in the two species; basitibial plate also shaped similarly, almost circular in outline, disk quite flat, clothed evenly with fine, appressed golden tomentum, border slightly thickened, almost black. Pygidial plate light brown, darker towards apex, surface only very slightly convex, rather dull, finely transversely wrinkled, shaped much as in *bucconis*, which has the apical portion of the plate rather more elevated, showing markedly depressed margins (cf. Fig. 49 and 54).

In my key to the identification of the males, the couplets leading to *bucconis* and *imitatrix* run out far apart, a diversion entirely due to the intentional selection of only two characters, viz. leg structure and vestiture of the abdominal sternites. In view of other characters separating these two species, it is difficult to judge whether too much stress has, perhaps, been laid on the above features. The male terminalia are very much alike. It should be noted that the shape of the appendages of the gonocoxite, when viewed from below (Fig. 53), probably depends largely on the amount of folding, or even shrinkage, of these delicate setiferous lamellae. It follows that their form can hardly be used as a means of distinguishing between these two species.

Habropoda radoszkowskii (Dalla Torre)
Fig. 56—62

Podalirius radoszkowskii Dalla Torre, 1896, Cat. Hym., 10: 285 (nom. nov., nec *Anthophora montana* Cresson, 1869, Trans. Amer. Ent. Soc., 2: 290, ♀). — Friese, 1897, Bienen Europa's, 3: 305—306 (♀ ♂ latin diagnosis, sec. Radoszk.). — Bingham, 1897, Fauna Brit. India, Hym. 1: 522 (♀ only!), fig. 177 (♀ insect), "The Himalayas from Sikhim to Simla, above 4000 ft."

Habropoda montana Radoszkowski, 1882, Wiadom. nauk przyrodz. Warszowa, 2: 77 (♀ ♂ Himalaja).

Habropoda radoszkowskii: Lieftinck, 1966, Tijdschr. v. Ent., 109: 144—145 (notes on allied species).

Type material examined. — North India: 1 ♂ (lectotype by present selection), 1 ♀, labelled "HIMAL" (print), "coll. Radosz." (print), both with "montana" (in Radoszkowski's hand), "Typus" (print on light red), "Habropoda montana, det. H. Hedicke" (MNB). 1 ♂ (syntype *montana* Rad.), "Cotype" (print on yellow disk), "HIMAL" (print on yellow), "Habropoda montana Rad. ♂" (Radoszkowski's writing), small gold disk (BM).

Further material examined. — NE India: 1 ♂ 2 ♀, "Sikhim, Coll. Bingham, montana, det. H. Hedicke" (MNB); 4 ♀, "Assam, Khasia Hills 96—135" (BM); 1 ♀, "Assam, Shillong, 10.03, Coll. Bingham, H. radoszkowskii ♀" (unknown hand),

"montana, det. H. Hedicke" (MNB); 1 ♀, "India, Darjeeling, 6.xi.1920, leg. Brunetti, BM 1927—184" (BM); 1 ♀, "Sikkim, Darjeeling, 7000 ft., 4.94" (Bingham's label), "H. radoszkowskii D.T., det. Bingham" (BM); 1 ♀, "Sikhim, 4.94, H. radoszkowskii Dall. Torr." (Bingham's hand) (OUM); 1 ♀, "Sikkim, Darjeeling, 7000 ft., 4.94, Bingham Coll. "(OUM); 1 ♂, "Sikkim, 4/95 31/5, Coll. C. T. Bingham 96—30" (BM); 5 ♀, "Darjeeling, 6—7000 ft., 10.93 & 4.5.94" (BM). North India: 2 ♂, "Kumaon, U.P., 10.89, Miss A. Brook, Habr. radosz. Coll. Bingham" (Bingham's hand) (BM); 2 ♀, "Kumaon, U.P., W. Almora Div., Nov. 1919, H.G.C. "(BM); 2 ♀," Punjab, Dalhousie, Oct. 1917, N.B. Kinnear" (BM). East Nepal: 13 ♂ (2 diss.), 10 ♀, Taplejung [Taplang Jung] Distr., deep river gorge, 5200′, and mixed shrubs in deep gorge, 5700′, between Sangu & Tamrang, x-xi.1961 (2 ♂), Sangu, 6200′, mixed vegetation by stream in gully, ix-x-1961, and yellow blooms of cultivated Composite, 16-29.x.1961, edge of mixed forest above Sangu, 6500′, 17.x—1.xi.1961 (1 ♂ diss.); Sangu, 6200′, blooms of wild cherry, 15—18.xi.1961 (4 ♂ 3 ♀); old mixed forest above Sangu, 6200′, 25—28.x.1961 (1 ♂ 2 ♀); Sangu, 6200′, on minute flowers of wild shrub, 25.xi.1961, clearing in small wood (2 ♂ 5 ♀); all specimens R. L. Coe leg., Brit. Mus. East Nepal Exp. 1961—62 (BM; 2 ♂ 2 ♀ ML).

Owing to some discrepancies in the existing descriptions, the confusion around this species has been considerable. In my 1966 paper, I have commented already upon some of these problems, which could mostly be solved since then. One of Bingham's males, described by him from Simla, is certainly not *radoszkowskii,* but its identity must remain uncertain.

Though several features obviously relate this species fairly closely with *bucconis* and *imitatrix*, both sexes of this bee are further distinguished by the shorter thoracic and abdominal pubescence, so that more of the dark integument is exposed, especially at base of the first three or four abdominal tergites. Fresh males in our series are as vividly coloured as those of the other two species, whereas the pile covering the thorax of the females has a more sallow, greyish orange, tint.

Male. — Proboscis relatively short, galea in repose not quite reaching fore coxae, measuring only 2.8 mm. As compared with the preceding species, the anterior border of the labrum is a little more convex on either side of the crescentic emargination; oblique ante-apical ridges deep black, more pronounced and meeting in the centre of the emargination; disk shining, with few superficial punctures, though densely hairy. Face shaped and coloured similarly to *imitatrix*. Yellow clypeal mark intermediate in shape between that of *bucconis* and *imitatrix*: the constricted part as broad as the yellow mark on the antennal scape. Antenna dark brown, but all segments lighter anteriorly: scape citron-yellow, the distal two-fifths of 3 and most of 4 conspicuously orange, the next segments gradually becoming less bright, rather more ochraceous, in front. Legs more robust and all tibiae more swollen than in the preceding species. Spurs brownish yellow. Sole of hind basitarsus exactly four times as long as its greatest breadth, apex markedly swollen and, when viewed obliquely from the inside, hollowed out internally (Fig. 57). Wing venation variable, but 2nd submarginal cell relatively longer than in the allied species and recurrent nervure never quite interstitial. Vestiture of gastral sternites differing from that seen in *bucconis* and *imitatrix*, approaching *tainanicola* more closely in this respect. The tufts of soft raised hairs at the sides are of great length, silvery white and most conspicuous at 3; from then on rearward, the marginal hairs gradually become shorter and wavy toward the median area of sternites, acquiring a yellowish tint, those

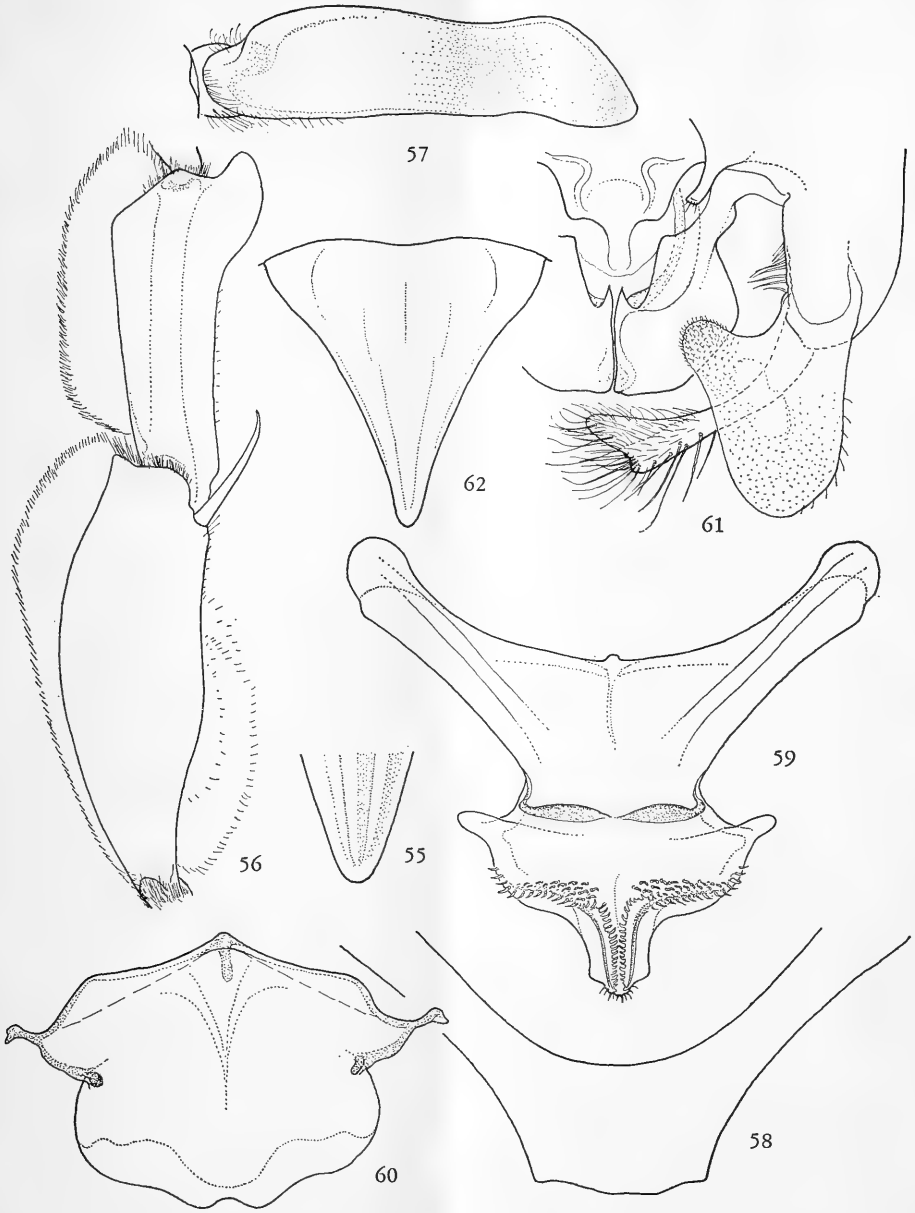

Fig. 55. *Habropoda hookeri* Ckll., Simla, apical portion of ♀ pygidial plate, dorsal view, greatly enlarged. — Fig. 56—62. *H. radoszkowskii* (D.T.), structures, Nepal; Fig. 56, exterior view of ♂ left hind tibia-basitarsus; Fig. 57, ventral aspect of basitarsal "sole" of same (slightly more enlarged); Fig. 58, ventral view of ♂ seventh tergite; Fig. 59—60, seventh (59) and eighth (60) sternites of ♂, exterior view; Fig. 61, left gonoforceps and penis valves of ♂, partial ventral view; Fig. 62, pygidial plate of ♀, dorsal view

covering tne apical portion of 5 being shortest, forming a transverse brushy belt of very dense, light golden pubescence, flanked by the equally dense (but much longer) white tufts at the sides of the sternite. Sternite 6 shaped similarly to *bucconis* and *imitatrix*, the bluntly triangular tip clothed densely all around margin with minute erect hairs. Sternites 7 and 8, Fig. 59—60. Intero-ventral process at apex of gonocoxite more elongate (cf. Figs. 53 and 61), its rounded basal portion longer, projecting cephalad, the whole plate concave dorsally; viewed from below, a narrow ridge extends from the margin inward (not shown in Fig. 61). Gonostylus about equal in length to the plate, apex broad, abruptly expanded and fringed with long, radiating bristles.

Female. — Antenna dark brown, as in male, but the orange apical spot in front of segment 3 is reduced in size, the flagellar segments (except 4) being less brightly ochraceous than in the other sex. Basitibial plate shaped and coloured as in *bucconis* and *imitatrix*, with the same compact quiff of downbent golden hair at apex of femur overlying its base.

Not all Indian localities mentioned by Radoszkowski and Bingham are precisely known, but the species seems to be widely distributed in the Himalayan region. In Nepal *H. radoszkowskii* was found in occupation of the same territory as several of its allies, two new species, viz. *apostasia* and *pelmata*, having been collected along with it in the Taplejung District, near Sangu, and all at one time (September till November) of the same year. The nearest ally of *radoszkowskii* would seem to be *H. plantifera* spec. nov., from Assam, described hereafter.

Habropoda plantifera spec. nov.
Fig. 63—67

Material examined. — N E I n d i a : 1 ♂ (holotype, diss.), Assam, labelled "Shillong, 10.03" (written), "Turner coll. 1912—111" (print), in drawer sub *radoszkowskii* (BM).

In the specific key to the males, couplet 7 carries this species to group 10^1, which comprises *radoszkowskii* and two of its immediate allies, viz. *plantifera* and *pelmata*, all characterized by the remarkable sole-shaped thickening on the hind basitarsus. There is only a single male.

As compared with *radoszkowskii*, the following additional peculiarities can be recorded.

Male (holotype). — Proboscis extended, but glossa retracted; galea equal in length proportionally to that of *radoszkowskii*, measuring 3.0 mm. Labrum subrectangular, a little broader, the anterior border nearly straight, hardly thickened, median incision unapparent, replaced by a pair of minute dark teeth; disk almost flat, smooth and shining, with few superficial punctures at base only; colour light brown, long hairs and apical fringe golden yellow. Clypeus as described; facial pubescence all pale, except long raised paraclypeal, interocellar, and occipital bristles, which are brown. Antenna dark brown, apical spot on anterior face of 3 and all along remaining flagellar segments somewhat lighter brown. Long pubescence covering genal area, basal segments of legs, and ventral parts of thorax and abdomen, palest yellow, not pure white. Sole of hind basitarsus over four times as long as its greatest breadth (100 : 24.2), apex a little less swollen and, when viewed from the inside, correspondingly less hollowed out, than in *radoszkowskii*. Wing venation lighter brown, the membrane of fore wing more deeply

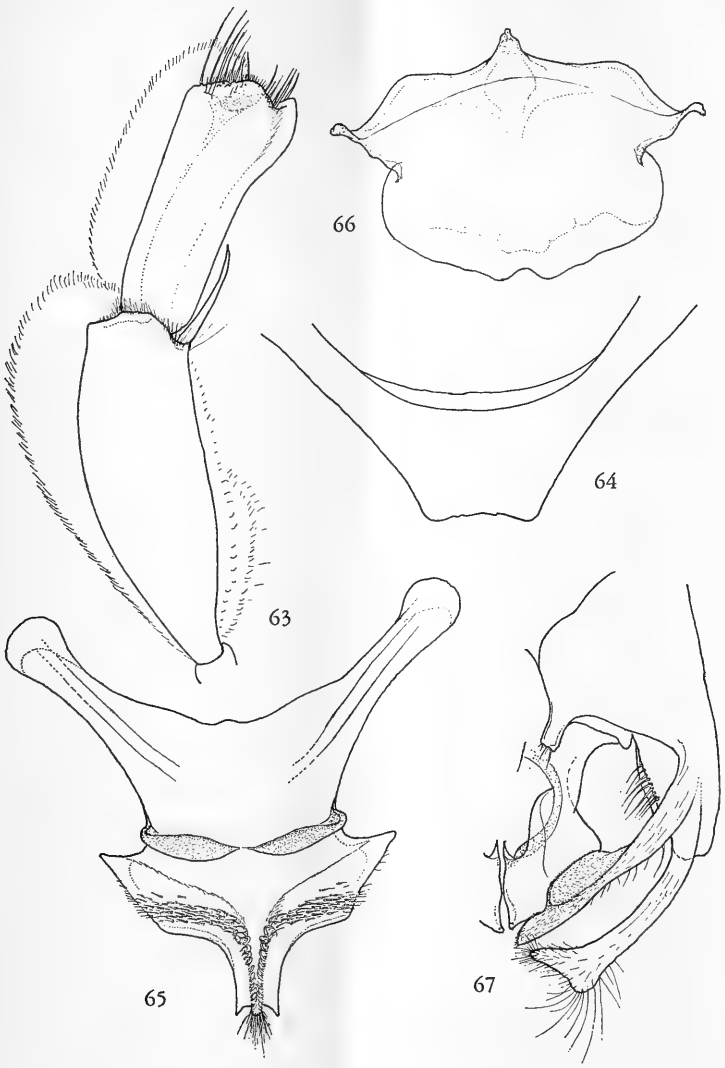

Fig. 63—67. *Habropoda plantifera* spec. nov., structures, ♂ holotype Shillong; Fig. 63, exterior view of left hind tibia-basitarsus; Fig. 64, ventral view of seventh tergite; Fig. 65—66, seventh (65) and eighth (66) sternites, exterior view; Fig. 67, left gonoforceps and penis valves, partial ventral view

stained with yellow, especially toward apex; costal side of 2nd submarginal cell markedly shorter than anal side; recurrent nervure entering cell well before distal side of the latter. Vestiture of thorax and abdominal tergites a little longer, the tergites distinctly more evenly and densely clothed with warm orange pubescence; arrangement of sternal hairs much as in *radoszkowskii*. Apex of tergite 7 slightly longer and narrower than in that species. Sternites 7 and 8, Fig. 65—66. Intero-ventral lamella at apex of gonocoxite very different in shape, the broadened subbasal portion not projecting cephalad, but inward, and more rounded off, the apex after a constriction being broadly

rounded and distinctly ridged interiorly (not shown in Fig. 67). Gonostylus equal in length to lamella, slender and strongly incurved basally, its apical portion foot-shaped, the "heel" fringed with long hair, as in the figure.

The name of this species refers, of course, to the form of the hind basitarsal plate.

Habropoda pelmata spec. nov.
Fig. 68—71

Material examined. — Nepal: 1 ♂ (holotype, diss.), E Nepal, Taplejung [Taplang Jong] Distr., Sangu, ca. 6200′, clearing in small wood, 25.xi.1961, R. L. Coe coll., Brit. Mus. East Nepal Exp. 1961—62 (BM).

This is the second nearest ally of *H. radoszkowskii*, quite distinct, but unfortunately represented only by a single male not in a too good condition. It has lost most of the antennae, the wing margins are torn, and the discoloured pubescence has been partly rubbed off. The diagnosis in the key can be extended as follows:

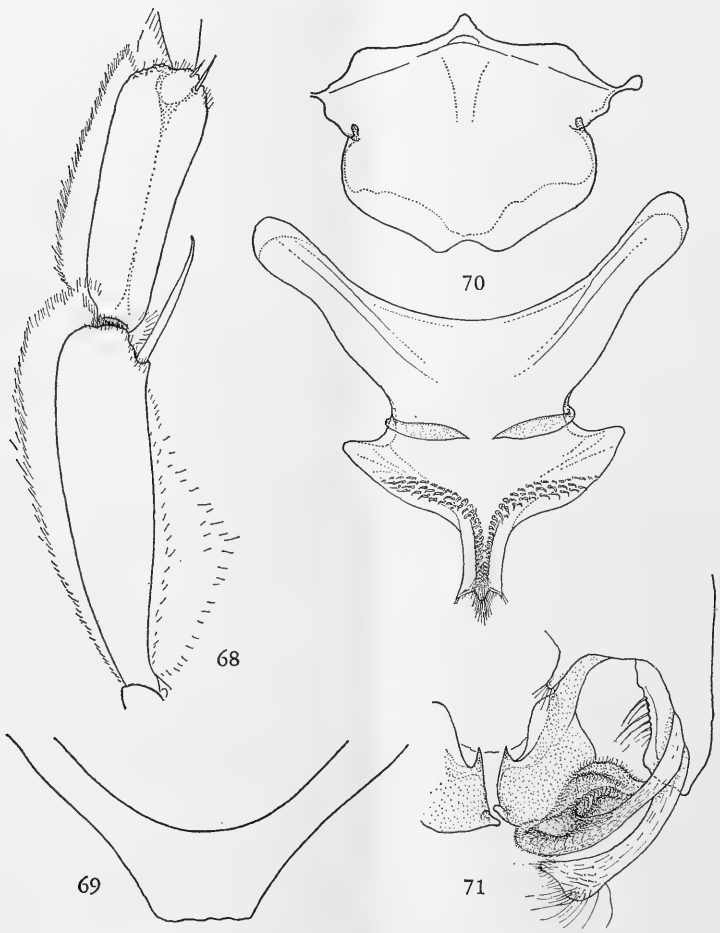

Fig. 68—71. *Habropoda pelmata* spec. nov., structures, ♂ holotype Nepal; Fig. 68, exterior view of left hind tibia-basitarsus; Fig. 69, ventral view of seventh tergite; Fig. 70, eighth and seventh sternites, exterior view; Fig. 71, left gonoforceps and penis valves, partial ventral view

Male (holotype). — Proboscis retracted, galea equal in length to that of *plantifera*, reaching to base of fore coxae in repose. Labrum also similar, brownish-yellow, becoming darker apically; no median incision, but ante-apical teeth less approximated; long pile covering disk and sides of paraclypeal area white. Basal two-thirds of clypeus rather dull, microscopically tessellate, quite similar to *plantifera*, which also has the apical portion indefinitely marked off, only its surface being more shining and the low rugae less distinct, than in *plantifera*. Antenna dark reddish-brown, segment 3 in front with vestigial basal and a somewhat larger apical ferruginous spot, (rest missing). Punctation in the centre of mesoscutum much less dense than at sides, though even here the punctures are a little smaller than the finely tessellated spaces separating them (apparently quite similar to *plantifera*, where much of the ground is hidden by pubescence). Body hair sallow, obviously rather discoloured, pale orange-yellow, hence much less bright than in the preceding species. Legs distinctly more slender (cf. Fig. 63 and 68), the tibiae and basitarsi with shorter hair. Sole of hind basitarsus noticeably narrower than in *plantifera*, though well marked off, 5.8 times as long as its greatest breadth (100 : 17.24), cylindrical with tapered apex; in profile, the presence of this inferior plate is revealed by a slight concavity of the lower margin, as well as by a gradual broadening toward the end of the segment itself. Wing membrane pale yellow; costal side of 2nd submarginal cell only little shorter than anal, the recurrent nervure is received slightly before the end of the cell. Abdominal pubescence long and thin, partly rubbed off so as to expose the broad, contrastingly pale-coloured posterior borders of all tergites; sternal pubescence as in *plantifera*. Tergite 7 and hidden sternal plates 7 and 8, Fig. 70. Intero-ventral lamella at apex of gonocoxite shaped much as in the preceding species, but in full ventral view the plate is on the whole broader, less deeply concave inward about halfway length. Apex of gonostylus very similar in outline, though less distinctly foot-shaped, than in *plantifera* (Fig. 71).

Female unknown, unless the ambiguous "*apatelia*" from Nepal may turn out to be the same species?

The males of the next two species, *deiopea* and *apatelia*, bear a close prima facie resemblance to *pelmata*, described above and are undoubtedly also members of the *radoszkowskii* group. As we have seen, they all share the curious smooth and hairless expansion on the underside of the hind basitarsus, which here forms a convex, lanceolate, or rather torpedo-shaped plate, a modification displayed in a more exaggerated way by the males of *radoszkowskii*, *plantifera* and *pelmata*, in which the plate is definitely sole-shaped.

The two species in question can be easily recognized from the other members of the group by lacking a yellow spot in front of the antennal scape. They are much alike, and if no fair series had been available, recognition would have been difficult, because little is still known of the individual variation of each. As it is, the most striking features exhibited by a total of 21 males were carefully compared, and this has resulted in the segregation of at least two closely similar species, discussed hereafter. In regard to the females, we have only a single individual of either species, and these could be matched with their males with reasonable certainty.

Habropoda deiopea (Cameron)
Fig. 72—77

Anthophora deiopea Cameron, 1897, Mem. & Proc. Manchester Lit. & Philos. Soc. 41 (4): 127—128 (♀ ♂ Mussouri, Rothney).

Type material examined. — NW India, Uttar Pradesh: 1 ♂ (diss., Fig. 75), "Mussoori", with small square label "m", and "Osmia deiopia [sic] Cam. Type", in P. Cameron's hand, and "Habropoda montana Radosk, ♂", in Bingham's writing. Lectotype *A. deiopea* Cam., by present designation (ex Rothney coll., OUM).

Further material examined. — North India, Uttar Pradesh: 9 ♂ (one diss., Fig. 73—74), each with typewritten labels "Simla 9.98", and "Coll. G. Nurse Collection 1920—72" (print), all unidentified (BM). 1 ♀, "India, Uttar Pradesh, Mussoorie, Lal Tibba, Alt. 7500′, 19.x.1964, S. W. T. Batra, on *Salvia glutinosa* L., Habropoda radoszkowskyi D.T.", det. Batra (UKL)

The series of males from Simla in the British Museum, were standing side by side with a single female in one drawer and bear identical typewritten locality labels, but originate from different collections. These males are not conspecific with the female, which corresponds closely with the original description of *H. hookeri* Ckll.; see that species. The males are exactly similar to Cameron's male of *A. deiopea,* marked "Type". As the original female *deiopea* is nowhere to be found and has apparently been lost, the male is here designated lectotype. The head markings, colour of pubescence, as well as the leg structure, are all precisely as in a specimen from Simla, the same congruity being manifest on comparing the internal sternal plates and genital organs, which were dissected out in both. These structures are here shown for one of the Simla males in the British Museum (Fig. 72—74).

Male. — Though resembling *H. apatelia* fairly closely in the uniformly coloured body pubescence, *deiopea* can be recognized, apart from the distinctives enumerated in the key, by its broader forms and, on dissection of the terminalia, by the shape of the gonostylus, the apex of which is emarginate (Fig. 76); the remaining differences are slight and difficult to paraphrase. In the lectotype the 7th tergite is shaped similarly to that of a Nepalese specimen of *apatelia,* shown in Fig. 79. It should be noted that, owing to a slight distortion of the genital capsule, the intero-ventral lamella of the gonocoxite, shown in situ (Fig. 75) for the lectotype, had to be drawn in a somewhat twisted vertical position; when viewed from the external side, it is shaped exactly as in Fig. 76, taken from a Simla male.

Female. — The present specimen from Mussoorie is topotypical and fits the description of the female in every respect. Here follow Cameron's diagnoses of the two sexes (loc. cit.: 127—128).

"Nigra, longe dense pallide hirta; capite nigro ♂ facie alba.

Long. 13 mm. ♀.

Hab. Mussouri (Rothney).

Head black, thickly covered with long pale grey hairs, especially on the front and vertex; the labrum fringed with golden hairs; the mandibles ferruginous, black at the apex. The vertex behind the front ocellus bare, shining, broadly depressed. Thorax thickly covered with long grey hairs all over. Legs: the femora and tibiae dark rufous; the former sparsely covered with long white hairs, the front four tibiae covered densely behind with pale fulvous hairs; the hairs on the hinder tibiae much longer, thicker,

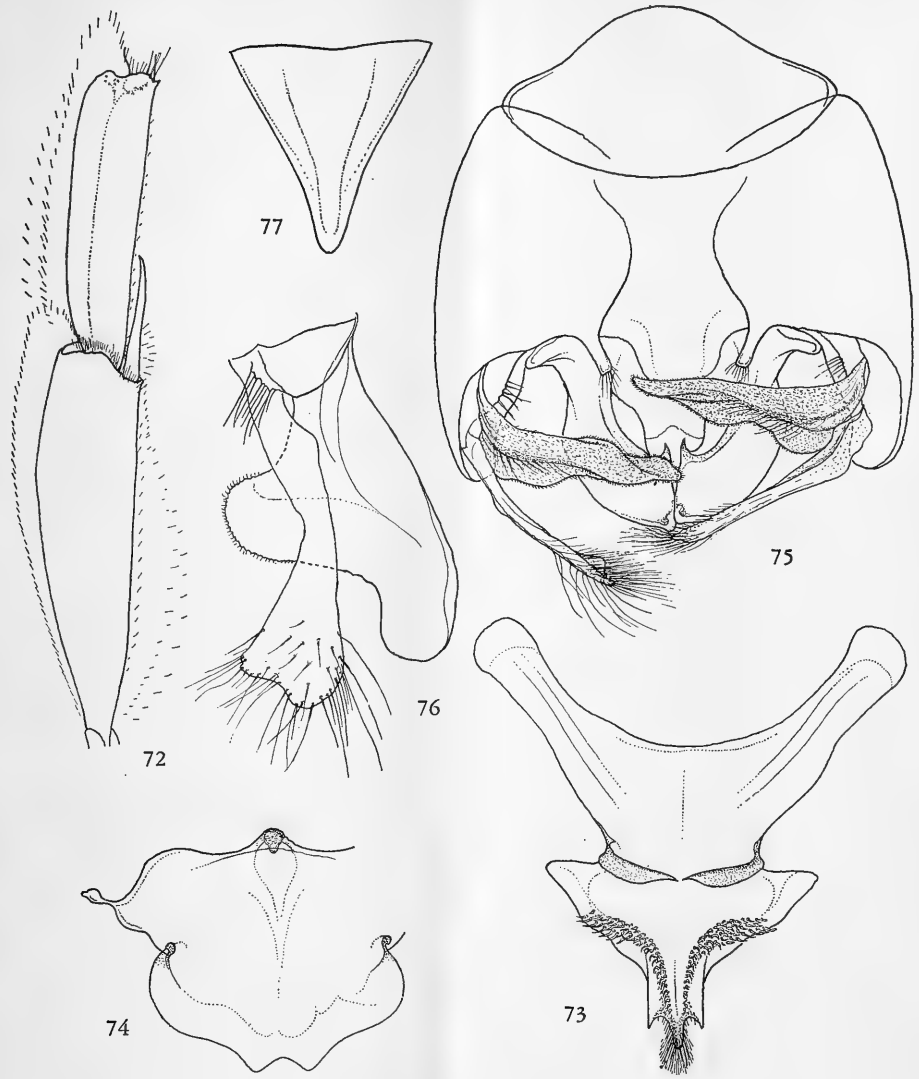

Fig. 72—77. *Habropoda deiopea* (Cam.), structures, Simla; Fig. 72, exterior view of ♂ left hind tibia-basitarsus; Fig. 73—74, seventh (73) and eighth (74) sternites of ♂, exterior view; Fig. 75, genital capsule of ♂ lectotype (Mussoorie), ventral view; Fig. 76, exterior view of right intero-ventral lamella and gonostylus of ♂ gonocoxite, more enlarged (Simla); Fig. 72, pygidial plate of ♀, dorsal view (Mussouri)

and of a brighter fulvous tint; the tarsi rufous, thickly covered with long golden hairs at the base. Wings hyaline, with a faint fuscous tinge; the costa and nervures blackish; the first recurrent nervure is received shortly before the second transverse cubital nervure; the second is interstitial. Abdomen above and at the sides thickly covered with long pale fulvous hairs; the penultimate segment rufous at the apex; the apical ferruginous, black at the apex, the base closely transversely striated; the sides, especially towards the apex,

broadly furrowed; abdominal segments black, the base and apex broadly ferruginous; the segments at the apices thickly fringed with fulvous hairs.

The ♂ is covered all over with long hoary hairs; the clypeus, except at the sides and the inner orbits, cream-yellow; the extreme apex piceous, the mandibles cream coloured; the tips black, ferruginous in front of the black; the labrum black, covered with white hairs; the ventral segments are coloured as in the ♀; this being also the case with the legs, which bear long white hairs."

In general appearance, colour and size, the female from Mussoorie makes an excellent match for our series of males, hence I do not doubt to have associated the sexes correctly. Pygidial plate, Fig. 77.

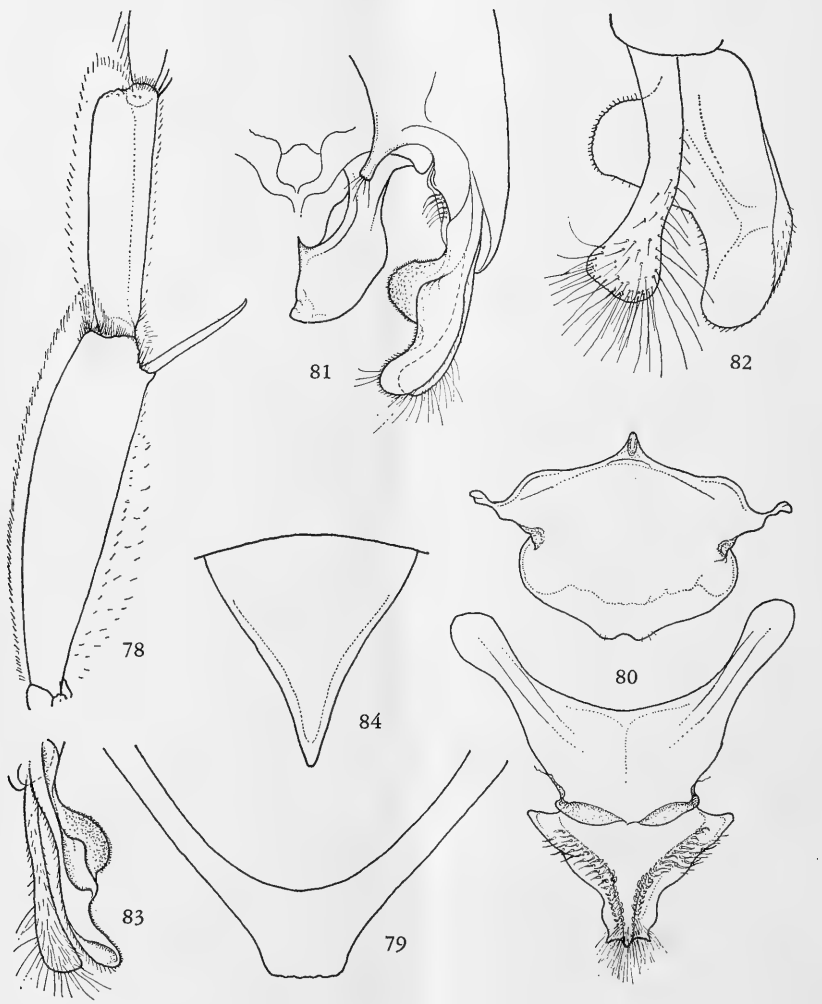

Fig. 78—84. *Habropoda apatelia* spec. nov., structures, Darjeeling; Fig. 78, exterior view of ♂ left hind tibia-basitarsus; Fig. 79, ventral view of ♂ seventh tergite; Fig. 80, eighth and seventh sternites of ♂, exterior view; Fig. 81—83, left gonoforceps and penis valves of ♂, partial ventral view (81), interior (82) and ventral (83) view of right gonocoxal appendages of same, more enlarged; Fig. 84, pygidial plate of ♀, dorsal view

Habropoda apatelia spec. nov.
Fig. 78—84 and 85—89

Material examined. — N E I n d i a : 7 ♂ (one diss., holotype), 1 ♀, Sikkim, all with identical printed labels "India Darjeeling 1920, Brunetti, B.M. 1927—184", and written on reverse side "10.X" (BM, sub *rowlandi*), no identification labels. Holotype ♂, unique ♀ and 4 ♂ paratypes (BM), 2 ♂ paratypes (ML).

Further material examined. — N e p a l : 4 ♂ (one diss.), E Nepal, Taplejung [Taplang Jong] Distr., old mixed forest above Sangu, ca. 6200′, 25—28.x.1961, R. L. Coe coll., Brit. Mus. East Nepal Exp. 19961—62 (♂ diss., BM); same area, Sangu, ca. 6200′, clearing in small wood, 25.xi.1961, same coll. (2 ♂, BM); same area, above Sangu, ca. ca. 6500′, evergreen scrub, 5—13.x.1961, same coll. (1 ♂, ML).

The following topotypical females are of uncertain identity and are only tentatively placed here; they may be conspecific either with *apatelia* or *pelmata*, also described from Nepal. N e p a l : 11 ♀, E. Nepal, Taplejung [Taplang Jong] Distr., Sangu, ca. 6200′, on minute florets of shrub, clearing in small wood, 25.xi.1961; and same area, old mixed forest above Sangu, ca. 6200′, 25—28.x.1961, same coll. (BM, ML).

Male. — It should be emphasized that the characters given in the descriptive key

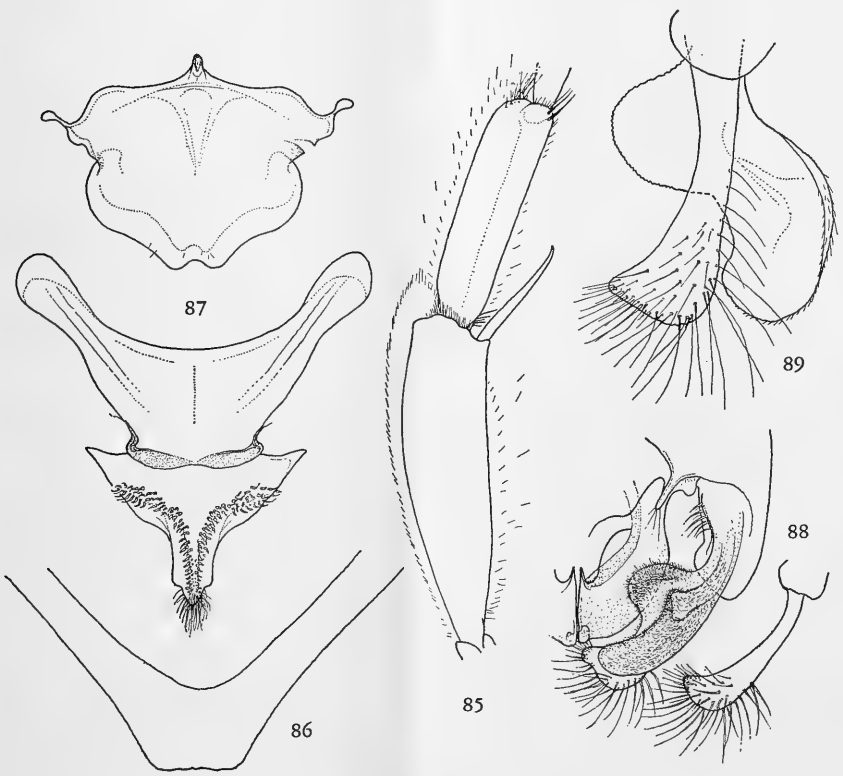

Fig. 85—89. *Habropoda apatelia* spec. nov., ♂ structures, Nepal; Fig. 85, exterior view of left hind tibia-basitarsus; Fig. 86, ventral view of seventh tergite; Fig. 87, eighth and seventh sternites, exterior view; Fig. 88—89, left gonoforceps and penis valves, partial ventral view, with detached right gonostylus, dorsal view (88), and interior view of right gonocoxal appendages, more enlarged (89)

were taken primarily from the Darjeeling males (including the type), and that only the latter can be considered paratypes of *apatelia*. The remainder, from Sangu in Nepal, differ so perceptibly from the typical series that they were first segregated from the others and given a new name. However, considering that all but one are worn and discoloured individuals, it was decided to keep them together. With better material and the discovery of females, these Nepalese males may well prove specifically distinct after all. The differences are briefly summarized in the key and structural details are given in Fig. 79—89.

Female (Darjeeling). — Closely resembling *deiopea*, but differing from that species in a number of details enumerated in the key.

Female (Nepal). — Of doubtful identity. Distinguished from the only authentic female of *apatelia* in that the integument of all parts of the body is of a darker brown. Clypeus with well defined ivory spot, usually forming an isosceles triangle, upon middle of distal half just before anterior border, this spot occasionally narrowly framed in reddish brown. IOD : OOD = 50 : 100 approx. Length ratios of antennal segments 3, 4 and 5 = 100 : 30 . 40. Pygidial plate shaped and sculptured much as in *bucconis* (Fig. 49), but surface dull and apparently not striated.

Except for their smaller size, these females are inseparable from those of undisputed *radoszkowskii*, with which they were collected simultaneously. As hinted at above, the possibility remains that these bees can be associated with our new Nepalese *Habropoda pelmata*, which also is a smaller-sized species.

Habropoda krishna Bingham

Habropoda krishna Bingham, 1909, Rec. Ind. Mus., 2; 366—367 (♂ Sikkim, Darjeeling, 7,000 ft.). — Cockerell, 1911, Proc. U.S. Nat. Mus., 39: 643 (note); Cockerell, 1920, Ann. Mag. Nat. Hist., (9) 6: 202 (Khasia Hills, Sladen). — Lieftinck, 1966, Tijdschr. v. Ent., 109: 145 (note on characters).

An enigmatic species. Type (ex Zoological Survey of India, Calcutta) probably lost. Female unknown.

The original description is based on a single male, sent to the describer by Dr. Nelson Annandale. It runs as follows:

"♂. Black. Head, thorax, and abdomen densely covered with long, pale brownish yellow pubescence turning to ferruginous golden on the posterior segments of the abdomen, and mixed throughout with a sprinkling of black hairs, the surface beneath more or less closely and finely punctured. Head: mandibles white; apical third rich castaneous; base black; clypeus white; apical margin narrowly castaneous; sutures at the sides and above narrowly black. Thorax: the wings hyaline; nervures and tegulae testaceous. Legs: apical joints of the tarsi rufo-testaceous; claws black. Head as wide as the thorax; the vertex broad, depressed; antennae comparatively long, second joint of the flagellum attenuate at base, clavate at apex, as long as the succeeding three joints; ocelli in equilateral triangle, the distance between the anterior and either of the posterior ocelli greater than either of the posterior ocelli and the eye next to it; eyes large, prominent, their inner orbits parallel. Thorax globose; mesonotum convex, scutellum and post-scutellum slightly raised, median segment short, very convex above.

In some specimens not so densely pubescent as others, the pubescence forms distinct

transverse bands on the apical margins of the segments beneath which the surface is rufo-testaceous. Female unknown.

Length, — ♂, 12—13; exp. 24—27 mm.

Hab. — Sikhim: Darjeeling, 7, 000 ft.

Nearest to *H. radoszkowskii*, but differs in sculpture and in colour of pubescence."

As follows from the above description, the relative lengths of the flagellar segments of antennae, in combination with the distance ratios of the ocelli, are characters not in accordance with any of the described species and at variance with all that is known about the morphology of male *Habropoda*. Cockerell (1911) evidently knew this species only from the description as he gave no further characters. In 1920, the same author claims to have seen a specimen from the Khasia Hills bearing a manuscript name by Friese, who dedicated the species to Mr. Sladen — an irrelevant observation. This example is not in the British Museum collection.

The aberrant features mentioned above may be due to incorrect observation, because everything else points to near relationship with *H. radoszkowskii* and its allies.

Habrophorula gen. nov.

Fig. 90—100

Of the Anthophorini. Medium-sized bee of elongate form, stature recalling *Elaphropoda* Lieft., but legs entirely unmodified, thin and slender, especially in male.

Head much broader than long in dorsal view; eyes moderate, widely distant, inner orbits subparallel, slightly convex inward and diverging anteriorly (Fig. 90—91). Proboscis long; last two segments of labial palpi short, fused together and ribbon-like; maxillary palpus 6-segmented, the second segment longest. Labrum broader than long, widest about middle, somewhat protuberant, anterior border not excised, its surface smooth, lacking subapical ridges or tubercles (♂); or longer, almost square, though otherwise similar (♀). Mandible with single, subapical, interior tooth. Malar area distinct, subequal in length to pedicel of antenna. Clypeus little protuberant, greatest anterior depth in side view nearly equal to diameter of eye (♂), or even less (♀). Frontal carina low and very short (♂), or a little longer (♀). Vertex slightly raised, surface convex, ocelli close together, forming an isosceles triangle. IOD : OOD = 49 : 100. Antenna slender, third segment exceptionally short in both sexes, remaining flagellar segments cylindrical, longer than thick (6th segment about 10 : 6).

Thorax short and small, globose. Legs of simple structure, those of male long and very slender; coxae unarmed, those of fore legs large, subtriangular, of mid leg elongate-oval, of hind leg more or less triquetral in cross-section; trochanter of fore and mid legs longer than broad, of hind leg squarish; all tarsal claws deeply cleft, the rami subequal in length (♂), or inner ramus shorter on fore, mid and hind tarsi: about four-fifths, three-fourths and two-thirds as long as outer, respectively (♀); arolia well developed. Basitibial plate of female forming an equilateral triangle with rounded angles, of male also well defined, subcordate with slightly produced, rounded apex. Scopa of female rather short and thin, hairs plumose.

Wings short. Marginal cell of fore wing considerably longer than distance from its apex to wing tip (100 : 62.5), free part of marginal cell rather shorter than rest of cell; first *s.m.* almost twice as long as second but shorter than second and third united, measured on anal side; second *s.m.* squarish, a little higher than long, as in many

Habropoda, with costal side shorter than anal; third *s.m.* much longer, about one and one-third as long as second (100 : 78), but shorter than first and with subparallel sides; first and second recurrent veins both interstitial; *cu-v* straight, transverse, and coincident with the point of origin of the basal vein. Hind wing with the transverse median vein (*cu-v*) very oblique, only half as long as its distance from fork; jugal lobe short and small, vannal lobe long, ending well beyond level of fork.

Integument throughout dull, except shining areas on summit of head, colour black and dark brown, the posterior margins of abdominal tergites broadly pallid, and disk of all tergites with distinct oily reflections. Punctation distinct, all punctures isolated, moderately deep. Apex of tergite 7 of male with broadly rounded, distinctly undulated margin (Fig. 94). Ventral surface of abdomen of male rather flat, both sexes with basal part of first four sternites almost impunctate, postgradular areas closely punctate; all posterior margins entire, but sternite 5 of male somewhat convex; sternite 6 of male greatly modified, the apical angles with smooth, transverse tubercle ventrally (Fig. 95); apodemes of sternite 7 of great length, directed laterad, lacking sclerotised transverse ridges at the transition to disk, which is thin, membranous, exceptionally short and broad (Fig. 96); sternite 8 of more normal shape, disk subrectangular (Fig. 97). Genital capsule 1.5 mm long; intero-ventral process at apex of gonocoxite cylindrical, forming a slender finger-shaped rod, subequal in length to gonostylus, which is much broader, flat and spatulate, its apex squarely cut off (Fig. 100); penis valves of aberrant form, the recurved subapical teeth unusually blunt, and distal portion tapering to a small, bipartite knob (Fig. 98—99). Pygidial plate of female only partly visible, the end flat, broadly triangular, with rounded apex.

Body vestiture much shorter and less dense than in most *Habropoda*, resembling *Elaphropoda* much more closely. Occiput, genal area, thorax and basal segments of fore legs posteriorly, clothed more densely with longish, raised, and heavily plumose hairs; wide, triangular, median propodeal area with very short, decumbent radiating hairs.

Type species: *Habropoda nubilipennis* Cockerell.

Hab.: E China.

Habrophorula nubilipennis (Cockerell) comb. nov.

Habropoda nubilipennis Cockerell, 1930, Ann. Mag. Nat. Hist. (10) 6: 52 (♀ Foochow, China). — Lieftinck, 1966, Tijdschr. v. Ent. 109: 147 (notes).

Type material examined. — S E C h i n a, Fukien Prov.: 1 ♀ (holotype), with label "Type, B.M. Type Hym. 17B.645" (printed on red-rimmed disk), "Habropoda nubilipennis Ckll. TYPE", and "Foochow China (Kellogg)", both in Cockerell's handwriting (BM).

Further material examined. — S E C h i n a, Fukien Prov.: 1 ♂ (diss., hitherto undescribed), Shaowu distr., Tachulan, 1000 m, 16—20.viii.1944, T. C. Maa (ML).

Original description:

"♀. — Length about 13 mm.

Robust, black, with the aspect of *Anthophora confusa*, Sm.; eyes dark brown, inner orbits parallel; clypeus coarsely punctured and obtusely carinate, the broad apical margin and a narrower median stripe light yellow; a transverse but not triangular supraclypeal mark, large triangular lateral face-marks (ending acutely on orbit at level of antennae), large basal spot on the otherwise brown labrum, and basal half of mandibles, all light

yellow; mandibles robust, curved, reddened beyond middle, and black and bidentate at apex; hair of face very scanty, partly pale and partly fuscous, of front thin and pale but some fuscous on upper part and vertex, but occiput with long pale fulvous hair; lower part of cheeks with long white hair; cheeks above bounded by a keel, which is continued across the top of head, behind the ocelli; antennae black, obscurely reddish beneath; thorax densely covered with fulvous hair; tegulae light fulvous. Wings short, dusky, shining, with dark nervures, the second cubital cell rather small, receiving first recurrent nervure at end; the membrane is strongly glaucous. Legs dark reddish (not ferruginous), with fulvous hair; hind spurs long and pale; abdomen finely punctured, with a strong glaucous or bluish tint, tergites 2 to 4 with narrow cream-coloured bands; sides of apex with long reddish-black hair; penultimate sternite fringed with red hair, but the three before it with whitish hair.

Foochow district, China (Kellogg).

This cannot be the female of *H. percarinata*, the wings being quite different. It is smaller than *H. pekinensis*, Ckll., with quite different abdominal bands."

Female (holotype). — Apart from the sexual characters very nearly resembling the male, described hereafter. Features worth mentioning in addition to those brought forward in the original description and generic diagnosis, are the following:

Shape of head and face-marks, see Fig. 91; colours as in male. Labrum clear yellow, a little longer than in male, gradually and slightly narrowed anteriorly. Punctation of clypeus coarser, some punctures confluent and wider than interspaces. Length ratios of antennal segments 3, 4 and 5 = 100 : 67 : 85 approx. Sculpture and pubescence of head and thorax exactly as in male. Legs slender. Basitibial plate partly covered by a hair tuft at apex of femur. Longitudinal ventral carina of hind tibia with thin hair-comb, the surface smooth, shining and bare on distal half. Hind tibia and basitarsus as in Fig. 93, the latter much shorter than tibia; surface of hind tibia well visible under the long, strong brownish yellow scopal hairs, which are about as long as diameter of tibia. Outer face of hind basitarsus with rather long, partly raised hairs shorter than on tibia and nowhere hiding the surface; inner faces more densely pubescent, all hairs decumbent and golden brown. Inner rami of all tarsal claws a little shorter than outer.

Abdomen as described for the male, the apical tergal fringes forming pale hair-lines, the fringe at apex of tergite 5 not at all compact, and darker (golden-brown) only at middle.

Male (hitherto undescribed; see also generic diagnosis). — Proboscis (fully extended) 7.2 mm, brownish-yellow; glossa densely hairy; galea smooth and hairless, 5.4 mm; first segment of labial palpus almost as long as galea. Maxillary palpus slender, length ratios of segments 1—6 as 18.2 : 100 : 54.5 : 82 : 59 : 22.7. Shape of head in frontal view and face-marks as in Fig. 90, ground colour light chrome; teeth of mandibles obscured, anterior border of labrum and labroclypeal suture ferruginous. Outer face of mandible smooth, with few scattered punctures, labrum and clypeus finely chagreened, rather shining, covered all over with large, shallow and partly flagging punctures, separated by spaces equal to their own diameter; no distinct median ridge on clypeus; paraclypeal area broad in proportion to clypeus, smooth and shining, impunctate, save for a few scattered punctures at level of tentorial pits; frontoclypeal suture straight. Head otherwise deep black; punctures circular and smaller than on face, those on summit of head more widely spaced on smooth and shiny ground; surface of vertex, between ocelli and upper orbits, distinctly impressed. Mouth-parts and face clothed sparsely with non-

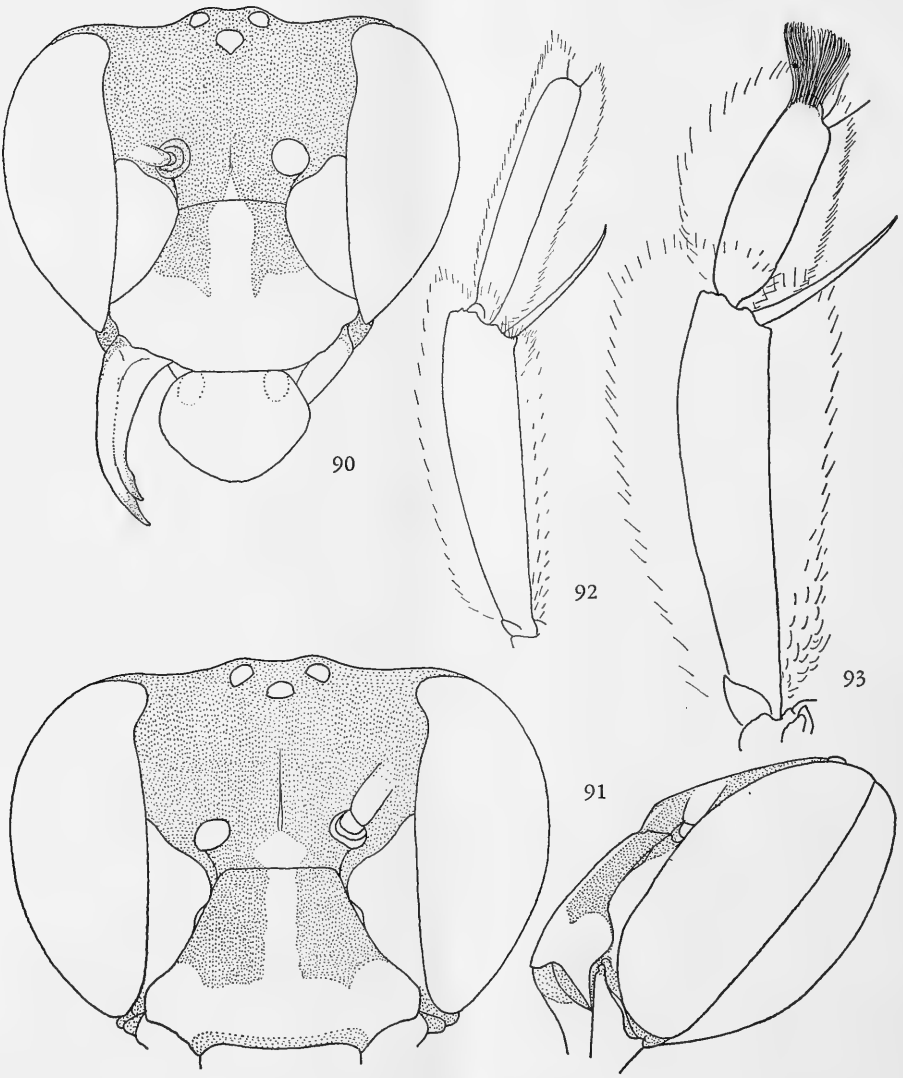

Fig. 90—93. *Habrophorula nubilipennis* (Ckll.), structures, Fukien; Fig. 90—91, frontal view of head of ♂ (90) and the same, frontal and left lateral view of ♀ holotype (91); Fig. 92—93, exterior view of left hind tibia-basitarsus of ♂ (92) and ♀ holotype (93)

plumose yellow hairs and erect bristles, the thin marginal fringe at labrum somewhat longer; short, white, plumose hairs only around base of antennae, long, raised and brown at occipital border, whitish and nowhere concealing surface on occiput and genal area. Antenna brown; scape short and cylindrical, not fully twice as long as thick at apex (10 : 6 approx.), not flattened anteriorly, but marked with an elongate yellow spot and with sparse fringe of long pale hairs on either side; all remaining segments densely, minutely tomentose; segment 3 less than half as long as 4 + 5, length ratios of first

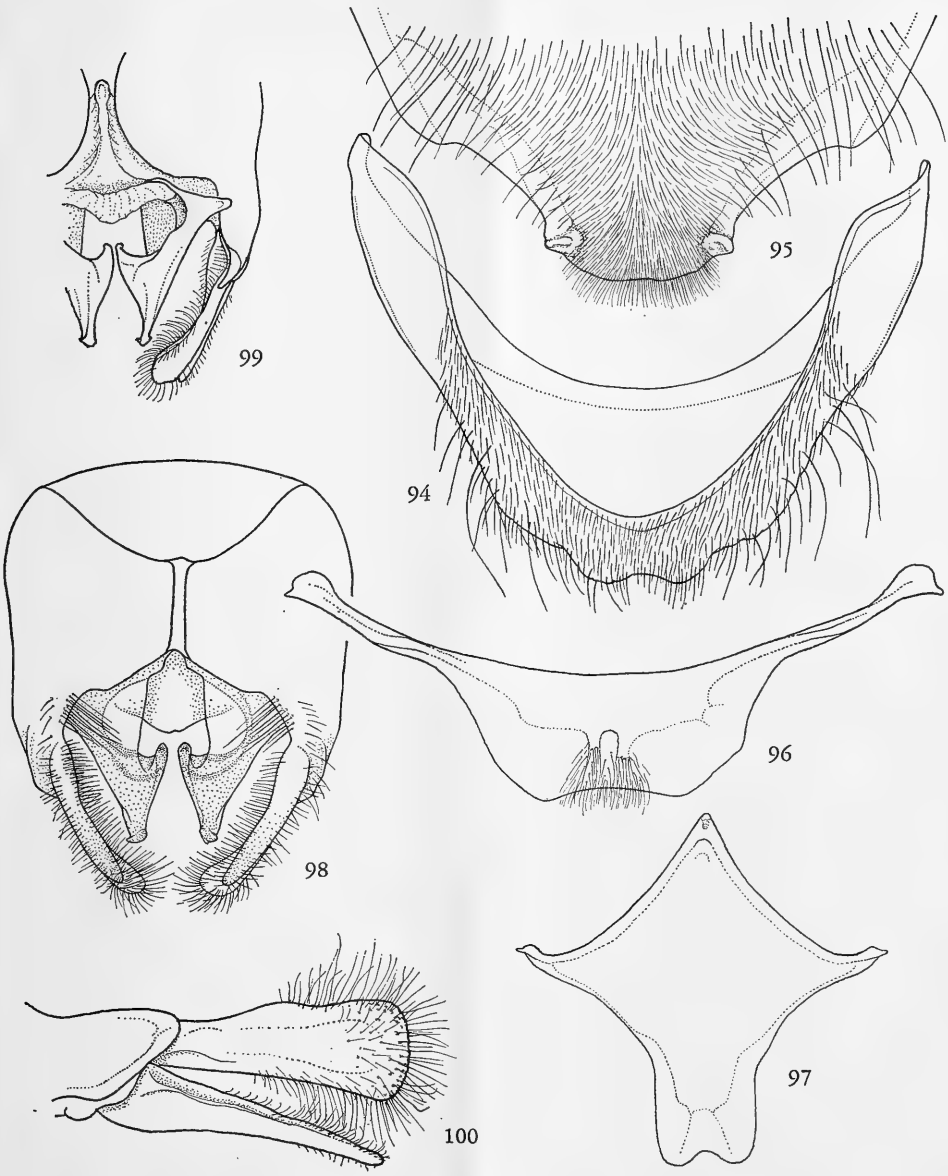

Fig. 94—100. *Habrophorula nubilipennis* (Ckll.), ♂ structures, Fukien; Fig. 94, ventral view of seventh tergite; Fig. 95, exterior view of sixth sternite, showing apical tubercles; Fig. 96—97, seventh (96) and eighth (97) sternites, exterior view; Fig. 98, genital capsule, ventral view; Fig. 99, right gonoforceps and penis valves, slightly more detailed, dorsal view; Fig. 100, right gonocoxal appendages, more enlarged, exterior view

six segments 100 : 23.7 : 37 : 50 : 58 : 60. Thorax black, dorsum and sides closely and rather deeply punctate, punctures circular, separated by less than one puncture width; propodeum almost vertical and flat, dark reddish-brown, surface densely and more finely punctate, except a lozenge-shaped median area, which is smooth and impunctate.

Pubescence ochraceous, fading to greyish white laterally and underneath, all hairs conspicuously plumose but nowhere entirely concealing surface. Tegulae large, almost semicircular, brownish yellow, surface shining, very finely superficially punctate, partly clothed with depressed, non-plumose hairs. Legs uniform yellowish brown; all segments (except distitarsi) somewhat laterally compressed; femora slender, broadest at base, tapering gradually, unarmed; tibiae slightly broadened apically; spurs yellowish, long and almost straight, microscopically serrulate, those of hind legs of equal length; hind tibia and basitarsus narrow (Fig. 92). Punctation of femora scanty and superficial, of tibiae and tarsi somewhat more dense; pubescence short, hairs sparsely distributed, except more crowded on the inside of basitarsi, though not quite concealing surface. Abdomen elongate-oval, dullish, all pregradular areas of tergites and sternites dark brown, the hind margins of 1—6 semitransparent, broadly yellowish and becoming ferruginous at the transition; surface covered with small, evenly distributed, setiferous punctures; all hairs brown, short and decumbent, except some longer raised ones dispersed at sides of tergites, which are paler in colour; also a single thin fringe of much longer, golden yellow depressed hairs covering the pallid membranous apical borders of the tergites. Postgradular areas of sternites smooth and shiny; pale anteapical fringes not dense, increasingly longer posteriorly, longest at 5 and 6. Terminal segments and genitalia, see generic diagnosis and Fig. 96—100.

Body length 12.0 mm approx., length of fore wing 8.0 mm.

The history of this highly remarkable bee is, briefly, as follows. The male and only known specimen of that sex was discovered in a large collection of Anthophorini assembled before and during the last world war by Dr. Tsing-chao Maa and his assistants in the province of Fukien. This collection was entrusted to me for study and sent over to Java as early as in 1953. It comprises a few thousand individuals belonging to four closely interrelated genera, viz. *Amegilla* (sens. lat.), *Anthophora*, *Elaphropoda* and *Habropoda* (sens. lat.). As the specimen in question was unique and on close inspection proved to differ considerably in a number of characters from other constituents of the tribe, it was set apart as something unfamiliar and left unattended for more than twenty years. As pointed out already in my preliminary survey of Old World anthophorines (Lieftinck, 1966), it would become necessary sooner or later to investigate more fully the Asiatic members of *Habropoda* and its immediate allies, several species requiring further study. The outcome of this can be found in the present paper. One of the critical taxa to be dealt with was *Habropoda nubilipennis* Ckll., a species already briefly commented upon in my former account (loc. cit.: 147). It was described from a single female collected in Fukien, but no suitable partner for it had ever turned up. The male being still unknown at the time of characterizing the female, Cockerell compared *nubilipennis* with another member of the genus which he described in the same paper as *Habropoda percarinata*. This was a male collected in Fukien at the same locality with the former. Though Cockerell observed that it resembled *nubilipennis* somewhat in general appearance, he nevertheless recognized it as a distinct species. Later investigations confirmed this view but at the same time the insect soon proved to be a member of the new genus *Elaphropoda*, both sexes of *E. percarinata* (Ckll.) being well represented in Dr. Maa's collections (Lieftinck, loc. cit.: 157—160). In the article cited above I left the female of *Habropoda nubilipennis* as it stood, and it was not until last year that I could re-examine the type of Cockerell's bee in the collection of the British Museum (Nat. Hist.). This was directly confronted with the solitary male from Fukien, a proceeding which enabled

me at last to establish the true identity of the latter. It means that a careful study of all salient characters revealed beyond doubt that the two are not only conspecific but should be transferred to a new genus, here defined under the name of *Habrophorula*, the type species consequently being *Habropoda nubilipennis* Cockerell.

The male of *H. nubilipennis* is immediately distinguished from all other members of the tribe occurring in the same region by the unique form of the terminal abdominal segments and genital organs, especially the shape of the hidden sternal plates and separate parts of the genital capsule being totally different from anything seen in allied genera.

On comparing *Habrophorula* with other genera in which the first recurrent nervure and distal side of the second submarginal cell in the fore wing are interstitial (or nearly so), the genus can be recognized by the following combination of characters: (1) body form markedly elongate; (2) labrum small with simply convex, projecting anterior border; (3) proboscis long and galea attenuated; (4) mandibles unidentate; (5) clypeus short and very little protruding; (6) ocelli approximated, forming together an isosceles triangle; (7) antennal segment 3 abbreviated and much shorter than succeeding segments; (8) no long hair tufts on vertex in front of and just behind anterior ocellus or between the latter and inner orbits; (9) legs extremely slender and unmodified (♂ ♀) and scopal hairs thin (♀); (10) marginal cell on fore wing of great proportional length, proximal and distal sides of 3rd *s.m.* weakly convex and almost parallel; transverse median nervure in hind wing very oblique, much shorter than its distance from fork; (11) dense silky hair covering thoracic segments conspicuously plumose; and (12) fine decumbent hairs covering disks of gastral tergites rather sparse and notably short, coupled with pale translucent posterior tergal margins and absence of conspicuous posterior sternal hair fringes.

The extraordinary array of characters here described and illustrated suffices to distinguish the new genus from *Habropoda.* In stature and some peculiarities of the venation and vestiture *Habrophorula* is rather strongly suggestive of *Elaphropoda*, sharing with this the characters mentioned above sub 1—3, 6, 8, 9 (female only), 10 (partly), 11 and 12. There are important differences, however, particularly the non-protuberant face, different proportional lengths of the proximal antennal segments, and the simple slender legs, are features which will serve to the easy recognition of *Habrophorula*, to say nothing of the very unusual structure of the male terminalia. Additional distinctives of *Elaphropoda* precluding the possibility of any close relationship between the two, are: (1) antennal segment 4 (instead of 3!) annular and much shorter than either 3 and 5; (2) mandibles bidentate interiorly; (3) proximal and distal sides of 3rd *s.m.* not at all parallel, the cell itself being much shorter than in *Habrophorula.*

In connection with the above it is of interest to mention the recently proposed Central American genus *Deltoptila* LaBerge & Michener, 1963 (type species *Habropoda montezumia* Smith), also of the Anthophorini. This was established some years in advance of *Elaphropoda* Lieft., from the eastern hemisphere, sharing with this the enormously protuberant clypeus, great length of both the proboscis and marginal cell of the fore wing, and the somewhat similarly formed male terminalia. For important differences between the two, see the existing descriptions.

Note. — In 1966, at the Paris Museum, I have cursorily examined a series of both sexes of the Mexican *Anthophora badia* Dours, 1869, from Oaxaca in Sichel's collection. This bee was not included in the specific list given by LaBerge & Michener, but undoubtedly also belongs to *Deltoptila.*

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No. 1. A J. Besseling, 1964. — De Nederlandse Watermijten (Hydrachnellae Latreille, 1802) (The Hydrachnellae of the Netherlands), 199 pp., 333 figs., D.Fl. 30.—.

No. 2. P. J. Brakman, 1966. — Catalogus van Coleoptera uit Nederland en het omliggende gebied (List of the Coleoptera of the Netherlands and adjacent region), 219 pp., map. D.Fl. 45.—.

No. 3. G. A. Graaf Bentinck en A. Diakonoff, 1968. — De Nederlandse Bladrollers (Tortricidae) (The Netherlands Leaf-Rollers (Tortricidae)), 350 pp. en 98 pl. D.Fl. 70,—.

SYSTEMATICS AND EVOLUTION OF THE PALAEARCTIC SPIALIA SPECIES (LEPIDOPTERA, HESPERIIDAE)

by

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Abstract

The Palaearctic members of *Spialia* have been revised taxonomically. Two species groups have been distinguished, viz. the *phlomidis* group and the *sertorius* group. The former comprises the species *phlomidis, osthelderi, geron* and *doris,* and is related to the African species *spio.* The *sertorius* group has two Palaearctic members, viz. *sertorius* and *orbifer,* united in a superspecies, and two members outside the Palaearctic, viz. the African *mafa* and the Indian *galba.*

By analyzing some characters as to their plesiomorphous or apomorphous conditions, a reconstruction has been made of the evolutionary and geographic history of the two species groups. This reconstruction forms the theoretical basis for the arrangement of the species and subspecies adopted.

Contents

1. INTRODUCTION

1. a. General

The aim of this study is to examine the phylogenetic relationships of the Palaearctic members of the genus *Spialia* by means of a reconstruction of the evolutionary and geographic history. For this purpose the species concerned have been revised taxonomically and several characters have been analyzed as to their conditions being derived or primitive. This leads to an arrangement of the species supposedly reflecting the phylogenetic relationships. This arrangement is not very different from former arrangements, but especially in *sertorius* and its allies the solution of the perpetual problem "species or subspecies?" is somewhat different from all former solutions. This is mainly due to the subspecies concept.

Under the term "subspecies" usually a number of various types of geographic variation is described. This fact appears to be little recognized and virtually is a source of much confusion. Some authors apply the term "subspecies" to any recognizable population, others use the term to denote rather arbitrary parts of the geographic variation. Recently, Dobzhansky (1970) defined a subspecies as "a race that a taxonomist regards as sufficiently different from other races to bestow upon it a Latin name". To my opinion such a concept must lead to confusion. This is not the place for an exhaustive discussion on the subspecies concept, therefore I will only stress that for a student wishing to trace the geographic history of a species, only that part of the geographic variation is useful for him which arose by geographic isolation. Consequently, in my paper on the genus *Pyrgus* (De Jong, 1972) I presented the following definition:

A subspecies is an, at present or formerly, geographically isolated group of populations of a species, which can be distinguished by one or more characters from other such groups of populations of the species.

The fact that the existence of a former geographic isolation must remain hypothetical cannot be a serious objection, so long we do not use the subspecies thus defined for proving the former existence of such an isolation. Virtually the distinction of subspecies is a hypothesis about the geographic history of the species. The hypothesis may be wrong, but the meaning is clear. I cannot see the use of a subspecies that is an aggregate of various kinds of variation. Some people may object that we better stick to the facts, but what is the use of facts we do not use?

The remainder of the geographic variation lays in the field of the ecologist and geneticist, rather than in that of the zoogeographer. However, the last-named is in the best position to notice this variation. Without experiments it is difficult to ascertain whether a variation is hereditary or not. Nevertheless, I have attempted to distinguish between non-genetic and genetic variation, which I have termed ecophenotypic and clinal, respectively. I consider it senseless to use a trinomen in the case of clinal variation. It not only would cause confusion with subspecific distinctions, but it also would suggest discontinuities where there are only continuities. It seems better to describe clinal variation than to denominate it. In many cases, however, parts of the clinal variation have already been described as subspecies. In such cases I am using Latin names, but separately and not as a trinomen.

The same applies to ecophenotypic variation. A large part of the nomenclatural and taxonomic confusion, at least in butterflies, is due to the practice of describing ecopheno-

typic varieties as subspecies (e.g. the form *hibiscae* of *sertorius,* see chapter 4).

b. Wing markings and genitalia

For the wing markings and genitalia I may refer to my paper on *Pyrgus* (De Jong, 1972). However, some parts of the male genitalia of *Spialia* are not so highly differentiated as in Palaearctic *Pyrgus* species. Therefore, the names of the parts can more easily be brought into accordance with the more currently used names as expressed in Tuxen (1970). So, with regard to the names used in *Pyrgus* the following alterations are made in this paper:

(1) lateral apophyses become gnathos. In *Spialia* this structure is much simpler than in *Pyrgus.*

(2) harpe becomes costa. In *Pyrgus* the distal end of the dorsal part of the valve is highly differentiated. Also in *Spialia* this part is differentiated, but in a different way and presumably by an independent evolution. It seems advisable to term this structure in *Spialia* by a trivial name and I use the name costal process. It would be senseless to replace the terms style, stylifer and antistyle in *Pyrgus* also by costal process.

(3) cuiller becomes cucullus. Also in *Pyrgus* it may be advisable to introduce this alteration.

c. Acknowledgements

It is a pleasure for me to express my gratitude to the following persons and institutions for offering me the opportunity of studying the material in their collections or for presenting specimens (abbreviations used in the text are placed in brackets):

W. L. Blom (Groningen) (WLB), H. Coene (Amsterdam) (HC), Dr. W. Forster (Zoologische Sammlung des Bayerischen Staates, Munich) (ZSM), Dr. L. Gozmany (Hungarian Natural History Museum, Budapest) (MB), T. G. Howarth (British Museum, Natural History, London) (BM), Instituut voor Taxonomische Zoölogie (Zoölogisch Museum, Amsterdam) (ITZ), Mrs. A. Vartian and Dr. F. Kasy (Naturhistorisches Museum, Vienna) (MW), J. H. Lourens (Amsterdam), H. van Oorschot (Amsterdam) (HO), J. Wolschrijn (Heerde, Netherlands) and C. W. Wyatt (Farnham, England) (CW). The Rijksmuseum van Natuurlijke Historie (Leiden) is abbreviated: (ML).

d. Methods and measurements

All names given to species, subspecies and forms of *Spialia* in the Palaearctic have been included in this study, with the exception of the few names relating to individual varieties. A full account of these names can be found in Evans (1949).

To avoid confusion between species and subspecies in the text, a species is indicated by the combinations *Spialia a-us, S. a-us,* or simply *a-us,* a subspecies by the combination *a-us b-us* or by ssp. *b-us.* Names referring to the infrasubspecific variation can be recognized by the word "forma" preceding the name of the variety.

Measurements refer to the length of the fore wing from base to apex.

2. Delimitation and classification of the genus *Spialia*

The genus *Spialia* was erected by Swinhoe (1913 : 99) to include the species *galba* (type-species), *zebra, geron* and *sao* which were previously placed in the collective genus of "black and white Skippers" known under the names *Hesperia* and *Syrichtus*. Thus, Swinhoe only included species occurring within the boundaries of the former British India. Evans (1937) placed also the Ethiopian black and white Skippers in *Spialia*. This extension of the genus is generally accepted, also in this study.

As a revision of the generic divisions of the *Pyrgus* group (Evans, 1949) is intended in the near future, it may suffice now to mention only the most conspicuous characters of *Spialia*, as against the genera *Pyrgus* and *Muschampia* (sensu Evans; recte *Syrichtus*). The fact that the last named genus is heterogeneous does not need to bother us here.

From *Pyrgus* species those of *Spialia* can easily be distinguished by the presence of a more or less well-marked and complete series of submarginal spots on the fore wing upperside and by the place of the median spots in spaces 4 and 5 (if present) that are in line with the median spots in spaces 6 to 8. In *Pyrgus* the submarginal spots are incomplete and faint or absent and the median spots in 4 and 5 (usually present and distinct), are not contiguous to the spots in 6 to 8, but much nearer the termen.

Other distinguishing characters can be found in the males, viz., a costal fold in the fore wing and a hair tuft on the hind tibiae, fitting into a thoracic pouch in *Pyrgus*. Both these secondary sexual characters are absent in *Spialia*, only the males of some Ethiopian species have an indistinct costal fold.

From *Syrichtus* species *Spialia* species can be distinguished by the median spot in space 2 of the fore wing upperside which is central between the cell spot and the median spot in space 3 or nearer the latter. In *Syrichtus* species the median spot in 2 is nearer to the cell spot than to the median spot in 3. Moreover, the termen of the hind wing is more or less crenulate in various *Syrichtus* species, but never so in those of *Spialia*. The males of *Syrichtus* species usually have a costal fold.

Few authors have tried to subdivide the genus *Spialia*. Warren (1926), while dealing with Palaearctic species (under the name *Powellia* Tutt, a junior homonym of *Powellia* Maskell, 1879; see Verity, 1940), distinguished two species groups, viz. the *geron* group and the *sertorius* group. I disagree with Warren about the assignment of species to these groups.

Picard (1947) proposed a more radical subdivision by erecting a new genus, viz. *Platygnathia* for *phlomidis, geron* and *doris*. However, he did not study the Ethiopian species and therefore, his classification is somewhat premature. For a revisional study of the taxonomy of the genus which I hope to complete in the near future, I have studied the male genitalia of all Ethiopian *Spialia* species. As a result of this study I consider the species *spio* a link between the relatives of *phlomidis* and the Ethiopian species. The genus may be subdivided into species groups, but there is no apparent use in making genera of such groups. I am an opponent of the use of subgenera: their application does not solve problems, but only adds to nomenclatural difficulties. Therefore I propose to subdivide the genus *Spialia* only into species groups, while placing *Platygnathia* as a junior subjective synonym of *Spialia*.

In the Palaearctic two species groups can be distinguished:

(1) the *phlomidis* species group, including the species *phlomidis, geron, osthelderi* and *doris*.

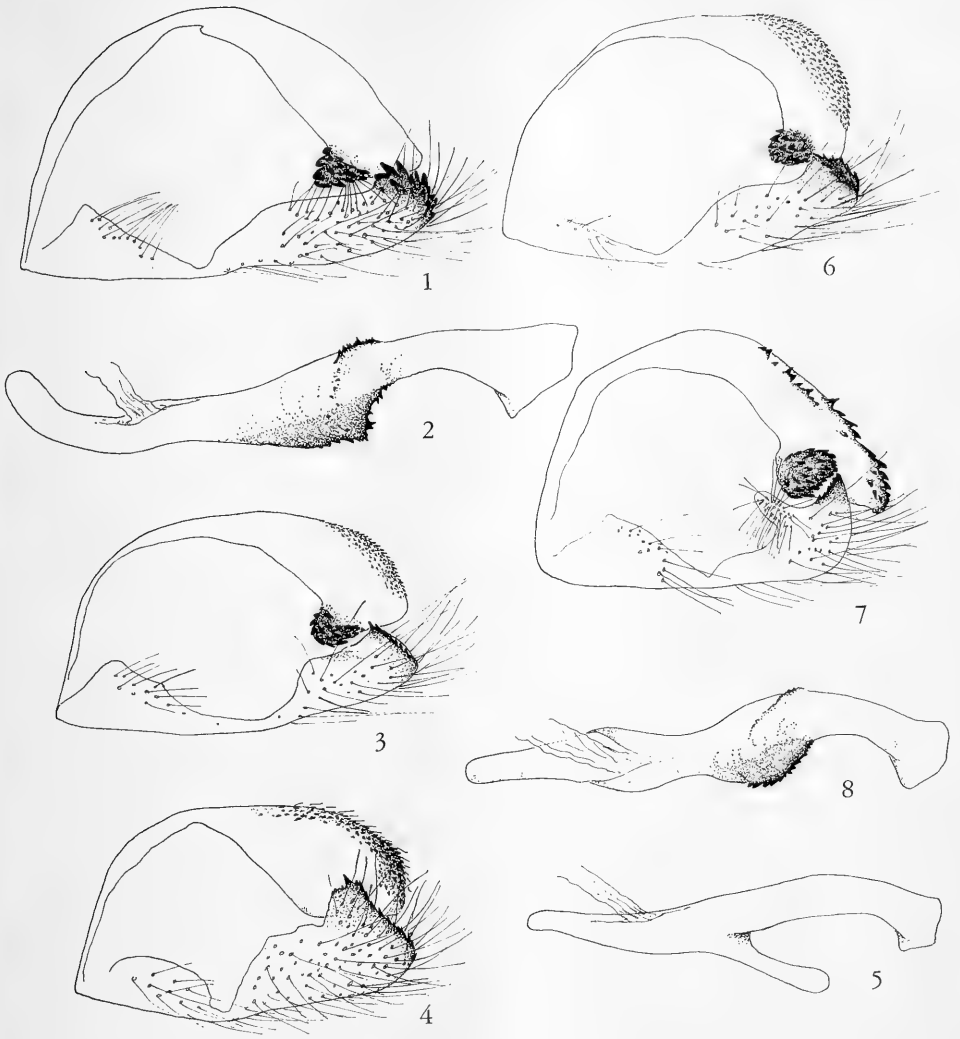


Fig. 1—8. Right valva and aedeagus of *Spialia.* 1—2, *S. phlomidis phlomidis* (Amasia); 3, *S. geron struvei* (Ferghana); 4—5, *S. geron geron* (Baluchistan, Kahan); 6, *S. osthelderi gecko* (Hyrcania); 7—8, *S. doris daphne* (S. Morocco, Ksar-es-Souk). Valva seen from the inside, aedeagus seen dorso-laterally from the left side

Male genitalia (Fig. 1—8). — Aedeagus with a strongly sclerotized and indented crest, latero-ventral in the middle, or a long, unindented branch in the same place, and with an extended apex. Cucullus spined at apex. Costa spined on dorsal surface and at the ventro-distal end, or only at the ventro-distal end.

Female genitalia (Fig. 9—13). — Two heavily sclerotized and indented wing-like structures at the base of the eighth sternite. No distinct genital plate.

External characters. — On the upperside of the fore wing a conspicuous spot or bar at the end of the cell.

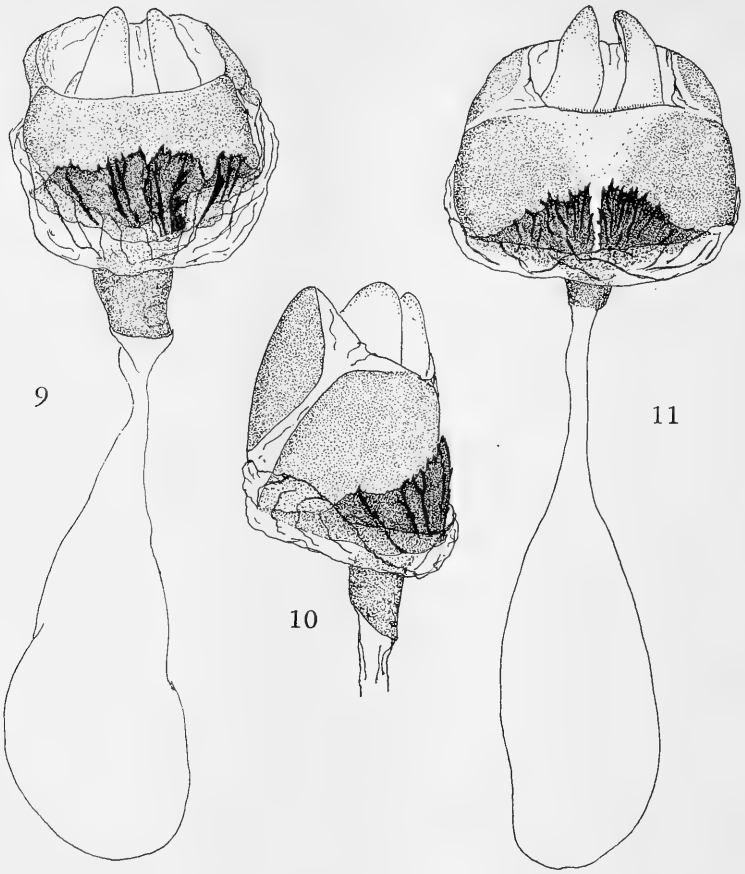


Fig. 9—11. Female genitalia of *Spialia*. 9, *S. phlomidis phlomidis* (Greece), ventral side; 10, idem, seen from the left; 11, *S. geron geron* (Baluchistan, Kahan), ventral side

(2) the *sertorius* species group, including the species *sertorius* and *orbifer* (united into a superspecies). Two non-Palaearctic *Spialia* species can also be referred to this group, viz. the Oriental *galba* and the Ethiopian *mafa*.

Male genitalia (Fig. 24—35). — Aedeagus without crest or branch and apex not extended. Cucullus little differentiated, without spines. Costa at ventro-distal end with a more or less ellipsoid extension bearing long upcurved spines. Between costa and cucullus a densely haired fold at the inside of the valva.

Female genitalia (Fig. 21—23). — No wing-like structures. In Palaearctic species genital plate narrow in proximal half, well developed.

External characters. — On the upperside of the fore wing, spot at end of cell faint or absent in Palaearctic species; *galba* can be distinguished from the *phlomidis* group by the inner spot in space 7 of the hind wing underside being placed directly over the basal spot in the cell; *mafa* has a pale basal spot in space lc of the hind wing underside, which is absent in the *phlomidis* group.

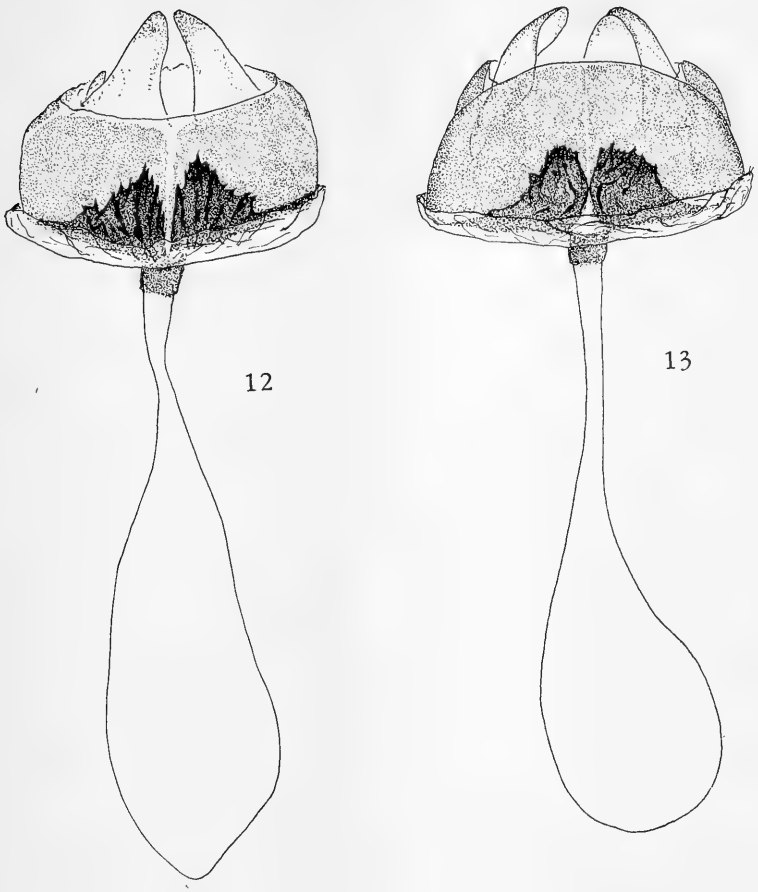


Fig. 12—13. Female genitalia of *Spialia,* ventral side. 12, *S. osthelderi osthelderi* (Akbès); 13, *S. doris doris* (Aden)

3. THE *phlomidis* SPECIES GROUP

The species of the *phlomidis* group can be regarded as closely related and Evans (1956: 750) is correct in stating that they "looked at from a very broad point of view, might be treated as conspecific". As a great overlap exists in the distributional areas of the species, it is undesirable to unite them even into a superspecies, but by bringing them together into a species group we can indicate their supposedly close relationship.

The species can be distinguished as follows.

Key to the species of the *phlomidis* group

1. Central band of hind wing underside directed and more or less conjoined to inner spot in space 7 (Fig. 18). Costa of valva without spines dorsally (Fig. 1). Aedeagus with a sclerotized crest medially (Fig. 2). Papillae anales (Fig. 14) rather pointed,

basal lobe large, covering about three quarters of base; length ratio papilla : apophysis posterior, 5 : 9 . . . . . *phlomidis*

— Central band of hind wing underside not conjoined to inner spot in space 7, but directed more or less to apex. Costa of valva with spines dorsally. Aedeagus with a sclerotized crest or branch medially. Papillae anales bluntly rounded, basal lobe covering half of base or less, apophyses posteriores relatively shorter 2

2. Central band of hind wing underside more or less directed to outer spot in space 7, without touching it (Fig. 20). Discal spot in space lb of fore wing upperside not touching vein 1. Small, ♂ 8.6—12.4 mm. Costa of valva distally strongly concave and reaching beyond cucullus (Fig. 7). Aedeagus with a sclerotized crest medially (Fig. 8). Basal lobe of papillae anales (Fig. 17), a small flap, nearly circular; length ratio papilla : apophysis posterior, 5 : 7.5 . . . . . *doris*

— Central band of hind wing underside directed to a point between the inner and outer spots in space 7 (Fig. 19). Discal spot in space lb of fore wing upperside usually touching vein 1. Costa of valva not extending beyond cucullus. Basal lobe of papillae anales elongate. Larger, ♂ 11—14.2 mm. 3

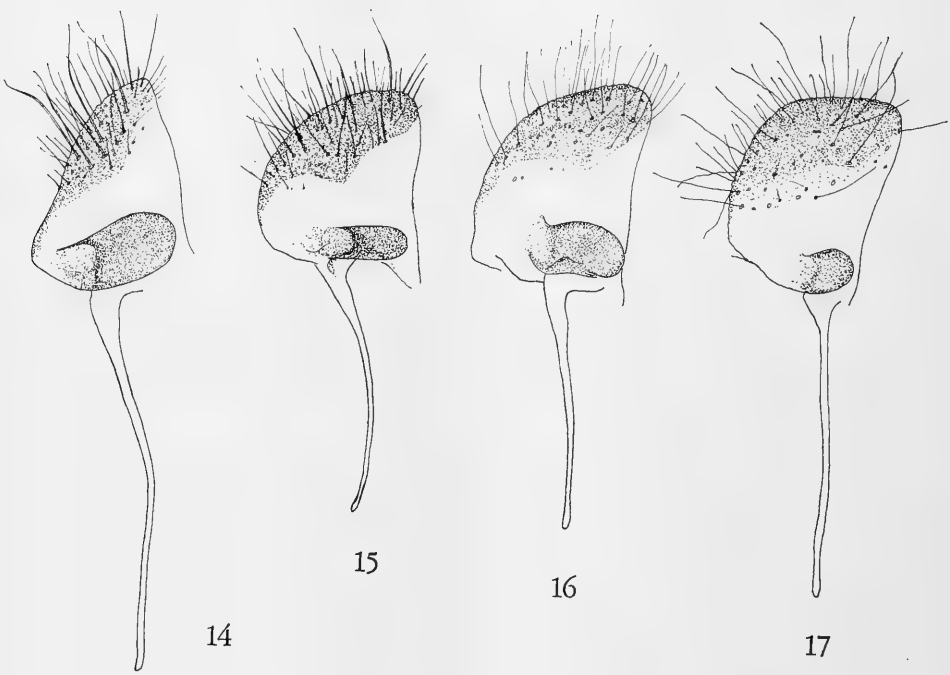


Fig. 14—17. Papillae anales of *Spialia*. 14, *S. phlomidis phlomidis* (Greece); 15, *S. geron geron* (Baluchistan, Kahan); 16, *S. osthelderi gecko* (Kerman); 17, *S. doris doris* (Ras Farták)

3. Colour of hind wing underside greenish. Spot at base of cell of fore wing upperside and cell spot of hind wing upperside present, or if absent, then colour of hind wing underside whitish with faint markings. ♂ 11—13.6 mm. Costa of valva strongly curved (Fig. 6). Aedeagus with a crest medially. Papillae anales with short apophyses posteriores; length ratio papilla : apophysis posterior, 5 : 5—6; basal lobe broad

(Fig. 16) . . . . . *osthelderi*

— Colour of hind wing underside yellowish. Basal cell spots of fore and hind wing uppersides usually absent. ♂ 11.7—14.2 mm. Costa of valva more gently curved (Fig. 4) *). Aedeagus with a branch medially (Fig. 5). Papillae anales (Fig. 15) with slightly longer apophyses posteriores, length ratio papilla : apophysis posterior, 5 : 7, basal lobe narrower . . . . . *geron*

18

19

20

Fig. 18—20. Underside of left hind wing of *Spialia*. 18, *S. phlomidis phlomidis* (Greece); 19, *S. osthelderi gecko* (Semnan); 20, *S. doris evanida* (Karachi)

Note. The differences in the female genitalia are much less conspicuous than in those of the male. It is recommendable to examine the papillae anales freely floating in water or alcohol, as their shape is easily influenced by the pressure of a cover glass.

There are also differences in the sclerotization of the postvaginal region. This is evenly sclerotized in *phlomidis,* with a central narrow membranous gap in *osthelderi* and *doris,* and with a wide central membranous region in *geron.*

The strongest sclerotization of the wing-like structures was found in *osthelderi* and the weakest in *doris.* However, this may be partly due to differences in mounting (e.g. length of maceration by KOH).

Spialia phlomidis (Herrich-Schäffer)

Distribution (Map 1). — From Macedonia and Albania through Greece and Turkey to NE Iran. A local species, known only from the following localities:

Albania : Kula e Lumes, Maliqsee, Korce (Alberti, 1965; material examined);

Yugoslavian Macedonia : Orasje, Drenovo, Ohrid, Petrina planina (Thurner, 1964; material examined);

Greece : Morea (Rebel, 1902); further only "Greece" (Oberthür, 1912; material examined);

Turkey : Brussa, Amasia, Tokat, Goynucek, Ayac Dagi, Berud Dagh (Taurus), "Armenia" (Staudinger, 1881; Oberthür, 1912; material examined);

South Russia: "S. Russia", "Caucasus", Kasikaporan, Ordubad (material examined);

Iran : Shahrud, "Hyrcania" (material examined);

Syria : Akbès (Oberthür, 1912);

Lebanon : Bludan (Ellison & Wiltshire, 1939), Mt. Hermon (material examined).

*) The figure of the valva of *geron* by Reverdin (1914) represents that of *osthelderi!*

Groum-Grshimailo (1890) recorded this species from Pamir, but this observation probably concerns *osthelderi gecko* or *geron struvei.*

Habitat. — According to Thurner (1964) in Macedonia mainly at low altitudes, exceptionally up to 1600 m; in Turkey to 1300 m (Ayac Dagi, material examined), at Bludan between 1700 and 2000 m (Ellison & Wiltshire, 1939). Always in dry and hot localities.

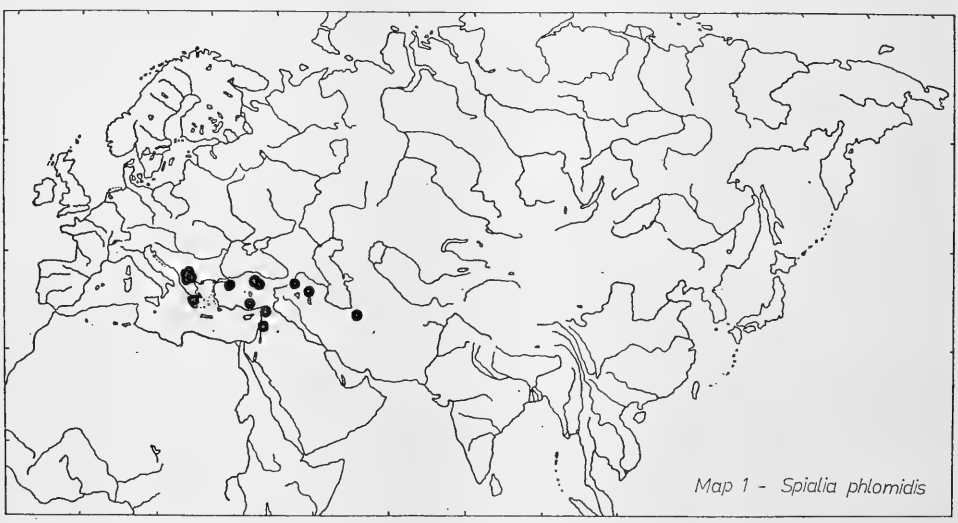
Biology. — All the known specimens are from June and July. No further records about the biology.

Geographic variation. — Two subspecies can be distinguished. The material, however, is very scanty, especially from the eastern part of the range.

Spialia phlomidis phlomidis (Herrich-Schäffer)

Herrich-Schäffer, 1845. — Syst. Schmett. Eur. 1 : 153; Hesp. pl. 2 fig. 8, 9. (For date of publication, see Hemming, 1937).

Type-locality: Turkey (shores of the Sea of Marmora).



Material examined. — 105 ♂ 33 ♀ : 28 ♂ 10 ♀ Macedonia (Ohrid) (HC, ML, ITZ), 21 ♂ 10 ♀ Albania (Korce) (BM), 12 ♂ 2 ♀ Greece (BM, ML), 37 ♂ 9 ♀ Turkey (Brussa, Tokat, Amasia, Goynucek, Ayac Dagi, Berud Dagh, "Pontus", "Turkey") (BM, ML), 1 ♂ 1 ♀ Kasikaporan, 2 ♂ Caucasus, 2 ♀ S. Russia, 1 ♂ Ordubad, 1 ♂ 1 ♀ Iran (Shahrud, "Hyrcania") (all BM).

Distribution. — As that of the species, except Anti-Lebanon and Mt. Hermon.

Subspecific characters. — ♂ 13.2—15.7 mm. A large and strongly marked form, if compared with ssp. *hermona.*

Variation. — Hemming (1932a) compared a long series of freshly emerged specimens (mainly males) from Mt. Chelmos and two specimens from Parnassos with specimens from E. Turkey, Armenia and Iran. He found differences, the specimens from the eastern part of the range being slightly larger, greyer and with larger spots. On account of this difference he described a new subspecies, viz. *phlomidis eupator* (type-locality: Amasia),

occurring in the eastern part of the range of *phlomidis,* while *phlomidis phlomidis* flies in the Balkans and in the western part of Asiatic Turkey (e.g. at Brussa).

I could examine much more material from the Balkans than Hemming. This material does not support the separation made by Hemming. Although the holotype and allotype of *phlomidis eupator* (in the BM) agree very well with the description, they are not representative for the eastern populations, as far as can be judged from the limited number of specimens available. We have to wait for further material from the eastern part of the range of *phlomidis* before we can hope to make a subspecific separation.

Spialia phlomidis hermona Evans

Evans, 1956. — Ann. Mag. Nat. Hist. 9 (12) : 750.
Type-locality: Mt. Hermon.

Material examined. — 1 ♂ Mt. Hermon, 30.VII.1945 (holotype) (BM).

Distribution. — Only the type specimen is known, but Ellison & Wiltshire (1939) recorded the occurrence of a small *phlomidis* near Bludan in the Anti-Lebanon, that undoubtedly concerns this subspecies.

Subspecific characters. — According to Evans (1956) this subspecies is smaller than *phlomidis phlomidis,* ♂ 12 mm, and on the upperside exactly like *osthelderi gecko,* but the valva resembles *phlomidis phlomidis.* To this I can only add that the fringes seem to be somewhat narrower relatively than in *phlomidis phlomidis* and that I was not able to find an essential difference in the male genitalia.

Spialia osthelderi (Pfeiffer)

Distribution (Map 2). — From SE. Turkey to Central Asia, but only few localities are known:

Turkey: Marash, Diarbekr (Pfeiffer, 1932; material examined); Sivrice (De Lattin, 1950); Yüksek Dagh (Amanus Mts) (material examined).

Syria: Akbès (material examined).

Lebanon: Bscherre (material examined).

Iraq: Kizil-Robat, Mirjana, Suleimanyeh (material examined).

Iran: "Hyrcania", Shahrud, Keredj, Semnan, Mashad, Seguck near Kerman (material examined); Shiraz, Sine-Sefid, Tchouroum (Brandt, 1939; material examined).

Afghanistan: Reschke (material examined; I was not able to trace this locality, possibly this is not the name of a locality but of a collector). Evans (1949) recorded 2 ♂ 1 ♀ from Kabul; these specimens, however, proved to belong to *geron.*

C. Asia: Ketmen Tjube (Sussamyr Mts) (material examined).

Habitat. — According to Pfeiffer (1932) flying on slopes up to 1000 m; in SW Iran up to 2600 m (material examined); in Iraq desert foothills and lower middle heights of the mountains (Wiltshire, 1957).

Biology. — According to Pfeiffer (1939) two generations per year. The specimens examined have been collected in all months from April till July and in September.

Geographic variation. — Evans (1949) distinguished two subspecies as follows:

(1) ssp. *osthelderi* — Above markings reduced, particularly on the hind wing upper-

side, where the discal spot in space lc and the basal cell spot are absent usually. Hind wing underside almost all white, with all markings faint.

(2) ssp. *gecko* — Above and below with well-marked spots. On the upperside of the fore wing basal cell spot present, as also the cell spot on the hind wing upperside.

This suggests a clear-cut difference between the two subspecies, but the impression is wrong. The only difference upon the upperside I could establish concerns the discal spot in space lb of the hind wing which is always visible and sometimes large in ssp. *gecko,* mostly inconspicuous or absent, but sometimes also large (e.g. ♂ paratype), in ssp. *osthelderi.*

Also on the underside of the hind wing the difference is not clear-cut. In spp. *osthelderi* the ground colour is always whitish, so that the white markings are very faint. In ssp. *gecko* the ground colour is olive greenish or brownish with well-marked spots, but in two males from the vicinity of Shiraz (Comèe, 2600 m; Sine-Sefid, 2200 m) the ground colour is whitish and the markings faint, so that these specimens are indistinguishable from ssp. *osthelderi.*

As the material is so scanty, the overlap of differentiating characters needs not be significant, but it can also mean that there is a large transitional zone or a clinal variation in the character mentioned. For the time being it seems advisable to consider both forms separate subspecies. The white underside of the hind wing does not appear to be a character of a purely ecological nature, forming a part of a cline. It is interesting to note that this character also occurs in the two Hesperid species *Pyrgus melotis melotis* Duponchel (see De Jong, 1972) and *Syrichtus tessellum nomas* Lederer (see Warren, 1926), both occurring in Turkey and Syria, much like *osthelderi osthelderi.*

Spialia osthelderi osthelderi (Pfeiffer)

Pfeiffer, 1932. — Mitt. Münch. Entom. Ges. 22 : 50, pl. 4 fig. 14, 15, 18.
Type-locality: Marash (Turkey).

Material examined. — 9 ♂ 6 ♀ : 4 ♂ 2 ♀ Marash (3 ♂ 2 ♀ paratypes) (ZSM, BM), 1 ♂ Diarbekr, 1 ♂ Amanus (Yüksek Dagh), 1 ♂ Bscherre (Lebanon) (all ZSM), 1 ♀ Akbès, 1 ♂ 3 ♀ River Dyala (Kizil-Robat, Mirjana), 1 ♂ Suleimanyeh (Kurdistan) (all BM).

Subspecific characters. — See above. ♂ 11.5—13.6 mm. Small specimens possibly belong to a second generation.

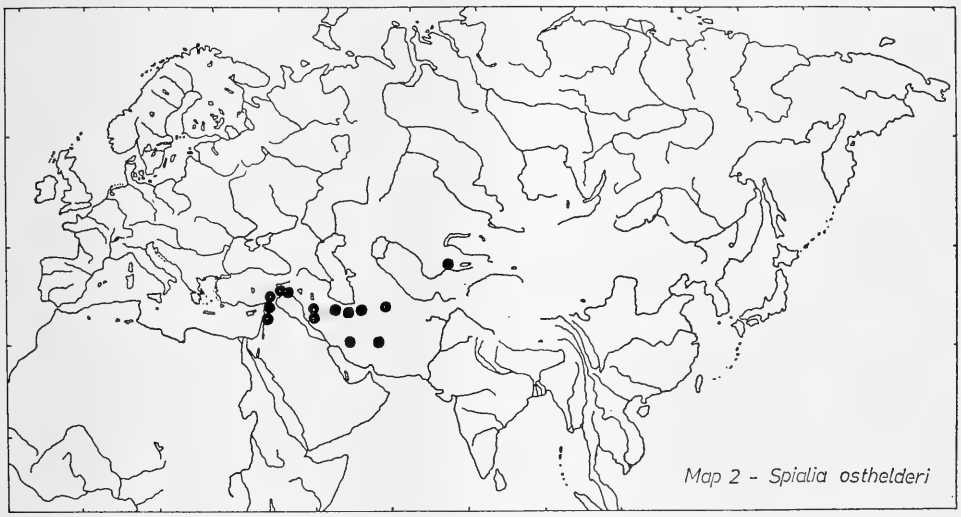
Distribution. — The western part of the range, eastward probably to W. Iran.

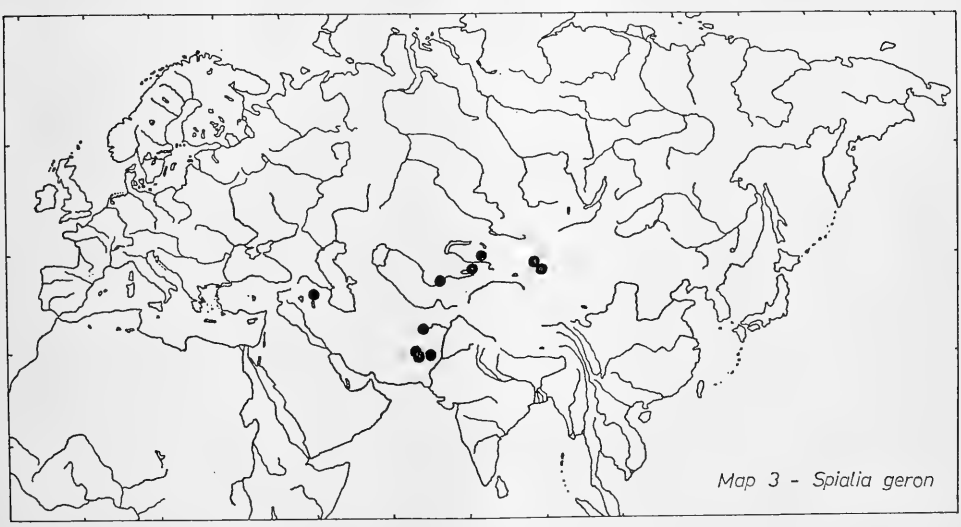
Spialia osthelderi gecko Evans

Evans, 1949. — Cat. Hesp. Eur. Asia & Austr. : 176.
Type-locality: Hyrcania.

Nomenclature. — Pfeiffer (1939) mentioned a new form of *osthelderi* that he would name and describe before long. Shortly thereafter, in a list of butterflies from S. Iran, Brandt (1939) mentioned *"Spialia osthelderi struveoides Pfeiffer"*. This is undoubtedly the same form as *gecko,* since *gecko* looks somewhat like *Spialia geron struvei* (at least, if compared with *osthelderi*). As the name *struveoides* was published in 1939, *gecko* would fall as a junior subjective synonym. However, Dr. Forster kindly informed me

that Pfeiffer never published the name *struveoides*. As the name is mentioned by Brandt without a description, it is not available in nomenclatural sense.





Material examined. — 15 ♂ 5 ♀ : 4 ♂ 1 ♀ Hyrcania (1 ♂ holotype) (BM), 1 ♂ Semnan (MW), 1 ♂ Mashad (WLB), 3 ♂ Keredj, 5 ♂ 1 ♀ Fars (Shiraz, Sine Sefid, Tchouroum, Comèe) (all ZSM), 1 ♂ Shahrud, 1 ♀ Seguck near Kerman, 1 ♀ Afghanistan (Reschke), 1 ♀ Ketmen Tjube (Sussamyr Mts) (all BM).

Distribution. — The eastern part of the range, from Iran to C. Asia.

Subspecific characters. — See above. ♂ 11—13.6 mm. Small specimens may belong to a second generation.

Spialia geron (Watson)

Distribution (Map 3). — From Ordubad (Russian-Iranian frontier, west of the Caspian Sea) to Barkul and Hami (eastern end of Tian Shan), but extremely local and only known from the following localities:

Iran: Ordubad (Evans, 1949: "Ordub") (material examined).

Afghanistan: Arbarp (10 mls W. of Kabul) (material examined; wrongly identified as *osthelderi* by Evans, 1949).

W. Pakistan: Baluchistan (Quetta and surroundings) (Watson, 1893; material examined).

C. Asia: "Ferghana" (material examined); Issyk Kul, Barkul (Püngeler, 1914); Dsharkent (= Panfilov) (Pfeiffer, 1932; material examined); Hami (material examined).

The *Pyrgus phlomidis* recorded by Groum Grshimailo (1890) from Pamir, probably is the present species, or *osthelderi gecko*. Clench & Shoumatoff (1956) listed a badly worn female from Panjao, southwest of Koh-i-Baba (Afghanistan) as a possible *geron*. This identification may be correct, but the specimen may also belong to *osthelderi gecko*.

Habitat. — Not recorded.

Biology. — Presumably two generations per year. The specimens from Baluchistan in the BM date from the periods February to March, and May to September, respectively.

Geographic variation. — The specimens from Afghanistan and Baluchistan differ constantly in size and in the male genitalia dissected: ten males from Afghanistan and Baluchistan, four males from Ferghana and one male from Ordubad.

Spialia geron geron (Watson)

Watson, 1893. — Proc. Zool. Soc. London 1893: 66.
Type-locality: Quetta (Baluchistan).

Material examined. — 42 ♂ 20 ♀ : 2 ♂ 3 ♀ Arbarp (Afghanistan, 10 miles W. of Kabul), 40 ♂ 17 ♀ Baluchistan (Quetta, Urak, Old Urak, Kahan, Chotair, Pasni Rek, Gunduk, Bolan, Giridik; 1 ♂ type Quetta) (all BM).

Distribution. — Only known from Afghanistan and W. Pakistan.

Subspecific characters. — ♂ 11.7—13.5 (—14) mm. Male genitalia (Fig. 4, 5): apex of cucullus much more pointed than in ssp. *struvei,* overlapping a great part of the costa; dorsal surface of costa densely clothed with small spines, but coarser than in ssp. *struvei;* ventro-distal end of costa unspined.

It is interesting to note that Reverdin, who, after Rambur, was the first to put the chaos of the Hesperiidae in order, perhaps never saw a true *geron*. His sketch (1914) of the valva of *geron* clearly shows an *osthelderi,* a species that was described eighteen years later. Perhaps the same applies to Warren (1926, Pl. 6 Fig. 5), but his photograph is to dark to be decisive.

Spialia geron struvei Püngeler

Püngeler, 1914. — Iris 28 : 37, pl. 2 fig. 13, 20.
Type-locality: Barkul.

Material examined. — 6 ♂ 3 ♀ : 1 ♂ Ordubad, 4 ♂ 2 ♀ Ferghana (BM), 1 ♂ Dsharkent, 1 ♀ Hami (ZSM).

Distribution. — The few known localities of this species outside Afghanistan and Baluchistan (see the distribution of the species).

Subspecific characters. — ♂ 13.5—14.2 mm. Male genitalia (Fig. 3): apex of cucullus not strongly developed, just reaching the costa; dorsal surface of costa densely clothed with very fine spines; ventro-distal end of costa spined.

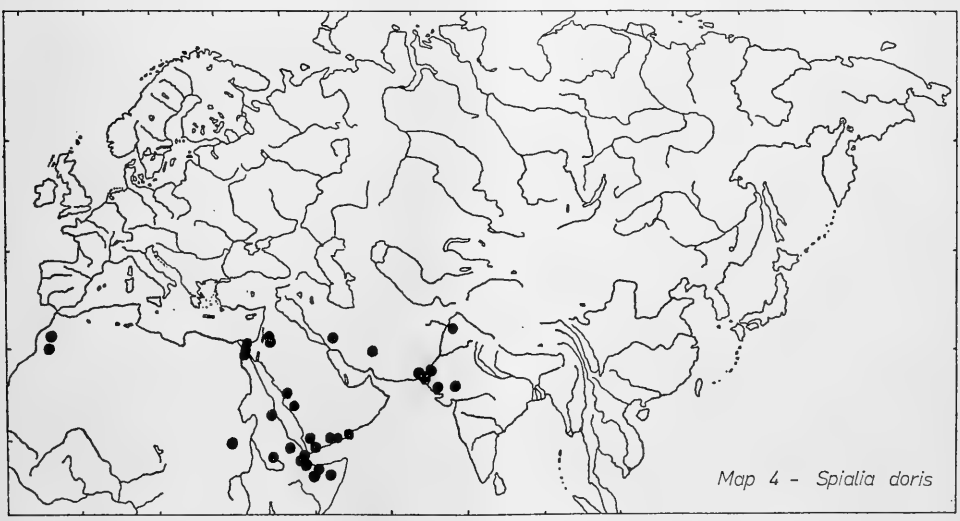
Spialia doris (Walker)

Distribution (Map 4). — Widely but apparently highly discontinuously distributed from Morocco to India.

In Morocco only captured in the following localities: El Aioun du Drâa (Rungs, 1945) and High Atlas, Ziz Valley (Evans, 1949) and Ksar-es-Souk (material examined). Several localities in N. Egypt, south to Heluan (Graves, 1925; Hemming, 1932b; Evans, 1949). From Jordan only known from Qasr Azraq and Hazin (Hemming, 1932b). Widely distributed in W. and SW. Arabia, from Jidda southward, and in Africa from Port Sudan and Kordofan to Somaliland (material examined) and N. Kenya (Baringo District; specimen in National Museum, Nairobi, according to personal communication by Mr. J. H. Lourens). SW. and S. Iran (Ahwaz, Kerman), Sind, Cutch, Punjab and Rajputana (Evans, 1949; material examined). Hemming (1932b) recorded a male from River Dyala (Iraq), but this specimen (in the BM) belongs to *Spialia osthelderi.*

Habitat. — Desert, as far as the food plant grows. In Yemen up to 2800 m (material examined).

Biology. — In Egypt possibly two generations per year. The material in the BM dates from the periods March—April and September—October. Reverdin (1914), however, used for his description of *amenophis* (see below), a male caught August 1st and a male caught November 11th (both from Heliopolis). The spring and autumn forms differ



in size.

In Arabia the species is known from all months in the period September to May, but in summer the species seems to be absent, apart from a few specimens taken in July. No size difference between the spring and autumn specimens could be established.

From other parts of the range the data are too scanty to allow for reliable conclusions.

The only known foodplant is *Convolvulus lanatus* (Graves, 1925: Egypt), a species of the desert.

Geographic variation. — There is a geographic variation in the size, the colour of the underside and the extension of the spots of the upperside.

Spialia doris daphne Evans

Evans, 1949. — Cat. Hesp. Eur. Asia & Austr. : 177.
Type-locality: Ziz Valley (High Atlas).

Material examined. — 13 ♂ 5 ♀ : 1 ♂ Ziz Valley, 21.IV.1935 (holotype) (BM), 12 ♂ 5 ♀ Ksar-es-Souk, 8—18.V.1950, 3500 ft (CW, ML).

Distribution. — Only known from S. Morocco. Rungs (1945) recorded the species from El Aioun du Drâa (S. Morocco) under the name *"Pyrgus doris adenensis* Butl.". This may be *daphne,* as this subspecies shows the greatest resemblance to subspecies *doris* (*adenensis* is a synonym of *doris*).

Subspecific characters. — The original description reads: "Unh very dark greenish brown, markings sharply defined, basal cell spot elongate. Upf basal cell spot elongate, no spots in spaces 4 and 5: outer discal spot in space 1b vestigial. ♂ F 12½ mm." This description of the type is correct, except that the length of the fore wing is only 11.5 mm. The other specimens, however, show some variation, viz. on the fore wing upperside the discal spots in spaces 4 and 5 and the outer discal spot in space 1b may be present, and the length of the fore wing varies from 11 to 12 mm.

Note. — It is a bad usage to describe subspecies on account of a single specimen. Although it is to be expected that in a geographically isolated population differentiating characters will develop, this is not necessary. As to the present instance, the type of ssp. *daphne* could have been an extreme variation of a population that is otherwise similar to ssp. *doris,* the more so as the variation concerns characters that are liable to variation in ssp. *doris.* Fortunately, the distinction of ssp. *daphne* is not superfluous, but Evans could not know that on account of his single specimen!

Spialia doris amenophis (Reverdin)

Reverdin, 1914. — Bull. Soc. Lép. Genève 3: 55—65, pl. 3 fig. 5, 11, pl. 4 fig. 1.
Type-locality: Heliopolis (Egypt).

Material examined. — 13 ♂ 12 ♀. Spring form: 7 ♂ 5 ♀ Mokattam Hills (near Cairo) (BM), 1 ♂ 1 ♀ Heliopolis (BM, MW). Autumn form: 4 ♂ 5 ♀ Qassasin, 1 ♀ Wadi Rished (near Heluan), 1 ♂ Wadi el Tih (all BM).

Distribution. — Northern Egypt, from northern Sinai (Mehemdia; Graves, 1925) to Heluan; Jordan (Qasr Azraq, Hazim; Hemming, 1932b).

Subspecific characters. — Spring form larger than autumn form: ♂ 11.1—12.4 mm

(♀ up to 13.7 mm!) and ♂ 10.2—11.2 mm, respectively. On the upperside the markings very broad. The discal spots in spaces 3 to 8 may be fused into an irregular band, while in other forms the discal spots in spaces 4 and 5 are minute or absent.

Spialia doris doris (Walker)

Walker, 1870. — Entomologist 5 : 56.
Type-locality: Tajora, Red Sea.

Material examined. — 58 ♂ 40 ♀ : 42 ♂ 35 ♀ Arabia (Jidda, Tihama Sabata, Yemen, Aden, Hadramaut) (BM, MW), 4 ♂ Perim, 2 ♂ French Somaliland (1 ♂ Djibouti; 1 ♂ holotype, Tajora), 6 ♂ 3 ♀ Somaliland (Ghibdo River, Djibouti, Berbera, Hargeisa, Sheikh, Saleh Spring, Bihendula, Buran), 2 ♂ 1 ♀ Ethiopia (Massowah, Meiso, Dire Daoua) (all BM), 2 ♂ 1 ♀ Sudan (Port Sudan; Kordofan: Jebel Angageh, Angageh Wells) (BM, MW).

Distribution. — The range of the species south of Jidda and Port Sudan: W., SW. and S. Arabia, Sudan, Ethiopia, Somaliland.

Subspecific characters. — A rather constant form. On the upperside well-marked, but all markings reduced as compared with ssp. *amenophis,* except the discal spots on the upperside of the hind wing. The discal spots in spaces 4 and 5 on the fore wing upperside minute or absent. Submarginal spots may be faint. Ground colour of hind wing underside dark greyish olivaceous, somewhat like ssp. *amenophis,* but sometimes more yellowish. ♂ (9—)10—11.6 mm.

Note. — Evidently overlooking the description by Walker, Butler (1884) described the same form under the name *Pyrgus evanidus* var. *adenensis* from Aden (holotype in the BM examined).

Spialia doris evanida (Butler)

Butler, 1880. — Ann. Mag. Nat. Hist. 5 (5) : 223.
Type-locality: Hubb River (S. Baluchistan).

Material examined. — 17 ♂ 5 ♀ : 1 ♂ 1 ♀ S. Iran (Ahwaz, Kerman) (BM), 13 ♂ 3 ♀ Sind (Hubb River, type; Karachi, Hidrabad) (BM, MW, ML), 1 ♂ Cutch, 2 ♂ Punjab (Campbellpore), 1 ♀ Rajputana (Deesa) (all BM).

Distribution. — The eastern part of the range of the species, from S. Iran eastward.

Subspecific characters. — Above like ssp. *doris,* below like ssp. *doris* but ground colour paler, particularly in the hind wing which is pale yellowish. There exists, however, some individual variation, while some specimens are as dark as ssp. *doris.* Smaller than the latter, ♂ 8.6—10.2 mm.

Note. — Of the four subspecies recognized here, *doris* and *evanida* are most alike. Evans (1949) even considered the difference between them too small for subspecific recognition. However, the populations of ssp. *doris* and ssp. *evanida* appear to be entirely isolated geographically and I consider the subspecific distinction of *evanida* justified.

4. The *sertorius* species group

In the Palaearctic region the *sertorius* species group is represented by seven allopatric forms, externally clearly distinguishable, but the differences in the genitalia are almost

imperceptible or absent. These forms are: *sertorius, ali, therapne, orbifer, hilaris, lugens* and *carnea*. Whether one considers these forms subspecies or separate species (perhaps united into a superspecies) seems to be only a matter of taste, apart from the following considerations.

(1). *therapne* is the forma of Corsica and Sardinia. Kauffmann (1955) recorded the capture of *sertorius* at Evisa (Corsica). According to Bretherton (1966) *sertorius* was recently found in two places in Corsica, and Higgins & Riley (1970) state that specimens taken at Corte and Evisa have been described as intermediates of *therapne* and *sertorius*.

(2). The second generation of the North African *ali* looks very much like *therapne*, the difference being mainly the shape of the central spot and the colour on the underside of the hind wing.

(3). In *sertorius, ali* and *therapne* the shape of the central spot of the hind wing underside is angular; in *orbifer, hilaris, lugens* and *carnea* this spot is rounded.

(4). In Central and Eastern Europe the forms *sertorius* and *orbifer* must approach each other very closely and possibly overlap to a small extent. In Poland only *sertorius* is known (Bleszynski e.a., 1965; Krzywicki, 1970). The only *orbifer* specimens examined from Czechoslovakia originate from Jung-Bunzlau (Bohemia), further I saw only *sertorius* from Czechoslovakia. According to Moucha & Novak (1960) only two reliable records of *orbifer* are known from Slovakia (Stúrovo, Kováčov), both near Hungary, while all other specimens collected in Slovakia belong to *sertorius* (see also Reiprich, 1960). The easternmost locality from where I have seen *sertorius* is Szobráncz, near the Czechoslovakian-Russian frontier.

Alberti (1965) said to have seen specimens with transitional characters from Northern Hungary in the Hungarian Natural History Museum, but the specimens of both *sertorius* and *orbifer* from the collections of this museum examined by me did not allow for such a conclusion. The boundary between *sertorius* and *orbifer* in Hungary appears to be the river Raba: all specimens collected west of it are *sertorius* (like all Austrian specimens), while east of the river only *orbifer* is known to occur.

In Northern Yugoslavia *sertorius* is widely, but locally distributed. I have seen specimens from the Sneznik (30 km north of Rijeka) and from Fuzine (15 km east of Rijeka). Prof. Lorkovič kindly informed me that *sertorius* has been captured at some more localities in northern Yugoslavia, viz. Zagreb and surroundings (Podsused, Samobor, Japetič), Klek near Ogulin, Hrvatsko (see also Lorkovič & Mladinov, 1971), Slunj, Ljeskovac (Plitvice lakes), Velika near Pozega, and Banja Luka. In the coastal region *sertorius* and *orbifer* appear to approach each other very closely. At Trieste only *sertorius* has been captured. Verity (1940) stated that *orbifer* occurs in Istria, but he did not give exact localities and the reliability of this record is doubtful. The northernmost locality in the coastal region from where I have seen *orbifer* is Senj (= Zengg). Koca (1901) recorded the same form from the nearby Krizpolje. Lorkovič (in litt.) found *orbifer* at Plitvice. Further south only *orbifer* has been collected (see also Lorkovič, 1973).

Rebel (1895) recorded specimens of the spring brood at Plitvice, with the spots on the underside of the hind wing of the *sertorius* type, but with the ground colour olive brown. It is not clear whether Rebel thought these specimens to belong to *sertorius* or to *orbifer*. Very probably they do not indicate a hybrid population. Lorkovič (in litt.) found several *orbifer* specimens at Plitvice and only one *sertorius* specimen, apparently without intermediate characters.

Thus, in spite of the close geographic vicinity of *sertorius* and *orbifer* the occurrence of intermediate populations has not yet been proved. According to the material available at present a possible hybridization is a rare event. This idea is supported by the discovery of differences between *sertorius* and *orbifer* in the larval and pupal stages in N. Yugoslavia (Lorkovič, 1973).

Exact localities in the border region of *sertorius* and *orbifer* from where I have seen specimens or reliable records have been represented in Map 5.

(5). Throughout Peninsular Italy only *sertorius* is found, but in Sicily it is replaced by an *orbifer* population with some *sertorius* features in the female (see under *Spialia orbifer*).

(6). The forms *hilaris* and *orbifer* and the forms *lugens* and *carnea* are connected by intermediates in SE. Turkey and the Samarkand region, respectively.

Of course, these arguments are not conclusive, but from the distribution and differentiation of *sertorius, ali* and *therapne* on one side and of *orbifer, hilaris, lugens* and *carnea* on the other, one may conclude that these forms fall taxonomically and geographically into two groups, viz. a western *sertorius* group and an eastern *orbifer* group.

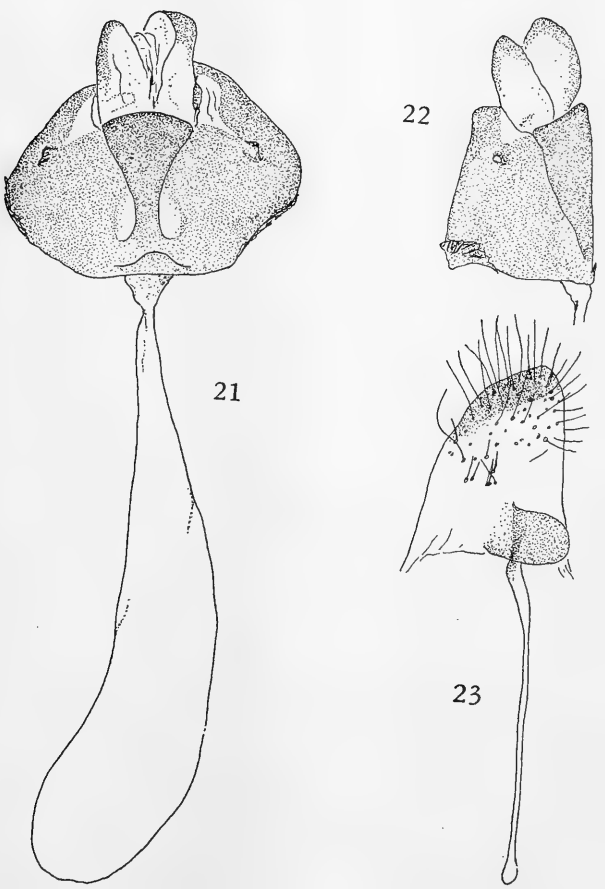


Fig. 21—23. Female genitalia of *Spialia sertorius sertorius* (Chiclana, S. Spain). 21, ventral side; 22, left side; 23 right papilla analis

For practical reasons I treat the two groups as species and I am uniting them into the superspecies *sertorius*. However, I must stress the fact that one could equally well consider *sertorius* and *orbifer* subspecies groups of one species. For the evolutionary and geographic history of superspecies *sertorius*, that shows the arrangement adopted to reflect the phylogenetic relationships, see Chapter 5.

In the Palaearctic no other representatives of the *sertorius* group exist. It is, however, surprising that there are two species outside that region which are apparently closely related to *sertorius* and *orbifer* and which show magnificently how the present type of valva of *sertorius* and *orbifer* has developed. One of these species viz. *mafa*, is African, and extends from South Africa to Abyssinia (Evans, 1937), SW. Arabia (Gabriel, 1954) and the vicinity of Mecca (material examined). The other species, *galba*, occurs throughout India, Ceylon and a part of Burma, and is also known from Hainan (Evans, 1949, 1956). Their valvae and gnathos are shown in Fig. 32—35. For the phylogenetic relations between *galba*, *mafa* and superspecies *sertorius*, see Chapter 5. From a broad point of view one could consider this species group a superspecies as the composing species are allopatric. However, by accepting a superspecies *sertorius* with the species *sertorius* and *orbifer*, it is impractical and obscuring history, to unite these species with *mafa* and *galba* into a single superspecies.

SUPERSPECIES SPIALIA SERTORIUS (Hoffmansegg)

Taxonomy.

It is not difficult to distinguish the species *sertorius* and *orbifer* with external characters. In *sertorius* the ground colour of the underside of the hind wing is red in various shades, from ochreous to a very vivid red, and the spots on the underside of the hind wing, particularly the central spot and the costal spot (in spaces 7—8) are more or less angular. In *orbifer* the ground colour of the underside of the hind wing is greenish or yellowish olive-grey, the spots are rounded and the costal spot is particularly distinct. Only in the subspecies *carnea*, *orbifer* can have a reddish underside of the hind wing, but as this subspecies is Asiatic it cannot be confused with *sertorius*.

In the male genital armature the difference between *sertorius* and *orbifer* is much less distinct. Moreover, the differential characters are subject to variation and not entirely reliable. The differences were discovered by Warren (1926), who emphasized their inconstancy. Kauffmann (1955) considered them too unreliable to be of any use, but this is slightly exaggerated.

The differences can be found in:

(a). Gnathos (Fig. 25, 27, 29, 31). The ventral spined part is narrowly pointed in *sertorius ali*, less narrowly pointed in *orbifer*, bluntly rounded in *sertorius therapne* and rounded in *sertorius sertorius*. Especially in *s. sertorius* the variation is considerable and specimens with a *therapne* or *orbifer*-like gnathos are not extremely rare. Further, the left and right parts of the gnathos may differ in form. Moreover, the angle from which the structure is observed, is important, an oblique position of the gnathos causing a more pointed appearance.

(b). Hairy fold at the inside of the valve. (Fig. 24, 26, 28, 30). In *orbifer* the ventral, horizontal part is usually best developed, in *sertorius* the horizontal and vertical parts are about equally well developed or the vertical part is best developed (*sertorius*

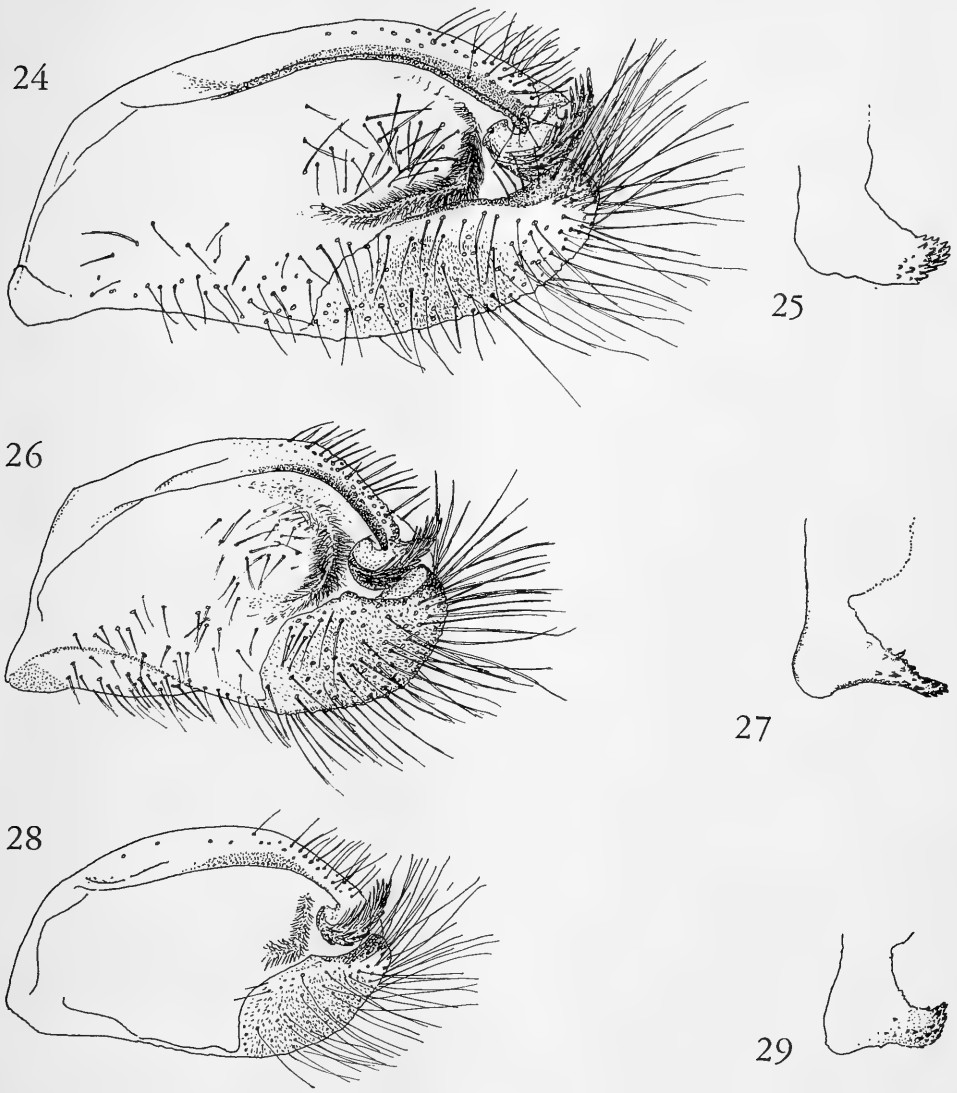


Fig. 24—29. Inside of right valva and outside of left part of gnathos of *Spialia*. 24—25, *S. sertorius sertorius* (Hannover); 26—27, *S. sertorius ali* (Algeria); 28—29, *S. sertorius therapne* (Corsica)

ali). The variation in this character does not depend on the angle from which the fold is observed.

In the female genitalia of *sertorius* and *orbifer* (Fig. 21—23) I could not find clear differences.

From these facts it is obvious, that a possible hybrid between *sertorius* and *orbifer* cannot be detected by the genital characters, and only by the external ones.

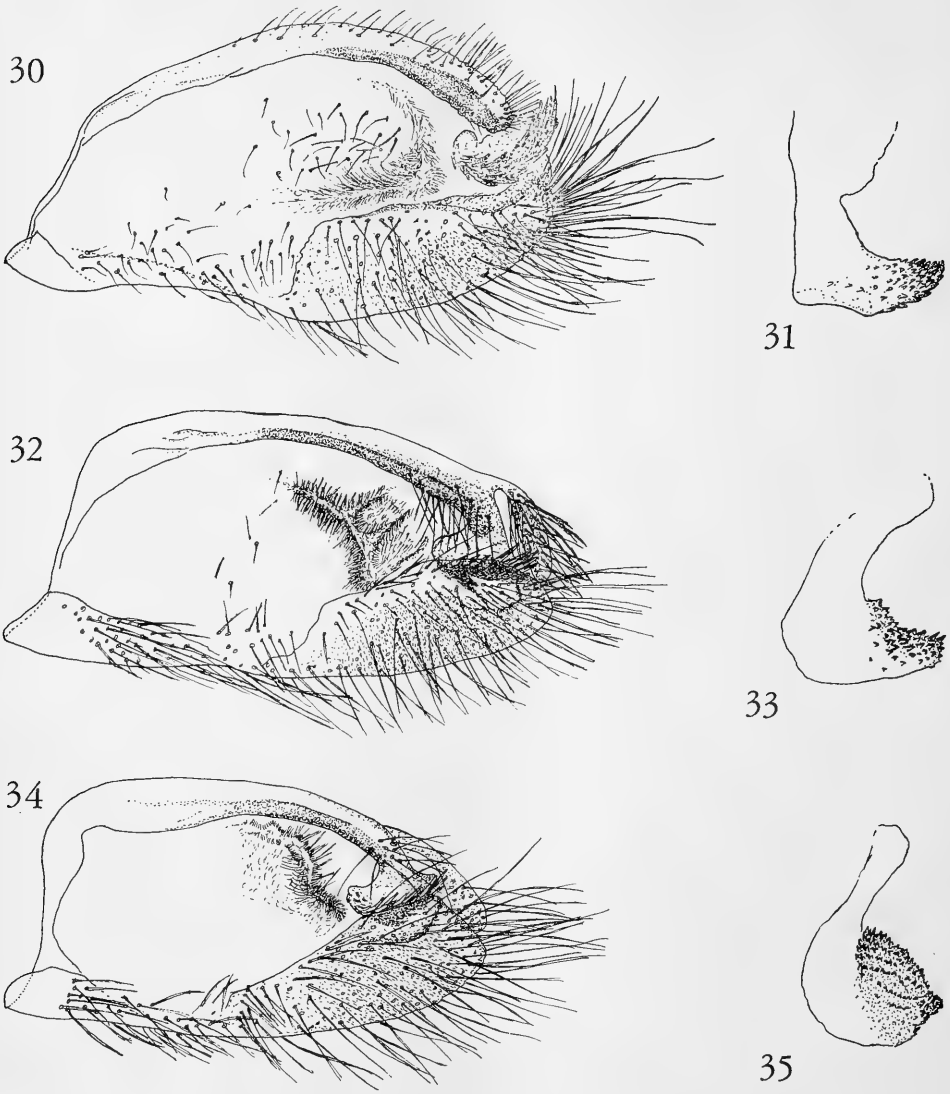


Fig. 30—35. Inside of right valva and outside of left part of gnathos of *Spialia*. 30—31, *S. orbifer orbifer* (Turkey); 32—33, *S. mafa* (S. Africa); 34—35, *S. galba* (Ceylon)

Spialia sertorius (Hoffmansegg)

Nomenclature. — Apart from *sertorius,* two names have been used for this species, viz. *sao* Hübner and *hibiscae* Hübner. Warren (1926) pointed out that *Papilio sao* Hübner, 1800—1803, is a junior homonym of *Papilio sao* Bergstrasser, 1779, and that *sertorius* Hoffmansegg, 1804, is the correct name. However, Hemming (1936) recorded the name *hibiscae,* attributed by him to Hübner (1790—93). This name has been used in important publications, such as Verity (1940, 1947) and Kauffmann (1951). Evans

(1947) indicated that there is no evidence that the paper "Lepidoptera Linnei" where Hemming found the name *hibiscae,* had ever been published, so that the name *hibiscae* Hemming, 1936, should be placed as a synonym of *sertorius* Hoffmansegg, 1804.

Some authors (e.g. Lempke, 1953) have made an efffort to alter the gender of the name *sertorius* in accordance with that of *Spialia,* resulting in the combination *Spialia sertoria.* This is incorrect, *sertorius* not being an adjective but a proper name.

Distribution (Map 6). — NW. Africa; from S. Europe northward to southern Bretagne (Picard, 1950), southern Netherlands, Osnabrück, Hannover and Harz Mountains, east to southern Poland (Krzywicki, 1970), the Czechoslovakian—Russian frontier, the river Raba in Hungary and Slavonia and Croatia in N. Yugoslavia. For details of the eastern distributional limits, see above and Map 5. *Spialia sertorius* occurs throughout Italy, Corsica and Sardinia, but in Sicily it is replaced by *orbifer.*

Habitat. — Flowery slopes, dry meadows from the lowlands up to 2200 m in the French Pyrenees Rondou, 1932), to 2400 m in Spanish mountains (Manley & Allcard, 1970) and to 2300 m in Switzerland (Schmidlin, 1949). Mainly in xerotherm limestone environments, undoubtedly in relation with the requirements of the food plants.

Biology. — Everywhere two generations a year, flying from April to June and from July to September, but in mountainous districts often monovoltine. The larva hibernates (Forster & Wohlfahrt, 1955).

Food plants: *Sanguisorba minor, Potentilla verna, Rubus idaeus* (Rosaceae) (Verity, 1940; Forster & Wohlfahrt, 1955). The food plants of the subspecies *ali* and *therapne* are unknown.

Geographic variation. — Three subspecies are recognized here.

Spialia sertorius ali (Oberthür)

Oberthür, 1881. — Etude d'Ent. 1 : 61, pl. 2 fig. 3.
Type-locality: Lambèse (Algeria).

Material examined. — 231 ♂ 114 ♀ : 38 ♂ 17 ♀ Morocco (Tanger, Tetuan, Azrou, Ketama, Timhadit, Ifrane, Ras-el-Ma, Valley of R'dat, Tamarouth, Asni, Ain Leuh, Mrassine, Marchand) (BM, ML), 193 ♂ 96 ♀ Algeria (Batna, Djebel-Aurès, Lambèse, Souk-Ahras, Tlemcen, Géryville, Sebdou, Hammam R'irha, Oran, Titen Yaya, El Hajeb, El Kantara, Djelfa, Khenchela, Algiers, Tafna, Aflou, Blido, El-Maouna, Nedroma, El Qutaya, Lafla-Marnia, El-biar, Hussein Dey, Sidi-bel-Abbès, Duffana) (BM, ML), 1 ♀ Tunisia (Ain-Draham) (BM).

Distribution. — Confined to NW. Africa.

Subspecific characters. — Male genitalia: gnathos ventrally narrowly pointed. External characters: first brood, ♂ 8.4—11.6 mm, underside of the hind wing red or pale brown with dark striae, at the termen alternating white and red or brown streaks, because the submarginal spots are modified, central spot with long projections towards base and termen; second brood: ♂ 8.3—10.3 mm, underside of the hind wing mostly yellowish red with less pronounced white markings, on the upperside of both wings the wite markings with a yellow shade.

Note. — The second brood is very similar to subspecies *therapne* and for this reason Oberthür (1910) gave it the name *therapnoïdes.* It can, however, easily be separated by the less warm ochreous red underside and by the central spot of the underside of the

hind wing, that in *therapnoides* has long projections towards base and termen (as in the first brood), while in *therapne* it only has a projection towards the termen.

Spialia sertorius therapne (Rambur)

Rambur, 1832. — Ann. Soc. Ent. France 1832 : pl. 7 fig. 4.
Type-locality: Corsica.

Material examined. — 54 ♂ 21 ♀ : 52 ♂ 20 ♀ Corsica (BM, ML, HO, HC), 2 ♂ 1 ♀ Sardinia (BM, ML).

Distribution. — Confined to Corsica and Sardinia.

Subspecific characters. — Male genitalia: ventral, spined part of gnathos not as narrow as in ssp. *ali,* blunt but not rounded as in *sertorius.* External characters: very small, ♂ 7.8—9.9 mm; on the upperside shaded yellow, spots yellowish, submarginal spots very faint or absent. On the underside warm ochreous red, spots arranged as in ssp. *sertorius;* see also ssp. *ali.*

Note. — According to Higgins & Riley (1970) *therapne* is bivoltine, flying in April and September. However, I have only seen specimens dated from June to September.

Spialia sertorius sertorius (Hoffmansegg)

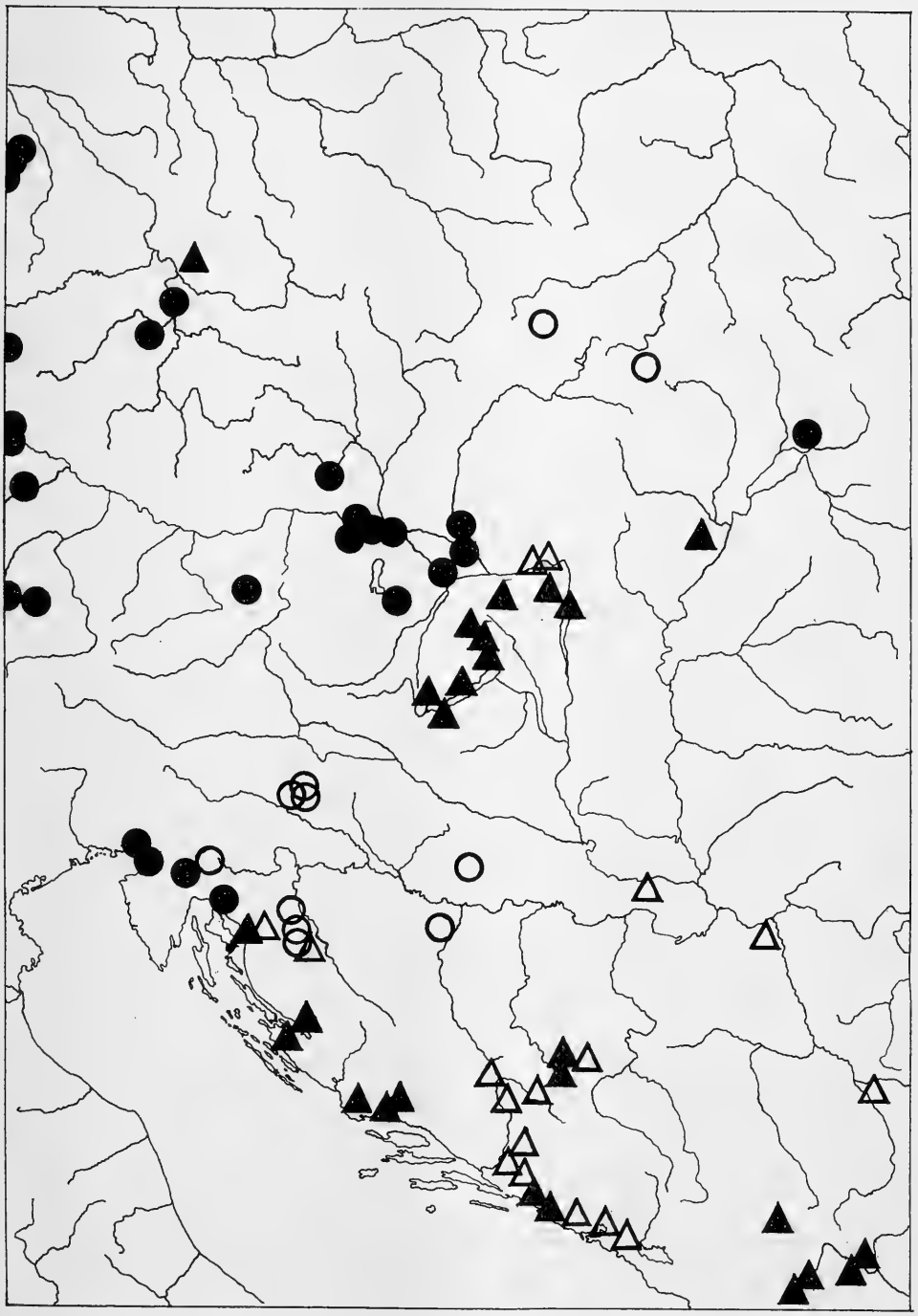
Hoffmansegg, 1804. — Mag. f. Insektenkunde (Illiger) 3 : 203.
Type-locality: Germany.

Material examined. — 779 ♂ 420 ♀ : 36 ♂ 13 ♀ Portugal (BM, ML), 49 ♂ 14 ♀ S. Spain (BM, ML, ITZ), 101 ♂ 33 ♀ C. and N. Spain (BM, ML), 10 ♂ 3 ♀ Spanish Pyrenees (BM, ML), 92 ♂ 45 ♀ French Pyrenees (Hautes Pyr., Pyr. Or.) (BM, ML, ITZ), 231 ♂ 148 ♀ France (BM, ML, ITZ), 13 ♂ 8 ♀ Belgium (BM, ML), 12 ♂ 10 ♀ Netherlands (ML, ITZ), 44 ♂ 16 ♀ Switzerland (BM, ML, ITZ), 34 ♂ 14 ♀ Germany (Bayern to Hannover and Leipzig) (BM, MB, ML, ITZ), 39 ♂ 35 ♀ Austria (BM, ML, MB), 7 ♂ 8 ♀ Czechoslovakia (Praha, Slany, Hlubočepy, Trencsén, Eperjes, Szobráncz) (MB, ML, BM), 1 ♂ 1 ♀ Hungary (Sopron, Magyarovár) (MB), 12 ♂ 4 ♀ N. Italy (BM, ML, ITZ), 84 ♂ 63 ♀ C. Italy (BM, ML), 1 ♀ Elba (ML), 2 ♂ 1 ♀ Calabria (BM), 10 ♂ 2 ♀ Trieste and Istria (BM, ML, MB), 1 ♂ Slovenia (Sneznik) (ML), 1 ♂ 1 ♀ Croatia (Fuzine) (ML).

Distribution. — The whole distribution area of the species, except NW. Africa and Corsica-Sardinia, i.e. West, Central and South Europe, east to Slavonia and E. Czechoslovakia; for details, see above and Map 5.

Subspecific characters. — Male genitalia: ventral, spined end of gnathos broad and rounded. There is some variation in the direction of ssp. *ali* and ssp. *therapne,* but these forms are rarely equalled. External characters: on the underside of the hind wing the submarginal spots not modified as in ssp. *ali,* ground colour red in various shades to ochreous red or, less commonly, yellowish, particularly in the second brood in S. Europe. The two broods differ in size: first brood ♂ 10—12 mm. second brood ♂ 9—11 mm, but there is much variation and a general rule cannot be given.

Variation. — This subspecies is rather variable, especially in Spain. Some authors, e.g. Verity (1940), have recognized several subspecies or "races". At least partly, this



Map 5. Distribution of *Spialia sertorius* and *orbifer* in Central and Southeastern Europe. ● = *sertorius,* material examined; O = *sertorius,* literature records; ▲ = *orbifer,* material examined; △ = *orbifer,* literature records.

variation does not seem to be geographic, but it is possible that some geographic variation exists. The following variation is known:

(1). The spots on the upperside may be all present and well-marked or may be reduced. Particularly the submarginal spots can be totally absent. Based on this variation Verity (1940, 1947) and Kauffmann (1951) recognized the subspecies *hibiscae* (by Verity attributed to Hübner, by Kauffmann to Hemming; see also above, under Nomenclature) (well-marked) and *sertorius* (markings reduced). The second brood of both forms is somewhat smaller than the first brood and has been named *parvula* Verity (for *sertorius*) and *minor* Rebel (for *hibiscae*).

Both Verity and Kauffmann state that the dark form (*sertorius*) is confined to humid places; therefore, it can hardly be assigned subspecific state. There are still more reasons to mistrust the correctness of the subspecific separation. In most places both forms occur together, connected by many transitions. I have seen both forms from Lisbon, the Pyrenees, the Basses Alpes, Belgium, the Netherlands, Germany and Lower Austria. Mostly *hibiscae* is the dominant form, but *sertorius* can dominate in some localities (and perhaps only in some years). Bergmann (1952) found proportionally more *hibiscae* when the years were drier.

Lempke (1953) is correct in stating that in the Netherlands the dark form dominates, but he also mentions better marked specimens and says (p. 244): "Such specimens agree totally with subsp. *hibiscae* Hemming (...). It is difficult to name such specimens as, with us, they belong to the infrasubspecific category, while the name was given to a group of higher rank. Nomenclaturally these limits are, of course, splendid, but in practice all limits disappear." However, in this case as well as in many others the difficulties arise from a wrong interpretation of the facts and a wrong concept of superspecies. In the present case, *sertorius* and *hibiscae* are not separate subspecies, but climatic forms. Consequently, I do not recognize *hibiscae* as a separate subspecies.

(2). Mostly, the ground colour on the underside of the hind wing is red or reddish, but in southern populations the colour may be ochreous yellow or even pale yellow. A yellow colour can also occur in the second brood in northern populations. The cause of this variation is unknown. As the yellow colour is not confined to any particular region, it cannot be used as a subspecific character.

(3). Particularly in southern regions there is a great variation in size, which is partly individual, partly geographic. In Spain larger and smaller specimens fly together (Warren, 1926). According to Zerny (1927), three size categories can be distinguished in the vicinity of Albarracin. This suggests that no transitional specimens occur, but that is not true. The difference can be very large: four males from San Ildefonso (Segovia, June to August) measured 9.8, 10.1, 12.2 and 13.1 mm, four females from the same locality 10.2, 13.1, 13.4 and 14.2 mm (BM).

In Peninsular Italy, except S. Calabria, all specimens are small, first brood ♂ 9.7—11 mm, second brood ♂ 8.4—10.1 mm. In N. Italy and S. Calabria the specimens measure as much as 12—13 mm.

(4). Some minor variation exists as mentioned below. Apart from *sertorius* and *hibiscae* the following forms have been described as "races":

(a). *gracilis* Verity, 1921 (type-locality: Florence). The small form of Peninsular Italy; on the upperside spots small but all present; underside of the hind wing red or pale yellow, with relatively few transitional specimens. The first generation (for measurements see above, under (3)) was named *subgracilis* by Verity (1921). This form is rather

constant in Italy, although the larger specimens of the first brood cannot be distinguished from *hibiscae*. In Spain *gracilis* occurs together with larger specimens, in France it occurs only in dry places in the south. Small specimens with pale underside of the hind wing were already known under the name *eucrate* Ochsenheimer, 1805. Such specimens can also be found in the second brood in northern populations.

At the moment I do not know how to place the form *gracilis*. As it does not seem to have a distributional area of its own, it appears inappropriate to give it subspecific rank. Nevertheless, it is not impossible that *gracilis* originated by geographic isolation (see also Chapter 5).

Note. — Verity described *gracilis* already in 1919 as the second generation near Florence. According to the International Code of Zoological Nomenclature, Article 45d, the original status of *gracilis* is determined as infrasubspecific. However, in 1921 Verity clearly applied the name to a particular geographic area and he called *gracilis* a "race". Therefore, the subspecific status of the name dates from 1921.

(b). *guadarramensis* Warren, 1925 (type-locality: La Granja, Sierra de Guadarrama). The largest form known, according to Warren (1925) 30—31 mm (centre of the thorax to tip of the fore wing x2). I saw only one female from the type-locality, that measured 14.2 mm. Furthermore, the form is characterized by the ground colour of the underside of the hind wing, which is vivid red, much deeper in shade and more brilliant than in Central European specimens. This, too, is the case in the single female seen from La Granja. However, as stated by Warren, *guadarramensis* occurs together with normal-sized and small specimens. I saw two males from Sierra de Guadarrama that were almost of the size of *gracilis*. Moreover, not all large specimens from Central Spain are richly coloured, e.g. the large male and female from San Ildefonso mentioned above (under (3)) have the ground colour of the hind wing underside dark yellow and brick red, respectively.

Like *gracilis,* this variety cannot be defined as a subspecies.

(c). *gavarniensis* Warren, 1926 (type-locality: Gavarnie). According to Warren, almost all specimens in the vicinity of Gavarnie (Hautes Pyrénées) differ from ssp. *sertorius* in the warm yellow-brown, almost orange colour of all parts of the underside, which are white in ssp. *sertorius* with the exception of the white spots. The ground colour of the underside of the hind wing of *gavarniensis* is brighter red than of *sertorius*.

Indeed, most specimens from Hautes Pyrénées show this type of variation, but rarely in an extreme form and many specimens are practically indistinguishable from Central European *sertorius*.

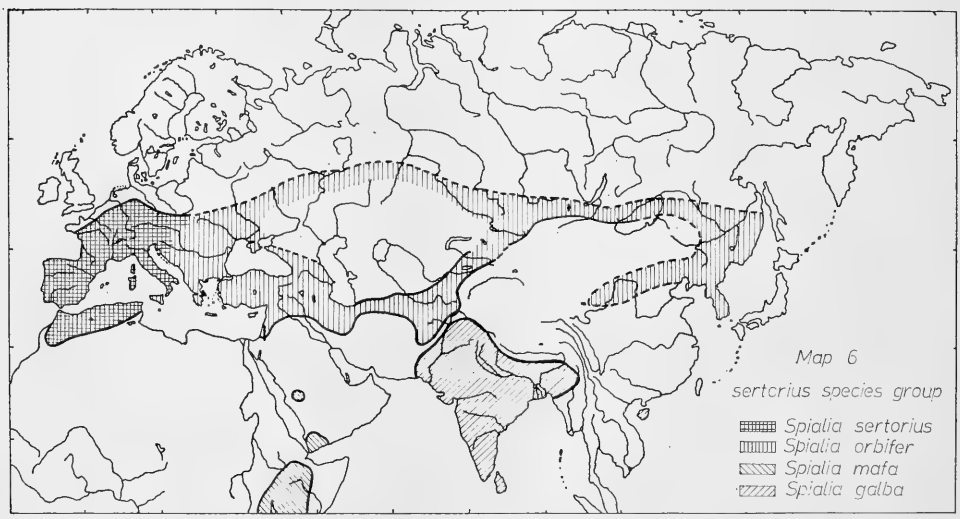
I have seen a female from Ordesa, at the Spanish side of Cirque de Gavarnie, that looked like *gavarniensis,* but another female and two males from the same locality did not show the colour that is typical for *gavarniensis*.

The cause of this variation which is confined to the Central Pyrenees, is unknown. It is not very likely that it originated during geographic isolation, as at least at present *sertorius* is wide-spread in the Central Pyrenees, flying from the lowlands up to 2200 m. At any rate it originated postglacially, as the Pyrenees were uninhabitable for *sertorius* during glacial periods. For this reason and for the fact that in the context of the total variation of the species *gavarniensis* is only an unimportant minor variety, it is undesirable to give it the same rank as the forms *ali* and *therapne*. I am placing it here as a local form.

(d). *alioides* Verity, 1926 (type-locality: Oulx, Cottian Alps). Central spot on the underside of the hind wing large with projections towards base and termen. Ground

colour of the underside of the hind wing ochreous or yellowish, whitish along termen, veins outlined in a paler shade. Upperside as ssp. *sertorius,* but the specimens are larger, up to 13 mm. Such specimens occur in the western Alps, but mostly the colour of the underside of the hind wing is red or ochreous red and all transitions to *sertorius* occur. This form seems to be still less sharply defined than *gavarniensis* and I regard it also a local form.

According to Verity (1940) the same form occurs in S. Calabria. I have seen only 2 ♂ and 1 ♀ from S. Calabria and these specimens looked like *sertorius* with some variation towards the Sicilian *orbifer.*



Spialia orbifer (Hübner)

Distribution (Map 6). — Sicily; from N. Yugoslavia, Hungary and Czechoslovakia eastward through S. Russia and S. Siberia to the Amur region and N. Thibet (Sining) and through the Balkans and Turkey to Baluchistan and Afghanistan from where it goes north through Turkestan to S. Siberia.

The distribution limits are badly known. For the distribution in E. Europe, see above and Map 5. Although it is very probable that this distribution is continuous, there are no records from large intervening areas in Russia and Siberia. From Russia we have the observation of Caradja (1895), that *orbifer* is widely distributed in SW. Russia and the Volga region, further the record of Eversmann (1844), who mentioned it from Saratov on the Volga. Krulikowsky (1908) recorded *orbifer* from Kasan and Spassk, but he only relied on some literature records. The species is known from the Crimea (Melioransky, 1897; Korshunov, 1964; material examined), the Caucasus and Transcaucasia (Romanoff, 1884; Alberti, 1969), but in the S. and SE. Russian steppe region it is apparently rare, as it is not mentioned, e.g., by Obraztsov (1936) from the Transdnjepr region, neither by Alberti & Soffner (1962) from S. Russia, nor by Gross (1925) from Chwalynsk on the Volga.

From the W. Siberian lowlands it is only recorded by Sjtsjuko (1916) from Tjumen.

Further east it is known from the upper Irtysch (Lederer, 1853), Altai and Kentei (Elwes, 1899; material examined) and it is widely distributed though uncommon in the Amur region and the Maritime Province (Staudinger, 1892; Kurentzov, 1949, 1970). Matsumura (1927) and Bryk (1946) did not record *orbifer* from Korea, but Sugitani (1936, see Evans, 1949) described the form *murasaki* from that country. In China it is undoubtedly much more widely distributed than is suggested by the few localities known (Shansi, S. Shensi, Sining; see material examined).

In the southern Palaearctic *orbifer* is widely distributed. The southernmost localities are: vicinity of Jerusalem (Graves, 1925; material examined), Bished (Iran) (Forster, 1939) and Ziarat (W. Pakistan) (material examined). Through Afghanistan, Transcaspia and Turkestan to the Ili region (Alphéraky, 1881; Wagner, 1913) and possibly continuously to the Altai. For details, see below.

Habitat. — Like the habitat of *Spialia sertorius*. In Macedonia I found *orbifer* up to 2000 m, in C. Anatolia it flies up to 1400 m (Pfeiffer, 1927), in Chitral it is not rare at 4000 m (Evans, 1927).

Biology. — Bivoltine in the western part of the area, west of Iran. According to Pfeiffer (1932) a third brood occurs near Marash (E. Turkey), but Graves (1925) is of the opinion that late specimens may rather be of the second brood, but delayed by the summer pause. Evans (1949) assumed that the Asiatic populations (from Transcaspia eastward) are single-brooded.

The larval stages remained unknown till, very recently, Lorkovič (1973) succeeded in rearing this species on *Sanguisorba minor* (Rosaceae).

Geographic variation. — Apart from the variation in number of broods per year, the species varies in size, colour and markings. The variation in C. and E. Asia is still badly known and with more material available subspecies *lugens* may prove to be heterogeneous.

Spialia orbifer orbifer (Hübner)

Hübner, 1823. — Samml. Eur. Schmett. 1, pl. 161 fig. 803—806.
Type-locality (designated here) : Hungary.

Material examined. — 424 ♂ 187 ♀ : 10 ♂ 6 ♀ Sicily (Messina, Castelbuono in Madonie, Palermo, Etna-Randazzo) (BM), 1 ♂ "Istria" (ML), 55 ♂ 27 ♀ Hungary (Öskü, Fenyöfó, Gyenesdiás, Szár, Ugod, Pilisvörösvár, Sümeg, Akali, Budapest) (MB, ML, BM), 1 ♂ 1 ♀ Bohemia (Jung Bunzlau) (BM), 7 ♂ 1 ♀ Croatia (Zengg=Senj) (BM), 10 ♂ 7 ♀ Bosnia (BM, ML, ITZ), 1 ♂ Hercegovina (ML), 9 ♂ 7 ♀ Dalmatia (BM, ML, ITZ), 81 ♂ 26 ♀ Yugoslavian Macedonia (ML, HC, ITZ), 102 ♂ 60 ♀ Greece (BM, ML, ITZ), 1 ♂ Crimea (BM), 143 ♂ 48 ♀ Turkey (European and Asiatic) (BM, ML), 3 ♀ Russian Armenia (Vartian), 3 ♂ 1 ♀ N. Iran (N. of Teheran) (BM, Vartian).

Distribution. — The western part of the range, eastward to W. Siberia, south-eastward to N. Iran (north of Teheran). Also in Sicily.

Subspecific characters. — Bivoltine. First brood, ♂ 11—12.6 mm, second brood, ♂ 8.4—11 mm. Markings on the upperside variable, sometimes all spots present, sometimes they are very reduced, particularly the submarginal spots. Ground colour on the underside of the hind wing greenish to ochreous olivaceous.

Variation. — The name *minor* Rebel, 1909, for the second brood of *Spialia sertorius*,

is also suitable for the small brood of *orbifer*. In a series of about 50 specimens collected in Mavrovo (Yugoslavian Macedonia) in the first half of July, the males measure 10.5—12.2 mm. As the specimens were collected between 1000 and 2000 m, it seems possible that a single brood exists there (and perhaps in other mountain regions).

A dark, less marked form was described as *tesselloides* by Herrich-Schäffer (1845) from Sicily. Verity (1940) gave some confusing remarks about the type-locality. Evidently, he did not examine the original description by Herrich-Schäffer and relied entirely on Keferstein (1851 : 326). The latter only mentioned that *tesselloides* occurs in "Türkei", without stating that it does not occur elsewhere. Herrich-Schäffer received the type specimens from Keferstein and he clearly stated that they originated from Sicily. Verity supposed that Herrich-Schäffer gave "S. Europe" as type-locality and that this was corrected by Keferstein in "Turkey". As this form occurs in Turkey, Saloniki, the Olympus and Sicily (according to Verity), the problem is not very important.

The smaller second brood of *tesselloides* was named *posttesselloides* by Verity (1938) after specimens from the Olympus. Evans (1949) correctly placed *tesselloides* as a name relating to *orbifer*, but his opinion that *posttesselloides* is a synonym of *sertorius* is an apparent mistake.

This dark form bears the same relation to the better marked nominate form, as the form *sertorius* does to the well-marked form *hibiscae*. Also its valuation must be the same, as both forms occur together over the main part of the distribution area, *tesselloides* perhaps dominating in some districts, but without a distribution of its own and connected with better marked specimens by innumerable transitions.

From the point of view of geographic history the occurrence of *orbifer* in Sicily is highly interesting. The species seems to be scarce there. Verity (1940) saw only two Sicilian specimens which he attributed to the form *tesselloides*. Indeed, all Sicilian males in the BM are dark on the upperside, but the females are somewhat more distinctly marked (this is a normal feature in *orbifer*). The hind wing underside of the males is of the colour and markings of *orbifer*, but the central spot is rather angular. The females, however, vary from ochreous to red and the central spot is very suggestive of *sertorius*. The measurements are: ♂ 10.5—12.7 mm, ♀ 12.2—13.8 mm. In all, it seems advisable to refer the specimens to *orbifer*, but they suggest a hybrid population rather than pure *orbifer*.

Spialia orbifer hilaris (Staudinger)

Staudinger, 1901. — *in* Staudinger & Rebel — Cat. Lep. Pal. : 96.
Type-locality: Mardin (SE Turkey).

Material examined. — 115 ♂ 41 ♀ : 80 ♂ 34 ♀ Syria and Lebanon (Akbès, Aleppo, Bscherre, Beirut, Damascus, Tripoli, Antiochia, Ain-Zahalta, Kassab, Bludan, Deir Billa, Hasbaya, Zahlé) (BM, ML, ITZ), 16 ♂ 5 ♀ Israël (BM, ITZ), 10 ♂ 2 ♀ Iraq (Shaqlawa, Dohuk Mts., "Iraq") (BM), 9 ♂ W. Iran (Harir, Kermanshah, Karind) (BM).

Distribution. — From SE. Turkey southward, to Matta (15 km SW. of Jerusalem; material examined) and Amman (Jordan; Hemming, 1932b) and eastward to Kermanshah (W. Iran; material examined).

Subspecific characters. — Bivoltine. First brood ♂ 10.8—13.8 mm, second brood

♂ 9—11.3 mm. On the upperside, the markings are more conspicuous than in ssp. *orbifer,* particularly the submarginal spots.

Variation. — The small second brood was named *secunda* by Graves (1925). In NW. Syria (Akbès) also less conspicuously spotted specimens occur which form a transition to ssp. *orbifer.*

Note. — If compared in series ssp. *hilaris* is quite distinct from ssp. *orbifer.* Its distribution, however, suggests, that it is a climatic form, adapted to hot and dry conditions, rather than a subspecies (though climatic forms and subspecies are, of course, not mutually exclusive). Provisionally I follow common use by considering *hilaris* a subspecies. It would be interesting to have more material from the contact zone between the subspecies *orbifer* and *hilaris* in order to study a possible clinal variation along a temperature and/or drought gradient.

Spialia orbifer lugens (Staudinger)

Staudinger, 1886. — Stett. ent. Zeitung 47 : 256.
Type-locality: Ferghana.

Material examined. — 71 ♂ 19 ♀ : 3 ♂ NE. Iran (Khush Yailaq) (WLB), 2 ♂ 1 ♀ Transcaspia (Merv, Achal-Tekke) (BM), 1 ♂ Bokhara (BM), 8♂ 5 ♀ Samarkand (BM, ML), 1 ♂ Hissar Mts. (ML), 5 ♂ 2 ♀ Ferghana (Namangan, Margelan, Gultscha) (BM), 24 ♂ 4 ♀ Naryn (BM, ML), 9 ♂ 1 ♀ Talass Ala-Tau (ML), 1 ♂ Tashkent (ML), 1 ♂ Alexander Mts., 1 ♂ 1 ♀ Issyk-kul, 2 ♂ Tian-shan, 3 ♂ Altai (Ongodai), 1 ♂ Amur region (Tjutju-ho), 5 ♂ 4 ♀ Shansi, 3 ♂ S. Shensi, 1 ♂ 1 ♀ Sining (all BM).

Distribution. — The whole Asiatic range of the species east of the Caspian Sea, except Afghanistan and from Baluchistan to Chitral.

Subspecific characters. — Monovoltine. Large, ♂ and ♀ to 14.6 mm, and dark on the upperside, submarginal spots mostly faint, may be absent, but sometimes (mainly in females) well-developed. On the underside of the hind wing indistinguishable from ssp. *orbifer.*

Variation. — Size is variable, large specimens are found in China, ♂ 12.6—14.6 mm, and in the Talass Ala-Tau, ♂ 13.3—14.1 mm, specimens from Naryn are somewhat smaller, ♂ 11—13.7 mm, the few males from the Altai measure only 11.9—12.6 mm. Therefore, one can also refer the Altai specimens to ssp. *orbifer,* at least with regard to their size.

Wagner (1913) remarked that *orbifer* occurred in the Ili region "sowohl in typischen Stücken, als auch in der grösseren und dunkleren var. *Lugens* Stgr." He also mentioned specimens with large spots which he called "var. *Hilaris* Stgr.". From these facts it seems possible that the subspecies *orbifer* and *lugens* meet in N. Turkestan and the Altai.

In some females from the province of Samarkand, the ground colour of the underside of the hind wing is reddish brown instead of greenish. Although such specimens have the submarginal spot in spaces 4 and 5 at the underside of the hind wing well-developed (unlike the usually less conspicuous spot in ssp. *carnea*), they are suggestive of ssp. *carnea.* Possibly there is a large transitional zone between the subspecies *lugens* and *carnea.* However, while I have seen ssp. *lugens* from Merv and the Achal-Tekke region, ssp. *carnea* is recorded from the vicinity of Herat in W. Afghanistan (Clench &

Shoumatoff, 1956).

Unfortunately, the material from N. Iran is too scarce to allow for a statement about the contact zone between the subspecies *orbifer* and *lugens*. Three males from the mountain Khush Yailaq in the eastern part of the Elburz Mountains are indistinguishable from *lugens* specimens from Turkestan. Two males and one female from Derbend and Vanak (N. of Teheran), about 400 km west of Khush Yailaq, look like *orbifer* specimens from more western localities, without any trace of the influence of ssp. *lugens*.

Spialia orbifer carnea (Reverdin)

Reverdin, 1927. — *in* Bang-Haas - Horae Macrolep. 1 : 52, pl. 7 fig. 28.
Type-locality: Paghman Mountains (Afghanistan).

Material examined. — 36 ♂ 14 ♀ : 15 ♂ 5 ♀ Baluchistan (Ziarat, Urak, Old Urak) (BM), 4 ♂ 3 ♀ Afghanistan (Paghman Mts., Arbarp, both W. of Kabul; Panjshir Valley, N. of Kabul) (BM, ML), 14 ♂ 5 ♀ Chitral (Chitral, Shandur plateau) (BM, CW), 3 ♂ 1 ♀ Gilgit (Ghizar, Hailtar, Gilgit) (BM).

Distribution. — Afghanistan and from Baluchistan (vicinity of Quetta) to Chitral.

Subspecific characters. — As ssp. *lugens*, but on the underside of the hind wing warm red to brown-yellow. ♂ 12.2—14.2 mm, ♀ 13.6—16.4 (!) mm. In most specimens the submarginal spot on the underside of the hind wing in spaces 4 and 5 is less conspicuous than in other subspecies.

Variation. — On the upperside, the spots are variable, the submarginal spots may be well-developed, but are sometimes totally absent (Chitral).

5. Evolutionary and geographic history of the genus *Spialia* in the Palaearctic region

a. General

In this chapter we will attempt to trace the evolutionary history of *Spialia* in the Palaearctic by analyzing some characters as to their plesiomorphous (primitive) or apomorphous (derived) condition (Hennig, 1966). The conclusions arrived at may serve for the reconstruction of the geographic history. The reconstruction of the evolutionary and geographic history forms the theoretical basis for the arrangement of the species and subspecies adopted in the preceding chapters.

The *phlomidis* and *sertorius* groups will be dealt with separately. Their phylogenetic relationship cannot be treated without a revision of the whole genus.

b. The *phlomidis* group

1. Evolutionary history.

We will at first examine the characters that are peculiar of the *phlomidis* group in order to show that the arrangement adopted in this paper is phylogenetically correct. Thereafter, we will try to detect the evolution within the *phlomidis* group.

(1). Valva. In the *phlomidis* group the cucullus is strongly spined at its apex. In the rest of *Spialia* this character only occurs in *spio*, but less strongly developed. In the

other *Spialia* species the cucullus is quite different, more or less concave dorso-distally and often forms a flap so as to envelop partly the costal process; spines as in the *phlomidis* group are absent, but sometimes the rim of the flap or the extreme apex of the cucullus is slightly indented. If we assume that the cucullus originally was a plain structure, merely the ventral thickening of the valva, the *phlomidis* type with its bent and spined apex is an apomorphous stage of the original, simple cucullus, just as the type of cucullus with a flap is its apomorphous stage (but apparently developed at a later time; this however, falls outside the scope of this paper).

Unless we assume that this character arose independently in the species of the *phlomidis* group and in *spio,* the *phlomidis* group plus *spio* can be considered a monophyletic group, as the species share the same apomorphous condition of the cucullus and as they comprise all species with this condition.

(2). Aedeagus. Outside the *phlomidis* group a sclerotized excrescence of the aedeagus is rare in *Spialia.* This part occurs in e.g. *nanus* and *abscondita* as a short, spined ventral branch, quite different from the latero-ventral crest or branch (somewhat to the left), found in the *phlomidis* group. Moreover, in the *phlomidis* group the distal end of the aedeagus is bent downward to the left and strongly developed, a unique feature in *Spialia.* Undoubtedly, an excrescence points to an apomorphous condition with regard to the situation where this structure is absent. Evidently, it evolved in the *phlomidis* group and in *nanus* and its allies along different lines. Also the type of apex found in the *phlomidis* type of aedeagus must be the apomorphous condition and the simple, straight aedeagus the plesiomorphous one.

So again we can state that the *phlomidis* group is monophyletic, but now *spio* falls outside the group.

(3). Antevaginal structures. The large, wing-like structures of the *phlomidis* group are unique in *Spialia,* but in *spio* a less developed type is found. The presence of such specialized structures appears to be an apomorphous condition as compared with their absence (3a) and the strong development in the *phlomidis* group appears to be an apomorphous condition as compared with the weak development in *spio* (3b).

Again, we find that the *phlomidis* group is monophyletic and that *spio* must be included, if we draw the limits more broadly.

Summarizing, it appears justified to call the species of the *phlomidis* group monophyletic, originating from a common ancestor and comprising all progeny of that ancestor known. *Spialia spio* is phylogenetically related to the *phlomidis* group, but it does not share the apomorphous condition of some characters. For this reason and for its distribution (Ethiopian against the eremian regions of the Palaearctic for the *phlomidis* group) *spio* can better be left out of the *phlomidis* group.

Now, we will try to trace the evolution within the *phlomidis* group.

(4). Aedeagus. The excrescence of the aedeagus forms a crest in *phlomidis, doris* and *osthelderi* and a branch in *geron.* We may assume that an outgrowth evolves from small to large. Thus the situation in *geron* is the apomorphous condition and the crest, the plesiomorphous one.

(5). Cucullus. The apex of the cucullus is scarcely bent in *phlomidis* but strongly bent in the other species. Apparently, the larger the bend, the more advanced the evolution. Thus the strongly bent condition appears to be apomorphous.

(6). Costa of valva. The costa is dorsally more or less densely set with small spines in *osthelderi, geron* and *doris,* smooth in *phlomidis.* These spines are unique in *Spialia.*

They appear to represent the apomorphous condition with regard to the smooth dorsal surface of the costa.

(7). Costa of valva. In *doris* the distal end of the costa is concave. This appears to be a further differentiation of the costa that originally was only a thickening of the dorsal ridge of the valva. Consequently, the condition in *doris* is apomorphous.

(8). Markings on the underside of the hind wing. The direction of the central band on the underside of the hind wing is rather variable in *Spialia,* but usually the band is connected with or directed to the outer spot in space 7 or to a point between the outer and inner spots in space 7. In *spio, osthelderi, geron* and *doris* the central band is directed to the outer spot in space 7 or somewhat more to the base, in *phlomidis* it is connected with the inner spot in space 7. The lastnamed condition appears apomorphous, unless we assume that the other condition arose independently in several species.

(9). Ground colour of the underside of the hind wing. In *Spialia* this ground colour

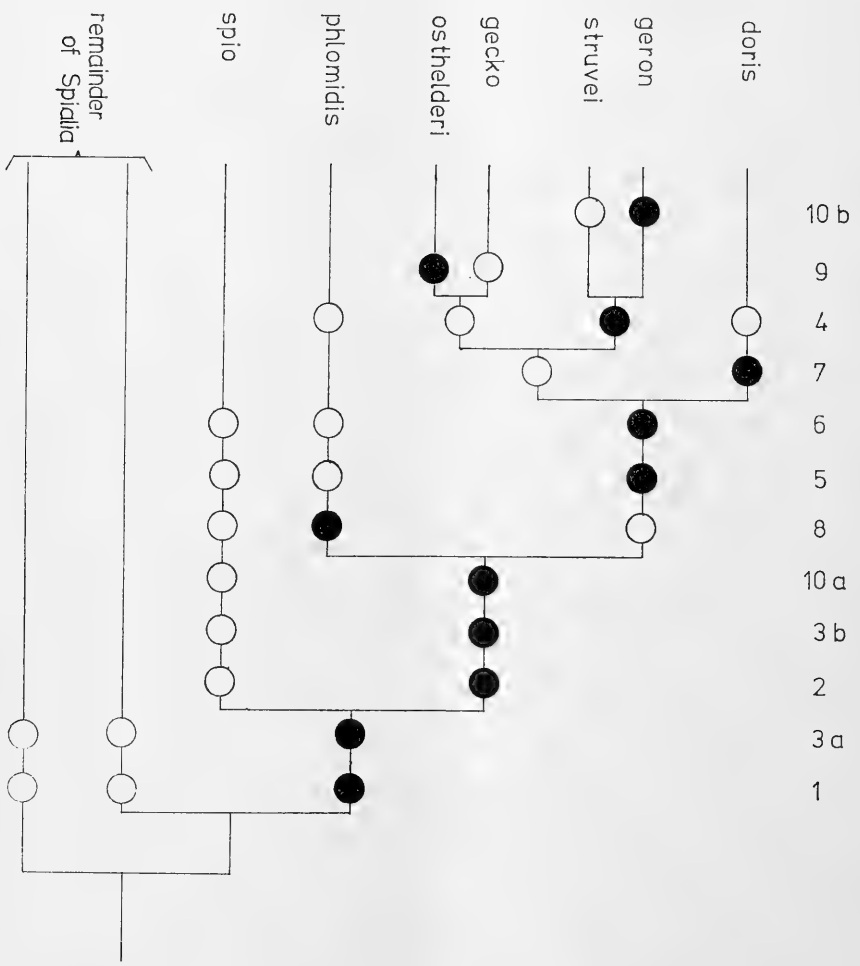


Fig. 36. Supposed evolution in the *Spialia phlomidis* species group. The numbers indicate characters as indicated in the text. O = plesiomorphous condition, ● = apomorphous condition

is never white or whitish, except in *osthelderi osthelderi.* Evidently, the white colour is the apomorphous stage. As mentioned above (chapter 3) the same character occurs in the same region in some other Hesperiidae.

(10). Costa of the valva. In the *phlomidis* group the ventro-distal end of the costa bears strong spines, except in *geron geron.* Generally, the absence of spines on the valves in *Spialia* appears to be a less differentiated, plesiomorphous condition. In the case of *g. geron,* however, we must suppose that the spines have been lost, for the following reason. In *Spialia* usually the ventral or ventro-distal part of the costa is differentiated with spines or brushes. In *phlomidis, doris, osthelderi* and *geron struvei* the position and development of the spines is the same and in *spio* we find the same spines about the middle of the ventral side of the costa. The situation in *spio* appears to be less differentiated (in Fig. 36 indicated by 10a). It is most unlikely that only in *geron geron* the original unspined condition was maintained, as this would contradict other characters and the spined condition would have evolved independently in some or all other forms. So we may assume that the condition in *geron geron* is apomorphous as compared with the condition in the other species of the group (in Fig. 36 indicated by 10b).

In Fig. 36 the supposed evolution of the *phlomidis* group is summarized and the plesiomorphous and apomorphous conditions of the characters dealt with are represented symbolically.

The subspecific differentiation of *phlomidis* and *doris* does not need to be dealt with here; see chapter 3 and, for *doris,* see also below.

2. Geographic history.

The species of the *phlomidis* group have a peculiar distribution: they occur in the eremian parts of the Palaearctic. Although there exists some overlap, the *phlomidis* group forms geographically a link between the *sertorius* group and the African *Spialia* species. However, as will be shown below, the phylogenetic link between the *sertorius* group and its African congeners has nothing to do with the *phlomidis* group.

In the last paragraph *spio* was shown to be the probable phylogenetic connection between the *phlomidis* group and the African *Spialia* species. Moreover, *spio* appears to have retained more characters of the supposed common ancestors than the species of the *phlomidis* group. This does not necessarily mean that the *phlomidis* group has an Ethiopian origin, it only makes probable that the development within the group is of a rather recent time. From Fig. 36 it follows that the most recent development was the separation of *doris, osthelderi* and *geron,* the most eremian species. This makes it probable that the desiccation of the southern Palaearctic and the broadening of the eremian zone in this region have played a part in the evolution of the *phlomidis* group, as the common ancestor of *doris, osthelderi* and *geron* may have been forced to adaptations to a very dry environment. However, once eremian, this supposed species must have suffered more from wet than from dry periods. Thus, the Pleistocene Pluvial Periods (cf. Moreau, 1955) have undoubtedly been important for the evolution of the *phlomidis* group by causing geographic isolations. It is, however, impossible to date or to locate more or less exactly the isolations that necessarily have started the evolution of the *phlomidis* group. This is due to our very incomplete knowledge about both the *phlomidis* group and the history of the regions concerned. Undoubtedly, the Zagros Mountains, the Mesopotamian plains and the Nile Valley have at some time played a part in the

geographic history of the *phlomidis* group, but this part is not clearly discernible, at least at the specific level. The subspecific differentiation of *doris* and *osthelderi,* however, appears to be clearly influenced and probably caused by a Pluvial Period that moistened the Zagros Mountains and made it possible for forests to develop in the Mesopotamian plains. Also an inundation of the latter region by transgression of the sea may have had influence. Thus, we have a western and an eastern subspecies in *osthelderi* (ssp. *osthelderi* and ssp. *gecko,* respectively) and a western group of subspecies and an eastern subspecies in *doris* (ssp. *doris* + *amenophis* and ssp. *evanida,* respectively). It is confusing that *doris doris* and *doris evanida* are so much alike and *doris amenophis* so different, as one is easily inclined to suppose the closest relationship between forms that resemble each other most closely. However, the large spots of *doris amenophis* are undoubtedly apomorphous; thus the resemblance between *doris doris* and *doris evanida* is based on a plesiomorphous character. As clearly pointed out by Hennig (1966), correspondence in plesiomorphous characters is no measure for phylogenetic relationship.

The distribution of *doris amenophis* suggests that the Nile is, and probably has been in the past, a distributional barrier, as *doris amenophis* is not known from the area west of the Nile. The occurrence of an isolated population of *doris* far to the west, in Morocco (*doris daphne*) shows that *doris* once had a larger distribution in N. Africa. As it is unclear why a species adapted to desert environment would die out in the desert, the lack of specimens of *doris* from the region between Morocco and Egypt may be rather the result of poor exploration than of true absence.

c. The *sertorius* group

1. Evolutionary history.

We will deal with the characters in the same way as in the foregoing paragraph.

(1). Valva: costal process. In *Spialia* the costal process usually consists of a ventro-distal thickening of the costa, with hairs or spines. This structure may be very differentiated and is often roofed in by a fold from the dorso-distal part of the costa. The type found in *sertorius* and its allies, viz., an appendage of the ventro-distal part of the costa, set with spines that are upturned and directed to the dorso-distal part of the valva, is not found elsewhere. Such a differentiated structure seems to be apomorphous rather than plesiomorphous. The plesiomorphous stage of this character is difficult to indicate in the other *Spialia* species, as most species appear to be rather differentiated. It is probable that the plesiomorphous stage of the *sertorius* type of costal process is no longer in existence. The most important statement, however, is that the resemblance between the species of the *sertorius* group in this case is based on an apomorphous character. An independent development of this character in various species in very unlikely.

(2). Valva. In the species of the *sertorius* group, and only in these species, the inside of the valve is provided with a conspicuous, hairy fold. This must be an apomorphous character as it is absent in all other *Spialia* species, as well as in related genera.

(3). Female genitalia: 8th abdominal segment. In the *sertorius* group the ventral and dorsal sclerites of the 8th abdominal segment are fused together so that the sclerotization of the segment consists of two parts that dorsally are connected by a membrane and ventrally by a narrow sclerotized antevaginal band. In other *Spialia* species the 8th abdominal segment bears four sclerites that are hardly or not fused together. The fusion of sclerites can be taken as an apomorphous character.

(4). Gnathos. All species of the *sertorius* group have a well-developed gnathos. In superspecies *sertorius* the strong differentiation into a stalk and a spined "head" appears to indicate an apomorphous stage as compared with the slighter differentiation in *mafa* and *galba.*

(5). Valva: costal process. If we imagine the evolution of the costa in *Spialia* from a plain structure towards a structure with highly differentiated appendages, there can be seen a gradual development of the costa in the *sertorius* group: from *mafa* through *galba* to *sertorius* and *orbifer* the costal process is shifted as it were towards the distal end of the costa and, eventually, replaces it. The difference between *mafa* and *galba* is slight as compared with the difference between *galba* and *sertorius.* So we can call the *sertorius* type the apomorphous stage and the *mafa/galba* type the plesiomorphous stage.

(6). Valva. The hairy fold at the inside of the valva shows different forms. There appears to be a gradual change from *mafa* through *galba* and *sertorius* to *orbifer* as the fold changes its position in that direction from horizontal-dorsal through vertical to horizontal-ventral. Possibly the development of the fold has run parallel to that of the costal process, but this cannot be more than an assumption as it is yet impossible to indicate the apomorphous and plesiomorphous stages of the position of the fold. Thus, we cannot use this character for the reconstruction of the evolution of the *sertorius* group.

(7). Tegumen and uncus. In *mafa* and *galba* there is an area between the uncus and the tegumen that is only weakly sclerotized, thus forming a more or less triangular "fenestra". In superspecies *sertorius* this "fenestra" is absent, though the connection between the uncus and the tegumen is clearly visible. The phylogenetic importance of this "fenestra" is still obscure. It may indicate that *mafa* and *galba* are closely related, as it is possible that the "fenestra" is an apomorphous character, but this statement is not very well founded at the moment. If also other characters are included, we may suppose that it is desirable to unite *mafa* and *galba* into a superspecies. This, however, falls outside the scope of this paper.

(8). Colour of the underside of the hind wing. In *Spialia* this underside shows various colours, mostly greenish or ochreous. In *sertorius* the colour is red or reddish ochreous, in *orbifer* it is greenish, but in *orbifer carnea* it is as red as in *sertorius sertorius.* The red and reddish ochreous tinges seem apomorphous if compared with the greenish colour. However, the red colour must have originated independently in *sertorius* and in *orbifer carnea,* as other characters (e.g. position of the hairy fold of the valva, measurements, spotting) show that *orbifer carnea* is an *orbifer lugens* with a red underside of the hind wing.

We can also suppose a parallel development of the red colour in the subspecies of *sertorius,* but this assumption is not supported by other characters (e.g. hairy fold, spotting). So we may assume that the red colour originated twice. In Fig. 37 this is indicated by the numbers 8a and 8b.

(9). Spotting on the underside of the hind wing. This is very variable in *Spialia,* some species having distinct spots, others straight or curved bands. If there is a distinct central band, this band is directed to or conjoined with the outer spot in space 7 or it is directed to a point between the inner and outer spots in space 7. It is, however, directed to or connected with the inner spot in space 7 in *sertorius* and *orbifer* and in *phlomidis.* As stated above, the situation in *phlomidis* can be considered apomorphous. Also the situation in superspecies *sertorius* can be called apomorphous. Apparently the resemblance

between *phlomidis* and superspecies *sertorius* in this respect is based on a parallel evolution. In Fig. 37 the character of the direction of the central band is indicated by the number 9a.

A main differentiating character between *sertorius* and *orbifer* is the shape of the central spot on the underside of the hind wing. This spot is angular in *sertorius* and rounded in *orbifer*. If a continuous central band is broken into spots by darkening of the veins one expects that the central spot is angular along veins 4 and 6, while these angles may become rounded off. This appears to have been the case in superspecies *sertorius*, but in *sertorius* the central spot became still narrower along veins 4 and 6 and, at the same time becoming angular along vein 5. I cannot consider this character otherwise than apomorphous. In Fig. 37 it is represented by the number 9b.

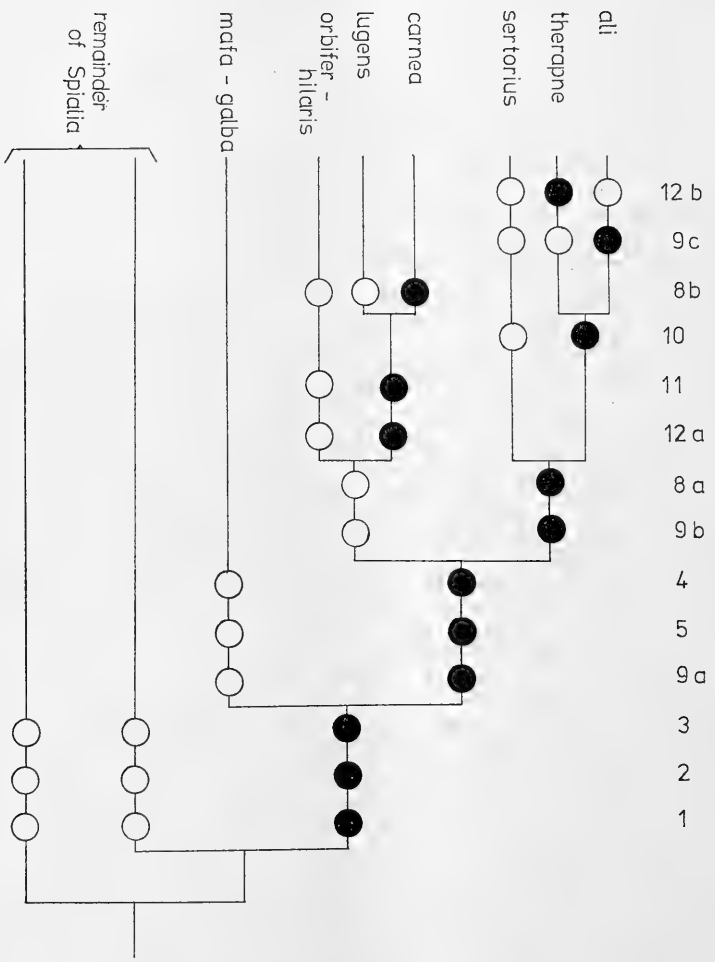


Fig. 37. Supposed evolution in the *Spialia sertorius* species group. The numbers indicate characters as indicated in the text. O = plesiomorphous condition, ● = apomorphous condition

The most advanced development of the central spot is found in *sertorius ali,* where the spot is projected towards termen and base, while also the submarginal spots are stretched out. This situation has been represented in Fig. 37 by the number 9c.

(10). Colour of the spots on the upperside. In all *Spialia* species this colour is white, but in *sertorius therapne* and in the summer brood of *sertorius ali* it is yellow. Undoubtedly the yellow colour is an apomorphous character and there is no apparent need for considering the yellow colour to have evolved independently in *sertorius therapne* and *sertorius ali.* It would, however, be very elucidating if the genetic background of this character was known, as apparently ecological factors influence the expression of the character (at least in *sertorius ali*).

(11). Submarginal markings on the upperside. The development of the submarginal markings is subject to much variation in superspecies *sertorius.* Though the genetic background is rather obscure, the expression of this character appears to be determined more ecologically than geographically, see under *sertorius sertorius* and *orbifer orbifer.* However, the whole Asiatic range of *orbifer* east of the Caspian Sea is inhabited by populations in which the submarginal spots are faint or absent, thus indicating that these populations are apparently incapable of developing well-marked submarginal spots. As in almost all *Spialia* species the submarginal spots are well-developed, the absence of these spots in some populations of a single species appears to be an apomorphous character.

(12). Number of broods per year. In superspecies *sertorius* the usual number of broods per year is two, though one brood may be more or less suppressed by ecological factors (mainly at higher elevations in the mountains). However, in spite of the large ecological diversities in Asia, the populations of *orbifer* east of the Caspian Sea appear to be single-brooded. Unless we assume that the double-brooded condition arose independently in *sertorius* and in the *orbifer* populations west of the Caspian Sea, the single-brooded condition must be considered apomorphous. In Fig. 37 this situation is represented by number 12a.

Very probably *sertorius therapne* also is single-brooded. In this case, too, it must be an apomorphous condition, that evidently arose independently of the development in Asia (Fig. 37: 12b).

2. Geographic history.

It is striking that there is only a single *Spialia* species in the Oriental region (*galba*) and, apart from the eremian *phlomidis* group only two *Spialia* species (united in superspecies *sertorius*) in the Palaearctic region, while there are many species in the Ethiopian region. Together with the supposed evolutionary history as expressed in Fig. 37, this makes it probable that *galba* and superspecies *sertorius* have an Ethiopian origin. Evidently, superspecies *sertorius* is the older offshoot. As the ancestor of superspecies *sertorius* appears to have been the only one that successfully colonized the Palaearctic, the eremian zone between the Palaearctic and Ethiopian regions must have been a serious barrier since long, even when it was much narrower than at present. In this connection, it is interesting that the eremian zone not only did not function as a barrier for the ancestor of the *phlomidis* group, but even became its habitat.

Possibly the widening of the eremian zone quickened and intensified the geographic isolation of the ancestor of superspecies *sertorius.* The evolutionary history and the little

variation in Asia east of the Caspian Sea show that this part of the range was colonized rather recently. Thus, the ancestor of superspecies *sertorius* inhabited the Mediterranean and there it became differentiated in *sertorius* and *orbifer*. The distribution of these (semi-)species shows the apparent cause of the differentiation, viz., geographic isolation in a western (*sertorius*) and an eastern (*orbifer*) Mediterranean refugium during a Glacial Period. The occurrence of *orbifer* in Sicily indicates that *sertorius* most probably originated in Spain, in a later time invading Italy where *orbifer* had become extinct during the preceding Glacial Period (possibly except in southern Calabria).

The close relationship between *sertorius therapne* and *sertorius ali* is somewhat puzzling as their distribution areas lie far apart, while the intermediate area is populated by *sertorius sertorius*. If we have interpreted the facts correctly, the following explanation may be an exact reconstruction of the history. At a moment that the red colour of the underside of the hind wing had developed to a certain degree, but probably not yet to the bright red of some recent populations of *sertorius sertorius,* in the western-most populations the white spots of the upperside became yellowish in the summer brood, while in more eastern populations (Italy) the spots remained white. Possibly this differentiation was initiated and influenced by a geographic discontinuity caused by a Glacial Period, but this is, of course, not necessary. A Glacial Period destroyed the greater part of the western-most populations and west of Italy the species survived in isolated areas only, viz., N. Africa, Corsica and Sardinia. As they are surrounded by water, these areas could not have much importance for the expansion of the species in an Interglacial Period and so the intermediate region became populated from another refugium (Italy). By inbreeding and other factors, the populations of Corsica and Sardinia became single-brooded without losing the yellow colour of the spots on the upperside: *sertorius therapne* is, as it were, the summer brood of *sertorius ali,* without producing a spring brood. Isolated in N. Africa *sertorius ali,* or rather its precursor, developed the peculiar markings on the underside of the hind wing, but the yellow spots remained the characteristic of the second brood.

There are two other explanations possible for the discontinuous distribution of the yellow spots: (1) the Iberian populations were not destroyed, but they lost again the newly developed character of the yellow spots, and (2) the yellow spots arose independently in *sertorius therapne* and *sertorius ali*. Both explanations appear to me less probable than the one given first.

The great diversity of *sertorius* in Spain may be an argument for the assumption that Spain was colonized from the east by a multiple invasion so that its genetic variability did not yet attain an equilibrious condition. In this way, possible remnants of populations with yellow spots in the second brood could have been trodden under foot.

In the meantime, *orbifer* invaded Asia. The lack of data from E. Russia and W. Siberia makes it impossible to decide about the route: north or south along the Caspian Sea. The small degree of variation over the large Asiatic range is surprising. It can be the result of a rapid expansion. However, the differentiation between *orbifer lugens* and *orbifer carnea* seems the result of geographic isolations in glacial refugia, so the presence of *orbifer* east of the Caspian Sea must date from the last Interglacial or earlier. Therefore, if the small amount of variation is the result of a rapid expansion, it must have been *orbifer lugens* that expanded its range rapidly from a glacial refugium. In this connection it can have been advantageous, that *orbifer lugens* is single-brooded, giving it the highest survival rate in the extreme continental climate.

The location of the refugium of *orbifer carnea* is not difficult, as this subspecies evidently did not extend its refugial range very much. So it must have survived the last Glacial Period in the Afghan refugium (cf. Gross, 1961; De Lattin, 1967). For *orbifer lugens* it is much more difficult to indicate a glacial refugium. From its present distribution we may conclude that it did not occur south of the Hwang-Ho and that the Mongolian-Siberian refugia are less probable for *orbifer lugens* (species extending from these refugia usually have another distribution pattern). So the Turkestanian and Manchurian refugia are considered for glacial refugia of *orbifer lugens*. The former seems the most probable, as otherwise *orbifer lugens* would already have colonized the whole of its present range before the Last Glacial. In that case, we would have expected a further differentiation of the species in Asia.

The differentiation between *orbifer orbifer* and *orbifer hilaris* is undoubtedly young, not older than since the Last Glacial. Presumably, *o. orbifer* originated in a refugium in the Balkans and W. Turkey, while *orbifer hilaris* did so in Syria/Iran. See, however, the note under ssp. *hilaris* in Chapter 4.

Summarizing, the geographic history of superspecies *sertorius* may be represented as follows.

(1). A northern branch of an Ethiopian species became isolated in the Mediterranean.

(2). Forced by advancing deterioration of the climate during a Glacial Period, the Mediterranean population became divided into a western and a more eastern group giving rise to *sertorius* and *orbifer,* respectively.

(3). During a following Glacial Period, *orbifer* died out in Italy, but could survive in Sicily. In the next Interglacial *orbifer* did not succeed in regaining the lost Italian territory, but was replaced there by *sertorius*. It is interesting to note, that the isolation of *orbifer* in Sicily did not lead to the development of a recognizable differentiation.

(4). In the western populations of *sertorius* the spots became yellow in the summer brood. A following Glacial Period destroyed all or almost all *sertorius* populations in Spain. The character of the yellow spots could survive in Corsica-Sardinia and NW. Africa only.

(5). The "empty" Iberian peninsula was invaded at least once and probably twice or more times by *sertorius* from Italy, resulting in much variation, that is partly locally determined.

(6). In the meantime, *orbifer* invaded Asia east of the Caspian Sea, where it became single-brooded during isolation in a glacial refugium, possibly in Turkestan. After extending its range during an Interglacial, the Central Asiatic population was driven back to glacial refugia during a following Glacial, in Afghanistan (*orbifer carnea*) and possibly in Turkestan (*orbifer lugens*).

(7). In the eastern Mediterranean a differentiation took place between *orbifer orbifer* and *orbifer hilaris* in glacial refugia in the Balkans and W. Turkey and in Syria/Iran, respectively.

(8). After the Last Glacial *sertorius sertorius* extended its range from Italy and presumably also from Spain to the north and the east. In Central Europe it encountered *orbifer,* which advanced from its Balkan refugium to the north and west. The greatest extension of the range was made in Asia by *orbifer lugens* that from its presumably Turkestanian refugium colonized Asia as far as the Amur region and NE. China.

The geographic history outlined above clearly shows the impact of the Glacial Periods

on the development of the superspecies *sertorius*. It is, however, difficult to date the various geographic isolations that must have taken place, as the influence of the different fases of the Glacial Periods are still little understood. Possibly various fases lasted too briefly to have much influence. But even if we claim a whole Glacial Period for each of the supposed geographic isolations, it is still obvious, that the entire development of superspecies *sertorius* took place during the Pleistocene. In other words, the superspecies *Spialia sertorius* originated as a result of the climatic fluctuations of the Pleistocene.

A few words must be said on an earlier hypothesis on a part of the geographic history of the superspecies *sertorius*. To explain the occurrence of species in islands authors have often projected land connections between islands and continents. Even if these connections are geologically demonstrable, we cannot be sure of the use the species made of it. An author who often used former land connections for explaining butterfly distribution in Italy, is Verity (1940). He considered the occurrence of *orbifer* in Sicily the result of the presence of a land connection from Greece through Calabria and Sicily to Tunesia in the Miocene. Apart from the question whether the connection existed in that form, there are the following objections against this explanation:

(1). It does not explain the presence of *sertorius* instead of *orbifer* in Calabria.

(2). It does not explain, why it is not *sertorius ali* that occurs in Sicily.

(3). The Miocene is much too long ago to explain the recent differentiation at the subspecific or semispecific level.

According to Verity, *sertorius ali* is "la forma più primitiva", from which *sertorius sertorius, sertorius therapne* and *orbifer* originated directly, but in different periods. In this hypothesis *orbifer* is a "trasformazione antichissima", *sertorius sertorius* originated "fin dal Miocene" and *sertorius therapne* is a "derivazione recente". Unfortunately, the only argument given by Verity is the shape of the spots on the underside of the hind wing; this argument is far from being convincing. If *orbifer* invaded Sicily in the Miocene, its differentiation from *sertorius ali* must have taken place earlier. It is quite incredible, that a differentiation originating so far back in the Tertiary could maintain itself rather undisturbed in a region that underwent enormous ecological changes. Reasoning in the way of Verity and various other authors, who neglect the overwhelming effect of the Pleistocene Glacial Periods on the differentiation and distribution of the species and forget that the Miocene ended some 12 million years ago (i.e. 12 times as long ago as the beginning of the Pleistocene), would lead to the assumption that the Hesperiidae originated in the beginning of the Tertiary or even earlier and that the Lepidoptera originated tens of millions of years before there were flowers, to suck honey from.

Summarizing, the explanation given by Verity does not explain anything. Apparently the presumption that butterflies cannot cross stretches of sea, is incorrect. This is also demonstrated by the discovery of *sertorius sertorius* in Corsica. This subspecies apparently reached Corsica in recent times, without the help of a land bridge. Moreover, Moreau (1952), summarizing the palaeogeography of Africa, did not mention a Greco-Tunisian land bridge in the Miocene, but only a Sicilo-Tunisian one in the Pliocene. This is much more in accordance with our hypothesis, as it places the evolution of superspecies *sertorius* after the severing of the Sicilo-Tunisian land bridge, i.e. entirely in the Pleistocene. Otherwise, *sertorius ali* would occur in Sicily, or *orbifer* in NW Africa.

Palaearctic species ultimately originating from Ethiopian species appear to be rare.

Their scarcety illustrates the effectiveness of the desert belt (partly in combination with the Mediterranean) as a barrier, though the width of this belt has varied much. Among the Palaearctic Hesperiidae the two *Gegenes* species possibly have an Ethiopian ancestry, but they are much more confined to a dry, steppe-like habitat than *Spialia sertorius* and *orbifer.*

Undoubtedly other examples can be found among the Palaearctic Lepidoptera, but I do not know of such cases from the literature. Professor Dr. K. H. Voous kindly informed me that a comparable case exists among birds, viz., the Collared Turtle Dove, *Streptopelia decaocto,* of the *roseogrisea/capensis* group. But at least part of the extension of this species into the Palaearctic is very young, not older than some centuries.

6. SUMMARY.

1. Four species and one superspecies, consisting of two (semi)species, of *Spialia,* have been recognized in the Palaearctic Region. They can be assigned to two species groups, viz. the *phlomidis* group and the *sertorius* group. The phylogenetic relationship between these groups has not been discussed in this paper, for an examination of such a relationship a revision of the Ethiopian *Spialia* species is necessary.

2. The *phlomidis* group (four species) is confined to the eremian parts of the southern and central Palaearctic. Phylogenetically it is directly related to the Ethiopian species *Spialia spio.*

3. The *sertorius* group has a very wide distribution. In the Palaearctic, where it comprises a superspecies with two (semi)species (*sertorius* and *orbifer*), it occurs from the Atlantic to the Amur region and China. An Ethiopian (*mafa*) and an Oriental species (*galba*) must also be assigned to this species group.

4. By the application of a subspecies definition that uses geographic isolation (at present or formerly) as criterion, several subspecies distinguished by previous authors have been assigned to clinal (local) and nongenetic ecophenotypic variation.

5. The theoretical basis for the arrangement of the species and subspecies adopted in this paper is the discussion on the evolutionary and geographic history. Several characters have been examined as for their apomorphous or plesiomorphous conditions.

6. The *phlomidis* group possibly has an Ethiopian ancestry. It developed in a recent time, probably not before the Pleistocene, in the eremian parts of the Palaearctic. The history of the group is obscured by lack of data.

7. The superspecies *sertorius* is the Palaearctic off-shoot of an Ethiopian ancestor which also gave rise to an Oriental representative of the *sertorius* group. Superspecies *sertorius* originated in the Mediterranean as a result of the Pleistocene climatic changes. East Asia was probably reached only in postglacial times, from Turkestan.

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Postscript

After having sent this paper to the printers', I came across a recent article by L. G. Higgins (J. Ent. (B) 43 (1) : 83—87) on a new subspecies of *Spialia phlomidis* from the Lebanon, which he named *S. phlomidis kiki.* Evidently, this name is a junior synonym of *Spialia phlomidis hermona* Evans.

Index

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THE GRAVENHORST, SCHIØDTE AND FOERSTER TYPES BELONGING TO THE GENUS MEGASTYLUS SCHIØDTE, 1838, WITH KEYS TO THE SPECIES (HYMENOPTERA, ICHNEUMONIDAE, MICROLEPTINAE)

by

G. VAN ROSSEM
Plant Protection Service, Wageningen

ABSTRACT

The lectotypes of *Plectiscus flavopictus* Gravenhorst, 1829, *Megastylus cruentator* Schiødte, 1838, *Megastylus mediator* Schiøde, 1838, *M. pumilio* Foerster, 1871, *Myriarthrus cingulator* Foerster, 1871, and *Dicolus pectoralis* Foerster, 1871, are designated. The male of *Megastylus cruentator* Schiødte is described for the first time. Two subgenera of *Megastylus* are recognized: *Megastylus* and *Dicolus* Foerster, 1868. Some new combinations and synonymy are proposed. The paper is illustrated with figures and 4 photographs.

Taxonomy and nomenclature

Foerster's (1868) establishment of *Myriarthrus* was incorrect as for no obvious reason he rejected the name *Helictes* Haliday, 1837. As the type species of *Myriarthrus,* Foerster (1871) took *Ichneumon erythrostoma* Gmelin, sensu Gravenhorst, 1829, the males of which have concavities on certain flagellar segments. Thus Foerster misunderstood Gravenhorst's description and consequently *Myriarthrus* became an unnatural assembly of species. Viereck therefore proposed *Myriarthridea* with *Myriarthrus cingulator* Foerster as the type species. The generic names *Dicolus* Foerster, 1868, and *Myriarthridea* Viereck, 1914, were both placed in the synonymy of *Megastylus* by Townes (1971).

There is sufficient reason to recognize *Dicolus* Foerster as a useful taxon, namely as a subgenus of *Megastylus*. The two subgenera of *Megastylus* are separated in the keys following below. The deep propodeal fossa and the very slender postanellus seem to be well defined characters of *Dicolus*.

I have not searched the Foerster collection for concealed *Megastylus* material in the modern sense. The Foerster (1868 and 1871) "Plectiscoid" genera were actually first revised by Perkins (1962) and later rearranged by Townes (1971).

Separation of the sexes

It is difficult to determine the sex of many specimens at first glance. For this reason Schiødte and later authors never recognized the proper male of *M. cruentator*. What Schiødte thought to be males of *M. cruentator* turned out to be females. I found this by making microscopic preparations of genitalia of the syntypes (Pl. 1 Fig. 2). As a consequence the male of *M. cruentator* was never described. One purpose of this paper is to rectify this strange confusion.

The sexes in *Megastylus* are easily separated by the shape of the antennal bristles. Males have very short, close and vertical setae (Fig. 1); the female antenna is characterized by the much longer and scarcer pilosity (Fig. 2).

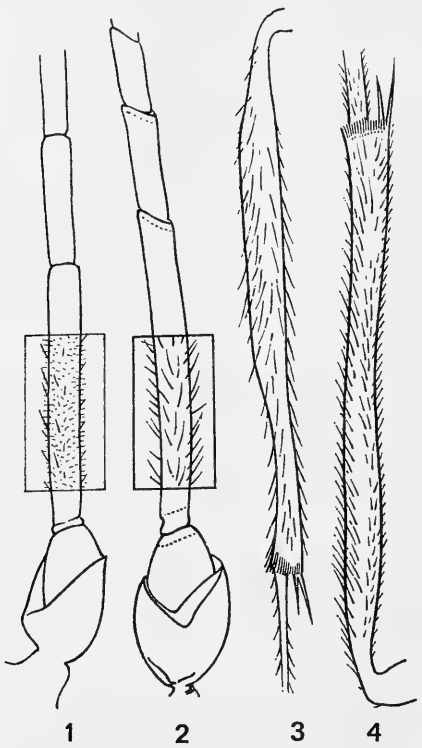

Fig. 1—4. Antennae and legs of *Megastylus*. 1, *M. cruentator*, ♂, Planken-Wambuis near Ede, 15.V.1966 (coll. van R); 2, the same, ♀, N Spessart, Lochmühle, 17-22.X.1971, trap (coll. van R); 3, *M. pectoralis*, ♀, left hind tibia (inner side), Lousberg (Aachen), 15.X., coll. Foerster (ZSM); 4, *M. impressor*, ♀, holotype, right hind tibia (inner side) (MC).

A NOTE ON THE FOERSTER TYPES

The Foerster *Megastylus, Myriarthrus* and *Dicolus* material is quite undisturbed, but it has a remarkable feature, namely, some kind of discoloration. Most specimens have a light brownish tone of the integument which is not the natural colour. The types of many species are surprisingly small specimens. Mounting and labelling are excellent.

TENTATIVE KEY TO FEMALES

1. Postanellus short, index 3.5—5.0. Subgenus *Megastylus* 2
— Postanellus long and slender, index 6.0—10.0. Subgenus *Dicolus* 5
2. Second gastral tergite striate. Hind coaxe on the lower inner side granulated*). In typical specimens frontal orbits always with broad white lining. Mesoscutum with

*) Difficult to see.

anterolateral yellowish marks, from these yellowish lines converge towards and coalesce on disk. Episternum 2 always completely black. Third gastral tergite in most cases yellowish to brownish . . . . . **flavopictus**

— Second gastral tergite with fine regular microsculpture, alutaceous, never striate 3

3. Frontal orbit (above antennal sockets) with conspicuous white lining. Rather small specimens, 3.5—4.6 mm, difficult to separate from *M. pumilio* . . . **rufipleuris**

— Frontal orbit without white lining 4

4. Middle femur stout, index 3.6—3.8. Small to minute specimens, 2.5—3.2 mm. Face, frons and thorax without any white or yellowish marks. Antennal base and legs, including coxae light brownish. Head, thorax and gaster almost uniformly dark reddish brown*) to black, except for yellow marking of gastral segment 3. All femora stout, indices: 3.0—3.1 (1); 3.6—3.8 (2); 5.0 (3) . . . . . **pumilio**

— Middle femur slender, index 5.1—7.0 Specimens with strong variability in size (4.0—7.0 mm) and colour, the latter ranging from deep black: head (exept clypeus), thorax (except legs) and gaster to specimens with most of notum 1, episternum 2, mesosternum and pleural parts of propodeum fulvous to deep brick-red. Palpi, mandibles and clypeus often white to dirty white. Anterior margin of notum 1 often marked white. Specimens with lighter gastral tergites 2 and 3 occur . . . . . **cruentator**

5. Hind tibia conspicuously inflated in the 0.7 proximal part, thus causing a constriction in the 0.3 distal part (Fig. 3) 6

— Hind tibia weakly inflated in proximal part, thus not strongly constricted in the distal part (Fig. 4) 7

6. Rather small specimens (3.3—4.4 mm). Frontal orbits dorso-laterad of antennal insertions without a broad yellow spot . . . . . **subtiliventris**

— More robust specimens (5.2—5.5 mm). Frontal orbits dorso-laterad of antennal insertions with broad yellow spot. Mesoscutum with vague yellow lines, coalescing on disk . . . . . **pectoralis**

7. Basitarsus of front leg about 0.56 of length front tibia, thus basitarsus (and also following tarsal segments) of front leg strikingly slender. Antennal cleaner large, causing conspicuous outcurving of basitarsal base (Fig. 5). Hind femur not inflated in proximal part . . . . . **excubitor**

— Basitarsus of front leg about 0.33—0.43 of length front tibia, not slender. Antennal cleaner not conspicuously outcurved (Fig. 6). Hind femur somewhat inflated in proximal part . . . . . **impressor**

Tentative key to males

Males of *M. rufipleuris, M. subtiliventris* and *M. excubitor* are unknown

1. Hind tibia somewhat inflated in its proximal 0.67 part (Fig. 7) (subgenus *Dicolus)* . . . . . **M. pectoralis** and perhaps **M. subtiliventris**

— Hind tibia not inflated in its proximal part (Fig. 8) 2

2. First and second gastral tergite striate. Specimens abundantly marked with yellow: palpi, mandibles, malar space, clypeus, face entirely, frontal orbits, pleuron 1, pronotum, mesoscutum with broad anterior lining and parallel lines coalescing on disk.

*) Especially in museum specimens.

Episternum 2 for the greater part black. Genitalia, Pl. 1 Fig. 3 . . **M. flavopictus**

— First and second gastral tergite not striate 3

3. The following characters combined: propodeum with a conspicuous transverse impression (fossa) in its 0.25—0.28 proximal part, thus clearly *away* from the apical boundary of notum 3 (postscutellum); postanellus relatively long and slender, index 8.8—12.5*); hind femur long and slender, index 7.0—8.5*). Hind tibia slimly clavate (Fig. 8) . . . . . **M. impressor**

— Propodeum with either a weak (in *M. pumilio*) or none evident impression; postanellus less slender, index < 8.8 (5.5—8.0); hind femur of normal shape, index 5.8—7.0. Hind tibia weakly to evidently clavate 4

4. Minute specimens (about 2.7—3.2 mm long). Index postanellus 5.5—6.5. Thorax entirely brown or black. Hind tibia somewhat clavate towards apex. Legs including coxae yellow. Face brown (to yellow?). . . . . **M. pumilio**

— More robust specimens, 4.1—5.4 mm long, abundantly marked with yellow: palpi, mandibles, clypeus, malar space, face entirely, frontal orbits, pleuron 1, pronotum, episternum 2. Vertex and back of head black. Mesoscutum for the greater part black, with vague brownish lining on disk. Propodeum including sternal parts mostly black. Index postanellus 6.0—8.0. Hind tibia clearly clavate towards apex. Legs with all coxae yellow. Genitalia, Pl. 1 Fig. 4 . . . . . **M. cruentator**

Subgenus **Megastylus** Schiødte, 1838

Type species: *M. cruentator* Schiødte, 1838.
Subgenus *Megastylus:* Thomson, 1888, Opusc. Ent. 12 : 1311.

Megastylus cruentator Schiødte

♂ (! ♀) *Megastylus cruentator* Schiødte, 1838, Rev. Zool. Cuv. 1 : 139.
Megastylus cruentator: Schiødte, 1839, Mag. Zool. (2)1 : 4—5.
♀ *Megastylus mediator* Schiødte, 1838, Rev. Zool. Cuv. 1 : 139.
Megastylus mediator: Schiødte, 1838, Mag. Zool. (2)1 : 5.
♀ *Megastylus nigriventris* Foerster, 1871, Verh. naturh. Ver. Rheinl. 28 : 105. **New synonymy.**
♀ *Megastylus conformis* Foerster, 1871, Verh. naturh. Ver. Rheinl. 28 : 105. **New synonymy.**
♀ *Megastylus fuscicornis* Foerster, 1871, Verh. naturh. Rheinl. 28 : 105. **New synonymy.**
Megastylus cruentator: Townes, 1971, Mem. Amer. Ent. Inst. 17 : 205.
Megastylus mediator (= *cruentator*): Townes, 1971, Mem. Amer. Ent. Inst. 17 : 205.

Characteristics of the type specimens. — *M. cruentator.* Female. Front wing 4.9**) Labels: a white printed museum label "Danmark ex coll. Schiødte"; lectotype label and ♀ added by me; distal part of gaster cut off and micro-slide for genitalia fixed on pin. M. cruentator det. van R.

M. mediator. Female. Front wing 4.4 mm. Labels: a white label (probably original) "♀ Kjöbenh. [the type locality] Schiødte"; a white museum label "Danmark ex coll. Schiødte"; lectotype label by me: M. cruentator det. van R.

M. nigriventris Foerster. Female. Front wing 5.7 mm. Labels: a white label (original) "45. gl.***) Mont-joie"; a blue-rimmed box label "nigriventris Frst.". Holotype labelled by me: M. cruentator det. van R.

*) Based on 3 specimens and probably not quite reliable.
**) From base of costal margin.
***) Meaning: "Glieder" = segments of antenna.

M. conformis Foerster. Female. Front wing 5.0 mm. Labels: a white label (original) '45 gl Aachen"; a blue rimmed box label "conformis Frst". Holotype labelled by me: M. cruentator det. van R.

M. fuscicornis Foerster. Female. Front wing 3.2 mm. Labels: a white label (original) "♀ + 39 gl. Aachen"; a blue rimmed box label "fuscicornis Frst.". Holotype labelled by me: M. cruentator det. van R.

Description of the male. — Body length 4.0—5.4 mm. Front wing 3.0—4.0 mm. Head with the following parts yellow: palpi, mandibles, lower gena, clypeus, entire face, lower part of frons and part of inner orbit. A sharply bounded rectangle below the central ocellus browish to black. Vertex and back of head black. Eyes and ocelli large. Labial palpi short; maxillary palpi strikingly long and slender, reaching at least well beyond front coxa. Mandible short, somewhat swollen at base, strongly tapering towards apex; teeth lying in horizontal plane. Clypeus strongly convex with characteristic, erect, sparse hairs. Clypeal fovea deep, with an open anterior tentorial pit. Malar space wide, with a groove. Head preponderantly polished, here and there finely coriaceous. Antennae, slender, of body length.

Thorax characteristically coloured: entire pronotum, pleuron 1, all coxae, episternum 2 (mesopleurae) and mesosternum ivory yellow towards reddish brown. Mesoscutum entirely black, in some specimens with light brown streaks along the prescutal sutures which may coalesce on the disk and backwards towards the scutellar fovea. Scutellum often brownish. The entire propodeum including the sternal part mostly black. Sculpture of pronotal and mesopleural (episternum 2) parts almost polished. Mesoscutum strongly convex, very finely coriaceous, prescutal sutures (notauli) weak. Propodeum only with pleural carina, sometimes posterior transverse carina present; dorsally finely coriaceous with a vague tendency towards transverse striation. Prepectoral carina present, in most specimens not reaching suture between notum 1 and episternum 2. Entire thorax with widely placed suberect, light-coloured hairs, wrich become more dense on the sublateral and pleural parts of propodeum. Wings hyaline. Legs long and slender, yellowish, except fuscous apex of hind tibia. All femora slender; index hind femur 5.8—7.1.

Gaster with 1st and 2nd tergite alutaceous and fuscous; 3rd and 4th tergite very often yellow and finely alutaceous. Following segments mostly fuscous. Male genitalia as in Pl. 1 Fig. 4.

Female. — I refrain from giving a full description, as the female is sufficiently characterized by the details given in the key. Two differential characters are: the slender middle femur, index 5.1—7.0 and the absence of a white lining on the inner orbits of the eyes. Ovipositor, Pl. 1 Fig. 2.

Remark. — In spite of the fact that Schiødte (1838, 1839) mentioned that he had males, the type series of this species comprises females only. Nor is it clear from his description that Schiødte recognized the male. The same holds for his second species *(M. mediator)* as well as for Foerster's three species, *M. nigriventris, conformis* and *fuscicornis,* and for all females and all specimens of *M. cruentator.* This strange state of affairs was thus pursued by Foerster (1871) and later by Schmiedeknecht (1908-1911). I conclude that the male of this rather common species has never been properly described. When studying the related *M. flavopictus,* I noted the strong sexual dimorphism in this species and assumed that also in *M. cruentator* the male could hereby be recognised. A series of males in the available material, formerly perhaps taken for *M. flavopictus* males, represent the missing male of *M. cruentator.* It is described above.

Biology. — The collecting dates on the examined material give some evidence that two generations per year occur. The first from April to early June, the second from August to the middle of October.

Material examined. — Denmark: 10 ♀, lectotype and 9 syntypes of *M. cruentator,* Sielland (coll. Schiødte) (MC); ♀, lectotype of *M. mediator,* Kjöbenhavn and 7 other ♀, no locality (coll. Schiødte) (MC); ♂, as *M. lineator!,* Møn (coll. Schiødte) (MC). Germany: ♀, holotype of *M. conformis* Foerster, Aachen (coll. Foerster) (ZSM); ♀, holotype of *M. nigriventris* Foerster, Montjoie (?) (coll. Foerster) (ZSM); ♀, holotype of *M. fuscicornis* Foerster, Aachen (coll. Foerster) (ZSM); ♀, ND Spessart, Lochmühle, 17—22.X.*)1971, trap (coll. van Rossem). Italy: ♀, Bolzano, 1914, leg. Smits van Burgst (ELW). Netherlands: ♂, Ede, Sijsselt, 25.VIII.1963, trap (coll. van Rossem); ♂, Ede, Sijsselt, 7.IX.1963, trap (coll. van Rossem); 3 ♂, Ede, Planken Wambuis, 15.V.1966 (coll. van Rossem); ♀, Ede (on window), 6.VII.1967 (coll. van Rossem); 2 ♀, Ede, Sijsselt, 14.VIII and 28.IX.1970, trap (CJZ); 4 ♀, Ede, Sijsselt, 12 & 22.V., 1 & 9.VI.1971, trap (CJZ); ♀, Radio Kootwijk (Gerritsfles), 27.IX.1964 (coll. van Rossem); ♂, Radio Kootwijk (Assel), 12.IX.1963 (coll. van Rossem); ♂, Kemperberg**) 28.V.1967, trap (coll. van Rossem); ♀, Hilversum, 9.IX.1960, leg. den Hoed (KWR); ♂, Nuth (Limburg), 17.V.1968, leg. den Hoed (KWR); ♀, Vaals (Limburg), IV.1914, leg. Smits van Burgst (ELW). No locality; 2 ♀, leg. Schmiedeknecht (coll. Smits van Burgst) (ELW).

Megastylus flavopictus (Gravenhorst) new combination

♂ *Plectiscus flavopictus* Gravenhorst, 1829, Ichn. Eur. 2(2) : 983.
♂ (!) *Megastylus lineator* Schiødte, 1838, Rev. Zool. Cuv. 1 : 139. **New synonymy.**
Megastylus lineator: Schiødte, 1839, Mag. Zool. (2)1 : 7.
Megastylus lineator: Foerster, 1871. Verh. naturh. Ver. Rheinl. 28 : 104.
♂ ♀ *Myriarthrus cingulator* Foerster, 1871, Verh. naturh. Ver. Rheinl. 28 : 103. **New synonymy.**
Myriarthrus flavopictus: Foerster, 1871, Verh. naturh. Ver. Rheinl. 28 : 103.
Myriarthridea cingulator: Townes, 1971, Mem. Amer. Ent. Inst. 17 : 205.

Characteristics of the type specimens. — *Plectiscus flavopictus.* Male. Front wing 3.6 mm, 2nd tergite striate. Labels: none. Lectotype label added by me: M. flavopictus det. van R. Probably the specimen from Genova ("sexus incerti").

Megastylus lineator. Male. Front wing 3.8 mm. Labels: a white, rimmed label (probably original) "♀ Strandm (Strandmöllen) Drewsen"; a printed museum label "Danmark ex coll. Schiødte". Holotype label and ♂ added by me: M. flavopictus det. van R. Schiødte indicated the sex of this specimen erroneously.

Myriarthrus cingulator. Male. Front wing 3.0. Labels: a white label "♂.32 gl. Aachen"; a blue rimmed box label "cingulator Frst.". Lectotype label added by me; 12 syntypes labelled paralectitype, M. flavopictus det. van R.

I refrain from giving full descriptions of both sexes because the differential characters of this species are recapitulated in the keys. Genitalia ♂ (Pl. 1 Fig. 3).

Material examined. — Austria: ♀, Carinthia, Ostkarawanken, Ebriach, 580—750 m, 21—29.VII.1964 (coll. van Rossem). Denmark: ♂, the holotype of *M. lineator,* Strand-

*) All specimens from this locality were wrongly labelled: IX.
**) Near Arnhem.

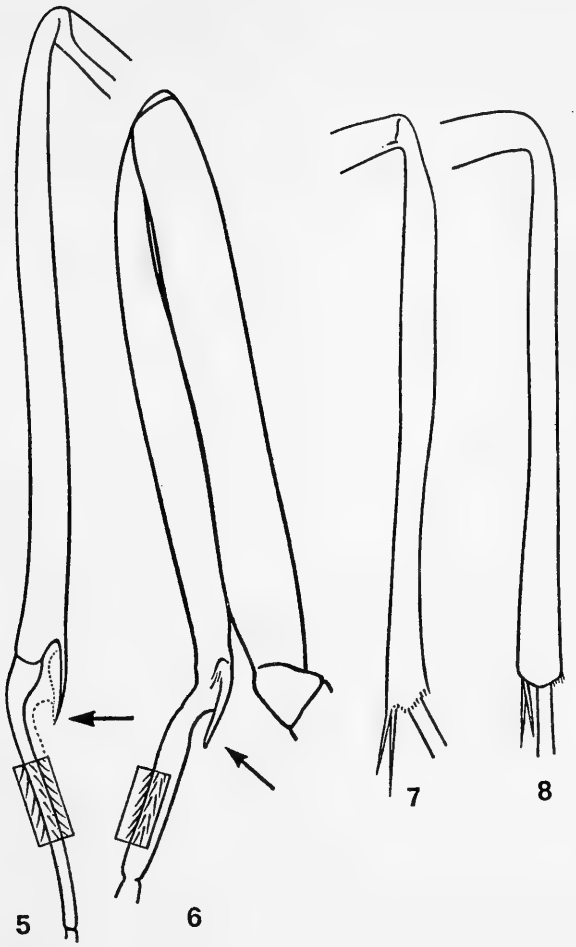

Fig. 5—8. Legs of *Megastylus*. 5, *M. excubitor,* right front leg, female, holotype (ZSM); 6, *M. impressor,* right front leg, female, Strandmøllen, coll. Schiødte (MC); 7, *M. pectoralis,* left hind tibia (outer side), male, Aachen, coll. Foerster (ZSM); 8, *M. impressor,* left hind tibia (outer side), male, Viborg, coll. Schiødte

möllen, leg. Drewsen (coll. Schiødte) (MC). Germany: ♂, lectotype of *Myriarthrus cingulator* and 12 syntypes, all Aachen, 2 specimens without label (coll. Foerster) (ZSM). Italy: ♂, lectotype of *Plectiscus flavopictus,* Genoa (?), coll. Gravenhorst (ZI). Netherlands: ♂, Hoge Veluwe, Kemperberg, 21.VII.1967 (coll. van Rossem); the following 4 ♂ & 7 ♀ all from Ede, Sijsselt, trap, 3 & 15.IX.1970; 17, 22 & 30.V.1971, 9 & 21.VI.1972 (CJZ); ♂ (genitalia, Pl. 1 Fig. 3), Ede, trap, 8—15.IX.1970 (coll. van Rossem). No locality, ♀, coll. Smits van Burgst (ELW).

Megastylus pumilio Foerster

♂ ♀ *Megastylus pumilio* Foerster, 1871, Verh. naturh. Ver. Rheinl. 28 : 105.
♂ *Megastylus retroligatus* Foerster, 1871, Verh. naturh. Rheinl. 28 : 105. **New synonymy.**
♂ *Megastylus leptoderus* Foerster, 1871, Verh. naturh. Ver. Rheinl. 28 : 105. **New synonymy.**
♂ *Megastylus pauxillus* Foerster, 1871, Verh. naturh. Ver. Rheinl. 28 : 105. **New synonymy.**

Characteristics of the type specimens. — *Megastylus pumilio.* Male. Front wing 2.5 mm. Antenna 31 segments. Labels: a white label "♂ 31 gl. Aachen". Lectotype label added by me. There are two specimens on the pin; the left one is selected as the lectotype.

Megastylus retroligatus. Male. Front wing 2.7 mm. Labels: a white label "♂ + 25 gl. Altenberg 28.5". A blue rimmed box label "retroligatus Frst.". Holotype labelled by me: M. pumilio det. van R.

Megastylus leptoderus. Male. Front wing 2.4 mm. Labels: a white label "♂.30 gl. Boppard 24.4". A blue rimmed box label "leptoderus Frst.". Holotype labelled by me: M. pumilio det. van R.

Megastylus pauxillus. Male. Front wing 2.4 mm. Labels: a white label "♂.29 gl. Aachen". A blue rimmed box label "pauxillus Frst.". Holotype labelled by me: M. pumilio det. van R.

Comment. — A number of very small specimens (♂ 2.7—3.2 mm; ♀ 2.5—3.2 mm) probably represent a third species, and one difficult to recognize. From the available names for this taxon I have chosen *M. pumilio* as the most suitable (both sexes described). I do not give full descriptions of both sexes but refer to the characters given in the keys. Setting aside the characters of the body or wing length which are not very reliable, the female is still rather clearly differentiated from the *M. cruentator* female by the stout middle femur (index 3.6—3.8) (5.1—7.0 in *M. cruentator).* The male, however, can only be separated from *M. cruentator* with unreliable characters, namely its size and either entirely brown or black thorax.

Apart from *M. pumilio,* Foerster described another three species, viz. *M. retroligatus, M. leptoderus* and *M. pauxillus.* Of each only one male is available. When studying these three holotypes I had to conclude that the character given by Foerster for separating these species, namely the position of the nervulus, is of no use. Besides, three different females have yet to be found in the field.

Material examined. — Germany: 2 ♂, lectotype of *M. pumilio* and 1 syntype, Aachen (coll. Foerster) (ZSM); 1 ♂ & 2 ♀, Boppard, 24 & 26.IV (coll. Foerster) (ZSM); ♂, holotype of *M. retroligatus,* Altenberg, 28.V (coll. Foerster) (ZSM); ♂, holotype of *M. leptoderus,* Boppard, 24.IV (coll. Foerster) (ZSM); ♂, holotype of *M. pauxillus,* Aachen (coll. Foerster) (ZSM); ♂, Aachen (coll. Foerster) (ZSM); ♂, Lousberg (bei Aachen), 3.X (coll. Foerster) (ZSM); 2 ♂, Altenberg, 28.V (coll. Foerster) (ZSM). Netherlands: ♀, Arkel, 20.VIII.1967 (CJZ); ♂, Asperen, 1.VII.17967 (CJZ).

Megastylus rufipleuris (Foerster) new combination

♀ *Myriarthrus rufipleuris* Foerster, 1871, Verh. naturh. Ver Rheinl. 28 : 103.

Characteristics of the holotype. — *Myriarthrus rufipleuris.* Female. Front wing 3.0 mm. Labels: a white label "♀ 39 gl Aachen". A blue rimmed box label "rufipleuris Frst.". Holotype labelled by me: M. rufipleuris det. van R.

Description of the female. — Front wing 3.0—4.0 mm. Head black. Labial palpi short, maxillary palpi long; white to brownish. Clypeus strongly convex, yellow to brown, with sparse, erect hairs. Face, yellow to brownish, polished, with suberect, sparse hairs. Frons with weak antennal scrobes, polished. Inner orbits above antennal sockets with broad white lining, which at most reaches the lower ocellus. Antennae with about 39—40 short segments, strongly pilose.

Thorax with rather characteristic colouring; pleuron 1, entire pronotum, episternum 2 (mesopleurae), including sternal part, all coxae and legs light yellowish to light brown. Mesoscutum dark brown to black, except for streaks along prescutal sutures. Scutellum light brown. Entire propodeum black. Thorax with sparse, suberect hairs. Wings hyaline. Index of middle femur: 4.2—4.8 (4 specimens!), thus lying between *M. cruentator* and *M. pumilio.*

Gaster with 1st and 2nd tergite relatively roughly alutaceous, following tergites more polished. Apical segments in undamaged specimens with rather long widely spaced hairs. Gaster fuscous with 3rd tergite lighter.

Male. — Unknown.

Comment. — The available material of this species is very scanty, not more than four females. Nevertheless there is reason to believe that we are dealing with a separate taxon. The females have the second tergite alutaceous and are thus differentiated from *M. flavopictus;* they also have a conspicuous white lining on the upper inner orbit which does not occur in any of *pumilio* or *cruentator* specimens I have so far seen. I have some suspicion that *M. rufipleuris* females might be aberrant specimens of *M. flavopictus,* with the second tergite alutaceous; the absence of males might support this view, but especially in a group of species with so few true morphological characters. Males may be hidden between those of other species (*M. pumilio).*

Material examined. — Germany: ♀, holotype of *Myriarthrus rufipleuris,* Aachen (coll. Foerster) (ZSM). Netherlands: 2 ♀, Ede, Sijsselt, 28.IX.1970 and 12.V.1971 (CJZ); ♀, Giessenburg, 1.VIII.1968 (CJZ).

Subgenus **Dicolus** Foerster, 1868

Type species: *D. insectator* Foerster, 1871 = *M. impressor* Schiødte, 1838.
Subgenus *Dicolus*: Thompson, 1888, Opusc. Ent. 12 : 1311.

Megastylus (Dicolus) inpressor Schiødte

♀ *Megastylus impressor* Schiødte, 1838, Rev. Zool. Cuv. 1 : 139.
Megastylus impressor: Schiødte, 1839, Mag. Zool. 2(1) : 5—6.
♀ *Dicolus insectator* Foerster, 1871, Verh. naturh. Ver. Rheinl. 28 : 97. **New synonymy.**
Dicolus insectator: Townes, 1971, Mem. Amer. Ent. Inst. 17 : 205.

Characteristics of the type specimens. — *M. impressor.* Female. Front wing 5.0 mm. Labels: a white, double rimmed label "♀ 2.5. 1834 Strandm. Drewsen". Strandm. = Strandmøllen, a locality near Skousborg (Sielland)*. The date in Schiødte's paper (1839!) is 21.V.1834*. There is no doubt about the originality of the specimen. A second printed label: "Danmark ex coll. Schiødte". Holotype labelled by the present author.

Dicolus insectator. Female. Front wing 4.5 mm. Labels: a white label "♀. 33 gl. Aachen". A blue rimmed box label "insectator Frst.". Holotype labelled by me.

Female. — Postanellus slender and long, index about 7.0—10.0. Hind tibia slightly inflated in proximal part (Fig. 4). Hind femur somewhat inflated in proximal part. Front tarsus of normal shape, basitarsus about 0.33—0.43 of front tibia (Fig. 6). In fresh specimens head, except clypeus, black, polished. Pronotum with yellowish to

*) Information from Dr. Børge Petersen.

reddish parts, mesoscutum black, polished. Mesopleurae and scutellum reddish brown. Propodeum black with conspicuous fossa in proximal part. Legs yellowish to reddish. Gaster with proximal tergites alutaceous. First and second tergite and apex brown to black, third and fourth (in part) tergite yellow to brown. Ovipositor, when not bent downwards, concealed, thus causing confusion with the male.

Male. — Males are difficult to recognize notwithstanding some important characters: the hind tibia is not inflated proximally and there is no constriction in the distal part as in males of *M. pectoralis* (compare Figures 7 and 8). The hind femur is long and slender, index 7.0—8.5 (some overlapping with *M. cruentator).* The postanellus is long and slender, index 8.8—12.5. The propodeum shows the conspicuous transverse impression in its 0.25—0.28 proximal part, typical for the subgenus *Dicolus.* The three specimens studied show a vividly brown coloration, with clypeus, latero-ventral parts, legs including coxae and spot on gaster, yellowish brown.

Material examined. — Denmark: ♀, holotype of *M. impressor,* Strandmøllen, 2.V.1834, leg. Drewsen (coll. Schiødte) (MC); ♀, Strandmøllen, leg. Drewsen (coll. Schiødte, not a type spec.) (MC); ♂, Viborg, leg. Schiødte (coll. Schiødte) (MC). Germany: ♀, holotype of *Dicolus insectator,* Aachen (coll. Foerster) (ZSM); ♀, Nd Spessart, Lochmühle, 17—22.X.1971, trap (coll. van Rossem). Netherlands: ♂, Planken Wambuis (near Ede), 5.IX.1964 (coll. van Rossem); ♀, Ede, 9.VI.1971, leg. Zwakhals (CJZ). No locality: ♀, Pt Ballon, 18.VIII.1961, 1100 m, leg. den Hoed (KWR); ♂, leg. Schmiedeknecht (coll. Smits van Burgst) (ELW).

Megastylus (Dicolus) pectoralis Foerster

♂ ♀ *Dicolus pectoralis* Foerster, 1871, Verh. naturh. Ver. Rheinl. 28 : 97.

Characteristics of the type specimens. — *Dicolus pectoralis.* Female. Front wing 4.6 mm. Labels: a white label "♀. 33 gl. Lousb. (= Lousberg, the type locality) 25.10"; a white label (not original) "pectoralis 7 ♀*)" in pencil; a label "Dicolus pectoralis Foerst. ♀ det. J. F. Aubert"; lectotype labelled by the present author. A second specimen, a male, undoubtedly a syntype, was labelled paralectotype.

Female. — The two characters of the subgenus *Dicolus* are well developed in *M. pectoralis* female: namely the slender postanellus, index about 8.0, and the deep transverse impression of the propodeum. Confusion with the subgenus *Megastylus* is out of the question. The conspicuously inflated hind tibia distinguishes this species from two other *Dicolus,* viz. *excubitor* and *impressor,* and Foerster quite rightly used this character (Fig. 3). An interesting feature which this female shares with *D. excubitor* and the doubtful *D. subtiliventris,* is the long regular pilosity of the antenna, not found in the other *Megastylus* species discussed in this paper.

Male. — The only two available males were in Foerster's set. These two show, somewhat weakened, the characteristic shape of the hind tibia of the female. (Compare Fig. 7). I think these males are *M. pectoralis.* The two specimens both have the face entirely ivory-yellow with the inner orbit above the antennal sockets marked yellow, as in the female. The extremely slender front and middle femora, indices between 7.4—10.0, are very conspicuous which makes differentiation from *Megastylus* s.str. males easy. The deep transverse propodeal impression of *Dicolus* is also present.

*) Probably not all female specimens are syntypes.

Biology. — Considering that nothing is known about the biology of this species it is perhaps worth noting that C. J. Zwakhals caught 4 females in his Malaise - Townes trap on 1 November 1970 on the northern slope of a diluvial hill covered with mixed wood *(Fagus, Quercus, Pinus* and some other components), about 75—100 years old. Microclimate of the site was cool and rather moist. Townes (1971) notes for the Microleptinae "moist habitats, such as cloud forests".

Material examined. — Germany: ♀, lectotype of *Dicolus pectoralis,* Lousberg (bei Aachen), 25.X. (coll. Foerster) (ZSM); ♂, paralectotype of *Dicolus pectoralis,* Lousberg (bei Aachen), 25.X (coll. Foerster) (ZSM); 5 ♀, Lousberg (Aachen), respect. 2 ♀, 16.VII.; 3.X.; 15.X.; 25.X. (coll. Foerster) (ZSM); ♂ ♀, Aachen (coll. Foerster) (ZSM). Netherlands: 4 ♀, Ede, Sijsselt, 1.XI.1970, trap, leg. Zwakhals (CJZ).

Megastylus (Dicolus) subtiliventrie Foerster

♀ *Dicolus subtiliventris* Foerster, 1871, Verh. naturh. Ver. Rheinl. 28 : 97.

Characteristics of the type specimen. — *Dicolus subtiliventris.* Female. Front wing 3.1 mm. Labels: a white label "♀, 31 gl. Lousb. (Lousberg bei Aachen, the type locality) 25.10". A blue rimmed box label "subtiliventris Frst.". Holotype labelled by the present author.

Comment. — The treatment of this species must be tentative because material available is limited, namely the holotype and only one corresponding specimen. The holotype and the second specimen do not differ essentially from *M. pectoralis.* There are only two points of difference, namely the smaller size and the absence of a broad yellow spot on the frontal orbit droso-lateral of the antennal sockets (present in *M. pectoralis),* though these characters are unhelpful in distinguishing it. I have at present treated *M. subtiliventris* as a separate taxon, since a number of specimens of *M. pectoralis* from two quite different localities all have the yellow spot, while both specimens of *M. subtiliventris* also from two separate localities, do not. Finally it should be noted that part of Foerster's material of *M. pectoralis* and the holotype of *M. subtiliventris* were collected in the same place on the same date!

Male. — Unknown.

Material examined. — Germany: ♀, holotype of *Dicolus subtiliventris,* Lousberg (bei Aachen) 25.X. (coll. Foerster) (ZSM); ♀, Nd Spessart, Lochmühle, 17-22.X.1971, trap (coll. van Rossem).

Megastylus (Dicolus) excubitor Foerster

♀ *Dicolus excubitor* Foerster, 1871, Verh. naturh. Ver. Rheinl. 28 : 97.

Characteristics of the type specimen. — *Dicolus excubitor.* Female. Front wing 4.8 mm. Labels: a white label "♀, 33 gl. Aachen". A blue rimmed label "excubitor Frst". Holotype labelled by the present author.

Comment. — Of this taxon only the holotype was available. This specimen shows relationships towards *M. pectoralis,* having the long pilose antenna and the slender front basitarsus (about half as long as front tibia*) (Fig. 5), but at the same time the

*) Basitarsus about 0.57—0.59 of tibia in *subtiliventris,* 0.57 in *pectoralis* lectotype, 0.33 in *impressor* lectotype.

differential character of the latter species is lacking, namely the inflated hind tibia. Though the shape of the hind tibia has much in common with that of *M. pectoralis* and some vague inflation could be suspected, the difference does not quite justify a synonymy of *M. excubitor* with *M. pectoralis*. The solution of this question has to wait for further material and for the present we shall have to accept Foerster's differential character in the hind tibia.

Male. — Unknown.

Material examined. — Germany: ♀, holotype of *Dicolus excubitor,* Aachen (coll. Foerster) (ZSM).

TYPE NOT IDENTIFIED

♂ *Megastylus facialis* Foerster, 1871, Verh. naturh. Ver. Rheinl. 28 : 105.

Characteristics of the type specimen. — *M. facialis*. Male. Front wing 2.9 mm. Face, including clypeus and oral parts ivory. Thorax entirely brown, except for a narrow ivory-yellow rim on anterior margin of pronotum. All coxae and further parts of legs light yellowish to brown, except for fuscous distal part of hind tibia. Index of postanellus, 6.0. Index of hind femur, 5.3. Labels: a white label "♂, 23 gl. Boppard 24.4"; a blue rimmed box label "facialis Frst.". Holotype labelled by the present author.

I have not succeeded in recognizing this holotype at the species level; certainly there seems no reason to regard it as a separate taxon. The specimen has much in common with *M. pumilio* although the true *M. pumilio* has a brown face. Definite identification has to wait for further information with regard to e.g. *M. rufipleuris* and *M. pumilio*.

SPECIES INQUIRENDAE

♀ *Megastylus orbitator* Schiødte, 1838, Rev. Zool. Cuv. 1 : 139 (type lost).

♂ *Myriarthrus aemulus* Foerster, 1871, Verh. naturh. Ver. Rheinl. 28 : 103. The orbita frontalis has a white lining in the type specimen. Foerster wrote: "Orbita frontalis nicht weiss." The specimen belongs to *Megastylus flavopictus* Gravenhorst.

I have not seen the type of the following species:

Miomeroides transsylvanicus Kiss, 1924, Verh. Mitt. Siebenbürg. Ver. Naturw., Hermannstadt 72—74 : 113. According to Townes (1971), a species of *Megastylus*.

Megastylus (Dicolus) hirticornis Strobl, 1903, Mitt. Nat. Ver. Steierm. 40 : 141. Strobl writes: "Steht etwa neben *subtiliventris* Frst., Thms., ist aber fast dreimal grösser und auch durch die Färbung ausgezeichnet". In all probability this is a specimen of *M. pectoralis*.

Megastylus pleuralis Thomson, 1888, Opusc. Ent. 12 : 1313. Probably a specimen of *M. cruentator*.

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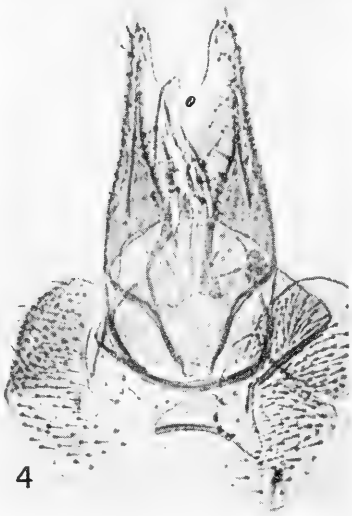

Plate 1. Fig. 1. Aussenstelle Lochmühle bei Bieber (Northern Spessart). Phot. van Rossem. Fig. 2, *Megastylus cruentator,* ovipositor of lectotype (MC). Fig. 3, *Megastylus flavopictus,* genitalia male, Ede, trap, 8-15.IX.1970 (coll. van R). Fig. 4, *Megastylus cruentator,* genitalia male, Ede, Sijsselt, 7.IX.1963 (coll. van R)

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