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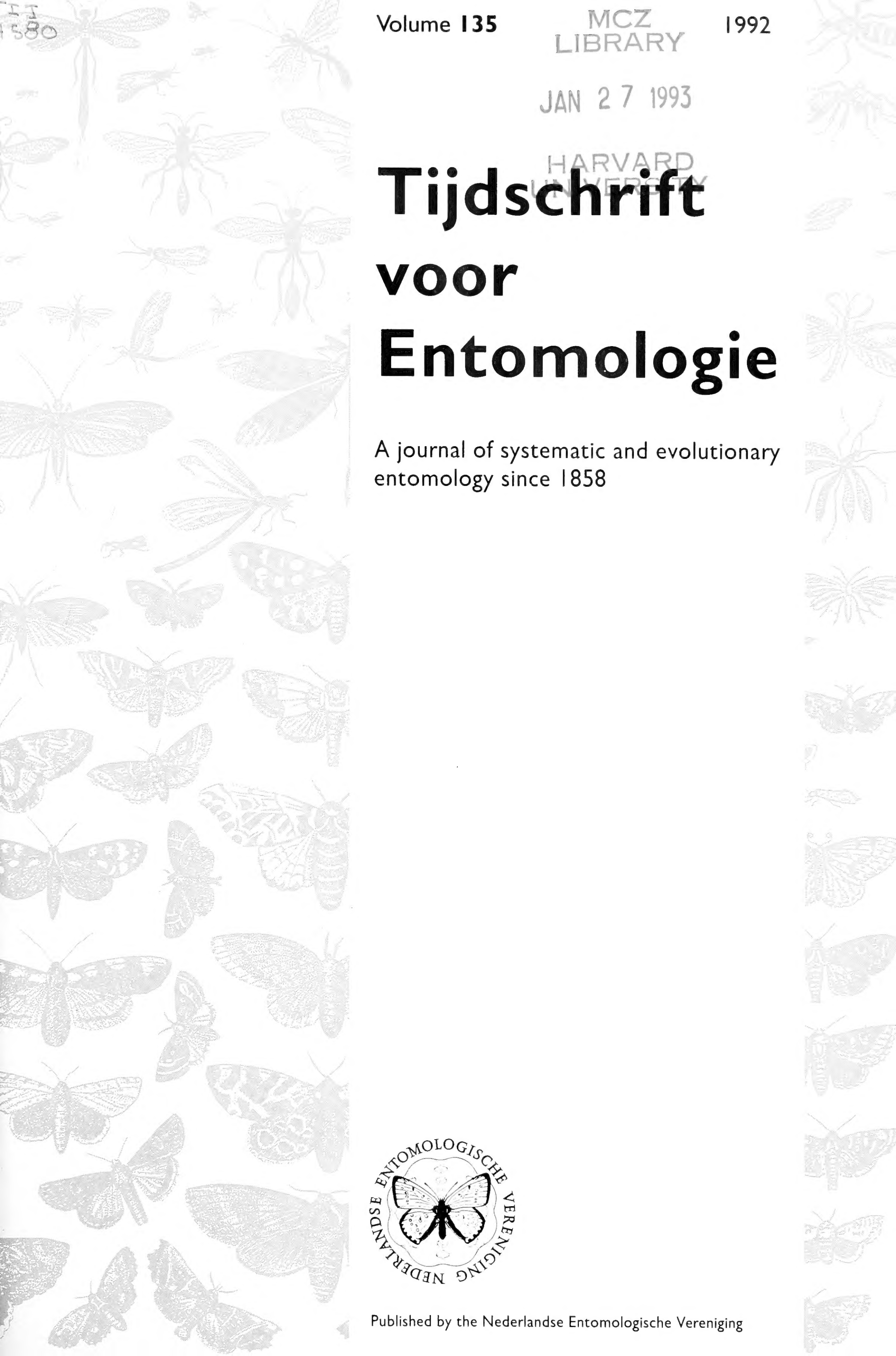

Tijdschrift voor Entomologie

A journal of systematic and evolutionary entomology since 1858

Published by the Nederlandse Entomologische Vereniging

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Tijdschrift voor Entomologie

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I. LANSBURY

Oxford University Museum, United Kingdom

NOTES ON THE MARINE-FRESHWATER GERRID GENUS *RHEUMATOMETROIDES* (HEMIPTERA, GERRIDAE) OF PAPUA NEW GUINEA[1]

Lansbury, I., 1992. Notes on the marine-freshwater gerrid genus *Rheumatometroides* (Hemiptera, Gerridae) of Papua New Guinea. – Tijdschrift voor Entomologie 135: 1-10, figs. 1-43, tables 1-4. (ISSN 0040-7496]. Published 15 July 1992.

The marine-freshwater gerrid *Rheumatometroides* Hungerford and Matsuda from Madang Province, Nagada Harbour were studied in February-March 1990 and the results compared with data from West New Britain, Kimbe area. *Rheumatometroides serena* sp. n. is described from Negada Harbour, and compared with *R. browni* Hungerford and Matsuda, originally described from Solomon Islands and now recorded from West New Britain. Variation between females of *R. browni* from West New Britain and Solomon Islands is commented upon. Notes are given on the habitat preferences of both species in Papua New Guinea and their localised distribution compared with other marine bugs (Gerridae and Veliidae).

I. Lansbury, Hope Entomological Collections, University Museum, Oxford, OX1 3PW, United Kingdom.

The genus *Rheumatometroides* Hungerford and Matsuda (1958) was described from the Solomons Islands, Kolombangara. No comment was made on the habitat of this genus. E. S. Brown, who collected the original series, describes the habitat in his field notes as 'surface of river running into lagoon (Jack Harbour). Slow flowing'. Specimens were collected on the 1st and 14th October, 1954. Matsuda (1960) redescribed the genus comparing it with other genera of the Trepobatinae Matsuda. Andersen and Polhemus (1976) refer briefly to *Rheumatometroides* and a closely related genus *Stenobates* Esaki, commenting that such records as there are indicate that both are marine occurring in estuaries and nearshore localities. Lansbury (1989) briefly summarises textual references to date.

In 1990 I visited the Christensen Research Institute (CRI), Madang, Papua New Guinea and the north coast of West New Britain, Kimbe area, to study marine bugs. A new species of *Rheumatometroides* was found at Nagada Harbour (CRI) and *R. browni* Hungerford and Matsuda was found in both freshwater and the intertidal zone in West New Britain, and what appears to be a form identical with that from Nagada, offshore in West New Britain.

Samples were collected both by handnet during daylight and other samples were obtained using a light trap run from the end of the CRI jetty.

Two immature stages of *R. browni* and a late instar of the new species are briefly described.

SYSTEMATICS

Rheumatometroides serena sp. n.
(figs. 1-20)

Type material. – Holotype male: Papua New Guinea, Madang Province, Madang, Nagada Harbour, collected between 22.ii and 16.iii.1990, collected at light (mvlt) (in OXUM). – Paratypes 39 ♂ 32 ♀ at mvlt, 43 ♂ 16 ♀ under jetty and in coral rubble close inshore (in OXUM, Forest Research Institute, Lae, coll. Christensen Research Institute, Madang, and RMNH Leiden)

Additional material. – West New Britain, Tamari, 100 m offshore, 30.iv.1989. R. N. B. Prior, 1 ♂; West New Britain, Tamari Beach, June 1989, R. N. B. Prior, 5 ♂ 2 ♀. – Immature stages: Nagada Harbour, 23.ii-14.iii.1990, 86 specs. at mvlt; 14 in coral rubble and under jetty; West New Britain, Tamari, 100 m offshore, 30.iv.1989. 1 spec.; Tamari Beach, June 1989, R. N. B. Prior, 1 spec.

Description

Adult apterous. Males 2.72-3.1 mm long, maximum width 1.24-1.32 mm, females 2.68-3.0 mm long, maximum width 1.44-1.60 mm.

Coloration. – Male: Head mesially with a broad longitudinal 'anchor-shaped' bluish-black stripe extending from anterior margin almost to posterior margin between eyes. Posterior margin adjacent to in-

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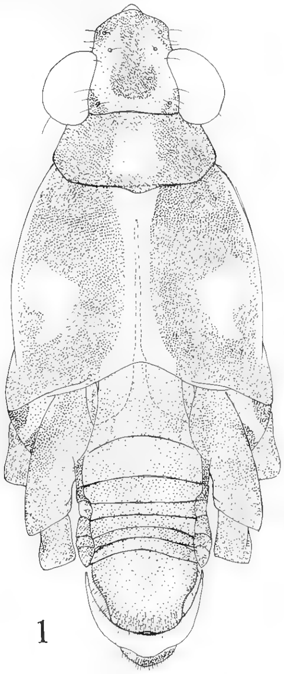
[1] Publication nr. 24 Christensen Research Institute, Madang, Papua New Guinea.



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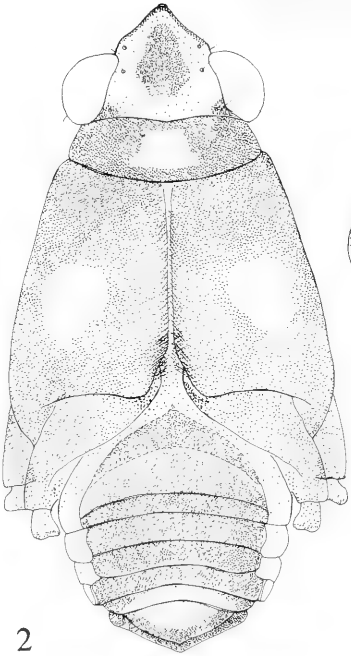

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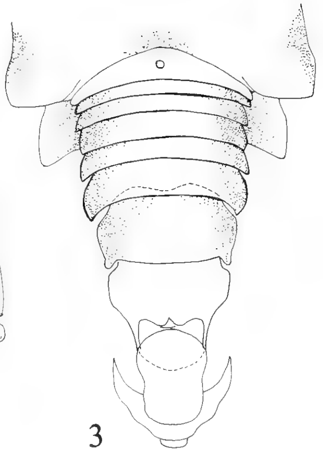

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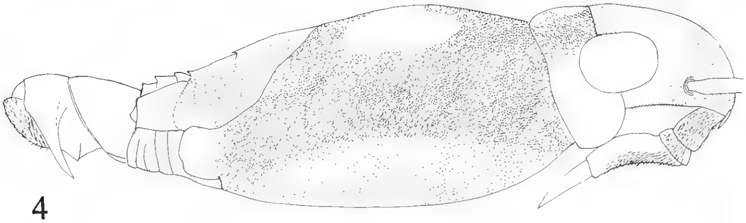

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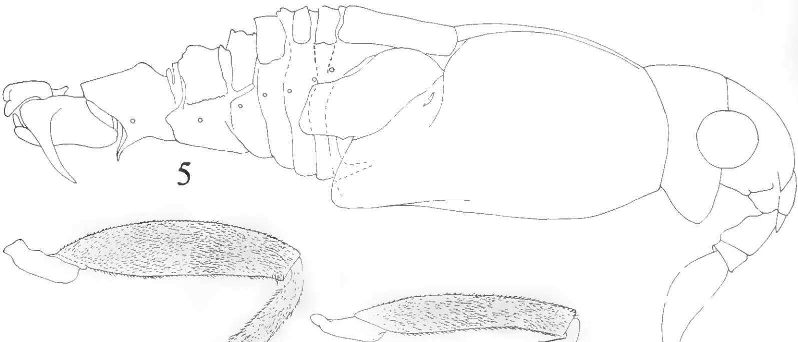

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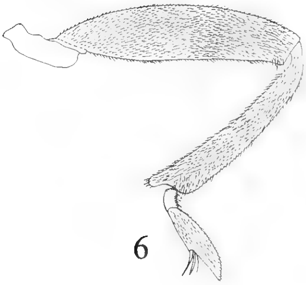

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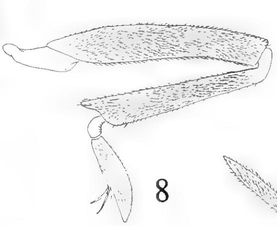

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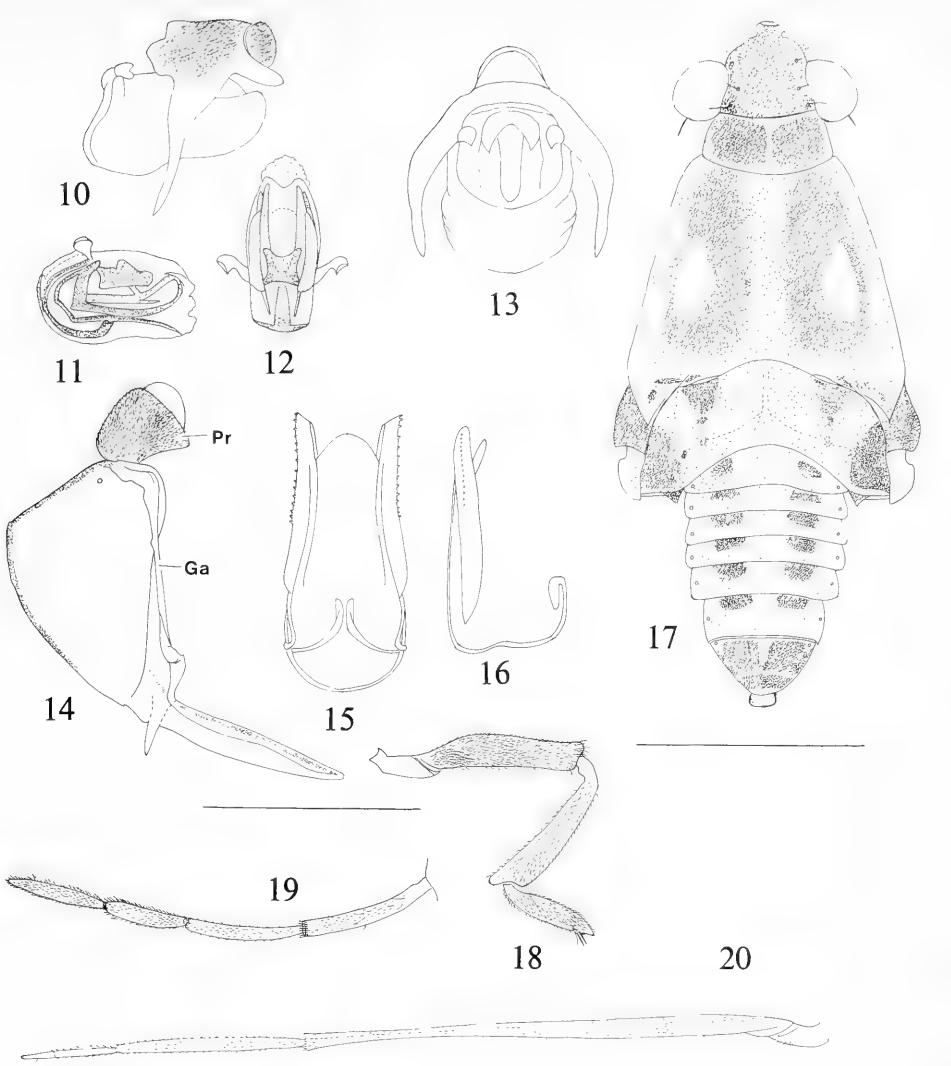


Figs. 10-20. *Rheumatometroides serena* sp. n. – 10-16, paratypes. – 10, suranal plate and genital segment, ♂; 11, genital sclerites side view, ♂; 12, ventral aspect of sclerites, ♂; 13, ventral aspect of surannal plate processes, ♂; 14, ovipositor side view, ♀; 15, ventral aspect 2nd gonapophyses, ♀; 16, side view 2nd gonopophyses, ♀. Abbreviations Ga gonangulum, Pr base of proctiger. Scale line 0.5 mm. – 17-20. Immature. – 17, dorsal aspect; 18, front leg; 19, antenna; 20, hind leg. Scale line 1 mm.

ner margin of eyes bluish black. Remainder of head orange yellow. Pronotum bluish-black with a variably shaped orange yellow blotch mesially. Mesonotum bluish-black with two (1+1) orange yellow blotches, mesially mesonotum appearing rather paler. Metanotum and tergites bluish-black evanescent. Eighth tergite yellowish brown, laterally bluish-black. Suranal plate pale yellow, processes distally black. Connexival segments 1-5 orange brown, remainder bluish black.

Head. Ventrally yellow. Rostrum pale to dark brown. Antennae black, proximal ventral margin of

Figs. 1-9. *Rheumatometroides serena* sp. n. paratypes. – 1, male dorsal aspect; 2, female dorsal aspect; 3, male abdomen ventrally, 4, male side view; 5, male (cleared in KOH and lactic acid); 6, male front leg; 7, male antenna; 8, female front leg; 9, female antenna. Scale line 1 mm.

first segment pale brown. Pronotum laterally dark brown-black, propleura and ventrally pale yellow. Mesopleura bluish-black graduating ventrally to pale yellow. Metathoracic spiracle orange. Dark abdominal coloration fading laterally, sternites pale yellow. Metacoxal plates bluish-black.

Legs. Front leg, inner margin of femur and tibia yellowish brown, outer margins of femur and tibia black. Middle and hind legs black.

Female: Superficially resembling male, dark area on head reduced. Tergites and connexivum tend to be uniformly dark brown to black. Depending upon the angle of filtered light on dry mounted specimens, the dark brown-black coloration especially of the pronotum, mesonotum, metanotum and adjacent tergites are partially covered by areas of pale bluish evanescent coloration.

Structure. – Male: Elongate parallel sided (fig. 1). Head length slightly greater than maximum width across almost straight posterior margin between eyes. Narrowest interocular space about 0.75 × posterior width. Head sometimes slightly dilated in front of eyes. Maximum eye width less than length and 0.66 × head length. Inner margin of eyes sinuate. Rostrum 8 : 13 : 9. Antenna male (fig. 7) segment 1-4 32 : 23 : 16 : 15.

Pronotum 0.25 × longer than head. Antero-lateral margins divergent, straight, postero-lateral margins convergent, hind margin straight. Mesonotum just over 2 median pronotal length, mesially with a shallow longitudinal depression becoming obsolescent anteriorly, posterior margin concave. Metanotum mesially about 0.4 × length of mesonotum with a faint Y-shaped figure. First visible tergite clearly longer than remainder, ratios 5 : 3 : 1.5 : 1.5 : 1.5. Eighth tergite as long as preceding five, lateral margins fringed with long hairs. Suranal processes curving round segment, directed cephalad. Metacetabula parallel from posterior of mesonotum. Connexivum strongly reflexed and folded onto dorsum.

Metasternum about 1.2 length of mesosternum. Omphalium prominent, located midway between anterior and posterior margins (fig. 3). A male partially cleared in KOH and examined in a 50% lactic acid solution has extended part of thorax and abdomen. Tergites are clearly visible and abdominal spiracles are aligned pleurally. The intersegmental membranes are narrow compared with tergal plates. The eighth segment bears a prominent spinose projection ventrally. This segment is normally aligned so that dorsal surface is continuous with 7th tergite and ventral projection partially encloses suranal plate segment (fig. 5).

Legs: Front femur broad, slightly curved (fig. 6), flattened on inner surface, tibia more strongly flattened with a prominent projection on inner distal margin. Distal ventral margin of femur and outer distal margin of tibia with clusters of longer hairs. Tarsi flattened, first very short, 2nd shining. Middle and hind femora moderately robust. Proportions of leg segments (table 1).

Table 1. Proportions of leg segments of *Rheumatometroides serena* sp. n.

	Femur	Tibia	Tarsus I	Tarsus II
Male front leg	35	31.5	3	13
Female front leg	35	30.5	3.5	15
Male middle leg	90	101	40	35
Female middle leg	87	102	40	35
Male hind leg	94	35	6	10
Female hind leg	91	35	6	11

Genitalia: Suranal plate and processes large, dorsally plate pilose. Genital capsule partially enclosed by lateral processes (fig. 10). Ventral aspect of suranal plate and genitalia (fig. 13). Internal structures a confusing array of paired sclerites (figs. 11, 12). Base of phallus, a heavily sclerotised plate with slightly projecting rounded corners. Parameres small and symmetrical.

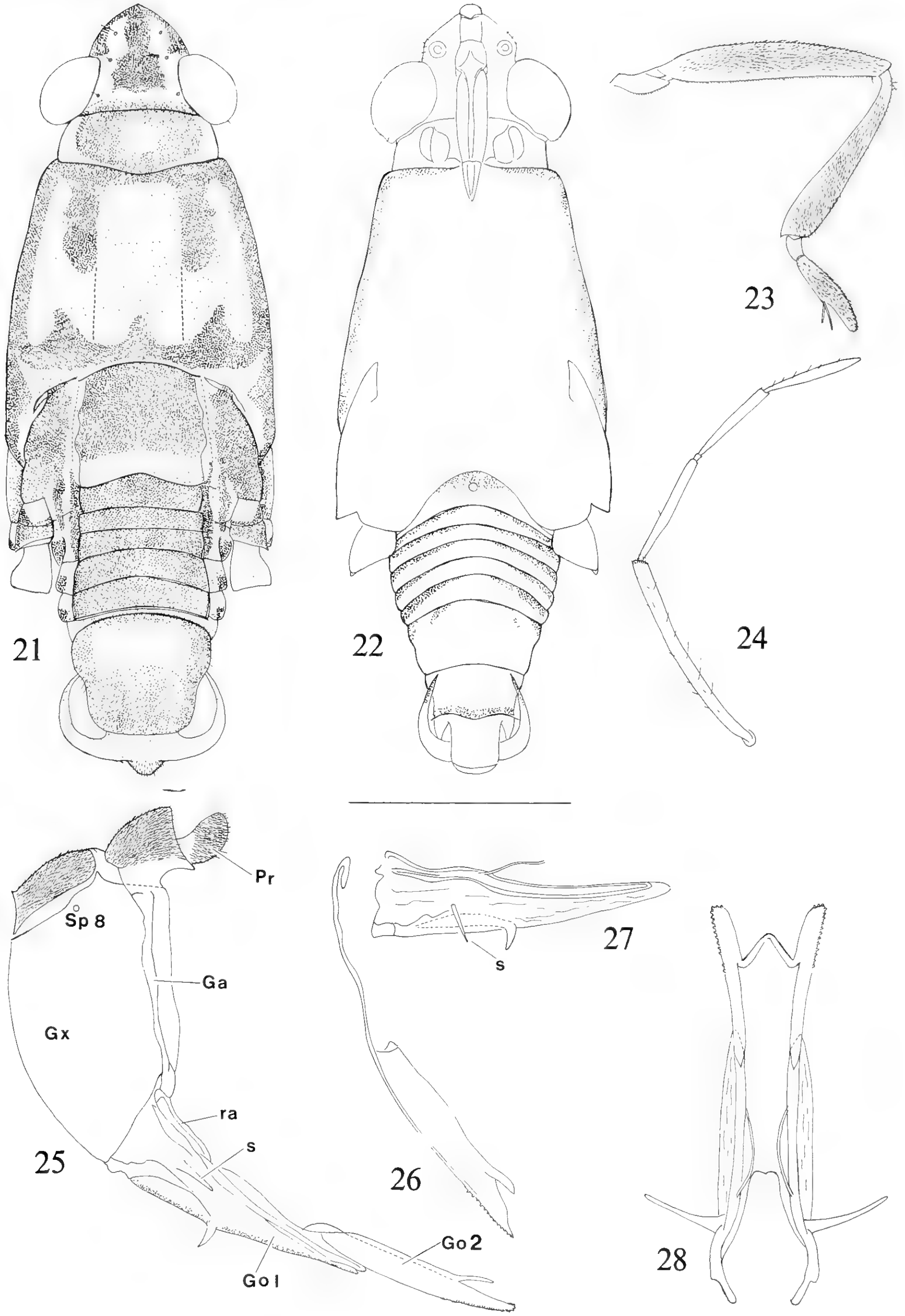
Female: Robust trapezoidal form (fig. 2). Head length equalling maximum width across slightly conave margin between eyes. Narrowest space 0.6 × posterior width. Maximum eye width less than length and about 0.35 × head length. Antennal segments 1-4 (fig. 9) 27 : 17 : 15 : 16.

Pronotum about 0.5 × longer than head, lateral margins slightly rounded and diverging, posterior margin evenly shallowly rounded. Mesonotum 3 × median pronotal length, mesially with a prominent longitudinal sulcus. Inner lateral margins of mesonotum curved inwardly, reflexed margins with numerous hairs increasing in length and density distally. Metanotum about 0.5 or less median length of mesonotum, posterior margin shallowly concave. Metanotum midway with a suture-like emarginate line extending from inner margin of connexivum. Visible tergites more or less subequal in length. Metacetabula sharply convergent anteriorly. Omphalium not conspicuous. Sternites increasing in length distally, 3 : 3.9 : 4 : 4.5 : 5 : 11.

Genitalia (figs. 14-16). First gonocoxa triangular, inner margin lightly sclerotised and reflexed inwards. Gonangulum long originating near spiracle below

Table 2. Proportions of leg segments of *Rheumatometroides serena* sp. n. Immature stages.

	Femur	Tibia	Tarsus
Front leg	25	23	16
Middle leg	74.5	84	65
Hind leg	74.5	30	16



Figs. 21-28. *Rheumatometroides browni*. – 21-24. Male Tamari Creek. – 21, dorsal aspect; 22, ventral aspect; 23, front leg; 24, antenna. Scale line 1 mm. – 25-28. Female, Kapiura. – 25, ovipositor side view; 26, second gonapophysis; 27, side view of first gonapophysis; 28, ventral aspect of first and second gonapophyses. Abbreviations Ga gonangulum; Pr proctiger; sp 8 8th spiracle; Gx gonocoxa; ra ramus; s stylus; Go1 Go2 first and second gonopophyses. Scale line 0.5 mm.

proctiger, attached to first gonapophyses, which has two (1+1) stylus-like projections basally, upper margin of first gonapophyses sclerotised. Second gonapophyses are longer than first and lightly sclerotised, widely separated and joined by a membrane which is raised lobe-like distally. Lateral margins reflexed bearing on outer margin a row of blunt spines (figs. 15, 16). Attached to proximal end of 2nd gonapophyses, a pair of lightly sclerotised ramus curving upwards and expanded into a pair of lobes joined by a membrane (fig. 16).

Immature stage 4th or 5th instar (figs. 17-20): Head dark brown with a narrow pale yellow U-shaped figure close to inner margin of eyes and across posterior margin of head. Pronotum with two (1+1) dark brown rectangular blotches. Mesonotum pale yellowish brown with two (1+1) large almost oval dark brown patches each with elongate pale yellow blotch closely resembling adult pattern. Metanotum yellow, laterally with an almost triangular dark brown patch. Anteriorly to insertion of middle and hind legs with variable triangular dark brown patches. Tergites with pairs of dark brown patches. Abdominal spiracles placed medially. Mesonotum 3 × median length of pronotum and 2 × length of metanotum. Anterior margin of first tergite deeply emarginate, tergites 2-5 subequal in length, tergites 6 and 7 clearly longer (fig. 17).

Front leg, femora more or less parallel sided resembling that of adult female, tibia strongly produced with a tuft of longer hairs distally (fig. 18). Hind femur moderately robust with an interrupted row of spine-like projections, ventral margin with four trichobothria-like hairs arising from circular areas devoid of fine short hairs. Tibia and tarsus to a lesser extent with short fine hairs (fig. 20). Antennae (fig. 19): first segment basally pale, remainder of first and other segments brown, segment 1-4 19 : 13.5 : 11 : 13.25. See also table 2.

Etymology. – A noun in apposition. This species is dedicated to Mrs Serena Jebb, wife of the Director, Dr. M. Jebb of the Christensen Research Institute, Madang, P. N. G.

Remarks. – *R. serena* with *R. aqaaqa* Lansbury and *R. metawa* Lansbury (Solomon Islands) form a distinct group based on the male front tibia, which is strongly produced, whereas that of *R. browni* is not so produced. The omphalium of *R. serena* is in the centre of the metasternum as are all the foregoing insects. According to Matsuda (1960) the omphalium of the closely allied *Stenobates* is more conspicuous and located at the intersegmental suture between the meso and metasternum. Andersen (1982) distinguishes *Stenobates* from *Rheumatometroides* by the former having the metasternum distinctly produced, whereas the latter is not produced.

Rheumatometroides serena is distinguished from *R. aqaaqa* and *R. metawa* (only males known) by the colour pattern. The 3rd and 4th antennal segments of *R. metawa* are almost subequal as are those of *R. serena*, wheras *R. aqaaqa* has the 4th segment longer. *Rheumatometroides serena* also resembles *R. metawa*. However, *R. serena* has as shorter mesonotum 2 median pronotal length compared with *R. metawa*, mesonotum 2.75 × longer than median pronotal length. The anterior suture between the meso and metasternum of *R. metawa* is antero-mesially produced, in *R. serena* it is evenly rounded.

Rheumatometroides browni Hungerford and Matsuda

(figs. 21-43)

Rheumatometroides browni Hungerford and Matsuda, 1958: 203-206. – Matsuda 1960: 351-353, Lansbury 1989: 63-65.

Description

Adult apterous. Males 3.2-3.48 mm long, maximum width 1.2-1.36 mm, females 3.2-3.48 mm long, maximum width 1.28-1.56 mm.

Coloration. – Male: Head, interocular space with a median longitudinal shining black stripe, inner margins of eyes and front of head black, remainder pale yellowish brown. Pronotum black with a median yellow blotch, lateral margins variably narrowly pale yellow. Mesonotum black with a large pale yellow W-shaped area. Metanotum black with silvery pubescence. Tergites black with silvery pubescence. Eighth tergite basally broadly pale yellowish brown, lateral margins and distally graduating to shining black. Suranal plate dorsally brown, lateral processes paler with tips darker. Propleura pale yellow, upper margins of mesopleura black with slight silvery pubescence, distal lower margin with brown stripe. Metacetabula dark brown to black with silvery pubescence and scattered pale yellow blotches. Connexivum pale brown basally, upper margins with black markings (fig. 21). Underside of head, prosternum and metasternum pale creamy yellow, sternites like-colored, lateral margins suffused with brown-black (fig. 22). Rostrum basally pale yellow graduating to black. Base of first antennal segment pale yellow, remainder of segments black. Legs, proximal underside of front coxae, femur, middle and hind femora pale yellow, remainder dark brown-black.

Female: Not differing in broad details from male. Tergites tend to be more densely covered with silvery pubescence. Connexivum uniformly brown with patches of silvery pubescence along outer margins. Sternites uniformly pale creamy yellow.

Structure. – Male: Elongate parallel-sided (fig. 21). Head length subequal to widest interocular space distally. Maximum eye width 0.75 × eye length and about half median head length. Rostrum 12 : 12 : 10. Pronotum 0.3 × longer than median head length, lateral margins rounded, median length about 2 lateral margins. Posterior margin slightly emarginate. Mesonotum mesially slightly depressed longitudinally. Metanotum depressed sloping caudad, less than 0.5 × median length of mesonotum, lateral margins sinuate. Posterior margin with a narrow transverse band of silvery pubescence. Tergites short with transverse bands of silvery pubescence. Eighth tergite longer than metanotum, lateral margins sinuate and pilose (fig. 32). Suranal plate short with a pair of processes directed cephalad. Connexivum strongly reflexed and folded over dorsum. Metacetabula diverging from posterior margin of mesonotum. Mesosternum long, metasternum 0.9 × length of mesosternum. Omphalium located centrally, lateral margins of metasternum pilose (fig. 22).

Genitalia: Abdominal segment 8 dorsally and laterally covered with fine hairs. Suranal plate densely pilose, dorsally processes large, inner margin almost straight. Ventrally segment enclosing capsule distad pilose. Phallic organ is partially inflated (fig. 33). Layout of structure broadly agrees with Brooks (1960) interpretation (fig. 33). Sclerotised structure within inflated organ is assumed to be dorsal plate of vesica. Endosoma figured by Brooks (1960) is broadly similar to fig. 34. Ventral plate attached to basal plate and connected to dorsal sclerite of vesica. Parameres symmetrical, small and rounded (fig. 35).

Female: Pronotum 0.7 longer than median head length, lateral margins slightly rounded, short about 0.3 median length, posterior lateral margins sinuate. Mesonotum 3 median pronotal length, postero-median margins straight, postero-lateral margins directed obliquely caudad against outer margin of metacetabula. Mesonotum mesially sulcate. Metanotum triangular, broad distal margin covered with silvery pubescence. Metanotum about 0.5 × length of mesonotum. Tergites with distal margins more or less straight, five distal segments with variable areas of silvery pubescence. Metacetabula diverging from posterior margin of mesonotum. Mesonotum length 7 length of metasternum. Omphalium close to anterior margin of metasternum.

Genitalia (figs. 25-28). (Kapiura form): First genocoxa plate-like elongate, inner margin evenly curved, outer margin slightly sinuate. Tergal margin narrowed dorsally pilose (fig. 25). Gonangulum narrow, heavily sclerotised, originating near dorsal margin of gonocoxa. First gonapophyses extending beyond 2nd gonapophyses, distally bluntly serrate along latero-ventral margins. First gonapophyses with a pair of long stylus-like projections (figs. 25, 28). Second gonapophyses basally attached to first gonapophyses which has a spatulate projection ventrally (figs. 25, 27). Membrane between 2nd gonapophyses distally turned upwards and slightly carinate mesially. Proximally 2nd gonapophyses with a pair of elongate ramus terminating in two (1+1) lobes (fig. 26).

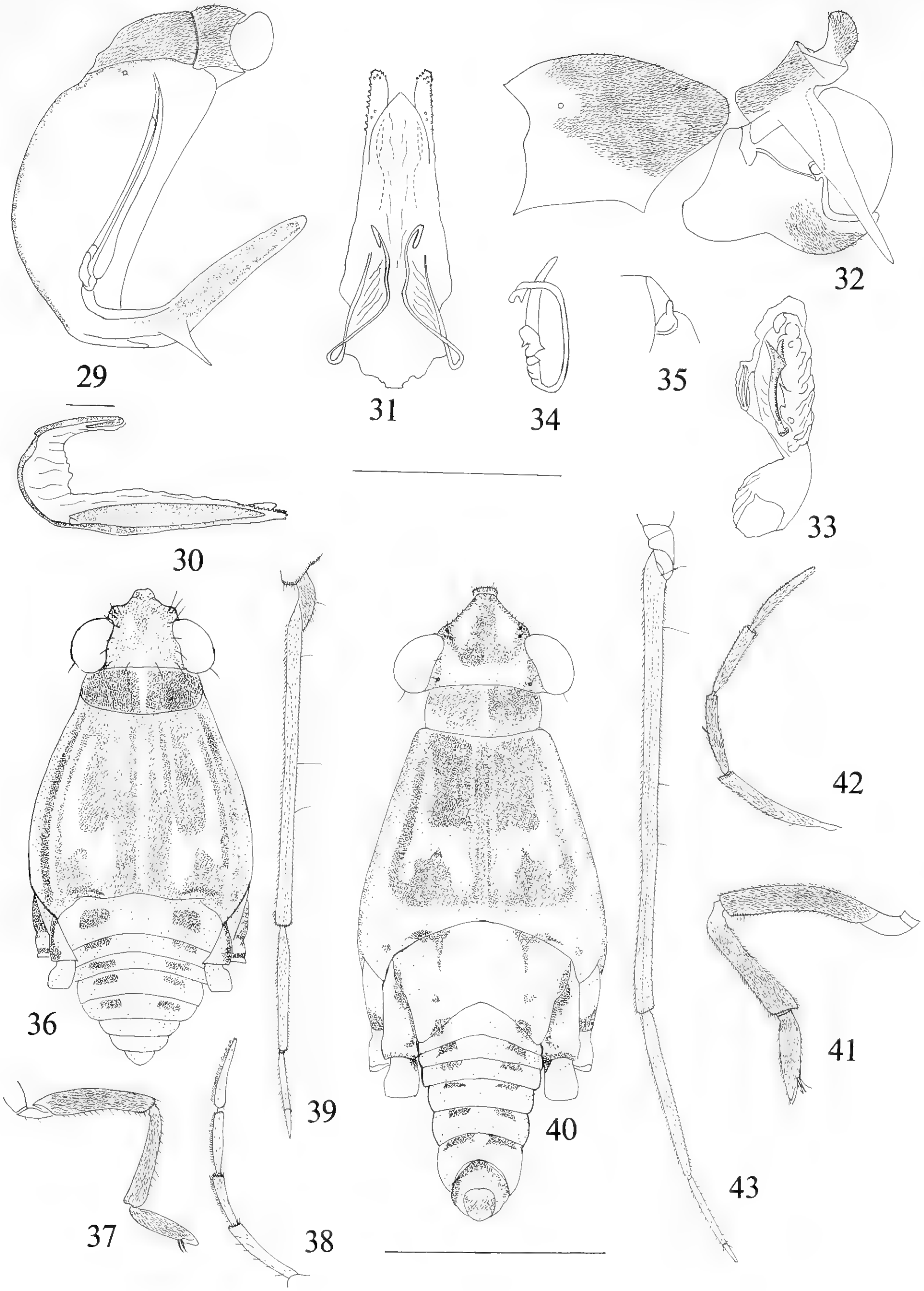
Female genitalia (figs. 29-31) (form from Kolombangara, Solomon Islands): First gonocoxa plate-like, appearing almost parallel sided, inner margin reflex and heavily sclerotised, tergal margins evenly curved (fig. 29). Gonangulum narrow, heavily sclerotised, attached to gonocoxa by an elongate membrane. First gonapophyses sclerotised, proximally with two (1+1) stylus-like projections (fig. 29). Second gonapophyses sclerotised, distally with a series of blunt projections. The two lobes of 2nd gonapophyses joined by a strong convoluted membrane, distally bluntly acuminate. Proximally attached to membrane, a pair of ramus terminating in two lobes (figs. 30, 31).

Legs (table 3): Male front femur, lower margin straight, inner surface of femur and tibia slightly flattened, tibia slightly produced distally, tarsi flattened (fig. 23). Middle femora more robust than hind femora. Antennal segments 1-4 male (fig. 24) 32 : 19.5 : 20 : 21.5, female 31 : 19 : 17 : 22.

Immature stages: Third (?) instar, partially cleared and slide mounted (figs. 36-39): Head pattern mostly dark brown with two pale areas anteriorly, posterior margin medially broadly pale brown. Antennae light brown, internodial pieces visible between segments 2-4 with a continuous fringe of hairs along outer margin (fig. 38). Pronotum largely dark brown, eyes very slightly overlapping antero-lateral margins of pronotum. Mesonotum with a complex pattern of light and dark brown linear stripes. Metanotum with two rectangular dark brown patches. First four tergites with pairs of dark brown blotches, distal segments uniformly pale brown (fig. 36).

Legs: Front leg uniformly pilose, tibia not produced distally (fig. 37). Ventral margin of femur and lateral margins of tibia with rows of prominent spines. Hind leg (fig. 39) femur moderately robust with a row of minute spine-like projections. Ventral margin with four trichobothria-like hairs arising from circular areas devoid of short fine hairs. Tibia and to a lesser extent tarsi covered with short fine hairs.

Fourth-5th instar, partially cleared and slide mounted (figs. 40-43): Posterior margin of head broadly pale yellowish brown, anteriorly with two (1+1) large triangular yellow blotches, remainder of head dark brown. Eyes not overlapping antero-lateral angles of pronotum. Distal lateral margins of head depressed with two (1+1) trichobothrial pits. Antennae brown, basal segment with scattered spines, fine hairs



Figs. 29-43. *Rheumatometroides browni*. – 29-31. Female, Kolombangara. – 29, ovipositor side view; 30, 2nd gonapophysis; 31, ventral aspect of 2nd gonapophysis. Scale line 0.5 mm. – 32-35. Male, Kapiura. – 32, terminal segments side view; 33, aedeagus; 34, internal sclerites; 35, paramere tilted aspect. Scale line 0.5 mm. – 36-43. Immature, Dami Creek. – 36, 40, dorsal aspect; 37, 41, front legs; 38, 42, antenna; 39, 43, hind legs. Scale line 1 mm.

Table 3. Proportions of leg segments of *Rheumatometroides browni* Hungerford and Matsuda.

	Femur	Tibia	Tarsus I	Tarsus II
Male front leg	34.5	32	4	15
Female front leg	37	31	4	17
Male middle leg	90	111	35	32
Female middle leg	94	118	37	36
Male hind leg	96	34	5.25	12
Female hind leg	102	40	7	13

Table 4. Proportions of leg segments of *Rheumatometroides browni* Hungerford and Matsuda. Immature stages.

	Femur	Tibia	Tarsus
Front leg	26	23	17
Middle leg	71	85	60
Hind leg	71	28	16

encircling distal end of segment. Remaining segments covered with fine hairs. Internodial pieces not conspicuous as in earlier instar (fig. 42). Antennal ratios 1-4 are 20 : 12 : 12 : 14. Pronotal shape similar to adult with two dark brown rectangles. Mesonotum tending towards pattern of adult. Metacetabula groove present along anterior margin close to posterior margin of metanotum. Metathoracic spiracle on lateral margin indicated by a dark brown spot. Metanotum large and pale brown, antero-laterally narrowly dark brown, posterior margin deeply concave. Abdominal segments narrowly marked with two (1+1) dark brown rectangular bars anteriorly. Legs: front femur curved and pilose, distally with a cluster of longer hairs. Tibia and tarsi covered with short fine hairs, tibia slightly produced distally (fig. 41). Hind leg moderately robust with four long trochobothria-like hairs arising from circular areas devoid of short fine hairs. Femur with a row of spine-like projections (fig. 43). Proportions of leg segments, see table 4.

Remarks. – The series from West New Britain compared with those from the Solomon Islands appear to be very similar externally, especially the colour pattern and general external morphology. The differences noted in the female ovipositor and ancilliary structures of the two populations (shape of gonocoxal plate, length of paired styli, distribution of blunt serrations and apparent absence of a ventral spatulate projection on 2nd gonapophyses, as figs. 27, 29), principally may indicate that the form from West New Britain may be distinct from the Solomon Islands form. The male genitalia appear to offer little to support this hypothesis at present.

MISCELLANEOUS BIOLOGICAL NOTES

Between 23 February and 16 March, *R. serena* was collected on a number of occasions. The first specimen was recorded on 22 February, when a female was collected from beneath the CRI jetty walkway at 5 pm. Subsequent searches for a number of days starting at 7 am through to late afternoon failed to find any more specimens in the intertidal zone and more exposed areas, although occasional specimens were seen most days in late afternoon in the shade of the walkway. Scattered adult *Halobates* Eschscholtz (Gerridae) and aggregations of *Halovelia* Bergroth s. l. (Veliidae) (adults and immatures) were frequently seen. Eventually numbers of *R. serena* were found in the interstices of a coral rubble wall built to prevent erosion (8-9 March). This species appears to shun direct sunlight and exposed areas. A number of samples were collected at light (mvlt) between 25 February and 16 March. The light was run between 8-9.30 pm from the end of the jetty over water always in excess of two m deep. The largest number was found on 27 February (11 males, 6 females, 28 immatures), low tide 1.2 m, high tide 1.45 m, and on 1 March (10 males, 14 females, 10 immatures), low tide 1 m, high tide 1.5 m. It is not clear if the samples taken at light came from the populations living amongst the coral rubble, or another population which was living beneath the main landing stage. This structure is supported by a series of piers made of tyres filled with concrete. Between each tyre a layer of concrete was used, which has numerous crannies. The area around the landing stage provides shelter for many *Halobates* and veliids. A mvlt sample collected on 13 March included approximately 70 adult and 360 immature *Halobates* and about 200 veliids. An aggregation taken on 1 March during daylight within one m of shore included 200 immature *Halobates*, 500 *Halovelia* adults and 1700 immature, but no *Rheumatometroides*.

Colonies of *Halovelia* were set up in large tanks to study their behaviour. Inadvertently small numbers of *R. serena* were also introduced. Veliid mortality was extremely high under these conditions, whereas the gerrids survived. Adult *R. serena* were watched grooming, the tip of the rostrum is ‘cleaned’ with the tarsi of the front legs, longer middle legs are used to groom the hind legs. At rest, the gerrid supports itself on the tarsi. The first antennal segment is held curving outwards, the second and third are always aligned in a more or less straight line, the fourth curved over at internodial piece, the alignment forming a shallow sickle-like outline. Live gerrids which were inadvertently transferred to diluted sea water quickly succumbed and drowned in the laboratory. *Rheumatometroides browni* appears to be far more tolerant of lower salinities. Specimens were found up to

200 m upstream in West New Britain, Tamari Creek. Habitat preferences from both regions (Solomon Islands and West New Britain) seem to be similar, *R. browni* occurring in the zone where freshwater flows into the sea. At Dami Creek, at low tide the creek appears not to receive any inflow of sea water, but the freshwater continues to flow down the beach into the sea (pers. obs.).

Rheumatometroides tends to skate across the surface in a series of short fast spurts. Unlike *Halobates*, it does not leap across the water to avoid the net. The colony living amongst the coral rubble proved difficult to collect as individuals would run across the rubble hiding in small cracks or getting behind the rubble where the substrate was moist. Between 22 February and 16 March no pairs were seen in copula and no females were seen ovipositing.

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REVISION OF *LIMNOMETRA* MAYR (GERRIDAE) IN THE MALAY ARCHIPELAGO

Notes on Malesian aquatic and semiaquatic bugs (Heteroptera), II

N. Nieser & P. Chen, 1992. A revision of *Limnometra* Mayr (Gerridae) in the Malay Archipelago. Notes on Malesian aquatic and semiaquatic bugs (Heteroptera), II. – Tijdschrift voor Entomologie 135: 11-26, figs. 1-60, table 1 [ISSN 0040-7496]. Published 15 July 1992.

A key to the species of *Limnometra* in Indonesia and E. Malaysia and new distributional data are presented. Nine new species of *Limnometra* are described: *L. aploa, L. arachnis, L. lepta* and *L. melanochroa* from Sulawesi, *L. genitalis* from Pulau Buton, *L. pseudoinsularis* from Kalimantan, *L. hysterema* from New Britain, *L. monochroma* from Guadalcanal and *L. poliakanthina* from Queensland (Australia).

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Key words. – Sulawesi; Buton; Kalimantan; Papua New Guinea; Solomon Is.; Australia; Gerridae; *Limnometra*; key; new species.

Representatives of the gerrine genus *Limnometra* are restricted to tropical Asia, although three specimens have been recorded from Tanzania (Hungerford & Matsuda 1958). We presume that the specimens from Africa are incorrectly labelled, since they belong to a large species never collected in that area again.

The present paper is mainly based on material recently collected in Sulawesi, where several species occur as a frequent component of the surface fauna of streams. When we started working up the material it soon turned out that we had several new species at hand. The examination of unidentified material from Malesia in several museum collections revealed even more species, so that we decided to report on this genus separately. A paper on the remaining Gerridae from Sulawesi is in preparation.

MATERIAL AND METHODS

Specimens from Sulawesi were mainly collected by J.P. Duffels (ZMA), J. van Tol (RMNH) and N. Nieser. Localities sampled by Nieser have numbers starting with N89 followed by two digits. All were taken in Sulawesi Tenggara (SE Sulawesi) and Buton in 1989. Details of localities can be found in Nieser & Chen (1991). In addition, specimens from G. Zimmermann's collection (ZC), collected within the framework of Project Wallace 1985, and by Dr. I. Lansbury (OXUM) from other places in Southeast Asia have been studied.

Although the number of species in the genus *Limnometra* is apparently large, there are very few distinctive characters. The colour pattern on head and thorax, which is usually very striking, is, apart from a few exceptions, very uniform. The parameres are all of the same shape, small, rod-like with the base slightly broader than the apex. The general shape of the genital segments is also quite similar in most species. In various cases identification has to rely on relative measurements, pilosity of the legs and annulation on legs and antennae. In addition, we found that the endosomal sclerites, especially the lateral pair, provide specific characters in some cases. For this purpose the endosoma has to be cleared, for which we used hot 10% KOH, and made free from the basal plate and phallotheca which enclose it. As the endosoma has to be studied from various angles, permanent microscopic slides are less appropriate than keeping it in a drop of glycerin in a microvial. There are usually four sclerites, a medio-dorsal and a ventral one, which are usually seen as one sclerite forming a wide arc within the endosoma. Secondly, there is a symmetrical pair of smaller lateral sclerites. We consider the open end of the arc as posterior and the thicker posterior Y-shaped part of the arc as dorsal, which corresponds to the active condition of the endosoma.

Measurements are in millimeters, presented as the range or the average value of five specimens (of each sex). Measurements were taken from specimens of the sample containing the holotype. In case of small samples additional specimens from other sites were used. The width of the head is measured across the eyes, the thoracic width is measured across the mesoacetabula.

Depositories

NC	Nieser collection, Tiel, The Netherlands.
OXUM	Oxford University Museum, England.
RMNH	National Museum of Natural History, Leiden, The Netherlands.
SNOW	Snow Entomological Collections, Lawrence, Kansas, U. S. A.
ZC	Zimmermann collection, Marburg, B.R.D.
ZMA	Zoological Museum, Institute of Taxonomical Zoology, Amsterdam, The Netherlands.

A pair of reference specimens of the Sulawesi species was sent to Museum Zoologi Bogor (Indonesia) and J. T. Polhemus collections, Englewood, Colorado (U. S. A.), when sufficient material was available.

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Thanks are due to R. Brooks (SNOW), J. Duffels (ZMA), I. Lansbury (OXUM), J. van Tol (RMNH) and G. Zimmermann (ZC) for the loan of specimens.

TAXONOMIC PART

Limnometra Mayr belongs to the Gerrinae and contains medium-sized to large species, which are commonly seen on streams in Southeast Asia. Some workers, e.g. Hungerford & Matsuda (1958), consider it to be a distinct genus, while Matsuda (1960) and Andersen (1982) rank it as a subgenus in *Tenagogonus* Stål. Although *Limnometra* and *Tenagogonus* are structurally very close, due to reduction of the abdomen in *Tenagogonus*, they can be kept apart at first sight. For our present purpose the actual taxonomic status is not important. *Limnometra* and *Tenagogonus* can be distinguished from other SE Asian Gerrinae by the following set of characters (adapted from the key by Andersen 1982): Length less than 25 mm. Pronotum with a dark median stripe, venter generally pale. Third segment of rostrum reaching mesosternum. Metasternum without lateral scent channels (from scent orifice to metacetabula), metathoracic spiracle located much more than its own length away from base of fore wing.

The difference between *Limnometra* and *Tenagogonus* is as follows (adapted from Hungerford & Matsuda 1958):

1. Connexival spines normal, as in fig. 37 (except *L. minuta* Mayr from Nicobar Islands). Male abdomen not reduced. Last ventral abdominal segment plus genital segments shorter than preceding four segments. Hind coxae of male rarely extending beyond middle of second ventral abdominal segment .... *Limnometra*
– Connexival spines reduced. Male abdomen reduced. Ventral abdominal segments short, last segment plus the genitalia at least as long as preceding four segments, usually longer. Hind coxae of male nearly reaching or surpassing posterior margin of second ventral abdominal segment .... *Tenagogonus*

Key to males of Malesian *Limnometra*

1. Eight large black spots on venter (character holds for female too), connexival spines shorter than first genital segment .... *L. octopunctatus*
– Usually only one black spot in front of mesoacetabula, connexival spines longer 2
2. Moderately small species. Head width usually under 1.8 mm 3
– Larger species, head width usually over 1.8 mm 6
3. Front femur as slender as middle femur 4
– Front femur broader than middle femur .... *L. borneensis*
4. Middle femur with a fringe of cilia about half as wide as femur .... *L. bruneiensis*
– Middle femur without a fringe of cilia (small spines and sparse hairs present) 5
5. Lateral endosomal sclerite parallel-sided (fig. 44) .... *L. pseudoinsularis*
– Lateral endosomal sclerite bulky in central part (fig. 6) .... *L. insularis*
6. Antennae, middle and hind femur unicolorous, the latter not paler near tip 7
– Antennae, middle and hind femur not unicolorous, hind femur pale near tip, or some antennal segments at least partly whitish 8
7. Ventro-posterior margin of first genital segment distinctly produced laterally. Middle femur with a short black line dorsally near base (holds in female too, but may be inconspicuous in specimens with dark femur) .... *L. ciliata*
– Rear margin of first genital segment with only a faint production laterally. Middle femur without the dorsobasal black line .... *L. cursitans*
8. Middle femur with a long and curved blunt spine at short distance from apex, two rows of small pegs .... *L. femorata*
– Middle femur without a large curved spine near apex (not to be confused with smaller sharply pointed apical spurs) 9
9. Both middle and hind femur with a conspicuous fringe of cilia 10
– Hind femur without a conspicuous fringe of cilia 11
10. Fore femur slender, ratio L/W over 20, without subapical indentation, ventrally with a dense fringe of cilia two thirds the width of femur .... *L. lepta*
– Fore femur broader, ratio L/W about 16, with a distinct subapical indentation, ventral fringe of

cilia about half the width of femur .... *L. pulchra*

11. Fore femur not broader than middle femur ... 12
– Fore femur broader (1.3× or more) than middle femur 16
12. Fore femur ventrally with conspicuous dense pubescence 14
– Fore femur without conspicuous pubescence 13
13. Segments of fore tarsus of subequal length (species keyed out twice as its head width centres around 1.8 mm) .... *L. bruneiensis*
– First segment of fore tarsus distinctly (1.2×) longer than second .... *L. kallisto*
14. General colour medium to dark brown, with pale yellowish spots dorsally at sutures of connexival segments; apical row of small pegs ranging over more than half the middle femur ....*L. melanochroa*
– General colour yellowish to light brown, sutures of connexiva not marked by light spots; apical row of small spines on middle femur short 15
15. Hind femur slightly (1.03×) longer than middle femur, both longer than body ...... *L. nigripennis*
– Hind femur distinctly (1.1×) longer than middle femur, which is slightly shorter than body .... *L. submarginalis*
16. Second antennal segment subequal (up to 1.1× as long as) width of head 17
– Second antennal segment longer (1.2×) than width of head .... *L. arachnis*
17. In ventral view first genital sternite (S8) about 1.5 times as long as second (pygophore, Pg): in dorsal view S8 covering Pg completely, only tip of proctiger (Pr) visible .... *L. genitalis*
– In ventral view S8 subequal to or shorter than Pg, dorsally both Pg and Pr visible 18
18. Fore femur relatively slender, its length 10 times its width, width of fore femur about 1.4× the width of middle femur .... *L. annulicornis*
– Fore femur stouter, its length about 7 times its width, width of fore femur about 1.7× the width of middle femur .... *L. aploa*

Limnometra annulicornis (Breddin)
(fig.1)

Gerris annulicornis Breddin, 1901: 83-85.
Limnometra annulicornis. – Hungerford & Matsuda 1958: 420-422, pl. 4 fig. 24, pl. 15, fig. 26.

Material. – Sulawesi Utara: Dumoga Bone N.P., Tumpah River, 900m, 23.ii.1985, 3 ♀, J.P. Duffels, project Wallace stat. 28 (zma); Dumoga Bone N.P., waterfall creek, tributary of Tumpah, UTM-XL0064, c. 225m asl., 23.iv.1985-B, 2 ♂, 2 ♀, J. van Tol; same Tumpah river nr. Edwards Subcamp, UTM-WL9365, c. 590 asl., 30.iv.1985, 1 ♀; same, 664m, at light, 3.vi.1985-A, 2 ♀, J. van Tol; same, brooklet c. 2 km W of Edwards subc., UTM-WL9265, 4.vi.1985-A, 1 ♂ 1 ♀, J. van Tol (rmnh); Dumoga Bone N.P., Toraut R., Maze, 7.xi.1985 3 ♂ 1 ♀, same 16/17.xi.1985, 6 ♂ 6 ♀, G. Zimmermann; Tumpah R., Sandinsel und Stromschnelle, 19.x.1985, 1 ♂ 2 ♀; waterfalls near Tumpah, 21.x.1985, 8 ♂, G. Zimmermann; 50 Km N Kotamobagu, thermal Quellen, 26.x.1985, 5 ♂ 6 ♀, G. Zimmermann (zc, nc). Sulawesi Selatan: Maros 1 ♂ 1 ♀ (rmnh).

Distribution. – Sulawesi.

Remarks. – Structurally very similar to *L. arachnis* sp. n. which is, however, distinctly larger. For further differences see under *L. arachnis.* The length of antennal segment related to width of head is rather fluid in this species. We have a male from Dumoga Bone NP, Toraut R., Maze, 16.ix.1985 with width of head 2.0, 2nd antennal segment of left antenna 1.9 and of right antenna 2.3 mm. The holotype has only one row of small pegs at apex of middle femur. Most specimens have, however, two short peg rows at apex of middle femur of male.

Limnometra borneensis Hungerford & Matsuda
(fig. 2)

Limnometra borneensis Hungerford & Matsuda, 1958: 407-408, pl. 2 fig. 12, pl.12 fig. 9.

Material examined. – Sarawak, Borneo, Mt. Pol, leg. Mjöberg 1 ♂ 1 ♀ paratypes. In addition: Mt. Tibang, 1200m, 1 ♀, leg. Mjöberg 1925 (zma).

Distribution. – Previously only known by the type series from Sarawak.

Remarks. – The female from Mt Tibang is slightly larger than the paratypes, but seems to fit best with this species. The spool-shaped fore leg in the male is diagnostic. The lateral endosomal sclerites are also peculiar in that they are posteriorly broadened and incised (fig. 2). The posterior triangular part of pronotum seems to be somewhat shorter than in the very similar *L. insularis* Hf. & Mats. We need, however, longer series of fresh specimens of both species to verify whether this is a specific difference or is related to development of indirect flight muscles.

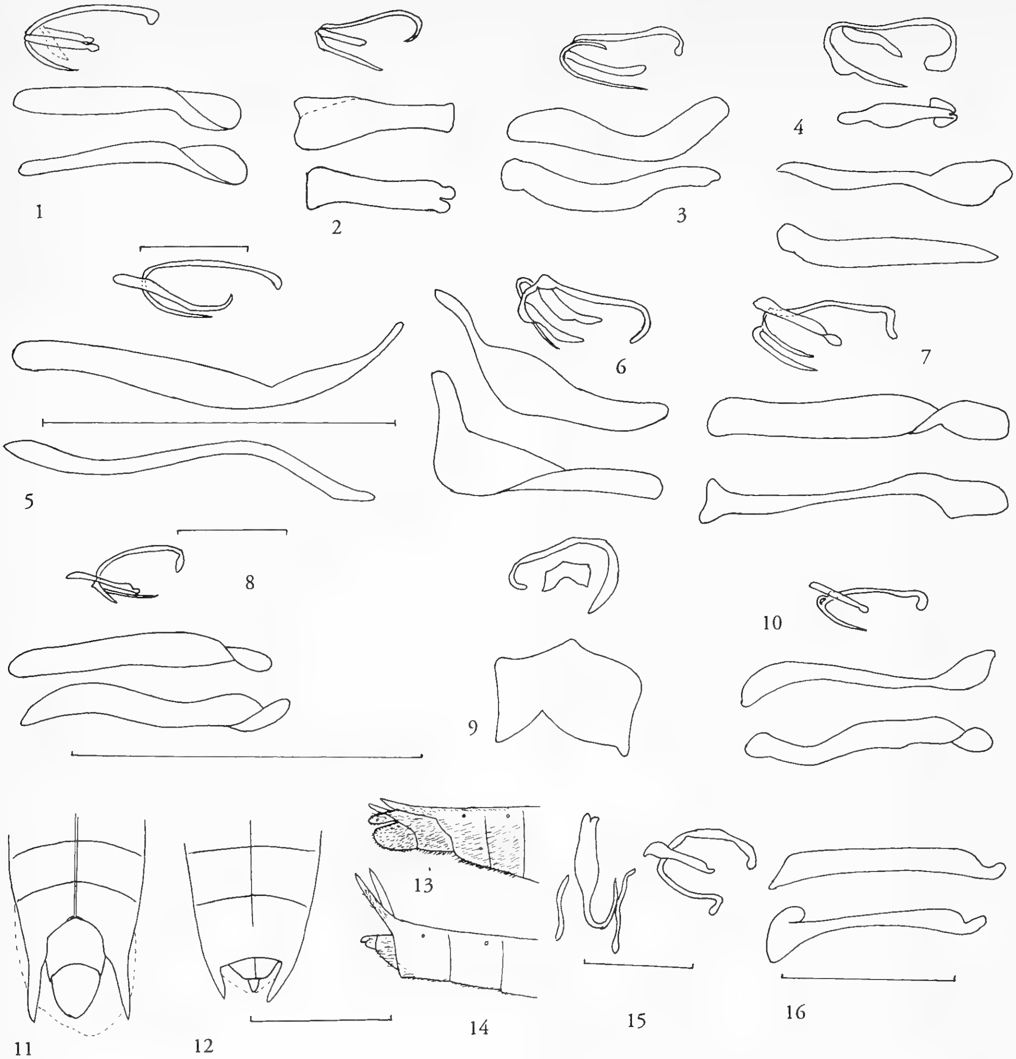
Limnometra bruneiensis Miyamoto
(fig. 3)

Limnometra bruneiensis Miyamoto, 1967: 229-232, figs. 24-29.

Material. – C. Borneo: Sg. Pijau, 1 ♂, leg. Mjöberg 1925; Malaysia: E. Sabah, 70 km S Lahad Datu, Danum Valley, main trail West 0 North 1-5, 150m, 7-9.xii.1989, narrow creeks in rainforest, 2 ♂ 1 ♀, leg. M.J. & J.P. Duffels sample Sabah 60 (zma).

Distribution. – N. and C. Borneo.

Remarks. – The types in Entomological Labora-



Figs. 1-10, Endosomal sclerites in *Limnometra*, upper: lateral view of median arc and lateral sclerite, lower: different views of lateral sclerite, scales 0.5 mm. 1, *L. annulicornis*, 2. *L. borneensis* (paratype), 3. *L. bruneiensis*, 4. *L. ciliata*, 5. *L. femorata*, 6. *L. insularis* (holotype), 7. *L. kallisto*, 8. *L. nigripennis*, 9. *L. octopunctata* (one view of lateral sclerite only), 10. *L. pulchra*. – 11-16: *L. aploa* (paratypes), 11-14 apex of abdomen, scale 2 mm, 11-12 ventral view, 11 ♂, 12 ♀, 13-14 lateral view, 13 ♂, 14 ♀; 15-16 endosomal sclerites, 15 median arc and lateral sclerite, left dorsal view, right lateral view, scale 0.5 mm, 16 different views of lateral sclerite, scale 0.25 mm.

tory of Kyushu University were, unfortunately, not available for study.

Limnometra ciliata Mayr
(fig. 4)

Limnometra ciliata Mayr, 1865: 44. – Hungerford & Matsuda 1958: 409-412, pl. 3 fig. 14, pl. 13 fig. 22 (redescription); Andersen 1964: 333.

Material. – • Viet Nam: Saigon (Than-Po Ho Chi Minh), 1.vii.1924, 1 ♀ E. le Moult (RMNH). – • Indonesia. Sulawesi Tenggara: Sungai Anggoro, 20.ii, N8901, 1 ♀; Kendari, 21.ii, N8903 5 ♂ 3 ♀; Pool near Sungai Sampara, 22.ii, N8910 2 ♂ 3 ♀ (2 ♀ apt.); small stream near S. Sampara, 22.ii, N8912 1 ♀; Jalan Asera, 24.ii, N8916 9 ♂ 17 ♀ (4 ♂ 6 ♀ apt.); Jalan Paku Jaya, 24.ii, N8920 2 ♀ (1 apt.); Tamborasi, 1.iii, N8925 1 ♂ 1 ♀; Road to Mowewe, 3.iii, N8933 3 ♂ 1 ♀ (2 ♂ 1 ♀ apt.); Teluk Kendari, 13.iii, N8946 1 ♂ 2 ♀, 3 lvV; Teluk Kendari, 13.iii, N8949 2 ♀. – P. Buton: Road to Lawele, 9.iii, N8939 3 ♀ apt. – Bali: garden ponds, 8.viii.1983, leg. N. Nieser 2 ♂ 1 ♀ apt. (NC). – N.E. Sumatra tusschen Serdang en Tobameer (between Serdang and Danau Toba), 2 ♀, Dr. B. Hagen; Sum[atra], Laula Slm., viii.1913, 2 ♀ apt., E. Jacobson; Sum. Kalung, xii.1913, 3 ♂ 5 ♀ apt., 1 ♀ macr., Le Moult; S. Coast, Palabuhan Ratu, 4.xii.1976, 1 ♂ 2 ♀, P. H. van Doesburg. – NE Borneo, 1 ♂ apt. – • Malaysia. Sabah, 16 km NE Tenom Agr.Res.Stat. 115°59'E 5°11'N, TL, 180m, 11.vi.1986, 1 ♀ apt., leg. J. Huisman. – • Papua New Guinea: West New Britain, Tamari, rain water tank, 14.i.1989, 2 ♂; West New Britain, Buluma nr. Dami, rain water pit, 17.i.1989, 2 ♂ 2 ♀; West New Britain, Blalla Apulpu village, freshwater creek, 27.i.1989, 1 ♂; Milne Bay prov. , South of Alotau, *Pandanus*, shade, 29.ix.1989, 1 ♂, all leg. R. N. B. Prior (OXUM, NC). Macropterous unless otherwise stated, most females with eggs.

Distribution. – Widespread. Thailand and Malaysia through Indonesia and Philippines to Guam, Solomon and Fiji Islands.

Remarks. – The males from Bali are even smaller than the small specimens recorded by Andersen (1964), body length 11.0 and 11.5 respectively.

Limnometra cursitans (Fabricius)

Gerris cursitans Fabricius, 1794: 192.
Limnometra cursitans. – Hungerford & Matsuda 1958: 413, pl.5 fig.28, pl.14, fig.23.

Material. – Irian Jaya, Bernhard camp, 50m, vii.1938, 1 ♀, J. Olthof (Neth. Ind-American New Guinea Expedit.) (-RMNH); Teluk Bintuni, Babo, 13.viii.1941, 1 ♀, E. Linquist (NC).

Distribution. – New Guinea and Australia (Queensland).

Limnometra femorata Mayr
(fig. 5)

Limnometra femorata Mayr, 1865: 443. – Hungerford & Matsuda 1958: 413-415, pl. 5 fig.27, pl. 13 fig. 21 (redescription), Cheng & Fernando 1969: 106-107, fig. 72-83.

Material. – NE Sumatra: Kuala Simpang, lowland forest, iv.1954, 2 ♀; Seleh Kuala Simpang, lowland forest, iv.1954, 1 ♂ 4 ♀, A. Sollaert (RMNH), all macropterous.

Distribution. – A widespread species: Malaysia (Perlis, Selangor), Philippines, Borneo and Banguey. New record for Sumatera.

Limnometra insularis Hungerford & Matsuda
(fig. 6)

Limnometra insularis Hungerford & Matsuda, 1958: 404-405, pl. 4 fig. 21, pl. 11 fig. 17. – Cheng & Fernando 1969: 105-106, fig. 60-71.

Material. – We have studied the holotype from Sumatera (Serdang, Tanjong Morawa, Hagen) and a paratype female from Jawa (Arjeano) from SNOW.

Distribution. – W. Malaysia, Sumatera and Jawa. Two reported females, one from an island near Borneo and one from Myanma may belong to a different species.

Remarks. – A small species, male length 11.8 mm, width of head 1.64 mm. General colour light brown with an orangeish tinge, with a striking pale yellow band all along the lateral margin of pronotum. Similar to *L. borneensis*, which has, however, a different shape of front femur and lateral endosomal sclerites (figs. 3, 6). *L. pseudoinsularis* is also very similar, only the form of lateral endosomal sclerites (fig. 44) is quite distinct.

Limnometra kallisto (Kirkaldy)
(fig. 7)

Gerris kallisto Kirkaldy, 1899: 506.
Limnometra kallisto. – Hungerford & Matsuda 1958: 422-424, pl.5 fig.31, pl.16 fig.27 (redescription)

Material. – • Indonesia: Irian Jaya, Bernhard Camp B., 100m, 13.iv.1939, L. J. Toxopeus (Neth. Ind.-American New Guinea Exp.) 7 ♂ 4 ♀ (RMNH); N. N. Guinea, Pionierbivak, vi-vii.1920, W. C. van Heurn, 1 ♂; Beaufort 14.ii.1913, Versteeg, 1 ♀ (ZMA). – • Papua New Guinea: Milne Bay prov., South of Alotau, *Pandanus*, shade, 29.ix.1989, 1 ♂ 1 ♀ leg. R. N. B. Prior (OXUM, NC).

Distribution. – Misool (Mysol), New Guinea, New Britain and Solomon Islands. Hungerford & Matsuda (1958) place Misool in the Maluku. However, biogeographically as well as both under Dutch and Indonesian administration it belongs (c. q. belonged) to New Guinea.

Limnometra nigripennis Mayr
(fig. 8)

Limnometra nigripennis Mayr, 1865: 443. – Hungerford & Matsuda 1958: 415-418, pl.4 fig.26, pl.14 fig.24; Andersen 1967: 262.

Material. – We have seen 1 ♂ 1 ♀, apterous from Palawan (Philippines), reported by Andersen (1967).

Distribution. – Widespread in the Philippine Islands, including the southern part of Mindanao. To be expected in the islands north of Sulawesi.

Limnometra octopunctata Hungerford
(fig. 9)

Limnometra octopunctata Hungerford, 1955: 67-68. – Hungerford & Matsuda 1958: 400-401, pl. 4 fig. 22, pl. 10 fig. 13; Andersen 1964: 329; Cheng & Fernando 1969: 107-108, figs. 84-93.

Material. – Sulawesi Tenggara: Near Sungai Sampara, 22.ii, N8912 1 ♀; Tamborasi, 1.iii, on the sea, between boulders, N8925 1 ♀.

Distribution. – W Malaysia, NE Sumatera and Sulawesi Tenggara (new record).

Limnometra pulchra Mayr
(fig. 10)

Limnometra pulchra Mayr, 1865: 443-444. – Hungerford & Matsuda 1958: 418-419, pl. 4 fig. 23, pl. 15 fig. 25.

Material. – Maluku: Bacan Wayana, logged forest and camp, alt. c 50m, 05/16.vi.1985, J. Huijbregts, 4 ♂ 2 ♀ (RMNH); Buru, Station 13, 28.viii-4.ix.1921, L. J. Toxopeus 1 ♂ 1 ♀ (ZMA).

Distribution. – Maluku. The record 'Celebes; Halmaheira' by Hungerford & Matsuda (1958) is confusing, as Halmaheira is not on Sulawesi, but one of the islands of Maluku (the Moluccas). Actually there are two records outside Maluku (Hungerford & Matsuda 1958): the type locality 'Java' and 2 ♂ 2 ♀ from 'Jawa Gunung Gede(h), Frühstorfer'. The label of the type seems to be a mistake of Mayr (1865) as the type series bears labels 'Amboina, Dr. Doleschal 1859'. Frühstorfer's labels are reported to be quite often incorrect. It is unlikely that this species occurs on Jawa because it should have been collected more often.

Limnometra submarginalis (Miyamoto)

Tenagogonus (Limnometra) submarginalis Miyamoto, 1967: 226-229, figs. 18-23 [not available for study].

This species is only known by the type series from N. Borneo. None of our specimens agrees with the description.

Limnometra aploa sp. n.
(figs. 11-16)

Type material. – Holotype ♂: Sulawesi Tengah, SW Luwuk, between Desa Seseba and Singsing Camp (±1°09'S 122°31'E), 80m, narrow stream in lowland rainforest, 14.x.1989, leg. J. P. Duffels (Sul12) (ZMA). – Paratypes, same data as holotype, 10 ♂ 9 ♀ (including allotype, 3 ♂ brach) (ZMA); Taki Lalang, small brooklet, 20.x.1989, 2 ♂ 1 ♀, leg. J. vanTol. – Sulawesi Tenggara: Road Lalimboe km 4, 21.ii.1989, N8903, 2 ♂ 1 ♀; Jalan Paku Jaya, 24.ii.1989, N8920 4 ♂ 3 ♀ (1 ♂ 1 ♀ SNOW); Sungai Kolaka, 27.ii.1989, N8921B, 1 ♂ 1 ♀; rd. Kolaka Kendari km 20, stream, 3.iii.1989, N8934 1 ♂ ♀; Sungai Mokowu 17.x.1989, 2 ♂ 5 ♀, same, 30.x.1989, 1 ♂, leg. J.van Tol (89JvT24); NE Kolaka, nr. G. Watuwila, Mokowu Camp along Mokowu river, 200m, disturbed lowland rainforest, 3 ♂ 4 ♀ (1 ♂ brach), leg. J. P. Duffels (Sul.24). Macropterous unless otherwise specified.

Description

Macropterous specimens. – Dimensions. Length ♂ 10.8-12.0, ♀ 10.5-11.6; width of head ♂ 1.80-1.97, ♀ 1.80-1.92; humeral width of pronotum ♂ 1.95-2.20, ♀ 1.90-2.02; thoracic width ♂ 3.15-3.50, ♀ 2.90-3.26.

Colour. Basic colour dark yellow to light dull brown, head and thorax with the normal pattern of blackish stripes. Antennae medium brown, apical third of second segment yellowish, not very contrasting. Fore femur and tibia light brown with variable longitudinal medium brown stripes on inner and outer faces, tarsus darker. Middle and hind legs light to medium brown, femora with yellow apical ring, not very contrasting. Hemielytra medium brown, veins dark brown to blackish. Venter pale yellow, whitish ciliation dense on thoracic, loose on abdominal venter.

Structural characters. Length of antennal segments I : II : III : IV, male 2.4 : 1.55 : 2.7 : 3.4, female 2.05 : 1.3 : 2.2 : 3.2. Second antennal segment shorter (0.9) than width of head in male, more distinctly so in female. Fore femur in male broader (1.5) than middle femur, slightly flattened ventrally, no conspicuous pubescence, with wide, shallow subapical indentation. Fore femur in female only slightly broader than middle femur. Middle femur of male with a fringe of cilia less (0.8) wide than femur, apically with two short rows of small pegs, inner row with 4-6, outer row with 2-4 pegs. Middle femur in female and hind femur in both sexes with short cilia only. Thoracic and abdominal venter, including male genital segments with long cilia, more dense and obvious in male than in female, looser on abdomen than on thorax.

Male. Middle and hind femur slightly (0.90 and 0.94 respectively) shorter than body. Hemielytra just reaching beyond the apices of connexival spines in most specimens. Connexival spines more or less parallel and horizontal, reaching to or up to 0.25 of their length beyond apex of genital segments. Median length of last two abdominal sternites subequal, shorter (0.85) than median length of first genital segment in ventral view. Endosomal sclerites figs. 15-16.

Female. Hind border of pronotum with a prominent fringe of dark hairs (a few shorter ones present at apex of pronotum in males). Middle and hind femur distinctly shorter than body. Hemielytra reaching halfway connexival spines. Last abdominal sternite along median line longer (1.2) than penultimate sternite and twice as long as genital sternites. Genital segments small, short, reaching at most halfway connexival spines. Connexival spines long, distinctly pointing dorsally (fig. 14), somewhat converging.

Brachypterous form. As macropterous, except for slightly reduced pronotum, humeral width 1.8 and hemielytra onto abdominal tergite 5.

Etymology. – Aploos (Greek adjective meaning simple) refers to the lack of striking characters in this species.

Comparative notes. – At first sight *L. aploa* looks like small specimens of *L. genitalis* sp. n. Apart from the smaller average dimensions, the genital segments and female connexival spines are relatively smaller and middle and hind femur shorter than length of body in *L. aploa*. *L. aploa* differs from *L. annulicornis* Breddin, also known from Sulawesi, by its smaller size, the fourth antennal segment distinctly longer (1.3× longer than the first (subequal in *L. annulicornis*), the connexival spines in the female pointing dorsally, and the shape of the endosomal sclerites (figs. 1, 15-16).

Limnometra arachnis sp. n.

(figs. 17-22)

Type material. – Holotype ♂, Sulawesi Tenggara, rd. Kolaka Kendari km 20, stream, 3.iii.1989, leg. N. Nieser N8934 (RMNH). Paratypes, same data as holotype 9 ♂ 7 ♀ (NC, 1 ♀ allotype RMNH); Sungai Mokowu, 30.x.1989, J. vanTol 1 ♂ 3 ♀ (RMNH); NE Kolaka, nr. Gng. Watuwila, Mokowu Camp along Mokowu River, 200m, disturbed lowland rainforest, 29-31.x.1989, J.P. Duffels, Sul. 24, 1 ♂ 3 ♀; Centipede Camp, (c. 3°49'S 122°31'E), nr. Gng. Watuwila, 1100m, undisturbed hilly rainforest, narrow stream, 2-5.xi.1989, J. P.Duffels, Sul. 30, 1 ♂; Sulawesi Tengah: Sungai Batui, 17.x.1989, J.v.Tol 1 ♂ 4 ♀; P.Buton: Jismil camp, 18.XI.1989, J. vanTol, 1 ♂ 2 ♀ (-RMNH).

Additional specimens. – P. Buton, Jismil camp, 13.xi.1989, J. vanTol 1 ♂ 1 ♀ (not made paratypes because third antennal segment is also whitish in apical half and the male is 15 mm long). All macropterous, most females with eggs.

Description

Dimensions. Length ♂ 16.5-17.5, ♀ 13.5-14.8; width of head ♂ 2.3-2.5, ♀ 2.08-2.12; humeral width of pronotum ♂ 2.8-3.0, ♀ 2.3-2.4; width across mesoacetabula ♂ 4.1-4.6, ♀ 3.6-3.8.

Colour. Basic colour dark yellow to light orangeish, posterior lobe of pronotum light brown, hemielytra medium brown, head and thorax with the normal pattern of blackish stripes. Antennae and legs light to medium brown, fore femur and tibia with a pair of distinct darker longitudinal stripes. Apical half of second and apical five sixth of fourth antennal segments and apices of middle and hind femurs and tibiae very pale yellowish to whitish. Venter pale yellow, with dense short whitish ciliation becoming longer and more loose on abdominal venter, less distinct in female than in male.

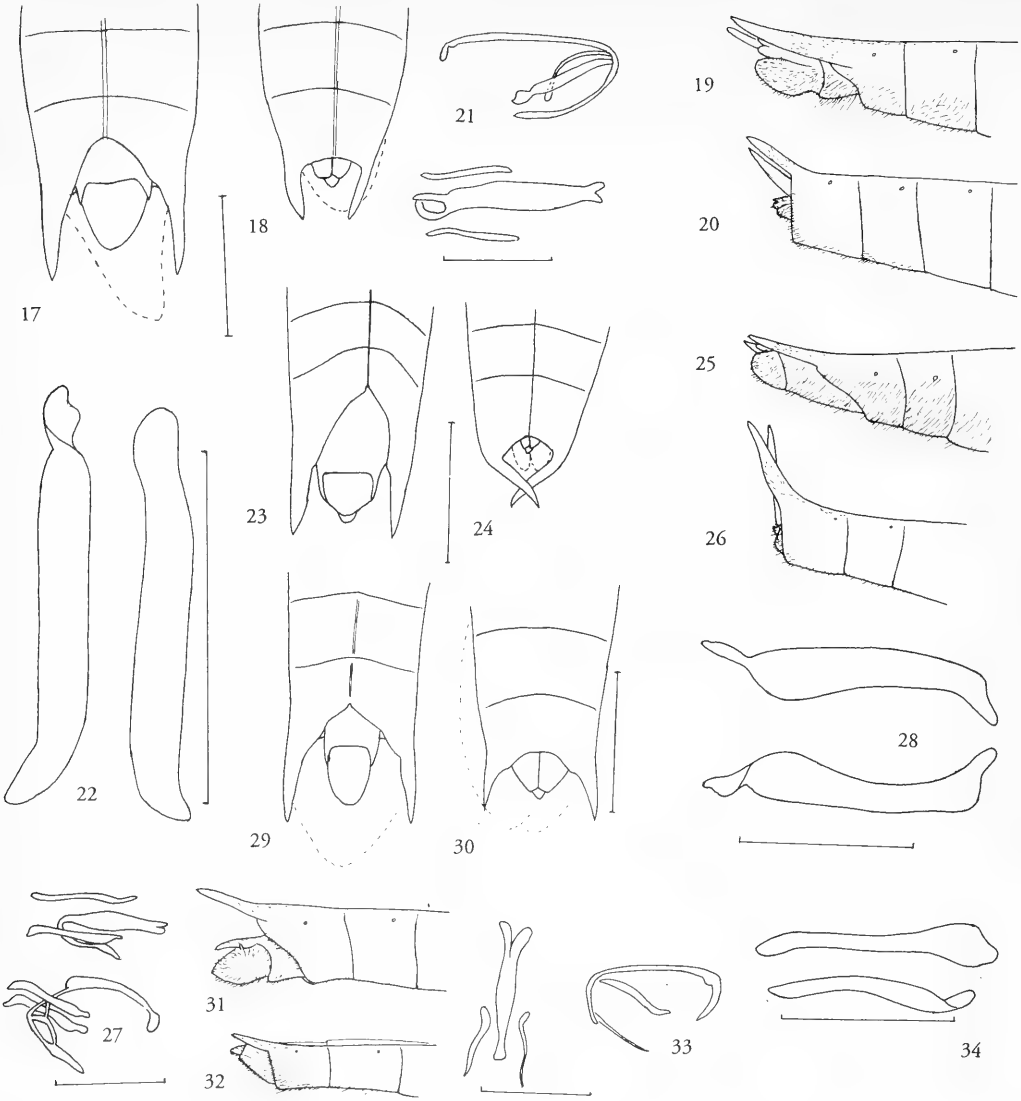
Structural characters. Length of antennal segments I : II : II : IV, male 4.1 : 2.6 : 3.5 : 3.6, female 2.7 : 1.7 : 2.5 : 2.9. Second antennal segment longer (1.08) than width of head in male, shorter (0.8) in female. Fore femur broader (1.3) than middle femur, slightly flattened ventrally, with dense short pubescence and wide, shallow subapical indentation (slightly less obvious in female). Middle femur of male with a fringe of cilia which is in the middle part about as wide as femur, apically with two short rows of small black pegs, inner row with 9-12, outer row with 4-8 pegs. Middle femur in female and hind femur in both sexes with short cilia only. Hemielytra reaching beyond the apices of connexival spines in males, just reaching connexival apices in female. Thoracic and abdominal venter, including male genital segments with quite long cilia, more dense and obvious in male than in female, looser on abdomen than on thorax. Abdominal venter with a distinct median carina over its whole length. Connexival spines long, reaching well beyond genital segments.

Male. Middle and hind femur slightly (1.05 and 1.1 respectively) longer than body. Connexival spines more or less parallel and horizontal, reaching one third of their length beyond apex of genital segments. Median length of last abdominal sternites subequal to first genital, shorter (0.65) than median length of penultimate abdominal sternite in ventral view. Endosomal sclerites figs. 21-22.

Female. Middle and hind femur distinctly shorter (0.8) than body. Last abdominal sternite along median line slightly longer (1.05) than penultimate sternite and more than twice as long as the small, short, genital segments. Connexival spines reaching half their length beyond apex of genital segments, slanting upwards by about 30°, (fig. 20), somewhat converging.

Etymology. – Arachnis (greek noun in apposition meaning spider) refers to the spidery impression these animals make when floating on the water.

Comparative notes. – Similar to *L. annulicornis* Breddin also from Sulawesi which is, however, smaller, has in male second antennal segment shorter than width of head and middle and hind femur slightly shorter than body. Females of *L. annulicornis* have the genital segments relatively larger.



Figs. 17-22. *L. arachnis* (paratypes), 17-20 apex of abdomen, scale 2 mm, 17-18 ventral view, 17 ♂, 18 ♀, 19-20 lateral view, 19 ♂, 20 ♀; 21-22 endosomal sclerites, scale 0.5 mm, 21 median arc and lateral sclerites, above lateral view, below dorsal view, 22 different views of lateral sclerite. – figs. 23-28. *L. genitalis* (paratypes), 23-28 apex of abdomen, scale 2 mm, 23-24 ventral view, 23 ♂, 24 ♀, 25-26 lateral view, 25 ♂, 26 ♀; 27-28 endosomal sclerites, 27 median arc and lateral sclerites, scale 0.5 mm, above dorsal view, below lateral view, 28 different views of lateral sclerite, scale 0.25 mm. – figs. 29-34: *L. lepta*, 29-32 apex of abdomen, scale 2 mm, 29-30 ventral view, 29 ♂ (holotype), 30 ♀ (paratype), 31-32 lateral view, 31 ♂, 32 ♀; 33-34 endosomal sclerites (paratype), 33 median arc and lateral sclerites, scale 0.5 mm, above dorsal view, below lateral view, 34 different views of lateral sclerite, scale 0.25 mm.

Limnometra genitalis sp. n.
(figs. 23-28)

Type material. – Holotype brachypterous ♂ P. Buton, cascade stream, 10.iii.1989, leg. N. Nieser N8942 (RMNH). – Paratypes, same data as holotype: 5 ♂ brach., 5 ♂ 6 ♀ macr. (1 ♀ allotype RMNH, 1 ♂ 1 ♀ macr. ZMA); Buton, rd. Bunga stream, 8.iii.1989, N8935 4 ♂ brach., 10 ♂ 8 ♀ macr. (1 ♂ macr. RMNH); small cascading stream near sea, 9.iii.1989, N8941 1 ♂ brach., 5 ♂ 10 ♀ macr.; small stream in wet forest, 10.III.1989, N8944, 9 ♂ brach., 6 ♀ macr., all leg. N. Nieser (NC, 1 ♂ ZMA, 1 ♂ 1 ♀ JTPC).

Description

Macropterous specimens. – Dimensions. Length

♂ 13.2-14.4, ♀ 12.1-13.4; width of head ♂ 2.1-2.2, ♀ 1.9-2.1; humeral width of pronotum ♂ 2.2-2.4, ♀ 2.1-2.3; width across mesoacetabula ♂ 3.5-3.8, ♀ 3.3-3.7.

Colour. Basic colour dark yellow with an orangeish tinge, head and thorax with the normal pattern of blackish stripes. Antennae medium brown, apical third of second segment yellowish. Fore femur yellow with longitudinal medium brown stripes on inner and outer faces, tibia and tarsus medium brown. Middle and hind femur light brown with yellow apical ring. Middle tibia and tarsus medium brown, apical quarter of middle femur usually lighter. Hemielytra dull light brown, veins blackish. Venter pale yellow with rather long and dense whitish ciliation on thorax and abdomen, more prominent in male than in female.

Structural characters. Length of antennal segments I : II : III : IV, male 2.2 : 2.2 : 3.1 : 3.5, female 2.5 : 1.6 : 2.4 : 3.0. Second antennal segment slightly shorter (0.95) than width of head in male, more distinctly so in female. Fore femur in male broader (1.5) than middle femur, flattened ventrally, with thickened pubescence, with wide, shallow apical indentation. Fore femur in female only slightly broader (1.1) than middle femur, apical indentation indistinct. Middle femur with a fringe of cilia about as wide as femur in male, half as wide in female. Middle femur of male apically with two short rows of 4-6 small pegs each. Middle and hind tibia about as long as body or hind femur slightly longer. Hemielytra just reaching the apices of connexival spines in male, reaching halfway in female.

Male. Connexival spines more or less parallel and horizontal, reaching to or up to 0.25 of their length beyond apex of genital segments. Median length of last two abdominal sternites subequal or penultimate slightly longer. Median length of first genital segment in ventral view about 1.5 times median length of last abdominal sternite (fig. 23). Endosomal sclerites figs. 27-28.

Female. Hind border of pronotum with a prominent fringe of dark hairs (a few shorter ones present at apex of pronotum in males). Last abdominal sternite along median line longer (1.15) than penultimate sternite and about four times as long as genital sternites. Genital segments very small. Connexival spines long, distinctly pointing dorsally (fig. 26) and converging with tips touching or nearly touching in most specimens.

Brachypterous form (males only). – Essentially as macropterous but slightly smaller. Mean length macropterous 13.7, brachypterous 13.2. Humeral width of pronotum just narrower than width of head (in macropterous just broader). Hemielytra reaching slightly over base to halfway last abdominal tergite. Middle and hind femur slightly longer than body.

Etymology. – Genitalis (a latin adjective meaning fertile, marked out to propagate) refers to the large genital segments in male.

Ecology. – N89412, N8942 and N8944 are small streams at shaded hilly sites in forests. *L. genitalis* was found on quiet pools. N8935 is a larger more open stream (over 10m wide), also in forest, with a small artificial waterfall (probably to retain some water during dry periods).

Comparative notes. – This species runs to *L. annulicornis* and *L. kallisto* with the key by Hungerford & Matsuda (1958), but does not seem to be related. The long first genital segment in males and the strongly converging and upward pointing connexival spines in females separate this species from other *Limnometra.*

Limnometra lepta sp. n.
(figs. 29-34)

Type material. – Holotype ♂, Sulawesi Utara, Dumoga Bone N.P., Bank Toraut R. near Base Camp, 2.ii.1985, stat.6, lowland rainforest MV light trap, J. P. Duffels & J. D. Holloway (Project Wallace). – Paratypes 5 ♀ same data as holotype (ZMA, NC). All macropterous. Additional paratypes, Sulawesi Tengah, Sg Batui, 15.x.1989, J. vanTol, 89JvT024, 1 ♀ (RMNH); Dumoga Bone N.P., Toraut R., Maze, 7-17.xi.1985, leg. G. Zimmermann 10 ♂ 17 ♀ (ZC,NC, RMNH, SNOW). Strasse nach Malibagu Restaurant, Bach, 18.xi.1985, 1 ♀ (ZC).

Description

Dimensions. Length ♂ 15.1-18.4, ♀ 13.5-14.7; width of head ♂ 2.3-2.6, ♀ 1.98-2.01; humeral width of pronotum ♂ 2.3-2.6, ♀ 1.95-2.2; width across mesoacetabula ♂ 3.6-4.3, ♀ 3.1-3.4.

Colour. Basic colour dark yellow to light dull brown, thorax with the normal pattern of blackish stripes. Dark M-shaped figure on head incomplete, only lateral legs distinct. Antennae medium brown, third and fourth segment largely pale yellowish with a black spot on their articulation. Fore femur light to medium brown, longitudinal darker stripes indistinct. Middle and hind femur light tot medium brown, lighter apical ring not apparent. Hemielytra medium to dark brown, veins lighter, no costal or sub costal light band. Venter pale yellow, in male with whitish ciliation dense on thoracic, loose on abdominal venter.

Structural characters. Length of antennal segments I : II : III : IV, male 4.9 : 4.0 : 5.1 : 5.0, female 2.8 : 2.2 : 3.0 : 3.3. Second antennal segment distinctly longer (1.6) than width of head in male, less distinctly so (1.1) in female. Fore femur without subapical indentation, about as broad as middle femur, in male ventrally, with dense ciliation, about half as wide as femur. Fore femur in female, middle and hind femur in both sexes, without obvious ciliation. Middle femur in male apically with a short row of 5-9 small pegs at border of inner and dorsal surface. Hemielytra reaching to or somewhat beyond the apices of connexival spines.

Male. Middle and hind femur longer (1.1 and 1.2 respectively) than body. Connexival spines very slightly diverging, horizontal or slightly pointing dorsad, reaching about half their length beyond apex of genital segments. Median length of last abdominal and first genital sternites subequal, shorter (0.75) than penultimate abdominal sternite. Endosomal sclerites figs. 33-34.

Female. Middle and hind femur distinctly (0.7) shorter than length of body. Connexival spines parallel and horizontal to very slightly diverging and/or pointing upward, reaching about one fifth of their length beyond apex of abdomen. Median length of last and penultimate abdominal sternite subequal and about one third as long as genital sternites.

Etymology. – Leptos, a Greek adjective meaning slender, refers to the relatively slender body of this species.

Comparative notes. – In the key by Hungerford & Matsuda (1958) this species runs to *L. nigripennis*, but it is a much more slender species. From other similar species *L. lepta* differs by characteristics of width of fore femur and leg ciliation as indicated in the key. The apex of the abdomen of the male is very similar to that of *L. annulicornis* Mayr (Hungerford & Matsuda 1958, pl.15 fig. 26), with which it forms mixed populations in Dumoga Bone National Park. *L. annulicornis* differs, however, in having a stouter fore femur, middle femur distinctly ciliated and apex of middle and hind femur with distinct light bands.

Limnometra melanochroa sp. n.
(figs. 35-40)

Type material. – Holotype brachypterous ♂ Sulawesi Tengah: Palu, 60 km SE: Lore Lindu N.P, Danau Tambing and brooklets, UTM SJ95, 1600m asl., *Pandanus*, 7.xii.1985, J.van Tol (RMNH). – Paratypes same data as holotype 5 ♂ 5 ♀ (including allotype) brach.; Lore Lindu N.P., Rano Rano, 10 km NE Gimpu, 1600m, lower montane forest, 15.iii.1985, 4 ♂ 3 ♀ brach., 1 ♂ 1 ♀ macr. J. P. & M. J. Duffels, stat 42 (ZMA). – Sulawesi Tenggara: NE of Kolaka, Centipede Camp, c. 3°49'S 121°40'E nr Gng Watuwila, 1100m, undisturbed hilly rainforest, narrow stream, 2-5.xi.1989, 4 ♂ macr., leg. J.P. Duffels, stat. Sul.30 (ZMA).

Description

Brachypterous specimens. – Dimensions. Length ♂ 14.6-18.5, ♀ 13.6-16.0; width of head ♂ 2.1-2.4, ♀ 1.9-2.1; humeral width of pronotum ♂ 2.3-3.0, ♀ 2.2-2.5; width across mesoacetabula ♂ 3.8-5.0, ♀ 3.5-4.0.

Colour. Basic colour medium to dark brown, head and thorax with the pattern as usual in genus. Antennae brown, without obvious lighter annulation. Legs medium brown with darker stripes indistinct. Middle femur with distinct, quite narrow, yellow apical ring. Apical part of tibiae and tarsi of middle and hind legs yellowish. Hemielytra dull light brown, veins with blackish margins and lighter centre. Connexiva with pale yellowish patches dorsally at segmental sutures. Thoracic venter yellowish, abdominal venter light brown.

Structural characters. Length of antennal segments I : II : III : IV, male 3.8 : 2.5 : 3.35 : 3.2, female 2.7 : 1.6 : 2.2 : 2.7. Second antennal segment subequal to or longer than (1.0-1.2) width of head in male, shorter (0.85) in female. Fore femur parallel sided, as wide as middle femur, hardly flattened ventrally. Fore femur in male with a shallow apical indentation. Fore and middle femur in male with dense long ciliation ventrally, half as wide as femur on fore, as wide as femur on middle. Hind femur in both sexes and fore and middle femur in female with short pubescence only. Middle and hind femur slightly longer (1.1) than body in male, shorter (0.85) in female. Middle femur slightly longer than hind femur in most large and slightly shorter in most small specimens. Middle femur in male with a row of small pegs on apical two thirds of inner surface, towards apex this row becomes double. Thoracic and abdominal venter with dense longer cilia in male, short pubescence in female. Hemielytra reaching halfway tergite 7 in male and halfway tergite 6 to anterior margin of 7 in female.

Male. Connexival spines medium sized, horizontal and slightly divergent, reaching just beyond apex of genital segments. Median length of last abdominal sternite longer (1.4) than first genital sternite and shorter (0.8) than penultimate abdominal sternite. Endosomal sclerites figs. 39-40.

Female. Connexival spines medium sized, parallel and hardly pointing dorsally caudally, usually reaching to apex of proctiger. Median length of last abdominal sternite subequal to penultimate sternite and about two times as long as first gonocoxa.

Macropterous form. – Essentially as brachypterous except for well developed prothorax, humeral width of pronotum 1.3 times the width of head. Hemielytra reaching beyond the apex of abdomen, leaving tips of connexival spines uncovered in both sexes.

Etymology. – Melanochroos (a greek adjective meaning dark skinned) refers to the dark general colour compared to other species in the genus.

Ecology. – So far only known from altitudes over 1000m apparently in more or less undisturbed forest in SE and Central Sulawesi.

Comparative notes. – Due to its dark colour and pale markings on connexiva, *L. melanochroa* is, at first sight, similar to some species of *Aquarius*, e.g. *A. ventralis* (Fieber). Closer examination of colour pattern and the position of the metathoracic spiracle, however, assign this species to *Limnometra*. By its coloration it is not similar to any other *Limnometra*.

Limnometra pseudoinsularis sp.n.

(figs. 41-44)

Type material. – Holotype ♂, C. Borneo, Sg. Birang, Mjöberg 1925 (ZMA).

Description

Based on unique holotype ♂. – Dimensions. Length 10.4; width of head 1.73; humeral width of pronotum 1.68; width across mesoacetabula 2.62.

Colour. Basic colour pale brown. Dark pattern on head indistinct. Dark pattern on thorax as usual in genus. Antennae with segments I, II, basal third of III and IV light brown, apical parts of III and IV whitish. Legs light to medium brown. Middle and hind femur with rather indistinct yellow apical ring. Hemielytra greyish brown, veins darker. Venter pale yellow.

Structural characters. Length of antennal segments I : II : III : IV, 2.8 : 2.3 : 3.2 : 3.0. Second antennal segment longer (1.3) than width of head. Fore femur parallel sided, slightly narrower (0.9) than middle femur, hardly flattened ventrally, with short denser pubescence without apical indentation. Middle and hind femur with short pubescence only. Middle femur apically with 2 rows of 5-6 small pegs on inner surface. Middle femur slightly shorter (0.96) than body, hind femur subequal in length with body. Venter with sparse longer cilia on last abdominal sternite and genital segments only. Hemielytra reaching well beyond the apices of connexival spines. Connexival spines long, parallel and horizontal reaching a third of their length beyond the apex of genital segments. Median length of last and penultimate abdominal sternite subequal slightly longer (1.08) than first genital sternite. Endosomal sclerites figs. 43-44.

Etymology. – Pseudoinsularis a Latin adjective meaning 'false-insularis' refers to the similarity to *L. insularis*.

Comparative notes. – Very similar to *L. insularis*. The most distinct difference is in the lateral endosomal sclerite, which is parallel-sided in *L. pseudoinsularis*, and with a thickened central part in *L. insularis* (figs. 44, 6).

Limnometra monochroma sp.n.

(figs. 51-56)

Type material. – Holotype ♂ Papua New Guinea: West New Britain, Buluma nr. Dami, rain water pit, 17.i.1989, leg. R. N. B. Prior (OXUM). – Paratypes, 1 ♂ 1 ♀ same data as holotype (NC); West New Britain, Von River, Banaule Village, torrential habitat, 21.iii.1990, leg. I. Lansbury, 2 ♀ (OXUM).

Description

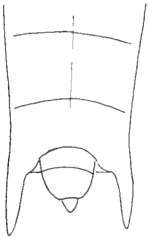
Dimensions. Length ♂ 11.2-11.9, ♀ 11.2-11.4; width of head ♂ 1.83-1.84, ♀ 1.78-1.88; humeral width of pronotum ♂ 1.90-1.92, ♀ 1.83-2.0; width across mesoacetabula ♂ 2.82-2.87, ♀ 2.9-3.1.

Colour. Basic colour yellow to light brown, dorsum of abdomen reddish. Head and thorax with the normal pattern of blackish stripes. Dark M-shaped figure on head incomplete, only lateral legs distinct (except for 1 ♀ from Von River, which is much darker than the other specimens, having a complete M-figure). Antennae medium brown, without whitish parts. Fore femur light brown with a dorsal and ventral longitudinal medium brown, stripe. Middle and hind femur medium brown, rather narrow lighter apical rings distinct. Tibiae and tarsi brown, tibiae yellowish in apical part. Hemielytra medium brown with darker veins, no costal or sub costal light band. Venter yellow.

Structural characters. Length of antennal segments I : II : III : IV, male 2.5 : 1.7 : 2.3 : 3.2, female 2.2 : 1.4 : 1.8 : 2.9. Second antennal segment distinctly shorter (♂ 0.9, ♀ 0.8)) than width of head. Fore femur of male broader (1.6) than middle femur, with a wide, shallow, subapical indentation and with short, dense pubescence ventrally. Fore femur in female slightly (1.3) wider than middle femur, with an indistinct subapical indentation, without obvious ciliation. Hemielytra reaching about halfway the apices of connexival spines. Ventral abdominal carina distinct on sternites 3-7 in male, and on 2-6 in female.

Male. Middle femur slightly shorter (0.9) than body, with a fringe of cilia about half as wide as femur and two short rows of 4-6 small pegs at border of inner and dorsal surface. Hind femur subequal to body length. Connexival spines parallel, virtually horizontal, reaching about half their length beyond apex of genital segments. Median length of last abdominal shorter (0.8) than penultimate abdominal sternite. Genital sternites subequal, shorter (0.6) than last abdominal sternite. Endosomal sclerites figs. 55-56.

Female. Middle and hind femur distinctly (0.8) shorter than length of body. Connexival spines parallel and slightly pointing upward, reaching about one third of their length beyond apex of abdomen. Median length of last and penultimate abdominal sternite subequal and somewhat (1.1) longer than genital sternites.



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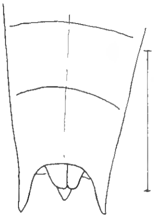

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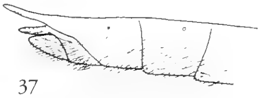

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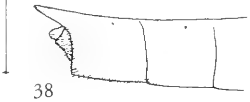

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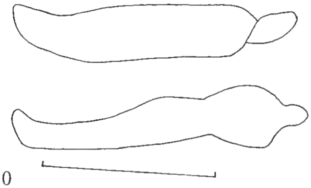

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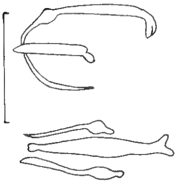

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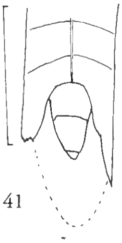

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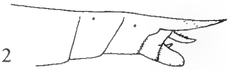

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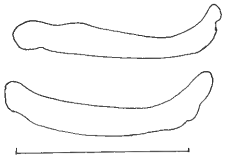

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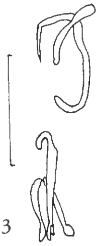

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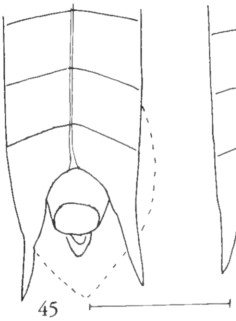

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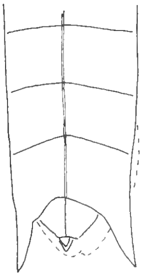

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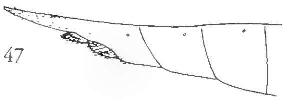

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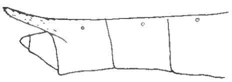

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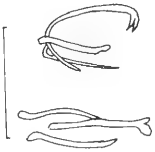

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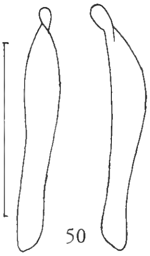

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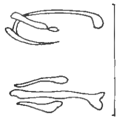

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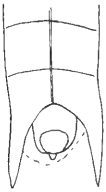

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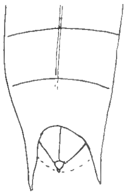

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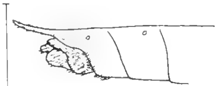

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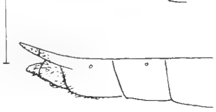

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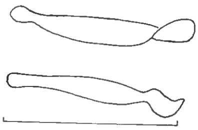

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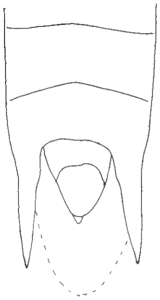

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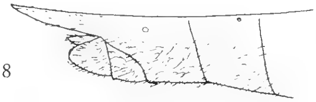

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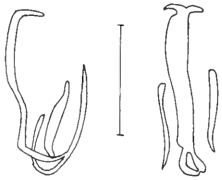

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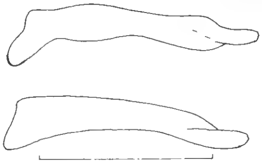

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Etymology. – Monochromos, a Greek adjective meaning unicolourous, refers to the unicolourous antennae of this species.

Comparative notes. – In the key by Hungerford & Matsuda (1958) and our key this species runs to *L. annulicornis*, from which it differs by having the antennae unicolourous. Males differ, moreover, by the second antennal segment relatively shorter compared to the width of head and hind femur longer than middle femur (subequal in *L. annulicornis*). From other similar species *L. monochroma* differs by characteristics of width of fore femur and leg ciliation as indicated in the key.

Limnometra poliakanthina sp. n.

(figs. 57-60)

Type material. – Holotype ♂: Australia, Queensland, Tulatten, rainforest creek, 21.v.1979, 0/0138, I. Lansbury (oxum). – Paratype: 1 ♂, same data as holotype (nc).

Description

Dimensions. Length ♂ 17.0-17.9; width of head 2.41-2.42; humeral width of pronotum 2.78-2.96; width across mesoacetabula 4.33-2.46.

Colour. Basic colour yellowish to light brown. Interoculus unicolourous, without M-shaped figure. Thorax with the normal pattern of blackish stripes, which is not very dark. Antennae medium brown, without whitish parts. Venter and legs about the same colour as rest of body, darker stripes indistinct. Middle and hind femur with lighter apical annulation, which is not strongly contrasting. Hemielytra dull medium brown with shining castaneous veins, no costal or sub costal light band, darker hind wings shining through.

Structural characters. Length of antennal segments I : II : III : IV, 3.5 : 2.25 : 3.1 : 3.8. Second antennal segment distinctly shorter (0.9) than width of head. Fore femur broader (1.3) than middle femur, with a shallow, subapical indentation, ventrally flattened without obvious pubescence. Hemielytra reaching beyond the apices of connexival spines. Ventral abdominal carina indistinct. Middle and hind femur subequal, longer (1.07) than body. Middle femur with short cilia and setae and a double row of small blackish pegs along its entire length except for basal 0.15 part, where there is a single row. Connexival spines parallel to slightly diverging, virtually horizontal, reaching about half their length beyond apex of genital segments. Median length of last abdominal shorter (0.85) than penultimate abdominal sternite. First genital sternite shorter (0.7) than last abdominal sternite and shorter (0.75) than last genital sternite. Endosomal sclerites figs. 59-60.

Etymology. – Poliakanthinos, a Greek adjective, meaning with many spines, referring to the double row of pegs on the middle femur.

Comparative notes – With the key by Hungerford & Matsuda (1958) and our key this species runs to *L. annulicornis*, which has, however, short rows of pegs on the middle femur. The only other species with a long partly double peg row on the middle femur is *L. melanochroa*, which has, however, a different general colour pattern and is more solidly built.

Limnometra hysterema sp.n.

(figs. 45-50)

Type material. – Holotype ♂: Solomon Islands, Guadalcanal, Tsarivonga R., 22.iii.1955, E. S. Brown (oxum). – Paratypes: Guadalcanal, Honiara District, Mt. Parsten, 13.vi.1964, E. S. Brown, 2 ♀ (oxum).

Description

Dimensions. Length ♂ 15.0, ♀ 12.8-13.0; width of head ♂ 2.14, ♀ 1.96-2.00; humeral width of pronotum ♂ 2.40 ♀ 2.17-2.20; width across mesoacetabula ♂ 3.50, ♀ 3.25-3.32.

Colour. Basic colour light brown, dorsum of abdomen with a reddish tinge. Head and thorax with the normal pattern of blackish stripes. Dark M-shaped figure on head partly indistinct. Antennae unicolor-

Figs. 35-40. *L. melanochroa* (paratypes), 35-38 apex of abdomen, scale 2 mm, 35-36 ventral view, 35 ♂, 36 ♀, 37-38 lateral view, 37 ♂, 38 ♀; 39-40 endosomal sclerites, 39 median arc and lateral sclerites, scale 0.5 mm, above lateral view, below dorsal view, 40 different views of lateral sclerite, scale 0.25 mm. – figs. 41-44. *L. pseudoinsularis*, ♂ (holotype), 41-42 apex of abdomen, scale 2 mm, 41 ventral, 42 lateral view; 43-44 endosomal sclerites, 43 median arc and lateral sclerites, scale 0.5 mm, above lateral, below dorsal view, 44 different views of lateral sclerites, scale 0.25 mm. – figs. 45-50: *L. hysterema*, 45-48 apex of abdomen, scale 2 mm, 45-46 ventral view, 45 ♂ (holotype), 46 ♀ (paratype), 47-48 lateral view, 47 ♂, 48 ♀; 49-50 endosomal sclerites (holotype), 49 median arc and lateral sclerites, scale 0.5 mm, above lateral view, below dorsal view, 50 different views of lateral sclerite, scale 0.25 mm. – figs. 51-56. *L. monochroma*, 51-54 apex of abdomen, scale 2 mm, 51-52 ventral view, 51 ♂ (holotype), 52 ♀ (paratype), 53-54 lateral view, 53 ♂, 54 ♀; 55-56 endosomal sclerites (paratype), 55 median arc and lateral sclerites, scale 0.5 mm, above lateral view, below dorsal view, 56 different views of lateral sclerite, scale 0.25 mm. – figs. 57-60: *L. poliakanthina*, 57-58 apex of abdomen of ♂ holotype, scale 2 mm, 57 ventral, 58 lateral view; 59-60 endosomal sclerites of ♂ paratype, 59 median arc and lateral sclerites, scale 0.5 mm, left lateral, right dorsal view, 60 different view of lateral sclerites, scale 0.25 mm.

ous, medium brown. Legs light to medium brown longitudinal stripes indistinct. Middle and hind femur with lighter apical rings distinct. Middle and hind tibiae yellowish in apical part. Hemielytra greyish brown with lighter veins, no costal or sub costal light band, hind wings darker. Venter pale yellow, in male with sparse lighter ciliation on thorax and base of abdomen.

Structural characters. Length of antennal segments I : II : III : IV, male 3.35 : 2.3 : 2.5 : 3.0, female 2.4 : 1.63 : 2.15 : 3.0. Second antennal segment longer (1.1) than width of head in male, shorter (0.8) in female. Fore femur of male broader (1.4) than middle femur, with a subapical indentation which has a very small tooth near its apical edge and with dense pubescence ventrally. Fore femur in female hardly (1.07) wider than middle femur, with an indistinct subapical indentation, without obvious pubescence. Middle femur in both sexes shorter than hind femur. Hemielytra reaching about halfway the apices of connexival spines. Connexival spines parallel, virtually horizontal to pointing somewhat dorsad, reaching about half their length beyond apex of genital segments. Ventral abdominal carina distinct on sternites 3-7 in both sexes.

Male. Middle femur slightly longer (1.07) than body, with a fringe of cilia about half as wide as femur and without a row of small pegs apically. The tiny black setae on middle femur become, however, peg like in basal part, suggesting several rows of very small pegs in the basal part of middle femur. Hind femur without apical pegs and with normal setae. Median length of last abdominal shorter (0.8) than penultimate abdominal sternite. Genital sternites subequal, shorter (0.6) than last abdominal sternite, second genital sternite slightly damaged. Endosomal sclerites figs. 49-50.

Female. Middle and hind femur distinctly (0.85 and 0.9 respectively) shorter than length of body. Median length of last sternite slightly longer (1.08) than penultimate abdominal sternite subequal and longer (1.3 and 1.45 respectively) than genital sternites.

Etymology. – Hysterema, a Greek noun meaning '-that what is lacking', refers to the absence of small peg rows in apical part of middle femur in males of this species.

Comparative notes. – Similar to *L. annulicornis, L. monochroma* and *L. arachnis.* The latter is much larger and more solidly built. All three differ in having one or two short rows of small pegs apically on the middle femur of male and the black setae in basal part of the middle femur not modified.

Discussion

Although we have not seen all species of the genus, some remarks on species groups can already be made. *Limnometra* includes several apparently isolated species, e.g. *L. femorata* Mayr with aberrant colour pattern, a peculiar midfemoral spur in the male and elongate lateral endosomal sclerites (fig. 5), *L. octopunctata* Hungerford with peculiar ventral markings similar to *Tenagogonus quinquemaculatus* Miyamoto, but not to any species of *Limnometra*, and an aberrant lateral endosomal sclerite (fig. 9). A further example is *L. melanochroa* with a colour pattern reminding somewhat of *L. rossi* Hungerford & Matsuda. The latter species falls outside the scope of this paper. It is one of the smallest species in the genus, has lateral endosomal sclerites of the *L. insularis* type, and a relatively more stout build.

L. ciliata and *L. cursitans* form a small group, characterised by uniformly coloured antennae and legs and a tendency of having broad dark sublateral bands on the pronotum. Unfortunately we have not seen the male of *L. cursitans,* so we are unable to comment upon the endosomal sclerites.

L. insularis, L. borneensis and *L. pseudoinsularis* form a group of slender species with a remarkably similar colour pattern, of which the lemon coloured caudolateral margin of the pronotum is striking. In addition, they have rather broad lateral endosomal sclerites without a twisted tip (figs. 2, 6, 44). *L. bruneiensis* is associated with this group by its lateral sclerites, but its more solid build reminds of the next group.

Finally there is a large group of medium-sized to large species: *L. annulicornis, L. arachnis, L. aploa, L. genitalis, L. hysterema, L. kallisto, L. lepta, L. monochroma* and *L. pulchra.* They have in common a very uniform general build (except for size) and colour pattern. In addition, the apex of the lateral endosomal sclerites is twisted (figs. 1, 7, 10, 16, 22, 28, 34, 50, 56). This group has so far only been found on Sulawesi where the genus has its highest species diversity eastward to the Solomon Islands.

Up to now, we have studied two genera, *Enithares* (Notonectidae) and *Limnometra,* with several apparently closely related species in Sulawesi and Buton. In *Enithares* we have found four closely related species occurring in Sulawesi and Buton, with restricted ranges. *E. horvathi* Kirkaldy in SW Sulawesi, *E. caesaries* Nsr. & Chen in Central Sulawesi, *E. lansburyi* Nsr. & Chen in SE Sulawesi and *E. skutalis* Nsr. & Chen on Buton (Nieser & Chen 1991). In *Limnometra* we have found in the same area five closely related species, viz. *L. annulicornis* in N Sulawesi (and ? S Sulawesi), *L. lepta* in N and NE Sulawesi, *L. aploa* in E Sulawesi, *L. arachnis* in E

Sulawesi and on Buton and *L. genitalis* endemic to Buton. A similar pattern has been found in the gerrid genus *Ptilomera* Amyot & Serville (Polhemus & Polhemus 1986, cited in Whitten et al. 1988). The genus *Rhagovelia* Mayr (Veliidae) seems to have a more complex distributional pattern in Sulawesi (Polhemus & Polhemus 1988), with a greater number of ecologically separated species in a given area.

The actual distributional ranges of the species of the three genera *Enithares*, *Limnometra* and *Ptilomera* show considerable similarity, possibly characterising areas of endemism for aquatic Heteroptera. We suppose that the presence of watersheds rather than a historical separation of Sulawesi Selatan with slightly higher sea level, was the most important causing factor for speciation in stream-dwelling insects. The latter phenomenon has been used in part for the explanation of speciation and subspeciation in macaques (*Macaca*, Cercopithecidae cited in Whitten et al. 1988), which also have similar distributional patterns. At present our knowledge of the distribution of aquatic Heteroptera is insufficient to make further comments. Some of these restricted ranges may appear artificial after more intensive collecting in unexplored parts of Southwest Sulawesi and the eastern islands as Banggai, Sula and Talaud.

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Table 1. Leg measurements in *Limnometra* in millimeters.

	femur	tibia	tars1	tars2
L. aploa male				
fore leg	4.1	3.2	0.45	0.45
middle leg	10.4	9.0	2.8	0.5
hind leg	10.8	6.7	0.9	0.45
L. aploa female				
fore leg	3.6	3.0	0.5	0.5
middle leg	9.1	8.1	2.6	0.5
hind leg	9.2	6.3	0.9	0.5
L. arachnis male				
fore leg	6.3	5.2	0.8	0.7
middle leg	17.5	16.4	4.0	0.6
hind leg	18.2	17.2	1.5	0.6
L. arachnis female				
fore leg	4.4	3.7	0.6	0.6
middle leg	11.6	10.5	3.1	0.6
hind leg	11.4	9.2	1.0	0.5
L. genitalis male				
fore leg	5.2	4.2	0.7	0.6
middle leg	13.3	12.1	3.4	0.7
hind leg	13.7	9.7	1.3	0.5
L. genitalis female				
fore leg	4.2	3.4	0.6	0.5
middle leg	10.2	9.6	3.2	0.6
hind leg	10.0	7.3	1.0	0.5
L. lepta male				
fore leg	6.9	5.5	1.2	0.9
middle leg	19.3	18.1	4.5	0.85
hind leg	20.8	14.1	2.5	0.8
L. lepta female				
fore leg	4.3	3.8	0.7	0.65
middle leg	11.3	10.4	3.3	0.65
hind leg	11.6	7.9	1.7	0.55
L. melanochroa male				
fore leg	6.3	5.4	1.05	0.8
middle leg	17.9	15.2	3.7	0.75
hind leg	17.7	15.6	1.6	0.7
L. melanochroa female				
fore leg	4.6	4.0	0.8	0.7
middle leg	12.4	10.9	3.2	0.6
hind leg	12.4	10.2	1.1	0.55
L. pseudoinsularis male				
fore leg	3.7	3.2	0.5	0.5
middle leg	10.0	8.2	2.9	0.5
hind leg	10.6	6.3	1.2	0.4
L. hysterema male				
fore leg	5.5	5.2	0.8	0.7
middle leg	16.0	12.8	3.2	0.7
hind leg	17.4	10.2	1.5	0.6
L. hysterema female				
fore leg	4.4	3.7	0.6	0.6
middle leg	11.0	10.1	3.0	0.6
hind leg	11.9	6.9	1.2	0.6
L. monochroma male				
fore leg	4.1	3.5	0.55	0.5
middle leg	10.7	9.3	2.8	0.5
hind leg	11.7	6.7	1.3	0.45
L. monochroma female				
fore leg	3.4	3.0	0.5	0.5
middle leg	9.2	8.2	2.6	0.5
hind leg	9.5	5.8	1.2	0.4
L. poliakanthina male				
fore leg	6.1	5.1	1.05	0.8
middle leg	18.8	17.2	4.7	0.8
hind leg	18.8	16.3	2.2	1.1

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SALICACEAE FEEDING GRACILLARIIDAE (LEPIDOPTERA) OF CENTRAL ASIA

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Seven *Phyllonorycter* species, two *Cameraria* and one *Caloptilia* species feeding on members of Salicaceae in Central Asia are reviewed. *Phyllonorycter dentifera* sp. n., mining on *Populus pruinosa* Schrenk, is described. *Phyllonorycter obliquifascia* (Filipjev) and *P. saliciphaga* (Kuznetzov) are transferred to *Cameraria* Chapman. A checklist and review of literature of all Central Asian Gracillariidae is provided. A key to the species, descriptions and figures of the imagos, male genitalia and mines of all species reviewed are provided.

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Keywords. – Gracillariidae, *Caloptilia, Phyllonorycter, Cameraria,* new species, Salicaceae, Central Asia, checklist.

The Gracillariidae form a large family of leaf-mining moths, known from all continents except Antarctica. About 600 species of this family occur in the Palaearctic (Kuznetzov 1981).

As far as known, the larvae of most Gracillariidae are leaf-miners of woody and herbaceous angiosperms belonging to 56 families of Dicotyledones (or Magnoliopsida; Takhtajan 1987). Only one species, *Spulerina corticicola* Kumata, 1964, has been recorded as a bark-miner of members of Pinaceae (Gymnospermae). The majority of species feed on Fagaceae and Rosaceae (almost 45-50% of the Palaeartic species). Further many species are specialized on Fabaceae, Betulaceae and Salicaceae. Most species are oligophagous. As an example, all species (except *Caloptilia stigmatella* (Fabricius)) feeding on *Salix* and *Populus* are restricted to Salicaceae. Only *C. stigmatella* has also been noted in addition on Betulaceae and Myricaceae (Kumata 1982).

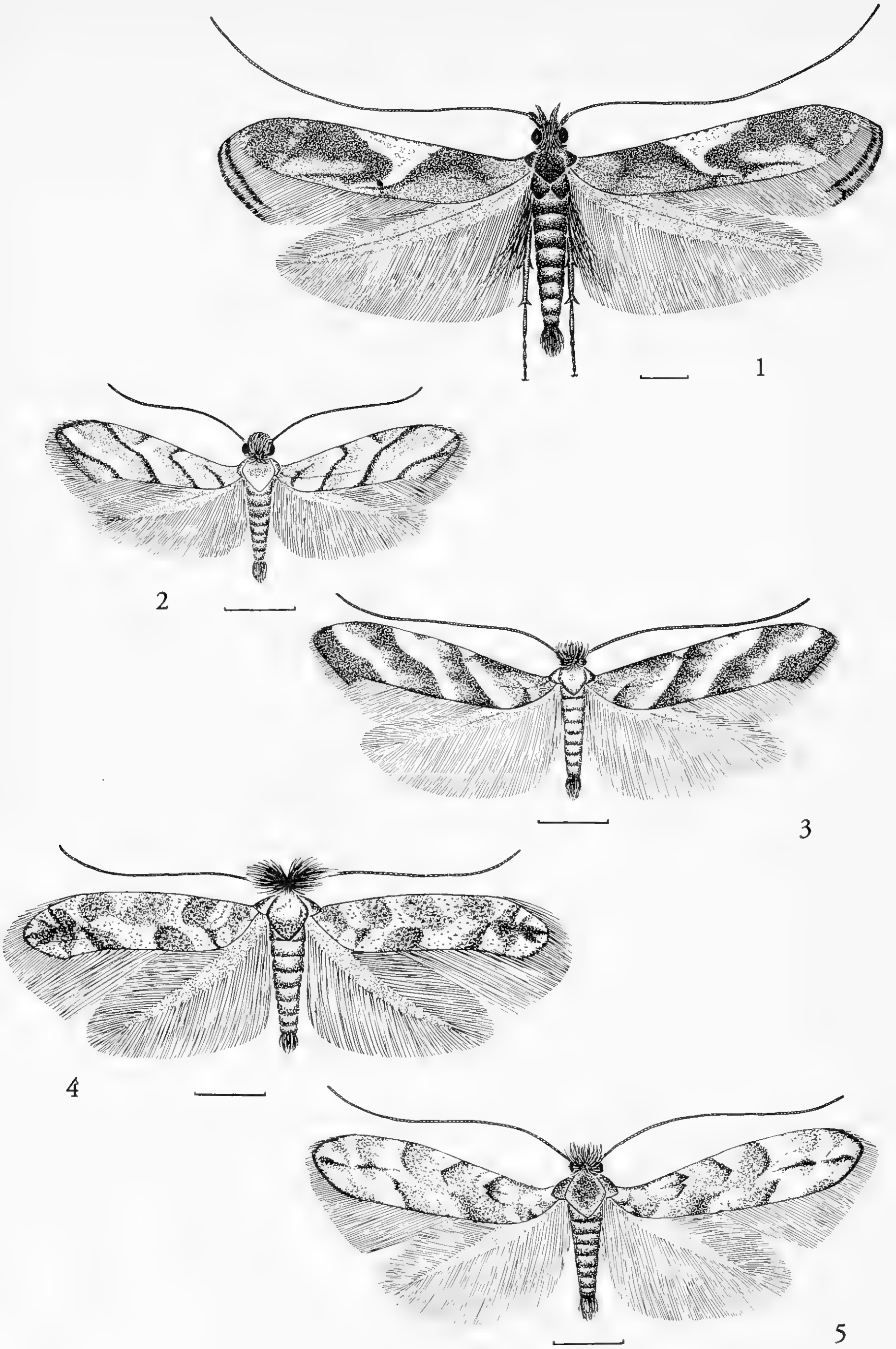
The study of the Gracillariidae of Central Asia was initiated by Gerasimov (1930, 1931, 1932). He noted 13 species from Central Asia, including eight new taxa. Later, one new species was added by Danilevsky: *Parornix persicella* Danilevsky, 1955 and many more species, including seventeen new species were added due to Kuznetzov's investigations (1956, 1975, 1978, 1979, 1981, 1985). Furthermore, some papers containing faunistic or ecological data on Gracillariidae from Tadzhikistan were published by Sherniyazova (1975, 1982, 1984, 1988).

In the course of our own investigations in Tadzhikistan, Turkmeniya, Uzbekistan and southern Kazakhstan from 1986 to 1991, ten species were recorded for the first time from Central Asia. One of them, *Dialectica scalariella* (Zeller), had earlier been known from southern Europe, North Africa and the Middle East (Wapshere & Kirk 1977). Eight species were described as new (Noreika 1991; Noreika and Puplesis in press).

The gracillarid fauna of the southern part of Central Asia is poorly known. Five species have been found in Iran (Deschka 1979; Triberti 1985, 1986, 1989) and four species are known from Afghanistan. Two species are known from northern Pakistan: *Phyllonorycter montanella* Bradley, 1980 (Bradley 1980) and *Parornix compressa* Triberti, 1989 (Triberti 1989). No species are known from Mongolia or the centralasiatic part of China. Most of these species mine leaves of various plant-families: Caprifoliaceae, Rosaceae, Plantaginaceae, Fabaceae, Fagaceae, Betulaceae, Viburnaceae and other ones. As yet, no Salicaceae feeding species have been recorded from these countries.

A vegetation type, dominated by Salicaceae, is widespread in Central Asia and forms a characteristic aspect of its vegetation. It is often predominant along rivers and streams, forming a forest type called 'Tugai'. As many as ten species out of the 72 species of Gracillariidae known from Central Asia are recorded as feeding on Salicaceae and apart from one species, restricted to this family. Only one species, *Caloptilia stigmatella* (Fabricius, 1781), appears to be disjunct oligophagous, since in other regions this species has also been noted on Myricaceae and Betulaceae (Kumata 1982).

The ten Salicaceae feeding species of the centrala-



Figs. 1-5. Adult Gracillariidae (males). - 1, *Caloptilia stigmatella*; 2, *Cameraria saliciphaga*; 3, *C. obliquifascia*; 4, *Phyllonorycter populifoliella*; 5, *Ph. populi*. Scale 1 mm.

siatic fauna are the topic of this paper. The treatment of species feeding on related host plants follows a tradition in Gracillariidae (compare Kumata 1963, Kuznetzov 1981, Ermolaev 1982, 1988) and is especially useful for diagnostic purposes. However, the polyphyly of such an 'ecological group' is evident.

Material and methods

Methods for the preparation of the genitalia largely follow Falkovitsh & Stekolnikov (1978). The genitalia were studied with the help of a Biolam microscope and a MBS-10 stereomicroscope.

The material studied has been collected during expeditions (from 1986 to 1991) in various regions of Central Asia, including previously unexplored areas (Kugitangtau mountains in eastern Turkmeniya and the valley of Vakhsh in southern Tadzhikistan). In addition, the collection of the Zoological Institute of the Russian Academy of Sciences in St. Petersburg (zias) was studied.

In the genera *Phyllonorycter* and *Cameraria* the female genitalia are not described, since in these genera they have little diagnostic value, and are rarely used for taxonomy or identification.

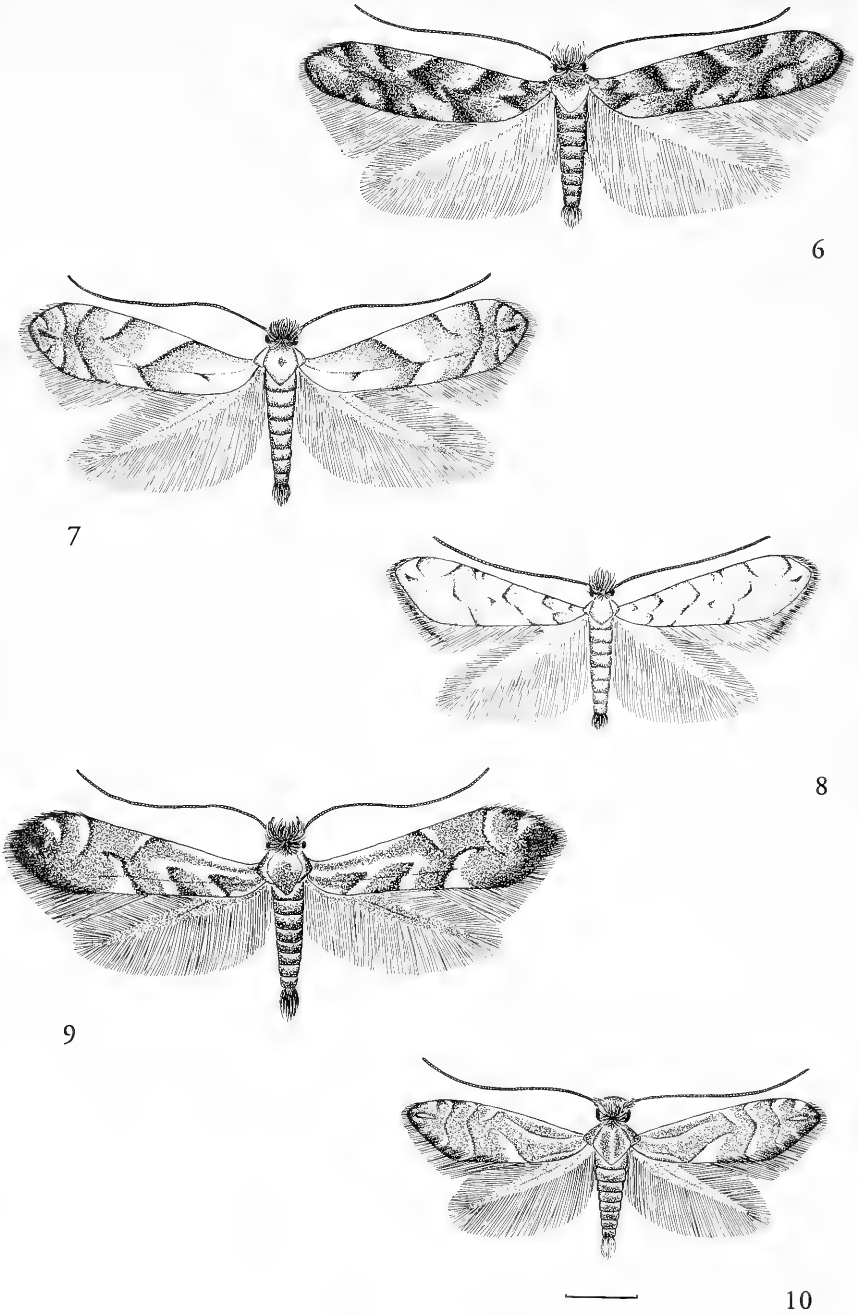
Locality names are spelled in accordance with the Times Atlas of the World (comprehensive edition 1975 and later).

Botanic nomenclature follows Cherepanov (1981) and Takhtajan (1987). Under 'Material examined' only centralasiatic material is listed.

The type specimens of the new species are deposited in the collection of the Minological Research Laboratory of the Zoological Department of the Pedagogical Institute, Vilnius, Lithuania (vpi), and in the National Museum of Natural History, Leiden, The Netherlands (rmnh).

Checklist of the Gracillariidae of Central Asia

Genus *Micrurapteryx* Spuler, 1910
  1. *M. kollariella* (Zeller, 1839)
  2. *M. sophorella* Kuznetzov, 1979
  3. *M. fumosella* Kuznetzov & Tristan, 1985
  4. *M. tortuosella* Kuznetzov & Tristan, 1985
  5. *M. sophorivora* Kuznetzov & Tristan, 1985
  6. *M. bidentata* Noreika, 1992a
  7. *M. minima* Noreika, 1992a
Genus *Polymitia* Triberti, 1986
  8. *P. eximipalpella* (Gerasimov, 1930)
  9. *P. laristana* Triberti, 1986
Genus *Gracillaria* Haworth, 1828
  10. *G. loriolella* Frey, 1881
Genus *Caloptilia* Hübner, 1825
  11. *C. flava* (Staudinger, 1870)
  12. *C. stigmatella* (Fabricius, 1781)
  13. *C. semifascia* (Haworth, 1828)
  14. *C. acerivorella* (Kuznetzov, 1956)
  15. *C. acericolella* Kuznetzov, 1981
  16. *C. fribergensis* (Fritzsche, 1871)
  17. *C. populetorum* (Zeller, 1839)
  18. *C. cuculipennella* (Hübner, 1796)
  19. *C. roscipennella* (Hübner, 1796)
Genus *Cupedia* Klimesch & Kumata, 1973
  20. *C. cupediella* (Herrich-Schäffer, 1855)
Genus *Aspilapteryx* Spuler, 1910
  21. *A. tringipennella* (Zeller, 1839)
  22. *A. limosella* (Duponchel, 1843)
  23. *A. magna* Triberti, 1985
Genus *Calybites* Hübner, 1822
  24. *C. phasianipennella* (Hübner, 1813)
Genus *Eucalybites* Kumata, 1982
  25. *E. aurogutella* (Stephens, 1835)
Genus *Acrocercops* Wallengren, 1881
  26. *A. iraniana* Triberti, 1989
Genus *Dialectica* Walsingham, 1897
  27. *D. scalariella* (Zeller, 1850
Genus *Leucospilapteryx* Spuler, 1910
  28. *L. omissella* (Stainton, 1848)
Genus *Parornix* Spuler, 1910
  29. *P. subfinitimella* Kuznetzov, 1956
  30. *P. hastata* Triberti, 1989
  31. *P. compressa* Triberti, 1989
  32. *P. kugitangi* Noreika, 1991
  33. *P. asiatica* Noreika, 1991
  34. *P. torquilella* Zeller, 1850
  35. *P. petiolella* Frey, 1863
  36. *P. cotoneasterella* Kuznetzov, 1978
  37. *P. turcmeniella* Kuznetzov, 1956
  38. *P. amygdalella* Kuznetzov, 1978
  39. *P. persicella* Danilevsky, 1955
Genus *Phyllonorycter* Hübner, 1822
  40. *Ph. medicaginella* (Gerasimov, 1930)
  41. *Ph. fabaceaella* (Kuznetzov, 1978)
  42. *Ph. insignitella* (Zeller, 1846)
  43. *Ph. schreberella* (Fabricius, 1781)
  44. *Ph. millierella* (Staudinger, 1871)
  45. *Ph. emberizaepennella* (Bouche, 1834)
  46. *Ph. montanella* Bradley, 1980
  47. *Ph. lonicerifaga* Noreika, 1992a
  48. *Ph. caspica* Noreika, 1992a
  49. *Ph. raikhonae* Noreika, 1992b
  50. *Ph. pastorella* (Zeller, 1846)
  51. *Ph. populifoliella* (Treitschke, 1833)
  52. *Ph. populi* (Filipjev, 1926)
  53. *Ph.populicola* Kuznetzov, 1975)
  54. *Ph. asiatica* (Gerasimov, 1931)
  55. *Ph. connexella* (Zeller, 1846)
  56. *Ph. dentifera* Noreika, sp.n.
  57. *Ph. pruinosella* (Gerasimov, 1931)
  58. *Ph. turcomanicella* (Kuznetzov, 1956)
  59. *Ph. aceripestis* (Kuznetzov, 1978)



Figs. 6-10. *Phyllonorycter* species (males). - 6, *Ph. populicola*; 7, *Ph. pastorella*; 8, *Ph. pruinosella*; 9, *Ph. asiatica*; 10, *Ph. dentifera*, holotype. Scale 1 mm.

60. *Ph. aceriphaga* (Kuznetzov, 1975)
61. *Ph. juglandicola* (Kuznetzov, 1975)
62. *Ph. infirma* Deschka, 1974
63. *Ph. platani* (Staudinger, 1870)
64. *Ph. pyrifoliella* (Gerasimov, 1933)
65. *Ph. malella* (Gerasimov, 1931)
66. *Ph. cerasicolella* (Herrich-Schäffer, 1855)
67. *Ph. iranica* Deschka, 1979
68. *Ph. corylifoliella* (Hübner, 1796)
69. *Ph. turanica* (Gerasimov, 1931)
70. *Ph. hissarella* Noreika, 1992b

Genus *Cameraria* Chapman, 1902

71. *C. obliquifascia* (Filipjev, 1926) **comb.n.**
72. *C. saliciphaga* (Kuznetzov, 1975) **comb.n.**

SYSTEMATIC PART

Key to the male Salicaceae feeding Gracillariidae of Central Asia (based on genitalia)

1. Uncus and transtilla absent; valva strongly broadened distally, with very long setae (fig. 11) .... *Caloptilia stigmatella*
- Uncus and transtilla present; valva not broadened distally, with short setae 2
2. Valvae symmetrical 3
– Valvae asymmetrical 7
3. Aedeagus half as long as valva, without apical hook and without bulge basally 4
– Aedeagus longer than valva, with apical hook, but without bulge basally 5
4. Valva strongly narrowed in apical third; 8th sternite with distal invagination .... *Cameraria saliciphaga*
– Valva gradually narrowed at tip only; 8th sternite without distal invagination .... *C. obliquifascia*
5. Aedeagus more than twice as long as valva; valva distally wide .... *Ph. populifoliella*
– Aedeagus almost as long as valva or slightly longer than valva; valva narrowed distally 6
6. Valva not abruptly tapered in distal half and with additional small tooth above middle and tiny one at apex .... *Ph. populi*
– Valva abruptly tapered in distal half and without additonal tooth above middle and with more or less long one at apex .... *Ph. pastorella*
7. Valvae almost equal in length and width; transtilla asymmetrical .... *Ph. asiatica*
– Right valva distrinctly more slender than left one 8
8. Vinculum large, more or less rectangular; only left valva with long distal process (right valva with extremely small tooth only) .... *Ph. pruinosella*
– Vinculum small, more or less triangular; both valvae with weakly sclerotized but more or less large, tooth-like distal process .... *Ph. dentifera*

Descriptions

Caloptilia stigmatella (Fabricius, 1781)
(figs. 1, 11, 22)

Tinea stigmatella Fabricius, 1781: 297.
Gracillaria stigmatica Matsumura, 1931: 1101.
Caloptilia stigmatella Inoue 1954: 1-26, Ermolaev 1977: 108, Kuznetzov 1981: 182-183, 192, 201, Kumata 1982: 32-34, 147, 157, Patzak 1986: 140, 149, 158.

Diagnosis. – Can immediately be separated externally from the other treated species by the shape of the costal blotch of the forewing. From similar oriental *C. chrysolampra* (Meyrick) it differs by larger size as well as broader and longer aedeagus.

External characters (fig. 1). – Wingspan 12-16 mm. Face whitish. Vertex and labial palpi greyish brown. Maxillar palpi pale grey. Scapus grey with some ferruginous scales. Flagellum grey annulated with dark grey. Thorax greyish brown. Forewing greyish brown with distinct white triangular costal blotch, slightly irrorate with ferruginous scales. Cilia pale grey with black cilia-line. Hindwing and cilia silvery grey.

Male genitalia (fig. 11). – Symmetrical. Vinculum triangular. Saccus weakly developed. Valva curved, slightly dilated apically, straight on terminal margin. Aedeagus slender, almost pointed distally, without cornuti.

Female genitalia. – See Kumata (1982).

Biology. – Host plants: *Populus* spp. and *Salix* spp., in Central Asia on *S. blakii* Goerz. Mine (fig. 22) starts as underside epidermal blotch; later the larva rolls the leaf up to more than half length, producing pyramid-like case.

Distribution. – Throughout Europe, Asia Minor, Central Asia, Siberia, Eastern Asia (including Japan and China), North America.

Material examined: 5♂, 4♀. – Turkmeniya: 1♂, Ashkhabad, env. Firyuza, 9.v.1991 larva on *Salix*, E. Kokanova (coll. Kokanova). – Tadzhikistan: 1♂, 30 km N Dushanbe, env. Varzob (loc. Kondara), 20.vii.1990, R. Noreika (VPI); 1♂, the same locality, 6.ix.1990, larva on *Salix blakii*, N5069, ex p. 10.x.1990, R. Noreika (VPI); 2♂, 4♀, same locality, 12.vi.-7.vii.1991, V. Sruoga (VPI).

Cameraria saliciphaga (Kuznetzov, 1975) comb. n. (figs. 2, 12, 23)

Lithocolletis saliciphaga Kuznetzov 1975: 418-420, 1981: 283, 287, 288.

Diagnosis. – Similar to *C. obliquifascia* (Filipjev), but differs by shape of medial fascia and especially by paler appearance of forewing (in *C. obliquifascia* it is irrorate with blackish scales) and strong bulbose broadening of medial part of valva.

External characters (fig. 2). – Wingspan 5.0-7.0

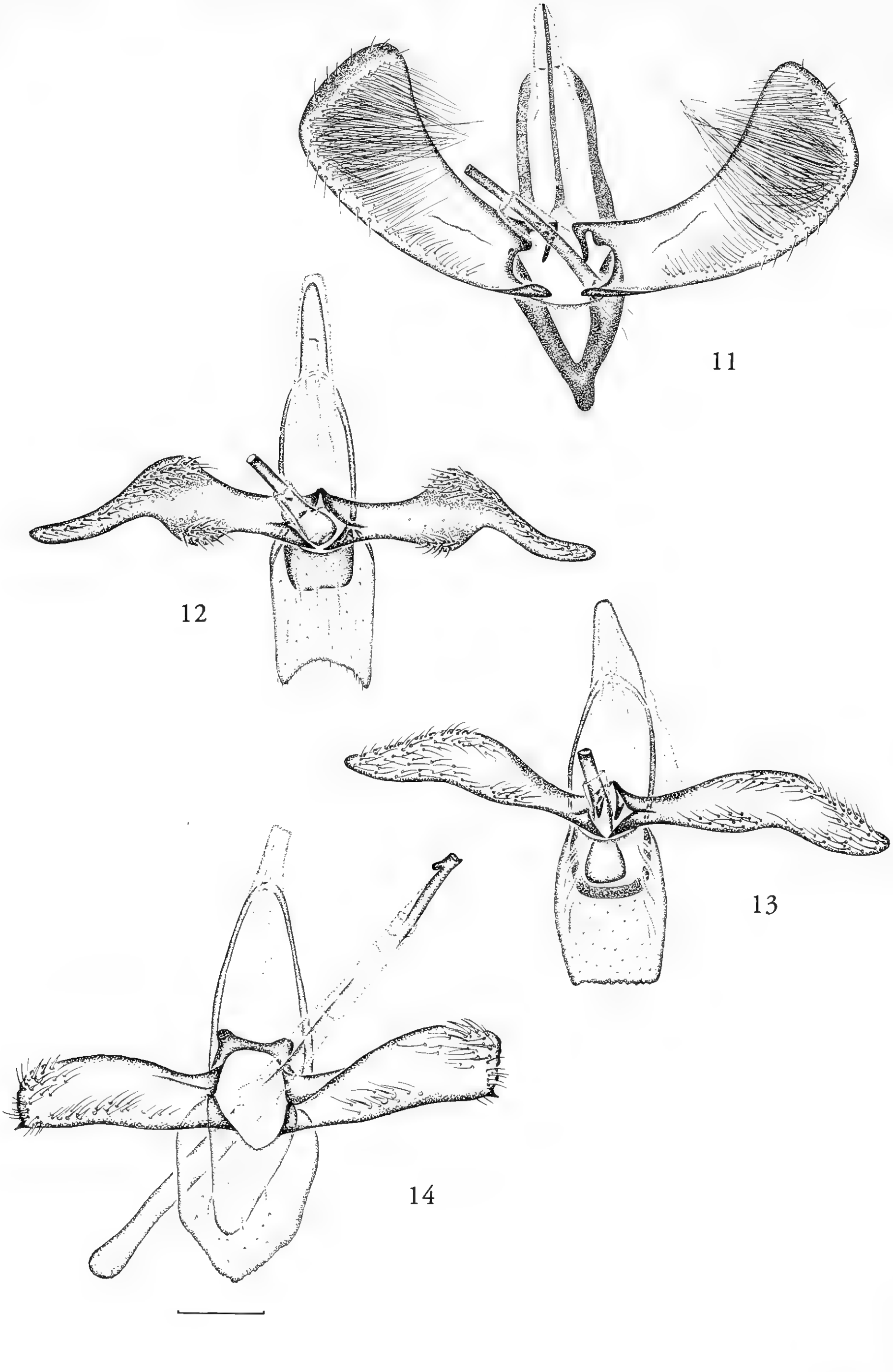


Fig. 11-14. Male genitalia.-11, *Caloptilia stigmatella*; 12, *Cameraria saliciphaga*; 13, *G. obliquifascia*; 14, *Phyllonorycter populifoliella*. Scale 0.2 mm.

mm. Face white, sometimes with central orange spot. Labial palpi white. Tuft on head consists of orange-ferruginous and white, piliform scales. Scapus greyish, with few ferruginous scales. Flagellum greyish, annulated with brownish black. Thorax orange-ferruginous with white margins. Forewing orange-ferruginous with four oblique fasciae, distally edged with fuscous or brown scales. Basal fascia short and not reaching costa. Second fascia inwards sharply curved towards costa. Medial fascia usually bifurcate towards costa, but occasionally only curved. Apical fascia sinuate and bifurcate distally; lower branch distinctly narrower than upper. Apical spot absent. Cilia grey. Hindwing and cilia grey. Abdomen dark ferruginous brown at upperside, dark grey laterally.

Male genitalia (fig. 12). – Symmetrical. Uncus shorther than distal process of valva. Vinculum broad, but invaginated distally. Valva simple, but it's medial part strongly broadened (bulbose). Apical parts of valva strongly and abruptly narrowed and elongate. Transtilla symmetrical. Sternite 8 broad, shorter than valva and slightly invaginated distally. Aedeagus tube-like in shape, almost twice as short as valva, broadened in basal part, narrowed apically.

Biology. – Host plants: *Salix excelsa* S. G. Gmel. and *S. triandra* L. Mine (fig. 23) on leaf upperside, as elongate blotch, usually occupying nearly one-fourth of width of leaf, and situated in various parts of leaf. Pupation in mine.

Distribution. – Turkmeniya, Uzbekistan and Tadzhikistan.

Material examined: 72♂, 64♀. – Turkmeniya: 5♂, env. Ashkhabad, Geok – Tepe, 12.v.1986, R. Puplesis (vpi); 1♂, Iolotan, 13.viii.1988, R. Puplesis (vpi); 3♂, 2♀, Tedzhen, 14-15.viii.1988, V. Sruoga et R. Puplesis (vpi); 6♂, 5♀, env. Svintsovyy Rudnik, 11.viii.1989, larvae on *Salix triandra*, R. Noreika (vpi); 1♂, 1♀, the same locality, 26.viii.1990, R. Noreika (vpi). – Uzbekistan: 3♂, 1♀, env. Dzharkurgan, 31.viii.1990, R. Noreika (vpi). – Tadzhikistan: 3♂, 5♀ (holotype and paratypes), 30 km N Dushanbe, env. Varzob (loc. Kondara), 27.vii.1970, larvae on *Salix excelsa*, R. Sherniyazova (zias); 6♂, 1♀, same locality, 27.vi.-20.viii.1986, R. Puplesis (vpi); 17♂, 23♀, same locality, 17-23.viii.1989, R. Puplesis (vpi); 1♂, same locality, 4.xi.1989, larva on *Salix* sp., N 5042, ex p. 1.iii.1990, R. Puplesis (vpi); 7♂, 12♀, same locality, 14.viii.2.ix.1990, R. Noreika (vpi); 13♂, 10♀, same locality, 20.vii-9.viii.1990, V. Sruoga; 4♂, 4♀, same locality, 5-8.viii.1990, J. Bajarunas (vpi); 2♂, env. Nurek (Zardolu), 6.viii.1990, V. Sruoga (vpi).

Cameraria obliquifascia (Filipjev, 1926) comb. n.

(figs. 3, 13, 24)

Lithocolletis obliquifascia Filipjev 1926: 284 Gerasimov 1932: 237-239, Kuznetzov 1981: 283, 287, 288.

Diagnosis. – Externally similar to *C. saliciphaga* (Kuznetzov), but considerably larger. In contrast to *C. saliciphaga*, forewing irrorate with blackish and brownish scales. In *C. obliquifascia* second fascia of forewing more oblique than in *C. saliciphaga* and not sinuate. In male genitalia it differs by lack of bulbous, medial broadening of valva.

External character (fig. 3). – Wingspan 7.0-8.1 mm. Face and labial palpi white. Tuft on head consists of pale yellowish ferruginous, piliform scales. Scapus white with mixture of brown-ferruginous scales. Flagellum yellowish ferruginous, annulated only on upperside with brown. Thorax ochreous with mixture of brownish scales in centre. Forewing ochreous, irrorate with black and brown scales, and with four white strongly oblique fasciae, with diffuse distal black edging. Basal fascia short, not reaching costa. Second fascia sometimes slightly interrupted just before reaching costa. Medial fascia slightly sinuate, and bifurcate near costa. Fourth (distal) fascia curved anteriorly. Forewing apex darker than rest of forewing, without apical spot. Line just proximal to cilia (not cilia line!) is narrow and fuscous. Cilia pale yellowish. Hindwing and cilia pale greyish. Abdomen dorsally dark grey, and laterally greyish.

Male genitalia (fig. 13). – Symmetrical. Uncus less than half length of valva. Vinculum broad, trapezium-shaped, twice as short as aedeagus. Valva simple, without abrupt broadening, rounded at apex, and bent ventrally. Transtilla symmetrical, with posterior (distal) margin. Aedeagus tube-shaped almost half as long as valva. Basal part of aedeagus flattened dorsoventrally, and broadened laterally. Tube of aedeagus slightly curved medially.

Biology. – Host plants: *Salix spp.* and *Populus afghanica* (Aitch. et Hemsl) Schneid, *P. alba* L. Mine (fig. 24) on upperside of leaf, occasionally on underside, variable in shape, sometimes elongate, and situated in various places of leaf. In centre of mine, round spot present with light surroundings along frass-line.

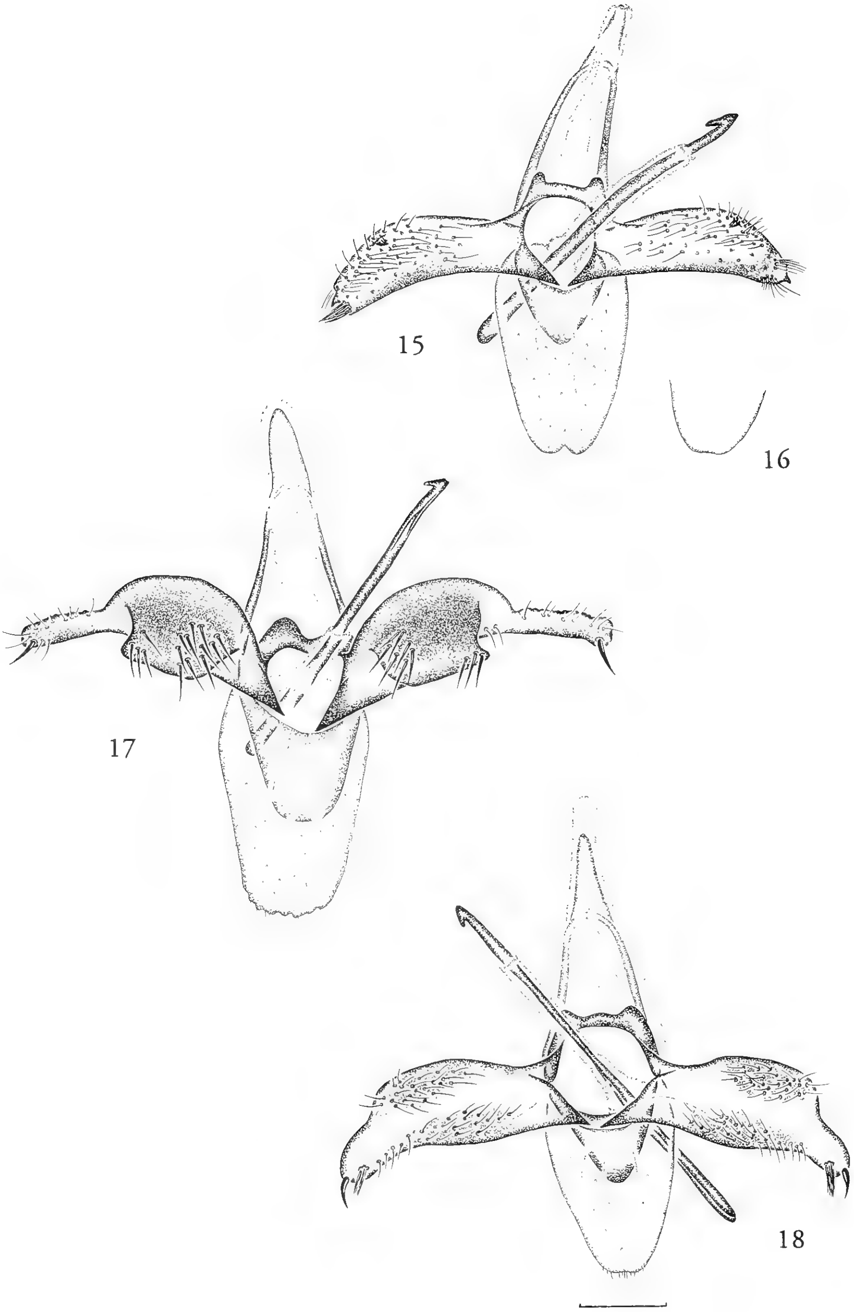
Distribution. – Turkmeniya, Uzbekistan and Tadzhikistan.

Material examined: 21♂, 35♂. – Tadzhikistan: 30 km N Dushanbe, env. Varzob (Kondara), 28.vi-21.viii.1986, R. Puplesis (vpi); 5♂, 1♀, same locality, 17-23.viii.1989, R. Noreika (vpi); 7♂, 14♀, same locality, 14-20.viii.1990, R. Noreika (vpi); 5♂, 5♀, same locality, 15.viii.1990, larvae on *Populus afghanica*, N 5054 and N 5071, R. Noreika (vpi); 2♂, 15♀, same locality, 9.vii-9.viii.1990, V. Sruoga (vpi); 1♂, same locality, 20.vii.1990, R. Puplesis (vpi); 1♂, same locality, 8.viii.1990, J. Bajarunas (vpi).

Phyllonorycter populifoliella (Treitschke, 1833)

(Figs. 4, 14, 25)

Lithocolectis populifoliella Treitschke, 1833: 188. Gerasimov 1932: 242-244, Kuznetzov 1981: 284, 285.



Figs. 15-18. Male genitalia of *Phyllonorycter*. - 15, *Ph. populi*, Sayat, Turkmeniya, 28.vii.1990; 16, *Ph. populi*, 8th sternite of other specimen, same data; 17, *Ph. populicola*; 18, *Ph. pastorella*. Scale 0.2 mm.

Phyllonorycter populifoliella (Treitschke); Buhl et al. 1983: 5-8.

Diagnosis. – Externally similar to *Ph. sagitella* (Bjerkander) and *Ph. apparella* (Herrich-Schäffer), but differs by indistinct forewing pattern. In male genitalia resembling *Ph. populi* (Filipjev), but differing by longer vinculum and aedeagus.

External characters (fig. 4). – Wingspan 7.0-8.0 mm. Face and palpi creamy white. Tuft creamy white with mixture of brownish scales. Scapus creamish. Flagellum brownish annulated with brown. Thorax white, slightly irrorate with brown. Forewing creamy white with variable, brown pattern. Five to six costal and four dorsal strigulae present, variably developed. Costal strigulae larger and more distinctive than dorsal strigulae. Apical spot brown. Line at apex of forewing creamy. Cilia creamy. Hindwing and cilia brownish creamy. Abdomen dark creamy.

Male genitalia (fig. 14). – Symmetrical. Uncus reaching slightly beyond apex of valva. Vinculum longer than width of valva, proximally narrowed. Valva simple, slightly broadened distally with small tooth at apex. Transtilla U-shaped. Sternite 8 triangular at apex and with slight distal invagination. Aedeagus more than twice as long as valva, with small hook at apex.

Distribution. – Throughout Europe, the Caucasus, Ural, Western Siberia, northern part of Central Asia.

Biology. – Host plants: *Populus tremula* L., *P. nigra* L., *P. balsamifera* L., *P. laurifolia* Ledeb. Mine (fig. 25) on underside, rarely on upperside of leaf, folded and situated between veins.

Material examined: 1♂. – Kazakhstan: 1♂, env. Alma-Ata, Zailiyskiy Alatau ridge, 22.ix.1957, M. Falkovitsh (-ZIAS).

Phyllonorycter populi (Filipjev, 1926)
(figs. 5, 15-16, 26)

Lithocolletis populiella Filipjev, 1926: 284 (preoccupied by *L. populiella* Chambers, 1878).
Lithocolletis populi Filipjev, 1931: 236 (replacement name for *L. populiella* Filipjev), Kuznetzov 1981: 284.

Diagnosis. – Most similar to *Ph. sagitella* (Bjerkander), but differs by distal part of valva not being narrowed and by presence of small tooth on apex.

External characters (fig. 5). – Wingspan 7.4-9.5 mm. Face and labial palpi white. Tuft on head consists of whitish and brownish-grey piliform scales. Scapus white. Flagellum greyish, weakly annulated with grey. Thorax irrorate with white, brown or brownish scales. Forewing with slightly diffuse pattern, consisting of five white, diffuse costal strigulae (irrorate with pale brownish scales) and four weakly distinct, white dorsal strigulae. All strigulae are proximally edged dark brown. Apical region of forewing with two dark brown streaks. Cilia line at distal margin of forewing dark brown. Cilia light grey. Hindwing dark creamy greyish, cilia light creamy greyish. Abdomen whitish creamy.

Male genitalia (figs. 15-16). – Symmetrical. Uncus extending slightly beyond valva. Vinculum triangular, more than twice as short as valva. Valva simple, slightly broadened medially, distally blunt, and with small denticle on apex between setae. Apical third of valva proximally strongly sclerotized, and with bifurcate denticle. Transtilla symmetrical, with two proximal processes. Sternite 8 broad, almost reaching apex of valva, with small invagination distally. However, smaller specimens without invagination of 8th sternite have been noted by us (fig. 16). Aedeagus with small hook at apex.

Biology. – Host plants: *Populus alba* L., *P. nigra* L. Mine (fig. 26) or underside of leaf, weakly folded, oval in shape, and usually situated between midrib and two lateral veins. Pupation in mine.

Distribution. – Southern Kazakhstan, Turkmeniya, Uzbekistan, Tadzhikistan.

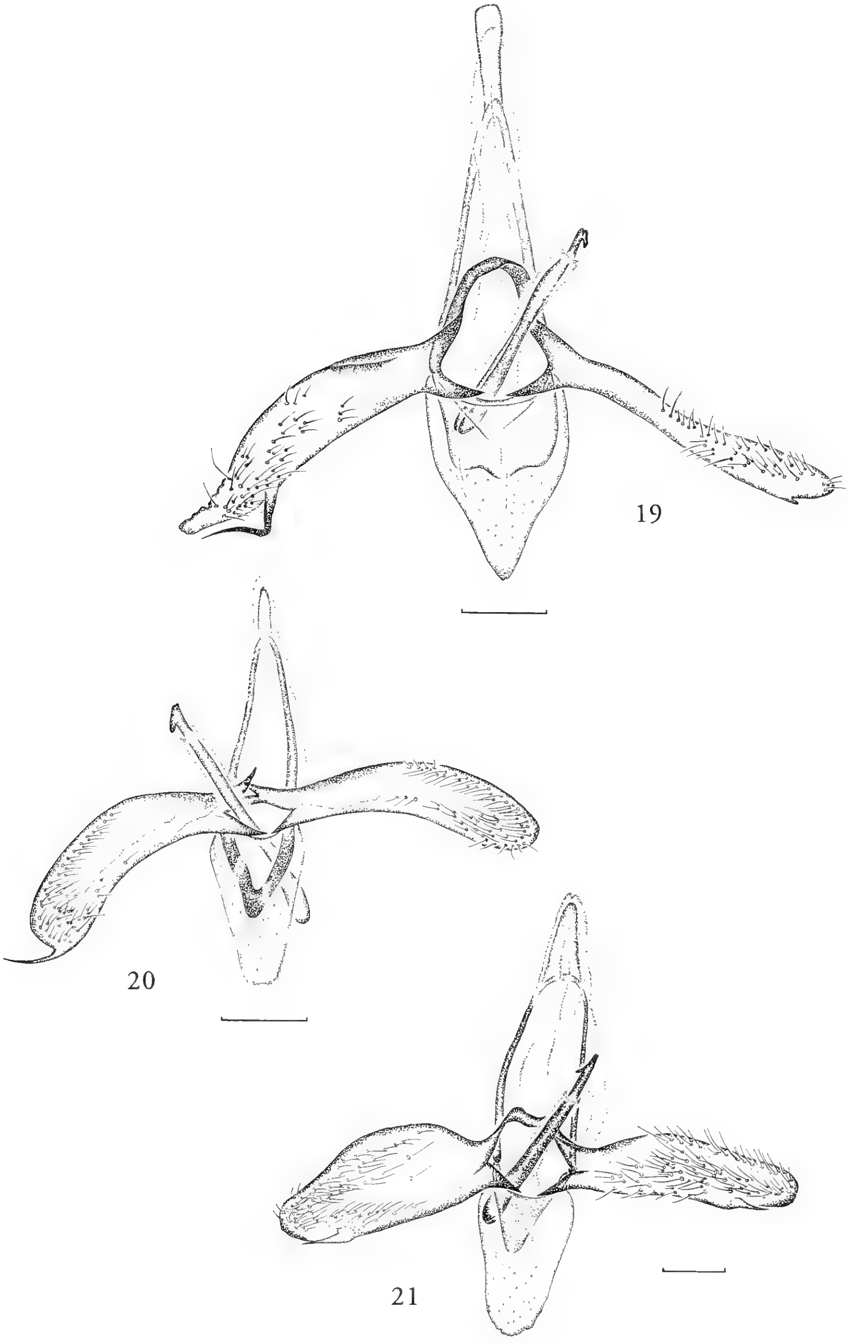
Material examined: 2♂, 2♀. – Turkmeniya: 2♂, 2♀, env. Svintsovyy Rudnik (loc. Sayat), 28.viii.1990, larvae on *Populus alba*, R. Noreika (VPI).

Phyllonorycter populicola (Kuznetzov, 1975)
(figs. 6, 17, 27)

Lithocolletis populicola Kuznetzov, 1975: 419-420, 1981: 287-288.

Diagnosis: – Externally most similar to *Ph. populialbae* (Kuznetzov) and *Ph. comparella* (Duponchel), but distinguished by absence of dark apical spot on forewing. The male genitalia of this species are unique in *Phyllonorycter*.

External characters (fig. 6). – Wingspan 6.5-7.5 mm. Face covered by white scales, tipped grey-brown. Labial palpi white. Tuft on head consists of white and grey-brownish scales. Scapus white with few brown scales. Flagellum grey-brown, annulated with fuscous. Thorax white with some grey-brown and orangeish scales, tipped dark brown. Forewing with slightly diffuse pattern, and covered by scales of various colours: orangeish, grey, dark grey and white, tipped dark brown to blackish. More or less distinct pattern consists of five costal and four dorsal white strigulae. All strigulae slightly irrorate with few orangeish and greyish scales, tipped, blackish. White strigular with brown to blackish lines at their proximal margin. Apical spot absent. Cilia grey, only at forewing apex orange. Hindwing and cilia grey. Abdomen grey.



Figs. 19-21. Male genitalia of *Phyllonorycter*. - 19, *Ph. pruinosella*; 20, *Ph. asiatica*; 21, *Ph. dentifera*, holotype. Scale 0.2 mm.

Male genitalia (fig. 17). – Symmetrical. Uncus not reaching apex of valva. Vinculum broad, long, apically rounded. Valva complex, medially strongly broadened and bulged; bulge with some large, strongly sclerotized spines; three to four smaller spines on distal margin of bulge. Apical third of valva abruptly narrowed, with dentate dorsal margin and cornutus-like spine at apex. Small setae covering apical third of valva. Transtilla symmetrical and broad. Sternite 8 not reaching apex of valva, broad and dentate distally. Aedeagus longer than valva, smooth and gradually narrowed toward apex, and with dorsal hook at apex.

Biology. – Host plant: *Populus afghanica* (Aitch. et Hemsl.) Schneid. Mine (fig. 27) on underside of leaf, occasionally on upperside, folded, situated in various parts of leaf and strongly distorting it.

Distribution. – Tadzhikistan only.

Material examined: 8♂, 3♀. – Tadzhikistan: 2♂ (holotype and paratype), 30 km N Dushanbe, env. Varzob (loc. Kondara), 3-22.vi.1971 larva on *Populus* sp., ex p. 7.vii.1971, R. Sherniyazova (zias); 1♂, same locality, 8.-viii.1986, R. Puplesis (vpi); 1♂, 2♀, same locality, 15.20.-viii.1990, R. Noreika (vpi); 2♂, 1♀, same locality, 15.-viii.1990, larva on *Populus afghanica*, N. 5060, ex p. 23.viii-14.ix.1990, R. Noreika (vpi); 1♂, 4♀, same locality, 20.vii-10.viii.1990, V. Sruoga (vpi); 1♂, same locality, 8.-viii.1990, J. Bajarunas (vpi).

Phyllonorycter pastorella **(Zeller, 1846)**

(figs. 7, 18, 28)

Lithocolletis pastorella Zeller, 1846: 250; Kumata 1963: 54-55.
Lithocolletis fainae Gerasimov, 1931: 128/130.
Lithocolletis pastorella fainae; Gerasimov 1932: 240-241, Kuznetzov, 1981: 281.

Diagnosis. – Externally closely resembling *Ph. apparella* (Herrich-Schäffer) and *Ph. chiclanella* (Staudinger), but distinguished by distinct, bright, white strigulae of forewing. In male genitalia, resembling Caucasian *Ph. armeniella* (Kuznetzov), but differing by valva being broader, not bilobed apically, and with horn-like spine, and by longer aedeagus. In male genitalia, *Ph. pastorella* also closely resembles the Japanese *Ph. pulchra* (Kumata), which feeds on Rosaceae, but *pastorella* is easily separeted from this species by its long aedeagus.

External characters (fig. 7). – Wingspan 6.7-9.00 mm. Face and labial palpi white. Tuft on head white. Scapus white with tuft of white scales at base. Flagellum shining white. Thorax bright white, sometimes with pale ferruginous-brown spot at its centre. Forewing with pale ferruginous-brown and white pattern. Basal streak and dorsal streak touching forming together one white spot, which does not reach costa of forewing, with some ferruginous-brown scales almost at its centre. In medial and apical part of forewing, five costal and four dorsal white strigulae; these proximally edged brown or black. First pair of strigulae oblique and situated almost at middle of forewing. First costal strigula reaching dorsal strigula, frequently joining each other. Second costal strigula almost equal in width as first costal streak, but shorter. Second costal strigula situated proximal to the tip of the dorsal strigula. Apical three costal and dorsal strigulae slightly oblique. Second dorsal is widest among all other strigulae of distal region. Brown-blackish apical spot present. Cilia line at apex of forewing blackish-brown. Cilia whitish. Hindwing grey cilia whitish. Abdomen ferruginous grey, but in distal part yellowish white and laterally whitish.

Male genitalia (fig. 18). – Symmetrical. Uncus reaching apex of valva. Vinculum triangular, and shorter than width of valva. Valva simple, broad, and in apical third narrowed, with horn-like spine on apex. Near this spine small cluster of strongly sclerotized small spines present. Transtilla symmetrical and U-shaped. Sternite 8 broad, slightly rounded and not reaching apex of valva. Aedeagus tube-shaped, twice as long as valva, and with hook-like process.

Biology. – Host plants: *Salix* spp. (in Central Asia *S. triandra* L. and *S. babylonica* L.). Mine (fig. 28) on underside of leaf, rarely in upperside, folded, and situated in various parts of leaf, but usually near midrib vein; occasionally midrib also damaged.

Distribution. – Throughout Europe, Turkmeniya, Tadzhikistan, Kirgiziya, Korea, Japan and possibly in fareastern territories of Russia.

Material examined: 55♂, 16♀ – Turkmeniya: 40 km E Kara-Kala, Kopet Dag, 28.v.1988, R. Noreika (vpi); 14♂, 9♀, env. Svintsovyy Rudnik, 11.viii.1989, larvae on *Salix triandra*, R. Noreika (vpi); 1♀, same locality, 28.viii.1990, R. Noreika (vpi); 4♂, Ashkhabad, botanic garden, 17.viii-14.x.1991, larvae on *Salix* sp., E. Kokanova (coll. Kokanova); 1♂, env. Ashkhabad, 24.vi.1991 larva on *Populus* sp., E. Kokanova (coll. Kokanova). – Tadzhikistan: 40♂, 2♀, env. Regar (loc. Tursunzade), 24.viii.1990, larvae on *Salix* sp., R. Noreika (vpi).

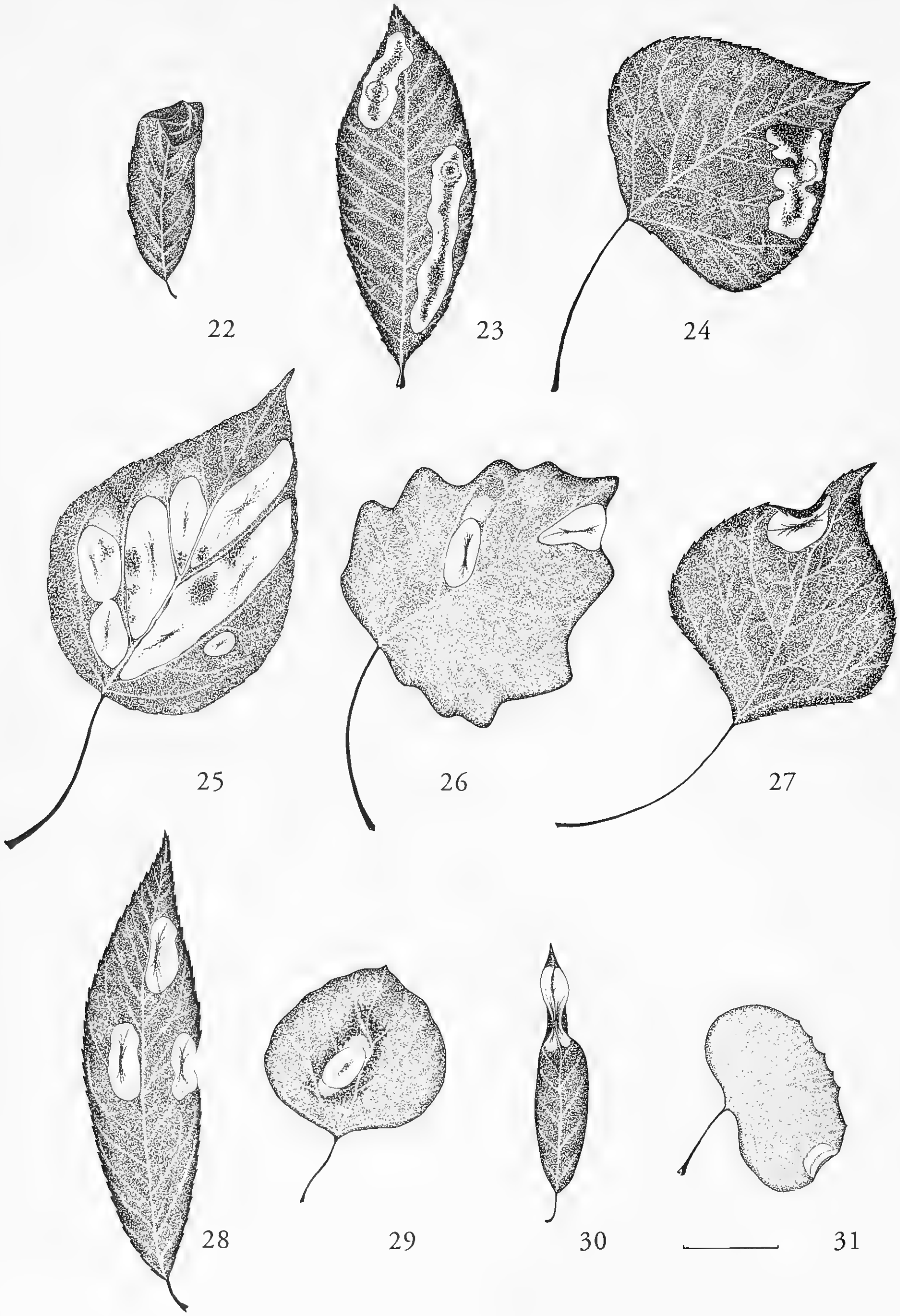
Phyllonorycter pruinosella **(Gerasimov, 1931)**

(figs. 8, 19, 29)

Lithocolletis pruinosella Gerasimov, 1931: 130-131, 1932: 127-129, Kuznetzov 1981: 283, 288, 289.

Diagnosis. – Externally and in male genitalia very characteristic species; among Salicaceae feeding species easily recognisable by strong asymmetry of valvae and by long spine on left valva.

External characters (fig. 8). – Wingspan 5.0-6.1 mm. Face, labial palpi and tuft on head white. Scapus and flagellum white without distinct annulation. Thorax bright white. Forewing snow-white with three pale yellow, perpendicular fasciae, more or less



Figs. 22-31. Leaf-mines. - 22, *Caloptilia stigmatella* on *Salix blakii*; 23, *Cameraria saliciphaga* on *Salix triandra*; 24, *C. obliquifascia* on *Populus afghanica*; 25, *Phyllonorycter populifoliella* on *Populus balsamifera*; 26, *Ph. populi* on *Populus alba*; 27, *Ph. populicola* on *Populus afghanica*; 28, *Ph. pastorella* on *Salix triandra*; 29, *Ph. pruinosella* on *Populus pruinosa* ; 30, *Ph. asiatica* on *Salix blakii* ; 31, *Ph. dentifera* on *Populus pruinosa.* Scale 2 cm.

equal in width. All fasciae edged dark brown. First and second fasciae situated in basal area of forewing, and having characteristic shape (see fig. 8). Apical area of forewing pale yellow with short costal strigula just before apex and small dark-brown apical spot. Distinct blackish cilia-line present. Hindwing and cilia of both wings white. Abdomen bright white laterally, and pale golden dorsally.

Male genitalia (fig. 19). – Distinctly asymmetrical. Uncus reaching beyond apex of valva. Vinculum broad, slightly trapezium-shaped. Left valva twice as wide as right one, tapering in apical part, and with long, strongly angled spine. Right valva with small tooth before apex. Transtilla symmetrical, and U-shaped. Sternite 8 triangular, broad at base, and distally pointed. Aedeagus tube-like with small hook at apex.

Biology. – Host plants: *Populus pruinosa* Schrenk, *P. euphratica* Olivier, occasionally *Salix* sp. Mine (fig. 29) small, smooth, oval, situated on upperside or underside of leaf, but on *Salix* only recorded from leaf underside. Pupation in mine.

Distribution. – Kazakhstan, Turkmeniya, Uzbekistan and Tadzhikistan.

Material examined: 10♂, 2♀. – Turkmeniya: 1♂ Tedzhen, 8.viii.1988, R. Puplesis (VPI). – Uzbekistan: 7♂ (holotype and paratypes), env. Bukhara, 5.viii.1928, larvae on *Populus pruinosa*, A. Gerasimov (ZIAS); 1♀, Khiva (Novyi Urgench), 24.vii.1927, larva on *Salix* sp., A. Gerasimov (ZIAS). – Tadzhikistan: 1♂, 30 km N Dushanbe, env. Varzob (loc. Kondara), 20.viii.1990, R. Noreika (VPI); 1♀, 20 km S Dzhilikul', 13.vii.1990, R. Puplesis (VPI).

Phyllonorycter asiatica (Gerasimov, 1931)
(figs. 9, 20, 30)

Lithocolletis connexalla asiatica Gerasimov, 1931: 130; 1932: 134-136.

Diagnosis. – Most similar to *Ph. connexella* (Zeller), but differs externally by paler background of forewing and colouration of flagellum, which has no annulation. In male genitalia, *Ph. asiatica* is distinguished from *Ph. connexella* by longer proximal process of vinculum.

External characters (fig. 9). – Wingspan 6.0-10.0 mm. Face white with some brownish-ferruginous scales at its centre. Palpi yellowish brown. Tuft pale yellowish at base and brownish-ferruginous at apex. Scapus white, with tuft of white, piliform scales at base. Flagellum white with annulation. Thorax yellowish brown with whitish lateral and anterior margins. Forewing yellowish ferruginous with white strigulae and streaks. Medio-basal streak short. White costal streak additionally present, slightly shorter than medio-basal streak. Three dorsal and three costal strigulae present, proximally edged with black. First costal strigula situated in middle of forewing. Second costal strigula narrower but twice as long as third costal strigula. Dorsal strigulae equally spaced. First and second of these with equal width, and connected by medio-basal streak at their apexes, third dorsal strigula with wider base than other dorsals and curved distally. Distal part of forewing dark, irrorate with brownish scales. Small, black apical spot present. Apex of forewing with brownish-ferruginous line. Cilia whitish. Hindwing and cilia greyish.

Male genitalia (fig. 20). – Asymmetrical. Uncus almost reaching apex of valva. Vinculum triangular, tapering distally. Valva simple and with long comb. Left valva shorter than right one, and with long, slightly arcuate apical process. Transtilla slightly asymmetrical; left process longer than right one. Abdominal sternite 8 gradually narrowed towards apex and with small distal invagination. Aedeagus tube-like and with small hook at apex.

Biology. – Host plants: *Salix alba, S. blakii* Goerz, *S. fragilis* L., *Populus nigra* L., and possibly also other Salicaceae. Mine (fig. 30) on underside of leaf, occasionally on upperside, folded and situated in various parts of leaf.

Distribution. – Kazakhstan, Turkmeniya, Uzbekistan, Tadzhikistan.

Material examined: 10♂, 28♀. – Turkmeniya: 2, ♀, env. Ashkabad, Firyusa, 1.vi.1988, larvae on *Salix* sp., R. Noreika (VPI); 1♂, Kugitangtau, env. Svintsovyy Rudnik, 11.viii.1989, R. Noreika (VPI); 1♂, 1♀, env. Ashkhabad, Firyusa, 22-27.v.1991, larvae on *Salix* sp., E. Kokanova (-coll. Kokanova). – Tadzhikistan: 1♂, 30 km N Dushanbe, env. Varzob (loc. Kondara), 9.viii.1986, R. Puplesis (VPI); 2♂, 10♀, same locality, 12.viii-6.ix.1990. 1990, R. Noreika (VPI); 2♀, same locality, 6.ix.1990, larvae on *Salix blakii*, N 5067, ex p. 15.ix.1990, R. Noreika (VPI); 3♂, 9♀, same locality, 21.vii-10.viii.1990. V. Sruoga (VPI); 1♂, same locality, 8.viii.1990, J. Bajarunas (VPI).

Phyllonorycter dentifera Noreika sp. n.
(figs. 10, 21, 31)

Type material. – Holotype ♂: southern Tadzhikistan, 20 km S Dzhilikul', 18.viii.1990, R. Noreika (VPI). Paratypes: 13♂, 9♀, same locality, 26.vii--18.viii.1990, R. Noreika, R. Puplesis, V. Sruoga (VPI); 1♂, same locality, 17.viii.1990, R. Noreika (RMNH). 1♂, same locality, 13.vii.1990, larvae on *Populus pruinosa*, N 4201, ex 1.1.17.viii.1990, R. Puplesis (VPI); 1♂, Turkmenistan, Tedzhen, 6.vii.1991, larva on *Populus* sp., ex 1.13.vii.1991, R. Puplesis (VPI).

Diagnosis. – Externally very distinct species. Recognizable by connected costal and dorsal strigulae in apical part of forewing, and by very large tuft of white, piliform scales on scapus. In male genitalia, slightly resembling some other *Phyllonorycter* species with asymmetrical valvae, such as *Ph. quinqueguttella* (Stainton), but easily distinguished from all these species by shape of apical process of valva, which is short and weakly sclerotized.

External characters (fig. 10). – Wingspan 5.2-5.8 mm. Face and palpi white. Tuft on head pale brown with some white, piliform scales. Scapus white and with large tuft of white piliform scales. Flagellum white on upperside and slightly brownish on underside. Thorax ferruginous-brown with three longitudinal pale lines. Forewing ferruginous-brown, usually distally with green-grey tinge and with narrow white strigulae. Costal-basal streak reaching middle of forewing and joining with first costal strigula. Mediobasal streak slightly arcuate, and slightly shorter than costal-basal streak. Dorsal-middle streak twice as short as costal-basal streak. Four costal and four oblique dorsal (except two apical ones, which are straight) strigulae present, all white. First costal strigula situated slightly beyond middle of forewing, and connected basally with costal-basal streak. First dorsal strigula wider than all other ones, situated before middle of forewing, and reaching half width of forewing. Second costal and second dorsal strigulae as well as third costal and third dorsal connected at their apexes and forming two narrow parallel fasciae. Fourth costal and fourth dorsal streaks short and straight. All strigulae proximally edged by blackish scales. Apical spot small and elongate, distally bordered by blackish scales. Apex of forewing edged black. Cilia white, costally slightly fuscous. Hindwing and cilia grey-creamy.

Male genitalia (fig. 21). – Asymmetrical. Uncus reaching apex of valva. Vinculum triangular. Each valva with small tooth-like ventral process near apex. Transtilla symmetrical, U-shaped. Sternite 8 rather narrow, and slightly arcuate in anterior view. Tube-like aedeagus slightly shorther than valva and distally somewhat narrowed. Small hook present before apex of aedeagus.

Biology. – Host plant: *Populus pruinosa* Schrenk. Mine (Fig. 31) on upperside of leaf, slightly folded, relatively small, usually near leaf margin.

Distribution. – Turkmeniya and southern Tadzhikistan.

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BOOK REVIEWS

Block, W., 1992. An annotated bibliography of antarctic invertebrates (terrestrial and freshwater). – British Antarctic Survey, Natural Environment Research Council, Cambridge U. K.: 1-263, figs [ISBN 0 85665 148 6]. Available from British Antarctic Survey, NERC, High Cross, Madingley Road, Cambridge CB3 0ET, United Kingdom.

In total 1430 references presented in alphabetical order per author, are given. Each reference has key words for the taxonomic groups. Abstracts provided have been arranged per aspect (systematics, ecology). The many indices (classification, taxonomic, species, author, subject, geographical) make this publication a welcome resource for anyone starting a study on antarctic invertebrates. The work seems to be compiled carefully and certainly gives many references which cannot be traced easily from abstracting services. Just one remark. The publication is spaciously printed in a unnecessarily large typeface on luxurious paper. I would suggest that an organisation working in area where raw material for the production of paper is virtually non-existent, adheres to a more reserved use of paper.

[J. van Tol]

Heie, O. E., 1992. The Aphidoidea (Hemiptera) of Fennoscandia and Denmark. IV. Family Aphididae: Part 1 of tribe Macrosiphini of subfamily Aphidinae. – Fauna Entomologica Scandinavica 25: 1-189, figs. 1-585, colour plates I-II. [ISBN 90 04 09514 4]. [ISSN 0106-8377]. Published by E. J. Brill, Leiden. Price Hfl. 90.-.

From volume 25 onwards the series Fauna Entomologica Scandinavica is published in the size of Tijdschrift voor Entomologie, also using a two-column format. Although this is certainly an advantage from many points of view, the author will regret that the design of his work, published in at least six parts, has changed for a second time. Descriptions and illustrations have the same high standard as the previous works of the author. Keys are provided for the genera and the species alike, with separate keys for the apterous viviparous females, the alate viviparous females and the oviparous females, whenever needed.

Printing as well as contents make this book a valuable addition to every biological library.

[J. van Tol]

Hansen, M., 1991. The Hydrophilid Beetles. Phylogeny, classification and a revision of the genera (Coleoptera, Hydrophiloidea). – Biologiske Skrifter Kongelige Danske Videnskabernes Selskab 40: 1-367, figs 1-340. [ISSN 0366-3612, ISBN 87-7304-226-9. Price 700 Danish Crowns].

Publication of 'The Hydrophilid Beetles' addresses several long standing problems in the study of this group of insects. Although many papers about Hydrophiloidea were published by authors as d'Orchymont and Balfour-Browne, an overview of the group (146 genera, ca 2400 species) was not available up to now. Furthermore there was no agreement as to the definition of the group as a whole.

The paper consists of three major parts: (1) a phylogenetic analysis of the Hydrophiloidea leading to a reclassification of the group, (2) descriptions of and keys to all genera and suprageneric taxa, (3) a catalogue of genus- and family-group names of Hydrophiloidea with nomenclatorial details.

A detailed comparison of all known hydrophiloid genera has not been published since the description of tropical genera started in the 19th century and was therefore long overdue. Most of the proposed classifications were rather subjective and usually without any argumentation. Hansen's attempt towards a classification based on arguments is a large step forward.

The last supraspecific classification for the whole group on a worldwide basis was published in 1924 by Knisch in an issue of the Coleopterorum Catalogus. From that time on numerous new genera were described and articles treating supraspecific taxa or regional faunas published. Newcomers attempting to identify a tropical hydrophilid to at least generic level were convicted to wade through decennia of the 'Zoological Record', usually ending with the conclusion that the particular group one was looking at was badly in need of revision. The keys, descriptions and figures in Hansen's new book will in most cases enable an unambiguous identification to genus. For each genus a description, a habitus illustration, the number of species included and the global distribution is given. It is unfortunate that a summary of the distributional data in a biogeographic analysis has not been tried.

The extensive catalogue of family and genus group names is especially important. It will most certainly contribute to the nomenclatorial stability of the group.

The book is well printed and bound. The quality of the figures is excellent. Separate indexes are provided on species, generic and suprageneric level. This book is a must for everybody who's interest in Hydrophiloidea goes beyond a regional fauna. Besides I recommend it to anybody interested in the general classification of Coleoptera. It may also be useful for ecologists who need to sort samples from more exotic locations.

[J. Huijbregts]

THOMAS PAPE

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PHYLOGENY OF THE TACHINIDAE FAMILY-GROUP (DIPTERA: CALYPTRATAE)

Pape, T., 1992. Phylogeny of the Tachinidae family-group (Diptera: Calyptratae). – Tijdschrift voor Entomologie 135: 43-86, figs. 1-11, tabs. 1-5. [ISSN 0040-7496]. Published 15 July 1992.

Family-level phylogeny within the Tachinidae family-group (Oestroidea) is analyzed using the computer package 'Hennig86'. All families except the Rhinophoridae are split into a number of groups, most of which are given subfamilial status, and terminal taxa are scored for a total of 50 characters. Outgroups are Anthomyiidae and Muscidae. The favoured cladogram lists the Sarcophagidae as the sister group of the Tachinidae, the Oestridae as the sister group of the Calliphoridae, and the Rhinophoridae as the sister group of the clade Calliphoridae + Oestridae. The monophyly of all taxa of family rank and above within the Tachinidae family-group is corroborated by explicit listing of apomorphic character states. Implications of various interpretations of character states and transformation series are discussed.

Mystacinobia zelandica Holloway, 1976 is accepted as a member of the Tachinidae family-group, but excluded from the analysis because of difficulties in interpreting character state homologies.

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Key words. – Phylogeny, Tachinidae family-group, Oestroidea, Calyptratae, Diptera, Hennig86.

CONTENTS

INTRODUCTION

All recent regional Diptera catalogues (Nearctic: Stone et al. 1965, Neotropical: Papavero 1966-?, Oriental: Delfinado & Hardy 1977, Afrotropical: Crosskey 1980a, Palearctic: Soós 1984-?, Australasian / Oceanian: Evenhuis 1989) more or less implicitly list or issue the Diptera families in some kind of phylogenetic sequence. With respect to what is here called the Tachinidae family-group, the Calliphoridae are usually treated first, followed by the Sarcophagidae, Rhinophoridae and Tachinidae respectively (the latter two sometimes united). The Oestridae take up various positions: issued first (Palearctic catalogue), situated between the Calliphoridae and the Sarcophagidae (Australasian/Oceanian catalogue), or following the Tachinidae (other catalogues). Other, more explicit phylogenetic hypotheses have proposed a sister group relationship between the Oestridae (in part) and the Tachinidae (Roback 1951), between the Rhinophoridae and Sarcophagidae (Rohdendorf 1967), between the Rhinophoridae and Calliphoridae (Tschorsnig 1985a), between the Rhinophoridae and Tachinidae (Wood 1987b), between the Oestridae and all other members of the Tachinidae family-group (Hennig 1976, Tschorsnig 1985a), or between the Calliphoridae and all other members of the Tachinidae family-group (Griffiths 1982). Shewell (1987b: 1162) was of the opinion that 'biological and distributional data suggest [that the Sarcophagidae] are younger than both the Calliphoridae and the Tachinidae'. In strict cladistic terms, this hypothesis implies that Shewell considers the Sarcophagidae to be the sister group of either the Oestridae, the Rhinophoridae, or both – although this actually may not have been the intention. Only McAlpine (1989) has made an attempt of fully resolving the phylogeny at the family level and he considered the clade [Calliphoridae + Mystacinobiidae] + Sarcophagidae as the sister group of the clade Oestridae + [Rhinophoridae + Tachinidae].

The primary objective of the present paper is to test these hypotheses through reconsideration of available data and incorporation of additional data. In order to be as objective as possible and to facilitate and encourage future retesting, I have applied a numerical cladistic approach including close to all (non-redundant) characters for which I have been able to obtain clearcut scorings. Several characters of potential phylogenetic value are discussed but not included in the analyses because of my uncertainty with regard to their proper scoring. It is hoped that the detailed annotations for most characters will serve as the basis for extensive discussions on character (state) interpretation as well as promote a search for additional morphological, behavioural and biochemical evidence.

The Tachinidae family-group contains the well known blowflies, botflies, flesh flies, tachinid flies, and woodlouse flies. Whether this entire group is given rank of family (Griffiths 1972), family-group (Griffiths 1982) or superfamily (Hennig 1958, McAlpine et al. 1981, Pape 1986a) is of minor concern for the present discussion, and I have simply followed current use of family rank for the subgroups included. It should be mentioned that the Tachinidae family-group in the present sense equals the Calliphoroidea of Hennig (1958), the Tachinoidea of Rohdendorf (1977) and Pape (1986a), and the Oestroidea of McAlpine et al. (1981). The latter is formally correct in the sense of the International Code on Zoological Nomenclature as the oldest family-group name within this taxon is based on *Oestrus* Linnaeus (C.W. Sabrosky, in prep.). Griffiths (1972) used Girschner's (1893) broad definition of the 'Tachinidae' for this taxon but later modified the name to the 'Tachinidae family-group' (Griffiths 1982). I have adopted the latter suggestion rather than applying a formal superfamily as I prefer to apply superfamily level much further down the cladogram of Diptera, as has been done by Griffiths (1972), Crosskey (1980a), Woodley (1989), and Thompson (1990). Furthermore, I prefer 'Tachinidae family-group' to 'Oestridae family-group' as the former is already in use (Griffiths 1982, Thompson 1990), and the latter may easily be misinterpreted as a group consisting of what is here considered subfamilies of an Oestridae sensu lato, like the Oestroidea of Hackman (1980) or the even more restricted Oestroidea of Papavero (1977).

Paraphyletic assemblages of families arising when excluding the Tachinidae family-group from more inclusive clades, e. g. from the Calyptratae, are here described as 'non-tachinoid', e.g. non-tachinoid calyptrates.

TERMINOLOGY, METHODS AND CHOICE OF TERMINAL TAXA

Terminology is straightforward and follows in general McAlpine (1981) and Teskey (1981). The only important exception is in the terminology of the structures of the male terminalia, where I have followed Michelsen (1988) and Wood (1990, 1991).

The character matrix (table 2) was analysed with the computer package Hennig86 (version 1.5, copyright J.S. Farris 1988) on an IBM PS/2-30 (8086 microprocessor). Cladograms (trees) were generated with 'mh*;bb*;' rather than any combination of implicit enumeration (ie) and branch-swapping (bb). As noted by both Farris (1988: Hennig86 documentation) and Fitzhugh (1989), this includes the possibility of not finding all minimum-length cladograms, but it may be a convenient trade-off as it is considerably faster and therefore will allow many more trials. The procedure chosen was judged to have no family-level impact on the resulting equally most parsimonious cladograms, although this hypothesis needs corroboration.

All character states were treated as unordered when producing a first set of cladograms (changing the Hennig86 default by 'cc-.;'), and a successive weighting procedure ('xsteps w;' in combination with 'mh*;bb*;' and 'cc;' until weights no longer change) was applied to any initial set of equally most parsimonious cladograms. The latter procedure, which weights characters according to their best fit to the cladograms concerned through multiplying consistency and retention indices and scaling these in the range 0-10, means that clades based on more reliable characters are given higher priority (Fitzhugh 1989). Thus, the resulting cladogram(s) may be different from any of the initial ones. Where successive weighting could not reduce the number of equally most parsimonious cladograms to one, a Nelson consensus tree was produced by the 'nelsen;' command. As discussed by Carpenter (1988), any of the equally most parsimonious cladograms will represent a stronger hypothesis than the Nelson consensus tree, but I have chosen the latter due to lack of good arguments for selecting amongst these (often numerous) resulting cladograms.

Transformation series for characters involving more than two states were deduced from the weighted Nelson consensus tree obtained through the procedure outlined above. With this new input of phylogenetic information, data were reanalyzed.

The number of characters (here defined as transformation series, see for example Mickevich (1982) and Platnick (1979)) in biological taxa is usually very large, and any phylogenetic analysis can only take a fraction of these into consideration. Exclusion of those characters that would be scored identically for all terminal taxa analysed and thus carry no phylogenetic information is straightforward. Similarly, those unique (autapomorphic) character states in a given analysis that define terminal taxa may be excluded as well, as they have no impact on the relationships between the taxa. In between is a potentially large number of characters that possess phylogenetic information in the given context. Of these, some are left unscored simply because they remain unknown to the observer, or because severe problems with regard to interpretation of homology or proper delimitation into states defer clearcut decisions. Therefore, the present data matrix (table 2) contains only those nonredundant characters for which I have been able to obtain 'reasonably unambiguous' scorings. In the present analysis, these characters are mostly well known and generally used in descriptive works, but the scorings – which are the heart of the analysis – represent hypotheses that should be tested through more information (morphological, biological, phylogenetic, etc.) on the terminal taxa considered.

All scorings are meant as features of the hypothetical ancestor of the group in question, and I have used 'groundplan state unknown' (scored simply as '–') whenever a character is inapplicable or when more than one state occurs in a pattern that does not suggest one to be a more probable groundplan feature than the other(s).

When scoring larger groups one almost always has to deal with exceptions, i.e. one or more species within a group showing a character state differing from that of the hypothetical groundplan chosen. Rather than scoring every deviating member separately, which would create an excessive number of terminal taxa; or using 'state unknown' for all instances where exceptions were found, which would greatly reduce the amount of information actually at hand, generalizations have sometimes been made. These are discussed in the annotations. Concurrently with the emergence of explicit hypotheses on the basal splits within each of the terminal taxa, these generalizations – and thereby the hypotheses emerging from them – become open to rigorous testing.

Two non-tachinoid members of the Calyptratae have been included in the analysis: the Anthomyiidae and the Muscidae. Both families were designated as outgroup relative to the Tachinidae family-group ('outgroup = 0.1;'). The Fanniidae are sometimes included within the Muscidae or considered their sister group, but they are here excluded from the analysis. All Fanniidae have the first anal vein (A_1 + CuA_2 or just A_1) shortened and may for this reason be considered as members of a group also containing the Muscidae and the Tachinidae family-group. The reduction of A_1, however, is associated with a strongly curved second anal vein (A_2), and this feature puts serious doubt on the interpretation of the shortening of the first anal vein as homologous to the condition seen in the Muscidae. Pont (1986a: 41) even mentioned that the Fanniidae 'may be the primitive sistergroup of the rest of the Muscoidea, or even of the Calyptrata', which finds interesting support in the analysis of ribosomal RNA phylogeny provided by Vossbrinck & Friedman (1989). McAlpine (1989) treated the Fanniidae as the sister group of the Muscidae, but he did not apply a numerical cladistic approach and his hypothesis needs testing by inclusion of more data. Non-tachinoid calyptrate phylogeny is beyond the purpose of the present paper and I have simply accepted Pont's statement cited above. Anyway, the in- or exclusion of this family in the phylogenetic analysis presented below would probably have no impact on groundplan estimates for the Tachinidae family-group nor on hypotheses of phylogenetic relationships between its members.

Except for the Rhinophoridae, which have been scored as a terminal taxon, I have split the tachinoid families into a number of subgroups to enhance the corroboration of family groundplan estimates. Note that my use of subfamilial (or tribal) endings should not necessarily be taken as an endorsement of subfamilial (or tribal) rank for these groups; they are simply more easily referred to as such for the present purpose. These subgroups generally equal named and well-known subfamilies or tribes, but a special case is made for the Tachinidae, the subfamilial classification of which is highly premature in so far as few currently recognized subfamilies emerge as well corroborated monophyletic groups. Crosskey (1980b: 822-823), for example, was of the opinion that the '-traditional' Tachininae 'almost certainly [are] polyphyletic'. According to Wood (1987c: 1201) 'the Dexiinae is the only subfamily that can be defined on the basis of a synapomorphy', and Tschorsnig (1985b: 120) stated that the monophyly of the Tachininae as well as the Exoristinae is unsupported ('Die Monophylie sowohl der Tachininae als auch der Exoristinae kann nicht begründet werden'). Still, however, recent suggestions on how to divide the Tachinidae into major subgroups and hypotheses of the phylogenetic relationships between these are almost exclusively restricted to the traditional concept of the four subfamilies Phasiinae, Exoristinae, Tachininae and Dexiinae (e.g. Shima 1989, Richter 1991).

For the present analysis I have applied a much wider concept of the Tachininae than the one referred to above, namely by uniting all species which embryonate (or are suspected to embryonate) their eggs in the uterus for at least some time after fertilization. This concept was originally proposed by Wood (1985: 8), who regarded the 'possession of a distensible ovisac for embryonating eggs .... as a synapomorphy of those tachinids that possess it.' I have recognized the Phasiinae as applied by Wood (1987c), and a 'rest-group', here named the '*Exorista* genus-group', including the non-embryonating, non-phasiine Tachinidae (mainly genera like *Aplomya* Robineau-Desvoidy, *Exorista* Meigen, *Medina* Robineau-Desvoidy, *Meigenia* Robineau-Desvoidy, *Phorocera* Robineau-Desvoidy, and *Winthemia* Robineau-Desvoidy, see Wood (1972, 1985)). This latter group is thus possibly para- or even polyphyletic, but the classification is considered superior to the more traditional division of the Tachinidae into four subfamilies as the suspected non-group is much less inclusive in terms of genera and species. The Dexiinae will thus be subordinate within the present Tachininae and are not scored separately.

The Rhinophoridae need some minor comments. The genus *Mimodexia* Rohdendorf was described in the Sarcophagidae (Rohdendorf 1935) and later considered a distinct subfamily, Mimodexiinae, of the Calliphoridae with a sister group relationship to the remaining members of this family (Lehrer 1970). Tschorsnig (1985a: 16) proposed *Mimodexia* as a senior synonym of *Callidesia* Kugler (Rhinophoridae). The phallus is highly rhinophorid-like and possesses the apical bend of the median sclerotization listed by Pape (1986a) as a synapomorphy for *Tromodesia* Rondani and *Callidesia*, and features like wing pattern, wing venation, and narrowing of frontal vitta also agree with this proposal (Rohdendorf 1935: figs. 79-82, Kugler 1978: figs. 10-11). Thus, I accept the synonymy and thereby the assignment to the Rhinophoridae.

Also, I prefer to include the New World *Bezzimyia* Townsend and the Oriental *Malayia* Malloch in the Rhinophoridae. Crosskey (1977) discussed the familial assignment of *Bezzimyia* and considered this genus in the Tachinidae (exclusive of the Rhinophoridae), because 'the head facies .... is conspicuously tachinid, and the enlarged fore tarsi of the female are of the minthoine type' (p. 13). This was accepted without further comments by Pape (1986a). However, still more evidence is accumulating in favour of an inclusion in the Rhinophoridae (Pape, unpubl.). The phallus of what appears to be an undescribed species of *Bezzimyia* (Mexico: Chiapas, El Triunfo, 1 male, 13-15.v.1985, A. Freidberg, deposited in the Department of Zoology, University of Tel Aviv) is strikingly similar to the phallus found in the Rhinophoridae (fig. 3), and as subscutellum, lower calypteres and abdominal sternite 2 agree more with the Rhinophoridae than with the Tachinidae, I prefer to include *Bezzimyia* in the former. The rhinophorid appearance may have been the reason why Sabrosky & Arnaud (1965) put *Bezzimyia* in the Rhinophorinae (as a subfamily of the Tachinidae). Crosskey (1976: 163, 209) listed *Malayia* as a genus incertae sedis within his possibly polyphyletic Tachininae (i.e. the traditional concept), but also *Malayia* possesses the rhinophorid-like features here given for *Bezzimyia*. Admittedly, they do not fit easily into the cladogram of rhinophorid genera produced by Pape (1986a), but lack of evidence does not corroborate anything. Thus, the only argument for treating these rhinophorid-like genera as Tachinidae is that they possess characters not found in any (? other) rhinophorid but which are encountered scattered in the Tachinidae, e.g. a laterally compressed fore tarsus (many *Bezzimyia*, some undescribed *Malayia*), heavily setose facial ridges that are elongated ventrally (*Bezzimyia busckii* Townsend), or a lobate first flagellomere (some undescribed *Bezzimyia*). But as long as they cannot be shown to share but a few possibly derived character states with any specific group of Tachinidae, the many apomorphic character states which are shared with the Rhinophoridae make an affiliation with this family most corroborated. Most probably, the description of either mature eggs or the first instar larvae of *Malayia* and *Bezzimyia* – still unknown for both genera – will provide definite clues to their systematic position. Apart from *Bezzimyia* and *Malayia*, some other undescribed species of Neotropical and Australasian Rhinophoridae have turned up lately (Pape in prep.), and as these do not fit easily in the cladogram of Pape (1986a), the family groundplan remains uncertain for some characters.

The lack of a well corroborated infrafamilial classification of the Calliphoridae urges some explanation of the subgroups used. I have treated the Toxotarsinae as including the Sarconesiinae, Kuschelomyinae and Netinae of Lopes & Albuquerque (1982), but distinct from the Chrysomyinae and Rhiniinae, with which they share a row of setae on the posterodorsal surface of the stem vein (remigium). This is not because I endorse subfamily rank for these taxa, but simply because a splitting will bring more detailed scorings and therefore result in better corroborated hypotheses of groundplans and therefore of phylogenetic relationships. The Auchmeromyiinae of Patton (1935a) [originally spelt Auchmeromyinae] is here widened and synonymized with the Bengaliinae as used by James (1966) and the Bengaliinae and Tricycleinae used by Lehrer (1970). This taxon will probably, in addition to *Auchmeromyia* Brauer &

Bergenstamm and *Bengalia* Robineau-Desvoidy, contain the genera *Booponus* Aldrich, *Cordylobia* Grünberg, *Hemigymnochaeta* Corti, *Neocordylobia* Villeneuve, *Pachychoeromyia* Villeneuve, *Termitoloemus* Baranov and *Tricyclea* Wulp, the species of which all are exclusively yellowish or brownish (Rognes 1991, pers. obs.). Moreover, all members may have the spermathecal ducts arranged in the 'all separate' configuration (see discussion under character 25 below), and all genera of this taxon examined by me (*Auchmeromyia*, *Bengalia*, *Cordylobia*, *Termitoloemus*, *Tricyclea*) have an elongated first anal vein (A_1 + CuA_2), reaching, or almost reaching the wing margin (see also Villeneuve (1924)). Rognes (1991) mentions that the complete first anal vein is a possible autapomorphy for the Auchmeromyiinae, although he simultaneously proposes to maintain the equally equipped genus *Bengalia* in a subfamily of its own. I know of no character states shared by the non-bengaliine Auchmeromyiinae, which may corroborate their monophyly. A similarity between *Auchmeromyia*, *Cordylobia* and *Bengalia* was, in fact, already noted by Patton (1935a: 229), who mentioned that 'practically all the chaetotactic characters [of *Auchmeromyia*] are common to *Bengalia* and *Cordylobia* as well'.

The monophyly of the Ameniinae and Mesembrinellinae, respectively, seems corroborated beyond any doubt (Crosskey 1965, Guimarães 1977), and the Phumosiinae, including *Euphumosia* Malloch and *Phumosia* Robineau-Desvoidy, may be defined by the character states macro- (or uni-) larviparous reproduction (Ferrar 1978), elongated spermathecae, and the 'all separate' configuration of spermathecal ducts.

The Helicoboscinae were dealt with by Rognes (1986), with whom I fully agree. Note that already Patton (1939: 107) suggested a calliphorid affiliation of this taxon: 'It is not possible at present to be certain of the systematic position of *Helicobosca muscaria* and *Helicobosca distinguenda*, one point, however, is certain they do not belong to the subfamily Sarcophaginae; the terminalia suggest relationships with the Calliphorinae'. Verves (1990) transferred the genus back into the Paramacronychiinae, but without a detailed discussion on how to explain the absence of the diagnostic sarcophagid groundplan features in this taxon.

The subfamilies Calliphorinae, Luciliinae, Melanomyinae, and Polleniinae have received a detailed and precise treatment by Rognes (1991) and need no further comment in this context. The subfamilial and tribal phylogeny proposed by Lehrer (1970) will not be thoroughly discussed in the present paper as this author did not explicitly list the (derived) character states defining clades as well as terminal taxa.

The Prosthetosomatinae, which were transferred to the Calliphoridae by Pont (1980a), have not been included as a separate (calliphorid) taxon as they in my opinion represent a group of convenience. The constitutive feature is the habit of all members infesting termite nest-mounds (in itself hardly a clearcut character state), and they are known from the larval stages only. They will probably fit into one or more of the groups applied in the present paper when adults become available.

The division of the Sarcophagidae into only three subfamilies has been dealt with by Pape (1987a). Oestridae in the present sense equals that of Wood (1987a), and they have been divided in four subfamilies: Cuterebrinae, Gasterophilinae, Hypodermatinae and Oestrinae. The Gasterophilinae have been further split into two subgroups: Cobboldiini with the genus *Cobboldia* Brauer on the one hand, and Gasterophilini with *Gasterophilus* Leach and *Gyrostigma* Brauer on the other. The systematic position of the monotypic genera *Neocuterebra* Grünberg and *Ruttenia* Rodhain within the Oestridae is uncertain (Zumpt 1965; Wood 1986, 1987a), and I have followed the tentative suggestion of Wood (1987a), that they belong to the Cuterebrinae.

The monotypic *Mystacinobia* Holloway from New Zealand has not been included in the analysis, neither as a separate taxon nor by inclusion in one of the accepted taxa. No shared character states have been found which will convincingly indicate inclusion within any of the currently applied families, but I do not consider this justification for a separate family. The strongly autapomorphic morphology renders homologies of most character states highly tentative or even inapplicable, and many scorings are open to serious doubt. I prefer to accept *Mystacinobia* as a member of the Tachinidae family-group and to treat it as a genus incertae sedis. Possible phylogenetic affinities are discussed further in the section dealing with clades of the Tachinidae family-group.

Characters and character states

Characters discussed below are given numbers according to their scorings in the data matrix (table 2), starting with 0 rather than 1 following the procedure of numbering characters in Hennig86 (version 1.5). All characters have been split into two or more states denoted by consecutive numbers (0-n). For the convenience of the later discussion, states have – where possible – been arranged in the transformation series deduced from the initial analysis and with the more plesiomorphic state having the lowest number.

Character 0. – Postocular setae; size
0 - equal size, 1 - alternating size, 2 - reduced.

Apart from Pape (1991), this character has not previously been employed for diagnostic purposes or otherwise explicitly mentioned in connection with the Tachinidae family-group. In the non-tachinoid Calyptratae, the row of postocular setae consists of equal-sized setae or these may increase gradually in size towards the vertex. In the Tachinidae family-group, this row consists of setae distinctly alternating in size, and only two exceptions are known to me: The Oestridae and the Miltogrammatinae (Sarcophagidae). All Oestridae have their general setosity greatly modified, with most setae soft and hairlike. The postocular setae are bristly in the sense that they are stiff and tapering, but obviously reduced in length, and they show no alternation in size. As this reduced condition could easily have evolved from any of the other two states, the oestrid condition has been scored as a separate state: reduced (2). In the Miltogrammatinae, species of *Macronychia* Rondani sometimes have postocular setae slightly alternating in size, but the subfamily has nevertheless been scored for equal sized postocular setae.

Character 1. – Postcranium; shape

0 - convex, 1 - concave.

The concave condition is found in all Oestridae and in the subfamily Miltogrammatinae of the Sarcophagidae. The groundplan of all other terminal taxa has been scored as convex.

Character 2. – Imaginal mouthparts; functionality

0 - fully developed and actively used, 1 - reduced and never used for feeding purposes.

Within the Oestridae, all species possess reduced mouthparts, and only species of *Cuterebra* Clark and some Hypodermatinae have been seen imbibing water from wet surfaces (Bennett 1955, Catts & Garcia 1963, Grunin 1965). Solutions of sugar or proteinaceous substances are never exploited. The non-oestrid taxa have all been scored for fully functional mouthparts (0) as the very few instances of much reduced mouthparts (e.g. *Dexia* Meigen and *Phasiops* Coquillett of the Tachinidae, *Chauliooestrus* Villeneuve of the Sarcophagidae [not Gasterophilidae as listed in Pont (1980b), see Pape (1991)], *Villeneuviella* Austen of the Calliphoridae) seem to involve genera far from the basal splits in their respective subfamilies.

Character 3. – General integument; coloration

0 - non-metallic, 1 - metallic.

The Anthomyiidae and Rhinophoridae possess no members with metallic colours, and the few examples in the Muscidae (e.g. *Neomyia* Walker), Sarcophagidae (only Sarcophaginae, e.g. *Sarcophaga metallescens* Bezzi, *Chlorosarcophaga* Townsend), and Tachinidae (e.g. *Gymnocheta* Robineau-Desvoidy of the Tachininae) may convincingly be characterised as isolated homoplasies by reference to what is known of infrafamilial phylogeny in these groups. In the subfamily Cuterebrinae, metallic colours occur in *Neocuterebra squamosa* Grünberg and *Dermatobia hominis* (Linnaeus, Jr). Members of the genus *Cuterebra* sensu lato generally have a shining integument and a few species present a distinct metallic tinge, e.g. *Cuterebra atrox* Clark. *Ruttenia loxodontis* Rodhain has no metallic coloration. The groundplan of the Cuterebrinae has been scored as unknown with regard to this character.

Metallic colours are not present in the Gasterophilini. In *Cobboldia*, the Afrotropical species *C. loxodontis* Brauer and *C. roverei* Gedoelst have thorax and abdomen metallic blue and green respectively, but the Oriental *C. elephantis* (Cobbold) is nonmetallic.

In the Calliphoridae, no member of the Helicoboscinae and the Bengaliinae possess a metallic coloured integument, and these have accordingly been scored as non-metallic (0). In the Polleniinae, metallic colours are generally absent but at least some New Zealand *Pollenia* Robineau-Desvoidy are metallic green (Dear 1986). The 'Australasian' concept of this genus, however, is much broader than that containing only those Palearctic species with soft, yellowish, crinkled hairs amongst the thoracic setae, and as I have been unable to differentiate *Pollenia* (s.l.) from the remaining genera of Polleniinae, the groundplan of the subfamily has been scored as unknown for this character. Also, several species of Rhiniinae and *Melanomya* Rondani of Melanomyinae are non-metallic and the groundplan of these subfamilies has been scored as unknown for this character. Remaining calliphorid subfamilies have been scored as metallic (1).

Character 4. – Imago; clothing setae

0 - unmodified setae, 1 - most setae hairlike.

The hairy condition of all members of the oestrid subfamilies is well known and needs no further comment. *Rhyncomya* Robineau-Desvoidy (Rhiniinae) and Palearctic *Pollenia* (Polleniinae) of the Calliphoridae possess whitish or yellowish hairs among the setae, but never to a degree comparable with any botfly, and the hairs are crinkled and unlike those found in the Oestridae.

Character 5. – Prosternum; setosity

0 - bare, 1 - setose.

In the Sarcophagidae, most members of subfamily Sarcophaginae have the prosternum setose and the groundplan has been scored as such. No

Paramacronychiinae and in the Miltogrammatinae only *Chrysogramma* Rohdendorf (preocc., no valid name at present) have setae on this sclerite. No Rhiniinae and Polleniinae have a setose prosternum, while the setose condition is widespread in all other terminal taxa of Oestridae and Calliphoridae. In the Tachinidae, I have not seen the setose condition in the Phasiinae nor in the *Exorista* genus-group, but both conditions occur in the Tachininae, and the groundplan of the latter has been scored as unknown for this character.

Character 6. – Proanepisternum; setosity
0 - bare, 1 - setose.

A setose proanepisternum (upper, depressed part of propleuron) may be found scattered throughout the Sarcophagidae, but always in distinct clades that are not engaged in the basal dichotomies of their respective subfamilies. Therefore, I feel confident by scoring the groundplan of the contained subfamilies as bare (0). In the Calliphoridae, I have found no instances of a setose proanepisternum in the Mesembrinellinae, Polleniinae and Rhiniinae – all scored as bare (0) – while both states occur in the Bengaliinae (setose in *Tricyclea*, bare in others) and Melanomyinae (bare in *Melanomya*, setose in *Melinda* Robineau-Desvoidy), which have been scored as unknown. Remaining calliphorid subfamilies have been scored as setose (1) as I know of no exceptions. No Rhinophoridae possess a setose proanepisternum, and in the Tachinidae no members of the Phasiinae and the *Exorista* genus-group seen by me have this surface setose. Both conditions occur in the Tachininae, the groundplan of which accordingly has been scored as unknown. The Oestridae probably have the setose condition as a groundplan feature. In the Cuterebrinae the proanepisternum is bare in *Neocuterebra* and *Ruttenia*, setose in *Dermatobia* Brauer and *Cuterebra*. *Gasterophilus*, *Gyrostigma* and *Cobboldia* of the Gasterophilinae all possess a setose proanepisternum. In the Hypodermatinae, the setose condition is found in *Oestromyia* Brauer, but only occasionally in the Hypodermatini. No Oestrinae possess a setose proanepisternum.

Character 7. – Postalar wall; setosity
0 - bare, 1 - setose.

The typical pattern of postalar setae is an isolated tuft of setae centrally on the postalar wall. Several genera of the sarcophagid subfamily Sarcophaginae possess postalar setae in this configuration, but no postalar setae are found in the genus *Tricharaea* Thomson, which is often considered close to the basal split(s) of this taxon, and the sarcophagine groundplan has been scored as unknown. No members of the Paramacronychiinae possess postalar setae, and where a few postalar setae occur in the Miltogrammatinae, e.g. *Metopia brasiliana* Townsend (Pape 1987c), these are probably homoplasic as probably basal groups like *Macronychia* and *Eumacronychia* Townsend do not possess any postalar setae. Both conditions are found in the Melanomyinae (bare in *Melanomya*, setose in *Melinda*), but of general occurrence in the other calliphorid subfamilies, which have been scored as setose (1). The oestrid taxa have been scored as setose (1), although apparently bare conditions occur in the Oestrinae, e.g. in *Tracheomyia macropi* (Frogatt) and in some *Gasterophilus* spp. These exceptions all possess setae higher up on the postalar wall which are confluent with the general setosity of notum, but I have not been able to decide whether this setosity is homologous to true postalar setae.

I have not found any Tachinidae with a setose postalar wall and the three subgroups here recognized have been scored as bare (0).

Character 8. – Metasternum; setosity
0 - bare, 1 - setose.

Note that what is here called metasternum (i.e. the convex sclerite situated in front of the hind trochanters) probably includes pleural elements, and the metasternum proper is largely invaginated. I have found no Anthomyiidae, Muscidae, Rhinophoridae or Tachinidae with a setose metasternum. In the Sarcophagidae metasternal setosity is present in all Sarcophaginae, absent in Paramacronychiinae, and in the Miltogrammatinae only present in *Chrysogramma*. All Oestridae seen by me have the metasternum setose. The calliphorid subfamilies have been scored as setose (1) as the few exceptions, e.g. some but not all *Melanomya*, are considered as derived from the setose condition.

Character 9. – Meron; setosity
0 - bare, 1 - with a vertical row of bristles, 2 - with a patch or tuft of hairs.

Usually, the row of meral bristles runs vertically at the posterior margin of the sclerite and may follow this where it curves forwards along the anteroventral margin of the metathoracic spiracle. Smaller species may have the number of bristles reduced to 2-3, e.g. many Rhinophoridae and small Tachinidae, while larger species often have numerous additional hair-like setae, especially anterior to the bristles. Very few Tachininae, e.g. the genera *Tarassus* Aldrich (Neotropical) and *Lophosiosoma* Mesnil (Oriental), lack meral bristles altogether, but these are considered reversals and the groundplan of the Tachininae has been scored as 1. Rognes (1986) considered the meral hairs found in the Oestridae as non-homologous to the meral bristles of the remaining Tachinidae family-group, possibly because the hairs usually form a patch rather than a vertical row. In my opinion, the identical position compared to that of the bristly row of the non-oestrid members of the Tachinidae family-group should be taken as *a priori* evidence of homology. The hairlike appearance of the meral setae is most parsimoniously regarded as part of the general hairiness, and it should be noted that the meral hairs sometimes are developed as a row of fine bristles, e.g. in *Dermatobia hominis* (Cuterebrinae) (Wood 1987a, pers. observation). Sabrosky (1986: 40) noted that *Cuterebra* has the meron equipped with 'a tuft of stiff, bristly, black hairs in most species'.

Meral setae are also found in non-tachinoid Calyptratae, especially well developed in the genus *Eginia* Robineau-Desvoidy (Muscidae) but also in more typical Muscidae (Pont 1986b, McAlpine 1989). A few Anthomyiidae possess meral setae, e.g. *Eutrichota* Kowarz (Huckett 1987) and 'McAlpine's fly' (pers. obs.), which tentatively has been assigned to the Anthomyiidae (Ferrar 1979, 1987). Only in *Eginia*, however, is the configuration reminiscent of a (very short) vertical row of long and bristly setae. Pont (1977) placed *Eginia* with some related genera in their own family, Eginiidae, but later transferred the group to the subfamily Phaoniinae of the Muscidae (Pont 1986b, as Eginiini). Skidmore (1985) was convinced that Eginiini did not belong in the Muscidae and he suggested affinities to be with the Tachinidae or the Calliphoridae. This decision, however, was primarily based on the presence of well developed parastomal bars in the cephalopharyngeal skeleton of what was thought to be a puparium of *Eginia ocypterata* (Meigen). As this puparium seems to belong to the Sciomyzidae (V. Michelsen, pers. comm.), the evidence for excluding Eginiini from the Muscidae is strongly reduced. A discussion of the systematic position of Eginiini is given by McAlpine (1989: 1498).

Character 10. – Subscutellum, shape
0 - concave, 1 - slightly swollen, 2 - strongly swollen.

The concave condition found in all Anthomyiidae and Muscidae examined by me is easily distinguished from the swollen conditions (1, 2). A similar concave condition is found in the three sarcophagid subfamilies except in *Nyctia* Robineau-Desvoidy of the Paramacronychiinae where the slightly swollen condition obviously has evolved independently. The tachinid taxa are here scored for the strongly swollen condition (2), although some exceptions occur, e.g. *Cinochira* Zetterstedt and *Cylindromyiella* Malloch. Crosskey (1976: 36), however, noted that it 'is not completely certain that *Cylindromyiella* is a tachinid'. Downes (1986) considered the groundplan of the Tachinidae to be characterised by a medium-sized subscutellum, which led him to assume that 'the subscutellum has become enlarged independently in more than one lineage' (p. 15) within the family. In my opinion, it is more parsimonious to consider the strongly swollen subscutellum of the Tachinidae as a groundplan feature.

Within the Oestridae, the subscutellum of the Cuterebrinae (Wood 1987a: fig. 9) and Gasterophilinae is considered as state 1, while the subscutellum of the Hypodermatinae (Wood 1987a: fig. 10) is distinctly larger and is scored as such (2). In the Oestrinae, *Oestrus* has a strongly swollen subscutellum but other states occur, like the almost concave subscutellum of *Cephenemyia* Latreille and *Pharyngomyia* Schiner (Zumpt 1965). The subscutellar groundplan of the Oestrinae has accordingly been scored as unknown.

All Rhinophoridae have a slightly swollen subscutellum (Wood 1987b: figs. 2,3), and so have the calliphorid subfamilies Ameniinae, Bengaliinae, Helicoboscinae, Mesembrinellinae and Polleniinae, which all possess a subscutellum that definitely is convex, but still much less swollen than the condition in the Tachinidae. As both the concave and the slightly swollen conditions occur in the Melanomyinae, this taxon has been scored as unknown for this character.

As an intermediate condition, the slightly swollen condition is poorly defined. More precise morphological descriptive terms will probably increase the number of states and add important phylogenetic information.

Character 11. – Anatergite; setosity
0 - bare, 1 - setulose.

If present, the laterotergal 'hairs or setae' of McAlpine (1989: 1498) [= infrasquamal setulae of Shewell (1987b: fig. 108.23)] are arranged in a small patch or cluster on the anatergite just below the lower calypter. I have not found infrasquamal setulae in any Anthomyiidae, and in the Muscidae only in *Neomyia*, and I have scored the groundplan of both families as bare (0). All Calliphoridae, Rhinophoridae and Tachinidae seem to possess infrasquamal setulae (I have, however, seen some specimens of the rhinophorid *Paykullia kugleri* (Herting) with few and even no setulae). Among the Sarcophagidae, all species of Paramacronychiinae and Sarcophaginae have infrasquamal setulae, but the large majority of Miltogrammatinae have the anatergite completely bare. Some exceptions, however, occur, e.g. *Eumacronychia* and *Macronychia*, and occasional specimens of *Xiphidiella* Villeneuve, and I have scored the miltogrammatine groundplan as unknown for this character. No Oestridae possess anatergal setulae.

Character 12. – Metathoracic spiracle; configuration of fringe

0 - continuous along posterior, ventral and anterior rim, 1 - divided into an anterior and a posterior fringe.

The Muscidae and the Anthomyiidae are scored for a continuous fringe, although this fringe often is distinctly thinned ventrally. Within the Tachinidae family-group, I know of only the following exceptions from the divided fringe: *Mystacinobia*, which is discussed separately below, has no fringe at all. The Mesembrinellinae were given family rank by Guimarães (1977), probably prompted by Crosskey's (1965: 43) statement that they 'may not be Tachinoidea at all'. Their metathoracic spiracle deviates strongly from that of other Calliphoridae in being equipped with a large continuous fringe, much like some Muscidae (e.g. *Phaonia* Robineau-Desvoidy). *Bequaertiana* Curran of the Rhinophoridae has almost no fringe, which added to Zumpt's (1956) conviction that this genus was an acalyptrate. The generic cladogram of Pape (1986a), however, suggests that the spiracular configuration of *Bequaertiana* is apomorphic. Groundplan estimates of the Oestridae are difficult as much variation occurs. In the Cuterebrinae, *Neocuterebra* and *Ruttenia* have a continuous fringe, all *Cuterebra* a divided fringe. In the Gasterophilinae species of *Cobboldia* have a divided fringe, those of *Gasterophilus* and *Gyrostigma* have a continuous fringe. All Hypodermatinae have a continuous fringe while all Oestrinae have a divided fringe.

Several small Tachinidae and Calliphoridae (e.g. *Cinochira*, some *Melanomya*), and all of Rhinophoridae have small metathoracic spiracles, but they still provide good examples of the divided condition. From the SEM figures given by Crosskey (1977: figs. 41-44), it may be observed that *Melanophora roralis* (Linnaeus), *Phyto discrepans* Pandellé and *Stevenia atramentaria* (Meigen) possess distinctly divided metathoracic fringes, and only the fringe seen in *Rhinophora lepida* (Meigen) could perhaps be taken for continuous, although even here a distinct break of the fringe can be observed ventrally (which is almost to the right in Crosskey's figure).

Character 13. - Metathoracic spiracle; relative size of anterior and posterior lappets

0 - both lappets small, 1 - narrow anterior lappet and large posterior lappet, 2 - both lappets large.

This attempt of fitting the configurational multitude of metathoracic spiracular lappets into a few states based on relative size alone may seem too simple as 'a wide range of "opercular" metathoracic spiracles occurs in Tachinidae-Calliphoridae-Sarcophagidae' (Crosskey 1977: 8). On the other hand, scoring most types of fringe configurations differently would cause an extreme splitting of taxa that would be difficult (and very time-consuming) to score at the present state of knowledge – and actually carry less phylogenetic information as far as interfamilial relationships are concerned. Therefore, I have tried to reduce the number of groundplan types, and the present three-state character seems in agreement with Crosskey (1977: 8), as his 'representative[s] of two very common types' fit my states 1 and 2 perfectly.

The Helicoboscinae, all Oestridae except those with continuous fringe, and the sarcophagid and tachinid taxa are scored for state 1 where the spiracular fringe is divided into a narrow, crescent-shaped anterior fringe (or lappet) and a broad, operculum-like posterior lappet that is often distinctly narrowed at base (Crosskey 1977: fig. 45; Rognes 1986: fig. 3). Rarely, the two lappets are more equal to each other, as in the genera *Macronychia* (Miltogrammatinae) and *Chrysotachina* Brauer & Bergenstamm (Tachininae) (Wood 1987c: fig. 169), a configuration which I consider as apomorphic for these genera. Anthomyiidae, Muscidae, Mesembrinellinae, *Gasterophilus* + *Gyrostigma* in the Gasterophilinae, and Hypodermatinae have been scored as inapplicable for this character as they possess a continuous fringe.

In many Calliphoridae, the anterior lappet is enlarged. Rarely it is very much larger than the operculum, as in the genus *Phumosia* (Calliphoridae) depicted by Crosskey (1977: fig. 46), but note that this figure is of the right metathoracic spiracle, contrary to all other spiracles figured. I have scored all non-helicoboscine calliphorid subfamilies for an enlarged anterior lappet (2) although exceptions occur, e.g. some *Melanomya* in the Melanomyinae. Species with a small metathoracic spiracle, e.g. all Rhinophoridae, often have a reduced and less operculum-like posterior lappet, and this condition is here considered a distinct state (0).

Downes (1986), Pape (1986a) and Rognes (1986) all mention more or less explicitly that a large metathoracic spiracle is characteristic for (part of) the Calliphoridae, and Downes (1986: 19) stated that he considered the enlarged metathoracic spiracle to have developed several times in that family: 'The Calliphoridae have repeatedly developed very large posterior thoracic spiracles that intrude forward into the hind margin of the meron.' Apparently, the spiracular fringe has enlarged as well, and the large majority of species in all non-helicoboscine calliphorid subfamilies show this state with unambiguous clarity. Rognes (1991) provides many line-drawings of calliphorid metathoracic spiracles. The Helicoboscinae, on the other hand, is a perfect representative of the 'narrow/large' condition (1), see Rognes (1986: fig.

3). The subfamily Ameniinae was for long considered in the Tachinidae, but Crosskey (1965) convincingly transferred them to the Calliphoridae, although noting that 'the Ameniinae [may be] as closely related to the Sarcophagidae as to the Calliphoridae' and that 'it may be better to treat [them] as a full family' (p. 43). The metathoracic spiracular fringe of most species is perfectly 'large/large' (2) and I have all reasons to consider this as homologous to the condition found in other non-helicoboscine calliphorid subfamilies. The few calliphorid species with a rhinophorid-like metathoracic spiracle fall nicely within their respective taxa through their close affinity with more typical calliphorids, like the close relationship between the genus *Melinda* and the *Melanomya* genus-group (Rognes 1986, 1991).

All species of Mesembrinellinae possess a metathoracic spiracle with one continuous, large fringe (Guimarães 1977: fig. 8). This non-opercular condition brings some problems of homology, i.e. whether all of the fringe or only the anterior part is homologous to the anterior lappet of other Calliphoridae. Accordingly, this character has been scored as inapplicable for the Mesembrinellinae.

The shape of the rhinophorid metathoracic spiracular fringe needs special mention as this could be considered intermediate between the operculate fringe found in Calliphoridae, Oestridae, Tachinidae and Sarcophagidae on the one side and the type with a continuous fringe found in the non-tachinoid calyptrates on the other. Note, however, that an operculate metathoracic spiracle occurs in the rhinophorid genus *Baniassa* Kugler, where it may be considered a reversal, i.e. apomorphic (Pape 1986a). Crosskey (1977: 8) made the following description of the rhinophorid spiracle: 'In Rhinophoridae .... the external opening of the spiracle lacks a definite occluding flap or pair of flaps and instead is margined by complex short fringes that stand out from the spiracular rim (there being normally an anterior and a posterior fringe that meet ventrally but that are widely separated dorsally),' and he considered 'the nature of the metathoracic spiracle [as providing] the most important single character for rhinophorid recognition'. McAlpine (1989: 1501) characterised the rhinophorid spiracle as 'subcircular, without distinct operculum, and margined with erect fringe of hairs' and considered this an 'important plesiomorphic character'. I have no *a priori* reason to do this, and McAlpine was, in fact, contradicted by his own cladogram (fig. 116.8).

Both outgroups, i.e. Muscidae and Anthomyiidae, have been scored as unknown/inapplicable for this character. I have insufficient knowledge of the metathoracic spiracular groundplan for these two families, and the continuous nature of the fringe would make any scoring rather tentative.

Character 14. – Anepimeron; setosity

0 - bare, 1 - setose.

Anepimeral setae occur in only a few Anthomyiidae (Huckett 1987) and Muscidae (Huckett & Vockeroth 1987), but in all members of the Tachinidae family-group. Also, while bristly anepimeral setae are virtually absent in the Anthomyiidae and Muscidae, they are widespread and common in the Tachinidae family-group. Therefore, the present scoring of the anthomyiid and muscid anepimeral groundplan as bare (0) and that of all other taxa as setose (1), seems well founded.

Character 15. – Wing vein M; course distal to crossvein dm-cu

0 - bent anteriorly at junction with dm-cu, 1 - a straight (or at least non-bent) continuation of proximal part, 2 - bent anteriorly at a more or less right angle, with bend distinctly removed from dm-cu, 3 - bent anteriorly at an obtuse angle, with bend distinctly removed from dm-cu.

Gasterophilus + *Gyrostigma* (Gasterophilini) show the straight condition (1), while species of *Cobboldia* as well as all Cuterebrinae and Oestrinae show the sharply bent condition (2). The Hypodermatinae are unique in having the bend occurring almost exactly at junction between M and crossvein dm-cu. The obtuse angle or gentle curve of M (state 3) is found in the Mesembrinellinae (Calliphoridae) and Rhinophoridae. This state is also found in many smaller species of Calliphoridae (e.g. some *Melanomya*), while some Tachinidae (e.g. *Freraea* Robineau-Desvoidy, *Cinochira, Cylindromyiella*) have the bend almost absent. These instances are here considered independent acquisitions derived from the bent conditions. The total absence of the distal part in various Tachinidae, and in *Bezzimyia, Bequaertiana, Melanophora asetosa* Kugler and *Oplisa aterrima* (Strobl) of the Rhinophoridae is obviously a distinct state. No evidence, however, suggests that this state may characterise the groundplan of any of the taxa scored in the present analysis, and I have not made a special entry. Note that some species of *Phyto* Robineau-Desvoidy, e.g. *P. armadillonis* Kugler, and *Mimodexia* spp. show a vein M with a bend that is very reminiscent of the condition found in most Calliphoridae, i.e. bent in an almost right angle (Rohdendorf 1935: fig. 82; Kugler 1978: figs. 11, 26). These species, however, do not seem to be close to the basal splits within the family and their venation is accordingly more parsimoniously regarded as homoplasic.

No Anthomyiidae possess a bent vein M, but in the Muscidae many Muscinae have this vein distinctly bent. However, as no other Muscidae to my knowledge share this condition, it is not considered a groundplan state of the family.

Character 16. – Wing vein Sc; course
0 - with a convexity at level of humeral break, 1 - straight at level of humeral break.

As noted by Herting (1955), vein Sc of all Oestridae takes a parallel course relative to the costa until it bends towards it, ultimately reaching the wing margin (Wood 1987a: figs. 5-8). In the Muscidae and the Anthomyiidae and the non-oestrid members of the Tachinidae family-group, this vein has a distinctly convex part (relative to the anterior wing margin) at level of, or just distal to the humeral break (McAlpine 1981: fig. 69).

Character 17. – Wing vein R_1; configuration at level of subcostal break
0 - with a knob, 1 - without a knob.

In most Calyptratae, and certainly in the non-oestrid taxa included in the present analysis, vein R_1 has a small knob on the anterior surface at the level where subcosta bends towards costa. This has been taken as vestiges of a crossvein (sc-r) connecting subcostal and radial veins (McAlpine 1981). All botflies examined by me lack this knob of R_1.

Character 18. – Posterodorsal surface of stem vein (remigium); setosity
0 - bare, 1 - setulose.

To my knowledge, all members of Chrysomyinae, Rhiniinae and Toxotarsinae possess the setose condition (1). Only two other occurrences of a setose remigium are known within the Tachinidae family-group: in two species of Mesembrinellinae, *Mesembrinella bellardiana* Aldrich and *M. peregrina* Aldrich, and in *Pollenia atramentaria* (Meigen) of the Polleniinae. As *P. atramentaria* does not seem to be the sister group of all remaining Polleniinae, I have scored the groundplan of this subfamily for a bare remigium (0). The groundplan of the Mesembrinellinae, however, has been scored as unknown for this character as the genus *Mesembrinella* Giglio-Tos seems to be defined exclusively on the possession of three (instead of two) humeral bristles (Guimarães 1977), which probably is plesiomorphic at this level. Thus, I cannot exclude that *M. bellardiana* and *M. peregrina* are included in the basal dichotomy of this subfamily.

Character 19. – First anal vein; length relative to wing margin
0 - extending to or almost to wing margin, 1 - reduced and ending in wing membrane distinctly before wing margin.

I have not seen any Muscidae, except for members of the Eginiini, with an extended A_1, and Huckett & Vockeroth (1987: 1116) stated that for the Nearctic Muscidae this vein is 'always incomplete'. As already mentioned, I have accepted the inclusion of Eginiini within the subfamily Phaoniinae of the Muscidae, and the groundplan of the family has been scored as reduced (1) for the present character. In the Anthomyiidae very few genera, *Acridomyia* Stackelberg and *Coenosopsia* Malloch, have a reduced first anal vein, but as there is no reason to consider these genera close to each other and neither as sister group of the remaining Anthomyiidae (V. Michelsen, pers. comm.), the reduction is probably derived independently. The family has accordingly been scored for an extended first anal vein (0). In the Tachinidae family-group all members of Bengaliinae and Gasterophilini possess an extended first anal vein. In the Cuterebrinae *Neocuterebra* possess an extended first anal vein, but as all other species have a distinctly shortened vein the groundplan of this subfamily has been scored as unknown. A few genera in the Tachininae (e.g. *Siphona* Meigen) and Rhinophoridae (*Malayia*) show the extended condition. These instances are all considered as derived.

Character 20. – Base of vein R_{4+5}; setosity
0 - bare, 1 - setulose.

The large majority of species within the Tachinidae family-group possess some setulae on the upper surface of the base of vein R_{4+5}, either as a few setulae at the very base (actually the common base of R_{2+3} and R_{4+5}) or as a distinct row along the vein. Usually, setulae are present on the lower surface as well. In the Cuterebrinae, the base of R_{4+5} is setose in *Dermatobia hominis* and the *Cuterebra* examined by me, while it is bare in *Neocuterebra* and *Ruttenia*. *Gyrostigma* + *Gasterophilus* of the Gasterophilini show the bare condition, *Cobboldia* the setose. All Oestrinae seen possess the setose condition, while both conditions occur in the Hypodermatinae. In the Polleniinae, all species of *Morinia* Robineau-Desvoidy and *Melanodexia* Williston have this vein bare while it is setulose in *Pollenia*. The Polleniinae has therefore been scored as unknown for this character, although the absence most probably is apomorphic for *Morinia* + *Melanodexia*, as already noted by Rognes (1991: 209). The only other instance of a bare base of vein R_{4+5} within the Tachinidae family-group known to me is in the *Phyto carinata* species-group of the Rhinophoridae (Pape 1987b), but several others may occur. A setulose base of vein R_{4+5} occurs sporadically in the Muscidae, e.g. species of *Graphomya* Robineau-Desvoidy, *Musca* Linnaeus, *Neomyia*, and *Stomoxys* Geoffroy (Huckett & Vockeroth 1987: figs. 21-30, Zumpt 1973: fig. 94), but not in *Achanthiptera rohrelliformis* (Robineau-Desvoidy), the sole member of subfamily Achanthipterinae.

Achanthiptera Rondani has abdominal spiracle 6 retained in the female terminalia and has for this reason been considered as one branch of the basal dichotomy of the family (Carvalho 1989). Huckett & Vockeroth (1987: 1117), however, found the female abdominal spiracle 6 retained 'in a few exotic species of several subfamilies', which weakens the argument that *Achanthiptera* should be considered a basal lineage.

Awaiting more knowledge of muscid phylogeny, I have scored the groundplan as unknown for this character. I have not seen any Anthomyiidae showing the setose condition.

Character 21. – Lower calypter; shape
0 - narrow, 1 - oval, 2 - broad, 3 - tongue-shaped.

With the convincing exclusion of *Melanomya* (here including *Angioneura* Brauer & Bergenstamm) from the Rhinophoridae presented by Downes (1986), Rognes (1986, 1991) and Pape (1986a), all Rhinophoridae possess a lower calypter, which is bigger than the upper calypter, diverging from the scutellum, and either slightly roundish or parallel-sided for part of its length (3). Species of the Rhiniinae possess a very rhinophorid-like lower calypter and have been scored similarly (3), while both the broad and tongue-shaped conditions occur in the Chrysomyinae (broad in *Chrysomya* Robineau-Desvoidy, tongue-shaped in all others), and the groundplan of this subfamily has been scored as unknown.

The Anthomyiidae are scored for the widespread narrow state (0), where the lower calypter does not exceed the upper calypter in size. However, examples occur where the lower calypter is subequal to or even exceed the upper calypter in length (Huckett 1987), and the character needs reconsideration. The Muscidae are difficult to score as numerous states occur, ranging from the rather short type found in *Achanthiptera rohrelliformis* with a posterior margin running almost perpendicular to the median plane, to lower calypteres fully as large and broad as those of the Tachinidae family-group. The oval type of the Muscidae (Huckett & Vockeroth 1987: fig. 15), which is smaller and slightly more tapering than the condition found in the Rhinophoridae, seems to be most widespread (and incidentally also the most common) and is here postulated as groundplan. Further knowledge of muscid infrafamilial phylogeny is needed.

The groundplan of all other terminal taxa seems to be characterised by the broad type with the median margin following scutellum for a considerable distance before turning outwards almost perpendicular to the median plane. The several non-rhinophorid and non-rhiniine taxa of the Tachinidae family-group with diverging lower calypteres, e.g. *Cinochira* and *Cylindromyiella* (Tachinidae: Phasiinae), some species of *Johnsonia* Coquillett and *Neophyto* Townsend (Sarcophagidae: Sarcophaginae), *Morinia* (Calliphoridae: Polleniinae), and *Melanomya* (Calliphoridae: Melanomyinae) are easily classified as derived from the broad condition by simple outgroup comparison within their respective subfamilies. *Morinia*, for example, may be the sister group of *Melanodexia* (corroborated by black body colour and absence of setae on wing vein R_{4+5}), and the tongue-shaped condition in *Morinia* is therefore most parsimoniously considered apomorphic at this level as *Melanodexia* and all other Polleniinae have broad lower calypteres. Likewise, if it is accepted that the Miltogrammatinae are the sister group of a monophyletic Paramacronychiinae + Sarcophaginae (Kurahashi 1975; Pape 1986b, 1987a; present analysis), the presence of broad lower calypteres in all species of both non-sarcophagine subfamilies is convincing evidence that the possession of narrow lower calypteres in *Johnsonia* and *Neophyto* is apomorhic. Downes (1986), however, takes the opposite standpoint and argues from a functional viewpoint. Broad lower calypteres are seen as independent adaptations to increase flight speed and agility, and the 'primitive-looking' groups are considered as having been 'shunted off from the mainstream of calyptrate evolution' (p. 17). Species of the Tachinidae family-group are generally very agile flyers compared to most Muscidae and Anthomyiidae, and this may indeed be correlated with the size of the lower calypteres. Flight patterns, however, are the functional manifestations of morphological and physiological character states and are thus obviously subject to reversals and homoplasy. I see no reason or argument for postulating a mainstream calyptrate evolution. It is more parsimonious, i.e. requires less ad hoc assumptions, to consider the shape of calypteres in *Neophyto*, *Johnsonia* and the Rhinophoridae as independent evolutionary events.

Character 22. – Abdominal sternite 2; degree of exposition
0 - freely exposed but only separated from margins of tergite 1+2 by a narrow strip of unfolded membrane, 1 - contiguous with or slightly overlapped by margins of tergite 1+2, 2 - completely overlapped by margins of tergite 1+2, 3 - overlapping margins of tergite 1+2, 4 - freely exposed and widely separated from tergal margins by more or less folded membrane.

The degree of exposition of the non-terminal abdominal sternites is a character of diagnostic value, but I have focused on sternite 2 rather than all of sternites 2-5 as this may be the easiest to score. The

Sarcophagidae are very homogenous, with abdominal sternite 2 distinctly overlapping margins of corresponding (syn)tergite in all but the aberrant and obviously apomorphic *Asilodexia* Townsend (Sarcophaginae). The Calliphoridae are more varied, from a perfectly muscid-like condition in the Mesembrinellinae to a rhinophorid-like condition in some *Melanomya*, the Helicoboscinae, and the Ameniinae. The configuration in the Rhinophoridae is here scored like the Ameniinae and Helicoboscinae (1) as I have no *a priori* reason to consider them non-homologous. The Phasiinae have been scored like the Rhinophoridae, although exceptions occur.

Character 23. - Alpha setae; presence/absence
0 - present, 1 - absent.

Alpha setae (sensilla trichodia) are found widespread in most Rhinophoridae and scattered in the Tachinidae (Lehrer 1973, Tschorsnig 1985b). They are absent from the Ameniinae (Rognes 1986), but are found in at least some species of all other subgroups of the Calliphoridae here recognized. No species of Sarcophagidae are yet known to possess alpha setae. The few botflies examined by me for this character (*Cuterebra atrox* Clark, *Gasterophilus intestinalis* (De Geer), *Hypoderma tarandi* (Linnaeus), *Oestrus ovis* Linnaeus) had no alpha setae, but what appears to be typical alpha setae is shown for *Dermatobia hominis* (Cuterebrinae) and *Cobboldia chrysidiformis* Rodhain & Bequaert by Patton (1935b, 1937).

Character 24. – Female abdominal sternite 8; median division
0 - entire, 1 - divided.

Depending on the degree of sclerotization of the median part of the female abdominal sternite 8, this may appear complete (0) or divided (1). The character was extensively discussed by Herting (1957) and needs only few additional comments. I have scored all taxa of the Tachinidae family-group for the entire (or undivided) condition although a few exceptions occur. In the Hypodermatinae, *Hypoderma* Latreille provides examples of a completely divided female sternite 8 (Wood 1987a: fig. 14). This may, however, be shown to be a derived condition by reference to the undivided condition found in the genera *Oestromyia* and *Portschinskia* Semenov, which are considered as basal lineages of the subfamily (Grunin 1965). *Calliphora stelviana* (Brauer & Bergenstamm) of the Calliphorinae is another example (Rognes 1991: fig. 182), but here considered derived within its subfamily.

Character 25. – Spermathecal ducts; configuration relative to uterus
0 - two ducts fused just before entering the uterus, 1 - all ducts enter the uterus separately.

Within the Schizophora and possibly within all of the Cyclorrhapha, it seems to be a groundplan condition that two of the three spermathecal ducts join each other shortly before ending in the uterus, thus leaving the latter with only two openings leading to the spermathecal ducts (Griffiths 1982, Wiegmann 1989). Note that McAlpine (1989: 1429) considered the groundplan of the Calyptratae to have all three spermathecal ducts reaching the uterus separately, relying on Sturtevant (1925-26). The latter author, however, never made extensive dissections of calyptrate taxa.

Griffiths (1982), referring to unpublished data from B. A. Holloway, delimits a clade of the Tachinidae family-group consisting of the Sarcophagidae, Tachinidae and Oestridae based on the complete separation of all three spermathecal ducts at junction with the uterus. My own dissections, however, have revealed another pattern (table 1). I have found the 'fused' condition with only 2 openings in the Muscidae (other non-tachinoid calyptrate families not examined by me), in the Cuterebrinae and Hypodermatinae, which are the only botfly subfamilies examined (figs. 4, 5), and in all calliphorid subfamilies except Helicoboscinae, Bengaliinae and Phumosiinae (table 1). All Rhinophoridae and Tachinidae examined possess three separate openings. It should be noted that figures of female reproductive organs drawn for other purposes may be unreliable with respect to this character, e.g. that of *Mesembrinella peregrina* illustrated by Guimarães (1977: figs. 39, 40). It is shown to possess the 'all-separate' condition. In the Sarcophaginae only *Sarcodexia lambens* (Wiedemann) is known to have two openings, but this is apparently an autapomorphic condition with the common spermathecal duct very long (Lopes 1941: figs. 8, 10). Among the species of Miltogrammatinae and Paramacronychiinae dissected by me, none possess the 'fused' condition with two spermathecal ducts joining close to the uterus (table 1). All possess three separate openings, but the openings may be so close to each other that they superficially appear as one. In *Sarcotachina subcylindrica* Portschinsky and *Sarcophila latifrons* (Fallén) (figs. 6, 7), both of the Paramacronychiinae, and in *Metopia argyrocephala* (Meigen) of the Miltogrammatinae, the three spermathecal ducts open into a more or less tube-like or stalk-like pouch of the uterus. More dissections of species close to the basal splits within the Miltogrammatinae and the Paramacronychiinae are needed to settle the groundplan condition for these two subfamilies – and thereby probably for all of the Sarcophagidae. This is important as it could be

Table 1. Species dissected for examination of configuration of spermathecal ducts relative to uterus (character 25). 1:1:1 indicates that all spermathecal ducts enter the uterus or a common uterine pouch separately. 1:2 indicates that two spermathecal ducts are fused just before entering the uterus or a common uterine pouch. Subfamilial assignment indicated where possible.

MUSCIDAE	
Achanthipterinae	
Achanthiptera rohrelliformis	1:2
RHINOPHORIDAE	
Melanophora roralis	1:1:1
Phyto melanocephala	1:1:1
Rhinomorinia sarcophagina	1:1:1
SARCOPHAGIDAE	
Miltogrammatinae	
Metopia argyrocephala	1:1:1
Xiphidiella anorubra	1:1:1
Paramacronychiinae	
Brachicoma devia	1:1:1
Nyctia halterata	1:1:1
Sarcophila sp.	1:1:1
Sarcotachina aegyptiaca	1:1:1
Sarcophaginae	
Blaesoxipha batilligera	1:1:1
Ravinia pernix	1:1:1
Tricharaea sp.	1:1:1
TACHINIDAE	
Exorista genus-group	
Exorista larvarum	1:1:1
Winthemia quadripustulata	1:1:1
CALLIPHORIDAE	
Helicoboscinae	
Eurychaeta palpalis	1:1:1
Bengaliinae	
Bengalia lorosa lateralis	1:1:1
Tricyclea sp.	1:1:1
Polleniinae	
Morinia melanoptera	2:1
Ameniinae	
Silbomyia sp.	2:1
Mesembrinellinae	
Mesembrinella bicolor	2:1
Phumosiinae	
Phumosia abdominalis pallida	1:1:1
Calliphorinae	
Calliphora vicina	2:1
Luciliinae	
Lucilia sericata	2:1
Phormiinae	
Protophormia terraenovae	2:1
Toxotarsinae	
Neta chilensis	2:1
OESTRIDAE	
Cuterebrinae	
Dermatobia hominis	2:1
Cuterebra atrox	2:1
Hypodermatinae	
Hypoderma tarandi	2:1

argued that the stalk-like pouch represents the fused bases of all three spermathecal ducts, which then should be given a separate scoring.

The configuration of the spermathecal ducts is interesting as the recent exclusion of some presumed Calliphoridae from the Rhinophoridae may be further corroborated. An examination of *Morinia melanoptera* (Fallén), for example, reveals the fused condition, and according to Downes (1986: fig. 26), this condition is found in *Melanomya* as well. Both these genera have been treated as Rhinophoridae by Herting (1961), Crosskey (1977), and Tschorsnig (1985a), while they were put in the Calliphoridae by Downes (1965, 1986), Rognes (1986, 1991) and Pape (1986a, 1988). The separate spermathecal ducts of the Sarcophagidae, Rhinophoridae and Tachinidae may have triggered the evolution of a tripartite acrophallus several times. A tripartite acrophallus is thus a groundplan feature of the subfamily Sarcophaginae (Pape, unpubl.), and tripartition was recently discovered in a single species of Miltogrammatinae (Pape 1989). Tripartition has probably evolved once in the Rhinophoridae (Tschorsnig 1985a, Pape 1986a) and several times in the Tachinidae (Andersen 1988). On the other hand, tripartition apparently never evolved in the Calliphoridae, Oestridae nor any of the non-tachinoid calyptrate families. However, many genera of the Bengaliinae show a complicated acrophallus with flaps and membranes that may guide sperm and/or accessory gland material into the openings of the spermathecal ducts and thus effectively be a tripartition. The lateral acrophallic ducts guiding the accessory gland material from the phallotreme to the female lateral sacs in species of *Lucilia* Robineau-Desvoidy are obviously not homologous to any of the examples of acrophallic tripartition discussed above as they are invaginations of the external wall of the phallic tube (Merritt 1989, Rognes 1991). It should be kept in mind that separate spermathecal openings most probably is a groundplan feature of all of Diptera (McAlpine 1981), while this groundplan probably had but a single male gonopore (Wood 1990).

Character 26. – Spermathecae; size
0 - equal sized, 1 - one reduced.

In the Oestridae, all Hypodermatinae and Oestrinae have one of the three spermathecae reduced (see figures in Grunin 1965, 1966). The Gasterophilini have also been scored as 'one reduced' (1) as the total absence of one spermatheca in *Gasterophilus* obviously has to be considered a reduction. I have no information on size or number of spermathecae in the genus *Gyrostigma*. In the genus *Cobboldia*, spermathecae of *C. chrysidiformis* and *C. elephantis* are figured in Patton (1937), showing three oval or slightly elongated spermathecae of which one is clearly reduced in the former species, slightly reduced in the latter. All Cuterebrinae may have spherical, equal-sized spermathecae, although I have examined only *Dermatobia hominis* (fig. 4) and *Cuterebra atrox*, but see also the figure of *C. fontinella* Clark in Patton (1935b, fig. 6). The Mesembrinellinae and Phumosiinae have elongated spermathecae, which may vary somewhat in size, but both taxa have been scored for equal sized spermathecae (0).

I have scored the Tachininae as having spermathecae of equal size, thereby considering the few instances of loss of one spermatheca, e.g. in *Siphona* (Andersen 1983), as secondary.

Character 27. – Male sternite 5; configuration of posterior margin

0 - deeply emarginated, 1 - simple or with a shallow emargination.

Although the posterior outline of the male sternite 5 shows much variation, the shallow posterior emargination in all Oestridae and in the subfamily Paramacronychiinae of the Sarcophagidae is very distinct. In the Miltogrammatinae *Chrysogramma* and *Eumacronychia* show a typical deep emargination, while the remaining members of the subfamily have no or a shallow emargination. The groundplan for the Miltogrammatinae has been scored as unknown.

Character 28. – Male tergite 6; connection to syntergosternite 7+8

0 - free, 1 - fused.

The fused condition is found in all of Paramacronychiinae and apparently in all Oestridae. The fused condition occurs scattered elsewhere in the Tachinidae family-group but cannot be ascribed to the groundplan of any other terminal taxon considered here.

Character 29. – Male bacilliform sclerites; configuration

0 - well developed and parallel, 1 - reduced and more or less perpendicular to the median plane.

All Sarcophagidae possess reduced bacilliform sclerites (processus longi, divided sternite 10). Usually only very short sclerites remain, and if distinct these are always more or less perpendicular to the median plane. The groundplan of all non-sarcophagid terminal taxa scored here is characterized by distinctly developed bacilliform sclerites, which are parallel and directed posteriorly.

Character 30. – Gonostylus; presence/absence of basal apodeme

0 - apodeme not present, 1 - apodeme present.

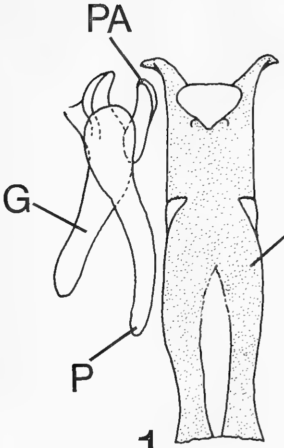
It has been known for decades, that some or most tachinoid calyptrates possess a small sclerite at the base of the gonostylus (paramere of McAlpine (1981)). This sclerite is figured but unnamed in Rohdendorf (1937), named 'Gelenkfortsatz' by Salzer (1968), 'additional forceps' by Lopes (1975), and 'basal parameral apodeme' by Pape (1990). The importance, in a phylogenetic context, of the presence/absence of this sclerite, was first recognized by Tschorsnig (1985a, b). The latter author found this structure in all Tachinidae, Sarcophagidae, Rhinophoridae, and Calliphoridae examined, but not in the few members of the Gasterophilinae, Oestrinae and non-tachinoid Calyptratae examined. Accordingly, he favoured the hypothesis of Hennig (1976) that the Oestridae are the sister group of all other members of the Tachinidae family-group (Tschorsnig 1985a: 10). Rognes (1991) found no gonostylar apodeme in *Cephenemyia trompe* (Modeer) (Oestrinae) and *Hypoderma tarandi* (Hypodermatinae). I have examined males of *Cobboldia chrysidiformis*, several *Gasterophilus*, *Hypoderma bovis* (Linnaeus) and *Oestrus ovis* Linnaeus, which all had no apodeme. However, males of *Cuterebra neomexicana* Sabrosky, *Oestromyia leporina* (Pallas) and *Cephenemyia trompe* examined by me show an unambiguous, although small and easily overlooked apodeme at the base of the gonostylus (fig. 1). In a single specimen of *Ruttenia loxodontis* examined, it appears as if the gonostylar apodeme is partly fused to the gonostylus. Therefore, the groundplan of the Cuterebrinae is scored as present (1), that of Gasterophilini and Cobboldiini as absent (0), and that of Hypodermatinae and Oestrinae as unknown (both states occur). A more careful search for this easily overlooked apodeme in the Oestridae is needed.

The sclerite may be homologous to the gonostylar apodeme found in other Diptera, part of the gonostylus proper, or a unique sclerite arisen *de novo* in the Tachinidae family-group. Contrary to the internal gonostylar apodeme found in other Diptera it forms part of the external cuticle, and the first possibility seems uncorroborated or even falsified. As nothing seems to indicate that the apodeme should have split from the base of the gonostylus, I am in favour of a *de novo* origin, but note that the use of the presence/absence of this apodeme in a phylogenetic context does not require an explicit interpretation of its potential homology with structures found in groups not included in the analysis.

Character 31. – Phallus; ventral surface of distal section

0 - smooth, 1 - with sclerotized denticles.

The denticles ('Körnchen oder Dörnchen' of Tschorsnig (1985b: 61)) are found throughout the



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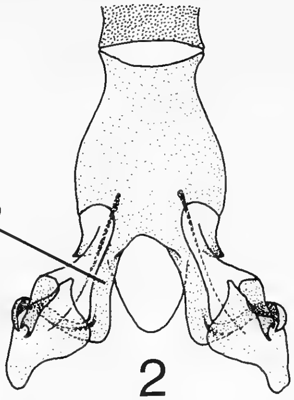

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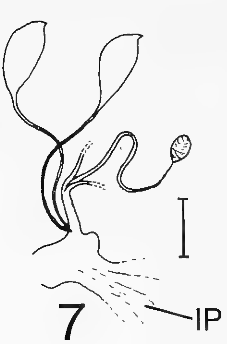

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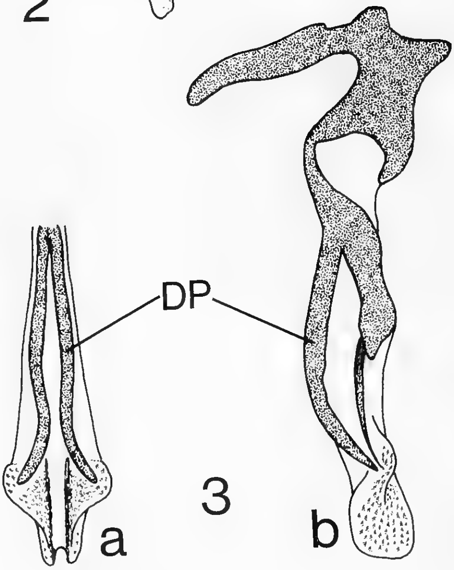

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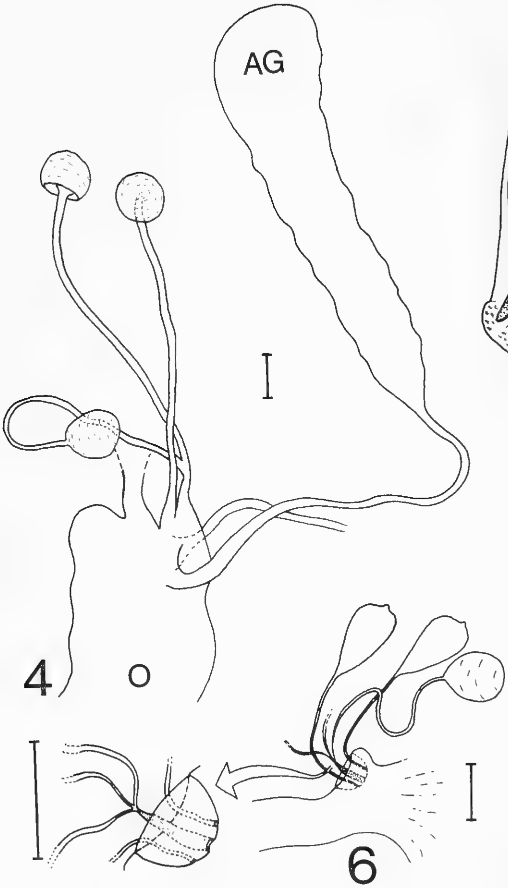

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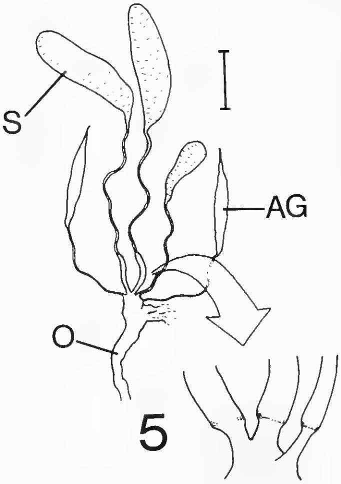

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Tachinidae family-group, and they usually cover a large part of the ventral surface. They are absent from the acrophallus and part of the ventral surface in the calliphorid subfamilies Melanomyinae and Polleniinae (Rognes 1991). In the Sarcophagidae they are absent in several members of the sarcophagid subfamily Paramacronychiinae, e.g. *Goniophyto* Townsend, *Wohlfahrtia* Brauer & Bergenstamm and *Sarcophila* Rondani. They are restricted to the lateral styli in many Sarcophaginae. In the Tachinidae, Tschorsnig (1985b) recorded an absence of phallic denticles in part of the subfamily Phasiinae. All taxa of both the Sarcophagidae and the Tachinidae, however, have been scored as denticled (1) because no evidence is present that favour a basal position of the 'non-denticled' taxa. In the Gasterophilinae, denticles are present in *Cobboldia* (Patton 1937), absent in *Gasterophilus.* I have not examined *Gyrostigma* for this character. Similar phallic denticles are absent from the Muscidae (personal observations, few samples), and in non-tachinoid Calyptratae they are known only from a subgroup of *Delia* Robineau-Desvoidy (Anthomyiidae), where the condition most probably has developed independently (Griffiths 1982).

Character 32. – Dorsolateral phallic processes; apical configuration

0 - confluent with distiphallic wall throughout, 1 - separate from wall of distiphallus, i.e. with a free tip.

Rognes (1986, 1991) stressed the phylogenetic importance of the free-tipped condition and considered this as synapomorphic for Calliphoridae and Rhinophoridae.

Subfamilies of the Sarcophagidae and Tachinidae have been scored as inapplicable for this character as their dorsolateral processes are fused along the dorsomedian line. Some Sarcophaginae possess what appears to be free dorsolateral processes, most notably *Sarcodexia lambens* (fig. 2) but also some species of *Blaesoxipha* Loew subgenus *Acridiophaga* Townsend. These processes, however, although derived from the dorsal plate, are probably not homologous to the processes seen in the Calliphoridae. A very large clade in the Sarcophaginae, containing both *Sarcodexia* Townsend and *Blaesoxipha*, is defined by the presence of a transverse, desclerotized strip distally on the dorsal side of the phallus, separating what is generally called a juxta from the more proximal part of the dorsal plate. The juxta may well contain elements of the fused dorsolateral processes, which means that any free sclerotized prongs in juxtate Sarcophaginae cannot be considered homologous to the free tips of the dorsolateral processes in Calliphoridae and Rhinophoridae.

All calliphorid subfamilies have been scored for free tips except the Bengaliinae and the Rhiniinae. For the Bengaliinae, my knowledge of phallic structures is rather limited, and the groundplan of dorsolateral processes has been scored as unknown/inapplicable. As dorsolateral processes in the Rhiniinae seem to have fused in the dorsomedian line, the character has been scored as unknown/inapplicable as in the Sarcophagidae and Tachinidae (see discussion under character 34 below).

All Hypodermatinae possess sclerotized processes laterally or dorsolaterally on the phallus and with tips just free of the wall (see figures in Grunin 1965). No other member of the Oestridae possesses similar processes. These processes are strikingly similar to the dorsolateral phallic processes of the Calliphoridae, and apical microserration may suggest a similar function. They differ, however, by apparently originating from the lateral plates rather than from the dorsal plate. Rudiments of the dorsolateral processes may be seen at the base of the dorsal plate (Grunin 1965: fig. 123). This puts serious doubt on the homology to the dorsolateral processes seen elsewhere in the Tachinidae family-group and I have scored the Hypodermatinae for the confluent condition.

Both Rognes (1986) and Pape (1986a) found no examples of free dorsolateral processes in the Tachinidae, and checking the numerous illustrations, e.g. in Wood (1972), Shima (1986, 1988), Tschorsnig (1985b) and Cantrell (1988), does not reveal any. It should be noted, however, that *Malayia* and some undescribed *Bezzimyia* (Pape unpubl.) possess free tips of dorsolateral processes, but I regard

Figs. 1-3. Details of male terminalia. – 1. *Cuterebra neomexicana* Sabrosky (Oestridae: Cuterebrinae), phallus, gonocoxite and gonostylus, posterior view; 2. *Sarcodexia lambens* (Wiedemann) (Sarcophagidae: Sarcophaginae), phallus, dorsal view; 3. *Bezzimyia* sp. (?Rhinophoridae), phallus; a = distiphallus, dorsal view, b = phallus, lateral view. Abbreviations: DP = dorsolateral process, G = gonocoxite, P = gonostylus, PA = gonostylar apodeme.

Figs. 4-7. Female internal genitalia, ovaries omitted. – 4. *Dermatobia hominis* (Linnaeus, Jr.) (Oestridae: Cuterebrinae), only one accessory gland shown; 5. *Hypoderma tarandi* (Linnaeus) (Oestridae: Hypodermatinae), with enlarged subset showing junction of spermathecal bases with uterus; 6. *Sarcophila* sp. (Sarcophagidae: Paramacronychiinae), with only one spermatheca shown and enlarged subset showing junction of ducts from spermathecae and accessory glands with uterus; 7. *Nyctia halterata* (Scopoli) (Sarcophagidae: Paramacronychiinae) with only one spermatheca shown. Abbreviations: AG = accessory gland, IP = remnants of incubatory pouch, O = uterus, S = spermatheca. Scale bar = 0.1 mm.

these to be Rhinophoridae as already discussed.

The Rhinophoridae have been scored as unknown for the present character as both conditions are of widespread occurrence. Processes free from distiphallic wall are found in *Mimodexia*, *Malayia*, *Phyto* and some *Bezzimyia*; processes confluent with distiphallic wall are present in remaining genera (see figures in Tschorsnig (1985a) and Pape (1986a)). The present knowledge of generic phylogeny is largely that of Tschorsnig (1985a) and Pape (1986a), with additional comments in Pape (1987d), but both authors did not consider *Bezzimyia* and *Malayia*. A proper evaluation of the most probable groundplan state is therefore not possible at present.

As I have never encountered distinctly free tips of dorsolateral processes within Muscidae and Anthomyiidae, these have been scored as confluent (0). This is in agreement with Hennig (1976: 690), who pointed out the free tips of the calliphorid dorsolateral processes and mentioned that dorsolateral processes in the Anthomyiidae were confluent with the distiphallic wall ('Bei den Anthomyiidae scheinen [die dorsolaterale Fortsätze] nur die Seitenteile einer geschlossenen in der Mitte membranösen oder ebenfalls sklerotisierten Dorsalwand zu bilden').

Character 33. – Acrophallus; position

0 - strictly terminal, 1 - on ventral surface of phallus.

All terminal taxa except the sarcophagid subfamilies Paramacronychiinae and Sarcophaginae possess a groundplan phallus with the spermexit almost perfectly terminal and situated on the longitudinal axis of the phallus, although this may be curved in the median plane. A very characteristic modification of both the paramacronychiine and sarcophagine phallus is the position of a very well-defined acrophallus ventrally on the distal part of the phallus.

Character 34. - Dorsolateral phallic processes; dorsomedian configuration

0 - separate, 1 - fused.

Phallic dorsolateral processes are here considered homologous throughout the Tachinidae family-group with the exception of the juxtate Sarcophaginae discussed under character 32 above. Tschorsnig (1985b: 119) suggested that the dorsolateral processes of the Calliphoridae and Rhinophoridae were homologous to the dorsal extension found in the Tachinidae, which I fully accept. To my knowledge, separate dorsolateral processes are unknown in the Tachinidae (if the exclusion of *Malayia* and *Bezzimyia* is accepted), and the tachinid taxa have been scored as fused (1), although some species may lack dorsolateral processes altogether. In the Sarcophagidae, all species possess fused dorsolateral processes (see for example Pape 1986c: figs. 1-4, Pape 1987a: figs. 29-33). Although some members of the subfamily Miltogrammatinae may have the dorsal plate partly desclerotized medially, they never present fully separate dorsolateral processes. The Hypodermatinae have been scored as unknown for this character as I consider the dorsolateral plates to be reduced.

I have not been able to fully evaluate the phallic groundplan of the Anthomyiidae and Muscidae, which have been scored as unknown.

Character 35. – Uterus; presence of ventral bilobed pouch

0 - not present, 1 - present.

A bilobed uterine pouch for embryonating eggs is found in the Sarcophagidae and seems here to be present without exceptions. In the botflies, all Oestrinae have a bilobed sac or pouch extending from the uterus, and although somewhat different in shape and tracheation, the Oestrinae have been scored like the Sarcophagidae (1). In the Tachininae (as here defined) eggs are retained (incubated or embryonated) in the uterus, which often becomes greatly distended, but no pouch is formed. *Eurychaeta palpalis* (Robineau-Desvoidy) of the Helicoboscinae has a pouch-like extension of the uterus, but this is never bilobed (Rognes 1986). Large incubatory pouches are known from *Bellardia* Robineau-Desvoidy and *Onesia* Robineau-Desvoidy (Calliphorinae), but these are lateral (Rognes 1991).

Character 36. – Oviposition behaviour; deposition relative to food source

0 - eggs (or larvae) deposited directly on the larval food source, 1 - eggs (or larvae) deposited away from the food source.

As correctly stated by Wood (1987b: 1189), the deposition of eggs away from the host in the Rhinophoridae is 'unusual among calyptrates'. McAlpine's (1989: 1501) claim that this is a plesiomorphic groundplan character state of this family is simply unsupported and may have come from Crosskey's (1977: 6) statement that the Rhinophoridae possess an 'oviposition habit of great simplicity and apparent primitiveness'.

Another instance of oviposition away from the host is found in the genus *Pollenia*. As the biology of other genera of the Polleniinae is largely unknown, this subfamily has been scored as 1. I know of no other calliphorid subfamily (as here defined), where oviposition away from the food source is a groundplan character state. Within the Sarcophagidae, *Sarcophaga* Meigen (s.str.) and at least some species of Miltogrammatinae (*Phrosinella* Robineau-Desvoidy and *Eumacronychia*) possess state 1 (Eberhardt 1955, Downes 1955, Lopes 1982a). As the groundplan of all other sarcophagid genera, for which extensive biological knowledge exists, seems to be characterised by state 0, the sarcophagid subfamilies have been scored as such. The gluing of eggs to the host-wasp carrying prey to the nest within some Miltogrammatinae (Day & Smith 1980) is here considered derived. Within the Oestridae, all *Cuterebra* oviposit in places frequented by the host, but never directly on a host specimen. *Dermatobia hominis* uses a carrier for its eggs, while the habit of oviposition for *Neocuterebra* and *Ruttenia* is unknown. Almost all non-cuterebrine botflies ovi- or larviposit directly on their host. One exception is *Gasterophilus inermis* (Brauer), which deposits eggs on grassblades and the like. This is here considered a derived condition. Within the Hypodermatinae, species of *Portschinskia* seem to produce eggs without any attachment apparatus (Grunin 1965), but no observation has been made of the oviposition, nor have any naturally deposited eggs been found. Grunin (1965) suggested an oviposition behaviour similar to that of *Cuterebra*, and I have scored the groundplan of the Hypodermatinae as unknown for this character.

Character 37. – Egg, ventral surface

0 - not glued to substrate, 1 - glued to substrate.

Many members of the Calyptratae will deposit eggs that are sticky and therefore adhere to the surface onto which they are positioned. This, however, is easily distinguished from the condition of all oviparous members of the Oestridae and Tachinidae, where eggs are glued firmly to the substrate. The Sarcophagidae are mainly ovi-larviparous but some will deposit embryonated eggs ready to hatch, especially when an ample larval food source induces prolific larviposition. In the subfamily Miltogrammatinae, some species may glue eggs to the host wasp (Day & Smith 1980), while others deposit eggs freely (Maneval 1929), and the groundplan of this subfamily has been scored as unknown with regard to this character. Nothing is known on egg structure and deposition in *Neocuterebra* and *Ruttenia.*

Character 38. – Egg; hatching mechanism

0 - by peeling off a long flap, 1 - by discarding an anterodorsal cap.

In the Tachinidae, eggs of the non-embryonating groups Phasiinae and the *Exorista* genus-group possess anterior cleavage lines flanking the aeropyles and delineating a somewhat operculum- or caplike structure through which the larva emerges (Herting 1960, Wood 1987c: fig. 110.264). This is very similar to the condition in plastronate groups, although with shorter hatching sutures. I have scored both groups as 0. Many different hatching mechanisms are known from the Tachininae, and they have been scored as unknown with regard to the groundplan for this character. Very little is known about egg structure and function in the Sarcophagidae (scored as inapplicable/unknown), but eggs of at least one species of Miltogrammatinae hatch through pushing off an anterior egg cap or operculum (Day & Smith 1980). In the genus *Sarcophaga* (s.l.), no preformed lines or weaknesses seem to exist, and the larva emerges by bursting the chorion (Baudet 1980). Eggs of all oviparous Oestridae hatch by discarding an anterodorsal cap (Wood 1987a: fig. 15, 17).

Within the Calliphoridae, *Booponus* of the Bengaliinae is to my knowledge the only known taxon with a somewhat oestrid-like hatching mechanism.

Character 39. – Progeny at deposition; stage of development

0 - unembryonated eggs, 1 - embryonated eggs or prehatched first instar larvae (ovolarviparous), 2 - larvae that for an extended period have received nourishment within the uterus (true larviparous).

In the Sarcophagidae, eggs do not necessarily hatch immediately upon deposition. They are always embryonated and except for *Sarcophaga nigriventris* Meigen, which is stated to deposit second instar larvae (Séguy 1965), I know of no cases of sarcophagid larvae being nourished in utero. In a species of *Oebalia* Robineau-Desvoidy, which oviposits directly on the 'host' carrying the prey, the first instar larva within the egg is fully mature and postpones hatching simply to await being transported to the host nest by its carrier (Day & Smith 1980). No embryonation takes place in the Rhinophoridae, and in the Oestridae only in the larviparous subfamily Oestrinae. All Phasiinae are stated by Wood (1987c) to deposit unembryonated eggs, and the Tachininae are here defined as including all embryonating Tachinidae.

Within the Calliphoridae the macro- or unilarviparous habit of the Helicoboscinae, Ameniinae, Phumosiinae and Mesembrinellinae is well known, but only the Mesembrinellinae will nourish the larvae during intra-uterine life (Rognes 1986, Crosskey 1965, Guimarães 1977, Ferrar 1978).

Character 40. – Mandible of first instar larva; relative development

0 - present as a distinctly sclerotized plate, 1 - reduced to an ill-defined sclerotization on side of mouth opening.

In all Tachinidae, what is probably a reduced mandible is present as 'a vaguely defined sclerotized area on side of mouth opening, without hook-like extension' (Wood 1987c: 1196). None of the non-tachinid terminal taxa applied here has a similar mandibular reduction as a groundplan feature. Note that McAlpine's (1989) statement that calliphorid first instar larvae lack paired mandibles is erroneous and was taken uncritically from Hennig (1973). All Calliphoridae possess easily recognizable paired mandibles in the first instar larva, although sometimes quite small (Rognes 1991).

Character 41. – Labrum of first instar larva; connection to remaining cephalopharyngeal skeleton

0 - labrum more or less connected to, but always distinct from remaining cephalopharyngeal skeleton, 1 - labrum firmly fused to, and contiguous with remaining cephalopharyngeal skeleton.

The unique cephalopharyngeal skeleton of the first instar tachinid larva is discussed and described sufficiently in the literature (e.g. Ferrar 1987). With no exceptions within the Tachinidae, and no homoplasies in the possible groundplan of any of the other terminal taxa, this character needs no further explanation.

Character 42. – Segments of first instar larva; development of spines

0 - without bands of strong spines, 1 - with bands of strong spines.

First instar larvae of all Oestridae are well-known for their bands of usually strong spines (Grunin 1965, 1966, 1969; Wood 1987a). These spines are always present in the first instar but may be modified or reduced in later instars.

Character 43. – Spiracular plates of third instar larva; development of peritreme and ecdysial scar

0 - complete, 1 - incomplete.

All larvae of Sarcophagidae have the peritreme incomplete ventro-medially and the ecdysial scar from the second instar posterior spiracles is absent or indistinct. A similar configuration belongs to the groundplan of the calliphorid subfamily Chrysomyinae (Rognes 1991). In the Cuterebrinae both *Dermatobia* and *Neocuterebra* show an incomplete peritreme while that of *Cuterebra* is complete. The cuterebrine groundplan has been scored as unknown for this character.

Character 44. – Posterior spiracles of second and third instar larva; position relative to surface

0 - more or less level with surrounding surface, 1 - set in a recession or cavity.

In the Sarcophagidae, close to all species for which larval morphology is known have the posterior spiracles concealed in a distinct recession. The only exceptions known to me are species of *Amobia* Robineau-Desvoidy sensu stricto (Miltogrammatinae), *Macronychia*, and at least some *Tricharaea* (Sarcophaginae), but these are here considered homoplasies. Somewhat similar conditions in the Gasterophilinae, where upper and lower lips can be pulled together, enclosing the spiracles, and in the Cuterebrinae, where the posterior spiracles can be pulled into the preceding segment, are considered non-homologous.

Character 45. – Parastomal bars of third instar larva; presence/absence

0 - parastomal bars present, 1 - parastomal bars absent.

Parastomal bars are easily recognized when present and need no further comments (see figures in Ferrar (1987)).

Character 46. – Posterior spiracle of second and third instar larva; vertical position of ecdysial scar

0 - low (or ventrally) on the spiracular plate, 1 - near the horizontal diameter of the spiracular plate.

This character has not previously been discussed in the literature, but illustrations of spiracular plates, e.g. in Ferrar (1987), show the difference in position of the 'low' ecdysial scar of non-botfly calyptrates compared to the much higher ecdysial scar of the botflies.

Character 47. – Posterior spiracles of second and third instar larva; configuration of openings

0 - three slits, 1 - a porous plate.

The porous condition is found in the Hypodermatinae and Oestrinae of the Oestridae (Zumpt 1965, Howard 1980, Ferrar 1987). *Cuterebra* deserves mention as the configuration with highly tortuous slits could be taken as resembling that found in Oestrinae and Hypodermatinae (see, e.g., Baird & Graham (1973: fig. 7D). However, the spiracular openings are still conspicuous slits, not porous plates, and with a clearly discernible tripartition. Typical tripartite slits occur in *Dermatobia*, *Ruttenia* and *Neocuterebra* (Ferrar 1987).

Character 48. – Posterior spiracular plates of second and third instar larva; configuration

0 - two isolated plates, 1 - plates fused in the median line.

Second and third instar larvae of all members of both *Cobboldia* and *Gasterophilus* + *Gyrostigma* have the spiracular plates fused (Zumpt 1965). Ferrar (1987: 137) mentioned that in *Dermatobia hominis* 'the two plates [of the posterior spiracles] are apparently joined, and have a single median button between the slits'. Figures in Kremer et al. (1978), however, show neither peritreme nor button. The fused character state has not been found in any other taxon of the Tachinidae family-group.

Character 49. – Puparium; hatching mechanism

0 - anterior end splits into a dorsal and a ventral piece, 1 - anterior end splits off only one, dorsal piece.

The groundplan condition of puparial hatching in the Cyclorrhapha (Ferrar 1987), seems to be a splitting off of an anterior cap, and this typically has a lateral suture causing further splitting into a ventral and a dorsal half. In the botflies, the ventral half is more or less fused to the remainder of the puparium and the dorsal half is flattened to a lid-like structure.

Unscored characters of potential phylogenetic value

As mentioned previously, character matrices are never complete, and some characters have not been included in the analysis because of uncertainty with regard to proper scoring. These are dealt with below in the hope that future studies will allow inclusion in the matrix.

Character a. – Eyes; holoptic/dichoptic condition

The typical holoptic condition with frontal vitta completely obliterated between eyes is widespread and common in the male sex of Calliphoridae, Muscidae and Anthomyiidae (Huckett 1987: fig. 4, Huckett & Vockeroth 1987: fig. 5, Shewell 1987a: fig. 6). The holoptic condition occurs scattered in the Tachinidae and is present in a few Rhinophoridae (some *Phyto* and *Stevenia* Robineau-Desvoidy), Sarcophagidae (*Agria* Robineau-Desvoidy, *Blaesoxiphella* Villeneuve) and Oestridae (some *Cuterebra*, *Pharyngobolus* Brauer). Much variation exists between and even within genera and groundplan estimates are difficult to assess at the subfamily and family levels.

Character b. – Intrapostocular setulae; presence/absence

Presence of intrapostocular setulae have been used in the definition of the Calliphoridae in spite of several exceptions: absences within the Calliphoridae as well as occurrences outside this family (Rognes 1986). I have not made a sufficiently extensive search for intrapostocular setulae to give a reliable scoring. They appear to be widespread in the non-rhiniine and non-ameniine Calliphoridae, including rare occurrences in the possibly basal lineage Helicoboscinae. I have not found any intrapostocular setulae in the Oestridae, Sarcophagidae and Rhinophoridae. Rognes (1986:86) found such setulae in *Dexiosoma caninum* (Fabricius) and *Tachina fera* Linnaeus of the Tachinidae. An extensive search in the Muscidae and Anthomyiidae is needed.

Character c. – Antennal arista; setosity

Whether the arista is bare or plumose or some intermediate condition is often used for diagnostic purposes at various levels within the Tachinidae family-group. The character is, however, quite variable, and I have failed in breaking it up into only a few clearcut states. The setose condition covers a whole array of types, from the single row of dorsal and ventral rays in *Musca* (Muscidae) to the bottle-rinser-type of *Melanophora roralis* (Rhinophoridae). However, the type with rays arranged dorsally as well as ventrally, with at least the dorsal row being double in the proximal part, and no hairs or pubescence on the sides is very characteristic. This 'calliphorid type' arista is found widespread in all non-helicoboscine Calliphoridae. *Eurychaeta* Brauer & Bergenstamm, which is the sole genus of the Helicoboscinae, has a unique arista with medium long rays on the whole surface, although with the dorsal and ventral rays longest. Members of the Rhiniinae have either a bare or a pectinate arista, with the latter type being identical to the typical calliphorid type except for the lack of ventral rays.

In the Oestridae, *Dermatobia* and most *Cuterebra* of the Cuterebrinae possess a plumose or pectinate calliphorid type arista. All other botflies have a completely bare arista.

No members of the Rhinophoridae and Tachinidae possess a calliphorid type arista as here defined. When a similar arista occurs in the Sarcophagidae, like in *Agria* and *Sarcophila* of the Paramacronychiinae, the arista often has distinct pubescence on the sides. In the Sarcophaginae, a plumose arista may be a groundplan feature and at least *Ravinia* Robineau-Desvoidy and *Oxysarcodexia* Townsend have a calliphorid type arista. In the large *Sarcophaga* sensu lato, however, the arista has pubescence on the sides. The apparently bare arista of the Miltogrammatinae and several Tachinidae is covered with short or minute pubescence.

The Rhinophoridae present several examples of a plumose arista, but never of the calliphorid type described above. McAlpine's (1989: 1501) statement that a plumose arista in the Rhinophoridae is an important plesiomorphic groundplan character state is to some extent contradicted by himself as he simultaneously, although tentatively, used this state as autapomorphic for the Calliphoridae.

My knowledge of the Muscidae and Anthomyiidae is too sparse to give a thorough discussion on variation in aristal setosity.

More accurate descriptions of different configurations of aristal setosity, preferrably using SEM, and further knowledge of their taxonomic distribution in all of the Calyptratae are needed before this character can effectively be used in interfamilial phylogenetic analyses.

Character d. – Outer posthumeral thoracic seta; position relative to the prealar seta

The position of the outer posthumeral seta outside (i.e. lateral to) a sagittal line through the prealar seta has often been used in the definition of the Calliphoridae (Rognes 1986). This lateral position seems to characterize the groundplan of all subfamilies except perhaps the Ameniinae, where both conditions occur (Crosskey 1965), and the Polleniinae, where the outer posthumeral seta is in line with the prealar seta in *Pollenia*, absent in *Morinia* (Rognes 1991). The groundplan of both the Tachinidae and Sarcophagidae has the outer posthumeral in a median position relative to a sagittal line through the prealar seta. Scoring the Rhinophoridae presents some problems. The outer posthumeral seta is generally absent, but when present as a fine seta in some species of *Phyto*, especially distinct in *Phyto sordidisquama* Villeneuve, it is in the lateral position. A scoring as absent would be equal to inapplicable and therefore rather uninformative; a scoring as lateral would ignore all the absences. The character is inapplicable for the Oestridae, as no bristly thoracic setae are differentiated.

I have not been able to give a reliable estimate of the groundplan for this character in the Anthomyiidae and Muscidae.

Character e. – Ventral surface of costa between junction with subcosta and R_1; setosity

This character is diagnostically valuable for various groups in the Calyptratae and clearly deserves more attention (Rognes 1991: fig. 8, inset). Within both the Calliphoridae and the Oestridae, this part of costa is setose in the majority of species, while the bare condition seems to be common and widespread in the Tachinidae and Sarcophagidae. In the latter family only a few genera of Sarcophaginae, e.g. *Boettcheria* Parker, *Emdenimyia* Lopes and *Notochaeta* Aldrich, possess the setose condition. Both conditions occur in the Rhinophoridae, Muscidae and Anthomyiidae with no obvious choice for the most probable groundplan condition.

Character f. – Anterior malpighian tubules of adults; length

This character state has not previously explicitly been used as a tachinid groundplan feature, and it is admittedly based on sparse evidence. Hori (1962) depicts the alimentary canal of *Sturmia sericariae* (Rondani), *Prosena siberita* (Fabricius) and *Trigonospila transvittatum* (Pandellé), which all possess reduced anterior malpighian tubules, which here are defined as the pair of tubules arising from a common malpighian duct in the right side of the gut and running anteriorly along the midgut. Three other tachinids are listed in Hori's (1962) table 1 and are likewise stated to have shortened anterior tubules. As in all other Calyptratae figured by Hori, the anterior tubules of the Tachinidae run forwards along the midgut. They do not, however, form a complete loop, with the tubules running all the way back and terminating at about the level of the rectal papillae. Instead, the anterior tubules make a slight curve or a very short loop, before ending well in advance of their starting point. It should be noted that no rhinophorids were dissected by Hori (1962), but specimens of *Phyto melanocephala* (Meigen) dissected by me show the long configuration of anterior malpighian tubules.

Character g. – Female terminalia; length

Long, retractile telescopic female terminalia are common and widespread in both the Anthomyiidae and Muscidae. In the Rhinophoridae, long telescopic terminalia occur in all genera except *Paykullia* Robineau-Desvoidy and *Melanophora* Meigen. In the Calliphoridae, all genera which have retained a plesiomorphic oviposition habit have telescopic female terminalia. In the Tachinidae, with the present exclusion of *Malayia* and *Bezzimyia*, all species possess shortened female terminalia, if not secondary lengthened, e.g. in some members of the phasiine tribe Cylindromyini. In all of Sarcophagidae, female terminalia are much shortened, and this holds for *Chilopodomyia* Lopes & Tibana as well, even though this genus was stated to have a telescopic ovipositor (Lopes & Tibana 1984). The subfamilies of Oestridae may also possess shortened female terminalia as a groundplan character state. Long female terminalia are unknown in the Cuterebrinae and Oestrinae, and the elongate terminalia of most female *Gasterophilus* are neither retractile nor telescopic. In the Hypodermatinae females of Hypodermatini and Oestromyini have long and telescopic ovipositors, but female terminalia of the genus *Portschinskia* are short.

I have not been able to break the structural diversity of female terminalia into unambiguous states except as a simple, and therefore probably little phylogenetically informative division into a short versus a telescopic condition. Also, the character is closely tied to the mode of oviposition, and it may be directly misleading to score larviparous groups and groups with a derived oviposition behaviour.

Character h. – Female tergites 7 and 8; median division

McAlpine (1989) considered the division of female abdominal tergites 7 and 8 as synapomorphic for the Calliphoridae. I know of no Calliphoridae having these tergites undivided, while the undivided condition occurs in at least some species of all other families of the Calyptratae (Herting 1957). However, most non-calliphorid terminal taxa included in the present analyses show examples of both the divided and the undivided condition and would be scored as unknown. Information is needed from genera considered to be close to the basal splits within each taxon.

Character i. – Spermathecal ducts; enclosion/non-enclosion in a common sheath

Hori (1961) distinguished between what he called a 1:2 and a 1:1:1 configuration, where either two spermathecal ducts were enclosed in a common sheath or all three were perfectly free of each other. This should not be confused with character 25, which deals exclusively with how the three ducts join the uterus. Enclosion in a common sheath, therefore, does not mean that they share a common duct or a common opening into the uterus.

Apparently, all species of Sarcophagidae and Tachinidae examined by Hori possess perfectly free spermathecal ducts, while all Calliphoridae and almost all non-tachinoid calyptrates with 3 spermathecal ducts examined showed the paired configuration. Within the Rhinophoridae, freshly killed female specimens of *Phyto melanocephala* dissected by me showed the paired condition with two spermathecal ducts closely appressed, while a female of *Melanophora roralis* had the two ducts only loosely connected. Among the Sarcophagidae, the miltogrammatine species *Senotainia litoralis* Allen figured by Allen (1926: fig. 25) seems to possess a paired configuration, while the pairing of spermathecal ducts in *S. trilineata* (Wulp) seems to be very loose (Allen 1926: fig. 20). I have dissected freshly killed specimens of *Brachicoma devia* (Fallén) of the Paramacronychiinae which showed either a free condition or a condition with two loosely connected ducts. In the Oestridae, the few figures available do not allow a definite conclusion (Catts 1964; Grunin 1965, 1966), but in the Tachinidae no examples of joined or paired spermathecal ducts are known (S. Andersen, pers. comm.). While dissection of dried females may give easy access to information on how the spermathecal ducts enter the uterus, fresh or properly fixed specimens are required to examine whether or not the ducts are paired or free. I have not been able to score the families consistently on the sparse material examined.

Character j. – Female accessory glands; attachment to oviducts

The detailed figures of Hori (1961) reveal another character that may prove to contain phylogenetic information, the attachment/non-attachment of female accessory glands to the oviducts through an extension of their sheath of connective tissue. In all Calliphoridae and non-tachinoid Calyptratae figured, the female accessory glands are distinctly attached (see also Kurahashi 1970: fig. 3), while they are free in all Sarcophagidae and Tachinidae. Fresh females of *Phyto melanocephala* and *Melanophora roralis* (Rhinophoridae) examined by me both have the accessory glands unattached. A single female of *Brachicoma devia* (Sarcophagidae: Paramacronychiinae) seen had the accessory glands suspended in a thin strand, and the female reproductive system of *Gonia* sp. (Tachinidae: Tachininae) depicted in Pantel (1910, identified as *atra* Cockerell and reproduced in Thompson (1963: fig. 2)) shows accessory glands likewise loosely attached to the oviducts. The only figures available of internal reproductive organs of female botflies suggest that the accessory glands are unattached (Catts 1964: figs. 3-7 (Oestrinae), Grunin 1965: fig. 37 (Hypodermatinae), Grunin 1969: figs. 16-20 (Gasterophilinae)). These figures, however, are hardly reliable as the dissections were not made for the special purpose of examining this feature.

Character k. – Uterus; presence/absence of lateral sacs

The uterus of many Calliphoridae, e.g. species of the genera *Calliphora* Robineau-Desvoidy, *Lucilia* and *Pollenia*, possesses distinct lateral sacs. These sacs seem to receive the tips of the dorsolateral phallic processes during copulation (Rognes 1991). Nothing equivalent is known from the Sarcophagidae (Lopes & Kano 1968), which do not possess lateral sacs (Hori 1961), nor from the common house fly (Degrugillier & Leopold 1973), which possesses distinct lateral sacs but no free dorsolateral processes. No lateral sacs have been shown to occur in non-calliphorid tachinoids (I have examined females of *Melanophora roralis* and *Phyto melanocephala* of the Rhinophoridae).

Character l. – Male terminalia; resting position

Wood (1987a: 1148) described the male terminalia of the Oestridae as being 'strongly retracted, and carried rather far forward on underside of abdomen'. This is distinct from the possible groundplan of the Tachinidae family-group, where male terminalia are almost apical. Many subfamilies within the Calliphoridae, with the notable exception of the Helicoboscinae, have the male terminalia slightly displaced forwards on the underside of abdomen. I have not, however, been able to produce an exact measure for this character.

Character m. – Testes; shape

Shape of testes may provide interesting phylogenetic information. In the Paramacronychiinae and Sarcophagidae, testes are of a uniform shape with a constriction proximal to middle. In the Tachinidae, a pyriform shape of testes may belong to the groundplan (see numerous figures in Townsend (1942) and Hori (1960)). Exceptions, however, exist and rigorous use of this character depends on more information from all terminal taxa.

Character n. – Testes; position relative to fat body

Based on data from Hori (1960), 'testes enveloped in fat body' was used by McAlpine (1989) to corroborate the monophyly of the Calliphoridae. However, data from many more calliphorid genera and especially from the Oestridae and Rhinophoridae, are needed before it will find proper usage.

Character o. – Median phallic sclerotization; relative development

This structure (= 'Mesohypophallus' of Salzer (1968)) was given the poor term 'spermduct sclerotization' by Pape (1986a) and later renamed 'median sclerotization' (Pape (1987d) following Tschorsnig's (1985a, b) 'Medianleiste des Ventralsklerits'). Although it may appear to be internal, as the ventral part of the phallus often is slightly invaginated, it is part of the phallic tube, not the sperm duct, as correctly stated by Tschorsnig (1985a). A median sclerotization is often present and well developed in the Tachinidae (see figures in Tschorsnig (1985b)), less distinct and often shortened in the Oestridae. The groundplan of the Rhinophoridae and Calliphoridae most probably is a well developed median sclerotization running the full length from the ventral plates to the acrophallus. In the Sarcophagidae, the median sclerotization is never complete. What could be a short median sclerotization occurs sporadically in the Miltogrammatinae (e.g. Pape 1987a: fig. 133), but no trace of a median sclerotization seems to be present in the Paramacronychiinae. Within the Sarcophaginae, the highly modified phallus makes homologies obscure, but a median sclerotization is either absent or may have given rise to the vesica and all or part of the median stylus.

Character p. – Dorsolateral phallic processes; serration of tip

A point of interest relating to the calliphorid phallus is that the dorsolateral processes often are equipped with serrations along the free part of their tip. In *Lucilia cuprina* (Wiedemann), these free, serrated tips have been shown to tear slits in the cuticular lining (intima) of the lateral sacs of the uterus. The curved dorsolateral processes assist in guiding the accessory gland material into intra-cuticular spaces (Merritt 1989). *Eurychaeta palpalis* (Helicoboscinae) and several species of Calliphorinae, Chrysomyinae, Melanomyinae, Mesembrinellinae and Polleniinae likewise possess dorsolateral processes with some kind of serration of the apical part (see figures in Guimarães (1977), Kurahashi (1970, 1971) and Rognes (1986, 1987, 1988, 1991)). Rognes (1988: 342) considered the presence of 'small to minute tubercles' on the tip of the dorsolateral processes as apomorphic within *Pollenia* and as an underlying synapomorphy corroborating a clade consisting of his *semicinerea*-group and *rudis*-group. It may be, however, that the synapomorphy should include all of the Calliphoridae. I have not seen any serrations, teeth or tubercles on the apical part of the very calliphorid-like dorsolateral phallic processes of *Phyto* spp. nor in the undescribed species of *Bezzimyia* shown in fig. 3, although extensive SEM studies are needed. It is tempting to postulate an ancestral calliphorid type of copulation which, possibly repeatedly, led to an elongation of the free tips of the dorsolateral processes with or without apical serration. It is interesting in this context that many Calliphoridae with long, free dorsolateral processes have the acrophallus equipped with a pair of lateral ducts on the external wall of the acrophallus. These ducts seem to facilitate the flow of accessory gland secretion from the gonopore to the slits made by the dorsolateral processes (Merritt 1989, Rognes 1991).

Character q. – ß-alanyl-L-tyrosine ('sarcophagine'); presence/absence in larval hemolymph

The accumulation of the dipeptide sarcophagine in larval hemolymph of at least *Agria housei* Shewell (Paramacronychiinae) and several species of *Sarcophaga* sensu lato (Sarcophaginae) is interesting as 'ß-alanine and tyrosine have never been detected in peptide linkage in proteins; nor has the free dipeptide been observed in any other natural source' (Bodnaryk 1970: 349). Later investigations by Bodnaryk (1972), however, have revealed sarcophagine in one species of Tachinidae. The Miltogrammatinae have not yet been examined for this character.

Character r. – Larval pharynx; presence/absence of a filter apparatus

McAlpine (1989) corroborated the monophyly of his parasitic clade Oestridae + Rhinophoridae + Tachinidae by the absence of a larval pharyngeal filter. I have insufficient information on the distribution of this character, e.g. in the Miltogrammatinae and possibly basal calliphorid lineages like the Helicoboscinae and Bengaliinae, to be able to make a proper scoring.

Character s. – Labrum of first instar larva; size

A labrum is completely absent in the Rhinophoridae (Bedding 1973), it is small but still distinct in the Sarcophaginae (Lopes 1982b) and Oestrinae (Grunin 1966). The labrum is short in the Cuterebrinae and Hypodermatinae (Grunin 1965, Ferrar 1987), long and tapering in the Gasterophilini (Grunin 1969). In the Calliphoridae, a labrum is usually well developed, but it is absent in the genera *Bellardia* and *Onesia* (Calliphorinae) and in *Protocalliphora* Hough (Chrysomyinae) (Rognes 1991).

Character t. – Dorsal cornu in cephalopharyngeal skeleton of third (and probably second) instar larva; posterior incision

The large majority of species within the Paramacronychiinae and Miltogrammatinae and all of Sarcophaginae have a posterior incision in the dorsal cornu. The few exceptions, however, make groundplan estimates uncertain until generic phylogeny becomes better resolved. McAlpine (1989) listed an unincised dorsal cornu as a tentative autapomorphic character state for the Calliphoridae, but he simultaneously gave this condition as autapomorphic for his clade Oestridae + Rhinophoridae + Tachinidae.

Roback (1951) gave the incised condition as a groundplan feature of the Anthomyiidae.

Character u. – Spiracular slits of posterior spiracles in third instar larva; orientation

The pattern in the Sarcophagidae is generally that of three more or less vertical slits, and in the Calliphoridae the most widespread condition is three slits radiating in a dorsolateral direction (see figures in Ferrar 1987). In all Gasterophilinae, the three spiracular slits are parallel and vertical, with secondary convolutions having occurred in *Gyrostigma*. In *Ruttenia* the spiracular slits are horizontal or almost so.

Character v. – Pupal prothoracic horns; presence/absence

Prothoracic horns are present in the pupa of many Calliphoridae and Oestridae and in at least some Tachinidae, while they are seemingly absent in the Rhinophoridae and Sarcophagidae. I have not included this character as the number of calliphorid and tachinid subfamilies for which this character is discussed in available literature is strongly limited.

Character w. – Puparium; shape

The shape of the puparium was used by McAlpine (1989) as a synapomorphy uniting his parasitic clade Oestridae + Rhinophoridae + Tachinidae. These three families were stated to possess a 'puparium fully inflated with both ends more or less equally hemispherical' (p. 1501). I have been unable to confirm this.

Character x. – Egg; surface of area dorsal to micropyle

The micropyle is here considered a morphological landmark, which means that the chorion dorsal to this may be considered homologous throughout the Tachinidae family-group. In at least some and probably most Calliphoridae, the surface between the two ridges or pleas demarcating the hatching sutures is modified into a plastron with struts and crossbars. A plastron seems likewise to be present in all Rhinophoridae as well as most Muscidae and Anthomyiidae (Hinton 1960a, b, 1963, 1965, 1967; Bedding 1973; Kitching 1976; Leopold et al. 1978; Richards & Morrison 1972; Erzinçlioğlu 1988, 1989; Greenberg & Szyska 1984). The similarity in position and ultrastructure suggest homology. No tachinid egg is known to possess a plastron as here defined. Instead, one or more areas with perforations (aeropyles) in the external covering, and therefore with free access to the columnar middle layer, may be found, as shown by figures and SEM-micrographs in Wood (1972). Although the aeropylar areas sometimes are situated dorsal to the micropyle and between the hatching pleas, I have no a priori evidence that these are homologous to the plastron of the Calliphoridae.

The sparse information available on the morphology of oestrid eggs indicates 'non-presence' of a plastronic network. It does, however, not allow a more explicit interpretation of homology, e.g. relative to the condition found in the Tachinidae. In *Dermatobia hominis* (Cuterebrinae), the egg cap is without any trace of a plastronic network and the external layer of chorionin, which in this species is similar to the general egg surface, has no apparent opening(s) (Leite 1988). Also in *Cuterebra tenebrosa* Coquillett is the sculpturing of the egg cap hardly different from that of the general surface (Baird & Graham 1973). In *Cuterebra cuniculi* (Clark) a modified sculpturing covers all of the egg cap (Baker 1986, as *Cuterebra horripilum* Clark). It does not look like a plastron similar to that found in the Calliphoridae, nor does it look like aeropyles as found in the Tachinidae. The only SEM-studies of eggs of Gasterophilini (Cogley & Anderson 1983) and Hypodermatinae (Cogley et al. 1981) do not pay special attention to the egg cap.

Too little is known on egg structure in the Sarcophagidae to allow a reasonable scoring of the groundplan. In *Miltogramma* Meigen, the egg seems devoid of any plastron or aeropylar area (Thompson 1921), but SEM studies are needed to confirm this.

In *Sarcodexia lambens*, the egg is pitted with aeropyles in the posterior third of what may be the dorsal surface (Lopes & Leite 1989), while eggs of *Sarcophaga*, to the extent they are known, only present a single aeropyle, which is situated opposite the micropyle (Baudet 1980, 1985). A true plastron is probably absent in the Sarcophagidae as this would be non-functioning during intra-uterine incubation.

Character y. – 28s ribosomal RNA sequence data

Vossbrinck & Friedman (1989) used sequence data from 28s ribosomal RNA to analyse relationships between selected cyclorrhaphan species. Their data have not been included in the present analysis for the following reasons. Firstly, ribosomal RNA of far too few taxa has been analysed, which would have given this input of character states proportionally more weight than it may deserve. Secondly, and perhaps more important, I prefer to await a consistent methodology for phylogenetic analysis of nucleotide sequence data. Of particular relevance before translating Vossbrinck & Friedman's (1989) table 1 into character states is a discussion of homology between the sequences analysed. However, it is obvious from the cladograms produced by these authors that their sequence data give results that show little congruence with results obtained in the present analysis.

Character z. – Parasitism

Parasitism of a certain taxon has been used explicitly as an apomorphic character state for all major parasitic clades of the Tachinidae family-group (Pape 1986a, Rognes 1986, McAlpine 1989). McAlpine (1989: 1501) even stated that being 'obligate parasites of other animals .... is presumed to be a primary, autapotypic adaption of [Oestridae + Rhinophoridae + Tachinidae] (synapotypic character of the component families)'. An important question, however, is how parasitism fits into a character analysis, i.e. whether or not parasitism really is a character and in case how the states are defined. As I have met numerous viewpoints on this issue in discussions with fellow systematists, a rather detailed elaboration of the problem seems justified.

Parasitism *per se* is here defined with the very broad concept adopted by Price (1980: 4), who simply cites the definition given in Webster's Third International Dictionary: A parasite is 'an organism living in or on another living organism, obtaining from it part or all of its organic nutriment, commonly exhibiting some degree of adaptive structural modification, and causing some degree of real damage'.

Parasitism, then, could be defined as a character with the states 'developed' and 'not developed'. This would imply that, say, the Agromyzidae (parasites of angiosperms) would be scored exactly like the Rhinophoridae (parasites of woodlice) in a family level phylogenetic analysis. This way of handling parasitism seems falsified by the very definition of a character accepted in the present paper, being an inheritable feature that is independent of any other inheritable feature(s). Parasitism *per se*, as here defined, is not built in as a message in the genetic code. One could elaborate the definition of the states so that states (of, say, life habit) pertaining to parasites were defined taxonomically as the most restricted (= smallest possible) recent taxon assumed to contain the hypothetical ancestral host or host-lineage. Put in a more informal wording, this means that the habit of parasitizing a certain taxon is considered a derived character state for the parasites of this taxon. In this way, parasitism of true bugs (Heteroptera) would be a synapomorphy of the Phasiinae, insect parasitism a synapomorphy of the Tachinidae, mammal parasitism a synapomorphy of the Oestridae, woodlice parasitism a synapomorphy of the Rhinophoridae, etc. But we still do not have characters or character states in the sense of inheritable features – organisms simply do not parasitize taxa, they parasitize other organisms. This may seem pure epistemology, but parasitism in this taxonomic definition can only be defined *a posteriori*, and corroborating a group of species based on the common habit of parasitizing the same taxon (whether of specific, generic, or any other rank) is unsound. The *Pieris* -butterflies, for example, do not possess the character state 'phytophages of Capparales'. They will readily eat any plant containing (or just tasting of) mustard oil glucosides, e.g. members of the Brassicaceae, Tropaeolaceae and some other Capparales, and the real character state should rather be 'mustard oil glucosides promote larval feeding' (David & Gardiner 1966) or perhaps even more specific 'larval maxillary sensilla styloconica with chemoreceptory cells sensitive to mustard oil glucosides' (Schoonhoven 1967). Taxonomic host data is merely information on the distribution of hosts within the classification available. Modern classifications of host organisms reflect their 'descent with modification', which cannot trigger oviposition behaviour.

Thus, in my opinion the monophyly of a group consisting of the Tachinidae + Rhinophoridae cannot be argued on the shared occurrence of parasitism of arthropods simply because arthropod parasitism has no validity as a character state. And if arthropod parasitism cannot be considered a character state, insect parasitism, wood-lice parasitism or animal parasitism obviously cannot do either. When dealing with still more restricted and/or specialized host taxa, however, one will often increase the probability that its associated parasites actually *do* belong to a monophyletic group. This, however, is nothing but *a posteriori* statistics and reflects that many parasite clades in nature really are restricted to one or a few host clades.

If parasitism (of a taxon) cannot be considered a character, this implies that even if the Tachinidae and Rhinophoridae constitute a clade one cannot make a straightforward deduction that their common ancestor was a parasite of either insects or woodlice unless we assume that the transition between woodlouse parasitism and insect parasitism (or vice versa) is more likely than the transition between scavenging and woodlouse/insect parasitism. Only if synapomorphic character states directly relating to the parasitic habit are present can we convincingly argue for a single origin of parasitism, and we may then consider woodlouse parasitism to have developed from insect parasitism (or vice versa) simply because this is more probable than the hypothesis of both habits arising simultaneously, i.e. in the same speciation event. Wood (1987b: 1189) tentatively suggests one such character: 'The tendency to stimulate the formation in the host of [a funnel-like integumental sheath] or at least to use it to advantage for support and respiration, may be a synapomorphy of the Rhinophoridae and Tachinidae'. Two problems should be considered in this context. Firstly, of course, one has to decide whether or not to accept the character at all. In my opinion, the formation of a sheath enveloping part of the parasite is a typical immunological reaction that would happen to any foreign body piercing the integument and penetrating into the haemocoel. Thus, the formation of a sheath could be plesiomorphic at this level. No sheath-formation has been reported from hosts of parasitic Sarcophagidae, e.g. the grasshopper-parasitizing *Blaesoxipha* (Léonide & Léonide 1986), which seem to be independent of direct access to the surrounding atmosphere in at least second and third instar. More tricky is the question whether or not the use of this sheath for support and respiration is a character state, but as the formation of the sheath probably is induced by the piercing of the integument, e.g. a trachea, use of the sheath cannot be considered in isolation. Numerous types of larval equipment for piercing the host's integument may be found in the Tachinidae, but all of these differ from what may be analogous structures in the Rhinophoridae and apparently without being related through transformation series. I have not accepted the use of a respiratory funnel or any associated feature within Rhinophoridae and Tachinidae as homologous.

Another matter is, that if the production within the host of a sheath of host integument, or its being used by the parasite, is considered a (derived) character state, the character would be inapplicable with regard to the Oestridae. Oestrid hosts, i.e. mammals, differ radically from arthropods in cytology, physiology and immunochemistry. A respiratory funnel, therefore, cannot in itself provide evidence that the Rhinophoridae are more closely related to the Tachinidae than are the Oestridae. Note the few but well documented cases of human myiasis produced by tachinid flies that even have resulted in the emergence of adults (Smith 1988). This shows that we cannot *a priori* exclude the possibility that mammal parasitism evolved from insect parasitism.

CLADES OF THE TACHINIDAE FAMILY-GROUP

Running the present character matrix (table 2) through Hennig86 (version 1.5) with all states unordered (outgroup = 0.1;cc-.;mh*;bb*;) results in an initial set of 630 most parsimonious cladograms (length = 111, consistency index = 55, retention index = 77). Subsequent successive weighting (xsteps w;mh*;bb*;xsteps w;mh*;bb*; etc.) reduces these 630 cladograms to 15, although with no changes in family level relationships. From the resulting Nelson consensus tree (fig. 9), deductions of transformation series between character states can be made for those characters where more than two states are involved (i.e. characters 0, 9, 10, 13, 15, 21, 22 and 39). Characters 0, 9, 13 and 21 may thus be arranged in linear transformation series, which correspond to the numeral sequences used when listing the states in the discussion above. [Note that transformation series need not be rooted at the lowest number, i.e. '0'. Character 13 has the transformation series 0–1–2 but is rooted at 1]. For characters 10, 15, 22 and 39, less straightforward transformation series are involved, and these characters were maintained as unordered (cc-10,15,22,39;). Specifically for the subscutellum (character 10), the cladogram in fig. 9 leads to the assumption that the convex state (2) most probably developed from the concave state (0) in the Tachinidae and from the medium-sized state (1) in the Hypodermatinae, and as the concave state also may have given rise to the medium-sized state as well as vice versa, all states are interconnected and should be treated as unordered.

With this new input of phylogenetic information, data were rerun (outgroup = 0.1;cc-10,15,22,39;mh*;bb*;xsteps w; etc.). This resulted in 30 trees, the Nelson consensus tree of which did not differ from the one resulting from all characters being unordered. This cladogram is the one I consider as the currently most corroborated hypothesis of family-level phylogenetic relationships within the Tachinidae family-group (fig. 8).

Competing cladograms resulting from different character or transformation series interpretations are discussed below (figs. 10, 11), with character states for non-terminal clades in tables 4, 5.

Explicit lists of apomorphic character states corroborating the monophyly of families and supra-familial

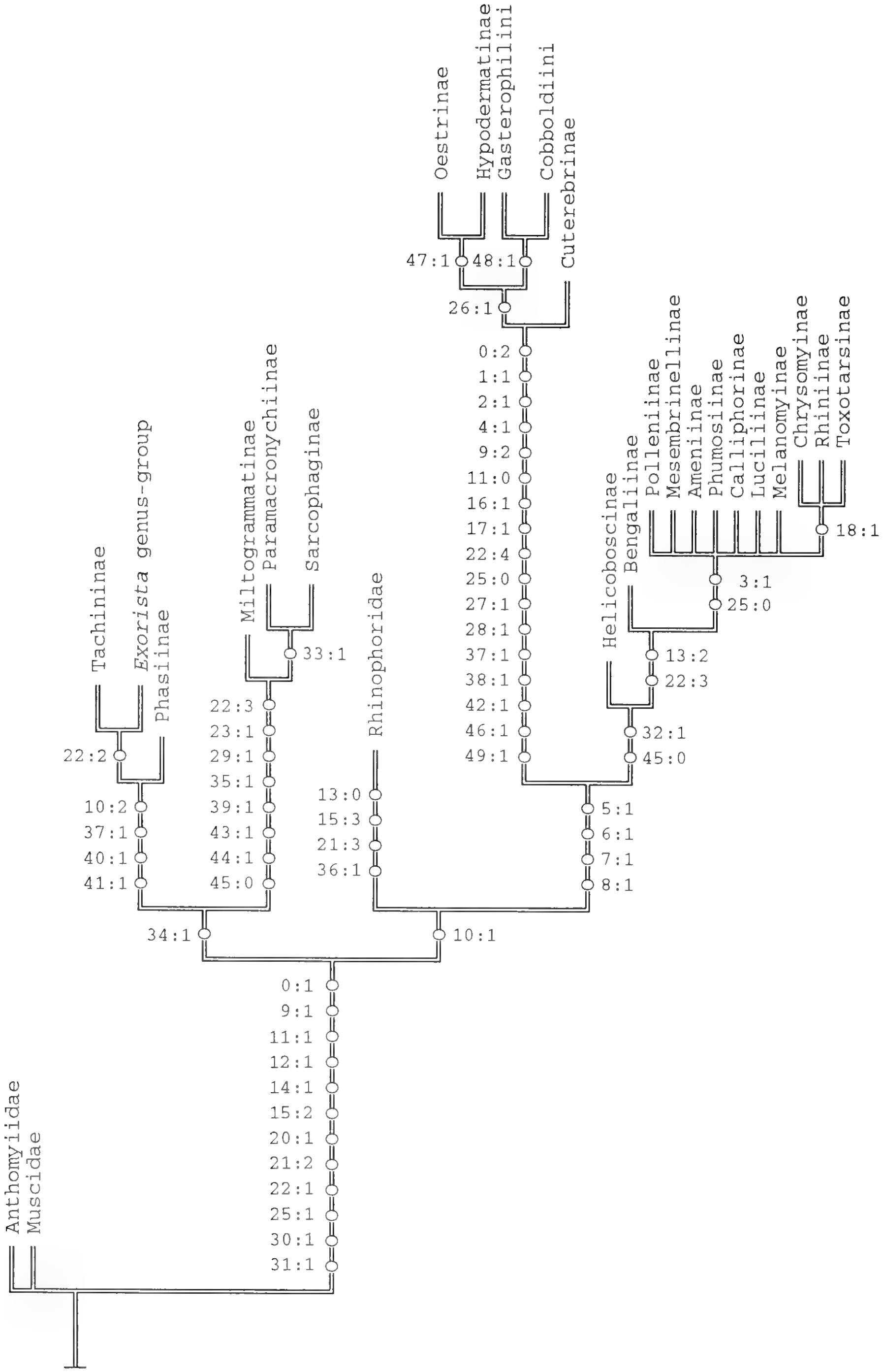

Fig. 8. Cladogram of the Tachinidae family-group with apomorphies indicated for non-terminal clades. Numbers refer to characters and states discussed in the text.

Table 2. Initial character matrix with scorings of 50 characters (0-49). See text for discussion of states.

Anthomyiidae	00000	00000	000–0	10000	00001	00000	00000	00000	00000	00000
Muscidae	00000	00000	000–0	10001	–1001	00000	00000	00000	00000	10000
Rhinophoridae	10000	00001	11101	30001	13100	10000	11–00	01000	00000	10000
Miltogrammatinae	01000	00001	0–111	20001	12310	10–01	11–01	10—1	00011	00000
Paramacronychiinae	10000	00001	01111	20001	12310	10111	11–11	100–1	00011	00000
Sarcophaginae	10000	10–11	01111	20001	12310	10001	11–11	100–1	00011	00000
Phasiinae	10000	00001	21111	20001	12100	10000	11–01	00100	11000	10000
Exorista genus-group	10000	00001	21111	20001	12200	10000	11–01	00100	11000	10000
Tachininae	10000	–0001	21111	20001	12200	10000	11–01	001–1	11000	10000
Cuterebrinae	211–1	1–112	10–11	2110–	–2400	00110	11000	01110	001–0	11001
Gasterophilini	21101	11–12	100–1	11100	02410	–1110	00–0–	00110	00100	11011
Cobboldiini	211–1	11112	10111	21101	12400	–1110	01000	00110	00100	11011
Hypodermatinae	21101	11112	200–1	01101	–2410	01110	–100–	0–110	00100	11101
Oestrinae	21101	10–12	–0111	21101	12410	–1110	–1000	10—1	00100	11101
Helicoboscinae	10000	11011	11111	20001	12100	10000	11100	00—1	00000	00000
Polleniinae	100–0	00101	11121	20001	–2300	00000	11100	01000	00000	00000
Bengaliinae	10000	1–111	11121	20000	123–0	10000	11–0–	0–000	00000	00000
Mesembrinellinae	10010	10111	110–1	300–1	12000	00000	11100	00—2	00000	–0000
Ameniinae	10010	11111	11121	20001	12110	00000	11100	0——1	00000	0–0—
Phumosiinae	10010	11111	01121	20001	12300	10000	11100	0——1	00000	0–0—
Calliphorinae	10010	11111	01121	20001	12300	00000	11100	00000	00000	00000
Luciliinae	10010	11111	01121	20001	12300	00000	11100	00000	00000	00000
Melanomyinae	100–0	1—11	–1121	20001	12300	00000	11100	00000	00000	00000
Chrysomyinae	10010	11111	01121	20011	1–300	00000	11100	00000	00010	00000
Rhiniinae	100–0	00111	01121	20011	13300	–0000	11–01	00000	00000	–0000
Toxotarsinae	10010	11111	01121	20011	123—	–0000	11100	00000	–0000	00000

clades within the Tachinidae family-group are listed below, including additional character states that may further corroborate the monophyly of the families, but which were not scored for the analysis. Apomorphic character states have been given a concluding composite number (character: state) referring to the discussion of characters and to the data matrix; or a letter for reference to the discussion of unscored characters.

Oestridae

As pointed out by Wood (1987a), the early concept of the botflies as a 'natural' (i.e. monophyletic) group has gained wider acceptance after a period with attempts of splitting the group and assigning the fractions to various other calyptrate families or even to the acalyptrates (see Grunin (1969) for references). Although mammal parasitism has evolved several times in the Calliphoridae and Sarcophagidae, it has never promoted the physiological coevolution shown by the botflies and their hosts. Some species of *Wohlfahrtia* (Sarcophagidae) and *Booponus* (Calliphoridae) are subdermal parasites of mammals and at least some species of the latter genus seem to be quite host specific. But the warbles, if any, formed by these species are simple swellings caused by the inflammatory response of the host. Contrary to the botflies, these larval feeding sites often leave a considerable scar.

Presently recognized botfly synapomorphies are:

1. Postocular setae reduced (0:2);
2. Postcranium concave (1:1);
3. Mouthparts reduced (2:1);
4. Clothing setae soft and hairlike (4:1);
5. Meron with a patch of hairs (9:2);
6. Anatergite bare (11:0);
7. Subcostal vein straight at level of humeral break (16:1);
8. Vein R_1 without a knob at level where subcosta joins with costa (17:1);
9. Abdominal sternite 2 freely exposed and widely separated from tergal margins by ample pleural membrane (22:4);
10. Two of the three spermathecal ducts fused just before entering the uterus (25:0);
11. Male sternite 5 simple or with shallow emargination (27:1);
12. Male tergite 6 fused to syntergosternite 7+8 (28:1);
13. Ventral surface of egg glued to substrate (37:1);
14. Egg hatching through discarding an anterodorsal cap or operculum (38:1);
15. Segments of first instar larva with 1-2 bands of strong spines (42:1);
16. Second and third instar larva with ecdysial scar of spiracular plate near horizontal diameter (46:1);
17. Puparium hatching by splitting off only one, dorsal piece (49:1).

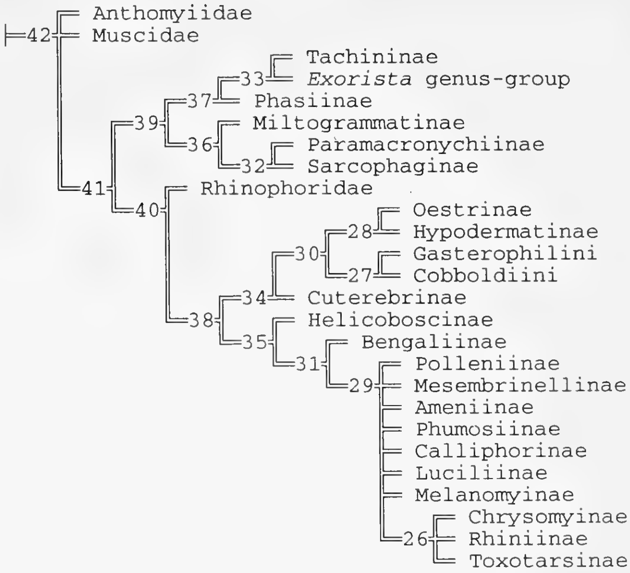

Fig. 9. Nelson consensus cladogram of 15 trees obtained from running the matrix in table 2 with all characters unordered and successive weighting. Weights and character states of nodes are given in table 3. For further explanation see text.

Rhinophoridae

The Rhinophoridae have recently been subject to some attention, but despite several attempts at a definition based on apomorphic character states in the adult morphology, only the morphology of the first instar larva has provided what seems to be unambiguous and autapomorphic character states.

Crosskey (1977) reviewed the family and provided a thorough discussion of the characters most often used in the characterization of the family. He admitted, however, that his recognition couplet for imagines still fits 'a very few aberrant tachinids' (p. 7). Tschorsnig (1985a), although including both *Melanomya* and *Morinia*, both of which now generally are accepted as Calliphoridae, described the structure of the male terminalia in detail and suggested (tentatively) that broadened bacilliform sclerites and a patch of setae anterobasally on the surstylus should be considered synapomorphic for the Rhinophoridae (see his figs. 7-10). Exceptions exist, and as some of these represent undescribed genera (Pape, unpubl.) I prefer to await a revised generic phylogeny with data on this character incorporated before evaluating the rhinophorid groundplan.

The phallic character state previously used by me, the fusion of the ventral plates in the median line (Pape 1986a), apparently does not have the diagnostic or defining powers stated. Although it may be apomorphic at the level of the rhinophorid groundplan, numerous homoplasies occur in the Calliphoridae and Tachinidae, and even within the Rhinophoridae reversals to the non-fused condition have to be assumed (*Paykullia*, several species of *Phyto*). I do not consider this character any further in this context. Wood (1987b: 1189) clearly pinpointed the current situation when he wrote: 'no character or group of characters has been found in the adult to render the group recognizable or to suggest that it is monophyletic'. But, on the other hand, the obviously apomorphic larval character states bring substantial evidence that a very well defined monophyletic group exists, and only our sparse knowledge of this stage prevents an easy delimitation of the group. Hence, I cannot agree when Downes (1986: 17) 'interpret[s the Rhinophoridae] as an intentionally practical rather than a natural taxon' which 'in practice....is analogous to the Fungi Imperfecti'.

All species of Rhinophoridae are obligate parasites (or parasitoids), but parasitism of woodlice will not be included as a character state, as already discussed.

1. Metathoracic spiracle with both anterior and posterior lappets small (13:0);
2. Vein M bend in an obtuse angle (15:3);
3. Lower calypter tongue-shaped (21:3);
4. Female ovipositing away from food source (36:1);
5. First instar larva with completely reduced labrum and closely appressed mandibles (s).

Some additional character states are found in the larval morphology (see figures in Bedding 1973).

6. First instar larva with dorsal arc of mandibles toothed or serrated;
7. First instar larva with anterior part of pharyngeal sclerite elongated;

Table 3. Character states and weights for clades 26-42 in fig. 9.

		Node																
		26	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*	*35*	*36*	*37*	*38*	*39*	*40*	*41*	*42*
Char	Wght																	
0	5	1	2	2	1	2	1	1	1	2	1	1	1	1	1	1	1	0
1	4	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0
2	10	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0
3	10	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
4	10	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0
5	1	1	1	1	1	1	1	0	0	1	1	0	0	1	0	0	0	0
6	1	1	1	1	1	1	1	0	0	1	1	0	0	1	0	0	0	0
7	4	1	1	1	1	1	1	0	0	1	01	0	0	01	0	0	0	0
8	2	1	1	1	1	1	1	0	0	1	1	0	0	1	0	0	0	0
9	10	1	2	2	1	2	1	1	1	2	1	1	1	1	1	1	1	0
10	4	0	1	12	01	1	1	0	2	1	1	0	2	1	0	1	0	0
11	4	1	0	0	1	0	1	1	1	0	1	1	1	1	1	1	1	0
12	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
13	10	2	1	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1
14	10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
15	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
16	10	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0
17	10	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0
18	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
20	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	01
21	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	012
22	4	3	4	4	3	4	3	3	2	4	1	3	1	1	1	1	1	0
23	1	0	01	1	0	01	0	1	0	0	0	1	0	0	0	0	0	0
24	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
25	1	0	0	0	0	0	1	1	1	0	1	1	1	1	1	1	1	0
26	10	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
27	4	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0
28	4	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0
29	10	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
30	3	1	0	01	1	01	1	1	1	1	1	1	1	1	1	1	1	0
31	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
32	10	1	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0
33	10	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
34	4	0	0	0	0	0	0	1	1	0	0	1	1	0	1	0	0	0
35	3	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	4	0	1	1	0	1	0	0	1	1	0	0	1	0	0	0	0	0
38	10	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
40	10	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
41	10	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
42	10	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0
43	3	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
44	10	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
45	2	0	1	1	0	1	0	0	1	1	0	0	1	1	1	1	1	1
46	10	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0
47	10	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	10	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	10	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0

8. First instar larva with modified posterior end; with inflated, ventral vesicles or terminal, sac-like lobes. [The use of this character state depends on whether or not the inflated vesicles and sac-like lobes can be considered homologous, as discussed (and accepted) by Pape (1986a).]

Table 4. Character states and weights for clades 26-42 in fig. 10

		Node																
		26	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*	*35*	*36*	*37*	*38*	*39*	*40*	*41*	*42*
Char	Wght																	
0	5	1	1	1	1	1	1	1	1	2	2	1	1	2	1	2	1	0
1	4	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0
2	10	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0
3	10	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
4	10	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0
5	0	1	1	01	1	01	1	0	01	1	1	0	01	1	0	1	0	0
6	0	1	1	0	1	0	01	0	01	1	01	0	01	01	0	01	0	0
7	4	1	1	0	1	0	1	0	0	1	1	0	0	1	0	1	0	0
8	1	1	1	01	1	01	1	0	01	1	1	0	01	1	0	1	0	0
9	10	1	1	1	1	1	1	1	1	2	2	1	1	2	1	2	1	0
10	2	0	01	0	01	0	01	2	01	1	12	2	1	1	1	1	1	0
11	10	1	1	1	1	1	1	1	1	0	0	1	1	0	1	0	0	0
12	0	1	1	1	1	1	1	1	1	01	01	1	1	01	1	01	01	0
13	10	2	2	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1
14	10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
15	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
16	10	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0
17	10	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0
18	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
20	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	01
21	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
22	5	3	3	3	3	3	3	2	3	4	4	1	1	4	1	4	014	0
23	1	0	0	1	0	1	0	0	0	01	1	0	0	01	0	0	0	0
24	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
25	4	0	0	1	1	1	1	1	1	0	0	1	1	0	1	0	0	0
26	10	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0
27	4	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0
28	4	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0
29	10	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
30	3	1	1	1	1	1	1	1	1	0	01	1	1	01	1	01	01	0
31	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
32	10	1	1	1	1	1	1	1	1	0	0	1	1	0	1	0	0	0
33	10	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	2	0	0	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0
35	3	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	4	0	0	0	0	0	0	1	0	1	1	1	0	1	0	1	0	0
38	10	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0
39	1	0	0	1	01	1	01	0	01	0	0	0	01	0	0	0	0	0
40	10	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
41	10	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
42	10	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0
43	3	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
44	10	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
45	4	0	0	0	0	0	0	1	0	1	1	1	0	1	1	1	1	1
46	10	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0
47	10	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
48	10	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
49	10	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0

Sarcophagidae

With the convincing exclusion of *Eurychaeta* provided by Rognes (1986), the Sarcophagidae have emerged as a very well-corroborated monophyletic group, with the following probable apomorphies:

1. Abdominal sternite 2 overlapping margins of tergite 1+2 (22:3);
2. Alpha setae absent (23:1);
3. Bacilliform sclerites (divided male sternite 10) reduced and more or less perpendicular to the median plane (29:1);

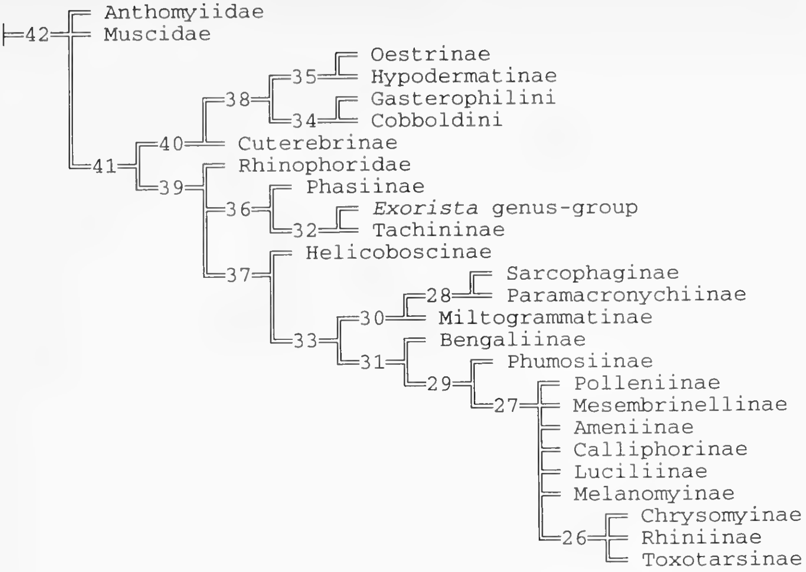

Fig. 10. Nelson consensus cladogram of 72 trees obtained from running the matrix in table 2 with Rhinophoridae scored for free tips of dorsolateral phallic processes. Weights and character states of nodes are given in table 4. For further explanation see text.

4. Uterus with a bilobed ventral pouch (35:1);
5. Progeny deposited as embryonated eggs or prehatched first instar larvae (39:1);
6. Peritreme of posterior spiracles of second and third instar larva incomplete and without a distinct ecdysial scar (43:1);
7. Posterior spiracles of second and third instar larva placed in a recession or cavity (44:1);
8. Parastomal bars of third instar larva present (45:0);
9. Median sclerotization of phallus reduced (o);
10. Dorsal cornu of third (and probably second) instar larval cephalopharyngeal skeleton with a posterior incision (t);
11. Prothoracic spiracular horn not protruding through puparium (v);
12. ß-alanyl-L-tyrosine ('sarcophagine') present in larval hemolymph (q).
    [The use of the presence of larval sarcophagine as an apomorphy corroborating the monophyly of the Sarcophagidae is, of course, tentative as too few records exist and especially as no Miltogrammatinae have been tested. But the almost total absence of this dipeptide from the non-sarcophagid calyptrates is strong evidence that the presence in the Sarcophagidae is derived, and testing one or more species of Miltogrammatinae may indicate whether this character state should be considered autapomorphic for the clade Paramacronychiinae + Sarcophaginae or for all of the Sarcophagidae.]

Some of the autapomorphic groundplan character states used by McAlpine (1989) to define the Sarcophagidae are not accepted here and should be discussed briefly: Coiled male accessory glands, sclerotized plate (sigma) in dorsal wall of uterus, looping of ovarian ducts and common oviduct, and reduced labral sclerite in the first instar larva, are states that define all or part of the subfamily Sarcophaginae. These states are not present in the Miltogrammatinae and Paramacronychiinae and should not be considered groundplan states for the family. Arista bare on at least apical half needs reconsideration as already discussed. If the sister group of the Sarcophagidae is the Tachinidae, a bare arista seems at least as probable for the hypothetical groundplan.

Tachinidae

The Tachinidae form a huge family and the species have diversified morphologically to an extent not seen in the other families of the Tachinidae family-group. However, apart from some species that are strikingly rhinophorid-like in adult morphology, like *Litophasia* Girschner, Tachinidae are easily recognized and they emerge as a well defined group of insect parasites. The few non-insect parasites with centipedes, spiders and scorpions as hosts (Wood 1987c,

Table 5. Character states and weights for clades 26-42 in fig. 11.

		Node																
		26	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*	*35*	*36*	*37*	*38*	*39*	*40*	*41*	*42*
Char	Wght																	
0	5	2	2	2	1	2	1	1	1	1	1	1	1	1	01	1	01	0
1	4	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2	10	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
3	10	0	0	0	0	0	0	0	1	0	1	0	0	01	0	0	0	0
4	10	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
5	1	1	1	1	0	1	0	1	1	0	1	0	0	0	0	0	0	0
6	1	1	1	1	0	1	0	1	1	0	1	0	0	0	0	0	0	0
7	4	1	1	1	0	1	0	0	1	0	1	0	0	1	0	0	0	0
8	2	1	1	1	0	1	0	1	1	0	1	0	0	0	0	0	0	0
9	10	2	2	2	1	2	1	1	1	1	1	1	1	1	1	1	1	0
10	4	1	12	1	2	1	2	1	0	1	01	0	1	01	0	01	0	0
11	4	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	1	0
12	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
13	10	1	1	1	1	1	1	1	2	1	2	1	1	2	1	1	1	1
14	10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
15	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
16	10	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
17	10	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
18	10	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
19	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
20	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	01
21	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
22	5	4	4	4	2	4	1	1	3	1	3	3	1	3	3	3	3	0
23	1	01	1	01	0	0	0	0	0	0	0	1	0	0	1	0	0	0
24	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
25	1	0	0	0	1	0	1	1	0	1	0	1	1	0	1	01	01	0
26	10	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	4	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
28	4	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
29	10	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
30	3	0	01	01	1	1	1	1	1	1	1	1	1	1	1	1	1	0
31	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
32		Omitted																
33	10	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
34	2	0	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	0
35	3	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	10	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
38	10	1	1	1	0	1	0	01	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
40	10	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
41	10	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
42	10	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
43	3	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
44	10	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
45	2	1	1	1	1	1	1	1	0	1	0	0	1	0	0	0	0	0
46	10	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
47	10	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	10	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0

Williams et al. 1990), have most probably evolved from insect parasites.

The following character states are here recognized as tachinid synapomorphies:

1. Subscutellum greatly swollen (10:2);
2. Ventral surface of egg glued to substrate (37:1);
3. Mandible of first instar larva reduced to an ill-defined sclerotization on side of mouth opening (40:1);
4. First instar larva with labrum firmly fused to, and contiguous with remaining cephalopharyngeal skeleton (41:1);

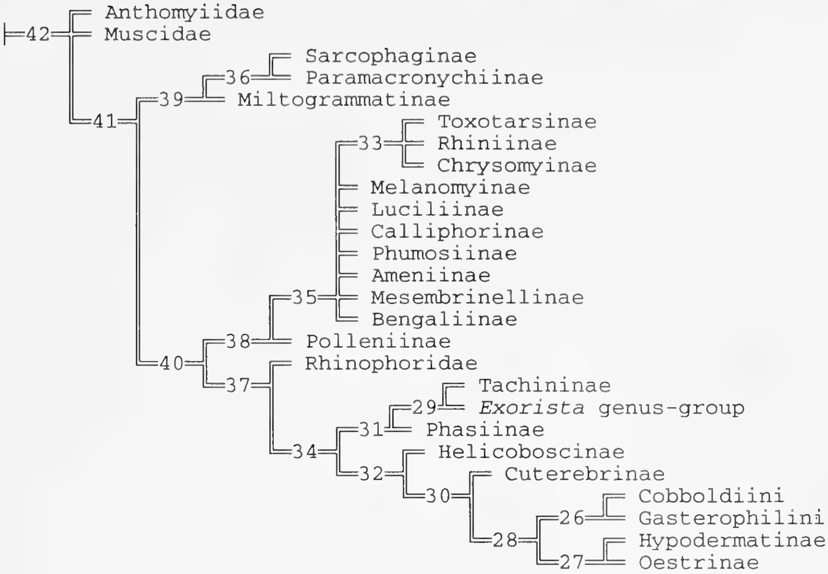

Fig. 11. Nelson consensus cladogram of 14 trees obtained from running the matrix in table 2 without character 32. Weights and character states of nodes are given in table 5. For further explanation see text.

5. Anterior malpighian tubules shortened in adults (f);
6. Testes pyriform (m).

Calliphoridae

The blowflies have generally been recognized among members of the Tachinidae family-group by exclusion of the more easily defined remaining families, and Griffiths (1982) concluded that no convincing evidence corroborated the possible monophyly of the Calliphoridae. Hennig (1973: 69) even mentioned that the Calliphoridae could be paraphyletic ('vielleicht eine paraphyletische Gruppe'). In the present analysis the Calliphoridae emerge as monophyletic, corroborated by the following character states:

1. Phallus with free tips of dorsolateral processes (32:1);
2. Parastomal bars present (45:0).

As already discussed, teeth or spines apically on the free apices of dorsolateral processes may be another synapomorphy (character p), but as long as both the toothed and the non-toothed condition occur widely, an assessment of the groundplan state within each of the terminal taxa requires a better knowledge of the distribution of both states as well as of generic phylogeny.

It is noteworthy that the metallic coloration of the integument cannot be considered apomorphic at the level of the Calliphoridae. Either this character state is synapomorphic for Calliphoridae and Oestridae, or it will define a subgroup of Calliphoridae, i.e. by exclusion of at least the Helicoboscinae.

McAlpine (1989) mentioned several tentatively apomorphic character states, but most of these need reconsideration. A coprophagous larval food habit is hardly 'autapomorphic' in the Calliphoridae, and even McAlpine himself did not really believe this as he used this state to corroborate the monophyly of his clade Calliphoridae + Mystacinobiidae + Sarcophagidae. It is worth noting that coprophagy in the Calliphoridae may not be plesiomorphic either, as none of the basal calliphorid lineages in the present cladogram (fig. 8) are typical coprophages. Rognes (1991: 27) is of the opinion that blowflies 'primitively ... lay their eggs on the exposed dead bodies of various animals, especially vertebrates, irrespective of size', but I find it very likely that the groundplan calliphorid breeding strategy was one of small-carrion-exploitation, e.g. dead invertebrates (especially snails) and small vertebrates. This is in agreement with the arthropod and mammal parasitism of the Rhinophoridae, Tachinidae and Oestridae, which has to have evolved from a non-parasitic life habit. The hypothetical ancestors of these taxa could easily have preferred small carrion: invertebrates for the

Rhinophoridae and Tachinidae, rodents for the botflies. 'Thoracic spiracles large' is closely connected to the size of the fringes, which has been discussed in detail above (character 13: state 2). Whether or not large size of spiracle (or anterior fringe) belongs to the groundplan of the Calliphoridae depends on the position of the Helicoboscinae. The 'posterior thoracic spiracle occluded by ... complex shutters' is obviously a groundplan feature of all of the Tachinidae family-group, as was correctly stated by Crosskey (1977: 8), although this author did not mention the Oestridae. 'Arista plumose' needs a more accurate scoring, but may well be synapomorphic with the Oestridae. Position of female abdominal spiracle 7 needs further consideration through scoring of more species from what may be considered basal lineages, and the presence of 'anal lobes' in the male perianal membrane may belong to the groundplan of the Tachinidae family-group. Other groundplan features have been discussed above.

Calliphoridae + Oestridae

1. Prosternum setose (5:1);
2. Proanepisternum setose (6:1);

[3. Postalar wall setose (7:1);]

4. Metasternum setose (8:1).

The third character state is given in brackets as its status as a synapomorphy for Calliphoridae and Oestridae is uncertain. The bare and the setose states are equally likely for the groundplan of this clade. It may, perhaps, be argued that an independent origin of setae on this surface is less likely than independent reductions.

Sarcophagidae + Tachinidae

1. Phallic dorsolateral processes fused (34:1).

Fused dorsolateral processes were used by Pape (1987a: 11) to corroborate the monophyly of the Sarcophagidae, but Tschorsnig (1985b) argued convincingly that the dorsal (or posterior) phallic sclerotization so common and widespread in the Tachinidae is homologous to fused dorsolateral processes. The character state will therefore indicate phylogenetic relationship.

Rhinophoridae + (Calliphoridae + Oestridae)

1. Subscutellum slightly swollen (10:1).

This synapomorphy is, of course, highly dependent on the scoring of subscutellar states, as will be discussed in more detail below.

Tachinidae family-group

Only two outgroups were used in the present study, Anthomyiidae and Muscidae. As these may be part of a separate clade, the Muscoidea of McAlpine (1989), the present analysis cannot give a reliable estimate of whether ground plan character states at the level of the Tachinidae family-group are apomorphic or plesiomorphic. Therefore, the states listed below as probably synapomorphic for members of the Tachinidae family-group may be tested when a more detailed phylogeny of all of the Calyptratae becomes available. However, in my opinion none of the states listed below can be ascribed to the groundplan of any non-tachinoid family of Calyptratae.

1. Postocular setae of alternating size (0:1);
2. Meron with row of setae (9:1);
3. Anatergite with setulae (11:1);
4. Metathoracic spiracle with divided (opercular) fringe (12:1);
5. Anepimeron with setae (14:1);
6. Vein M with a distal angular bend (15:2);
7. Vein R_{4+5} setose basally (20:1);
8. Lower calypter broad and following scutellum for considerable distance (21:2);
9. Abdominal sternite 2 contiguous with or slightly overlapped by margins of tergite 1+2 (22:1);
10. Spermathecal ducts join uterus separately (25:1);
11. Gonostylar apodeme present (30:1);
12. Phallus with denticles along the ventral surface of distiphallus (31:1).

Mystacinobia

The single New Zealand species of this peculiar taxon, *M. zelandica* Holloway, is highly adapted to living in bat roosts and the morphology leaves few apparent clues to phylogenetic relationships. Originally described as a distinct family Mystacinobiidae belonging to the Drosophiloidea (Holloway 1976), Griffiths (1982) argued convincingly for an inclusion in the Tachinidae family-group and proposed synonymization with the Calliphoridae although no synapomorphic character states with this family were suggested. Kurahashi (1989) accepted an assignment to the Calliphoridae and put *Mystacinobia* in a subfamily of its own.

McAlpine (1989: 1500) recognized an affinity between *Mystacinobia* and the Calliphoridae but endorsed family rank for the genus because it possesses 'many autapomorphies in all stages .... that set it apart from all Calliphoridae' – in my opinion a little convincing argument. Furthermore, McAlpine's cladogram (Mcalpine 1989: fig. 116.8) corroborated the monophyly of the non-mystacinobiine blowflies (his Calliphoridae) by listing the synapomorphies 1) first larval instar without paired mandibles, 2) arista plumose, and 3) testes enveloped in fat body. The first state was based on Hennig (1973) and is erroneous as already mentioned. The second apomorphy is dubious and actually contradicted by McAlpine himself on p. 1501, where he stated that a plumose arista is present in the calliphorid + sarcophagid groundplan. The third synapomorphy is hardly more convincing as no mention is made of the actual distribution of this character state, and Hori (1960), who first used this character, examined only very few representatives of Calliphoridae. Even if fresh or properly preserved specimens of *Mystacinobia* were examined by McAlpine, we are still in need of data from many other members, especially from the Oestridae and Rhinophoridae, and from possibly basal calliphorid lineages like the Helicoboscinae. McAlpine listed more calliphorid autapomorphies in the text (p. 1499), but none of these will corroborate a separate family status for *Mystacinobia*. The non-mystacinobiine calliphorids cannot be defined by being coprophagous when their sister group is stated to be 'living in [bat] guano' (p. 1500) and when coprophagy is listed as a groundplan feature of Sarcophagidae + Mystacinobiidae + Calliphoridae (fig. 116.8).

Indeed, *Mystacinobia* is highly aberrant, and as only a single species is involved, monophyly as such is irrelevant. A list of autapomorphic character states is given by McAlpine (1989) and needs not be discussed here. Griffiths (1982) gave three character states of *Mystacinobia* that will corroborate its assignment to the Tachinidae family-group: 1) 8th sternite of female entire, 2) phallus with denticles on ventral surface of distal section, and 3) meron with row of setae below metathoracic spiracle. To these could be added the presence of anepimeral bristles (character 14 in the discussion above). Many more characters are involved in the definition of the Tachinidae family-group, but several of these are wing-characters and therefore inapplicable, which probably holds also for the infrasquamal setulae (character 11). Thus, only four characters need a comment. Postocular setae are hardly recognizable in *Mystacinobia*, and the great reduction in eye-size and the deviating head-shape makes this character inapplicable. Abdominal sternites, in their degree of exposition, may be more like the condition found in the Oestridae than that of any other taxon here considered, and it is thus perfectly possible – even probable – that it is derived relative to the groundplan of the Tachinidae family-group. The small metathoracic spiracle of *Mystacinobia* has no fringe at all, and could thus easily be considered as derived from any of the conditions found in the Calyptratae. Moreover, it is almost to be expected that a flightless species living in the constantly damp atmosphere of a bat roost should show modified metathoracic spiracles, as this is one of the major sites for loss of water in a flying calyptrate fly. Finally, no gonostylar apodeme is present, and this may in itself be taken as evidence of a sister group relationship with the remaining Tachinidae family-group. However, other reductions are present in the male copulatory apparatus, e.g. small gonocoxites and absence of epiphallus, and it seems somewhat premature to assign familial status to *Mystacinobia* – not to mention a sister group relation to the (remaining) Tachinidae family-group – based exclusively on this sparse evidence.

With regard to familial affinities, an inclusion within any of the Oestridae, Rhinophoridae, Sarcophagidae and Tachinidae seems highly improbable as this would imply that *Mystacinobia* should have lost the numerous character states defining these clades. Also, I have no convincing evidence that *Mystacinobia* should belong to any subfamilial clade within any of these families. Inclusion within the Calliphoridae cannot be corroborated either. *Mystacinobia* does not possess any of the two character states here listed as synapomorphies for the Calliphoridae, namely parastomal bars and free tips of dorsolateral phallic processes, and there is no obvious calliphorid subfamily with which it could be affiliated. Still, however, the spermathecal ducts are of the 'two fused' condition (see character 25 above), which is absent from all of Rhinophoridae, Sarcophagidae and Tachinidae. In the present analysis this character defines a large subgroup of the Calliphoridae, namely all subfamilies except Helicoboscinae and Bengaliinae.

The dorsolateral processes are fused as in the clade Sarcophagidae + Tachinidae and as in the Rhiniinae of the Calliphoridae. However, no other evidence favours an inclusion in either of these groups, and no member of the Rhiniinae has yet been reported from New Zealand (Dear 1985).

I have not included *Mystacinobia* in the analysis at the present state of knowledge. A strict scoring would hardly give a reliable result and would rather interfere with the not too stable phylogeny presented. Therefore, I will simply consider *Mystacinobia* as a genus (and species) incertae sedis within the Tachinidae family-group. Until a better corroborated hypothesis for the inclusion within one of the existing taxa, or for a sister group relationship to one or more of the other families is available, I prefer to avoid using a family group name to accommodate the species.

Discussion

An interesting – although hardly surprising – result of the present analysis is that the monophyly of all families except the Calliphoridae is well corroborated.

The monophyly of the Calliphoridae is supported by few, and perhaps not very convincing synapomorphies, and the family may even come out as polyphyletic with regard to the Helicoboscinae under certain circumstances, which are discussed below. Also interesting is the surprisingly few derived character states that define suprafamilial clades, and it is noteworthy that none of these states have been used previously in corroborating inter-familial phylogenetic relationships. We simply have no conclusive evidence on any sister group relationship at the family level within the Tachinidae family-group. As a consequence of this limited evidence, of course, the cladogram favoured here is far from stable. Reinterpretations of characters and/or the addition of new characters by future students are highly encouraged to test the present hypothesis.

In the Calliphoridae, presence of parastomal bars is a very consistent character state in the sense that homoplasic occurrences are virtually non-existent. I know of no calliphorid larva without parastomal bars in the third instar, except for *Mystacinobia* if evidence can be found that corroborates an inclusion in the Calliphoridae. Parastomal bars do not occur at all in the Tachinidae, Rhinophoridae and Oestridae. It is interesting, however, that presence of parastomal bars generally has been considered plesiomorphic in the Calyptratae, e.g. by McAlpine (1989).

The free tips of dorsolateral phallic processes was used by Rognes (1986, 1991) to unite the Rhinophoridae and the Calliphoridae; with the Rhinophoridae as a subfamily, but not necessarily as a sister group of the remaining Calliphoridae. As already discussed, I have been unable to score the groundplan of the Rhinophoridae for this character, which in combination with its inapplicability with regard to the Sarcophagidae and Tachinidae (see below) really leaves it with very limited diagnostic power in the present analysis. Thus, it is interesting to note that if the Rhinophoridae are scored for free tips of phallic dorsolateral processes in the matrix (i.e. Rhinophoridae are scored for 1 in character 32 of table 2), and if this is run as discussed above (outgroup = 0.1;cc-10,15,22,39;mh*;bb*;xsteps w; etc.), the resulting consensus tree will depict the Oestridae as the sister group to the remaining Tachinidae family-group and the Helicoboscinae as the sister group of a clade Sarcophagidae + non-helicoboscine Calliphoridae (fig. 10). Scoring the Rhinophoridae for the alternative state; namely dorsolateral processes confluent with phallic wall (0 in character 32 of table 2), has no impact on the configuration of the resulting Nelson consensus tree.

The clade Calliphoridae + Oestridae is corroborated by three character states with the possible addition of a fourth. These states are presence of setae on well-defined thoracic surfaces, which have been used widely in the diagnosis of the Calliphoridae. They have probably been overlooked or neglected in the Oestridae because of the long, dense hairs, which tend to conceal the thoracic sclerites.

Only one character state, the fusion of phallic dorsolateral processes, corroborates the monophyly of the clade Tachinidae + Sarcophagidae. This fusion complicates the assessment of at which level in the cladogram the free-tipped dorsolateral processes are apomorphic. I have argued that the dorsomedian fusion of these phallic sclerotisations makes a scoring for presence/absence of free tips inapplicable. With the condition in the Rhinophoridae being uncertain, this will imply that the possibility of free tips being a groundplan state of the Tachinidae family-group cannot be excluded. In the analysis, this would be equal to omitting this character (outgroup = 0.1;cc-10,15,22,39;cc]32;mh*;bb*;xsteps w; etc.). This results in the Sarcophagidae being the sister group to the remaining Tachinidae family-group and the Calliphoridae become polyphyletic as the Helicoboscinae move to a sister group position of Oestridae (fig. 11).

The monophyly of the clade Rhinophoridae + Calliphoridae + Oestridae is corroborated by a single character state: presence of a slightly swollen subscutellum. This is indeed weak evidence as the present division of subscutellar shape in three states may be too simplified. Differences between the various types, however, are not easy to put on formal descriptive terms. If the slightly swollen subscutellum seen in the Rhinophoridae, the botfly subfamilies, and some of the calliphorid subfamilies are considered as derived independently in each terminal taxon, this character will have no effect on interfamilial phylogeny and could as well be excluded from the matrix. This exclusion (outgroup = 0.1;cc]10;cc-15,22,39;mh*;bb*;-xsteps w; etc.) results in a cladogram identical to that of fig. 10, with the Oestridae being the sister group of the remaining Tachinidae family-group. This will happen irrespective of how the Rhinophoridae are scored with regard to free or confluent tips of dorsolateral processes.

Even the ordering of the subscutellar states is open to discussion. As already discussed, I prefer to avoid ordering these states as I have no reason to consider the swollen condition of the Tachinidae to have arisen from a less swollen condition rather than from the concave condition. If, however, these states are put in a linear transformation series with increasing convexity (i.e. 0–1–2), and if all characters but 15, 22 and 39 still are treated as ordered (outgroup = 0.1;cc-15,22,39;mh*;bb*;xsteps w; etc.), the resulting cladogram will again put the Oestridae as the sister group to the remaining Tachinidae family-group (fig. 10).

These examples are excellent illustrations of the importance of character and transformation series interpretation.

It should be obvious from the discussion above that inter-familial phylogenetic relationships within the Tachinidae family-group still are open to considerable discussion. While the monophyly of the non-calliphorid tachinoids are becoming better and better corroborated we are still short of a satisfactory definition of the Calliphoridae. However, the main problem relates to the position of the subfamily Helicoboscinae (currently with the single genus *Eurychaeta*), as the large size of the metathoracic spiracle (or its fringe) provides a character state consistingly uniting all non-helicoboscine blowflies. It should also be emphasized that the present study is insufficient in the sense that several characters have been excluded from the analyses because of uncertainty with regard to their proper scoring. Presence in *Eurychaeta* of intrapostocular setulae and divided female abdominal tergites 7-8 (characters b, h) may provide important additional support for a monophyletic Calliphoridae when included.

What should be given high priority in future studies is a better definition of the Calliphoridae. Important information may be obtained through better definitions of subfamilies as well as through patterns of subfamilial relationships. Also the Rhinophoridae need a closer examination. Their definition relies heavily on larval characters, which are known for less than half the included genera, and our present ignorance of generic phylogenetic relationships for genera like *Bezzimyia* and *Malayia* makes groundplan estimates of certain characters ambiguous within this family.

Inclusion of additional outgroups will be a proper test of the hypothetical groundplan of the Tachinidae family-group outlined in this study. Thus, studies on the phylogenetic relationships of the non-tachinoid calyptrate families are needed, and if McAlpine's (1989) hypothesis of a monophyletic Muscoidea finds additional support, outgroup information should be obtained from the Hippoboscidae family-group and/or from the Acalyptratae.

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FEATHER MITES (ACARINA, XOLALGIDAE) IN THE UROPYGIAL GLAND TUFT OF *ARATINGA HOLOCHLORA* (SCLATER) (AVES, PSITTACIDAE)

Pérez, T. M. Feather mites (Acaria, Xolgidae) in the uropygial gland tuft of *Aratinga holochlora* (Sclater) (Aves, Psittacidae). – Tijdschrift voor Entomologie, 135: 87-90, figs. 1-6. [ISSN 0040-7496]. Published 15 July 1992.

The microhabitats for all stages of a new species of feather mite near *Fainalges longissimus* Mejía-González and Pérez, 1988 (Acarina, Analgoidea, Xolalgidae) on *Aratinga holochlora* (Sclater, 1859) (Aves, Psittacidae) are reported. Eggs are laid on the barbs of the eight modified down feathers of the uropygial gland tuft, moulting takes place within the quills of these feathers, and active instars inhabit the downy barbs of the tail coverts. The uropygial gland tuft for the host bird is briefly described.

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Key words. – Feather mite, Xolalgidae, parrot, Psittacidae, uropygial gland tuft.

Ontogenetic studies of astigmatid mites are limited. To add to the meager information on this subject, I am associating all instars of seven species of the feather mite genus *Fainalges* Gaud & Berla, 1964 (Xolalgidae) from field collected specimens of the green conure, *Aratinga holochlora* (Sclater), taken in Tamaulipas, Mexico.

The most demanding part of this and similar ontogenetic studies is to unequivocally associate feather mite larvae with their eggs. To do this, it is necessary to dissect fully developed larvae from their eggs for microscopic examination. In the *Fainalges* investigation, the larvae of six species had been identified and associated with their eggs, but the egg of a seventh larva, a new species near *Fainalges longissimus* Mejía-González & Pérez (1988) remained undetected until a small group of specialized feathers were examined, namely, the uropygial gland tuft. Herein, this specialized microhabitat and their acarine occupants will be described

MATERIALS AND METHODS

Uropygial gland papillae were taken from two frozen, field collected *Aratinga holochlora.* The tuft feathers were excised, the quills split lengthwise and the quill contents either mounted on SEM stubs or microslides. To obtain mature larvae for identification, eggs were taken from the barbs and opened, either on an SEM stub or in a small drop of Hoyers mounting medium. Thus, correlation of eggs and larvae were established. Additional specimens for ontogenetic studies were obtained from samples taken from approximately 30 museum study skins.

Dissections and measurements of the feathers were done with a dissecting microscope equipped with an ocular micrometer. Identification of the mite life stages was with a Wild-Heerbrugg M-20 phase contrast microscope and specimens for electron scanning microscopy were gold-coated and examined with an Amray 1000 SEM.

Uropygial gland papilla and associated feathers

The uropygial gland (oil gland, preen gland, rump gland) is positioned dorsomedially in the tail region of a bird. When present and functional, the bilobed gland is usually indicated by an elevation of the skin, the uropygial eminence, from which a terminal papilla arises; the papilla usually contains two ducts opening to the exterior at its tip. The papilla is variously shaped and may have a cluster of modified down or modified semiplumes, termed the uropygial gland tuft or circulus uropygialis, surrounding the openings of the uropygial gland ducts; the tuft feathers are in different numbers and arrangements according to group (Lucas & Stettenheim 1972, Jacob & Ziswiler 1982: table 1, Johnston 1988). Tuft feathers have unusually large quills and relatively short barbs when compared to typical down feathers.

In *Aratinga holochlora* the papilla is cylindrical (3.6

mm in length, 2.2 mm in diameter, N=1) and the uropygial gland tuft (barbs only, 7.9-9.4 mm, N=2) is arranged as a single oval of eight modified down feathers around the duct orifices. The tuft is saturated with uropygial gland secretions, but when degreased it resembles an airgun dart as all diverging barbs end at the same level (Type I of Johnston 1988). Each uropygial gland feather lacks a rachis and hyporachis (aftershaft), and the barbs arise directly from the upper rim of the calamus at the skin level (figs. 1, 2). The calamus (approximately 3.0 mm, N=12), completely embedded in the skin, is a tubular structure (fig. 1) filled with pulp caps. The eight quills form a rosette around the apex of the papilla. The distal end of the quill may represent the superior umbilicus, and as mites can enter, the umbilicus must be open. By being open, each quill probably contains uropygial gland secretions (sebum) and can provide a refuge for organisms unaffected by these secretions.

Fainalges and the uropygial gland tuft

When studying the biology of the seventh *Fainalges* species mentioned above, all active instars were observed on the down barbs of the tail coverts, but neither eggs nor exuviae were noted. In previous studies of the feather mites of parrots, it had been determined that for some mite species, different instars occur in different microhabitats (e.g. Pérez & Atyeo 1984, Atyeo & Pérez 1988). Therefore, the feathers above and below the tail coverts were examined, but again, neither eggs nor exuviae were discovered. The only feathers never examined were those of the uropygial gland tuft, a microhabitat that was never considered a viable candidate for mite habitation as it has been thought that the uropygial gland secretions inhibit parasites (e.g. Jacob & Ziswiler 1982). So, a tuft was excised and examined under a dissecting microscope. At the bases of the barbs and surrounding papillary skin, detritus could be seen, but under higher magnification, the 'detritus' consisted of masses of eggs, egg shells and exuviae. Eggs (fig. 2) and immatures were observed on the barbs. Furthermore, the eight quills of the tuft, examined through the translucent papillary skin, appeared dark brown, a color condition of quills containing feather mites.

Individual feathers and surrounding papillary tissue were removed and quills split longitudinally (fig. 1). Within each quill there was a compact plug of material which, when removed, revealed densely packed and haphazardly arranged exuviae, pharates and active stages for all immature instars partially covered with uropygial gland secretions (fig. 3).

The density of mites within a quill varied. When few mites were observed, limited numbers occupied the more distal interspaces between the pulp caps, up to 4/5 of the distal quill. Some quills were so packed with mite material that the pulp caps were no longer evident. These compact masses (plugs) always overflowed the quill interior, to form a mound of 'detritus' external to the quill proper. The lengths of the plugs varied from quill to quill in the same bird.

From 30 museum study skins and eight field collected *Aratinga holochlora*, the active stages of this new species have been known for four to five years, but neither oviposition nor moulting sites had not been described until now. On a related host species, the orange-fronted conure, *A. canicularis* (Linnaeus, 1758), the active instars of *Fainalges longissimus* were described from a single microhabitat, the downy barbs of the tail coverts (Mejía-González & Pérez 1988), but oviposition sites were not studied.

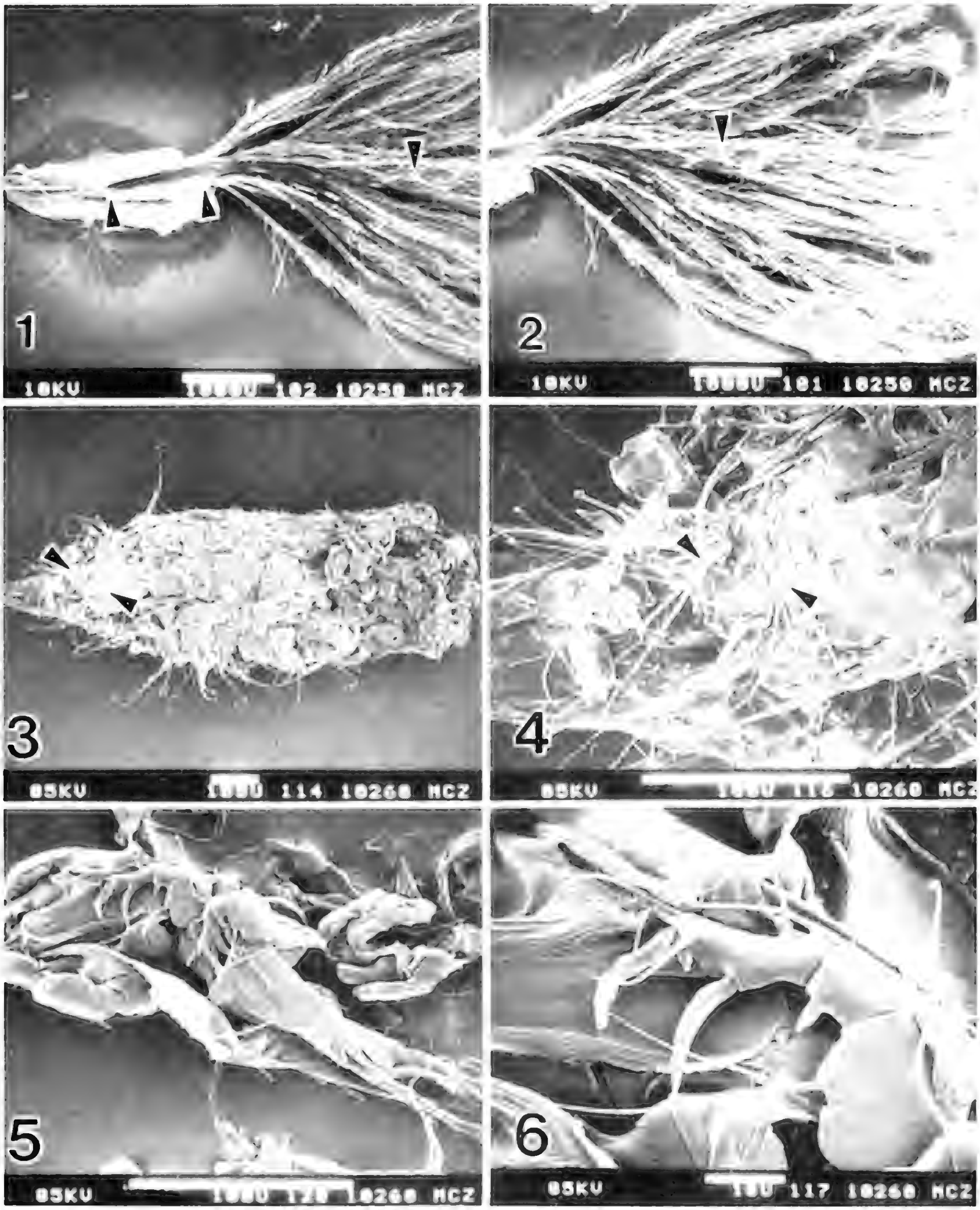
From the information obtained from mites of *Aratinga holochlora*, it was hypothesized that the uropygial gland tuft is the oviposition and ecdysial site for *Fainalges longissimus* and related species on other parrot taxa. For a preliminary test of the hypothesis, a tuft was removed from one specimen each of *Aratinga canicularis* and a related taxon, the Carolina parakeet, *Conuropsis carolinensis* (Linnaeus, 1758), which has been extinct since the 1920s.

Results

Each quill of the uropygial gland tufts examined from *Aratinga holochlora*, *A. canicularis* and *Conuropsis carolinensis* had at least small populations of *Fainalges* species in all tuft feather quills and many barbules had *Fainalges* eggs cemented to them. Each host species supported a different species of the *Fainalges longissimus* morphotype. This morphotype, as characterized by Mejía-González & Pérez (1988), has all instars with leaflike ventral setae on tarsi I and II (fig. 6), and in immatures and females, tarsi III and IV have many spinelike setae, minute ambulacral discs, and ambulacral stalks longer than the corresponding tibiae (fig. 4). *Fainalges longissimus* is associated with *Aratinga canicularis*, whereas *A. holochlora* and *Conuropsis carolinensis* each support a new species of the *F. longissimus* species complex.

Discussion

The probable scenario for these species of *Fainalges* is: females oviposit on bases of the barbs, the barbules of the tuft feathers (Fig. 2) and on the papillary skin; the emerging larvae move to the downy barbs of the tail coverts for feeding; and eventually go to a uropygial gland quill for moulting. Each successive instar has the same activity, that is, emerging from the quill, feeding, and then returning to the quill for ecdysis. Because of the out-of-quill sites for the active instars, it is assumed that the uropygial gland secretions with-



Figs. 1-6. Scanning electron micrographs. – 1, One uropygial gland feather embedded in papillary tissue cut along longitudinal axis (approximately 1/3 of quill cut off) to show interior of most of the calamus: two left arrows=area of quill from which plug (fig. 3) was removed (constriction of quill is artifact due to pressure while cutting), right arrow = *Fainalages* egg; 2, detail of uropygial gland feather with truncated barbs; arrow = *Fainalages* egg; 3, 'plug' of mites and exuviae removed from quill of fig. 1: arrows=legs III and IV of nymph; 4, enlargement of fig. 3: arrows=same legs in fig. 3; 5, exuviae emphasizing proterosomata; 6, enlargement of exuvial leg I of fig. 5 showing tarsal structures needed for morphotype identification. Scale bars: figs. 1, 2: 1000 μm; fig. 3: 200 μm; figs. 4, 5: 50 μm; fig. 6: 10 μm.

in the quill provide little or no nourishment, and also that the secretions have no deleterious effect(s) on the mites or their eggs.

Three questions need to be addressed: Is there a relationship between the moult of the uropygial gland tuft feathers and populations of feather mites? Does preening reduce the mite populations of these mites? Do undiscovered species of the *Fainalges longissimus* morphotype have the same modus operandi vis-a-vis oviposition and moulting sites?

The literature does not specifically answer the question of whether or not the old gland feathers moult. Even so, it is assumed that these feathers do moult as populations of mites within the quills vary, which also suggests that these feathers moult at different times.

The previously reported microhabitats of feather mites on the external feather surfaces relate to the channels created by adjacent barbs, usually on the ventral feather surfaces (e.g., Dubinin 1951, Atyeo & Pérez 1988). Thus, these mites live in a three-dimensional space bounded by ramal walls laterally and barbules dorsally or ventrally; this space affords protection from the bills of preening birds.

Depending on the type of uropygial papilla, sebum for preening is obtained by various methods, 'either directly from the drops passing out of the [gland] orifices or by drawing away the fluid from the tuft circlet feathers' (Jacob & Ziswiler 1982: 252). As regards the uropygial gland tuft in *Aratinga* species, these parrots probably '...take the sebum by brushing its beak along the tuft whenever it needs it' (Jacob & Ziswiler 1982: 252). With this suggested type of preening, it is doubtful that many mite eggs or active instars would be dislodged or destroyed.

Do species related to *Fainalges longissimus* oviposit and ecdyse in the uropygial gland feather quills? The genus *Fainalges* has never been revised, however, distinct morphotypes are known (Mejía-González & Pérez 1988). The *F. longissimus* type, restricted to New World parrots, was characterized as having all instars with leaflike ventral setae of tarsi I and II (fig. 6), and in immatures and females, pretarsi III and IV (fig. 4) with many spinelike setae, minute ambulacral discs, and ambulacra longer than the corresponding tarsi (Mejía-González & Pérez 1988). The *F. longissimus* morphotype is now known from three species of the Aratinginae (sensu Wolters 1975), therefore, it is probable that this morphotype will be found on other New World Aratinginae, and possibly on other parrots with tufted uropygial gland feathers.

ACKNOWLEDGEMENTS

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WATER MITES FROM NEW SOUTH WALES AND QUEENSLAND, AUSTRALIA (ACARI, HYDRACHNELLAE)

Smit, H., 1992. Water mites from New South Wales and Queensland, Australia (Acari, Hydrachnellae). – Tijdschrift voor Entomologie 135(1): 91-112, figs. 1-74. [ISSN 0040-7496]. Published 15 July 1992.

One new subgenus of the genus *Unionicola*, viz., *Australionicola*, and ten new species, viz., *Hydrachna palustris*, *Aspidiobates unidorsalis*, *Kallimobates cooki*, *Unionicola hammeni*, *Unionicola davidsi*, *Recifella pectinatus*, *Koenikea purpurea*, *Albia brokenensis*, *Arrenurus roobeeki*, *Arrenurus vanderpalae* are described from New South Wales and Queensland, Australia. *Limnesia trituberculata* is considered a junior synonym of *Physolimnesia australis*. In addition, descriptions are provided of the opposite sex of various species known from one sex only. An annotated list is given for all species recorded during this study.

H. Smit, Emmastraat 43-a, 1814 DM Alkmaar, The Netherlands

Key words. – Water mites, Australia, new species.

Cook (1986) is the most comprehensive work on Australian water mites published so far. Of 263 species treated by him, 203 were described as new. Since then various studies of Australian water mites were published by Harvey (1987, 1988a-c, 1989a-b, 1990a-d), Harvey & Cook (1988), and Smith & Harvey (1989), all dealing with a limited number of genera or families.

During a trip to New South Wales and Queensland in the austral winter of 1989, the present author was able to collect water mites at 46 locations, including lentic as well as lotic habitats. The material was collected by using a dip net and preserved in Koenike's solution. All material, including the holotypes, is deposited in the collection of the Institute of Taxonomic Zoology of the University of Amsterdam (Zoological Museum). Localities are summarized in appendix 1.

SYSTEMATIC PART

The terminology of Cook (1974) is followed for the description of the species. For a number of species (especially the genera *Flabellifrontipoda*, *Frontipoda* and *Oxus*), without external sexual characters, the sex has not been determined when not necessary for identification.

Hydrachna Müller

Hydrachna palustris sp. n.
(figs. 1-5)

Type material. – Holotype male: Hasties Swamp, Queensland (loc. 28). – Paratype: Hasties Swamp, Queensland, 1 ♀ (loc. 28).

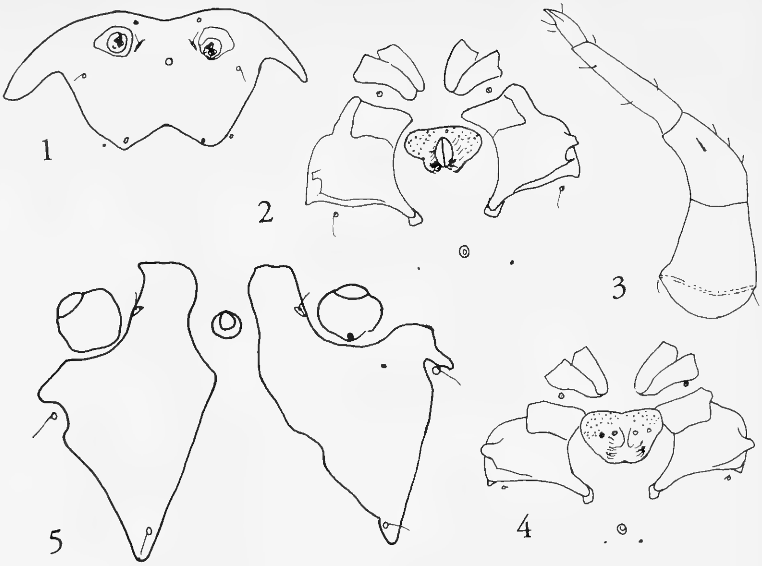
Description

Male: Body 1800 μ in length and 1704 μ in width. Integument papillate. Dorsum with one large plate, the anterior portions extending laterally. Pre- and post-ocularia and one pair of glandularia are incorporated in dorsal plate; eyes outside dorsal plate. Posteromedial portions of fourth coxae long and narrow, apodemes of fourth coxae short. Dorsal lengths of palp segments: PI 204 μ, PII 173 μ, PIII 238 μ, PIV 82 μ, PV 41 μ.

Female: Body 1824 μ in length and 1584 μ in width. Integument papillate. Dorsum with two large, broad plates, extending anteriorly of eyes; posterior portion of dorsal plates triangular. Pre-ocularia and one pair of glandularia incorporated in dorsal plate. Posteromedial portions of fourth coxae long and narrow, apodemes of fourth coxae short. Dorsal lengths of last four palp segments: PII 184 μ, PIII 252 μ, PIV 84 μ, PV 48 μ; PIII stockier than that of male.

Etymology. – The species is named after its occurrence in a swamp.

Discussion. – The long and narrow posteromedial portion of the fourth coxae and the form of the dorsal plates are diagnostic. As stated by several authors (e.g. Cook 1974), subgeneric classification of the genus *Hydrachna* is somewhat arbitrary. The *H. palustris* male could be assigned to the subgenus *Hydrachna*, but the female shows the characters of *Diplo-*



Figs. 1-5. *Hydrachna palustris* sp. n. – 1, dorsal plate ♂; 2, ventral view ♂; 3, palp ♂; 4, ventral view ♀; 5, dorsal plates ♀ (figs. 1-3 holotype).

hydrachna. For this reason no subgeneric assignment is given here for *H. palustris*.

Hydrachna (*Rhabdohydrachna*) *approximata* Halik, 1940

The species has been reported before from West Australia and Victoria (Halik 1941).

Material examined. – New South Wales: 1 ♂, loc. 43.

Hydrachna sp.

Lundblad (1941) described *Hydrachna lateriscuta*, but later (1948) placed this species into synonymy of *Hydrachna bilobata* Halik. Cook (1986) found his specimens of *H. bilobata* to be in good agreement with Halik's type material, but discovered differences between the material described by Lundblad (1948) as *H. bilobata* and his own (and thus Halik's) material of that species. Cook (op. cit.) thus suggested that *H. lateriscuta* Lundblad is a distinct species. Three female *Hydrachna* specimens collected in the present study agree with the description of the female of *H. bilobata* presented by Lundblad (1948) and Cook (1986) and tentatively considered as *H. lateriscuta* by Cook. As no males were found, the three females are left unnamed until the taxonomy of the species concerned is better understood. The three specimens are larger than the female collected by Cook. Body length varies from 2280 to 2424 μ. Measurements of dorsal plates (length/width) are also larger, 816/1080 μ; 768/1008 μ and 840/1008 μ respectively.

Material examined. – Queensland: 1 ♀, loc. 19; 1 ♀, loc. 22; 1 ♀, loc. 28.

Eylais Latreille

Australian *Eylais* species were described by Rainbow (1906), Lundblad (1948), Szalay (1953) and Viets (1980). As the variation in morphological characters is rather extensive, taxonomical problems within the genus *Eylais* remain. Lundblad (1948) stated that (in translation) 'the Australian *Eylais*-species seem to vary highly like everywhere in the world, and it is difficult to find two specimens which are completely alike'. Nothing is known about the variation of the Australian species, and it seems to me that a number of species are based on highly variable characters, e.g. the eye-bridge. A revision is required and therefore no effort is made here to describe the material taken during this study.

Material examined. – New South Wales: 1, loc. 1; 1, loc. 10; Queensland: 7, loc. 39; 15, loc. 37; 1, loc. 36.

Hydryphantes Koch

Hydryphantes (*Polyhydryphantes*) *haliki* Cook, 1986

Cook (1986) described this species from a pond in Queensland.

Material examined. – New South Wales: 1 ♀, loc. 46.

Pseudohydryphantes Viets

Pseudohydryphantes aroona Harvey, 1988 (figs. 6-10)

The species is known from the holotype only, a male collected in a stream in Victoria. The specimen in this study is a female, and a description is given below.

Female: Body 902 μ in length and 630 μ in width, lateral side of body undulating. Integument papillate. Dorsally with 6 pairs of dorsoglandularia and 5 pairs of lateroglandularia; sclerites associated with glandularia crescent shaped. Lateral eyes on ocular tubercles. Median eye between dorsoglandularia 2 on a small sclerite. Chelicera of normal size, each with a number of short teeth. Ventrally with 5 pairs of ventroglandularia. Coxae in four groups, tips of first, second and third with thickened setae. Three pairs of acetabula, two anterior pairs elongate and third pair of acetabula rounded. Genital flaps with long setae on mesal edge; genital field 184 μ in length. Dorsal lengths of palp segments: PI 46 μ, PII 91 μ, PIII 62 μ, PIV 139 μ, PV 34 μ; PIII with convex dorsal and ventral margins. Dorsal length of leg segments: I-leg-1 60 μ, I-leg-2 79 μ, I-leg-3 89 μ, I-leg-4 127 μ, I-leg-5 151 μ, I-leg-6 156 μ; IV-leg-1 120 μ, IV-leg-2 98 μ, IV-leg-3 130 μ, IV-leg-4 211, IV-leg-5 214 μ, IV-leg-6 175 μ. Legs III and IV with swimming setae. Claws without serrations, but with a short dorsal tooth.

Discussion. – The enlarged sclerotisized rings surrounding the median eye, preocularia and postocularia, the crescent shaped dorsoglandularia sclerites and the position of the median eye between dorsoglandularia 2 are diagnostic for the species. The palp of the female is stockier compared with the male.

Material examined. – Queensland: 1 ♀, loc. 33

Diplodontus Dugès

Diplodontus haliki Lundblad, 1948

This species probably has a widespread distribution in Australia; it has been reported from Tasmania, Victoria and New South Wales (Lundblad 1948, Cook 1986).

Material examined. – New South Wales: 1 ♀, loc. 43.

Mamersa Koenike

Mamersa corndorl Harvey, 1988
(figs. 11-13)

Previously reported from the Northern Territory.

Material examined. – Queensland: 1 ♂, 1 ♀, loc. 28.

Hydrodroma Koch

Hydrodroma spec A **Cook, 1986**

Cook (1986) suggested that *H. despiciens* could be divided into morphologically similar but distinct species. I have compared the Australian material with European specimens, and it is indeed difficult to find any marked differences. As with Cook, the species was found in ponds in Queensland.

Material examined. – Queensland: 1, loc. 17; 3, loc. 21; 3, loc. 25; 18, loc. 32; 1, loc. 36; 3, loc. 39; 1, loc. 46.

Hydrodroma spec B **Cook, 1986**

This species is characterized by the reduced number of swimming setae. This species occurred only in lotic habitats, but Cook (1986) also found it in lentic habitats.

Material examined. – Queensland: 3, loc. 18; 1, loc. 23; 5, loc. 33; 2, loc. 35.

Flabellifrontipoda Lundblad

Flabellifrontipoda pectinata Lundblad, 1948

This species has a widespread distribution in Australia; it is reported from Tasmania to Queensland.

Material examined. – Queensland: 4, loc. 18.

Flabellifrontipoda carteza Cook, 1986

The species is known from the holotype only, a female collected in a stream in Queensland. The specimen collected in this study is also a female. It is larger than the holotype, 776 μ in length and 630 in height. Dorsal lengths of palp segments: PII 57 μ, PIII 60 μ, PIV 84 μ, PV 14 μ.

Material examined. – Queensland: 1 ♀, loc. 18.

Frontipoda Koenike

Frontipoda spinosa Viets, 1977

Viets (1977) described this species from Lake Eacham. It was recollected there, and also from the nearby Lake Barrine.

Material examined. – Queensland: 1, loc. 29; 2, loc. 31.

Frontipoda tasmanica Viets, 1978

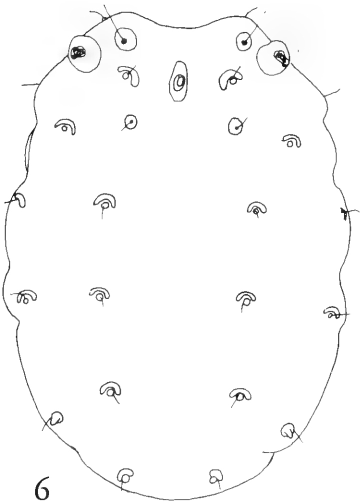
A species previously reported from Tasmania and New South Wales.

Material examined. – Queensland: 4, loc. 16.

Oxus Kramer

Oxus meridianus (Lundblad, 1948)

Previously reported from Tasmania.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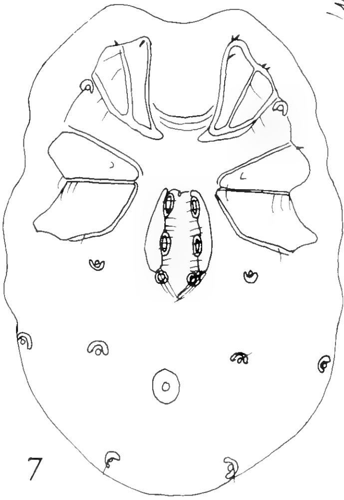
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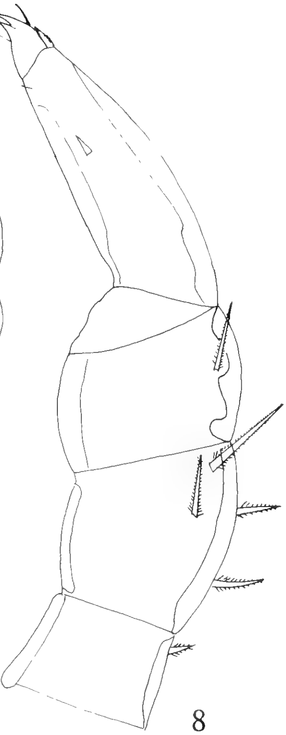
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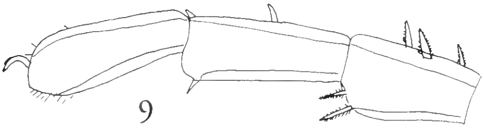
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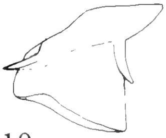
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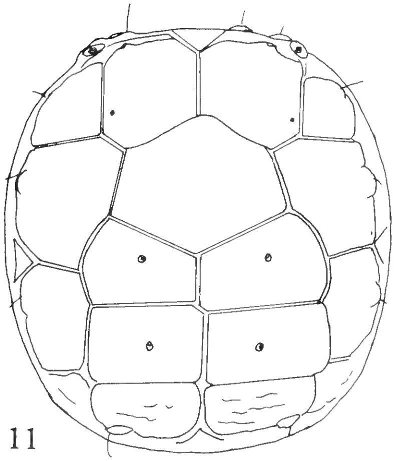
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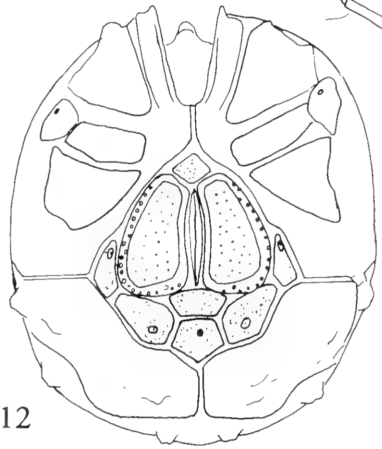
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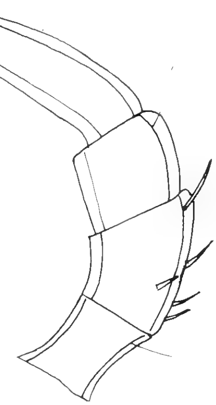
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Figs. 6-10. *Pseudohydryphantes aroona* Harvey. – 6, dorsal view ♀; 7, ventral view ♀; 8, palp ♀; 9, first leg ♀; 10, lateral view capitulum and chelicera ♀. – Figs. 11-13. *Mamersa corndorl* Harvey.– 11, dorsal view ♀; 12, ventral view ♀; 13, palp ♀.

Material examined. – New South Wales: 1, loc. 1; 4, loc. 6; 4, loc. 10. Queensland: 1, loc. 18; 2, loc. 15.

Oxus orientalis Walter, 1915

With the exception of being larger, the specimens collected agree with the description by Cook (1986). Males vary from 795-863 μ (Cook: 684 μ), females from 863-1392 μ (Cook: 851-972 μ). The male from New South Wales is 688 μ in length. The specimens of Walter (1915) measure 1500 and 1050 μ. Cook (op. cit.) collected only one male and two females, apparently small specimens. Males and females differ in length of the long seta on tip of IV-leg (up to 120 μ in length), and in the form of the coxae near the genital field.

The species was described from New Caledonia.

Material examined. – New South Wales: 1 ♂, loc. 10. Queensland: 5 ♂, 14 ♀, loc. 21; 2 ♀, loc. 25; 1 ♂, loc. 32; 1 ♂, loc. 31.

Physolimnesia Halik

Physolimnesia australis Halik, 1940

Limnesia trituberculata Viets, 1955. Syn. n.

Cook (1986) could not distinguish females of *Physolimnesia australis* and *Limnesia trituberculata* Viets. I compared the females of *P. australis* with the illustrations of Viets and concluded that the two species are identical.

Material examined. – New South Wales: 17 ♂, 50 ♀, loc. 3; 1 ♂, 7 ♀, loc. 6. Queensland: 3 ♀, loc. 29; 4 ♂, 8 ♀, loc. 34; 3 ♂, 6 ♀, loc. 15.

Limnesia Koch

Limnesia longigenitalis Lundblad, 1941

A species previously reported from Victoria.

Material examined. – New South Wales: 2 ♂, 5 ♀, loc. 1; 1 ♀, loc. 46.

Limnesia dentifera Viets, 1980
(figs. 14-15)

Viets (1980) described only the female of this species from the Myall Lakes area, New South Wales; a description of the male is given below.

Male: Dorsum not sclerotisized, with only one pair of small platelets. Dorsum 679 μ long and 495 μ wide. Capitular bay V-shaped. Genital field triangular, 213 μ in length and 136 μ in width. Glandula Limnesiae (see Cook 1986, fig. 414) shifted to posterior margin of third coxae. Dorsal lengths of palp segments: PI 22 μ, PII 108 μ, PIII 89 μ, PIV 151 μ, PV 77 μ; PIII medially with one large seta. Peg-like seta on ventral side of PII not on a tubercle. III-leg-4 and 5, and IV-leg-4 and 5 with 6-7 swimming setae.

Material examined. – New South Wales: 1 ♂, 2 ♀, loc. 1; 1 ♂, 12 ♀, loc. 7; 3 ♂, 3 ♀, 1 nymph, loc. 8.

Limnesia parasolida Viets, 1984

The species is reported from Queensland, where it is probably widespread. Viets (1984) described it from the Alice Springs area, Northern Territory.

Material examined. – Queensland: 7 ♂, 5 ♀, loc. 23; 30 ♂, 17 ♀, loc. 38; 3 ♂, 1 ♀, loc. 35; 3 ♀, loc. 18.

Limnesia solida Lundblad, 1948
(fig. 16)

Lundblad (1948) described the female from Victoria. The male was hitherto unknown; a description is given below. Viets (1975) reports the species without location, but probably in Queensland.

Male: Body soft, 650 μ in length and 524 μ in width. Dorsum without platelets. Coxae in three groups. The Glandula Limnesiae shifted to posterior margin of third coxae. Three pairs of genital acetabula, the first anterior pair noticeably separated from second pair. Gonopore relatively small, 78 μ in length. Dorsal lengths of palp segments: PI 24 μ, PII 91 μ, PIII 70 μ, PIV 131 μ, PV 36 μ. Palp as illustrated for the female by Cook (1986). Dorsal lengths of distal three segments of fourth leg: IV-leg-4 178 μ, IV-leg-5 178 μ, IV-leg-6 156 μ; IV-leg-5 with 1 and IV-leg-4 with 3 swimming setae.

Material examined. – Queensland: 1 ♀, loc. 33; 2 ♀, loc. 39; 1 ♀, loc. 41; 2 ♂, 2 ♀, loc. 35.

Limnesia lembangensis Piersig, 1906

A species with a wide distribution, known from India through to Australia. Gledhill (pers. comm.) has seen material from Sri Lanka. Halik (1941) reported it from New South Wales.

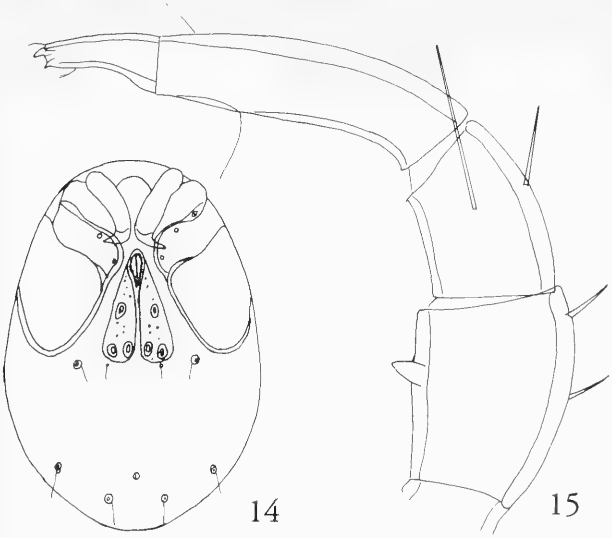
Material examined. – Queensland: 7 ♂, 41 ♀, loc. 21; 2 ♀, loc. 32.

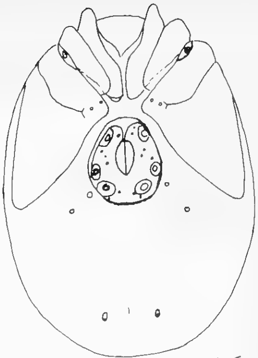
Hygrobates Koch

Hygrobates hamatus Viets, 1935

A widespread species. *Hygrobates hamatus hamatus* is known from Indonesia and Queensland, the subspecies *H. hamatus bharatensis* is recorded from India (Cook 1967).

Material examined. – Queensland: 1 ♂, 3 ♀, loc. 23; 1 ♀, loc. 31.

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Figs. 14 - 15. *Limnesia dentifera* Viets. – 14, ventral view ♂; 15, palp ♂. – Fig. 16. *Limnesia solida* Lundblad. – 16, ventral view ♂.

Australiobates Lundblad

Australiobates mutatus Viets, 1978

Based on the very long palp segments one specimen is assigned to *A.mutatus*, the most common of the Australian *Australiobates* species and known from Tasmania to Queensland.

Material examined. – Queensland: 1 ♀, loc. 27 .

Australiobates linderi Lundblad, 1941
(figs. 17-19)

Specimens from three locations are provisionally assigned to *A.linderi*. Specimens from loc. 7, loc. 42 and some males from loc. 40, however, lack setae on the ventral side of PIII. This segment has a ventral margin which is almost straight, slightly convex or convex, similar to fig. 33B of Lundblad (1948). Palp segments and leg segments are rather stocky, like *A. emalus* Cook, which is known from one male only. However, the ventral margin of PIII in *A. emalus* is straight. The peg-like setae of PIV are bluntly and/or sharply pointed (this character being variable within a single specimen), so this is not a good character. Some measurements are provided here of specimens from loc. 7.

Male: Dorsal lengths of palp segments: PII 82 μ, PIII 120 μ, PIV 108 μ, PV 36 μ. Dorsal lengths of first leg: I-leg-4 182-209 μ, I-leg-5 187-211 μ, I-leg-6 158-177 μ.

Female: Dorsal lengths of palp segments: PI 43-46 μ, PII 106-108 μ, PIII 149-151 μ, PIV 134-139 μ, PV 43-48 μ. Dorsal lengths of first leg: I-leg-4 272, I-leg-5 281 and I-leg-6 213 μ.

Material examined. – New South Wales: 4 ♂, 4 ♀, loc. 7. Queensland: 6 ♂, 6 ♀, loc. 40; 2 ♂, 28 ♀, loc. 42.

Coaustraliobates Cook

Coaustraliobates minor (Lundblad, 1948)
(fig. 20)

In addition to material from lotic habitats I also found this species at lentic sites. Cook (1986), however, only collected this species from streams. Specimens from Lake Eacham, Queensland have a rather long anterior acetabulum and more setae on the anterior margin of the genital field (see fig. 20).

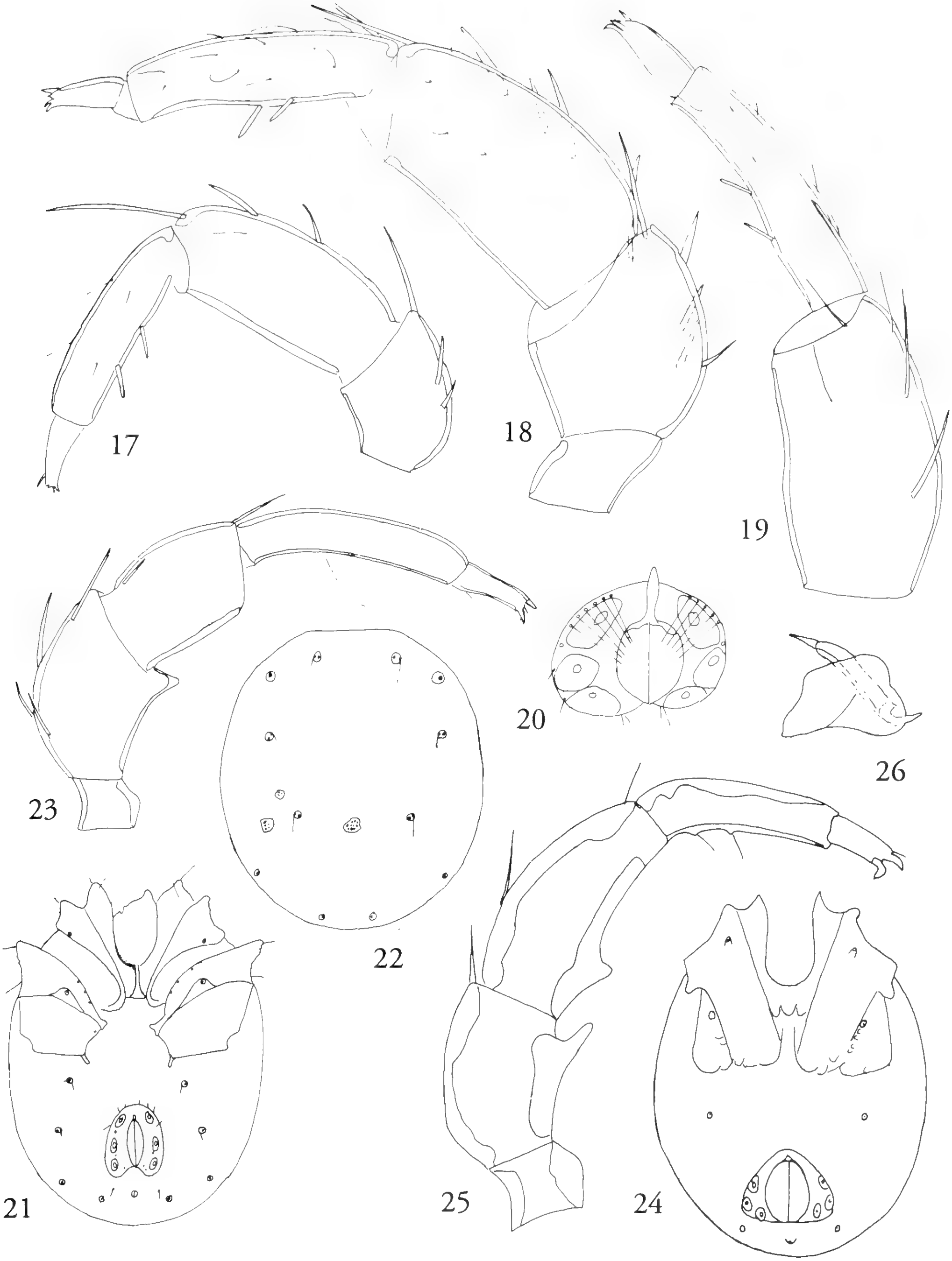
Material examined. – New South Wales: 3 ♀, loc. 2; 1 ♂, loc. 3; 2 ♀, loc. 4; 1 ♂, loc. 6; 3 ♂, 22 ♀, loc. 9; 1 ♂, loc. 10. Queensland: 3 ♀, loc. 23; 8 ♂, 5 ♀, 1 nymph, loc. 30; 2 ♂, 1 ♀, loc. 31; 1 ♀, loc. 38.

Aspidiobates Lundblad

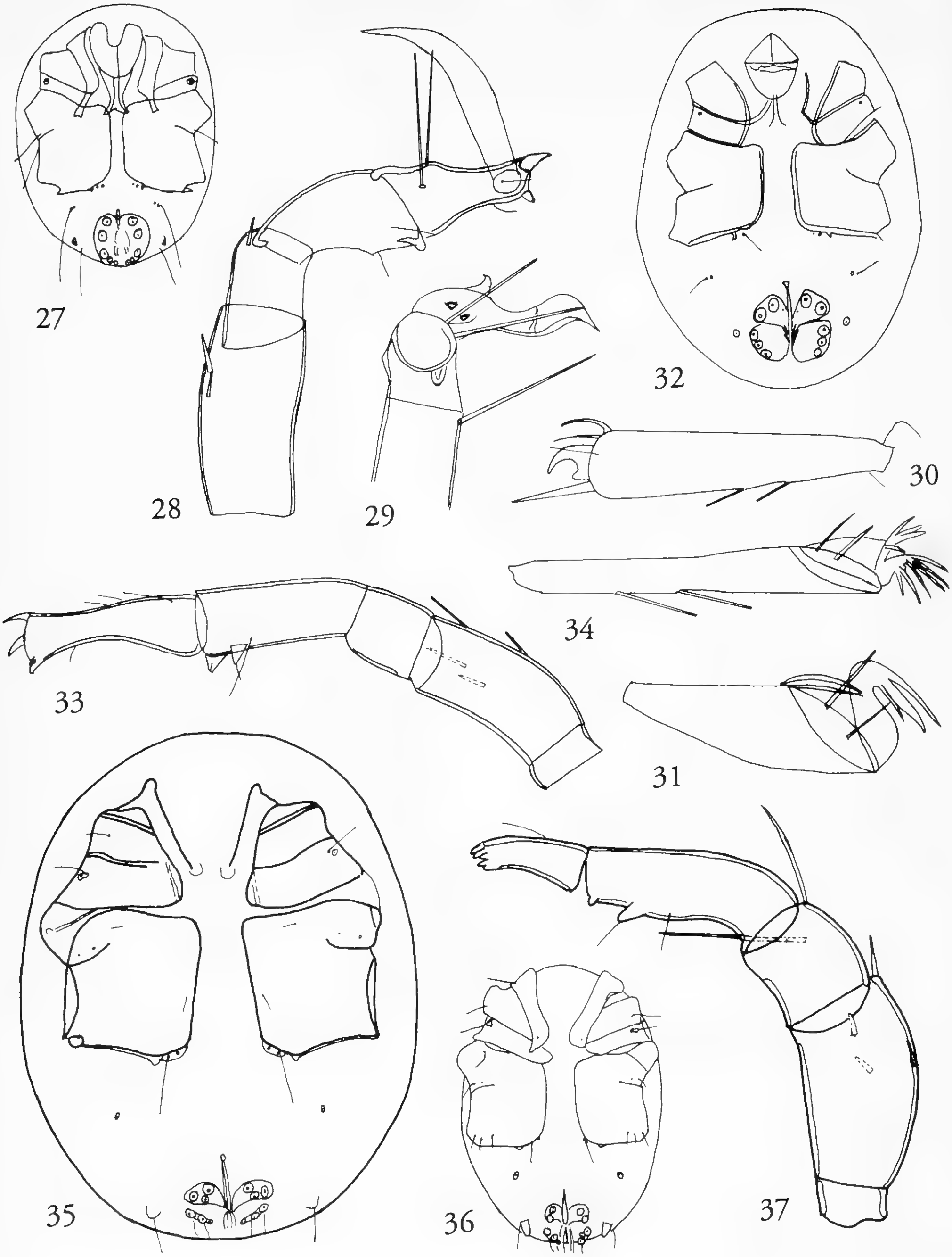
Aspidiobates geometricus Cook, 1986

Previously reported from Victoria, New South Wales and Queensland.

Material examined. – Queensland: 1 ♀, loc. 20.



Figs. 17-19. *Australiobates linderi* Lundblad. – 17, palp ♂; 18, palp ♀; 19, palp ♀. – Fig. 20. *Coaustraliobates minor* (Lundblad), genital field ♂. – Figs. 21-23. *Aspidiobates unidorsalis* sp. n. – 21, ventral view ♂, 22, dorsal view ♂; 23, palp ♂ (figs. 21-23 holotype). – Figs. 24-26. *Kallimobates cooki* sp. n. – 24, ventral view ♀; 25, palp ♀; 26, lateral view capitulum and chelicera ♀ (figs. 24-26 holotype).



Figs. 27-37. *Unionicola.* – Figs. 27-34. *Unionicola hammeni* sp. n. – 27, ventral view ♂; 28, palp ♂; 29, dorsal view palp ♂; 30, 4-leg-6 ♂; 31, 1-leg-6 ♂; 32, ventral view ♀; 33, palp ♀; 34, 4-leg-6 ♀ (figs. 27-31 holotype). – Fig. 35. *Unionicola flabelliseta* Cook. – 35, ventral view ♀. – Figs. 36-37. *Unionicola davidsi* sp. n. – 36, ventral view ♀; 37, palp ♀.

Aspidiobates scutatus Lundblad, 1941

Previously reported from Tasmania, Victoria and New South Wales.

Material examined. – Queensland: 1 ♂, loc. 11; 1 ♂, 2 ♀, loc. 13.

Aspidiobates unidorsalis sp. n.

(figs. 21-23)

Type material. – Holotype male: Darraboola Creek, Lamington NP, Queensland (loc.13).

Description

Male: Dorsal and ventral shields present. Dorsal shield complete, 591 μ in length, 543 μ in width and with six pairs of glandularia each lying on a small platelet, together with the associated seta. Genital field 145 μ in length and 78 μ in width. Three pairs of acetabula, anterior pair separated from the others. Fourth coxae with small posteromedial projections. Glandularia of the fourth coxae shifted onto the third coxae. Dorsal lengths of palp segments: PI 26 μ, PII 94 μ, PIII 77 μ, PIV 120 μ, PV 38 μ.

Female: Unknown

Etymology. – The species is named for its complete dorsal shield.

Discussion. – This is the fifth known *Aspidiobates* species with a complete dorsal shield. Viets (1969) described two species from New Caledonia and Hopkins (1975) described one species from New Zealand. The only known Australian species with a complete dorsal shield, *A. bidewel* Harvey, exhibits sexual dimorphism in IV-leg-4. The form of the dorsal shield and the genital field distinguish the new species easily from the other Australian *Aspidiobates* species.

Caenobates Viets

Caenobates acheronius Viets, 1978

The species was previously known from Tasmania, Victoria and New South Wales.

Material examined. – Queensland: 1 ♀, loc. 12.

Kallimobates Viets

Kallimobates cooki sp. n.

(figs. 24-26)

Type material. – Holotype female: Creek near Elabama Falls, Lamington NP, Qld (loc.11). – paratype: Same location as holotype, 1 ♀.

Description

Female: Dorsal and ventral shields present. Dorsal shield 563 μ in length and 514 μ in width and with three pairs of glandularia, one pair lying in the dorsal furrow posterior to dorsal shield. Three pairs of acetabula; gonopore 111 μ in length and 97 μ in width. Capitular rostrum tapers gradually anteriorly. Dorsal lengths of palp segments: PI 29 μ, PII 89 μ, PIII 117 μ, PIV 74 μ, PV 43 μ. PII with a large projection; PI-II with a smaller projection, which does not extend distoventrally. Legs without swimming setae.

Male. – Unknown.

Etymology. – The species is named after Dr. D. R. Cook.

Discussion. – Females of the new species differ from those of the two known species of the genus *Kallimobates* in the form of the palp. The projection on PIII is intermediate between *K. australicus* Viets (almost without a projection on PIII) and *K. vietsi* Cook (with a large projection on PIII). The capitulum is similar to that of *K. vietsi.* PIV is rather short, as in *K. australicus.*

Encentridophorus Piersig

Encentridophorus sarasini Walter, 1915

A widespread species, known from New Caledonia to India; from Australia it has been reported from Victoria and Queensland.

Material examined. – Queensland: 1 ♀, loc. 39; 1 ♂, 13 ♀, 1 nymph, loc. 22; 6 ♀, loc. 26; 1 ♂, 1 ♀, loc. 37; 2 ♂, 23 ♀, loc. 25; 3 ♀, loc. 36.

Unionicola Haldeman

Australionicola subgen. n.

Diagnosis

Characters of the subfamily Unionicolinae. Genital field with 5 pairs of acetabula; male with one acetabular plate, female with two acetabular plates. Pronounced sexual dimorphism in male palp and fourth leg. Fifth palp segment of male relatively long, with a large claw-like structure. Fifth palp segment of female relatively long, with 3 short, thickened setae on posterior margin. Legs with large claws with 2-4 clawlets; fourth leg of male with a small claw and without clawlets.

Type species. – *Unionicola* (*Australionicola*) *hammeni* sp. n.

Discussion. – The sexual dimorphism found in the male palp is not found in any other subgenus of *Unionicola* (see Vidrine 1986, 1987). Also the large claws with 3-4 clawlets are unique for the subgenus, although subgenera (e.g. *Anodontinatax*) with large, bifid claws do occur.

Unionicola (*Australionicola*) *hammeni* sp. n.
(figs. 27-34)

Type material. – Holotype male: Cattle pond Upper Daintree Road, Daintree, Queensland (loc. 32). – Paratypes: One male and one female from same location as holotype.

Description

Male: Body soft, 592 µ in length and 359 µ in width; eyes large. Apodemes of anterior coxae extending to third coxae. Epimeroglandularia 2 small. Two acetabular plates (which are possibly fused anteriorly, but this is difficult to determine) each with 5 acetabula, the anterior two acetabula of each side and the posterior three acetabula arranged one behind the other; each acetabular plate with two setae. (The slide of the type specimen is of poor quality, so the illustration of the ventral side (fig. 27) is of the paratype). Gonopore 107 µ in length. Dorsal lengths of palp segments: PI 17 µ, PII 103 µ, PIII 60 µ, PIV 70 µ, PV 72 µ. Fourth palp segment with two small tubercles on posterior margin. Fifth palp segment with a large, stiff lateral seta and a large claw-like structure. Dorsal lengths of fourth leg: IV-leg-2 94 µ, IV-leg-3 101 µ, IV-leg-4 125 µ, IV-leg-5 163 µ and IV-leg-6 134 µ; IV-leg-6 relatively short, with a small claw without clawlets. All other legs with large claws and 2-3 clawlets. There are two types of long setae present: broad setae which probably act as swimming setae (and here referred to as swimming setae) and long, hair-like setae. I-leg-4 with 4 hair-like setae, I-leg-5 with 5 swimming setae; II-leg-3 with 1 hair-like seta, II-leg-4 with 5 swimming setae, II-leg-5 with 3 swimming and 1 hair-like setae; III-leg-3 with 1 hair-like seta, III-leg-4 with 5 swimming setae and III-leg-5 with 3 swimming and 2 hair-like setae; IV-leg-4 with 4 hair-like setae and IV-leg-5 with 5 swimming setae.

Female: Body soft, 747 µ in length and 553 µ in width. Anterior coxae with apodemes, but it is not possible to determine how far they extend posteriorly due to the poor condition of the specimen. Epimeroglandularia 2 small. Two pairs of acetabular plates, lying close two each other; the anterior plates with two pairs of acetabula and two setae, the posterior plates with three pairs of acetabula (arranged one behind the other) and each plate with one seta. Dorsal lengths of palp segments: PI 17 µ, PII 89 µ, PIII 38 µ, PIV 84 µ and PV 60 µ; PIV with two small tubercles, PV with three short setae on dorsal margin. Dorsal lengths of fourth leg: IV-leg-2 142 µ, IV-leg-3 154 µ, IV-leg-4 178 µ, IV-leg-5 221 µ and IV-leg-6 187 µ. Legs 1-3 with large claws and 3 clawlets (2 large and one small), leg 4 with 4 clawlets. Similarly the female has long, hair-like setae and broad swimming setae. I-leg-3 with 1 hair-like seta, I-leg-4 with 5 swimming setae, I-leg-5 with 5 swimming and 1 hair-like setae; II-leg-3 with 1 hair-like setae, II-leg-4 with 6 swimming setae, II-leg-5 with 5 swimming setae; III-leg-3 with 1 swimming and 1 hair-like seta, III-leg-4 with 5 swimming and 1 hair-like setae, III-leg-5 with 3 swimming and 1 hair-like setae; IV-leg-5 with 3 swimming and 1 hair-like setae, IV-leg-4 with 2 swimming and 1 hair-like setae.

Etymology. – The species is named after Mr. Henk van der Hammen.

Discussion. – The unique structure of the male palp separates this species from any other member of the genus. Other diagnostic characters for the male include the number of clawlets of the claws. The structure of the palp of the female is also diagnostic.

Unionicola (*Unionicola*) *flabelliseta* Cook, 1986
(fig. 35)

Cook (1986) described only the male. Only females were found in the present study and a description is given below.

Female: Body soft, 999 µ in length and 805 µ in width. Ventrally with a pair of raised glandularia tubercles at posterolateral corners of body. Fourth coxae with small posteromedial projections but with very long setae. Epimeroglandularia 2 small. Two pairs of acetabular plates, each plate with three acetabula. Dorsal lengths of palp segments: PI 17 µ, PII 214 µ, PIII 62 µ, PIV 178 µ, PV 82 µ. The female, like the male, has an expanded fan-shaped peg-like setae on PIV. Dorsal lengths of distal segments of first leg: I-leg-4 262 µ, I-leg-5 223 µ, I-leg-6 194 µ. Dorsal lengths of distal segments of fourth leg: IV-leg-4 252 µ, IV-leg-5 369 µ, IV-leg-6 349 µ.

Discussion. – The fan-shaped peg-like seta of PIV is diagnostic for the species. Cook described the species from a river in Queensland, the females described above were found in a lake in Queensland.

Material examined. – Queensland: 3 ♀, loc. 19.

Unionicola (*Pentatax*) *longiseta* Walter, 1915

A widespread species previously known from New Caledonia and Australia (Tasmania and Victoria).

Material examined. – Queensland: 2 ♀, loc. 19; 1 ♀, loc. 36.

Unionicola (*Pentatax*) *minutissima* Lundblad, 1948

Reported before from Tasmania and Queensland.

Material examined: Queensland: 2 ♀, loc. 19; 3 ♀, loc. 18.

Unionicola (*Pentatax*) *davidsi* sp. n.
(figs. 36-37)

Type material. – Holotype female: Cattle pond north of Bundjalung NP, New South Wales (loc. 6).

Description

Female: Body soft, 553 μ in length and 398 μ in width. A pair of raised glandularia tubercles at posterolateral corners of body. Tips of second and third coxae rounded. Five pairs of genital acetabula, these placed on two pairs of acetabular plates. Posterior pair of acetabular plates with three pairs of acetabula and one pair of heavy setae; anterior plates with two pairs of acetabula and two pairs of heavy setae. Lengths of palp segments: PI 14 μ, PII 103 μ, PIII 48 μ, PIV 106 μ, PV 55 μ. Peg-like seta of PIV at extreme distoventral end not on a tubercle; one of the hair-like setae on PIV on a short tubercle. PIII with a long lateral seta; PII with two short lateral setae. Dorsal lengths of first leg: I-leg-4 226 μ, I-leg-5 218 μ, I-leg-6 151 μ. Dorsal lengths of fourth leg: IV-leg-4 262 μ, IV-leg-5 320 μ, IV-leg-6 272 μ.

Male: Unknown.

Etymology. – The species is named after Dr. C. Davids.

Discussion. – This species is close to *U. minutissima* Lundblad and *U. alpa* Cook. It differs from both species in the structure of the palp (PV of *U. davidsi* is relatively short and PIV has a different shape), the larger size and the very long leg segments.

Unionicola (*Pentatax*) sp.

Two *Unionicola*-females from location 19 have shorter palps and shorter leg segments than *U. davidsi.* They resemble the latter species in most details, but may belong to a different species. For one of these female the dorsal lengths of the palp and leg segments are: PII 84 μ, PIII 34 μ, PIV 86 μ, PV 53 μ; I-leg-4 175 μ, I-leg-5 168 μ, I-leg-6 125 μ; IV-leg-4 194 μ, IV-leg-5 261 μ, IV-leg-6 240 μ.

Unionicola (*Giselatax*) *lundbladi* Viets, 1975

Viets (1975) described the species from Queensland.

Material examined. – Queensland: 1 ♀, loc. 36.

Neumania Lebert

Neumania (*Neumania*) *ambigua* Piersig, 1906

A widespread species, known from Japan to Indonesia, Philippines and eastern Siberia.

Material examined. – Queensland: 1 ♂, loc. 19; 1 ♂, loc. 21; 1 ♂, loc. 22; 2 ♀, loc. 24; 3 ♂, 2 ♀, loc. 25; 1 ♀, loc. 30; 1 ♂, loc. 32.

Neumania (*Neumania*) *nodosa* (Daday, 1898)

N. nodosa is a widespread species, reported from India, Indonesia, Japan and also from the Northern Territory, Australia (Viets 1981).

Measurements and number of acetabula are variable. The Australian specimens are larger than the specimens taken by Cook (1967) in India. Australian females measured 960-1248 μ, females from India 653-714 μ. Females from Indonesia are intermediate i.e. 800-1000 μ (Piersig 1906). There are also differences in the lengths of the leg and palp segments. Dorsal lengths of first leg of Australian females: I-leg-3 257 μ; I-leg-4 378 μ; I-leg-5 378 μ; I-leg-6 262 μ; dorsal lengths of fourth leg: IV-leg-3 281 μ; IV-leg-4 310-349 μ; IV-leg-5 340-378 μ; IV-leg-6 310-349 μ; dorsal lengths of palp segments: PII 137 μ; PIII 89 μ; PIV 132 μ; PV 50 μ. Indian specimens have smaller leg- and palp segments. Additionally, Australian females bear 20-22 acetabula, specimens from India 15-18 and specimens from Indonesia 28-34.

Material examined. – Queensland: 1 ♀, 1 ♂, loc. 21; 1 ♀, loc. 22; 5 ♀, loc. 25; 2 ♀, loc. 28.

Neumania (*Lemienia*) *gila* Viets, 1975

Reported before from several localities in Queensland (Viets 1975).

Material examined. – New South Wales: 5 ♀, loc. 6. Queensland: 2 ♂, 1 ♀, loc. 17; 8 ♂, 5 ♀, loc. 36.

Neumania (*Lemienia*) *falcipes* Koenike, 1906

The first record of this species from Australia. The species is known from Sri Lanka, Indonesia and Africa.

Material examined. – Queensland: 2 ♂, loc. 38.

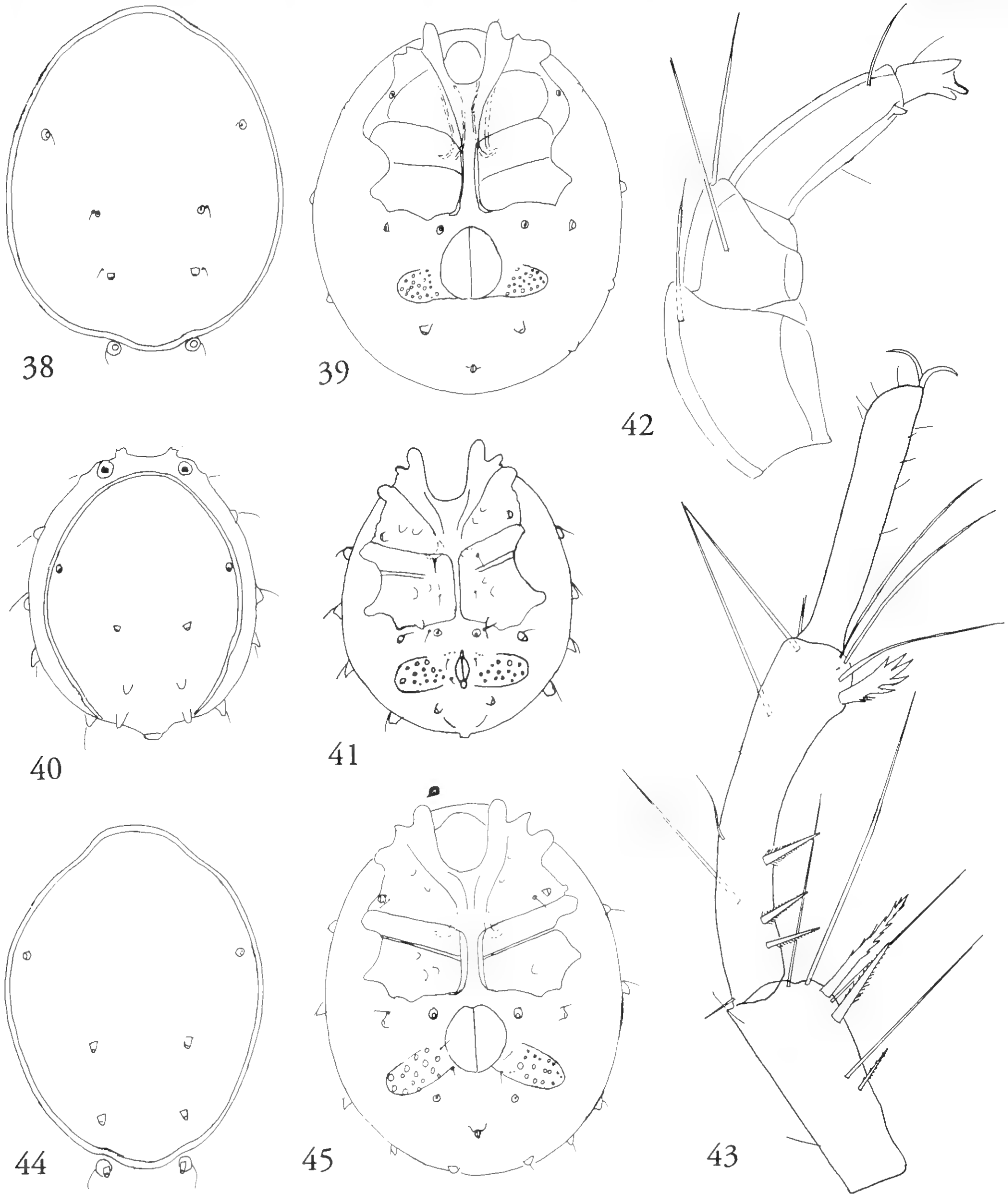
Recifella Viets

Recifella (*Recifellida*) *tinka* (Viets, 1975)

(figs. 38-39)

Viets (1975) described the male of this species from a location in Queensland; the female was hitherto unknown. At one location both males and females were found and the female is described below.

Female: Dorsal shield 640 μ in length and 553 μ in width. Dorsal shield bearing three pairs of glandularia, the most posterior lying on small tubercles; a fourth pair of glandularia lying free in the dorsal furrow posterior to the dorsal shield; these glandularia on large tubercles. Glandularia of ventral shield on small tubercles. Dorsal lengths of palp segments: PI 29 μ, PII 98 μ, PIII 46 μ, PIV 96 μ, PV 25 μ. Palp stocky, as illustrated for the male by Viets (1975). Dorsal lengths of fourth leg: IV-leg-6 194 μ, IV-leg-5 209 μ,IV-leg-4 158 μ, IV-leg-3 122 μ, IV-leg-2 110 μ; IV-leg-5 and IV-leg-4 each with three swimming setae.



Figs. 38-45. *Recifella*. – Figs. 38-39. *Recifella tinka* (Viets). – 38, dorsal shield ♀; 39, ventral view ♀. – Figs. 40-45. *Recifella pectinata* sp. n. – 40, dorsal view ♂; 41, ventral view ♂; 42, palp ♂; 43, fourth leg ♂; 44, dorsal shield ♀; 45, ventral view ♀ (figs. 40 - 43 holotype).

Discussion. – See under *R. pectinatus* sp. n.
Material examined. – Queensland: 7 ♀, 1 ♂, loc. 30.

Recifella (*Recifellida*) *doomba* Cook, 1986

Reported before from New South Wales and Queensland.
Material examined. – Queensland: 1 ♂, 1 ♀, loc. 38

Recifella (*Recifellida*) *pectinatus* sp. n.

(figs. 40-45)

Type material. – Holotype male: Lake at Eungella Dam, Queensland (loc. 19). – Paratypes: 5 ♂ and 8 ♀ from same location as holotype; 2 ♀, loc. 17.

Description

Male: Dorsal shield fused with ventral shield posteriorly thus making the dorsal furrow incomplete. Dorsal shield 446 μ in length and 393 μ in width and with 4 pairs of glandularia, the three most posterior pairs on tubercles. Tips of first coxae rounded and projecting beyond the body proper. Genital field with 15-20 acetabula. Dorsal lengths of palp segments: PI 24 μ, PII 96 μ, PIII 46 μ, PIV 84 μ, PV 26 μ. Dorsal heavy terminal seta of PV diverging from the others; ventral side of PII straight, PII stocky. Dorsal lengths of fourth leg: IV-leg-2 107 μ, IV-leg-3 116 μ, IV-leg-4 145 μ, IV-leg-5 242 μ, IV-leg-6 184 μ. IV-leg-5 bowed, the three unmodified specialized setae in the proximal half of segment. Proximal two of these setae closer to each other than the two distally sited setae. The distal end of this segment with a prominently pectinate seta. IV-leg-4 and IV-leg-5 with 3 swimming setae; IV-leg-4 with 2 large pectinate setae and 1 small pectinate seta, IV-leg-3 with 1 pectinate seta.

Female: Dorsal and ventral shield present; dorsal shield 611 μ in length and 495 μ in width. Dorsal shield with three pairs of glandularia on small tubercles, a fourth pair of glandularia lying free in the dorsal furrow on large tubercles. Tubercles on ventral shield large, especially on lateral side of body. Posterior apodemes of anterior coxal groups extending to middle of third coxae. Acetabular plates with numerous acetabula. Dorsal lengths of palp segments: PI 24 μ, PII 96 μ, PIII 46, PIV 89 μ, PV 29 μ; palp as illustrated for the male. Dorsal lengths of distal three segments of first and fourth leg: I-leg-4 136 μ, I-leg-5 155 μ, I-leg-6 155 μ; IV-leg-4 155 μ, IV-leg-5 208 μ, IV-leg-6 194 μ; III-and IV-leg-5, III- and IV-leg-4 with three swimming setae, III- and IV-leg-3 with two swimming setae.

Etymology. – The species is named for its large, pectinate setae.

Discussion. – The fourth leg of the male of this species resembles that of *R. baltoona* and *R. tinka*; it differs from the first species in the absence of a bulge on IV-leg-4 and the heavy pectinate seta on the distal end. *R. tinka* has the three setae of IV-leg-4 close to each other and on a small but clear bulge. Males and females of *R. tinka* and *R.pectinatus* have a stocky second palp segment; females of the two species differ in the form of acetabular plates and tubercles.

Koenikea Wolcott

Koenikea (*Koenikea*) *sorpresa* Cook, 1986

Known from a few specimens from Queensland and New South Wales.

Material examined. – Queensland: 1 ♀, loc. 19.

Koenikea (*Notomideopsis*) *australica* Lundblad, 1941

Reported by Lundblad (1948) from Tasmania and Victoria.

Discussion. – See *K. verrucosa.*

Material examined. – New South Wales: 2 ♂, 4 ♀, loc. 8. Queensland: 1 ♀, loc. 16.

Koenikea (*Notomideopsis*) *verrucosa* Lundblad, 1948

Lundblad (1948) described the species from a newly metamorphosed male from Tasmania. This male differed from *K. australica* in having much larger glandularia tubercles. Cook (1986) suggested that older specimens have smaller tubercles, and therefore questioned the validity of *K. verrucosa.* At one location in this study males and females were found with large glandularia tubercles and these were compared with males and females with small tubercles assigned to *K. australica.* It is clear that *K. verrucosa* should stand as a distinct species. The glandularia tubercles of *K. verrucosa* measure 24-29 μ and those of *K. australica* 12-16 μ. Further, *K. verrucosa* has more and larger papillae on the body than *K. australica.* The female of *K. verrucosa* is briefly characterized below.

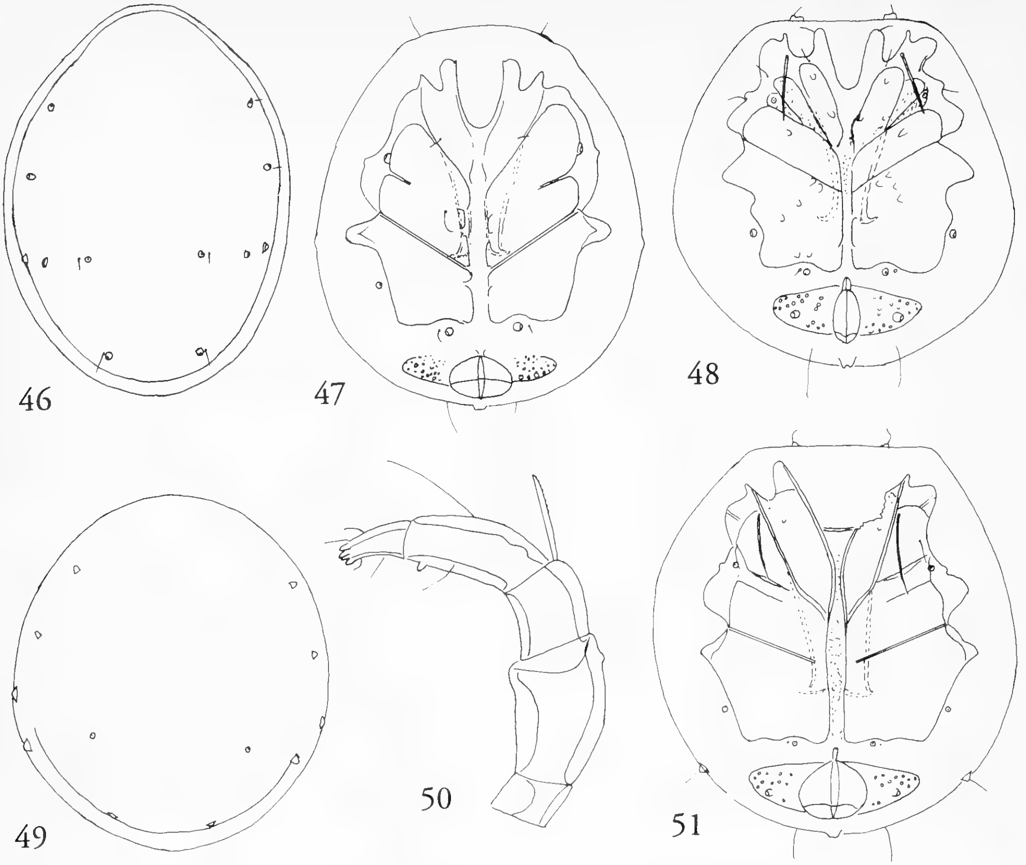
Female: Body 630 μ in length and 601 μ in width; dorsal shield 563 μ in length and 495 μ in width. Dorsal shield with five pairs of large glandularia tubercles. Body with large papillae. Dorsal lengths of palp segments: PI 24 μ, PII 74 μ, PIII 48 μ, PIV 72 μ, PV 38 μ.

Material examined. – Queensland: 3 ♂, 2 ♀, loc. 14.

Koenikea (*Notomideopsis*) *branacha* Cook, 1986

Previously reported from Queensland and New South Wales.

One of the two females from loc. 18 is much larger than other specimens found (and also larger than the measurements given by Cook 1986), but is otherwise similar. Dorsal shield of this female is 824 μ in length and 616 μ in width; dorsal lengths of palp segments: PI 25 μ, PII 96 μ, PIII 67 μ, PIV 106 μ, PV 46 μ; dorsal lengths of distal three segments of first leg: I-leg-4 213 μ, I-leg-5 189 μ, I-leg-6 199 μ; ventral shield is 858 μ in length; gonopore 136 μ in width. It is provisionally assigned to *K. branacha*, but may belong to a different species.



Figs. 46-47. *Koenikea voloma* Cook. – 46, dorsal shield ♀; 47, ventral view ♀. – Figs. 48-51. *Koenikea purpurea* sp. n. – 48, ventral view ♂; 49, dorsal shield ♂; 50, palp ♂; 51, ventral view ♀ (figs. 48-50 holotype).

Material examined: Queensland: 2 ♀, loc. 16; 2 ♀, loc. 18; 1 ♀, loc. 40.

Koenikea (*Notomideopsis*) *voloma* Cook, 1986
(figs. 46-47)

Previously reported from Tasmania and New South Wales.

Cook (1986) provided a good description of this species. Only females were found in the present study, which, although not entirely fitting the description of *K. voloma* by Cook (1986), have all been assigned to that species. A short description of these specimens is given below (the measurements given by Cook for the allotype and paratype are shown in parentheses).

Female: Dorsal shield 650-718 μ (684-729) in length and 504-548 μ (562-638) in width. Dorsal shield with 6 pairs of glandularia; glandularia 3, 4 and 5 more or less in a line. Tips of first coxae rounded and not projecting to anterior end of body. Epimeroglandularia 2 located near posterior suture lines of fourth coxae. Genital field close to posterior of body. Gonopore 116-126 μ (120-122) in width; acetabular region 281-310 μ (318-347) in width. Dorsal lengths of palp segments: PI 26 μ (26-27), PII 77-84 μ (85-86), PIII 48-53 μ (48-51), PIV 77-84 μ (88-90), PV 38 μ (40-43); peg-like seta of PIV on a short tubercle. The location of this seta varies (even within a specimen), from near the distal end of this segment to somewhat more proximal. First leg with long 'rillborsten' (fluted or grooved setae).

Discussion. – The females of this study have a more elliptical dorsal shield compared with the original description presented by Cook (1986). The location of the peg-like seta of PIV varies, so this character does not separate this species from other species, e.g. *K. jacunda.*

Material examined. – Queensland: 5 ♀, loc. 18; 1 ♀, loc.40.

Koenikea (*Notomideopsis*) *purpurea* sp. n.
(figs. 48-51)

Type material. – Holotype male: Teewah Creek, Cooloola NP, Queensland (loc.16). – Paratype: Same location as holotype, 1 ♀.

Description

Male: Body purple, 669 μ in length and 640 μ in width. Dorsal furrow complete; dorsal shield 655 μ in length and 601 μ in width and with 6 pairs of glandularia on small tubercles. Tips of first coxae not extending to anterior end of body. Second coxae each with one very large, stiff seta. Posterior apodemes of anterior coxal groups extending posteriorly beyond suture lines between third and fourth coxae. Epimeroglandularia 2 lying in an indentation of the posterior margin of the fourth coxae. Acetabular plates broad, 116 μ in length with one pair of glandularia and 10-15 small acetabula. Gonopore 87 μ in length. Excretory pore terminal. Dorsal lengths of palp segments: PI 22 μ, PII 70 μ, PIII 48 μ, PIV 70 μ, PV 36 μ; peg-like seta of PIV not inserted on a tubercle. Dorsal lengths of last three segments of fourth leg: IV-leg-4 126 μ, IV-leg-5 155 μ and IV-leg-6 184 μ. One swimming seta on II-leg-4, two on I-leg-5, II-leg-5, III-leg-4, III-leg-5, and three on IV-leg-4 and IV-leg-5. First two legs with 'rillborsten'.

Female: Body purple, 718 μ in length and 679 μ in width. Dorsal furrow complete; dorsal shield 708 μ in length and 621 μ in width. Tips of first coxae not extending to anterior end of body. Posterior apodemes of anterior coxal groups extending posteriorly beyond suture lines between third and fourth coxae. Second coxae each with one very long, stiff seta. Acetabular fields with one pair of glandularia and 10-15 small acetabula. Gonopore 107 μ in length. Dorsal length of palp segments: PI 21 μ, PII 74 μ, PIII 48 μ, PIV 72 μ, PV 43 μ; setae on PIII larger than in male, PV relatively more slender; peg-like seta on PIV not on a tubercle. First two legs with 'rillborsten'. Dorsal lengths of last three segments of fourth leg: IV-leg-4 136 μ, IV-leg-5 155 μ and IV-leg-6 165 μ. One swimming seta on II-leg-3 and IV-leg-4, two swimming seta on I-leg-5, three swimming setae on II-leg-5, III-leg-5, IV-leg-4 and IV-leg-5; legs 3 and 4 with rather large setae.

Etymology. – The species is named for its conspicuous colour.

Discussion. – The colour of the body (purple, even after preservation in Koenike's solution) and the very long stiff seta on the second coxa are diagnostic for this species.

Albia Thon

Albia (*Albiella*) *brokenensis* sp. n.
(figs.52-54)

Type material. – Holotype female: Broken River, Eungella NP, Queensland (loc. 18).

Description

Female: Dorsal and ventral shields present. Body 1047 μ in length and 737 μ in width. Dorsal shield with 5 pairs of glandularia, one pair of glandularia lying in the dorsal furrow. Dorsoglandularia 3 and 4 lying very close to each other, dorsoglandularia 4 more medial. Glandularia of the fourth coxae extending forward causing a slight bowing of the suture lines between third and fourth coxae. None of the coxal setae thickened. Acetabular plates with numerous acetabula, inner margin free of acetabula. Pre-genital shield present, triangular in form. Dorsal lengths of palp segments: PI 35 μ, PII 120 μ, PIII 72 μ, PIV 139 μ, PV 53 μ. Dorsal lengths of last three segments of first leg: I-leg-4 110 μ, I-leg-5 125 μ, I-leg-6 132 μ. Fifth segment of second, third and fourth legs with numerous swimming setae; claws of legs with one clawlet.

Male: Unknown.

Etymology. – The species is named after the type locality.

Discussion. – This species is very close to *A. australica* Cook. It differs in the position of dorsoglandularia 3 and 4, and in the form of the acetabular plates. The anterior margin of the body of *A. brokenensis* is almost straight, whilst that of *A. australica* is rounded.

Momoniella Viets

Momoniella australica Cook, 1986

Widespread in Australia, and reported from Tasmania, New South Wales and Queensland. Previously only collected in streams, but location 31 is Lake Eacham in the Atherton Tablelands area.

Material examined. – Queensland: 1 ♂, loc. 20; 1 ♀, loc. 27; 1 ♀, loc. 31.

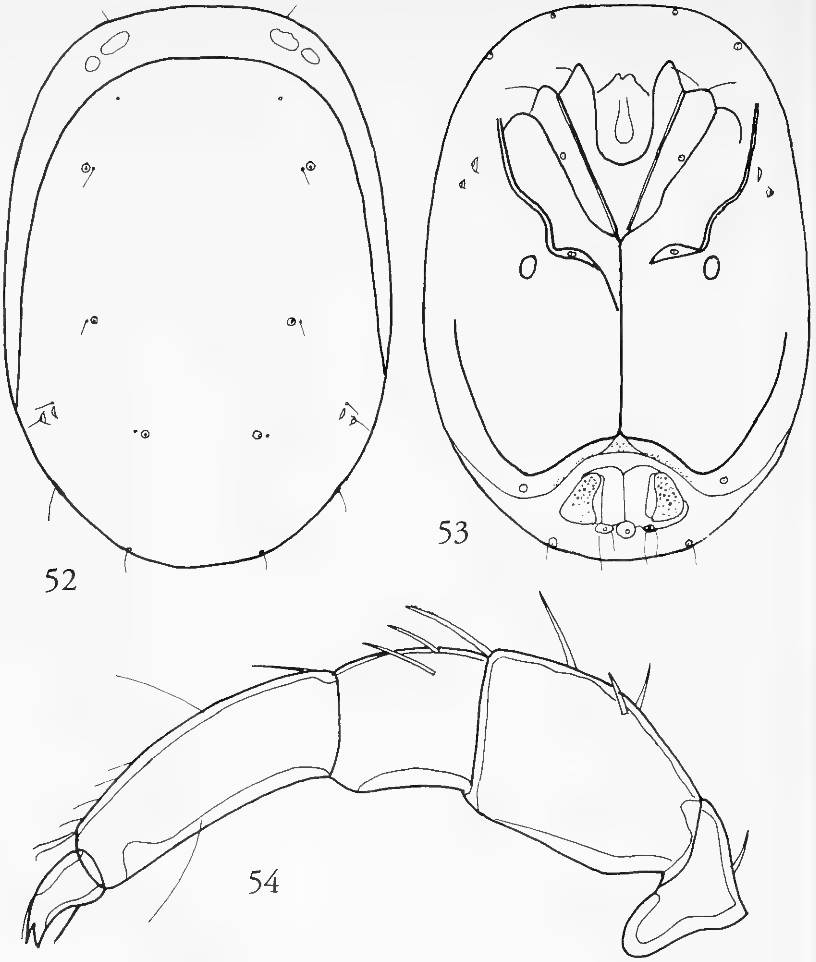
Gretacarus Viets

Gretacarus sp.

Males of *Gretacarus* exhibit the most useful taxonomic characters and a number of species are known only from males. Since only a female was found during this study, no name can be applied to this specimen.

Material examined. – Queensland: 1 ♀, loc. 40.

Figs. 52-54. *Albia brokenensis* sp. n. – 52, dorsal view ♀; 53, ventral view ♀; 54, palp ♀ (figs. 52-54 holotype).



Arrenurus Dugès

Arrenurus (*Arrenurus*) *balladoniensis* Halik, 1940

The type locality of this species is Farm Balladonia, southwestern Australia. Also reported from Victoria (Lundblad 1948) and Queensland (Cook 1986).

Material examined. – Queensland: 1 ♂, loc. 39.

Arrenurus (*Arrenurus*) *pseudoaffinis* Piersig, 1906

A widespread species, also reported from Thailand, Singapore, India and Indonesia.

Material examined. – Queensland: 1 ♀, loc. 21.

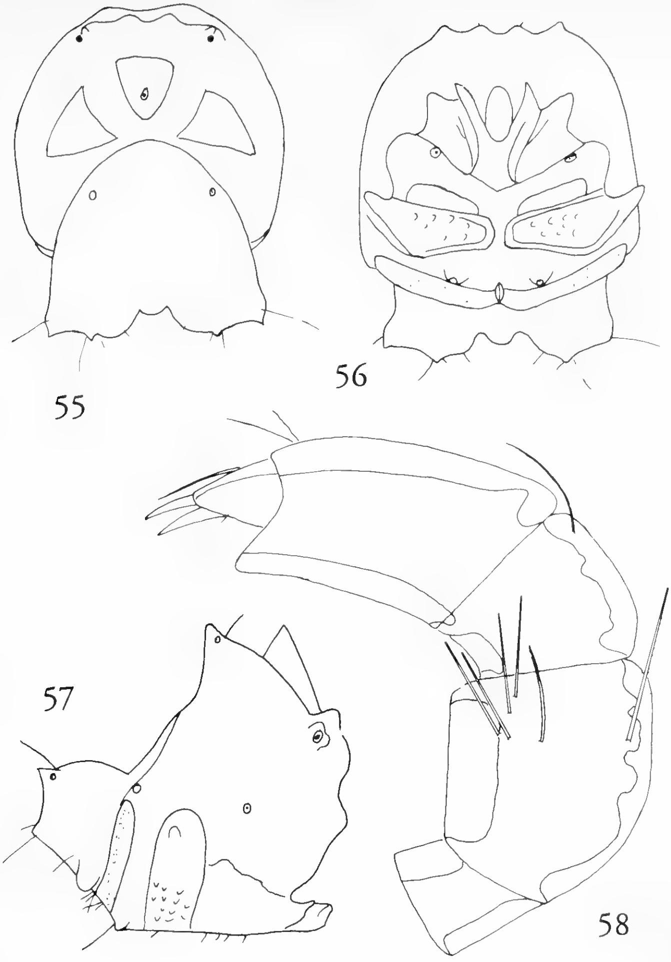
Arrenurus (*Megaluracarus*) *tricornutus* Viets, 1955 comb. n.

(figs. 55-58)

Viets (1955) described the female from a pool near Mossman, Queensland. The species is also mentioned by Viets (1975), without giving the precise location (but possibly Queensland). The male was hitherto unknown. At one location both females and males were collected. The male characters indicate that the species belongs to the subgenus *Megaluracarus*. A description is given below.

Male: Body 1536 μ in length , 1248 μ in width and 1416 μ in height. Dorsum with three large, well separated humps (as in the female) and four smaller humps in anterior portion of dorsum. Eyes located on the most lateral, rather pointed humps; the more medial pair of these humps less pointed. Dorsal furrow complete. Ventral side with a small epimeral field. Acetabular plates extending to lateral margins of body, the posterior margin slightly undulating. Gonopore small, 68 μ in length. Dorsal lengths of palp segments: PI 52 μ, PII 122 μ, PIII 72 μ, PIV 134 μ, PV 62 μ; PII with five setae on medial side. Legs II, III and IV with swimming setae; IV-leg-4 without a distal projection.

Material examined: 1 ♂, 2 ♀, loc. 22; 1 ♂, 1 ♀, loc. 25; 1 ♀, loc. 26; 1 ♀, loc. 32; 1 ♂, 1 ♀, loc. 37.



Figs. 55-58. *Arrenurus tricornutus* Viets. – 55, dorsal view ♂; 56, ventral view ♂; 57, lateral view ♂; 58, palp ♂.

Arrenurus (*Megaluracarus*) *rostratus degeneratus* Viets, 1984

A. rostratus is a widespread species, known from China, Singapore, India, Shri Lanka and Indonesia. Viets (1984) described the subspecies *A. rostratus degeneratus* from the Northern Territory.

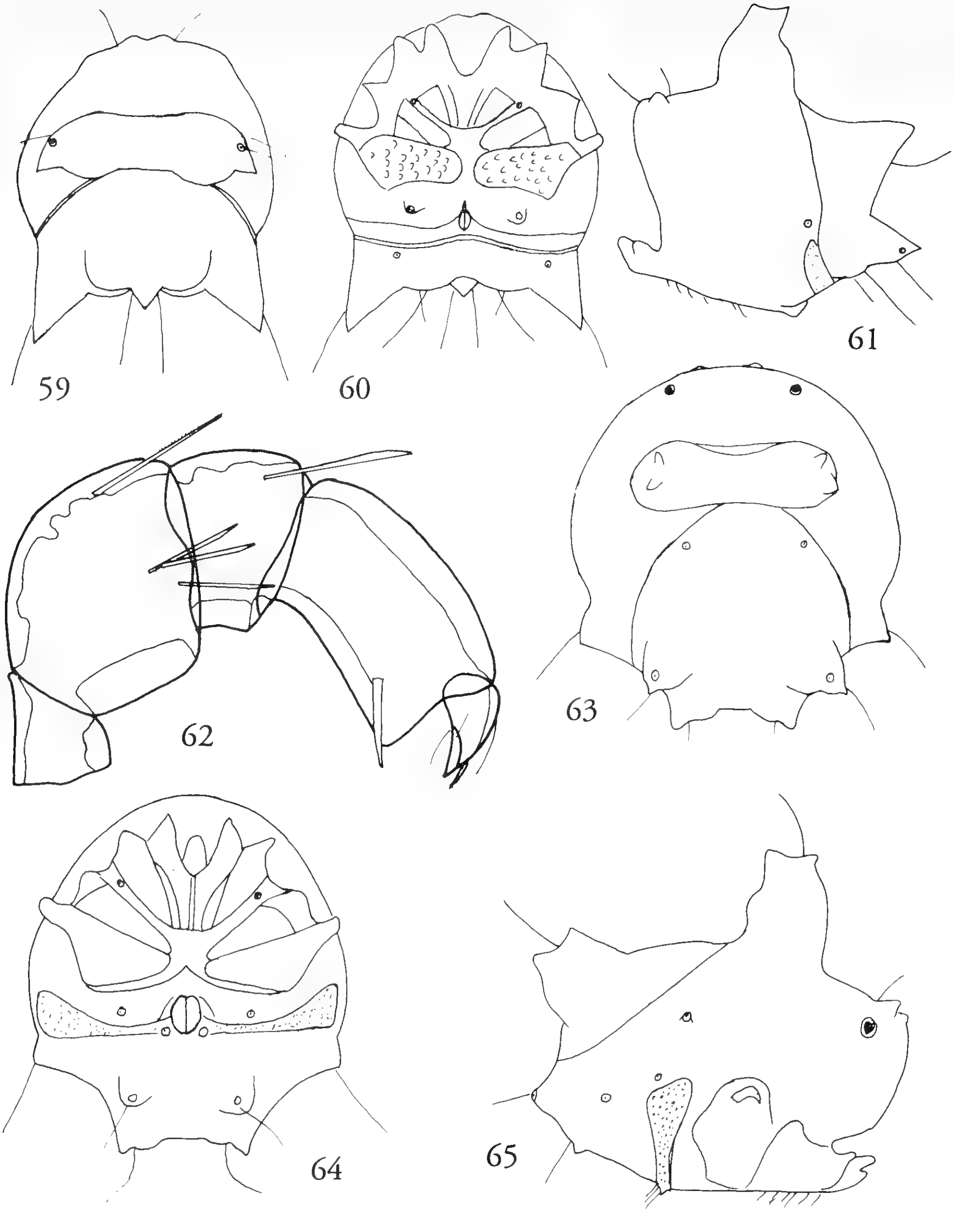
Material examined. – Queensland: 1 ♀, loc. 29.

Arrenurus (*Megaluracarus*) spec A
(figs. 70-72)

Only one female has been collected, and therefore no name is assigned. It is possibly a subspecies of *A. rostratus* (see discussion), and may therefore be placed in the subgenus *Megaluracarus.*

Female: Length of body 844 µ, width 630 µ and anteriorly pointed. Dorsal shield incomplete; lateral sides with small indentations. Body posterior with a short, truncate cauda. First coxae anteriorly pointed. Gonopore 136 µ in length. Dorsal length of palp segments: PI 24 µ, PII 60 µ, PIII 41 µ, PIV 62 µ, PV 41 µ; PII and PIV short, PII with two setae on medial side. (Note: antagonistic bristle of normal length, but depicted rather short in fig. 72). Legs II, III and IV with swimming setae; I-leg-4 and 5 with only 1-2 swimming setae.

Discussion. – This species is possibly a subspecies of *A. rostratus* Daday. Viets (1984) described *A. rostratus degeneratus* from the Northern Territory, Australia. Similar characters with this and other subspecies are the pointed first coxae, the anteriorly



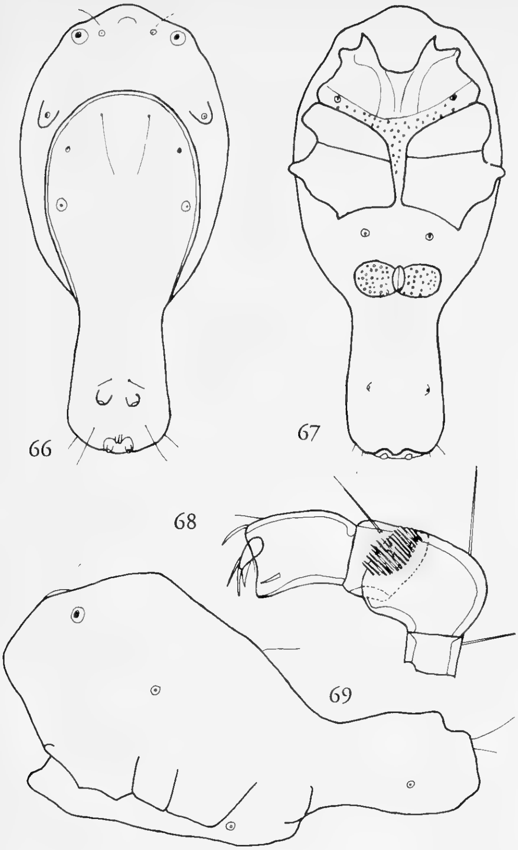
Figs. 59-65. *Arrenurus roobeeki* sp. n. – 59, dorsal view ♂; 60, ventral view ♂; 61, lateral view ♂; 62, palp ♂; 63, dorsal view ♀; 64 ventral view ♀; 65, lateral view ♀. (figs. 59 - 62 holotype).

pointed body and the short PII and PIV. This female differs in the form of the cauda and a very short PII and PIV.

Material examined. – One ♀ from a pond near Normanton, Queensland (loc. 37).

Arrenurus (*Megaluracarus*) *roobeeki* sp. n.
(figs. 59-65)

Type material. – Holotype male: Old river branch, south of Mackay, Queensland (loc. 21). – Paratypes: Same location as the holotype, 4 ♀, 1 ♂.



Figs. 66-69. *Arrenurus vanderpalae* sp. n. – 66, dorsal view ♂; 67, ventral view ♂; 68, lateral view ♂; 69, palp ♂ (figs. 66-69 holotype).

Description

Male: Body 1392 μ in length, 1140 μ in width and 1416 μ in height (including the humps). Dorsal furrow complete. Dorsum with three large humps, two anterior bifid humps and one posterior. Epimeral field small; fourth coxae with a medial side. Acetabular plates extending to the lateral body margins; acetabular plates not well sclerotisized, and therefore difficult to observe. Gonopore small, 82 μ in length. Epimeroglandularia 2 on tubercles. Dorsal lengths of palp segments: PI 53 μ, PII 110 μ, PIII 62 μ, PIV 125 μ, PV 62 μ; PII with three setae on medial side. Second, third and fourth leg with many swimming setae; IV-leg-4 without a distal projection.

Female: Body 1584 μ in length, 1440 μ in width and 1584 μ in height (including the humps). Dorsal furrow complete. Dorsum with four large, bifid humps. Third and fourth coxae almost without a medial side. Acetabular plates extending and expanding towards to the lateral sides of body and not well sclerotisized. Gonopore 136 μ in length and 145 μ in width. Epimeroglandularia 2 on tubercles. Dorsal lengths of palp segments: PI 53 μ, PII 118 μ, PIII 67 μ, PIV 127 μ, PV 62 μ. Legs II, III and IV with many swimming setae.

Etymology. – The species is named after Mr. C. F. Roobeek, who spend many hours drawing water mites.

Discussion. – The new species belongs to a group of water mites mainly distributed on the Pacific islands, e. g. *A. lohmanni* Piersig, 1898, *A. bicornutus* Piersig, 1898, and *A. multicornutus* Walter, 1915.

Arrenurus (*Megaluracarus*) *vanderpalae* sp. n.
(figs. 66-69)

Type material. – Holotype male: Cloncurry River, Cloncurry, Queensland (loc. 38).

Description

Male: Body 1176 μ in length and 572 μ in width. Dorsal furrow incomplete, with two pairs of glandularia. Dorsum with two small humps, on which glandularia are located. Cauda 398 μ in length, broadening posteriorly. Posterior margin with two small hyaline appendages and a small hyaline area. Dorsal side of posterior end of cauda with a rudimentary petiole consisting of two small spines. Glandularia of the cauda on tubercles. Gonopore 78 μ in length. Acetabular plates short and broad, 24 μ in length. First coxae pointed anteriorly; medial space between third and fourth coxae narrowing posteriorly; fourth coxae large. Dorsal lengths of palp segments: PI 26 μ, PII 74 μ, PIII 48 μ, PIV 72 μ, PV 41 μ; PII with a patch of setae. Leg IV with swimming setae; IV-leg-4 with a short distal projection. Legs I, II and III with long spines; legs II and III with a few short, rudimentary swimming setae.

Female: Unknown.

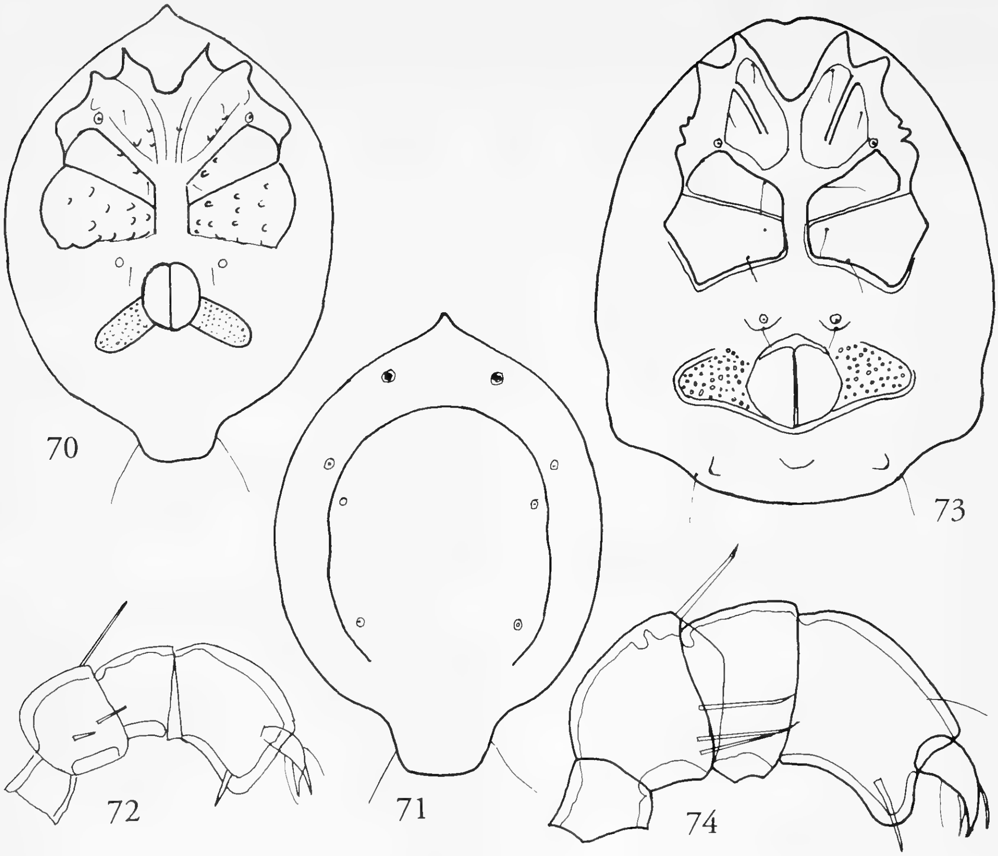
Etymology. – The species is named after Mrs. G. M. van der Pal, who assisted me with the field work.

Discussion. – The shape of the cauda and the structure of the hyaline appendages are diagnostic for the species.

Arrenurus (*Micruracarus*) *forcipatoides* Lundblad, 1941

Previously reported from Victoria and South Australia (Lundblad 1948), this species is widespread in ponds and small lakes in Queensland, including inland localities.

Material examined. – Queensland: 2 ♀, loc. 39; 4 ♂, 2 ♀, loc. 22; 1 ♂, loc. 26; 10 ♂, 15 ♀, loc. 37; 1 ♂, 3 ♀, loc. 28; 4 ♂, 1 ♀, loc. 25.



Figs. 70-72. *Arrenurus* spec A. – 70, ventral view ♀; 71, dorsal view ♀; 72, palp ♀. – Figs. 73-74. *Arrenurus* spec B. – 73, ventral view ♀; 74, palp ♀.

Arrenurus (*Truncaturus*) *tasmanicus* Lundblad, 1941

The species has been reported by Lundblad (1948) from Tasmania.

Material examined. – New South Wales: 1 ♂, 8 ♀, loc. 1; 1 ♂, 1 ♀, loc. 8.

Arrenurus spec B
(figs. 73-74)

Description

Female: Body 892 μ in length and 752 μ in width; dorsal furrow incomplete. Gonopore 155 μ in length. Acetabular plates short and broad; genital field 436 μ in width. Ventral shield posterior with two small humps. Dorsal length of palp segments: PI 34 μ, PII 86 μ, PIII 58 μ, PIV 82 μ, PV 46 μ; PII medially with three long setae. Third and fourth leg with many swimming setae, second leg with only a few swimming setae.

Male: Unknown.

Discussion. – As only the female is known, no name is assigned.

Material examined. – Cloncurry River, Cloncurry, Queensland, 1 ♀ (loc. 38)

ACKNOWLEDGEMENTS

I am indebted to G. M. van der Pal for her assistance during the field work and Dr. T. Gledhill for critically reading the manuscript. C. F. Roobeek made a number of illustrations.

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[1] Most authors (including Lundblad himself) cite this paper from Lundblad incorrectly as published in 1947. However, it is printed in 1947, but published in 1948. In the Zoological Record it is cited as Lundblad 1948.

APPENDIX I

Localities

New South Wales

1. Pond near Bombah Point, Myall Lakes NP (National Park). July 11, 1989.
2. Muirs Creek, near Myall Lakes NP. July 11, 1989.
3. Pond near Boolambay Creek, east of Bulahdelah. July 12, 1989.
4. Boolambay Creek, east of Bulahdelah. July 12, 1989.
5. Pond near Iluka, 50 km NE of Grafton. July 14, 1989
6. Cattle pond, north of Bundjalung NP, south of Woodburn. July 15, 1989.
7. Stream near Gap Road, Booroora Rest Area, near Bundjalung NP. July 16, 1989.
8. Heath pond, northern part Bundjalung NP. July 16, 1989.
9. Stream near Gap Road, north of Bundjalung NP. July 17, 1989.
10. Pond near Gap Road, Bundjalung NP. July 17, 1989.
42. Stream near Blackman campsite, Warrumbungle NP, 25 km east of Coonabarabran. August 21, 1989.
43. Spring, near Blackman campsite, Warrumbungle NP. August 2, 1989.
44. Cattle pond nr. 1 near Blackman campsite, Warrumbungle NP. August 21, 1989
45. Cattle pond nr. 2 near Blackman campsite, Warrumbungle NP. August 21, 1989
46. Small lake near Bundeena, Royal NP, 25 km south of Sydney. August 25, 1989.

Queensland

11. Creek at Elabama Falls, Lamington NP, 100 km south of Brisbane. July 18, 1989.
12. Blue Pool, Lamington NP. July 18, 1989.
13. Darraboola Creek, Lamington NP. July 19, 1989.
14. Poona Lake, Cooloola NP, 50 km NE of Gympie. July 21, 1989.
15. Pond along road to Rainbow Beach, Cooloola NP. July 21, 1989.
16. Teewah Creek, Cooloola NP. July 22, 1989.
17. Ululah Lagoon, Maryborough. July 22, 1989.
18. Broken River, Eungella NP, 80 km west of Mackay. July 27, 1989.
19. Lake near Eungella Dam, 10 km west of Eungella. July 28, 1989.
20. Small stream, tributary of Broken River, Eungella NP. July 28, 1989.
21. Old river branch, south of Mackay. July 29, 1989.
22. Pond near Crocodile Rd, Bowling Green Bay NP, 40 km south of Townsville. July 31, 1989.
23. Alligator Creek, Mnt. Elliot NP, 30 km south of Townsville. July 31, 1989.
24. Small lake, Townsville Common NP, north of Townsville. August 1, 1989.
25. Pond Townsville Common NP. August 1, 1989.
26. Freshwater Lagoon, Horseshoe Bay, Magnetic Island. August 3, 1989.
27. Douglas Creek, Palmerston NP, 30 km SE of Millaa Millaa. August 5, 1989.
28. Hasties Swamp NP, 4 km south of Atherton, Atherton Tablelands. August 6, 1989.
29. Lake Barrine, 15 km east of Atherton, Atherton Tablelands. August 7, 1989.
30. Lake near Tinaroo Falls Dam, Tinaroo, 15 km NE of Atherton, Atherton Tablelands. August 7, 1989.
31. Lake Eacham, 15 km east of Atherton, Atherton Tablelands. August 8, 1989.
32. Cattle pond, Upper Daintree Road, Daintree. August 9, 1989.
33. Elizabeth Creek, east of Mnt. Surprise. August 11, 1989.
34. Creek near Eubanangee Swamp NP, 15 km north of Innisfail. August 11, 1989.
35. Creek Innot Hot Springs, 30 km west of Ravenshoe. August 11, 1989.
36. Cattle pond, 21 km west of Georgetown. August 12, 1989.
37. Pond north of Normanton. August 14, 1989.
38. Cloncurry River, Cloncurry. Dry river bed with some ponds. August 14, 1989.
39. Pond north of Longreach. August 15, 1989.
40. Carnarvon Creek, Carnarvon NP, 100 km SE of Rolleston. August 17, 1989.
41. Pond between Carnarvon NP and Injune, approximately 38 km east of Carnarvon. August 19, 1989.

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PYCNOGONIDA FROM SOUTHERN BRAZIL

Stock, Jan H., 1991. Pycnogonida from southern Brazil. – Tijdschrift voor Entomologie, 135: 113-139, figs. 1-80. [ISSN 0040-7496]. Published 15 July 1992.

Records of Pycnogonida collected at 85 different stations in southern Brazil, between 18°34' S and 34°27' S. Four of these were sampled by hand or by skin-diving in the littoral and upper infralittoral zones, six stations were located on the continental slope between 250 and 1100 m, the remaining 75 were on the continental shelf. Forty-four species are represented, dispersed over 16 genera in seven families. Seven species are new to science, in the genera *Eurycyde* (*E. platyspina* sp. n.), *Achelia* (*A. columnaris* sp. n.), *Nymphon* (*N. bullatum, N. inaequipes, N. vulcanellum* spp. n.), *Anoplodactylus* (*A. spurius* sp. n.), and *Pycnogonum* (*P. ornans* sp. n.). New to the fauna of Brazil are eight species. New synonymies are proposed in *Pallenopsis* (*P. boehmi* Schimkewitsch, 1930 = *P. longicoxa* Stock, 1966) and *Anoplodactylus* (*A. petiolatus* (Krøyer, 1844) = *A. guyanensis* Child, 1977).

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Key words. – Pycnogonida, taxonomy, distribution, Brazil, littoral, shelf, continental slope.

The pycnogonid fauna of southern Brazil is relatively well-studied, mainly through the monographic treatment of Marcus (1940b) and a number of satellite papers in the following decades by Corrêa (1948), Sawaya (1945, 1947, 1950, 1951), Zilberberg (1963), Zago (1970), de Mello-Leitão (1945, 1946, 1949 a, b, 1955), Marcus & Marcus (1963) and Marcus-du Bois-Reymond (1952). Occasionally, large expeditions collected material on the Brazilian coast, e.g. the 'Challenger' (Hoek 1881), the 'Vettor Pisani' (Schimkewitsch 1890), the 'Calypso' (Stock 1966), and some American cruises (Child 1982a). Nevertheless the present collections from southern Brazil form a fine addition to our previous knowledge. The material was brought together by the late Dr. Plínio Soares Moreira of the Instituto Oceanographico of the University of São Paulo (USP), mainly on board of the Oceanographic Research Vessel 'Prof. W. Besnard'.

The amount of previous work done explains why the number of new species in the present collection is relatively low (7 out of 44, or 16%). However, taken into consideration that another eight species are new to Brazil, a total of 15 species is added to the Brazilian fauna, which is not too bad a score (more than one-third of the species represented in this collection).

Biogeographically, endemics and warm-water species are predominant in the Brazilian fauna, not surprising in the light of the South Atlantic Drift which distributes tropical waters along major parts of the coastline of the country.

As table 1 shows, a good number of species (viz. 21) is endemic to Brazil (and neighbouring territories, the Mar del Plata and the Guyanas). Another group of eleven species are mainly warm-water elements which have their distribution centre in the Caribbean. One of these species, *Ammothella spinifera,* occurs on the Pacific coasts of the Americas as well. Interesting is a small group of seven species occurring on both sides of the Atlantic Ocean (so-called amphi-Atlantic species). Finally, some Magellanean cold-water species reach their northern distribution limits on the shelf of southern Brazil, but this group contains only three species in all.

METHODS

Entire specimens were studied and measured in glycerin or lactophenol, dissected appendages on permanent slides in Reyne's modification of Faure's medium. All specimens have been deposited in the Zoölogisch Museum, Amsterdam (ZMA).

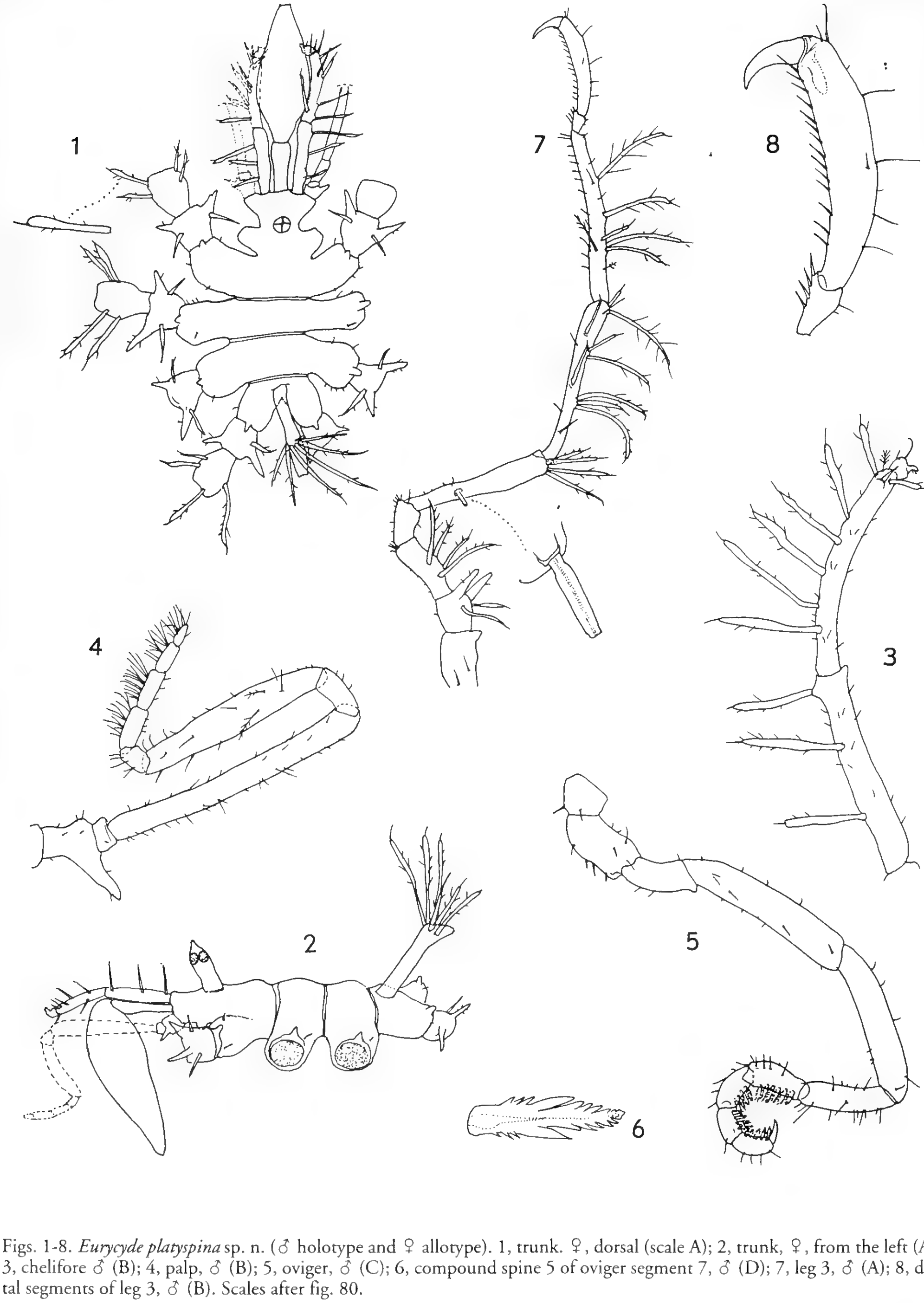
DESCRIPTIVE PART

Family Ammotheidae

Eurycyde platyspina sp. n.
(figs. 1-8)

Type material. – 1 ♀ (holotype), 1 ♂ (paratype), Project Isotan-Draga I, Stn. MBT 155: 22°22' S 41°32' W, 34 m, 5 Sep 1970 (ZMA Pa. 3443).

Description. – Unlike certain other species of the



Figs. 1-8. *Eurycyde platyspina* sp. n. (♂ holotype and ♀ allotype). 1, trunk. ♀, dorsal (scale A); 2, trunk, ♀, from the left (A); 3, chelifore ♂ (B); 4, palp, ♂ (B); 5, oviger, ♂ (C); 6, compound spine 5 of oviger segment 7, ♂ (D); 7, leg 3, ♂ (A); 8, distal segments of leg 3, ♂ (B). Scales after fig. 80.

genus, the two sexes are very similar in spination, etc., even in the morphology of the oviger. Secondary sexual differences (presence of femoral cement gland tube in male, large genital pores on ventral surface of coxa 2 of all legs in female) may serve to discriminate between the sexes.

Trunk completely segmented; mid-dorsal line without tubercles. Lateral processes separated by narrow intervals, distally with low tubercle. Oviger implantation free of first lateral process. Proboscis with articulated stalk, distal part directed downward. Abdomen straight in basal part; at about 80% of its length 6 setae are implanted at bend of abdomen. Ocular tubercle cylindrical with pointed tip; eyes small, well-pigmented, touching; no setae on ocular tubercle.

Chelifore scape 2-segmented, segments subequal in length; segm. 1 with 3 long spines, segm. 2 with 7. Chela not retracted in distal end of scape; hand globular, with 1 rudimentary finger and 2 setae.

All spines (on chelifores, coxae 1 and 2, femur and tibiae 1 and 2) are of rather peculiar morphology (fig. 1, detail), viz. flattened, with more or less obtuse tip and with distal spinule, both margins with some lateral setules.

Palp segm. 1 with very strong lateral spur; segm. 2 minute; segm. 3 longest; segm. 6 shorter than 7; segms. 7 to 9 subequal, segm. 10 shorter.

Oviger segm. 4 longest; segms. 7 to 10 with 2 rows of compound spines, in longest row according to formula 6:4:4:5. Compound spines with 3 small proximal marginal teeth, then 1 large tooth, and 4 to 5 smaller distal teeth. Terminal claw short, slightly curved, smooth.

Coxa 1 with 2 long disto-dorsal spurs and 2 more proximal dorsal spines. Coxa 2 with 2 + 2 dorsal spines. Coxa 3 with minute spinules only. Femur of male with swelling at about 40% of posterior surface, bearing tube of cement gland; femur of female without such swelling; distal end of femur with 4 long spines. Tibiae 1 and 2 with several (5-7) long dorsal spines, plus some long lateral spines. Tarsus short. Propodus slightly curved, distally widening, no heel; sole with 12-14 spinules of uniform size. Claw short, curved; no auxiliary claws.

Female genital pores on distoventral surface of coxa 2 of all legs; male cement glands on femur of all legs.

Measurements (mm) of holotype: Length trunk (frontal margin cephalic segment to tip 4th lateral process) 1.71; diameter across 2nd lateral processes 1.17; length abdomen 0.58; length proboscis 1.36. Paratype, leg 3: first coxa 0.31; second coxa 0.49; third coxa 0.27; femur 1.01; first tibia 1.17; second tibia 1.17; tarsus 0.10; propodus 0.70; claw 0.23.

Etymology. – The specific name, *platyspina*, refers to the curious shape of the spines on chelifores, abdomen and legs.

Remarks. – Child (1988b) has presented a key to the species of *Eurycyde*. Since the construction of this key, three more species became known: *E. antarctica* Child, 1987 (which can be traced down to couplet 7 of the key), *E. longioculata* Müller, 1990 and *E. diacantha* Stock, 1990 (both 'strand' in couplet 3 of the key). Child (1988b: 7) remarks that *E. acanthopus* Stock, 1979 (described from a female) is probably the opposite sex of *E. curvata* Child, 1979 (described from a male). If this supposition is true, it might be useful to know which name has priority. It turned out to be almost a photofinish: *E. acanthopus* was published Sep 10, 1979, and *E. curvata* Sep 27, 1979, so the former name has priority.

Eurycyde platyspina sp. n. can be followed in Child's key to couplet 7, along with the couple *acanthopus* / *curvata*, *hispida* (Krøyer, 1844) and *antarctica.* It differs from *antarctica* in having long spines on the abdomen (abdomen practically glabrous in *antarctica*), and from *acanthopus/curvata* in having the abdominal spines arranged in a single dorsal group (versus scattered over the abdomen). Finally it differs from *hispida* in the presence of a tubercle on the lateral processes and 2 spurs on coxa 1 (none in *hispida*).

Nymphopsis melidae Sawaya, 1947

N. melidae Sawaya, 1947: 83-87, pls. I-II.

Material. – 1 chelate juvenile, Project Isotan-Draga I, Stn. MBT 157: 21°46'S 40°58' W, 15 m, 5 Sep 1970; 1 ♀, 2 chelate juveniles, Project Isotan-Draga I, Stn. MBT 165: 21°20' S 40°39' W, 28 m, 6 Sep 1970; 1 ♂, Project Petrobas/USP, Stn RD 54: 18°54.8'S 39°15.4' W, 41 m, 12 Aug 1972.

Remarks. – Up to now this species has been recorded only once: Sawaya (1947) described a single male from the upper littoral zone of Ilha das Palmas, Baía de Santos (ca. 24° S). The present records are more north, and from deeper shelf waters (15-41 m).

The juveniles in this collection have an unsegmented scape, the adults a 2-segmented scape. This feature, often used as a key character, should be used with some care.

Cilunculus sp.

Material. – 1 juvenile, Project Isotan-Draga I, Stn MBT 143: 24°08'S 42°28'W, 1020 m, 2 Sep 1970.

Remarks. – This juvenile has still retained its chelae, and the ovigers are an undeveloped, sausage-like structure. In most of its characters, it resembles closely *C. europaeus* Stock, 1978, from deep waters of the Bay of Biscay and the entrance of the English Channel (absence of an ocular tubercle, long setae on the legs, long auxiliary claws, absence of mid-dorsal trunk tubercles), but it differs from *C. europaeus* in the naked lateral processes (setose in *europaeus*) and in the greater space between the anterior lateral processes (interval 3 times the diameter of the lateral process). The propodal heel bears 1 larger spine (2 in *europaeus)* and the sole bears only 6 spines, which are longer than those of *europaeus.*

I presume this specimen represents an undescribed species, but in absence of adults I refrain from naming it. The genus *Cilunculus* is new to Brazil.

Ammothella appendiculata (Dohrn, 1881)

A. appendiculata; Child 1979: 9 [refs.].

Material. – 1 ♂, USP Stn. F 23: Enseada do Flamengo, Ubatuba, State of São Paulo; intertidal of rocky shore; 13 Feb 1965; 1 ♀, Project Isotan-Draga I, Stn. MBT 165: 21°20'S 40°39'W, 28 m, 6 Sep 1970.

Remarks. – The female of Stn. MBT 165 is in agreement with the general diagnosis of this species. The male of Stn. F 23 is intermediate between *A. appendiculata* and *A. rugulosa* (vide infra), in that it has the short first scape segment of the former, but it possesses a hollow spine on the scape and spines on the lateral processes, that characterize the latter. Presumably the two species are identical.

A. appendiculata is an amphi-Atlantic species, already known from Brazil (Marcus 1940b).

Ammothella rugulosa (Verrill, 1900)

A. rugulosa; Child 1979: 11 [refs.].

Material. – 1 ♂, 1 juv., Project Isotan-Draga I, Stn. MBT 155: 22°22'S 41°32'W, 34 m, 5 Sep 1970.

Remarks. – The adult male agrees well with the characteristics presumed to characterize this species. However, in view of the large range of variation observed in *A. appendiculata* (vide supra), and in agreement with the opinion of Stock (1975a) and Child (1979), *A. rugulosa* is probably synonymous with that species.

A. rugulosa is a West Indian species, recorded before from Brazil by Marcus (1940b).

Ammothella spinifera Cole, 1904

A. spinifera Cole, 1904: 275-277, pl. 12 fig. 8, pl. 20 figs. 7-9, pl. 21 figs. 1-6; Hilton 1915: 204; Child 1979: 11-12, fig. 3f-h [older refs.]; Wicksten 1980: 198; Austin 1985: 428; Salazar-Vallejo & Stock 1987: 269; Müller & Roth 1990: fig. 4; Müller 1990b: 278.

Material. – 1 ♂ (ovig.), 1 ♂, 4 ♀, 3 juvs., USP Stn. F 10: Ponta de Santa Rita, Enseada do Flamengo, State of São Paulo; amongst ascidians, bryozoans and sponges in infralittoral zone on rocks; 13 Feb 1965.

Remarks. – The present material falls perfectly within the range of variation described by Child (1979). The species is mainly known from the Pacific (from southern California to the coast of Panamá and the Galapagos Islands). Child (1979) was the first to record it from the Caribbean coast of Panamá, and recently Müller (1990b) recorded it from Martinique and Barbados. Its range is considerably extended southward, to the coast of southern Brazil, by the present record.

Achelia besnardi Sawaya, 1951

A. besnardi; Stock 1975b: 70-71, figs. 1-9 [older refs.].

Material. – 1 ♂, Project Petrobas/USP, Stn. RD 40: 19°15.8'S 38°56.3'W, 59 m, 11 July 1972.

Remarks. – This specimen resembles closely Sawaya's (1951) good illustrations. It is a relatively rare species, having been found off Rio de Janeiro, in the Virgin Islands, and the Bahamas. There is no material available that substantiates Fry & Hedgpeth's claim (1969: 102) that the species occurs in the former Belgian Congo or (on their distribution map, fig. 155) on the South American coast as far south as 45°. Probably, these authors have confused *A. besnardi* with *A. sawayai* (vide infra) which was recorded by Fage (1949) from Zaïre.

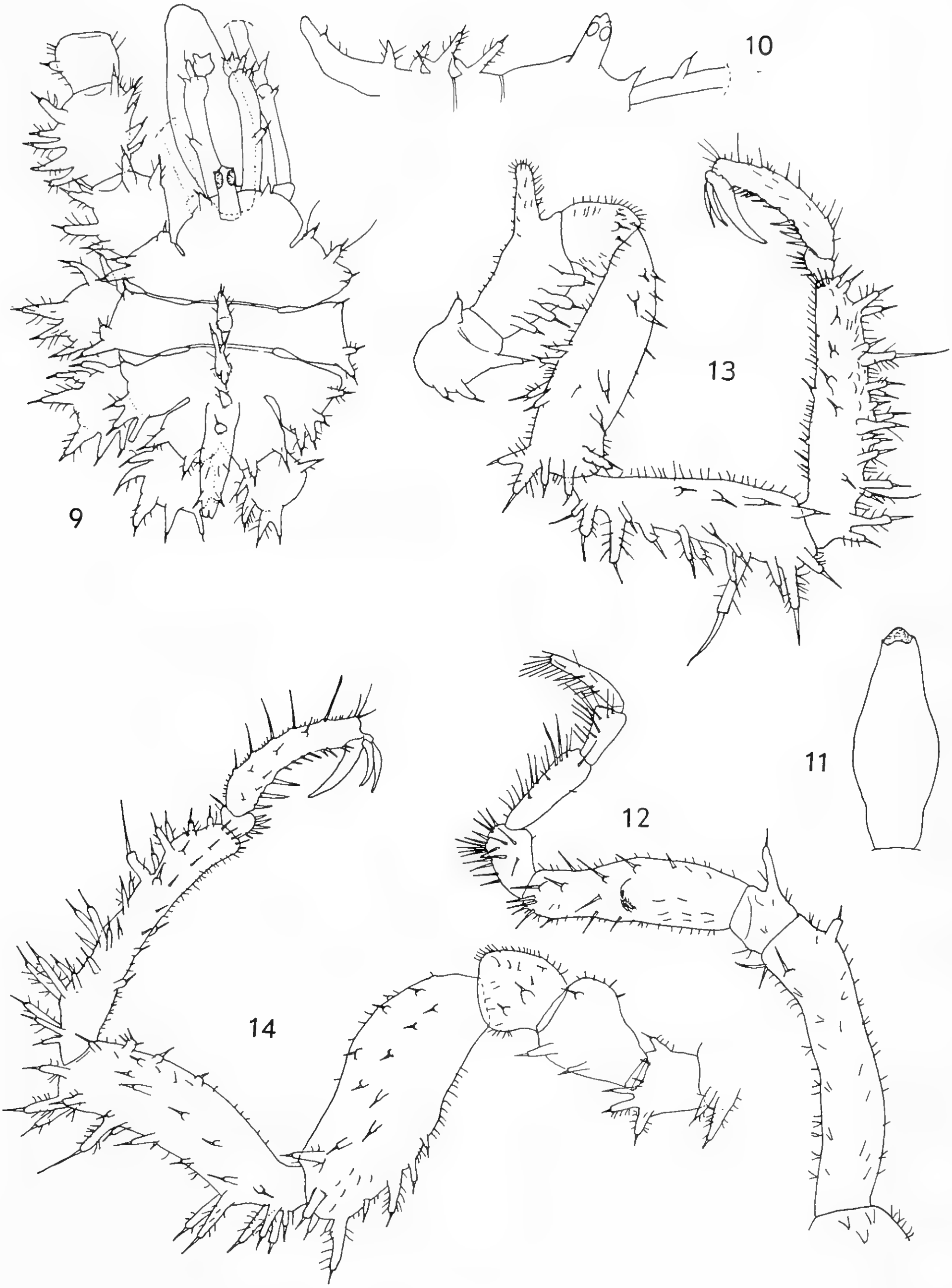
Contrary to Fry & Hedgpeth's (1969: 105) opinion, I consider this species closely related to *A. sawayai*, with which it agrees in two essential characters: (1) all spines on the propodal sole are of equal size, and (2) absence of a male genital spur.

Achelia columnaris sp. n.
(figs. 9-18)

Type material. – 1 ♂ (ovig.), holotype and 3 ♀ paratypes, Project Isotan-Draga I, Stn. MBT 155: 22°22'S 41°32'W, 34 m, 5 Sep 1970 (ZMA Pa. 3444).

Description. – Male: Trunk compact, hardly any space between lateral processes. Trunk segments 1, 2, and 3 separated by articulation lines, segments 3 and 4 fused. Trunk segments 2 and 3 with bifid mid-dorsal spur (anterior branch longer than posterior one), tipped with spinules. Trunk segment 4 and proximal end of abdomen with lower, simple mid-dorsal spur. Anterior margin of cephalic segment with pointed tubercle on either corner. Ocular tubercle with 2 minute lateral knobs and small distal knob; eyes small, pigmented. Lateral processes with spiniferous spurs, some bifid or trifid at tip.

Proboscis of type C (greatest width at less than mid-length, distal part tapering). Abdomen reaching to distal end of coxa 1 of leg 4, slightly upcurved; apart from dorsal spur in basal part, it bears 2 lateral



Figs. 9-14. *Achelia columnaris* sp. n. (♂ holotype and ♀ paratype). 9, trunk, ♂, dorsal (scale A); 10, contour of dorsum, ♂, from the right (A); 11, proboscis, ♂, ventral (A); 12, palp, ♀ (B); 13, leg 3, ♂ (A), 14, leg 3, ♀ (A). Scales after fig. 80.

spiniferous tubercles near distal end.

Chelifore scape with 1 tall mediolateral spur, and 2 distolateral spurs of unequal length. Chela with 2 pointed processes (rudiments of fingers).

Palp 8-segmented; basal segments covered with short spinules; segm. 2 with distolateral spiniferous process; a much taller, pillar-shaped process present on distolateral corner of segm. 3. Segm. 2 > 4; segm. 5 < 6; 6 > 7; 7 < 8. Distal segms. slender, with ventral brush of setae.

Oviger segms. 4 and 5 subequal, with recurved row of spinules. Segm. 6 with strong, reversed spine in basal part, and several other, smaller, reversed spinules. Compound spines elongate, with some 8 pairs of marginal teeth; formula 2:2:1:2.

Legs: Coxa 1 with 1 or 2 tall spiniferous spurs on anterior margin, 2 on posterior margin, and 2 or 3 on distal margin. Coxa 2 with 3 or 4 tall spurs on anterior and posterior margins. Coxa 3 with 1 or 2 spiniferous tubercles. Femur with numerous spiniferous processes on posterior and dorsal surface, taller towards distal end. Tibia 1 with many very tall, pillar-shaped, spiniferous spurs on dorsal and posterior surface, tibia 2 with still more numerous, but slightly less tall such spurs. Tarsus short, with 4 or 5 ventral spines. Propodus slightly curved, heel with 3 or 4 large spines; sole with some 7 smaller spines. Auxiliary claws more than half as long as main claw. Genital spur long, thump-shaped, on ventrodistal corner of coxa 2 of legs 3 and 4.

Female: Mid-dorsal trunk tubercles simple (not bifid); tubercle over base of abdomen lacking. Spurs on lateral processes and legs as tall as in male, but coxa 1 without marginal spurs (only with distal spurs, occasionally with 1 small posterior spur). Coxa 2 with 1 pair of marginal spurs and 1 pair of distal spurs. Femur more swollen than in male. Genital apertures on ventral surface of coxa 2 of all legs.

Measurements (mm) of male (those of female in parentheses). – Length proboscis (ventral) 1.10 (1.15); greatest diameter proboscis 0.44 (0.43); length trunk (to tip 4th lateral process) 1.30 (1.26); width across 2nd lateral processes 1.16 (0.94); length abdomen 0.59 (0.59); length scape 0.57 (0.67); diameter egg on male oviger 0.15.

Leg 3: first coxa 0.46 (0.34); second coxa 0.50 (0.57); third coxa 0.34 (0.38); femur 1.177 (1.37); first tibia 1.27 (1.39); second tibia 1.31 (1.46); tarsus 0.13 (0.11); propodus 0.71 (0.74); claw 0.39 (0.40); auxiliary claw 0.23 (0.28).

Etymology. – The proposed specific name, *columnaris* (Latin, pillar-shaped) alludes to the shape of the spurs on femur and tibiae.

Remarks. – The new species shows, by the presence of a row of mid-dorsal trunk tubercles, a strong similarity to the *Achelia assimilis/wilsoni/variabilis* complex (see Hedgpeth 1961), frequently recorded from the major oceans of the southern hemisphere. However, none of the recorded 'variations' has tall, pillar-shaped spurs on femur and tibiae. Similar tall spurs are present on palp segments 2 and 3 of the new species, whereas in the *A. assimilis* group just a tubercle is present.

The very strong armature of the legs is not unlike that found in *A. setulosa* (Loman, 1912), but that species lacks mid-dorsal trunk and palp spurs, and has a less slender distal palp segment.

Other very spinose *Achelia* species from the central Atlantic Ocean are *A. turba* Stock, 1990 (which has however no mid-dorsal trunk spurs, shorter spurs on the long leg segments, a shorter male genital spur, and a less pointed proboscis), and *A. armata* (Bouvier, 1916) (which lacks spurs on the long leg segments or in the mid-dorsal line and has less elongate femur, tibiae 1 and 2, and propodus).

Achelia gracilis Verrill, 1900

A. gracilis; Hedgpeth 1948: 244, fig. 38 f-g [older refs.]; Stock 1954: 117; Stock 1979: 10; Stock 1986: 416; Zambrana et al. 1985: 30 [refs.]; Markham 1986: 276, fig. 87.

Material. – 1 ♂, Project Petrobas/USP, Stn. RD 50: 19°02.5'S 39°30.6'W, 28 m, 12 July 1972.

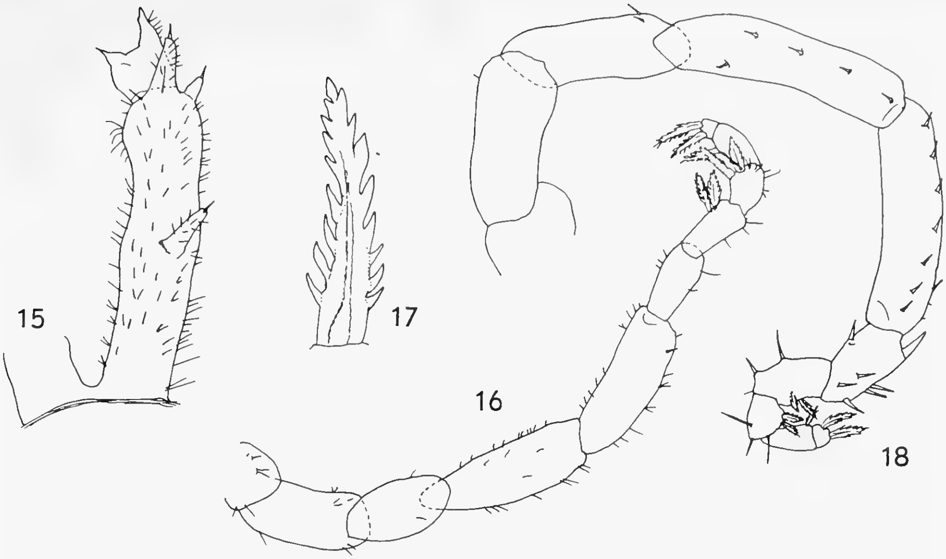
Remarks. – This species was known from Bermuda to the West Indies. It is new to the fauna of Brazil.

Achelia sawayai Marcus, 1940

A. sawayai; Krapp & Kraeuter 1976: 342-343 [older refs.]; Stock 1986: 414-416 [older refs.]; Stock 1989: 87-89; Müller 1989: 124; Müller 1990a: 105-106; Müller 1990b: 277; Stock 1990: 218-219.

Material. – 64 spms., USP Stn. P.E.: Ponta do Espia, Ubatuba, State of São Paulo, on seaweeds of rocky shore, infralittoral, 20 Nov 1964; 3 ♂, 6 ♀, 25 juvs., USP Stn. F 23: Enseada do Flamengo, Ubatuba, State of São Paulo; infralittoral, on large boulders, amongst ascidians, bryozoans, sponges, 13 Feb 1965; 1 ♀, 1 juv., USP Stn. F 10: Ponta de Santa Rita, Enseada do Flamengo, Ubatuba, State of São Paulo; intertidal, rocky shore, on *Dyctiota* sp., 12 Dec 1965; 1 ♂ ovig., 1 ♂, 1 ♀, Project Isotan-Draga I (PID) Stn. MBT 152: 23°03'S 41°10'W, 98 m, 4 Sep 1970; 1 juv., PID Stn. MBT 159: 22°00'S 40°06'W, 90 m, 5 Sep 1970; 1 juv., PID Stn. MBT 161: 21°42'S 40°15'W, 56 m, 6 Sep 1970; 2 ♂, 1 ♀, 5 juv., PID Stn. MBT 164: 21°15'S 40°50'W, 19 m, 6 Sep 1970; 1 ♂ ovig., Project Petrobas/USP, Stn. RD 54: 18°54.8'S 39°15.4'W, 41 m, 12 July 1972; 1 ♂, 1 ♀, 1 juv., Project Petrobas/USP, Stn. RD 56: 18°54.7'S 38°53.5'W, 38 m, 12 July 1972.

Remarks. – Originally described from Brazil, the species is now recorded from all over the West Indies, the Gulf of Mexico, the American east coast as far north as Georgia, the Cape Verde Islands, Mauritania



Figs. 15-18. *Achelia columnaris* sp. n. (♂ holotype and ♀ paratype). 15, chelifore, ♀ (scale B); 16, oviger, ♀ (B); 17, compound spine of oviger segment 10 (free-hand sketch); 18, oviger, ♂ (B). Scales after fig. 80.

(unpubl. record based on material in the Museum Gr. Antipa, Bucarest), Zaïre, Madagascar, and the Society Islands.

Tanystylum acuminatum Stock, 1954
(figs. 19-21)

T. acuminatum Stock, 1954: 125-127, fig. 29; Stock 1979: 11; Müller 1990b: 278.

Material. – 15 spms. (incl. ovigerous males), USP Stn. P.E.: Ponta do Espia, Ubatuba, State of São Paulo, on seaweeds growing in the infralittoral of rocky shore, 20 Nov 1964; 1 ♀, USP Stn F 27: Rocky shore between Praia do Dionisio and Praia do Flamengo, Enseada do Flamengo, Ubatuba, State of São Paulo, on algae at low tide, 15 Feb 1965; 1 ♀, USP Stn F 10: Ponta Santa Rita, Enseada do Flamengo, Ubatuba, State of São Paulo, intertidal of rocky shore, on *Dyctiota* sp., 12 Dec 1965; 1 ♀, Project Isotan-Draga I, Stn. MBT 157: 21°46'S 40°58'W, 15 m, 5 Sep 1970.

Remarks. – The male has never been described before. It resembles the female in almost every character, except for the tuberculation of coxa 1, which is slightly stronger in the male, and of course the structure of the oviger. The male oviger has an ecto-distal apophysis on segment 7, which places *T. acuminatum* in a group of species comprising *T. tubirostrum* Stock, 1954, *T. dowi* Child, 1979, *T. oculospinosum* Hilton, 1942, *T. isthmiacum* Stock, 1955, and *T. isabellae* Marcus, 1940.

T. acuminatum is new to Brazil; it was previously known from the Lesser Antilles only (St. Barts, Anguilla, Martinique).

Tanystylum evelinae Marcus, 1940

T. evelinae Marcus, 1940b: 99-102, fig. 13.

Material. – 1 ♂ ovig., USP Stn. P.E.: Ponta do Espia, Ubatuba, State of São Paulo, on seaweeds growing on rocky shore, infralittoral, 20 Nov 1964.

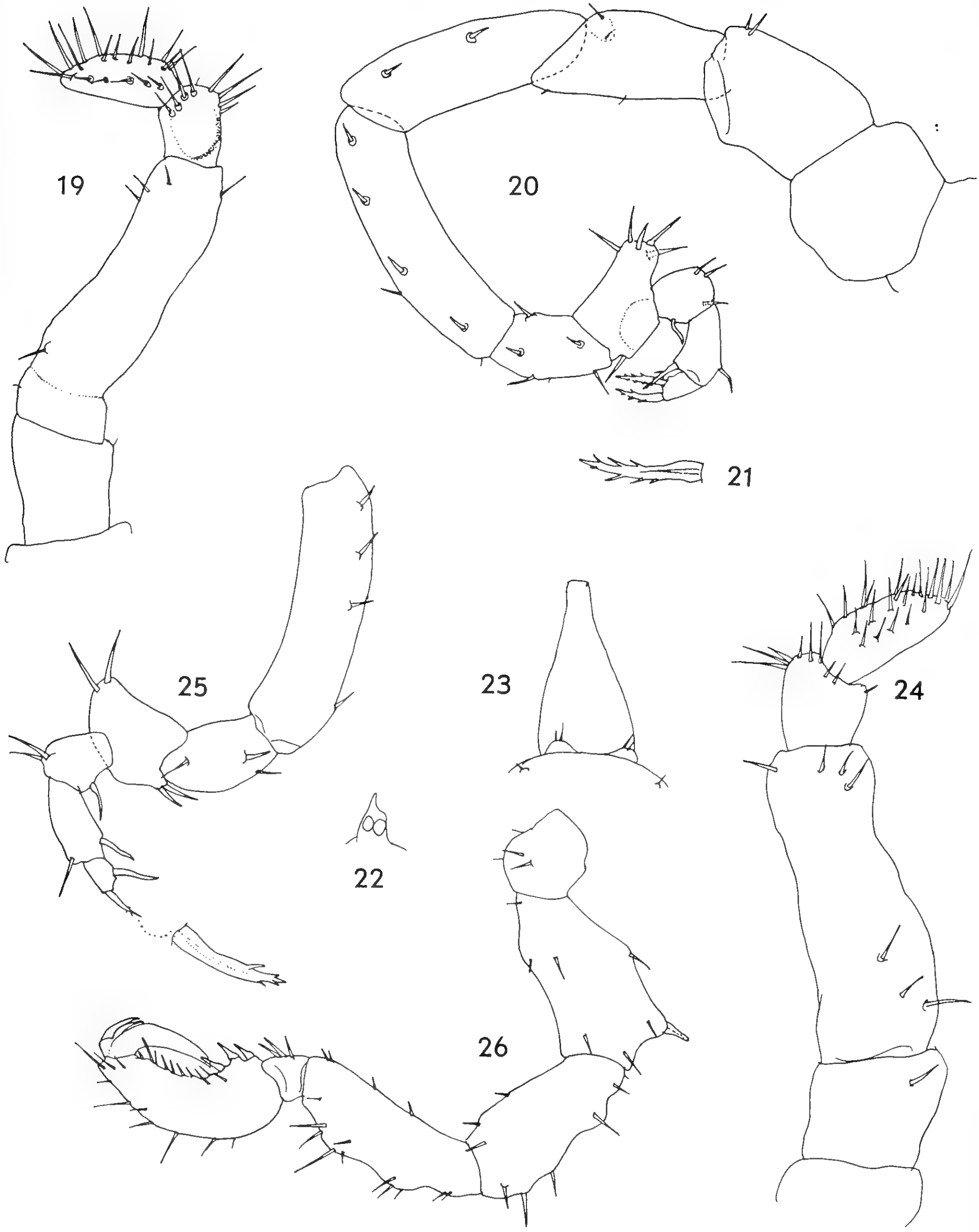
Remarks. – The single specimen is badly damaged, but is probably this species. *T. evelinae* was already found in the same general area by Marcus (1940b), but was never recorded again. As point of fact it resembles strongly *T. haswelli* Child, 1990, an Australian form. The palps of *haswelli* are 4-segmented, those of the types of *evelinae* 6-segmented, but in the present specimen, articulation lines in the basal part of the palp are obscure, resulting in a 4-segmented appearance of the appendage.

Tanystylum isabellae Marcus, 1940
(figs. 22-26)

T. isabellae Marcus, 1940b: 95, 102-105, fig. 14; Fage 1949: 29, fig. 5.

Material. – 1 ♂, 3 juvs., USP Stn. P.E.: Ponta do Espia, Ubatuba, State of São Paulo, on seaweeds growing on rocky shore, infralittoral, 20 Nov 1964.

Remarks. – The types come from the same area and the same depth. Fage (1949) records it moreover from Zaïre.



Figs. 19-21. *Tanystylum acuminatum* Stock, 1954 (♂ from Stn. usp/P.E.). 19, palp (scale E); 20, oviger (E); 21, spine 1 of oviger segment 10 (free-hand sketch).
Figs. 22-26. *Tanystylum isabellae* Marcus, 1940 (♂ from Stn. usp/P.E.). 22, ocular tubercle from the left (free-hand sketch); 23, proboscis and chelifores (A); 24, palp (E); 25 distal part of oviger (E); 26, leg 2 (B). Scales after fig. 80.

Some new illustrations are incorporated here, mainly to show the shape of the proboscis. The penultimate palp segment is slightly less lobate than Marcus' figure 14E suggests, but it is in good agreement with Fage's fig. 5.

This species is strikingly similar to *T. oculospinosum* Hilton, 1942 (vide Child & Hedgpeth 1971: 619, fig. 5, and Child 1979: 34), a Pacific species ranging from Baja California to the Galapagos Islands. The only difference seems to be the second tibia which looks shorter in Child & Hedgpeth's fig. 5c. I suppose, however, that both species are synonymous, in which case Marcus' name has priority. Child (1979) records another *Tanystylum, T. tubirostrum* Stock, 1954 and several other species of Pycnogonida from both the Atlantic and the Pacific side of the Americas, so from a biogeographic point of view it would not be too surprising if the Pacific *T. oculospinosum* and the Atlantic *T. isabellae* were synonymous.

Tanystylum isthmiacum difficile Stock, 1966

T. isthmiacum difficile Stock, 1966: 389-390, fig. 2 a-h; Fage & Stock 1966: 318; Stock 1975a: 984; Child 1979: 29-30; Stock 1979: 11-13, fig. 3 b-f; Zambrana et al. 1985: 31 [refs.].

Material. – 1 juv., Project Petrobas/USP, Stn. RD 50: 19°02.5'S 39°30.6'W, 28 m, 12 July 1972.

Remarks. – This young specimen, with still poorly developed ovigers, agrees well with the published descriptions of this (sub)species. It was already known from the same general depth in the same area (Stock 1966).

Tanystylum orbiculare Wilson, 1878

T. orbiculare; Krapp 1973: 69, fig. 4; Child 1990: 319, fig. 3 [holotype re-illustrated].

Material. – 5 spms., USP Stn. P.E.: Ponta do Espia, Ubatuba, State of São Paulo, on seaweeds of intertidal zone of rocky shore, 20 Nov 1964; 1 ♀, USP Stn. F 27: Rocky shore between Praia do Dionisio and Praia do Flamengo, Enseada do Flamengo, Ubatuba, State of São Paulo, on algae slightly exposed at low tide, 15 Feb 1965.

Remarks. – The proboscis shape resembles Marcus (1940b) figure rather than Krapp's (1973) illustration. The female oviger is 10-segmented (versus 9-segmented in the closely similar *T. conirostre)* and the propodal armature is as Krapp describes for *T. orbiculare.* The abdomen too, resembles Marcus fig. 15A, instead of Child's (1990) fig. 3 A-B. Perhaps this is not *orbiculare* at all, but another look-alike in this difficult genus.

Family Nymphonidae

Nymphon bullatum sp. n.
(figs. 27-34, 47-51)

Type material. – 1 ♂ (holotype), 8 ♂ (of which 1 ovigerous), 6 ♀, 25 juvs. and larvae (paratypes), Project Isotan-Draga I (PID), Stn. MBT 149: 23°41'S 41°55'W, 250 m, 4 Sep 1970 (ZMA Pa. 3446).

Other material. – 1 juv., PID, Stn. MBT 153: 22°48'S 41°14'W, 65 m, 4 Sep 1970; 1 ♂ (fragm.), PID, Stn. MBT 181: 25°35'S 46°03'W, 136 m, 29 May 1971.

Description. – Trunk completely segmented, unadorned. Lateral processes narrow, separated by intervals distinctly larger than their own diameter. Neck strongly widened in anterior end; narrow, parallel-sided portion just in front of oviger implantation; latter practically in contact with first lateral process. Ocular tubercle truncate in frontal view, with 2 minute distolateral tubercles; in side view as illustrated; eyes well-pigmented. Proboscis almost cylindrical. Abdomen reaching to distal end of coxa 1 of leg 4.

Chelifore scape thin, longer than proboscis, armed with some setules in middle and at distal end. Chela much shorter than scape; palm much shorter than fingers; both fingers curved; movable finger with 19 regular teeth, immovable finger with 14.

Palp segm. 2 longest; segm. 3 ca. two-thirds of segm. 2; segm. 4 distinctly shorter than segm. 5; long setae on segms. 3 to 5.

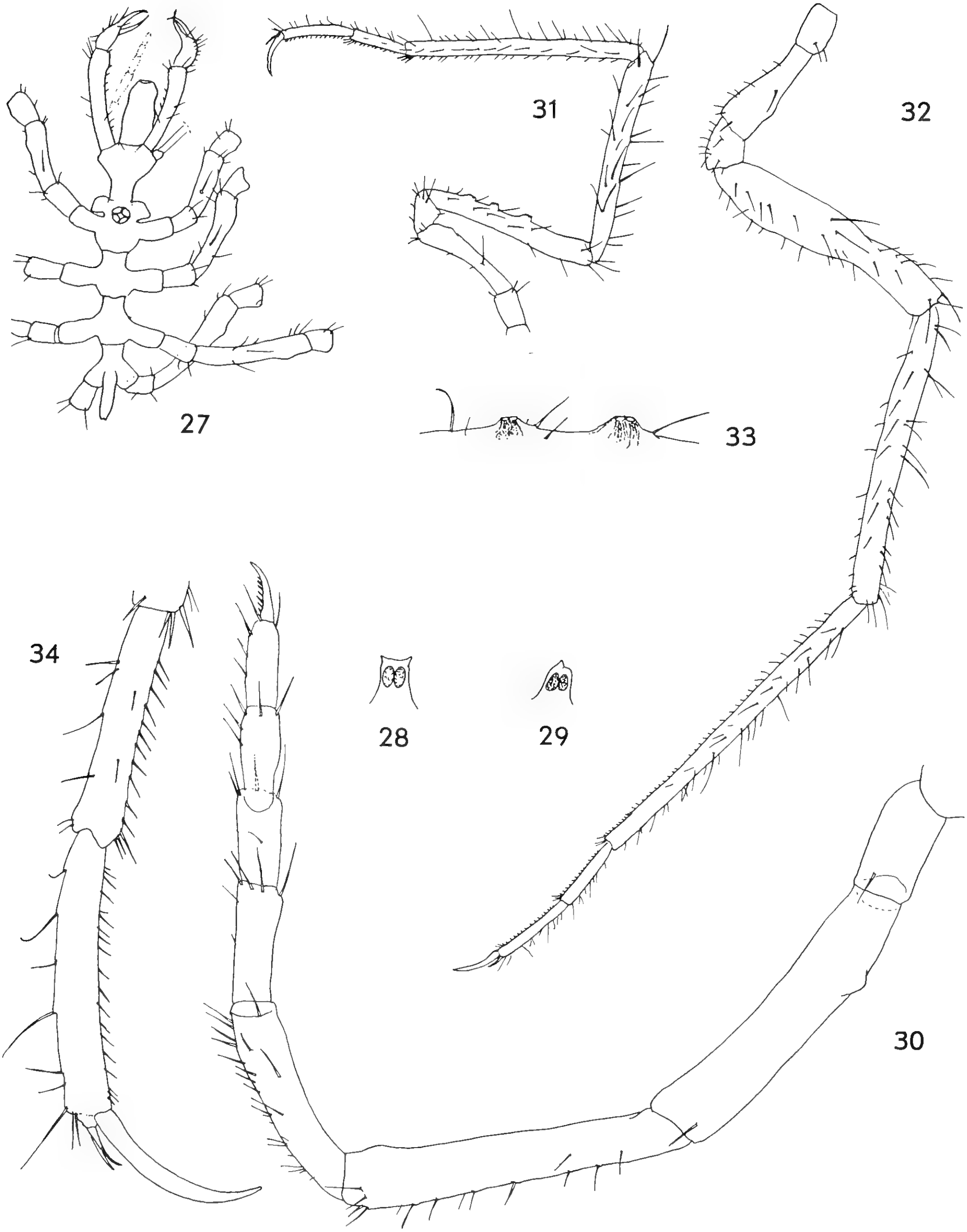
Oviger of male highly characteristic: segm. 5 longest, somewhat S-shaped, with strong apophysis at two-thirds of its endal margin; segm. 6 curved, setiferous. Compound spine formula 7:4:3:4; compound spines with 2 or 3 pairs of marginal teeth. Distal claw with 7 endal teeth.

Oviger of female: segm. 5 hardly longer than segm. 4, straight. Compound spine formula 6:5:4:4. Distal claw with 6 endal teeth.

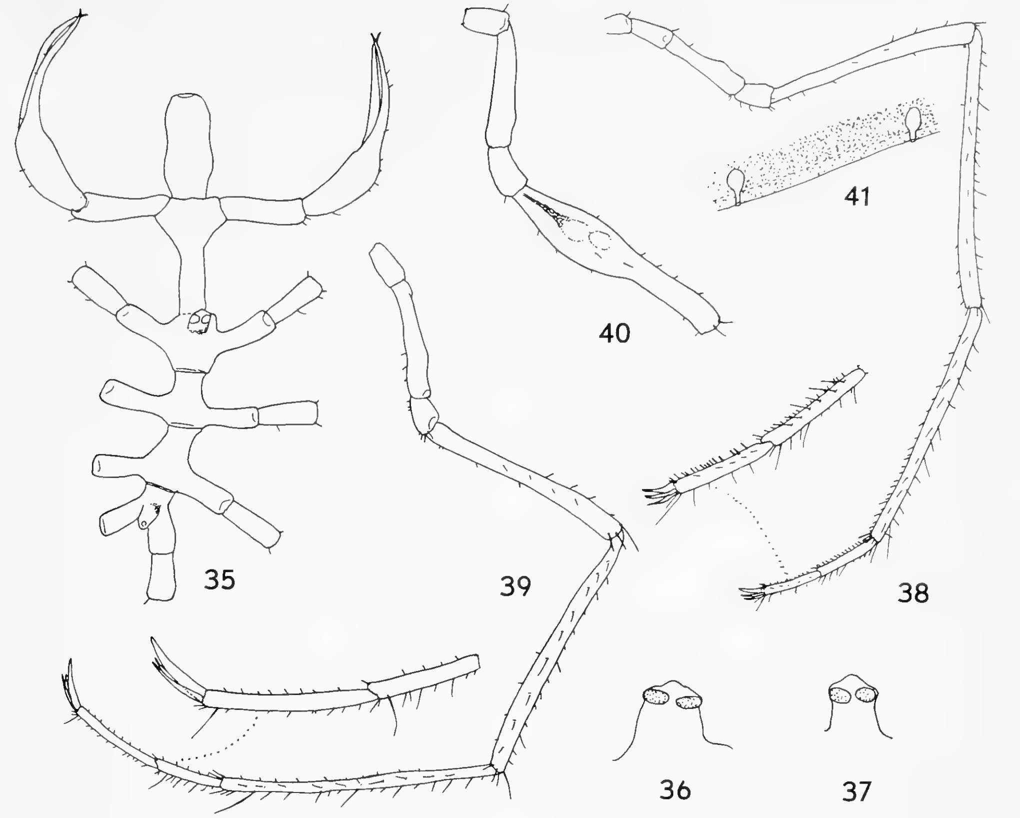
Legs thin, slender. Coxa 2 shortest in leg 1, longest in legs 3 and 4; very slender in posterior legs. Femur < tibia 1 < tibia 2. Femur of male with 3 ventral cement gland apertures, shaped as truncate cones. Femur of female: basal two-thirds swollen (containing eggs). All long leg segments with many setae, mostly about as long as segment diameter. Tarsus slightly shorter than propodus; both segments with row of small spinules of uniform size on ventral margin; no heel or heel spines differentiated. Claw curved, about 60% of length of propodus; auxiliary claws feeble, about 30% of length of claw.

Measurements of ♂ holotype (mm). – Length proboscis (dorsal) 1.04; greatest diameter proboscis 0.45; greatest diameter crop 0.91; length first trunk segm. 1.61; length second trunk segm. 0.80; length third trunk segm. 0.78; length fourth trunk segm. (to tip abdomen) 1.24; width across second lateral processes 1.57; length scape 1.41; length chela 0.91.

Leg 3: first coxa 0.63; second coxa 1.92; third coxa



Figs. 27-34. *Nymphon bullatum* sp. n. (from Stn. MBT 149). 27, trunk, ♂ (scale F); 28, ocular tubercle, ♀ (free-hand sketch); 29, ocular tubercle, ♀, from the left (free-hand sketch); 30, oviger, ♀ (B); 31, leg 3, ♂ (F); 32, leg 3, ♀ (F); 33, cement gland apertures of leg 3, ♂ (B); 34, distal segments of leg 3, ♂ (B). Scales after fig. 80.



Figs. 35-41. *Nymphon inaequipes* sp. n. (from Stn. MBT 142). 35, trunk, ♀, dorsal (scale F); 36 ocular tubercle, ♀, from the left (free-hand sketch); 37 ocular tubercle, ♀, frontal (free-hand sketch); 38, leg 1, ♂ (F); 39, leg 3, ♂ (F); 40, leg 4, ♀ (F); 41, cement gland apertures of leg 1, ♂ (free-hand sketch). Scales after fig. 80.

0.43; femur 2.74; first tibia 3.59; second tibia 4.05; tarsus 0.95; propodus 1.07; claw 0.58; auxiliary claws 0.15.

Etymology. – The specific name is derived from *bulla* (Latin = knob, bump) and alludes to the apophysis on oviger segment 5 in the male.

Remarks. – Two outstanding features of the male differentiate this species from the 200-odd others in the genus: (1) the cement glands discharging through volcano-shaped prominences; and above all (2) the apophysis on oviger segment 5 which is not apical (as in many other *Nymphon* species) but localized at two-thirds of the segment.

Cement gland apertures similar to those of the new species, are known from two other species only: *N. discorsicoxae* Child, 1982 and *N. caldarium* Stock, 1988. The former, however, is a brevitarsal species (whereas *N. bullatum* is longitarsal) and the latter is uniunguiculate (whereas *N. bullatum* possesses auxiliary claws).

Morphologically closest to *N. bullatum* are perhaps *N. sandersi* Child, 1982 (from off Rio de la Plata, Argentina, 3815-4435 m) and *N. longicollum* Hoek, 1881 (off Valparaiso, Chile, 2225 fms = 4072 m). Since some of the most useful diagnostic characters in the genus *Nymphon* are sex-linked (male oviger and male cement glands), it is hard to judge about the relationships of these two species, of which the (adult) male is unknown. Both differ from *N. bullatum* in that the auxiliary claws are tiny or lacking, and the ocular tubercle is slender and conical, without eyes. Some additional differences between *N. sandersi* and *N. bullatum* are: (1) palp segm. 2 = 3 in *sandersi*, 2 > 3 in *bullatum*; (2) oviger claw with 3 teeth in *sandersi*, 6-7 in *bullatum*; (3) compound oviger spines with 5 pairs of teeth in *sandersi*, 2-3 in *bullatum*. In *N. longicollum* (vide Gordon 1932a) the chela is straighter and the palm is longer than in *N. bullatum*, and each finger bears 11-12 teeth only (14-19 in *bullatum*).

Nymphon inaequipes sp. n.
(figs. 35-46)

Type material. – 1 ♂ holotype, 1 ♀ allotype, 23 paratypes, Project Isotan-Draga I (PID), Stn. MBT 142: 23°46'S 43°00'W, 150 m, 2 Sep 1970 (ZMA Pa. 3445).

Other material. – 1 ♀, PID, Stn. MBT 94: 25°56'S 46°42'W, 124 m, 18 June 1970; 2 ♀, PID, Stn. MBT 139: 30°52'S 49°51'W, 126 m, 27 June 1970; 1 ♀, PID, Stn. MBT 148: 23°19'S 41°57'W, 136 m, 3 Sep 1970; 7 spms., PID, Stn. MBT 151: 23°36'S 41°23'W, 475 m, 4 Sep 1970; 1 ♀, PID, Stn. MBT 152: 23°03'S 41°10'W, 98 m, 4 Sep 1970; 2 ♂, 1 ♀, PID, Stn. MBT 194: 24°27'S 44°57'W, 26 m, 1 June 1971; 1 ♂, 2 juvs., PID, Stn. MBT 195: 24°03'S 44°59'W, 73 m, 1 June 1971; 1 ♂, 1 ♀, PID, Stn. MBT 196: 23°31'S 44°57'W, 38 m, 1 June 1971; 208 spms., PID, Stn. MBT 197: 23°47'S 44°44'W, 65 m, 1 June 1971; 5 spms., PID, Stn. MBT 198: 24°03'S 44°30'W, 124 m, 2 June 1971; 47 spms., PID, Stn. MBT 206: 23°14'S 44°03'W, 52 m, 3 June 1971; 4 spms., PID, Stn. MBT 208: 23°20'S 43°26'W, 78 m, 4 June 1971; 34 spms., PID, Stn. MBT 211: 23°59'S 43°01'W, 220 m, 4 June 1971; 1 ♀, R. V. 'Prof. W. Besnard', Stn. RIG 591: 24°27'S 44°00'W, 500 m, 8 Feb 1969; 2 juv., R. V. 'Prof. W. Besnard', Stn. RIG 1330: 23°13'S 44°06'W, 40 m, 16 Feb 1968.

Description. – Trunk completely segmented, naked. Lateral processes long, slender, separated by intervals more than twice as wide as diameter of each lateral process. Neck widened at anterior end, followed by long, narrow, parallel-sided part. Oviger implantation in contact with anterior margin of first lateral process; on dorsal side of neck, right and left implantations fused (looking like segmentation line, but such line absent on ventral surface of neck). Ocular tubercle mainly cylindrical, rather low; rounded point at distal end; eyes small, well-pigmented. Abdomen short (in dorsal view not extending beyond 4th lateral processes), directed obliquely upward and backward (angle with horizontal ca. 75°).

Proboscis swollen at basal third, and again at distal third, shorter than neck.

Chelifore scapes strongly diverging, practically unarmed. Chela much longer than scape. Fingers longer than palm, curved near tip. Each finger with numerous (ca. 55) unequal teeth: a larger tooth is alternating with 2 to 4 smaller teeth (some of the smaller teeth bifid); larger teeth of movable finger shorter and more obtuse, on immovable finger larger and pointed. In juveniles, number of teeth on fingers lower.

Palp segms. 2 to 5 very slender, in proportions 9:7:8:6. Long setae in particular on segms. 4 and 5.

Oviger of male: Segm. 5 almost straight, by far longer than segm. 4, with row of recurved spinules on ventral margin and with small distal apophysis. Segm. 6 curved, about one-third of length of segm. 5, with inconspicuous tubercle on dorsal margin. Compound spines, according to formula 8:6:6:6, with 3 large basal teeth and 3 much smaller distal teeth on either margin. Distal claw long, slender, with 7 teeth.

Oviger of female: Much weaker than that of male, segm. 5 not so much longer than segm. 4, straight, without recurved spinules. Segm. 6 straight. Spine formula 10:7:6:8::10.

Legs long and thin. Coxae almost naked; coxa 2 of leg 1 less elongate than that of P2-P4. Femur < tibia 1; tibia 2 slightly longer than tibia 1. Several rather short setae, in particular on tibiae. Leg 1 having distal segms. different from those of other legs (heteropody); in leg 1 tarsus > propodus, both densely set with small spinules of uniform size on ventral surface;7 claw of leg 1 short (ca. 25% of length of propodus); auxiliary claws almost 90% of length of main claw. In remaining legs, tarsus < propodus, sparsely armed with small spinules; claw long (about 50% of length of propodus); auxiliary claws about 80% of length of main claw. Heteropody already visible in juveniles. Femur of female strongly swollen in basal half, for conception of eggs. Femoral gland pores in male inconspicuous; a bulbous, subcutaneous vesicle opens through a longish, narrow, subcutaneous duct into a minute pore; 8 or 9 glands present on each leg. Sexual openings of female on distoventral end of coxa 2 of all legs.

Measurements (mm) of female from Stn. MBT 142. – Length proboscis (dorsal) 0.93; greatest diameter proboscis 0.45; length first trunk segm. 1.47; length second trunk segm. 0.51; length third trunk segm. 0.53; length fourth trunk segm. (to tip fourth lateral process) 0.59; width across second lateral processes 1.40; length scape 0.72; length chela 1.63. First leg: tarsus 0.71; propodus 0.64; claw 0.16; auxiliary claws 0.14. Third leg: first coxa 0.33; second coxa 1.40; third coxa 0.39; femur 2.03; first tibia 2.77; second tibia 2.85; tarsus 0.64; propodus 0.96; claw 0.49; auxiliary claws 0.40.

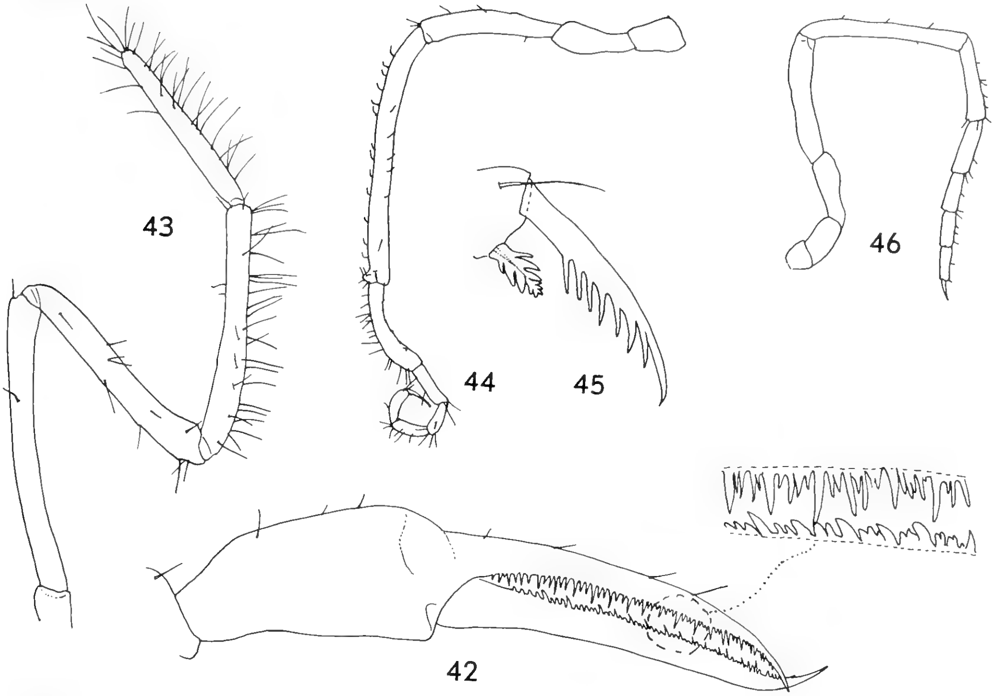
Etymology. – The specific name, *inaequipes* (Latin, with unequal legs) alludes to the morphological differences between leg 1 and the remaining legs.

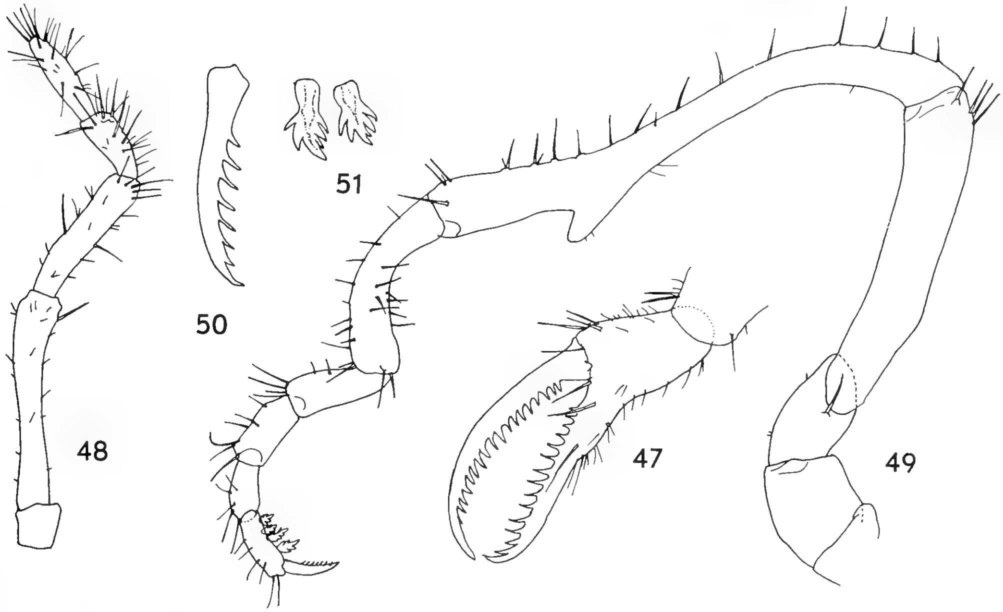
Distribution. – This is a rather common, sometimes even abundant species in our samples. It has been found in depths between 26 and 500 m.

Remarks. – The present species is rather similar to the next, *N. vulcanellum*. Look-alikes must be sought amongst such taxa as *N. macrum* Wilson, 1880, *N. gracillimum* Calman, 1915, and *N. hiemale* Hodgson, 1907.

N. inaequipes differs from these as follows:

– From *N. vulcanellum* by the cement gland apertures which are flush with the femoral surface (not raised), the fingers of the chela which bears >50 teeth of unequal size (versus <26 teeth of uniform size), the longer auxiliary claws, and the heteropodous nature of the legs. In mixed collections of *N. vulcanellum* and *N. inaequipes*, which are common, the latter can be distinguished at first glance by its smaller size,





Figs. 42-46. *Nymphon inaequipes* sp. n. (from Stn. MBT 142). 42, chela, ♂ (scale B); 43, palp, ♂ (B); 44, oviger, ♂ (A); 45, distal part of oviger, ♂ (G); 46, oviger, ♀ (A).
Figs. 47-51. *Nymphon bullatum* sp. n., ♂, from Stn. MBT 149. 47, chela (scale B); 48, palp (B); 49, oviger (B); 50, oviger claw (free-hand sketch); 51, compound spines of oviger segment 10 (free-hand sketch). Scales after fig. 80.

longer neck, and shorter, erect abdomen.

– From North Atlantic *N. macrum* by the second tibia which is hardly longer than the first (versus 1.3 to 1.5 times as long as tibia 1), the oviger implantation which is in contact with the first lateral process (well in front of it in *N. macrum*), the number of compound oviger spines, viz. a total of 25-31 (versus > 60 in *macrum*), and the number of teeth on the oviger claw (<11, versus ca. 19 in *macrum*).

– From *N. gracillimum* and *N. hiemale* (which might be synonymous, see Gordon, 1932b: 42), from cold to polar waters of the Southern Hemisphere, by the presence of a distal apophysis (though small) on oviger segment 5 of the male in *inaequipes*, the propodal armature (sole with uniform spinules in *inaequipes*, versus unequal in the other two), the subequal tibiae of *inaequipes* (versus second tibia 1.4-1.5 times as long as the first), the higher number of teeth on the fingers of the chela (>50 versus <36), and the longer auxiliary claws.

In none of these species heteropody is recorded. In fact, this is a rather rare phenomenon, more usually found in unrelated genera, such as *Ascorhynchus*.

Nymphon vulcanellum sp. n.
(figs. 52-61)

Nymphon spec.; Stock 1966: 392-393, fig. 3a-d.

Type material. – 1 ♂ (ovig.) holotype, 1 ♀ allotype, 9 ♂ (partly ovig.), 2 ♀, 39 juvs and larvae (paratypes), Project Isotan Draga I (PID), Stn. MBT 148: 23°19'S 41°57'W, 136 m, 3 Sep 1070 (ZMA Pa. 3447).

Other material. – 14 larvae (probably this species), PID, Stn. MBT 111: 27°22'S 47°27'W, 140 m, 21 June 1970; 1 ♀, PID, Stn. MBT 116: 27°59'S 47°31'W, 150 m, 22 June 1970; 1 juv., 2 larvae, PID, Stn. MBT 141: 23°25'S 43°00'W, 113 m, 2 Sep 1970; 3 ♀, 19 juvs. & larvae, PID, Stn. MBT 142: 23°46'S 43°00'W, 150 m, 2 Sep 1970; 1 ♂ (ovig.), 2 ♀, 3 juvs., PID, Stn. MBT 145: 23°25'S 42°27'W, 130 m, 3 Sep 1970; 1 ♂, 9 larvae, PID, Stn. MBT 149: 23°41'S 41°55'W, 250 m, 4 Sep 1970; 1 juv., PID, Stn. MBT 152: 23°03'S 41°10'W, 98 m, 4 Sep 1970; 5 larvae, PID, Stn. MBT 156: 22°06'S 40°53'W, 32 m, 5 Sep 1970; 30 juvs. & larvae, PID, Stn. MBT 161: 21°42'S 40°15'W, 56 m, 6 Sep 1970; 1 spm. (fragm.), PID, Stn. MBT 173: 25°32'S 47°11'W, 55 m, 27 May 1971; 1 juv., PID, Stn. MBT 195: 24°03'S 44°59'W, 73 m, 1 June 1971; 2 ♀, PID, Stn. MBT 197: 23°47'S 44°44'W, 65 m, 1 June 1971; 1 larva, PID, Stn. MBT 210: 23°46'S 43°10'W, 128 m, 4 June 1971; 4 juvs., PID, Stn. MBT 211: 23°59'S 43°01'W, 220 m, 4 June 1971; 1 ♀, R. V. 'Prof. W. Besnard' Stn. 1490: 22°08'S 41°00'W, 21 m, 12 Mar 1971.

Description. – Trunk completely segmented, practically unarmed. Lateral processes > diameter trunk, intervals slightly larger than diameter of lateral process. Anterior part of neck strongly widened; short parallel-sided basal part. Ocular tubercle truncate, with 2 minute lateral, and 1 terminal tubercle; eyes present. Oviger implantation in contact with anterior margin of first lateral process. Abdomen long, reaching beyond middle of coxa 1 of leg 4, almost horizontal. Proboscis barrel-shaped, short.

Chelifore scapes strongly divergent, poorly armed. Chela longer than scape. Fingers not in same plane as palm, longer than palm. Movable finger curved at tip, immovable finger regularly curved; each finger with 20-25 teeth, those of immovable finger longer than those of movable finger.

Palp segm. 2 > 3 > 4 > 5; segms. 3 and 4 unusually slender.

Oviger of male: Segm. 5 >> 4, somewhat S-shaped, distally swollen. Segm. 6 most remarkable, because showing a subdivision into 2 segments (segmentation more or less distinct, sometimes looking functional, see arrow in fig. 58). Compound spines with 3, rarely 4, marginal teeth; formula 12:8:6:6. Claw with 6 teeth.

Oviger of female: Segm. 5 straight, slightly longer than 4; segm. 6 not subdivided. Spine formula 5:6:6:7::5.

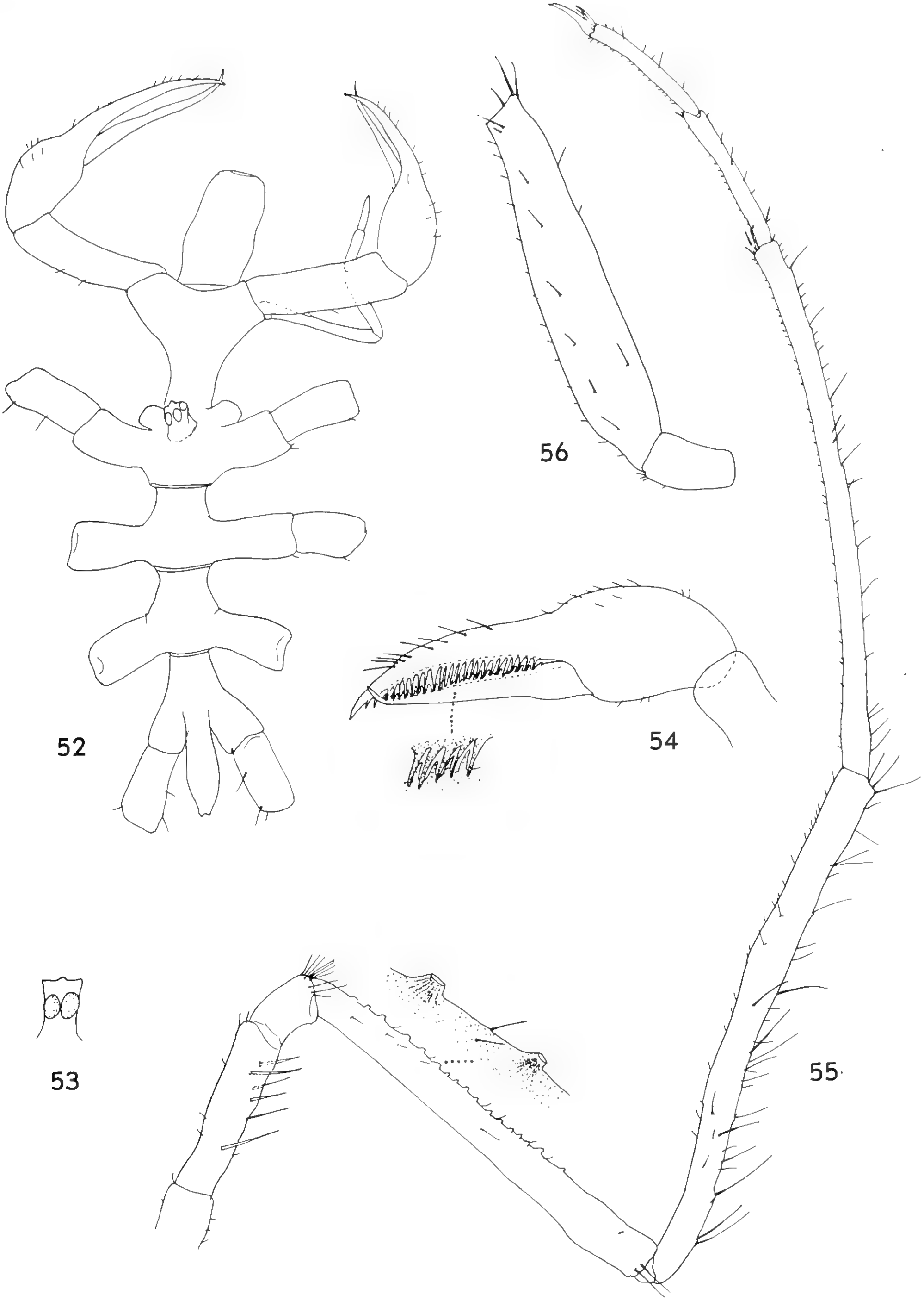
Legs: Femur of female slightly swollen in proximal part. Femur of male with some 16 cement gland apertures on ventral margin of all legs. Apertures shaped like low, truncate volcanoes. Coxa 2 and both tibiae with some long setae. Femur < tibia 1; tibia 1 slightly longer than tibia 2. Tarsus slightly longer than propodus; ventral margin of tarsus and propodus densely packed with minute spinules of uniform size (no heel, no heel spines). Claw short; auxiliary claws about half length of main claw. Legs homoiopodous.

Measurements of ♀ from Stn. MBT 142 (mm). – Length proboscis (dorsal) 1.24; greatest diameter proboscis 0.64; length first trunk segm. 1.59; length second trunk segm. 0.87; length third trunk segment 0.82; length fourth trunk segment (to tip fourth lateral process) 1.05; width across second lateral processes 2.15; length abdomen 0.91.

Leg 3: first coxa 0.90; second coxa 1.64; third coxa 0.63; femur 3.78; first tibia 5.29; second tibia 5.12; tarsus 1.40; propodus 1.11; claw 0.40; auxiliary claws 0.20.

Etymology. – The specific name, *vulcanellum* (Latin = little volcano) alludes to the low, volcano-shaped cement gland apertures on the femur of the male.

Remarks. – This is no doubt the same species recorded as '*Nymphon* spec.' by Stock (1966), from one of the 'Calypso' stations off the South American Atlantic coast. In 1966, though it was recognized that probably a new species was concerned, it was not named because only a female was available. Now, the male being discovered, I have no hesitation any more to attribute this highly characteristic animal to a new species.



Figs. 52-56. *Nymphon vulcanellum* sp. n. (♂ from Stn. MBT 149, ♀ from Stn. MBT 142). 52, trunk, ♀, dorsal (scale F); 53, ocular tubercle, ♂, frontal (free-hand sketch); 54 chela, ♀ (A); 55, leg 3, ♂ (F); 56, femur, ♀ (F). Scales after fig. 80.

By the large chela, the absence of propodal heel spines, and the slender palp segments, the new species looks like the North Atlantic *N. macrum* Wilson, 1880. Obvious differences are, apart from the volcano-shaped cement gland apertures, the ratio tibia 1/tibia 2 (subequal in the new species, tibia 2 by far the longest in *N. macrum*), the low number of denticles on the oviger claw, and the low number of marginal teeth on the compound oviger spines of the new species. Finally, the oviger implantation is in contact with the first lateral process in the new species, implanted well in front of it in *N. macrum.*

For the differences from *N. inaequipes*, consult the remarks under the latter.

Distribution. – Found often together with *N. inaequipes* (vide supra), but is less abundant. Its bathymetrical range lies between 21 and 250 m.

Family Callipallenidae

Callipallene evelinae Marcus, 1940

C. evelinae Marcus, 1940b: 31-33, fig. 2 A-D.

Material. – 1 juv., usp, Stn. F 10: Rocky intertidal of Ponta de Santa Rita, Enseada do Flamengo, Ubatuba, State of São Paulo, on *Dyctiota* sp., 12 Dec 1965; 2 ♀, Project Isotan-Draga I (pid), Stn. mbt 145: 23°25'S 42°27'W, 130 m, 3 Sep 1970; 1 ♀, pid, Stn. mbt 155: 22°22'S 41°32'W, 34 m, 5 Sep 1970.

Remarks. – *C. evelinae* is mainly characterized by male characters (presence of plumose setae on distal leg segments, absence of lobe on 5th oviger segment). Thus, the identification of the present material (lacking males) must be taken with some reservation. However, nothing in the morphology seems to prevent identification with *C. evelinae,* previously known only from Ilha das Palmas, Bahia de Santos, 0-5 m. The present records extend the range to east of Rio de Janeiro, and to a depth of 130 m.

Callipallene gabriellae Corrêa, 1948

C. gabriellae Corrêa, 1948: 1-4, figs. 1-6.

Material. – 76 spms. (incl. ovigerous males and juveniles), usp, Stn. P.E.: Collected by hand by divers in the infralittoral zone on seaweeds growing on rock, Ponta do Espia, Ubatuba, State of São Paulo, 20 Sep 1964.

Remarks. – This species is extremely close to *C. emaciata* (Dohrn, 1881), known from the Mediterranean and from New England to the West Indies. Child (1979: 41) examined specimens from the entire range of *C. emaciata* and made some observations on its morphology. In the configuration of the propodal spines and the auxiliary claws, the present material agrees with Child's observations. Evidently, the shape of the trunk, oviger spines, proportions of the leg segments, curvature of the propodus, and length of the auxiliary claws, *C. gabriellae* and *C. emaciata* are practically identical. Corrêa used the presence or absence of a suture between trunk segments 3 and 4 as a key character to separate the two species, but in the large sample from Brazil at hand, this feature proved to be too variable to be reliable.

The only characters that made me decide to retain *C. gabriellae* as a distinct species, are its more swollen male(!) femur and the number of teeth on the fingers of the chela. Child (1979, in key) records about 15 teeth on each finger of *C. emaciata,* whereas in the present material of *C. gabriellae* there are 6-9 teeth. The number of propodal heel spines, considered to be diagnostic character by Child, varies between 4 and 5 in *C. gabriellae.*

C. gabriellae has been described from the upper littoral zone of Ilha das Palmas, Bahia de Santos (Brazil). As far as I know, no further specimens have ever been recorded.

Callipallene margarita (Gordon, 1932)

Pallene margarita Gordon, 1932b: 82-85, figs. 40-41.
Callipallene margarita; Marcus 1940b: 30; Corrêa 1948: 6; Child 1982a: 26.
? *Callipallene margarita*; Hedgpeth 1961: 3, fig. 1.

Material. – 1 ♂, 3 juvs., Project Isotan-Draga I, Stn. mbt 149: 23°41'S 41°55'W, 250 m, 4 Sep 1970.

Remarks. – The formula of the compound oviger spines in the present male is 8:6:8:8, which is lower than the number recorded by Gordon (1932b), but about similar to that found by Hedgpeth (1961).

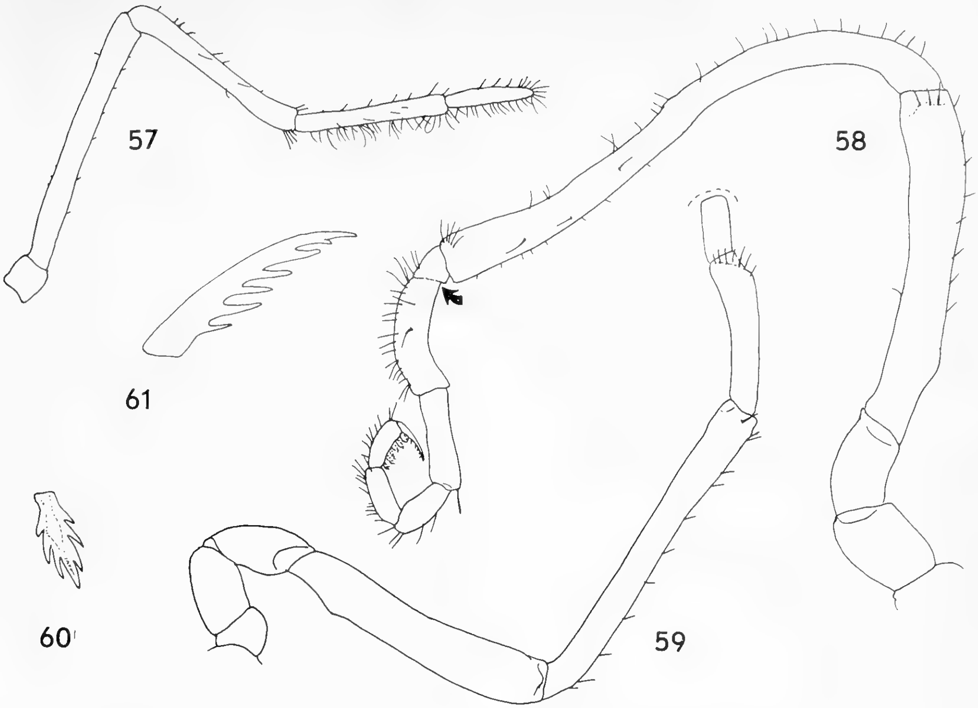
The species is known from South Georgia, N. of the Falkland Islands, 120-320 m (Gordon 1932b); southern Chile, 70 m (Hedgpeth 1961), and from the Argentine slope, between 36°53'S and 38°13'S, 454-2323 m (Child 1982a). The present record extends the range of the species further north to 23°41'S, but falls within the bathymetrical range.

Callipallene producta (Sars, 1888)

C. producta; Stock 1990: 227 [refs.].

Material. – 1 ♂, Project Isotan-Draga I, Stn. mbt 145: 23°25'S 42°27'W, 130 m, 3 Sep 1970.

Remarks. – This specimen resembles closely Sars' (1891) figures based on material from northern Europe, except that the second tibia is provided with some long setae. This species is mainly distributed in the northern and central Atlantic, from Norway to the Cape Verde Islands. It is new to Brazil.



Figs. 57-61. *Nymphon vulcanellum* sp. n. (♂ from Stn. MBT 149, ♀ from Stn. MBT 142). 57, palp, ♀ (scale A); 58, oviger, ♂ (A); 59, proximal part of oviger, ♀ (A); 60, compound spine of oviger segment 10, ♂ (free-hand sketch); 61, terminal oviger claw, ♂ (free-hand sketch). Scale after fig. 80.

Pallenoides amazonica Stock, 1975

P. amazonica Stock, 1975a: 1012-1015, figs. 23-24; see also Arnaud & Child 1988: 142-143.

Material. – 1 juv., Project Isotan-Draga I (PID), Stn. MBT 148: 23°19'S 41°57'W, 136 m, 3 Sep 1970; 1 ♀, 2 juvs., PID, Stn. MBT 157: 21°46'S 40°58'W, 15 m, 5 Sep 1970; 2 ♀, 2 juvs., PID, Stn. MBT 163: 21°29'S 40°56'W, 17 m, 6 Sep 1970; 1 ♂ ovig., 3 ♀, 2 juvs., PID, Stn. MBT 165: 21°20'S 40°39'W, 28 m, 6 Sep 1970.

Remarks. – The eggs carried by the ovigerous male from Stn. MBT 165 are, in preserved state, of a deep-brown colour.

The species was described from Brazilian shelf waters, but much further north (between 00°31 N and 02°15'S). Arnaud & Child's South African record (1988) based on a larva, is 'certainly questionable' (1988: 143).

Family Phoxichilidiidae

Pallenopsis (Pallenopsis) boehmi Schimkewitsch, 1930

P. boehmi Schimkewitsch, 1930: 236-237 [new name for *P. fluminensis*, sensu Böhm 1879, nec Krøyer 1844]. – Marcus 1940a: 190-191; Marcus 1940b: 22; Stock 1973: 349-350, figs. 1-10 [redescr. of types]; Stock 1975a: 1018 [in key].

P. longicoxa Stock, 1966: 394-396, fig. 4 [**syn. n.**].

Material. – 1 ♂, R. V. 'Prof. W. Besnard', Stn. RIG 588: 23°50'S 44°16'W, 100 m, 7 Feb 1968; 2 ♂, 1 ♀, R. V. 'Prof. W. Besnard', Stn. RG 1333: 23°13' 44°18'W, 35 m, 17 Feb 1968; 2 ♂, 3 ♀, R. V. 'Prof. W. Besnard', Stn. 1477: 23°29'S 42°54'W, 105 m, 9 March 1971; 1 ♀, Project Isotan-Draga I, Stn. MBT 153: 22°48'S 41°14'W, 65 m, 4 Sep 1970.

Remarks. – *P. boehmi* was based on females (see Stock 1973), whereas *P. longicoxa* was based on males. Some of the present samples contain both sexes, and prove *boehmi* to be a senior synonym of *longicoxa*, as already suspected by Stock (1973). The length of the auxiliary claws is variable in these samples: in some specimens they are some 40% of the length of the main claw, in others they are fully half as long.

P. boehmi is predominantly a cold-water species, distributed from Magellan Strait to southern Brazil. One of the above stations, Stn. 1477, is located very close to the type-locality of *P. longicoxa*.

Pallenopsis (Pallenopsis) candidoi de Mello-Leitão, 1949

P. (*P.*) *candidoi*; Stock, 1975a: 1030, fig. 31 a-b [refs.].

Material. – 1 ♂, 1 ♀, R. V. 'Prof. W. Besnard', Stn. RD 54: 18°54.8'S 39°15.4'W, 41 m, 12 July 1972.

Remarks. – This species is known from southern Brazil to Surinam, between 15 and 65 m.

Pallenopsis (*Pallenopsis*) *fluminensis* (Krøyer, 1844)

P. (*P.*) *fluminensis;* Stock 1975a: 1020-1021, fig. 25 [refs.].

Material. – 1 ♂, R. V. 'Prof. W. Besnard', Stn. RG 1325: 23°14'S 43°56.5 W, 49 m, 16 Feb 1968.

Remarks. – A Brazilian species, known from the State of São Paulo to N. of Pernambuco. Depth range 0-49 m.

Pallenopsis (*Pallenopsis*) *kempfi* Stock, 1975

P. (*P.*) *kempfi* Stock, 1975a: 1025-1028, figs. 28-29; Stock 1986: 427-429, fig. 8 a-f.

Material. – 1 ♂, R. V. 'Prof. W. Besnard', Stn. 1848: 30°22'S 48°41'W, 178 m, 3 Aug 1972.

Remarks. – Previously recorded from Florida (ca. 24°36'N) to Brazil (ca. 04°13'S). The present records forms a significant southward extension of the range.

Pallenopsis (*Pallenopsis*) *tumidula* Loman, 1923

P. (*P.*) *tumidula* Loman, 1923: 32-34, fig. G; Marcus 1940a: 191; Marcus 1940b: 24 [in key]; Stock 1957: 103-105, fig. 18; Stock 1966: 393, fig. 3e; Stock 1975a: 1018 [in key].

Material. – 1 ♂ ovig., 2 ♀, R. V. 'Prof. W. Besnard', Stn. RG 1332: 23°14.3'S 44°13.3'W, 42 m, 17 Feb 1968; 1 ♂ ovig., 2 ♀, R. V. 'Prof. W. Besnard', Stn. 1883: 30°22'S 48°41'W, 178 m, 3 Aug 1972.

Remarks. – Previously recorded from off La Plata (ca. 37°30'S). The present records extend the range to southern Brazil (23°14'S).

Anoplodactylus aragaoi Sawaya, 1950
(figs. 63-64)

A. aragaoi Sawaya, 1950: 63-67, 77-80, pls. I-II.

Material. – 1 ♂ ovig., R. V. 'Prof. W. Besnard', Stn. RD 56: 18°54.7'S 38°53.5'W, 38 m, 12 July 1972.

Remarks. – The chelifore and chela were not illustrated in great detail before; therefore some figures of this appendage are incorporated in the present paper. The single specimen collected agrees in every detail with Sawaya's description. Previously recorded from 20°33'S 40°14'W, 35 m.

Anoplodactylus brasiliensis Hedgpeth, 1948

A. brasiliensis Hedgpeth, 1948: 224 [pro *A.pygmaeus* sensu Marcus 1940b: 63-65, Pl. VI fig. A-D, nec Hodge, 1864].

Material. – 2 ♀, 6 juvs. & larvae, USP, Stn. P.E.: Ponta do Espia, Ubatuba, State of São Paulo, on seaweeds growing on rocky shore, infralittoral, 20 Nov 1964.

Remarks. – I agree with Lebour (1945) and Hedgpeth (1948) in considering this south Brazilian shallow water species different from *A. pygmaeus,* under which name it was recorded by Marcus (1940b). Hedgpeth coined the name *A. brasiliensis* for it, which is adopted here. The species differs from *A. pygmaeus* by the presence of small auxiliary claws, and the absence of a tubercle on the lateral processes (a single spinule is present, however). The propodal sole has a rather short lamina, preceded by 3 or 4 sole spines. Unfortunately, the present collection contains no males, so I can add nothing to Marcus' description.

Anoplodactylus evelinae Marcus, 1940

A. evelinae; Child 1982b: 368-369 [refs.].

Material. – 24 spms., USP, Stn. P.E.: Ponta do Espia, Ubatuba, State of São Paulo, on seaweeds growing on rocky shore, infralittoral, 20 Nov 1964; 1 ♀, USP, Stn. F 10: Ponta Santa Rita, Enseada do Flamengo, Ubatuba, State of São Paulo, on intertidal algae (*Dyctiota* sp.) on rocky shore, 12 Dec 1965; 1 ♀, USP, Stn F 27: Rocky shore between Praia do Dionisio and Praia do Flamengo, Enseada do Flamengo, Ubatuba, State of São Paulo, on algae slightly exposed at low tide, 15 Feb 1965.

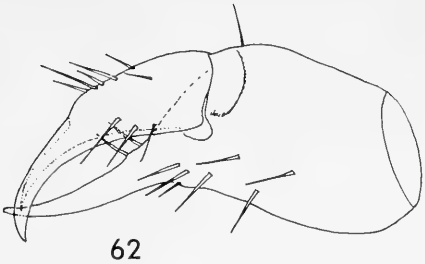
Remarks. – The species was described from the same general area; later records extended the range to shallow waters of the West Indies.

Anoplodactylus insignis (Hoek, 1881)

A. insignis; Stock 1975a: 1056-1058, fig. 44 [refs.]; Stock, 1986: 437-438, fig. 15 a-b.

Material. – 1 ♂ (fragm.), Project Isotan-Draga I, Stn. MBT 165: 21°20'S 40°39'W, 28 m, 6 Sep 1970; 1 ♀, R. V. 'Prof. W. Besnard', Stn. RD 54: 18°54.8'S 39°15.4' W, 41 m, 12 July 1972.

Remarks. – Originally described by Hoek from Brazil (Bahía, 13-37 m). Later records show it to have a vast range in the Caribbean and on the American east coast up to North Carolina. The female from Stn. RD 54 belongs to var. *calcaratus* Stock, 1986, previously found in the West Indies, Venezuela and the Guyanas.



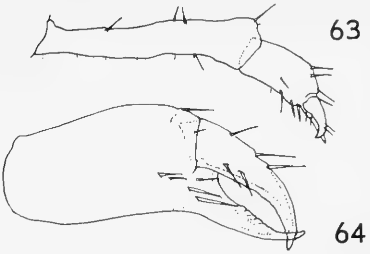


Fig. 62. *Anoplodactylus stictus* Marcus, 1940 (♀ from Stn. MBT 165), chela (scale E). Figs. 63-64. *Anoplodactylus aragaoi* Sawaya, 1950 (♂ from Stn. RD 56). 63, chelifore (scale B); 64, chela (E). Scales after fig. 80.

Anoplodactylus maritimus Hodgson, 1914

A. maritimus; Stock 1975a: 1072, 1074, fig. 54 [syn. & distr.].

Material. – 1 ♀, R. V. 'Prof. W. Besnard', Stn. RG 1331: 23°14.7'S 44°09.4'W, 45 m, 16 Feb 1968; 2 ♂, Project Isotan-Draga I (PID), Stn. MBT 153: 22°48'S 41°14'W, 65 m, 4 Sep 1970; 2 ♂, PID, Stn. MBT 164: 21°15'S 40°50'W, 19 m, 6 Sep 1970; 2 ♂, 4 ♀, PID, Stn. MBT 184: 24°33'S 46°50'W, 30 m, 30 May 1971; 4 ♂, 2 ♀, 2 juvs., PID, Stn. MBT 195: 24°03'S 44°59'W, 73 m, 1 June 1971; 15 ♂, 12 ♀, PID, Stn. MBT 206: 23°14'S 44°03'W, 52 m, 3 June 1971.

Remarks. – This species, often associated with floating *Sargassum*, is widely distributed in the (sub)-tropical Atlantic. It is recorded here from the first time from Brazil.

Anoplodactylus monotrema Stock, 1979

A. monotrema; Child 1982b: 372 [refs.].

Material. – 1 ♂, 1 ♀, 1 juv., USP, Stn. F 10: Ponta de Santa Rita, Enseada do Flamengo, Ubatuba, State of São Paulo, on intertidal algae (*Dyctiota* sp.) on rocky shore, 12 Dec 1965; 1 ♂, R. V. 'Prof. W. Besnard', Stn. RD 54: 18°54.8'S 39°15.4'W, 41 m, 12 July 1972.

Remarks. – The males in this collection have one slit-like cement gland aperture on the legs, and agree also otherwise with the original description. The female from Stn. F 10 has more 'angular' corners of the proboscis, and thus resembles *A. robustus* (Dohrn, 1881), but has well-spaced lateral processes 1 and 2 as in *A. monotrema*.

These records confirm the presence of *A. monotrema* on the coasts of Brazil, already anticipated by Stock (1979).

Anoplodactylus petiolatus (Krøyer, 1844)

A. petiolatus; Stock 1975a: 1072-1075, fig. 53 [incl. *A. longicollis* (Dohrn, 1881)].
A. guyanensis Child, 1977 [**syn. n.**].

Material. – 8 ♂ (of which 1 ovig.), 2 ♀, Project Isotan-Draga I (PID), Stn. MBT 50: 23°39'S 45°06'W, 28 m, 8 May 1970; 1 ♀, PID, Stn. MBT 77: 23°39'S 43°09'W, 128 m, 12 May 1970; 4 ♂, 1 ♀, PID, Stn. MBT 101: 25°51'S 47°54'W, 41 m, 19 June 1970; 1 ♂, PID, Stn. MBT 106: 26°45'S 47°16'W, 130 m, 20 June 1970; 9 spms., PID, Stn. MBT 113: 27°19'S 48°15'W 54 m, 21 June 1970; 3 ♂, 2 ♀, PID, Stn. MBT 116: 27°59'S 47°31'W, 150 m, 22 June 1970; 1 ♀, PID, Stn. MBT 127: 29°33'S 48°46'W, 118 m, 25 June 1970; 1 ♀, PID, Stn. MBT 128: 29°23'S 49°10'W, 54 m, 25 June 1970; 1 ♂, PID, Stn. MBT 141: 23°25'S 43°00'W, 113 m, 2 Sep 1970; 5 ♂, 1 ♀, PID, Stn. MBT 145: 23°25'S 42°27'W, 130 m, 3 Sep 1970; 3 ♂, PID, Stn. MBT 147: 23°01'S 41°59'W, 66 m, 3 Sep 1970; 1 ♂, 3 ♀, 1 juv., PID, Stn. MBT 148: 23°19'S 41°57'W, 136 m, 3 Sep 1971; 1 ♂, 3 juvs., PID, Stn. MBT 152: 23°03'S 41°10'W, 98 m, 4 Sep 1970; 5 ♂, 2 ♀, 8 juvs., 1 larva, PID, Stn. MBT 161: 21°42'S 40°15'W, 56 m, 6 Sep 1970; 1 ♂, PID, Stn. MBT 164: 21°15'S 40°15'W, 19 m, 6 Sep 1970; 6 ♀, PID, Stn. MBT 171: 25°05'S 47°40'W, 20 m, 27 May 1971; 16 spms., PID, Stn. MBT 173: 25°32'S 47°11'W, 55 m, 27 May 1971; 1 ♂, 3 ♀, PID, Stn. MBT 185: 24°12'S 46°09'W, 38 m, 30 May 1971; 4 ♂, 3 ♀, 2 juvs., PID, Stn. MBT 186: 24°28'S 45°54'W, 59 m, 30 May 1971; 1 ♂, PID, Stn. MBT 195: 24°03'S 44°59'W, 73 m, 1 June 1971; 5 ♂, 3 ♀, PID, Stn. MBT 197: 23°47'S 44°44'W, 65 m, 1 June 1971; 2 ♂, 1 ♀, PID, Stn. MBT 210: 23°46'S 43°10'W 128 m, 4 June 1971; 1 ♂, R. V. 'Prof. W. Besnard' (RVWB), Stn. RIG 588: 23°50'S 44°16'W, 100 m, 7 Feb 1969; 2 ♀, RVWB, Stn. RD 4: 19°59'S 39°56'W, 41 m, 6 July 1972; 1 ♂, RVWB, Stn. RD 5: 19°54'S 39°50'W, 51 m, 6 July 1972; 1 ♂ ovig., RVWB, Stn. RD 50: 19°02.5'S 39°30.6'W, 28 m, 12 July 1972; 1 ♂, 1 ♀, RVWB, Stn. RD 54: 18°54.8'S 39°15.4'W, 41 m, 12 July 1972; 1 ♀, RVWB, Stn. RD 71: 18°34'S 39°14.6'W. 35 m, 14 July 1972; 1 ♂, RVWB, Stn. RD 74: 18°34'S 38°38'W, 59 m, 14 July 1972; 1 ♂, RVWB, Stn. RD 82: 19°55'S 39°54'W, 46 m, 16 July 1972; 1 ♂ ovig., Project Petrobas/USP, Stn. RD 36: 19°18.1'S 39°39.4'W, 16 m, 10 July 1972.

Remarks. – The present material gave me considerable trouble. After re-examination of many samples from various origins (North Sea, Bay of Biscay, Israel, the Guyanas), I came to the conclusion that *A. petiolatus* is a variable species and that the variation occurs in a geographically unordered way. North Sea specimens have the lowest number of spines on the propodal sole in front of the lamina (viz. 3 to 6), medium-sized tubercles on the lateral processes, and no tubercle on coxa 1. Guyana specimens have 4 to 8 spines on the propodal sole, very tall tubercles on the lateral processes, and sometimes a distinct tubercle on coxa 1. Finally Brazilian specimens have the highest number (4 to 10) of spines on the propodal sole, medium-sized tubercles on the lateral processes, and a vestigial tubercle on coxa 1.

The Bay of Biscay specimens look very much like *A. guyanensis* Child, 1977, but the abdomen is slightly longer and less erect. Israel specimens look strongly like *A. vemae* Child, 1982, but oviger segment 2 is shorter. The length of the cement gland tube and the trunk segmentation can vary as well. In our Brazilian collection, the tube is usually rather short, and specimens with an unsegmented trunk are more common, but other specimens show a segmentation line between trunk segments 1 and 2, or between 1, 2 and 3. Comments on the variability of *A. petiolatus* are already briefly provided in the papers by Stock (1966, 1975a). For these reasons, I consider *A. petiolatus* a variable species, and has united *A. longicollis* (Dohrn, 1881) from the Mediterranean and *A. guyanensis* Child, 1977 with *A. petiolatus* (Krøyer, 1844).

A. petiolatus was recorded before from Brazil (Marcus, 1940b) and northern Argentina (Stock, 1966).

Anoplodactylus spurius sp. n.
(figs. 65-75)

Type material. – 1 ♂ holotype, 1 juv., Project Isotan-Draga I (PID), Stn. MBT 211: 23°59'S 43°01'W, 220 m, 4 June 1971 (ZMA Pa. 3448); 1 ♀, 3 juvs. (paratypes), PID, Stn. MBT 142: 23°46'S 43°00'W, 150 m, 2 Sep 1971 (ZMA Pa. 3449); 3 ♂ (paratypes), PID, Stn. MBT 145: 23°25'S 42°27'W, 130 m, 3 Sep 1970 (ZMA Pa. 3450); 1 ♀, 1 juv. (paratypes), PID, Stn. 159: 22°00'S 40°06'W, 90 m, 5 Sep 1970 (ZMA Pa. 3451); 1 ♀ (paratype), PID, Stn. MBT 164: 21°15'S 40°50'W, 19 m, 6 Sep 1970 (ZMA Pa. 3452).

Description. – Trunk segments 1 and 2, and 2 and 3 well-articulated, intersegmental line between segments 3 and 4 vestigial. One tall spur and 1 or 2 spinules on distodorsal end of each lateral process. Lateral processes separated by interval greater than own diameter. Ocular tubercle with 2 minute lateral tubercles, tip conical; eyes pigmented. Abdomen more or less strongly directed upward, as long as 4th lateral process.

Proboscis of adult female with 2 ventral alar processes, free part of each lobe pointing forward. In ventral view, lobes are heart-shaped. Male proboscis without alar processes. Proboscis (♂, ♀) surrounded by collar-like expansion with on either side a rounded swelling which might represent a rudiment of palp.

Chelifore scape just overreaching tip of proboscis, with low distal spur. Chela with slender palm; curved fingers slightly longer than palm. Both palm and ectal margin of movable finger with several long setae. Each finger with 2 proximal setae on endal margin.

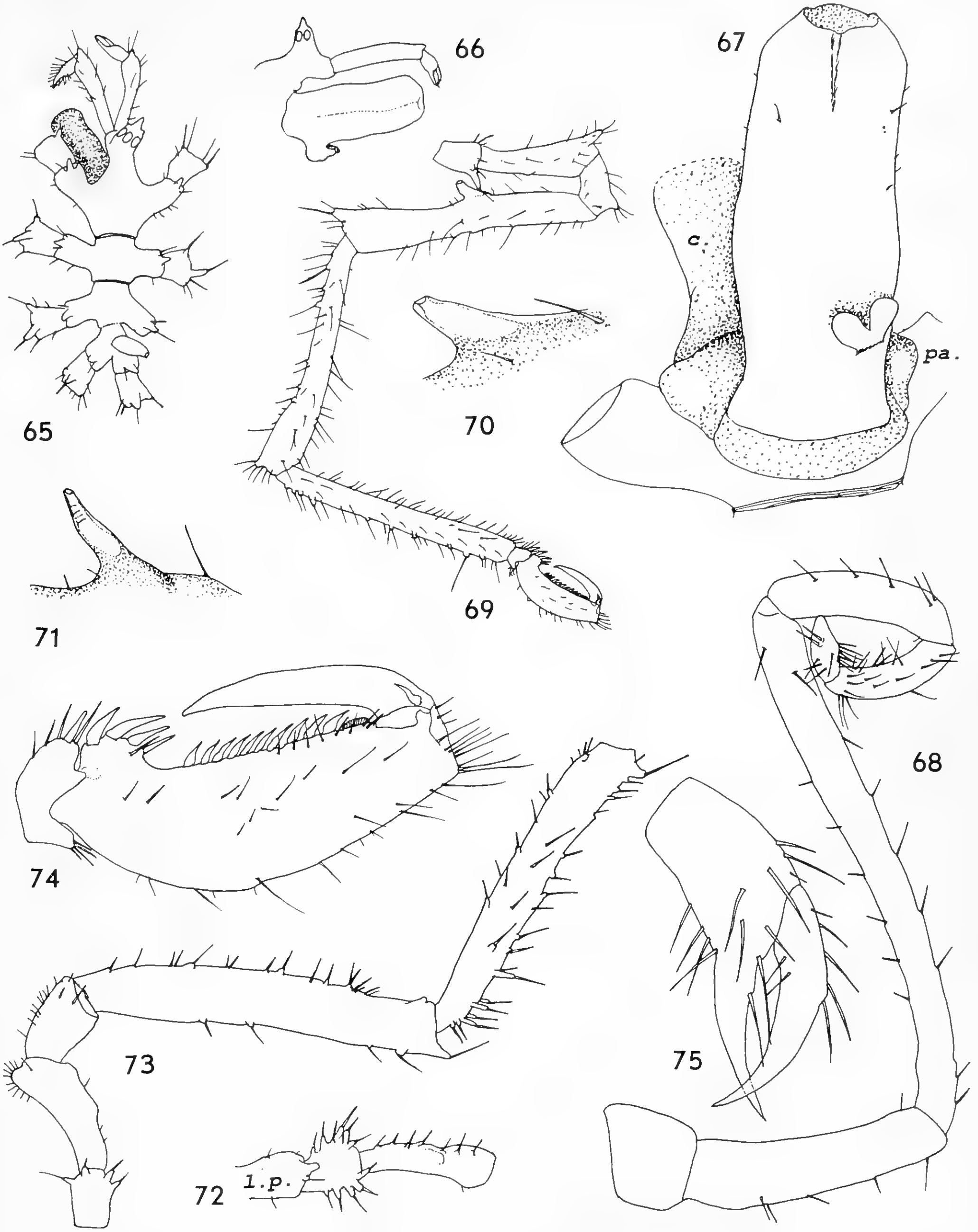
Oviger 6-segmented; segm. 2 slightly less than half as long as segm. 3; segm. 3 very elongate; segms. 5 and 6 with several long setae; segm. 6 longer than wide, pointed.

Legs setose, especially femur and tibiae. Tubercles and spurs variously developed (strongest development in one of the females!). Coxa 1 with 2 to 10 tubercles, most tubercles spine-tipped. Coxa 2 with ventrodistal genital spur only (male spur thump-shaped, present of legs 3 and 4; female spur broadly rounded, on all legs). Coxa 3 sometimes with ventrodistal, rounded process. Femur slightly longer than tibiae 1 and 2, with distodorsal spur; setae implanted on low or vestigial tubercles. Tibiae 1 and 2: setae implanted on tubercles, which may assume columnar shape. Tarsus short. Propodus with strong heel forming right angle with sole, armed with 1 or 2 basal spines and row of thin spinules; propodal lamina very short. Rudimentary auxiliary claws present. Cement gland slightly proximad of middle of dorsal surface of femur of all legs in male, discharging through strong, heavy, tapering, thump-shaped tube directed obliquely distad; length of tube variable: usually as illustrated in fig. 70, but in male from Stn. MBT 211 more slender (fig. 71).

Measurements (♂ from Stn. MBT 211) in mm. – Length proboscis (ventral) 1.14; greatest diameter proboscis 0.34; length trunk (frontal margin cephalic segment to tip 4th lateral process) 1.76; width across 2nd lateral processes 1.08. Leg 3: first coxa 0.30; second coxa 0.96; third coxa 0.46; femur 1.85; first tibia 1.78; second tibia 1.82; tarsus 0.15; propodus 0.64; claw 0.49.

Etymology. – The specific name, *spurius* (Latin = illegitimate child) alludes to the dubious taxonomic position of the new species.

Remarks. – By the presence of two ventral outgrowths on the female proboscis, as well as by almost all points of the general morphology (structure of chela, oviger, shape of propodus, short propodal lamina, genital spurs in both sexes...) the present material shows a close similarity to *A. stictus* Marcus, 1940. The differences with *A. stictus* pertain to the degree of setosity and tuberculation of legs and lateral processes and to a longer cement gland duct. These characters



Figs. 65-75. *Anoplodactylus spurius* sp. n. (65, 68, 69, 70 and 74 from Stn. MBT 145; 66, from Stn. MBT 165; 67, 73 and 75 from Stn. MBT 159; 71 and 72 from Stn. MBT 211). 65, trunk, ♂, dorsal (scale F); 66, cephalon, ♀, from the right (free-hand sketch); 67, proboscis, ♀, ventral (B); 68, oviger, ♂ (B); 69 leg 3, ♂ (F); 70, 71, cement gland of leg 3, ♂ (B); 72, lateral process, coxae 1 and 2 of leg 2, ♂, dorsal (A); 73, leg 3, ♀ (A); 74, distal segments of leg 3, ♂ (B); 75, chela, ♀ (E). [*c* = cephalic segment; *l.p.* = lateral process; *pa.* = palp.] Scales after fig. 80.

may be subject to variation in *Anoplodactylus*. The length and number of tubercles, processes and spurs fluctuate for instance in *A. insignis* (Hoek, 1881) (see Stock 1986: 437), whilst the length the cement gland duct is variable in *A. petiolatus* (vide supra). To complicate matters, the material attributed here to *A. spurius* sp. n. is not uniform throughout, but shows marked variability in degree of development of the leg armature and length of the gland tube. Moreover, Bremec et al. (1986: figs. 7-8) illustrate material from Argentina with a distinct tubercle on the lateral processes (as in *A. spurius*), but with a low cement gland duct and non-tuberculate legs (as in *A. stictus*).

Therefore, I find it hard to decide whether the present material represents a new species or just 'a more strongly armed' variety of *A. stictus*. I have decided to describe it as a new species, mainly to draw attention to the plasticity of the morphological characters in this genus. More material will be necessary to decide if the chosen solution was correct.

The following expression of character states separates for the moment *A. spurius* from *A. stictus*: (1) lateral processes with tall distodorsal tubercle in *spurius*, tubercle lower or absent in *stictus*; (2) coxa 1 with 2 to 10 tubercles in *spurius*, none in *stictus*; (3) cement gland rather long to long in *spurius*, short or rather short in *stictus*; (4) femur and tibiae with numerous long setae, placed on (tall) basal tubercles, in *spurius*; few setae and no basal tubercles in *stictus*.

Comparison with other species. – Child (1979) has described *A. reimerae* from the Pacific coast of Panamá that looks very similar to *A. spurius* (lateral processes and coxa 1 with tubercles). But *A. reimerae* has lateral (not ventral) alar processes on the female proboscis, its oviger segments have different proportional lengths, and a different terminal oviger segment setation. *A. spurius* is also very similar to *A. simulator* Stock, 1975 from Florida, but this species lacks ventral alar processes on the female proboscis (Stock 1986: 440).

Anoplodactylus stictus Marcus, 1940
(fig. 62)

A. stictus Marcus, 1940b: 65-68, pl. VI fig. 7E, pl. VII fig. 7A-D; Sawaya 1945: 231-234, pl. XXIII; de Castellanos 1965: 16-17; Stock 1966: 405; Bremec et al. 1986: 36-37, figs. 7-8.

Material. – 1 ♀, USP, Stn. P.E.: Ponta do Espia, State of São Paulo, on seaweeds growing in the infralittoral of rocky shore, 20 Nov 1964; 1 ♂, 5 ♀, Project Isotan-Draga I (PID), Stn. MBT 50: 23°39'S 45°06'W, 28 m, 8 May 1970; 1 ♀, PID, Stn. MBT 149: 23°41'S 41°55'W, 250 m, 4 Sep 1970; 1 ♂, 2 ♀, 3 juvs., PID, Stn. MBT 155: 27°22'S 41°32'W, 34 m, 5 Sep 1970; 1 ♀, PID, Stn. MBT 156: 22°06'S 40°53'W, 32 m, 5 Sep 1970; 1 ♀, 16 juvs., PID, Stn. MBT 157: 21°46'S 40°58'W, 15 m, 15 Sep 1970; 1 ♀, PID, Stn. MBT 171: 25°05'S 47°40'W, 20 m, 27 May 1971; 2 ♀, PID, Stn. MBT 173: 25°32'S 47°11'W, 55 m, 27 May 1971; 3 ♂, 1 ♀, PID, Stn. MBT 195: 24°03'S 44°59'W, 73 m, 1 June 1971; 5 ♂, 6 ♀, PID, Stn. MBT 197: 23°47'S 44°44'W, 65 m, 1 June 1971; 1 ♂, PID, Stn. MBT 206: 23°14'S 44°03'W, 52 m, 3 June 1971; 1 ♀, R. V. 'Prof. W. Besnard' Stn. RD 4: 19°59'S 39°56'W, 41 m, 6 July 1972.

Remarks. – This species is known shallow waters, mostly in the upper part of the shelf, of the coast of Brazil (Marcus 1940b, Sawaya 1945) and northern Argentina (de Castellanos 1965; Stock 1966; Bremec et al. 1986). The bathymetrical range of the species is extended by the present records to 250 m. An illustration of the chela is presented here (fig. 62), to allow for proper comparison with *A. spurius* (see above).

Endeis biseriata Stock, 1968

Endeis biseriata Stock, 1968: 57-60, fig. 21; Stock 1970b: 1; Stock 1974: 17; Stock 1979: 28-30, fig. 9.
Endeis biserata [lapsus calami]; Child 1988b: 20; Child 1990: 332-333.
Phoxichilus meridionalis; Loman 1908 [nec Böhm, 1879]: 78-79, pl. XI figs. 153-155.

Material. – 1 ♂, USP, Stn. P.E.: Ponta do Espia, Ubatuba, State of São Paulo, on seaweeds in the infralittoral of rocky shore, 20 Nov 1964; 1 ♀, 2 juvs., USP, Stn. F 23: Enseada do Flamengo, Ubatuba, State of São Paulo, amongst ascidians, bryozoans and sponges growing of large boulders in infralittoral, 13 Feb 1965.

Remarks. – This species is known from almost the entire tropical Indo-Pacific, from Hawaii to the Great Barrier Reef in the east, to the Gulf of Eilat and Madagascar in the west. The only published Atlantic record (Stock 1979) is, like the present records, from Brazil, but in ZMA there is also a sample from the mediolittoral zone of Antigua (West Indies). The single available male of the present collection has the cement gland pores arranged in 2 rows on the posterior surface of the tibiae. A count of the longest row on leg 4 amounts to about 29 pores. The 3 distal femoral spurs are rather short (as in Stock's 1979, fig. 9c). This is a shallow-water species, found between 0 and 46 m.

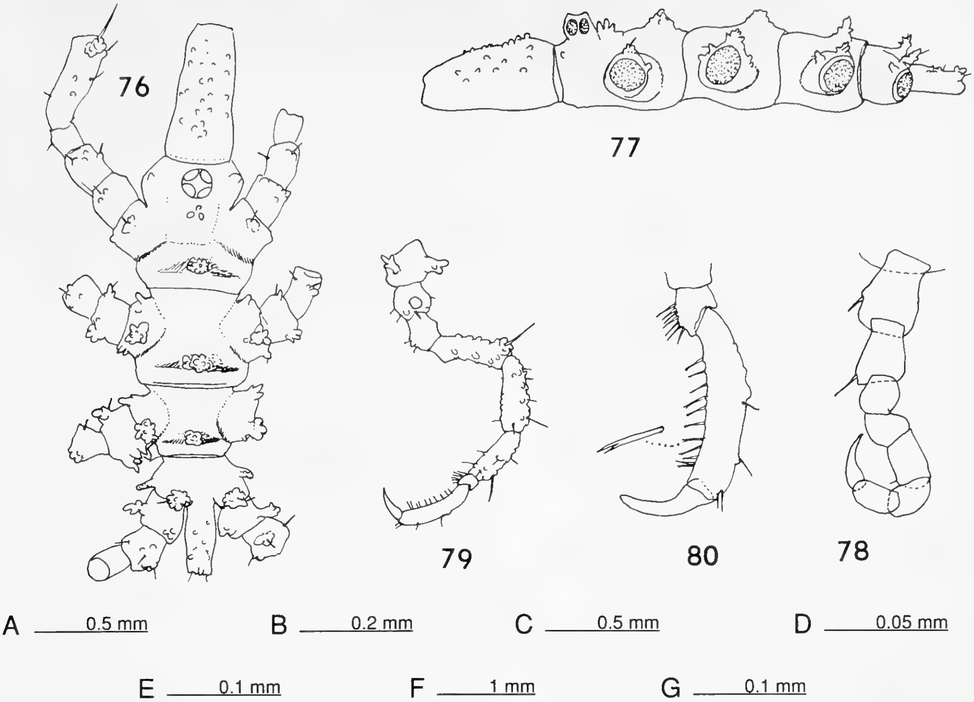
Family Colossendeidae

Colossendeis geoffroyi Mañe-Garzón, 1944

C. geoffroyi Mañe-Garzón, 1944: 1-6, figs. 1-5; Stock 1966: 396-397, fig. 3f; Larramendy 1974: 149-152, figs. 1-3.

Material. – 1 specimen (fragm.), probably this species, Project Isotan-Draga I, Stn. MBT 141: 23°25'S 43°00'W, 113 m, 2 Sep 1970; 4 spms., R. V. 'Prof. W. Besnard', Stn. 1743: 33°50'S 51°51'W, 65 m, 19 Apr 1972.

Remarks. – The record from Stn. 1743 is rather close to the type-locality, 36°05'S 53°03'W, 130 m. If the fragmentary specimen from Stn. MBT 141 (dis-



Figs. 76-80. *Pycnogonum ornans* sp. n. (♂ holotype). 76, trunk, dorsal (scale A); 77, trunk, from the left (A); 78, oviger (E); 79, leg 3 (A); 80, distal segments of leg 3 (B).

tal leg segments and palps lacking) is really this species, the range would be considerably extended in northward direction. Minnaard & Zamponi (1984: 272-275, fig. 11) describe a *Colossendeis* identified as *C. geoffroyi* from the 'Walther Hertwig' 1966 cruise, Stn. 340, 200 m. This station is off Mar del Plata, Argentina (ca. 40°S). Both the rough figures and the measurements provided by the Argentinean authors seem to indicate that a different species is concerned, because the tarsus is almost twice as long as the propodus, whereas in all other specimens of *C. geoffroyi* recorded, there is no great length difference between tarsus and propodus.

Family Rhynchothoracidae

Rhynchothorax mediterraneus **Costa, 1861**

R. mediterraneus; Child 1988a: 56 [refs.]; Stock 1988: 507; Arnaud & Krapp 1990: 4.

Material. – 14 spms., Project Isotan-Draga (PID), Stn. MBT 155: 22°22'S 41°32'W, 34 m, 5 Sep 1970; 1 spm., PID, Stn. MBT 156: 22°06'S 40°53'W, 32 m, 5 Sep 1970; 4 spms., PID, Stn. MBT 159: 22°00'S 40°06'W, 90 m, 5 Sep 1970; 1 spm., PID, Stn. MBT 169: 21°50'S 39°52'W, 1100 m, 8 Sep 1970; 1 spm., Project Petrobas/USP (PP), Stn. RD 31: 19°27.5'S 39°03.4'W, 58 m, 10 July 1972; 1 spm., PP, Stn. RD 53: 18°56'S 39°26'W, 27 m, 12 July 1972.

Remarks. – The present specimens agree pretty well with the illustrations of *R. mediterraneus* (cf. Dohrn 1881; Stock 1974), but for a few details that I do not consider of great importance. These differences concern (1) the anterior and posterior spurs on coxa 1 which in some specimens of the present collection are taller; (2) the presence in some specimens of a well-marked tubercle on palp segment 2; (3) a narrow, unarmed 2nd segment in the palp, vaguely indicated in Mediterranean material, is more distinctly present in Brazilian specimens; (4) oviger segments 5 and 6 are subequal (versus 6>5); (5) the posteroventral spur on coxa 3 of leg 3 ♂ is less pronounced than Dohrn's figures suggests.

The species was recorded before from Brazil by Zago (1970) and Zilberberg (1963). Child (1988a) re-examined some of Zilberberg's specimens and concluded that they consisted of a mixture of *R. mediterraneus* and *R. monnioti*. Apart from Brazil, *R. mediterraneus* has been recorded from the Mediterranean basin (see Arnaud & Krapp 1990, for references), Madagascar (Stock 1974), off Gibraltar (Stock 1988), and the Seychelles (Child 1988a). The present records fall within the known bathymetrical range of the species (1-200 m), except for Stn. MBT 169, which extends this range to 1100 m.

Family Pycnogonidae

Pycnogonum (*Retroviger*) *cessaci* Bouvier, 1911

P. (*R.*) *cessaci;* Stock 1975a: 1085, fig. 58d [syn., refs.]; Child 1979: 72 [refs.]; Child 1980: 325; Stock 1990: 231-232.

Material. – 37 spms., USP, Stn. P.E.: Ponta do Espia, Ubatuba, State of São Paulo, on seaweeds, rocky infralittoral, 20 Nov 1964.

Remarks. – The species was recorded before from Brazil, under the name of *Pycnogonum pamphorum* Marcus, 1940, a junior synonym.

Pycnogonum (*Retroviger*) *gibberum* Marcus & Marcus, 1963

P. gibberum Marcus & Marcus, 1963: 3-7, pl. I.

Material. – 1 ♂, 1 ♀, R. V. 'Prof. W. Besnard' (WB), Stn. RG 1325: 23°14'S 43°56.5'W, 49 m, 16 Feb 1968; 1 ♀, WB, Stn. RIG 587: 23°22'S 44°26'W, 50 m, 7 Feb 1969; 1 juv., Project Isotan-Draga I (PID), Stn. MBT 50: 23°39'S 45°06'W, 28 m, 8 May 1970; 1 larva, PID, Stn. MBT 161: 21°42'S 40°15'W, 56 m, 6 Sep 1970; 1 ♀, Project Petrobas/USP (PP) Stn. RD 4: 19°59'S 39°56'W, 41 m, 6 July 1972; 1 juv., PP, Stn RD 25: 19°38'S 39°27'W, 9 Aug 1972.

Remarks. – *Pycnogonum elephas* Stock, 1966, from the same general area (between Rio de Janeiro and Rio de la Plata) is very similar to *P. gibberum,* but is almost twice as large. Moreover, the tubercles on the lateral processes and on coxa 1 are much less conspicuous than in *P. gibberum,* and the proboscis is, especially in lateral view more slender. It is possible that the male of *P. elephas* lacks ovigers; the male of *P. gibberum* has 7- (or 8-?) segmented ovigers.

Apart from the three specimens on which the original description is based, *P. gibberum* has never been recorded again. The original material came from Ilha Lage de Santos, 32 m (Marcus & Marcus 1963: 6) and Alcatrazes Island, 36 m (Marcus & Marcus 1963: 3), both in Brazil. The present records extend both the geographical and the bathymetrical ranges slightly, to 19°38'S and 56 m.

Pycnogonum (*Retroviger*) *ornans* sp. n.
(figs. 76-80)

Type material. – 1 ♂ holotype, R. V. 'Prof. W. Besnard', Stn. RD 49: 19°05.5'S 39°14.3'W, 47 m, 12 Aug 1972 (ZMA Pa. 3441); 1 ♀ paratype, Project Isotan-Draga I, Stn. MBT 196: 23°31'S 44°57'W, 38 m, 1 June 1971 (ZMA Pa. 3442).

Description. – A small-sized *Pycnogonum.*

Male: Trunk long with respect to width, completely segmented. Lateral processes widely spaced. Ocular tubercle low, truncate; eyes well-pigmented. Three pointed tubercles behind ocular tubercle. Three mid-dorsal bosses near posterior margin of trunk segments 1, 2, and 3; bosses as tall as ocular tubercle; bosses 1 and 2 broadly conical, boss 3 narrower; each boss coarsely tuberculate. Similar bosses on dorsal surface of all lateral processes, that on lateral process 4 tallest. Anterior and posterior margins of lateral processes 2 and 3, posterior margin of lateral process 1, and anterior margin of lateral process 4 with 1 or more large tubercles. Abdomen reaching beyond middle of coxa 2 of leg 4, with small tubercles; distally truncate.

Proboscis widest near proximal end, slightly tapering, distally truncate. Dorsal surface with numerous small tubercles. Oviger 7-segmented; 1 spine on segments 1 and 2. Distal claw long, sharp, curved.

Legs short, thin. Coxa 1 of legs 2 to 4 with large, tuberculate or branched, somewhat upcurved, processes on dorso-anterior and dorso-posterior surface; coxa 1 of leg 1 with low tubercles only. Coxa 2 not strongly ornamented. Coxa 3 smooth. Femur not widened; with ventroproximal, triangular hump and several large tubercles; dorsodistal end marked by tuberculate bump and 1 strong seta. Tibia 1 slightly longer than femur, with smaller tubercles and shorter distal seta. Tibia 2 much shorter than tibia 1, about 3 times as long as wide, with some tubercles and rather short distal seta. Tarsus with ventral 'brush' of some 7 spinules. Propodus curved, longer than tibia 2; sole evenly armed with some 10 spinules, some of these bifid. Claw curved, less than half as long as propodus; no auxiliary claws.

Female: No ovigers. Ornamentation of dorsum and legs slightly less pronounced than in male.

Measurements of holotype (mm). – Length proboscis (dorsal) 0.71; greatest diameter proboscis 0.34; distal diameter proboscis 0.18; length first trunk segm. 0.73; length second trunk segm. 0.42; length third trunk segm. 0.33; length fourth trunk segm. (to tip lateral process) 0.25; width across second lateral processes 0.74; length abdomen 0.36. Leg 3: first coxa 0.17; second coxa 0.19; third coxa 0.15; femur 0.35; first tibia 0.36; second tibia 0.30; tarsus 0.06; propodus 0.35; claw 0.16.

Etymology. – The specific name *ornans* (Latin = ornamented) alludes to the ornamentation of trunk, lateral processes, proboscis, and certain leg segments with bosses and tubercles.

Remarks. – The narrow body shape is reminiscent of *P. cessaci* Bouvier, 1911 and *P. guyanae* Stock, 1975. However, *P. cessaci* possesses small auxiliary claws (absent in the new species), a more barrel-shaped proboscis, whereas the propodal armature tends to concentrate in the distal half of the sole (evenly spread over sole in the species), tibia 1 shorter than the femur and post-ocular tubercles are absent. Both in *P. cessaci* and in *P. guyanae*, the coxae and the proboscis are devoid strong tubercles and bosses, so characteristic for the habit of the new species.

Although *P. leticiae* de Mello-Leitão, 1945 is generally considered synonymous with *P. cessaci*, its propodal armature resembles that of the new species. However, by the absence of strong tubercles on the legs, it is clear that the present species cannot be identified with *P. leticiae*.

Pentapycnon geayi Bouvier, 1911

P. geayi; Stock, 1975a: 1088 [refs.].

Material. – 1 juv., Project Isotan-Draga I, Stn. MBT 164: 21°15'S 40°50'W, 19 m, 6 Sep 1970; 1 juv., Project Petrobas/USP (PP), Stn. RD 51: 19°05.1'S 39°40.4'W, 18 m, 12 July 1972; 1 ♀, PP, Stn RD 67: 18°34'S 39°40', 15 m, 13 July 1972.

Remarks. – This extra-legged form is known from Puerto Rico, the Guyanas, and the northern coast of Brazil (southernmost record hitherto 06°04.7'S). The present records extend the range to 19°05.1'S.

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Table 1. Taxa represented in the USP collections and their biogeographic characterization.
In brackets after the species name, the following abbreviations are used:

AA	amphi-Atlantic elements (on the warm and warm-temperate Atlantic coasts of America and Europe, the Mediterranean basin, and the northern and central Atlantic coasts of Africa)
CT	circum-tropical elements
E	endemics of Brazil, the Mar del Plata region and the Guyanas
M	Magellanean elements (cold-water elements of South America, from Argentina south of the Rio de la Plata to the Falkland Islands and South Georgia, southern Chile, sometimes extending northward to southern Brazil).
P	also on the warm and warm-temperate Pacific coasts of the Americas
WAW	western Atlantic warm-water elements (from southern Florida and the West Indies, the Guyanas, to Brazil and the Mar del Plata in northern Argentina).

Family Ammotheidae
- Genus *Eurycyde* Schiödte, 1857
  - *E.platyspina* sp. n. [E]
- Genus *Nymphopsis* Haswell, 1884
  - *N. melidae* Sawaya, 1947 [E]
- Genus *Cilunculus* Loman, 1908
  - *C.* sp. [E?]
- Genus *Ammothella* Verrill, 1900
  - *A. appendiculata* (Dohrn, 1881) [AA]
  - *A. rugulosa* (Verrill, 1900) [WAW]
  - *A. spinifera* Cole, 1904 [WAW + P]
- Genus *Achelia* Hodge, 1864
  - *A. besnardi* Sawaya, 1951 [WAW]
  - *A. columnaris* sp. n. [E]
  - *A. gracilis* Verrill, 1900 [WAW]
  - *A. sawayai* Marcus, 1940 [mainly AA, possibly CT]
- Genus *Tanystylum* Miers, 1879
  - *T. acuminatum* Stock, 1954 [WAW]
  - *T. evelinae* Marcus, 1940 [E]
  - *T. isabellae* Marcus, 1940 [E]
  - *T. isthmiacum difficile* Stock, 1966 [WAW]
  - *T. orbiculare* Wilson, 1878 [AA, possibly CT]

Family Nymphonidae
- Genus *Nymphon* J.C. Fabricius, 1794
  - *N. bullatum* sp. n. [E]
  - *N. inaequipes* sp. n. [E]
  - *N. vulcanellum* sp. n. [E]

Family Callipallenidae
- Genus *Callipallene* Flynn, 1929
  - *C. evelinae* Marcus, 1940 [E]
  - *C. gabriellae* Corrêa, 1948 [E]
  - *C. margarita* (Gordon, 1932) [M]
  - *C. producta* (Sars, 1888) [AA]
- Genus *Pallenoides* Stock, 1951
  - *P. amazonica* Stock, 1975 [E]

Family Phoxichilidiidae
- Genus *Pallenopsis* (subgenus *Pallenopsis*) Wilson, 1881
  - *P.* (*P.*) *boehmi* Schimkewitsch, 1930 [M]
  - *P.* (*P.*) *candidoi* de Mello-Leitão, 1949 [E]
  - *P.* (*P.*) *fluminensis* (Krøyer, 1844) [E]
  - *P.* (*P.*) *kempfi* Stock, 1975 [WAW]
  - *P.* (*P.*) *tumidula* Loman, 1923 [M]
- Genus *Anoplodactylus* Wilson, 1878
  - *A. aragaoi* Sawaya, 1950 [E]
  - *A. brasiliensis* Hedgpeth, 1948 [E]
  - *A. evelinae* Marcus, 1940 [WAW]
  - *A. insignis* (Hoek, 1881) [WAW]
  - *A. maritimus* Hodgson, 1914 [AA]
  - *A. monotrema* Stock, 1979 [WAW]
  - *A. petiolatus* (Krøyer, 1844) [AA]
  - *A. spurius* sp. n. [E]
  - *A. stictus* Marcus, 1940 [E]
- Genus *Endeis* Philippi, 1843
  - *E. biseriata* Stock, 1968 [CT]

Family Colossendeidae
- Genus *Colossendeis* Jarzynski, 1870
  - *C. geoffroyi* Mañé-Garzón, 1944 [E]

Family Rhynchothoracidae
- Genus *Rhynchothorax* Costa, 1861
  - *Rh. mediterraneus* Costa, 1861 [AA, probably CT]

Family Pycnogonidae
- Genus *Pycnogonum* Brünnich, 1764, subgenus *Retroviger* Stock, 1968
  - *P.* (*R.*) *cessaci* Bouvier, 1911 [AA]
  - *P.* (*R.*) *gibberum* Marcus & Marcus, 1963 [E]
  - *P.* (*R.*) *ornans* sp. n. [E]
- Genus *Pentapycnon* Bouvier, 1910
  - *P. geayi* Bouvier, 1911 [WAW]

BOOK ANNOUNCEMENTS AND REVIEWS

Skou, Peder, 1991. Nordens Ugler. Handbog over de i Danmark, Norge, Sverige, Finland og Island forekommende arter af Herminiidae og Noctuidae (Lepidoptera). – Danmarks Dyreliv 5: 1-565, 37 colourplates, 530 figs., 469 maps. – [ISBN 87-88757-26-9]. Price DKK 600.- Available from publisher, Apollo Books, Kirkeby Sand 19, DK-5771 Stenstrup, Denmark.

This book, part 5 of the series 'Animal life in Denmark', deals with the Noctuidae and Herminiidae (traditionally included in Noctuidae) of Denmark, Fennoscandia and Iceland. All 469 species occurring in the area are treated. The text for each species includes paragraphs on diagnostic characters, distribution in general and in detail for the Nordic countries, a distribution map for each species, habitat and biology, including remarks of larval hostplants. For most species the catterpillar is illustrated with a black-and-white photograph, and for some species also a photograph of the typical habitat is provided.

All species are shown in colour on 37 colour plates, in total showing 1137 specimens in natural size, so giving some impression of variability or sex dimorphism. These colour plates are made by the well known english photographer David Wilson, who has recently made similar colour-plates for various books on Lepidoptera. The plates are very well photographed, well in focus throughout, and also very well printed: they form the core of the book. Only for the smaller species one wonders if indeed natural size is sufficient to see the sometimes detailed differences.

The text unfortunately is in Danish, but with the aid of the english introduction, in which the Danish paragraph titles are explained, people unfamiliar with the scandinavian languages will certainly be able to understand part of the systematic treatment. For identification purposes the text illustrations together with the colour-plates are usually sufficient.

Unfortunately the book can only be fully used for the countries listed above: going southwards, soon other species will be found. For instance, in The Netherlands occur about 20 species, not found in 'Nordens Ugler'. Still the book is a most useful addition to the existing literature on noctuids, firstly because of the beautiful colour plates, much better than in most European literature on the subject, secondly because it contains information on the most recent taxonomic changes, e.g. in *Mesapamea* and the very recent separation of *Noctua janthina* and *N. janthe.*

Although a series on all European Noctuidae is on its way (vol. 1 recently being published by the same publisher, and with plates by the same photographer), it will certainly take many years before this is completed. Mr. Skou's book will therefore fill a gap throughout much of West and Central Europe for several years to come. Further it is a handy book, which could easily be carried when going out for collecting. The price is slightly on the high side (with 15% discount if one subscribes to the series 'Danmarks Dyreliv'), but worth the buy.

It is regrettable that it has been decided not to publish an english version, as was done with Peder Skou's earlier book on the geometroids.

[E. J. van Nieukerken]

Cherepanov, A. L., 1991, Cerambicidae of Northern Asia. Volume 3. Lamiinae. Part III. – E. J. Brill, Leiden: i-xiii + 1-395, figs. 1-158 [ISBN 90 04 09398 7]. Price Hfl 190.-

This is the third part of volume three of a complete revision of the cerambycid beetles of Northern Asia. Volume 1-2 and the first two parts of volume 3 were reviewed in Tijdschrift voor Entomologie 134 (1991): 154. According to information provided by the publisher the book is intended for entomologists, general ecologists, plant-protection workers and forestry specialists.

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Articles

Book Announcements and reviews

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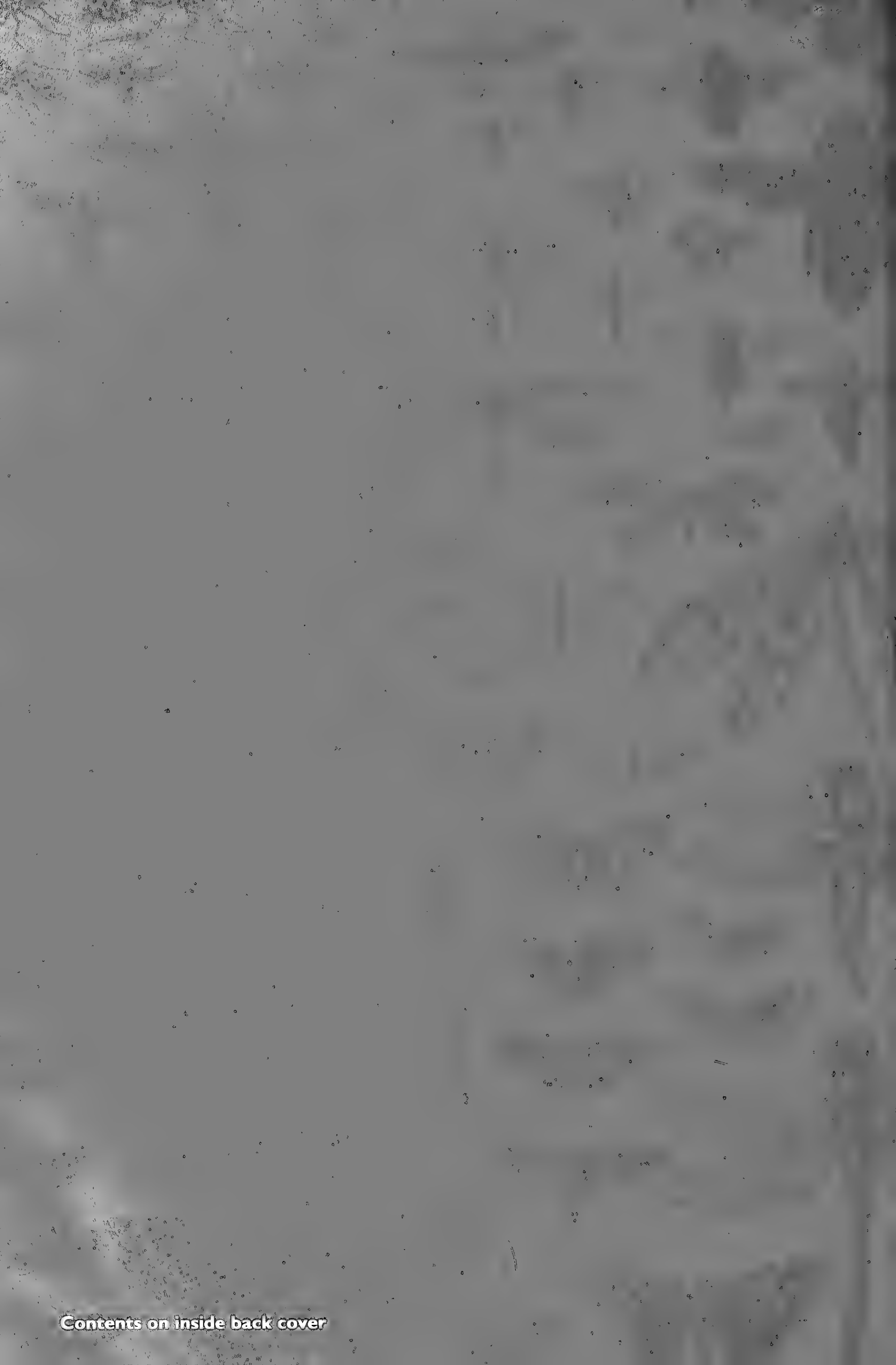

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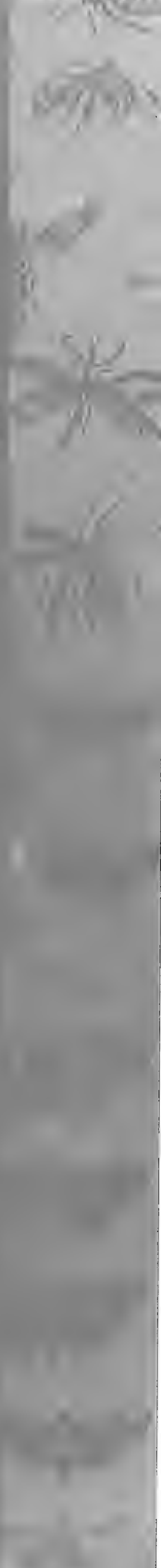

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A NEW SPECIES OF *OREAGRION* (ODONATA: COENAGRIONIDAE): MONTANE DAMSELFLIES FROM NEW GUINEA

Brooks, S. J. & S. J. Richards, 1992. A new species of *Oreagrion* (Odonata: Coenagrionidae): montane damselflies from New Guinea. – Tijdschrift voor Entomologie 135: 141-144, figs. 1-8. [ISSN 0040-7496]. Published 1 December 1992.

Oreagrion pectingi sp. n. (Coenagrionidae) is described from specimens collected above 3000 m on the slopes of Mt Wilhelm and Mt Capella, Papua New Guinea. The discovery of this new species sheds new light on the relationship of *Oreagrion* with other ischnurines.

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Key words. – Odonata, *Ischnura, Oreagrion,* New Guinea, phylogeny.

The ischnurine genus *Oreagrion* Ris was originally based on a single female collected at 3000 m in the Snow Mountains (now called the Maoke Range) of central New Guinea (Irian Jaya) (Ris 1913). Thirty years later, from the same general area, Lieftinck (1949) described a further three species collected near Lake Habbema and Mt Wilhelmina (now called Mt Trikora) between 3000-3500 m. Since then no further species of the genus have been described, although Lieftinck predicted that others would probably be found residing throughout the sub-alpine highlands of New Guinea. About 700 km to the east of Lake Habbema, in Papua New Guinea, similar tropic-alpine conditions occur on Mt Wilhelm and it was here that a fifth species was discovered by George Beccaloni in August 1990. Subsequently, in November, 1991 one of us (SJR) discovered another population on the southern slopes of Mt Capella, in the Star Mountains, central New Guinea.

At both localities, no other insects were flying on the cool, exposed slopes, so it is of note that this species of damselfly can tolerate such harsh conditions. However, *Oreagrion* species are stout and robust, and the head, thorax, and basal segments of the abdomen have a sparse covering of long, fine hairs which may play a role in thermoregulation. Similar hairs occur in *Protallagma*, a neotropical genus of ischnurines from the high Andes.

Because of the absence of a ventral spine on the 8th abdominal segment in females of *Oreagrion*, Lieftinck (1949) regarded the genus as the primitive progenitor of *Ischnura* which it otherwise resembles. However, *Oreagrion pectingi* sp. n. does possess a ventral spine which throws into doubt Lieftinck's interpretation of the phylogenetic relationships of the genus.

TAXONOMY

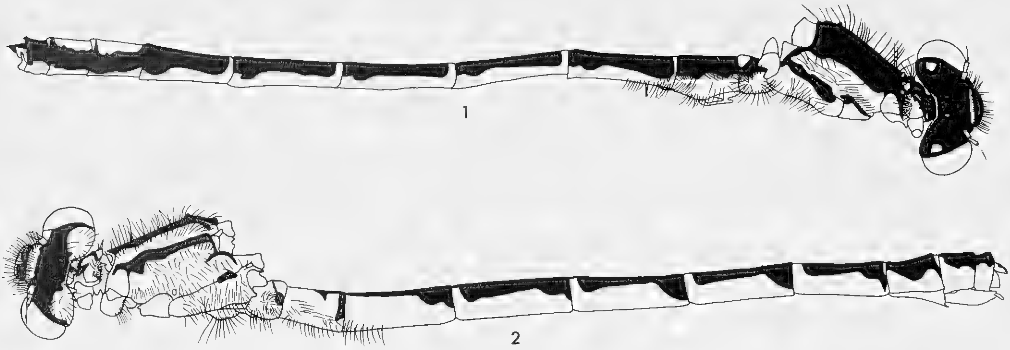
Oreagrion pectingi sp. n
(figs. 1-8)

Type material. – Holotype ♂: Papua New Guinea, Chimbu Province, Mt. Wilhelm, near waterfall entering west end Lake Piunde, 3600 m, 6 August 1990, G. Beccaloni (BMNH). – Paratypes: 1 ♀, same data as holotype; 2♂ 1♀ (incl. one pair), Papua New Guinea, Star Mountains, southern slopes of Mt Capella, Dokfuma, pond in subalpine meadow, 5°1'S 141°7'E, 3000-3200 m, 16/19 Nov 1991, S. J. Richards (all paratypes in BMNH).

Description

Male holotype. Note that the markings described below are based on living specimens; after the death the pale areas become orange-brown.

Head (fig. 1). Width across eyes 4.1 mm. Eyes (in life) dark brown in dorsal half, pale blue ventrally. Labrum blue-green with narrow black basal stripe and black median triangular spot. Base of mandible blue-green. Gena blue-green. Clypeus black. Frons blue-green. Vertex black with small, rounded, pale blue post-ocular spots and narrow, pale blue occipital stripe. Long fine hairs sparse on labrum, clypeus, vertex (especially in post-ocular region), occiput; dense on frons.



Figs. 1-2. *Oreagrion pectingi* sp. n. – 1, male, right lateral view; 2, female, left lateral view;

Prothorax (fig. 1). Anterior lobe black with small lateral blue-green spot; propleuron blue-green; median lobe black with small lateral blue-green spot; posterior lobe black. Hairs on posterior lobe sparse, dense on posterior margin of propleuron.

Mesostigmal lamina (fig. 3): black medially, peripherally blue-green, with small, rounded submedian tubercles on posterior margin; tubercles black on anterior face, blue-green dorsally and posteriorly.

Pterothorax (fig. 1). Bronze-black on dorsum, pale antehumeral stripe absent; mesepimeron black in dorsal half, blue-green below; metepisternum almost entirely blue-green but with narrow black stripe adjacent to second lateral suture; metepimeron with narrow black stripe adjacent to second lateral suture, the rest blue-green. Fine long hairs covering most of synthorax but absent antero-laterally. Legs: black with narrow blue-green stripe on flexor surface of femora; coxa blue-green. Wings: hyaline with faint amber suffusion. Venation black. Pterostigma (fig. 4) medially dark brown in fore wing, pale brown in hind wing, with narrow yellow-brown border in all wings; 2.5 cells below pterostigma in fore wing, 1.25-1.50 cells in hind wing. Fore wing with 12 postnodals, 10-11 in hind wing. R3 arises between 4th and 5th postnodals in fore wing, 3rd and 4th in hind wing. Measurements. Hind wing 17.5 mm, 4.5 mm at greatest width, pterostigma (fore wing) 0.80-0.84 mm long, 0.5-0.6 mm wide, (hind wing) 0.56-0.62 mm long, 0.36-0.38 mm wide.

Abdomen (fig. 1). S1 with black dorsal spot in anterior half, apple green posteriorly; S2-S7 black dorsally, apple green ventro-laterally; S8-S9 entirely sky-blue dorsally; S10 entirely black dorsally. Fine hairs in ventro-lateral region of S1 and S2, but hairs confined to anterior half of S3. Appendages: superior (figs. 5-6) apple green at extreme base and extero-laterally, black dorsally and interno-laterally; about 3 times as long as inferior, about same length as S10; conical and diverging in dorsal view with broad, recurved median ventral tooth which narrows towards its apex. Hairs short, sparse. Inferior with apex of dorsal branch black, rest apple green; bifurcate with broad, blunt ventral branch and narrow, cylindrical dorsal branch. Total length 30.5 mm, abdomen 24 mm (including appendages 0.58 mm).

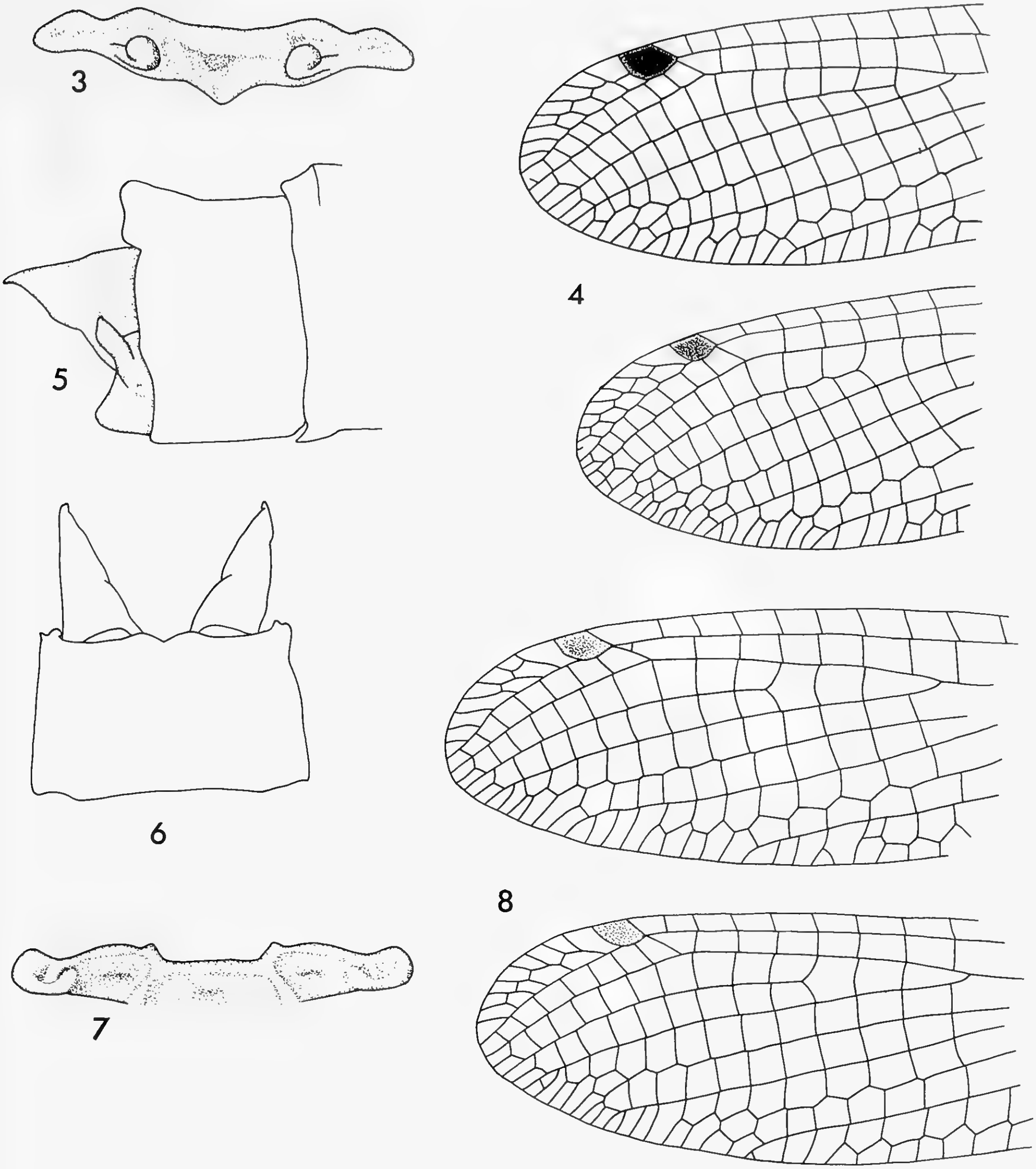
Female paratype. – As male except the following.

Head (fig. 2). Eyes dark brown in dorsal half, apple green ventrally. Labrum apple green with small medio-basal black spot. Base of mandible apple green. Gena apple green. Clypeus black with narrow apple green border. Frons apple green. Vertex black; postocular spots apple green, large and confluent with occipital stripe.

Prothorax (fig. 2). Anterior lobe apple green; propleuron apple green; median lobe black dorsally with large apple green lateral spot; posterior lobe black medially, apple green laterally. Mesostigmal lamina (fig. 7). Black medially with anterior margin and lateral lobes apple green; lateral lobes reniform.

Pterothorax (fig. 2). Blonze-black on dorsum with broad apple green antehumeral stripe; mesepimeron with narrow black stripe adjacent to first lateral suture, the rest apple green; metepisternum apple green with short black stripe near posterior margin; metepimeron apple green with black posterior spot on second lateral suture. Fine, long hairs over most of synthorax but absent from antero-lateral region. Legs: femur and tibia apple green with lateral black stripe on external face; tarsus black. Wings: hyaline with pale amber suffusion. Venation black. Pterostigma (fig. 8) pale brown in fore and hind wing; 1.5 cells below pterostigma. Measurements: hind wing 19.5 mm, 4.0 mm at greatest width; pterostigma 0.72 mm long, 0.32 mm wide in fore wing; 0.62 mm long, 0.32 mm wide in hind wing.

Abdomen (fig. 2). S1 apple green with small black



Figs. 3-8. *Oreagrion pectingi* sp. n. – 3, male mesostigmal lamina, dorsal view; 4, male apex of fore and hind wing; 5, male anal appendages, right lateral view; 6, male superior appendages, dorsal view; 7, female mesostigmal lamina, dorsal view; 8, female apex of fore and hind wings.

lateral spot connected by fine black line to black dorsal spot in anterior half; S2 apple green with small black antero-dorsal spot and black sagittal spot in posterior half; S3-S10 with black dorsal stripe, narrow anteriorly, broadening posteriorly, apple green laterally. S8 with ventral spine. Ovipositor short, extending 0.2 mm beyond apex of abdomen. Anal appendage (fig. 2) short, conical, blunt apically and slightly downturned. Measurements: total length 30.5 mm, abdominal length 22.5 mm (including anal appendages 0.38 mm).

Habits. – The type locality is a steep east-facing bank, supporting alpine vegetation, about 100 m above Lake Piunde on the slopes of Mt Wilhelm. A full description of the terrain is given by Smith (1982). The lake is oligotrophic and appeared to be devoid of higher plants and invertebrates. During August rain may fall every afternoon but up to 22 consecutive dry days have been recorded. Night temperatures fall below freezing and day temperatures may exceed 20°C. The holotype and paratype were collected over a shallow seepage trickling through grass, low herbage and bare rocks. The seepage was unshaded and exposed to the wind. Several additional zygopterans, probably of the same species, were observed, but not collected, flying in sunshine at the locality. No other odonates were seen. The holotype and paratype were photographed ovipositing in tandem into rotting grass stems in about one cm of water. Both male and female had their legs in contact with emerging grass stems during oviposition.

The locality at Mt Capella is similar in character. The meadow floor is covered with a thick mat of ferns with clumps of large tree-ferns and stunted rhododendrons. The entire meadow is very boggy and with scattered small areas of open water. *O. pectingi* occurred around these pools. The ponds were devoid of vegetation and supported a depauperate fauna. No Odonata larvae were discovered in the ponds. Temperatures in November fell to 1°C at night and got no higher than 15°C during the day. Individuals flew during brief periods of sunshine. They ceased activity during cloudy or rainy weather. At one pond, about 4 m in diameter, five males rigorously defended territories around the perimeter, chasing off intruding males. Two of these males successfully mated at least once during the three days they were observed.

Remarks. – Females of *Oreagrion pectingi* may be distinguished from other members of the genus by the presence of a ventral spine on the 8th abdominal segment. Otherwise *pectingi* has similar markings to *O. oreadum* Lieftinck. However, the lateral lobes of the mesostigmal lamina are rounded in *pectingi* but narrow and taper apically in *oreadum.*

The abdominal markings of the male *pectingi* also most closely resemble male *oreadum* but the pale colouration is yellow rather than blue-green in the latter species. In *oreadum* males there is a broad antehumeral stripe which is absent in *pectingi* and the pterostigma of the fore wing is uniformly brown and lacks the pale apical outer angle of *oreadum.* The anal appendages most readily differentiate *pectingi* from other *Oreagrion* species and are not as densely pubescent. However, they are closest in appearance to *oreadum.* Like this species the superior appendages taper apically but are more acutely pointed in *pectingi.* The large ventral tooth arises subapically in *pectingi,* but is apical in *oreadum.* The inferior appendages in *oreadum* are narrow, directed posteriorly and are considerably longer than the superiors. The inferiors of *pectingi* are short and bifurcate, although the narrow dorsally directed branch is again reminescent of *oreadum.* Male and female of *O. pectingi* are considerably larger than *oreadum.* The similarities of the characters noted above suggest that *O. pectingi* is most closely related to *O. oreadum,* which Lieftinck (1949) thought was the most primitive of the *Oreagrion* species.

Lieftinck (1949) considered *Oreagrion* to be an ischnurine because the males have dissimilar pterostigmata in the fore and hind wing and because of certain penile characters, synapomorphies that suggest a close relationship with *Ischnura.* However, unlike *Ischnura,* the females of the four *Oreagrion* species known to Lieftinck lacked a ventral spine, which implied that they were less derived than *Ischnura.* Nevertheless, in *O. pectingi,* a fully developed ventral spine is present. If Lieftinck's assertion is correct, and *Oreagrion* is a primitive ischnurine, then the ventral spine must have arisen independently once in *O. pectingi* and again in the *Ischnura*-related ischnurines. Another interpretation of the phylogeny of *Oreagrion* is that the ventral spine has been secondarily lost in the other four species of *Oreagrion,* but plesiomorphically retained in *O. pectingi.* This would imply that, rather than being a stem-group ischnurine, *Oreagrion* is more closely related to *Ischnura* than Lieftinck suggested. However, until more species of *Oreagrion* are discovered and more work is done on ischnurine phylogeny this problem will be difficult to resolve.

ACKNOWLEDGEMENT

We are very grateful to George Beccaloni for allowing us to study the dragonflies he collected while on the Imperial College Expedition to Papua New Guinea.

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GERRIDAE, MAINLY FROM SULAWESI AND PULAU BUTON (INDONESIA)

Notes on Malesian aquatic and semiaquatic bugs (Heteroptera), III.

Chen, P. & N. Nieser, 1992. Gerridae, mainly from Sulawesi and Pulau Buton (Indonesia). Notes on Malesian aquatic and semiaquatic bugs (Heteroptera), III. – Tijdschrift voor Entomologie 135: 145-162, figs. 1-41, table 1. [ISSN 0040-7496]. Published 1 December 1992.
Gerridae mainly from Sulawesi, Pulau Buton and Sabah (E. Malaysia) are revised and keys to Indonesian genera and Sulawesi species are provided, with records and distributional notes. Nine new species are described: *Cylindrostethus akanthinos, Metrocoris breviculus, Potamometropsis anomalis, Rheumatometroides drepanephoros, R. makraitos* and *Ventidius xyele* from Sulawesi, *Ventidius xiphibion* from Sulawesi and Buton, *Tenagogonus akanthinos* and *Ventidius kurtokalami* from Sabah.
Correspondence: Dr. N. Nieser, Htg. Eduardstr. 16, 4001 RG Tiel, The Netherlands.
Key words. – Sulawesi; Buton; Sabah; Gerridae; keys; new species.

As our contribution to the Fauna Malesiana program, we are working on the Nepomorpha and Gerromorpha mainly collected by staff members of the Zoological Museum Amsterdam and the National Museum of Natural History Leiden. The first part of the Gerridae, viz. a revision of the genus *Limnometra* in the Malay archipelago, was published as the second part of our series (Nieser & Chen 1992a), while Naucoridae, Nepidae and Notonectidae appeared in the first part (Nieser & Chen 1991).

The specimens studied in this paper were mainly collected by J. P. Duffels, N. Nieser, J. van Tol and G. Zimmermann on several expeditions to Sulawesi, the nearby island of Buton, and to Borneo. For more details (e. g. a list of localities) the reader is referred to Nieser & Chen (1991, 1992a). In addition, unidentified Gerridae from Indonesia kept in RMNH and ZMA have been studied. Dr. D. A. Polhemus (presently at Bishop Museum, Honolulu, Hawaii) is working on a revision of the genus *Ptilomera* Amyot & Serville. Most of the specimens of this genus taken by the collectors mentioned above are at his disposal.

A key to the genera of Gerridae occurring in Indonesia and E Malaysia is included. When relevant, keys to species of Sulawesi and Buton are given as well. These should be used with caution as the fauna of the region is still poorly known.

Measurements are in millimetres and present the range or the (arithmetic) mean based on five randomly chosen specimens, or in case there are less than five, on all specimens available. The width of the head is measured across the eyes, the width of the thorax is measured across the metaacetabula.

Most of the females in the samples carried eggs; only where such was not the case this has been indicated.

MATERIAL

Localities are in Indonesia, unless stated otherwise. The areas in Sulawesi (Celebes) used with the localities agree with the Indonesian provinces, viz. Sulawesi Utara, Tengah and Tenggara for respectively for Northern, Central and Southeastern Sulawesi (see Whitten et al. 1988). Pulau Buton is mentioned separately although it belongs administratively to Sulawesi Tenggara.

Collections from which material has been studied or in which material has been deposited (with abbreviations in brackets) are: Museum Zoologi Bogor, Bogor, Jawa (MBBJ); Bagian Pertanian, Universitas Haluoleo, Kendari, Sulawesi (BPUH); J. T. Polhemus Collection (University of Colorado Museum), Englewood, Co. U. S. A. (JTPC); Snow Entomological Museum, University of Kansas, Lawrence, Kansas, U. S. A. (SEMC); N. Nieser collection, Tiel, The Netherlands (NC); P. Chen collection, Beijing, P. R. China (PCHC); National Museum of Natural History (Rijksmuseum van Natuurlijke Historie), Leiden, The Netherlands (RMNH); G. Zimmermann collection, Marburg, B. R. D. (ZC); Zoölogisch Museum, Afdeling Entomologie, Amsterdam, The Netherlands (ZMA); Zoological Museum of the University, Copenhagen (ZMC).

Specimens collected by J. P. Duffels are deposited in ZMA, those by J. van Tol in RMNH, those by G. Zimmermann in ZC and those by N. Nieser in his own collection, unless otherwise stated. Deposition of material is usually specified only with rare or new species.

ACKNOWLEDGEMENTS

Thanks are due to Dr. J. P. Duffels (ZMA), Mr. J. van Tol (RMNH) and Dr. G. Zimmermann (Marburg, B. R. D.) for putting specimens in their care to our disposal; to Dr. N. Møller Andersen (ZMC) for discussing several problems in identification and Dr. I Made Ebeneser (BPUH) for showing the senior author some interesting localities.

SYSTEMATIC PART

Key to Indonesian and East Malaysian genera of Gerridae

(Adapted from Andersen 1982)

1\. Ventral lobes of head produced (fig. 1), first abdominal sternum present. Female ovipositor well developed, serrate (Rhagadotarsinae) .... *Rhagadotarsus*

– Ventral lobes of head not produced, first abdominal sternum absent or fused with metasternum. Female ovipositor short and nonserrate 2

2\. Middle femora usually stout, shorter than middle tibia and hind femora (Trepobatinae) 3

– Middle femora slender, usually distinctly longer than middle tibiae 5

3\. Metasternal scent gland opening absent .... *Metrobatopsis*

– Metasternal scent gland opening small but distinct 4

4\. Metasternum not produced anteriorly, scent gland opening in the centre of metasternum .... *Rheumatometroides*

– Metasternum produced anteriorly, scent gland opening near anterior border .... *Stenobates*

5\. Metasternum extremely reduced, usually only represented by a very short subtriangular plate enclosing the scent gland opening (Fig. 2). Claws of hind tarsi modified, straight or S-shaped (Halobatinae) 6

– Metasternum well developed, laterally clearly reaching the metaacetabular region. Claws of hind tarsi, if present, falcate 10

6\. Clypeus with basal margin well defined, anterior margin of head not smoothly rounded. Metasternum reduced but reaching metaacetabula laterally, marine .... *Halobates*

– Clypeus with basal margin obliterated or lost, anterior margin of head broadly and smoothly rounded. Metasternum strongly reduced, not reaching metaacetabula laterally 7

7\. Metanotum with lateral longitudinal elevation reaching intersegmental suture between meso- and metanotum. Male third antennal segment with stiff hairs on margin .... *Esakia*

– Metanotum with lateral longitudinal elevation indistinct or ending somewhere on metanotum, not reaching intersegmental suture between meso- and metanotum. Pilosity of third antennal segment variable, but no stiff hairs on margin . 8

8\. Eyes overlapping anterolateral angles of mesonotum 9

– Eyes not overlapping anterolateral angles of mesonotum .... *Metrocoris*

9\. Metaacetabula and hind coxa of female produced medially .... *Ventidiopsis*

– Metaacetabula and hind coxae of female not produced medially .... *Ventidius*

10\. Fore tarsi long, at least one half the length of fore tibia. Metaacetabular groove dorsally reaching anterior end of first abdominal tergum (Ptilomerinae) 11

– Fore tarsi shorter. Metaacetabular groove not reaching anterior end of first abdominal tergum 14

11\. Hind coxae with a small spine on apical margin, hind femora much longer than middle femora ... . *Ptilomera*

– Hind coxae without spines, hind femora subequal to or shorter than middle femora 12

12\. Anterior margin of head rounded, first antennal segment shorter than three following segments together .... *Rheumatogonus*

– Anterior margin of head not rounded, first antennal segment about as long as or longer than three following segments together 13

13\. First antennal segment about as long as three following segments together, middle and hind tarsi with distinct claws .... *Potamometropsis*

– First antennal segment longer than three following segments together, middle and hind tarsi without distinct claws .... *Pleciobates*

14\. Rostrum short, not surpassing the prosternal margin, forth antennal segment short and curved. First segment of fore tarsi less than one-half the length of second (Cylindrostethinae) .... *Cylindrostethus*

– Rostrum longer, clearly surpassing the prosternal margin, forth antennal segment straight. First segment of fore tarsi usually more than one-half the length of second segment 15

15. Wingless form with posterior lobe of pronotum absent, small species (length up to 5 mm), anterior lobe of pronotum with a central and a pair of sublateral longitudinal light stripes, tarsal claws of middle and hind legs present (Eotrechinae) .... *Amemboa*
– Wingless form with posterior lobe of pronotum present, usually larger species, if length about 5 mm or less, then tarsal claws of middle tarsi absent or anterior lobe of pronotum light with a dark longitudinal median stripe (Gerrinae) ... 16
16. Dorsal surface of head and abdominal venter generally dark. Metathoracic spiracle located only a little more than its own length from base of fore wing .... *Aquarius*
– Dorsal surface of head light or dark with longitudinal dark stripes or elongate spots, venter generally light. Metathoracic spiracle located much more than its own length from base of fore wing 17
17. Anterior lobe of pronotum dark with a large median light spot. Claws absent on middle tarsi .... *Neogerris*
– Anterior lobe of pronotum light or dark with a pair of small light spots. Claws present on middle tarsi 18
18. Posterior lobe of pronotum dark, usually with a median longitudinal white stripe ..... *Limnogonus*
– Pronotum basically light with a median longitudinal dark stripe, sometimes with quite extensive other dark markings 19
19. Connexival spines normal. Male abdomen not reduced. Last ventral abdominal segment plus genital segments shorter than preceding four segments. Hind coxae of male rarely extending beyond middle of second ventral abdominal segment .... *Limnometra*
– Connexival spines reduced. Male abdomen reduced. Ventral abdominal segments short, last segment plus the genitalia at least as long as preceding four segments, usually longer. Hind coxae of male nearly reaching or surpassing posterior margin of second ventral abdominal segment .... *Tenagogonus*

Gerrinae Bianchi, 1896

Limnogonus Stål, 1868

A tropicopolitan genus with a relatively small number of, often widespread, species. Andersen (1975) provides an excellent revision of the Old World species.

Most *Limnogonus* live on small stagnant waters including cattle ponds and pools and ditches in sawahs. Some species have good tolerance for brackish water. Three species, one with two subspecies, are known from Indonesia; all three occur in Sulawesi.

Key to *Limnogonus* of Sulawesi

1. Connexival spines well developed (fig. 3), pronotal lobe usually without a mesial pale stripe .... *L. nitidus*
– Connexival spines reduced, pronotal lobe with a mesial pale stripe 2
2. Pale stripe on upper part of mesopleuron tapering posteriorly, ending in front and below second spiracle (fig. 4) .... *L. fossarum skusei*
– Pale mesopleural stripe widened posteriorly, ending above the second spiracle (fig. 5) .... *L. hungerfordi*

Limnogonus fossarum fossarum (Fabricius)

Cimex fossarum Fabricius, 1775: 727.
Limnogonus fossarum; Cheng 1966: 121-127 (biology).
Limnogonus fossarum fossarum; Andersen 1975: 30-36, figs. 30-36, 49-53, 56-61, 64-67, 69, 70, 72, 73, 78-85 (redescription, synonymy); Selvanayagam & Rao 1989: 474-484 (biology); Rubia & Heong 1990: 34-35 (life history).

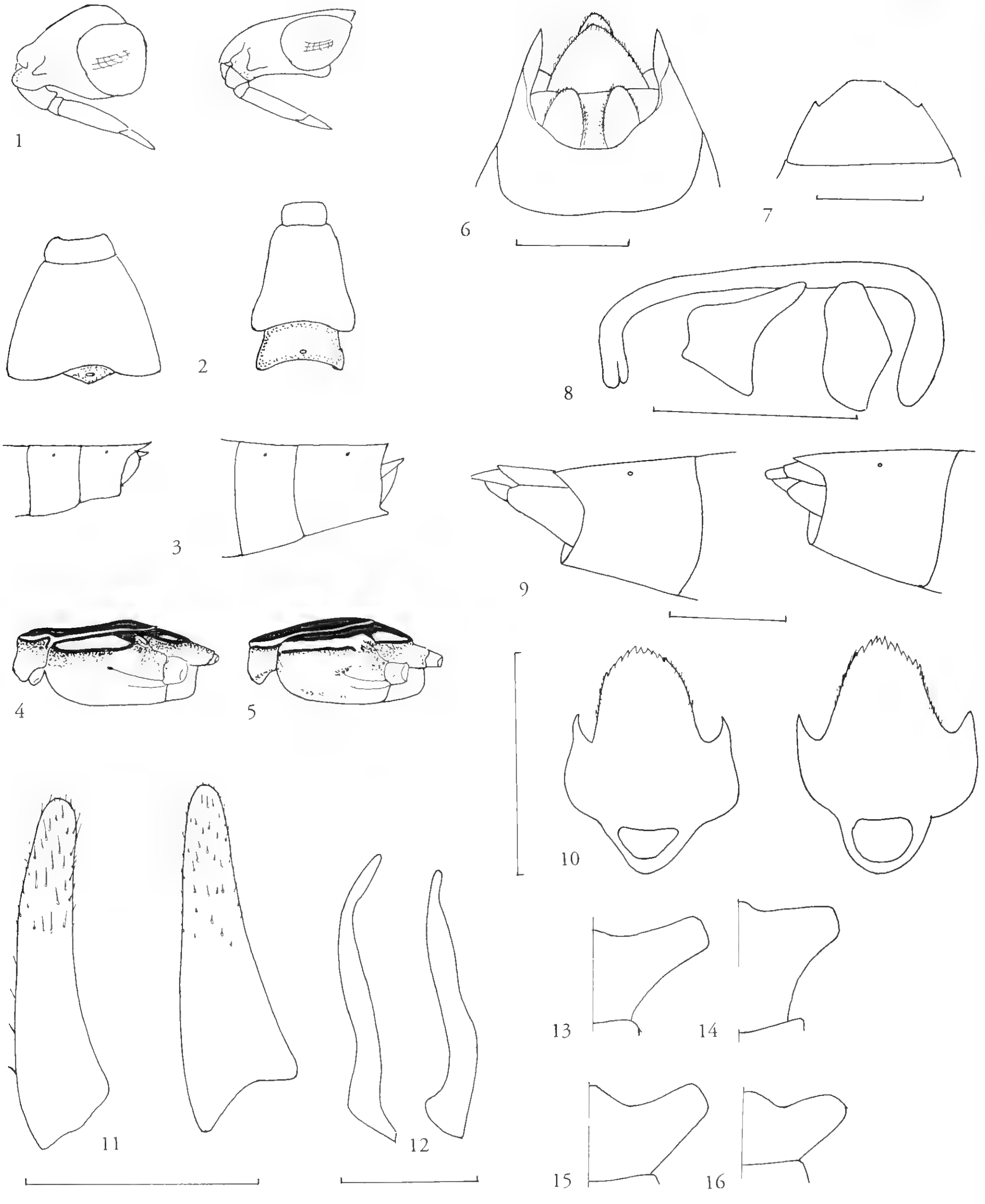
Material. – INDONESIA. N. Sumatera: Alas valley, Kutacane, Tanah merah, 3°31'N 97°47'E, ca. 200m, 8. VI. 1972, 3♀, leg. J. Krikken No 9; NE Sumatra: Kuala Simpang, lowland cultivated area, at light, XI. 1953, 2♂ 5♀; same II. 1964, 1♂, leg. A. Sollaert. – MALAYSIA, Sabah: 16 km NE Tenom Agr. Res. Station, 115°59'E, 5°11'N, TL, 180m, 11. VI. 1986, leg. J. Huisman, 2♂ 2♀ (1♂ brach.); same 23. XI. 1987, leg. J. Huisman & R. de Jong, 1♂; Kinabalu Park HQ, roadside, ML, 116°32'E, 6°00'N, 1500m, 14. V. 1987A, 1♀; leg. J. Huisman (all RMNH).

Distribution. – Widespread: India (except the NE), Indochina, extreme S of China including Hong Kong and Taiwan, Ryu Kyu Is., Philippines, Sumatera and N Borneo (Andersen 1975).

Remarks. – One of the very few species of tropical Asian Gerridae of which the biology has been studied (Cheng 1966, Selvanayagam & Rao 1989, Rubia & Heong 1990). Chinese texts report that it is useful as a component of a cure against malaria (Anonymous 1982).

Limnogonus fossarum skusei (Bueno)
(figs. 3-4)

Limnometra skusei Bueno, 1926: 129 (new name for *Hydrometra australis* Skuse, preoccupied by *Hydrometra australis* Say).
Limnogonus fossarum; Lundblad 1933: 374-380, fig. 119 (redescription based on specimens from Java).
Limnogonus fossarum skusei; Andersen 1975: 36-39, figs. 54, 71, 74-77, 86-89, 91-92 (subspecific status).



Figs. 1-16. – 1, diagram of head of Gerridae, left *Rhagadotarsus* right *Cylindrostethus*, stippled area is the ventral lobe; 2, diagram of thoracic sternites in Gerridae, left Halobatinae, right Gerrinae, sclerite with stippled margin is metasternum with scent gland orifice; 3, apex of abdomen in female *Limnogonus*, left *L. nitidus*, right *L. fossarum*; 4, lateral view of thoracical pattern in *Limnogonus fossarum skusei*; 5, idem, *L. hungerfordi*; 6, *Tenagogonus akanthinos* sp. n., holotype ♂, apex of abdomen ventral view, scale 0.5 mm; 7, idem, allotype ♀, apex of abdomen ventral view, scale 1 mm; 8, idem, lateral view of endosomal sclerites of paratype, scale 0. 25 mm; 9-12, *Cylindrostethus*, left *C. brachyakanthinos* sp. n., right *C. persephone* Kirk; 9, apex of abdomen of ♀, scale 1 mm; 10, suranal plate of ♂, scale 1 mm; 11, paramere, scale 0.2 mm; 12, lateral sclerite of endosoma, scale 0.2 mm; 13, left half of suranal plate of *Ptilomera oribasis* Bred. ♂, scale 1mm; 14, idem, *P. laelaps* Bred.; 15, idem, *P. dorceus* Bred.; 16, idem, unnamed new species.

Material. – Sulawesi Utara: Dumoga Bone National Park, Toraut, Fischteich südl. Base Camp, 18. X. 1985, 1♂ 1♀; Danau Alea, Bergsee bei Kotamobagu, 1500m, X. 1985, 1♀; S. Coast, Malibagu, mangrove, 8. XI. 1985, 2♂ 3♀ (no eggs). Sulawesi Tenggara: Desa Kagunyala, N8908, 1♀; Aopa Marsh, N8913, 4♂ 5♀ (3♂ 5♀ apterous); Jalan Asera, N8918 1♂ 1♀; Sungai Kolaka N8921B, 2♂ 2♀; Tamborasi, N8925, 4♂ 6♀ (on the sea, without eggs); Mowewe, N8924, 1♀; Pomalaa, N8930 1♀, N8931 3♀ (2 apt.); Teluk Kendari, N8948, 4♂ 6♀. Buton: Desa Gareng-Gareng, N8937, 1♂ 2♀ (1♀ apt.). West Flores: 1♀, leg. F. A. F. Verheijen (RMNH). Macropterous unless otherwise indicated.

Distribution. - Widespread: Indonesia (except Sumatera), Mariana Is., New Guinea, N and E Australia to Cook Is.

Limnogonus hungerfordi Andersen
(fig. 5)

Limnogonus hungerfordi Andersen, 1975: 46-47, figs. 115, 116, 120-122.

Material. – INDONESIA. Sulawesi Utara: 50 km N Kotamobagu, Thermalquellen, 26. X. 1985, 1♀, leg. G. Zimmermann. Sulawesi Tengah: Palu 60 km SE of: Lore Lindu N. P., Danau Tambing and brooklets, UTM SJ95, 1600m asl, *Pandanus*, 7. XII. 1985, 1♂, leg. J. van Tol. Sulawesi Tenggara: Wawonggole, N8901, 6♂ 7♀ (3♂ 2♀ apterous), N8902, 1♀ apt. ; Kendari, N8903A, 1♀ apt., 1♀ macr. ; Desa Kagunyala, N8905, 1♂ 1♀; N8907, 1♂; Sungai Sampara, N8910, 3♂ 2♀ (1♂ apt.), N8911, 1♂ 1♀, N8912, 2♂ 4♀; Jalan Asera, N8916, 2♂ 3♀, N8917, 5♂ 8♀, N8918, 23♂ 16♀ (2♂ apt.); Pomalaa, N8928 5♂ 2♀ (4♂ 2♀ apt.), N8929 5♂ 4♀ (apt.); Mowewe, N8932, 4♂ 5♀ (3♂ 1♀ apt.), Teluk Kendari, N8945, 1♂. P. Buton: Desa Gareng-Gareng, N8937 1♀; Mangrove swamp, N8939, 1♂ 1♀ apt. ; N8943, 1♂ 1♀. Irian Jaya: Neth. New Guinea Exp., Star Range, Bibil, 1290m, 2♀ (RMNH). – MALAYSIA: Sabah: 60 km W Lahad Datu, DVFC, building site staff quarters, ML-light, 117°48'E 4°58'N, 150m, ML-light, 28. X. 1987, 1♂; 23 km W Sandakan, Sepilok tree tower, 118°06'E 5°49'N, 0-100m, ML, 1. XI. 1987, 1♀; 20 km W Sandakan, Sepilok-laut, nr. Resthouse, 118°06'E 5°49'N, 0m, ML-light, 4. XI. 1987, 1♀; 23 km W Sandakan, Sepilok, 118°06'E 5°49'N, 0-100m, ML-light, 31. IX. 1987, 1♂; 12.5 KM S Nabawan, Kg. Pamuntaria, nr river, 116°27'E 5°02'N, 400m, ML-light, 16. XI. 1987, 1♂, leg. J. Huisman & R. de Jong (RMNH). Macropterous unless otherwise indicated.

Distribution. - Widespread: Taiwan, Malay Peninsula, Philippines, Indonesia to New Guinea and NE Australia (Andersen 1975).

Limnogonus nitidus (Mayr)
(fig. 3)

Hydrometra nitidus Mayr, 1865: 443.
Limnogonus nitidus; Lundblad 1933: 387-388, fig. 122 (redescription); Andersen 1975: 62-65, figs. 191, 192, 195-203, 205-208; Selvanayagam & Rao 1989: 474-484 (biology); Nieser & Chen 1992b: (in print).

Material. – INDONESIA. Sulawesi Utara: Dumoga Bone N. P., Toraut alt. 210m, sec. growth, at light, 28. VIII. 1985, 1♂ 1♀, leg. J. Huijbregts; S coast, Malibagu, Mangrove, 8. XI. 1985, 1♂ 2♀ (no eggs). Sulawesi Tengah: Palu, 65 km SSE of: Lore Lindu N. P., Marena shelter, UTM-SJ62, 600m, 15. XII. 1985, 2♀, leg. van Tol & Krikken (RMNH). Sulawesi Tenggara: Wawonggole, N8901, 1♂; Sungai Sampara, N8912, 1♀; Jalan Asera, N8916 1♂; N8917, 2♂; N8918, 1♂ 4♀; Sungai Kolaka, N8921B, 2♂ 3♀; Tamborasi, N8925 (on the sea), 3♂ 4♀ (3♀ without eggs); Wolo, N8926 (pools on banks), 1♂ 1♀; Pomalaa, N8927, 1♂ (apterous) 1♀; N8930, 1♀; N8931, 1♀. P. Buton: Desa Gareng-gareng, N8936, 1♀. – MALAYSIA: Sabah, 16 km NE Tenom, Agr. Res. Station, 115°59'E 5°11'N, 180m; TL; 11. VI. 1986, 1♀, J. Huisman. Macropterous unless otherwise indicated.

Distribution. – Widespread: Maldive Is., India, Indochina, Indonesia to Sulawesi, Sumbawa and Flores.

Neogerris Matsumura, 1913

A tropicopolitan genus which until recently was usually treated as a subgenus of *Limnogonus*, with which it deals habitat preference. A revision of Old World species is given in Andersen (1975). Only one species occurs in Sulawesi.

Neogerris parvula (Stål)

Gerris parvula Stål, 1859: 265.
Limnogonus parvulus; Lundblad 1933: 384-387, fig. 121, pl. 11 (redescription).
Neogerris parvula; Andersen 1975: 86-89, figs. 288, 289, 292, 297, 298, 300, 302-306, 309-312.

Material. – Sulawesi Tenggara: Wawonggole, N8901, 1♀, N8902, 3♂ 1♀ (2♂ apterous); Desa Kagunyala, N8905, 1♀; N8906, 2♂ 1♀ (1♂ apt.), N8907, 2♂ 2♀ apt., N8908, 1♀; Sungai Sampara, N8912, 1♂; Aopa marsh, N8913, 5♂ 2♀ (5♂ 1♀ apt.); Jalan Asera, 1♂ 1♀, N8918, 14♂ 14♀ (2♂ apt.); Tamborasi, N8925, 1♀ (on the sea); Pomalaa, N8927 1♀ apt., N8929, 1♂ 1♀ (apt.), N8931, 1♂ 3♀ (2♀ apt.), 1 lv V. – Maluku: Bacan, Wayauna, alt. ca. 50m, sec. growth, eutrophic pool, 06-07. VII. 1985, 1♀. Macropterous unless otherwise indicated.

Distribution. – Widespread: SE tip of Arabian Peninsula, SE Iran, India Indochina, Macao, Amoy, Taiwan, Ryu Kyu Is., Philippines, Indonesia, New Guinea and Solomon Is.

Aquarius Schellenberg, 1800

This genus is not represented in Sulawesi. The nearest localities where species have been encountered are Sumatera and West Australia (Andersen 1990).

Limnometra Mayr, 1865

The Indo-Australian species of this genus have been reviewed recently (Nieser & Chen 1992a). This is essentially a SE Asian and Australian genus with thirty known species of which seven occur in Sulawesi and one on Buton. Sulawesi is the region richest in species for this genus. For a key to the species and other details readers are referred to Nieser & Chen (1992a).

Tenagogonus Stål, 1853

This genus is represented in Africa, Myanma and Sumatera through Indonesia and the Philippines to New Guinea. Not recorded from Sulawesi.

Tenagogonus akanthinos sp. n.
(figs. 6-8)

Type material. - Holotype ♂, allotype ♀, 4 paratype ♂: E. Malaysia, Sabah, Danum Valley, 70 km W Lahad Datu, Main Trail West 5 South 3, 150 m, narrow creeks in rainforest, 16. XII. 1989, sample Sab. 70, M. J. & J. P. Duffels, all apterous (ZMA, 2 paratypes NC).

Description

Apterous specimens. - Dimensions. Length ♂ 6.0-7.6, ♀ 6.8; width of head ♂ 1.23-1.50, ♀ 1.41; width of thorax ♂ 2.22-2.95, ♀ 2.80. Colour. Pale brown, legs medium brown, antennae dark brown. Eyes and apical segment of rostrum shiny dark castaneous. Interoculus with dark brown V-shaped median mark and margins along eyes. Pronotal lobe with blackish margin all around and a dark median longitudinal stripe. Pleura with a dorsal blackish band which is very broad and anteriorly dived in an upper and lower part by a narrow light line on mesopleuron. Ocellated spot dorsally in front of mesoacetabula, dorsal edge of connexiva and lateral margins of abdominal tergites dark brown to blackish. Venter with mesoacetabular suture and patch anteriorly black. Some variable and often ill defined brownish marks on meso- and meta- sternum and first abdominal sternum. Sometimes somewhat similar to the pattern in *T. maai* Hungerford & Matsuda.

Length of antennal segments I : II : III : IV male 2.1 : 1.7 : 2.4 : 2.8; female 1.9 : 1.3 : 1.9 : 2.5.

Rostrum moderately slender, reaching slightly over one third of mesosternum. Posterior lobe of pronotum rather narrow and exposing small parts of mesonotum around its tip. Connexiva rather broad, no connexival spines. Last abdominal segment, however, with a pair of dorsocaudolateral projections, better developed in male than in female, which look like connexival spines. Hind coxae reaching halfway fourth abdominal sternite in male, reaching third in female. Last abdominal sternite as ling as three preceding ones. In male last sternite with genital segments as long as preceding part of abdominal venter. Leg measurements, see table 1.

Male first genital sternite with a mediocaudal groove bordered by a pair of broad caudally slightly diverging carinae (fig. 6). Ninth segment without obvious hair tufts. Endosomal sclerites as in fig 8.

Female, caudal margin of last abdominal sternite with small lateral spines and a short, broad median lobe (fig. 7).

Comparative notes. – At first sight very similar to *T. pravipes* Bergroth (= *Limnometra brevis* Lundblad, = *T. robustus* Hungerford & Matsuda, see Polhemus 1991), which lacks, however, the spine like projections caudally on segment 7 an differs in details of genital segments. *T. kampaspe* Kirkaldy which has caudal projections on 7th segment in male, has these placed more ventrally, has a different colour pattern, and different genital segments. *T. maai* Hungerford & Matsuda (= *T. quinquemaculata* Miyamoto) (see Polhemus 1991), which may look similar and occurs in the same region, is smaller (♂ length 5.5 mm, width of thorax 1.64), more slender (over three times as long as wide) and has more pronounced spine-like projections of the last abdominal segment.

Etymology. – Akanthinos (Greek adjective meaning spinose) refers to the spine like projections of seventh abdominal segment, which differentiate this species from *T. robustus*.

CYLINDROSTETHINAE Andersen, 1975

Cylindrostethus Mayr, 1865

A tropicopolitan genus, the species live mostly on shaded, quiet parts of streams, like most representatives of the genus *Aquarius*. At first sight, species of both genera are quite similar in size and general shape. Two species have been found in Sulawesi. The comparative notes under *C. brachyakanthinos* sp. n. will serve to separate them.

Cylindrostethus persephone Kirkaldy

Cylindrostethus persephone Kirkaldy, 1899: 508; Hungerford & Matsuda 1962: 97-99, pl. 3 figs. E, F, pl. 5 figs. h, i (redescription).

Material. – Sulawesi Utara: Dumoga Bone National Park, Tumpah river nr. confl. Toraut, UTM XL0063, c. 210 m als., 18. V. 1985-A, 2♂ 1♀ (1 copula); same 23. V. 1985-A, 1♂ 2♀ (1 copula); same 3. VI. 1985-A 2♂ 3♀ 3 lvv, leg. J. van Tol. Dumoga Bone N. P. Tumpah R. Staustufe, 13. X. 1985, 3♂ 3♀; Tumpah R., Sandinsel u Stromschnelle, 19. X. 1985, 4♂ 3♀; Dumoga R. 22. X. 1985, 2♂ 2♀, leg. G. Zimmermann; Str. nach Malibogu, Bach, 18. XI. 1985, 3♂ 3♀ leg. G. Zimmermann. – Sulawesi Tengah: Palu, gardens and agricultural fields, 28.

XI. 1985-A, 1♂ 1♀, leg. J. van Tol. – Sulawesi Tenggara: Sungai Sampara, N8911, 12♂ 13♀. All apterous.

Distribution. – Sulawesi.

Cylindrostethus brachyakanthinos sp. n.
(figs. 9-12)

Type material. – Holotype ♂, allotype ♀, 14 paratypes ♂, 15 paratypes ♀, Sulawesi Tengah, Luwuk area, Sungai Batui, 15 Nov 1989, J. van Tol (RMNH). Additional paratypes (larvae excluded): Luwuk area, S. Batui, 17 Nov. 1989, 36♂ 18♀; Luwuk area, Sungai Biak, 21. X. 1989, 9♂ 8♀; NE Luwuk, 24. I. 1989, 9♂ 3♀, J. van Tol (RMNH). NE Luwuk, Sungai Bantayan, near road Kayutanyo-Siuna, (0°47'S 123°00'E), 50-100m, medium sized river in slightly disturbed lowland rainforest, sta. Sul 2, 7. Oct 1989, 18♂ 12♀ 1 lv; SW Luwuk, between Desa Seseba and Singsing Camp (ca 1°09'S 122°31'E), 80m, narrow stream in lowland rainforest, sta. Sul12, 4 Oct 1989, 5♂ 5♀ 1 lv; SW Luwuk, Sungai Batui at Singsing Camp (ca 1°09'S 122°31'E), 90m, middle sized stream in lowland rainforest, sta. Sul14, 14 Oct 1989, 4♂ 5♀ 13 lv; SW Luwuk, Totop Camp along Sungai Batui (1°09'S 122°31'30"E), 120m, lowland rainforest, sta. Sul18, 19/21 Oct 1989, 13♂ 20♀ (1♀ macropterous) 25 lv, leg. J. P. Duffels (ZMA). Apterous unless otherwise indicated.

Description

Apterous specimens. - Dimensions. Length ♂ 10.9-11.7, ♀ 13.9-15.2; width of head ♂ 1.60-1. 64, ♀ 1.80-1.89; width of thorax ♂ 2.50-2.54, ♀ 3.24-3.48. Colour and pilosity. Dorsally generally black with conspicuous stripes of silvery hairs at dorsal margins of pleura and ditto dots on acetabula. Median band dorsally on head, thorax and abdomen glabrous in spite of short golden pubescence especially on abdominal tergites. Apex of head with dirty yellowish pilosity at sides, becoming blackish with sparse lighter hairs posteriorly. Fulvous spot on base of head and narrow median fulvous stripe on pronotum rather indistinct. Lateral margins of mesonotum broadly with short thick velvety black pilosity. Outer (upper) margin of connexiva fulvous. Anterior femur black with yellowish base and variable yellowish stripes on inner and outer faces, tibia and tarsus blackish. Middle and hind legs blackish except for coxae and trochanters mainly yellowish. Venter with silvery pilosity on dark base in males; background except for dark spots anteriorly on thorax, yellowish in females.

Length of antennal segments I : II : III : IV, male 1.8 : 1.1 : 0.6 : 0.95, female 2.1 : 1.15 : 0.6 : 1.0. In dorsal view head longer than pronotum (1.2 in males, 1.4 in females). Pronotum medially depressed. Mesonotum not depressed but with a very thin median groove over its length in female, only in posterior part in males. Caudal part of mesonotum in female without oblique ridge. Metanotum flat, its rear margin sinuate. Connexiva slightly less than half the width of tergites, flaring laterally in males, more or less erect in females (except when abdomen swollen with eggs). Connexival spines short, reaching halfway first genital segment in both sexes, tips not or hardly divergent caudally. Metasternum with lateral groove leading from omphalium, deep and well marked, much more prominent than caudal margin of metasternum, which is subequal to or slightly longer than median length of first two abdominal sternites combined. Leg measurements, see table 1.

Male. Suranal plate in male as shown in fig. 10; wings convex lateroproximally. Last two abdominal sternites of subequal median length, posterior margin of last abdominal sternite evenly concave, posterior margin of first genital sternite slightly produced to nearly straight medially, their median length subequal. Parameres and lateral sclerite of endosoma as in figs. 11, 12.

Female. Last abdominal sternite medially slightly longer than penultimate, its hind margin slightly and obtusely produced medially. Macropterous female (apex of hemielytra broken off) as apterous except for development of pronotum and wings. Length 14.5, humeral width of pronotum 2.35, thoracic width 3.25. Hemielytra dark brown with blackish veins.

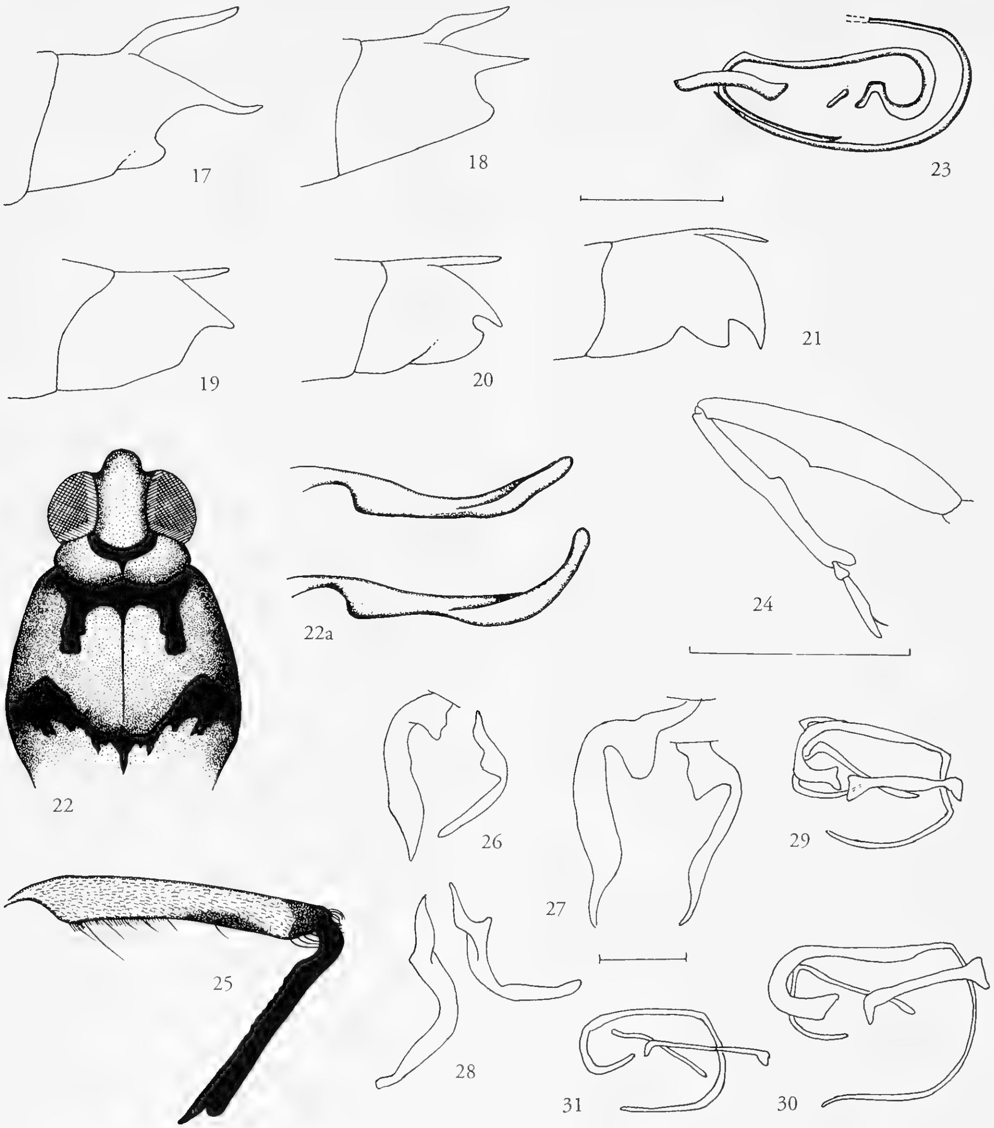
Comparative notes. – Very similar to *Cylindrostethus persephone* Kirk., also from Sulawesi. There is a series of small differences: *C. brachyakanthinos* is slightly larger on average, the fulvous marks on head and pronotum are less distinct, the male abdomen is darker, the posterior part of mesonotum in female is not differentiated. The connexival spines in *C. brachyakanthinos* are shorter (fig. 9), the wings of the suranal plate of male are convex basally (straight in *C. persephone*, fig. 10) and the paramere is broader at base and consequently more tapering in *C. brachyakanthinos* (fig. 11). The endosomal sclerites are nearly identical, only the laterals show very small differences in shape (fig. 12).

Etymology. – *Brachyakanthinos* (Greek adjective meaning 'with short spines') refers to the short connexival spines.

EOTRECHINAE Matsuda, 1980

No species of this subfamily have been reported from Sulawesi. Members of this subfamily live rather cryptically on wet places along waters. If any are to be found they will most likely belong to the widespread genus *Amemboa* Esaki, of which species have been recorded from Java and Mindanao (Polhemus & Andersen 1984).

RHAGADOTARSINAE Lundblad, 1933



Figs. 17-31. – 17, lateral view (left) of seventh abdominal segment of *Ptilomera doreceus* Bred., ♀, scale 2 mm; 18, idem, *P. oribasus* Bred.; 19, idem, *P. laelaps* Bred.; 20, idem, unnamed new species; 21, idem, *P. sumizone* Esk. (redrawn after Hungerford & Matsuda 1965); 22, *Metrocoris breviculus* sp. n., holotype, scale 0.5 mm, paramere; 23, idem, endosomal sclerites, lateral view; 24, forelegs of male *Ventidius kurtokalami* sp. n. paratype (Halobatinae), scale 1 mm, 25, idem, *Metrocoris breviculus* sp. n., holotype; 26, Parameres of *Ventidius xiphibion* sp. n., scale 0. 25 mm; 27, idem, *V. xyele* sp. n.; 28, idem, *V. kurtakalami* sp. n.; 29, lateral view of endosomal sclerites of *Ventidius xiphibion* sp. n., scale 0. 25 mm; 30, idem, *V. xyele* sp. n.; 31, idem, *V. kurtakalami* sp. n.

Rhagadotarsus Breddin, 1905

A small tropical genus with one species in Asia, which is also known from Sulawesi, and one (attributed to a different subgenus) in Africa.

Rhagadotarsus kraepelini Breddin

Rhagadotarsus kraepelini Breddin, 1905: 136-139, figs. 12-14; Lundblad 1933: 412-415, fig. 132, pl. 11; Cheng & Fernando 1969: 128-129, figs.292-306.

Sulawesi Tenggara: Wawonggole, N8901, 1♂ 1♀; Sungai Sampara, N8909 4♂ 7♀ (2♀ macr.). Apterous unless otherwise indicated.

A very widespread species, from Sri Lanka, Myanma and SW China to Philippines, Sulawesi and Sumbawa.

PTILOMERINAE Esaki, 1927

Ptilomera Amyot & Serville, 1843

Widely distributed in tropical Asia. Large and conspicuous inhabitants of streams usually near places with rather strong current on which they venture when disturbed. Regularly on very narrow streams. In spite of their size and obvious morphological specialization identification is difficult as there are several species groups consisting of very similar species. At present the genus is under revision by D. A. Polhemus (Bishop Museum, Honolulu, Hawaii); material of our expeditions will be included in Polhemus' study. We present a preliminary key to Sulawesi species (Polhemus & Polhemus 1986).

Key to *Ptilomera* of Sulawesi

1. Specimens with posterior sclerite in dorsal view (suranal plate) with a pair of lateral wings, a pair of caudally directed more or less curved styli (which are actually the parameres) and in ventral view a large boat-shaped posterior segment (the pygophore) with a pair of lateral extensions, males 2
– Apex of abdomen in lateral view with a broad lateral plate on last segment which hides the apex of abdomen, females 7
2. Lateral wings of suranal plate with rostral and caudal margins nearly parallel in apical part (fig. 13) [Sulawesi Selatan & Tengah] .... *P. oribasus* Breddin, 1901
– Rostral and caudal margins of lateral wings of suranal plate convergent lateroapically 3
3. Lateral wings of pygofer long and slender, apically acutely pointed and laterally surpassing the wings of suranal plate [Sulawesi Tengah] .... *P. pamphagus* Breddin, 1901
– Lateral wings of pygofer shorter, laterally at most as long as the wings of suranal plate or with broadly truncate apex 4
4. Caudal margins of lateral wings of suranal plate perpendicular on longitudinal body axis (fig. 14) 5
– Caudal margins of lateral wings of suranal plate pointing obliquely caudad compared to longitudinal body axis 6
5. First genital segment strongly swollen dorsally in caudal half [Sulawesi Tenggara] .... *P. sumizone* Esaki, 1925
– First genital segment not swollen dorsally [Sulawesi Selatan] .... *P. laelaps* Breddin, 1901
6. Caudal margins of lateral wings of suranal plate nearly straight (fig. 14) [Sulawesi Utara] .... *P. dorceus* Breddin, 1901
– Caudal margins of lateral wings of suranal plate convex (fig. 15) [Sulawesi Tenggara] .... *Ptilomera* sp. n.
7. Dorsal lobe of seventh abdominal segment (lateral view) long and spine-like, reaching beyond well developed connexival spines (fig. 17) . *P. dorceus*
– Dorsal lobe relatively shorter 8
8. Dorsal lobe well developed and narrow, reaching to apex of connexival spines (fig. 18) *P. oribasus*
– Dorsal lobe broader 9
9. Incision between dorsal and ventral lobe of seventh abdominal segment in lateral view wide, ventral lobe reduced (fig. 19) .... *P. laelaps*
– Incision narrow, ventral lobe more distinct ... 10
10. Caudoapical margin of dorsal lobe of seventh abdominal segment vertical 11
– Caudoapical margin of dorsal lobe of seventh abdominal segment pointing obliquely caudad (fig. 20) .... *Ptilomera* sp. n.
11. Lateral lobe of seventh abdominal segment ventrobasally with an incision (fig. 21) .. *P. sumizone*
– Lateral lobe of seventh abdominal segment ventrobasally without an incision ....*P. pamphagus*

Pleciobates Esaki, 1930

One species known from the Malay Peninsula, *P. tuberculatus* Esaki, 1930.

Rheumatogonus Kirkaldy, 1909

Three species, of which *R. intermedius* Hungerford, was described from Sumatera and occurs in the Malay Peninsula too (Cheng & Fernando 1969). The other two occur in the Philippines, one extending into N. Borneo.

Rheumatogonus borneensis Esaki

Rheumatogonus borneensis Esaki, 1927: 267-268, fig. 3d; Andersen 1967: 267-272, figs. 12-14, 16-17 (redescription).

Material. - MALAYSIA, Sabah, Danum Valley, 70 km W Lahad Datu, Main Trail W 12, 180 m, 2. XII. 1989, narrow stream, sample 52, 7♂ 2♀; same, 4 km S main trail W 5, nr. Sungai Segama, 150 m, 3. XII. 1989, middle sized stream and water fall, sample 54, 1♂ 1♀; same, Main Trail West 5 South 3, 150 m, 18. XII. 1989, narrow creeks in rainforest, sample 70, 2♂ 5♀, leg. M. J. & J. P. Duffels (ZMA), all apterous.

Table 1 Measurements of leg segments of Gerridae described in this paper. In species marked with an *, the tarsal segments have not been measured separately, the entire length is given under tars1.

	femur	tibia	tars1	tars2
Cylindrostethus brachyakanthinos				
♂ fore leg	3.1	2.9	0.2	0.6
♂ middle leg	11.1	7.4	3.5	0.8
♂ hind leg	11.4	6.0	0.5	0.3
♀ fore leg	3.6	3.5	0.3	0.65
♀ middle leg	12.1	8.5	5.1	1.0
♀ hind leg	12.2	8.9	0.7	0.4
*Metrocoris breviculus**				
♂ fore leg	2.03	1.68	0.70	
♂ middle leg	5.65	3.93	1.82	
♂ hind leg	4.79	2.50	0.72	
♀ fore leg	1.74	1.43	0.70	
♀ middle leg	4.80	3.48	1.70	
♀ hind leg	4.20	2.42	0.71	
Potamometropsis anomalis				
♂ fore leg	5.1	4.0	1.9	0.85
♂ middle leg	13.2	7.1	3.0	0.47
♂ hind leg	13.2	4.6	0.10	0.12
♀ foreleg	5.1	3.9	2.1	0.98
♀ middle leg	12.9	7.2	3.1	0.50
♀ hind leg	13.2	5.0	0.10	0.13
Rheumatometroides drepanephoros				
♂ fore leg	0.85	0.7	0.09	0.36
♂ middle leg	2.12	2.59	0.79	0.77
♂ hind leg	2.24	0.80	0.11	0.27
♀ fore leg	0.85	0.74	0.09	0.38
♀ middle leg	2.18	2.59	0.81	0.79
♀ hind leg	2.30	0.88	0.12	0.31
Rheumatometroides makraitos				
♂ fore leg	1.15	0.96	0.1	0.5
♂ middle leg	2.82	3.26	1.18	1.08
♂ hind leg	3.01	1.16	0.19	0.38
♀ fore leg	1.17	0.92	0.12	0.60
♀ middle leg	3.17	3.59	1.30	1.25
♀ hind leg	3.05	1.25	0.21	0.37
Tenagogonus akanthinos				
♂ fore leg	3.1	2.55	0.35	0.64
♂ middle leg	8.1	5.6	2.0	0.58
♂ hind leg	7.6	3.2	0.64	0.62
♀ fore leg	2.9	2.3	0.3	0.57
♀ middle leg	6.5	4.8	2.0	0.60
♀ hind leg	6.4	2.9	0.55	0.51
*Ventidius kurtokalami**				
♂ fore leg	1.2	1.0	0.40	
♂ middle leg	3.3	1.8	1.1	
♂ hind leg	3.6	1.5	0.5	
♀ fore leg	1.6	1.0	0.5	
♀ middle leg	3.6	1.8	1.1	
♀ hind leg	4.0	1.7	0.6	
*Ventidius xiphibion**				
♂ fore leg	1.1	0.9	0.35	
♂ middle leg	3.2	1.9	1.1	
♂ hind leg	3.5	1.5	0.4	
♀ fore leg	1.2	0.9	0.3	
♀ middle leg	3.3	1.9	1.1	
♀ hind leg	3.7	1.6	0.4	
*Ventidius xyele**				
♂ fore leg	1.2	1.0	0.4	
♂ middle leg	3.4	1.9	1.1	
♂ hind leg	3.9	1.7	0.5	
♀ fore leg	1.2	1.0	0.4	
♀ middle leg	3.5	1.9	1.1	
♀ hind leg	3.9	1.8	0.5	

Potamometropsis Lundblad, 1933

Three species, one from Sumatera and two from the Philippines are known (Hungerford 1957). We add a new species from North Sulawesi.

Potamometropsis anomalis sp. n. (figs. 38-41)

Type material. - Holotype ♂ allotype ♀ (ZMA), 1♂ 8♀ paratypes (1♀ macropterous): Sulawesi Utara, Dumoga Bone N. P., Tumpah R. Staustufe (barrage), 23 Oct. 1985, leg. G. Zimmermann (1♀ MBBJ, 1♂ 3♀ NC, 1♀ RMNH, 4♀ ZC). – Additional paratypes: Sulawesi Utara, Dumoga Bone N. P., Base Camp, bridge, 16. X. 1985, leg. G. Zimmermann, 3♂ 4♀ (1♂ 2♀ macropterous) (NC, ZC); Tumpah River, beach, 19. X. 1985, 1♀, leg. G. Zimmermann same, Edwards Camp, Tumpah River, 900m, 23.II.1985, Stat. 28 (Project Wallace), 1♂ leg. J. P. Duffels (ZMA), apterous unless otherwise indicated.

Description

Apterous specimens. – Dimensions. Length ♂ 7.8-8.4, ♀ 9.4-10.3; width of head ♂ 1.41-1.45, ♀ 1.41-1.48; thoracic width ♂ 2.46-2.50, ♀ 2.90-3.05.

Colour black. Head yellowish brown with a large median blackish spot anteriorly and a pair of smaller blackish spots in posterior part of interoculus. Venter of head, rostrum except for apex, prosternum, posterior half of mesosternum, metasternum, abdominal venter, acetabula, coxae and ventral and dorsal stripe apically and proximally widened on fore femur, yellow. Antennae and legs dark castaneous. Mesosternum, metasternum and abdominal venter with dense short silvery pilosity. A broad band of silvery pilosity on upper part of mesothoracic pleuron extending on dorsum of metaacetabulum. A pair of submedian bands of silvery pilosity on pro- and mesonotum, in some specimens hardly developed. A band of silvery pilosity just ventrally and just dorsally of base of connexiva.

Length of antennal segments I : II : III : IV ♂ 3.51 : 1.43 : 1.23 : 1.09, ♀ 3.67 : 1.33 : 1.22 : 1.11. So second segment longer than third. Pronotum slightly wider than head, median length 0.8. Median length of mesonotum three times as long as pronotum and metanotum. Fore tibia laterally compressed, with a slight constriction subapically, accentuated by tufts of setae proximally and distally of constriction. Inner apical process bluntly triangular, equally developed in both sexes. First segment of fore tarsus slightly over two times as long as second (table 1). Middle and hind femur of subequal length in both sexes sometimes middle > hind, sometimes the reverse. Leg measurements, see tabel 1.

Male. Tergite 7 two times as long as tergite 6, sternite 7 caudally broadly and shallowly emarginate. Tergite 8 twice as long as sternite, caudally broadly rounded. Paramere, well developed, rather broad compared to other species in the genus (fig. 40), in rest hidden in the prominent pygophore. Endosoma, fig. 41.

Female. Tergite 7 nearly two times as long as 6. Sternite 7 twice as long as 6, with a broad mediocaudal lobe, in ventral view covering most of the genital segments (fig. 39).

Macropterous form as apterous except for development of thorax and pronotum. Length (including hemielytra) 10.0-10.2, humeral width of pronotum 2.4-2.5. Pronotum mostly shining black with rough impressed punctures, median length 2.9. Anterior lobe be divided from posterior lobe by a medially interrupted ridge caudally accentuated by a groove with some silvery pilosity, posterior part of anterior lobe and anterior part of posterior lobe with a median longitudinal carina. Hemielytra rather membraneous, medium brown with swollen, slightly darker, veins.

Etymology. – *Anomalos*, a greek adjective meaning aberrant.

Comparative notes. – *P. anomalis* differs from other species in the genus by having second antennal segment longer than third and first segment of fore tarsus over twice as long as second. The male has a shorter and broader paramere than other species, the abdominal sternite 7 of the female is quite different from the other species.

Remarks. – The macropterous female from 'Staustufe' has the hemielytra broken off which seems to be the normal condition in this genus (Hungerford 1957). The macropterous specimens from 'bridge' have the hemielytra complete, these are recently moulted specimens, with belly still soft (bending inward under slight pressure). Its general form, absence of specialization of the venter in female and presence of claws on middle and hind tarsi place this species in *Potamometropsis*. This species differs in several characters from all its congeners (see comparative notes). Pending a cladistic analysis of the entire subfamily we refrained from describing a new genus for it.

We have seen a teneral female from Sabah, Kg. Sapulut, 116°36'E 4°38'N, leg. Huisman in RMNH, which might belong to another species of this genus but as the abdomen is shrivelled, this material is insufficient for a description.

HALOBATINAE Bianchi 1896

Halobates Eschscholtz, 1822

Exclusively marine. Several species live on the open ocean, have wide distributions and are only found near or even on the shore after high winds. *Halobates micans* Eschscholtz is tropicopolitan and the only species found in the open Atlantic. It has been recorded from Laut Sulawesi. A second species has been recorded from the same area : *Halobates germanus* White (Herring 1958). These species are easily separated by size, *H. micans* is over 4-4.5 mm long, *H. germanus* 3.5-3.9 mm. We have seen two specimens of the largest species in the genus *H. princeps* which measures 6-7 mm. So far this is the only species recorded from the coast of Sulawesi (Andersen 1991b). The genus was revised by Herring (1961); a survey of phylogeny and evolution is given by Andersen (1991a).

Halobates princeps White

Halobates princeps White, 1883: 44, pl. 1 fig. 3; Herring 1961: 267-270, fig. 70 (redescription); Andersen 1991b: 158, fig. 8.

Material. – Sulawesi Utara, N. Coast, Molosso, reef, rock pools, 16. X. 1985 2♀, leg. G. Zimmermann.

Distribution. – Range included Solomon Isles, N New Guinea, NW Australia, Nusa Tenggara, Malay Peninsula, extreme S of Philippines and Palau (Andersen 1991b). This species has apparently been found on more or less open sea (the type is from 'Celebes Sea') and on coastal habitats.

Metrocoris Mayr, 1865

Widespread, from the Arabian Peninsula to SE Asia. The species from Malay Archipelago and Philippines have recently been revised by Polhemus (1990). The genus as a whole will be revised by Chen & Nieser (in prep.). Two species are known from Sulawesi.

Key to *Metrocoris* from Sulawesi

1. Transverse black band on pronotum covering anterior third to nearly half of pronotum, body length 5-6.3 mm .... *M. celebensis*
– Transverse black band on pronotum covering less than anterior third of pronotum, body length 4-4.3 mm .... *M. breviculus*

Metrocoris celebensis D. Polhemus, 1990

Metrocoris celebensis D. Polhemus, 1990: 8-9, figs. 3, 19-22, 47).

Only known by the type series from Lore Lindu National park (Sulawesi Tengah), we have seen 1♂ 1♀ apterous paratypes in ZMA.

Metrocoris breviculus sp. n.

(figs. 22-23, 25)

Type material. – Holotype ♂, allotype ♀, 1♀ paratype: Sulawesi Tengah, between Desa Seseba and Singsing Camp, SW of Luwuk, c 1°09'S 122°31'E, 90m, narrow stream in lowland forest, 14. X. 1989, Sta. Sul12, J. P. Duffels. Batui River at Singsing Camp, 90m, middle sized stream in lowland rainforest, 14-17. X. 1989, Sul. Sta. 14, J. Duffels 1♂ 1♀ paratypes, all apterous (ZMA, NC).

Description

Apterous specimens. - Dimensions. Length ♂ 4.3, ♀ 4.0-4.2; width across metaacetabula ♂ 2.2-2.3, ♀ 2.3-2.4; width of head ♂ 1.32-1.33, ♀ 1.29-1.31. Colour. Dark pattern variable, somewhat reduced compared to other species. Interoculus without dark mark or anterior half dark with caudal arms along inner margins of eyes. Dark mark of pronotum T-shaped, dark mark of mesonotum T-shaped with lateral edges of T produced caudally. Metanotum with a broad anterior and mesal band. First abdominal tergite black with a pair of yellowish spots, connexiva anteriorly blackish, posteriorly yellowish, remaining tergites yellowish with blackish margins. Mesopleura yellow without longitudinal dark stripe. Fore femur with an apical dark ring, which may extend over the apical quarter of femur, ventral longitudinal stripe present, other indistinct or absent. Venter yellowish, area around metasternal scent gland opening dark to black in both sexes.

Width of an eye slightly less than its posterior width, 0.42 and 0.46 in ♂, 0.50 and 0.53 in ♀ respectively, width of interoculus 0.48. In lateral view posterior half of eye covering anterior three fifths of propleura. Length of antenna ♂ 4.6, ♀ 3.7. Length of antennal segments I : II : III : IV ♂ 1.92 : 1.11 : 0.91 : 0.60, ♀ 1.51 : 0.79 : 0.81 : 0.60. Antenna in male reaching well beyond the apex of abdomen, in female reaching the apex of abdomen, antenna in male distinctly thicker than in female. Antennal segments II and III in males with curved woolly pilosity, especially developed on ventral face, its thickness over half the width of the segments. Pronotum not bulbous, its width 1.4-1.5, slightly more than width of head. Meso- and metapleura with blackish pilosity which tends to become bristle-like at rear end of metapleura. Male fore femur (fig. 25) not incrassate, ratio length: width about 6, without stiff dark spinules, long hair fringe on inner face, constriction, indentation or tooth; fore tibia without tooth like elevation. Female fore femur, ratio length : width 6-6.5. Length of hind trochanter 0.5 in both sexes, in female without a tuft of long curved hairs apically. Middle and hind femur without long hair fringe. Leg measurements, see table 1.

Male. Pregenital tergite and genital segments rather small, pregenital segment, length 0.2, width 0.5. Parameres, fig. 22, endosomal sclerites fig. 23.

Female. Subgenital sternite large, its median length subequal to the median length of preceding abdominal sternites together, caudal margin sinuate without tongue-like caudal process, apex of abdomen visible in ventral view.

Macropterous form unknown.

Etymology. – *Breviculus* (latin adjective meaning rather small) refers to the small size of the species.

Comparative notes. – Recognized at once by its small size in combination with yellowish venter, absence of mesopleural stripes and the paramere fig. 22. *M. breviculus* is 1 mm or more shorter than the only other species occurring in Sulawesi: *M. celebensis* D. Polhemus.

Esakia Lundblad, 1933

Species of *Esakia* are very similar to *Ventidius* and *Ventidiopsis*. The genus is considered by Matsuda (1960) to have evolved from *Ventidius* by acquiring some specialized characters such as the strongly modified third antenna of the male. Three of the six species known occur in the Malay Peninsula, *E. ventidioides* Lundblad (1933) was described from Sumatera.

Ventidiopsis Miyamoto, 1967

Monotypic; *V. imadatei* Miyamoto (1967) was described from N. Borneo (Brunei).

Ventidius Distant, 1910

The largest and most widespread genus within this group of small Halobatinae, 16 species have been described. Greatest species density seems to be in the Malay Peninsula (Cheng 1965, Lansbury 1990) but various regions of its range have been poorly sampled.

Ventidius xiphibion sp. n.

(figs. 26, 29)

Type material. - Holotype ♂, allotype ♀ (RMNH), 42♂ (1♂ macropterous) 64♀ paratypes: Sulawesi Tenggara, Small stream 8 km E of Sungai Sampara along road Kendari-Wawotobi, N8911, 22 Feb 1989. – Additional paratypes: P. Buton: Stream just N of Bau-bau, N8935, 8 Mar 1989, 35♂ 40♀ (1♀ macr.); stream about 15 km E of Bau-bau, N8942, 10 Mar 1989, 40♂ 18♀ (1♀ macr. teneral). Apterous, unless indicated otherwise. Samples N8935 and N8942 contained also many larvae.

Description

Apterous specimens. Dimensions. Length ♂ 2.7-3.0, ♀ 3.0-3.3, width of thorax ♂ 1.95-2.05, ♀ 2.20-2.32. Colour. Eyes and anterior half of interoculus blackish, posterior half of interoculus yellow. Pronotum black with 5 small yellowish spots: anteromedian, one pair halfway laterally at posterior border and a pair laterally at margins of eyes. These spots are variable, specifically the three central ons may be confluent. meso- and meta- notum with a large central bilobed yellow area (general pattern as in *V. henryi* and *V. werneri* Hungerford & Matsuda, but with light area larger although quite variable between series). A broad black longitudinal band, which may be interrupted in lightly coloured specimens, on border of notum and pleuron. Posterior part of metanotum, first abdominal tergite black, with caudally tapering lateral black bands on remaining abdominal tergites, connexiva from second segment on yellow. Genital segments black in male, laterally and caudally black in female. Variable black dots anteriorly of acetabula. Venter yellow with a pair of small black dots at anterior point of mesoacetabular suture. Apex of rostrum, antennae except for base of first segment, apex of fore femur and rest of fore leg, middle and hind leg blackish. Body dorsally with rather sparse short black pilosity giving the specimens a dull appearance.

Antennae when folded back over venter as long as body in male, slightly shorter in female. Length of antennal segments I : II : III : IV, male 1.22 : 0.48 : 0.34 : 0.46, female 1.23 : 0.48 : 0.44 : 0.50. Eyes twice as long as head, overlapping lateral margin of prothorax and anterolateral angles of mesothorax. Anterior and posterior margins of pronotum medially concave. In lateral view, mesonotum softly convex dorsally, metanotum declivent. Intersegmental suture between meso- and meta- notum as well as anterior margin of first tergite indistinct or lost. Lateral longitudinal suture of metanotum not reaching the level of meso/metanotal intersegmental suture. Posterolateral angle of metaacetabula bilobate. Ventral margin of front femora nearly straight in female; convex, but without tubercle in the middle, in male; ratio length: width 5.7 in male, 6.4 in female. Leg measurements, see table 1.

Male. Parameres asymmetrical, fig. 26. In the centre of mesosternum is a small patch of minute black bristles which are not on a tubercle.

Macropterous form. – As apterous except for development of pronotum and hemielytra. Length ♂ 2.8-3.3, ♀ 3.4-3.6, humeral width of pronotum ♂ 1.65-1.70, ♀ 1.80-1.95. Pronotum black, lateral margin and apex brownish, anterior margin variable from black to a predominantly yellow transverse band; a pair of large pale yellow pear-shaped patches on centre of disc. Hemielytra extending beyond apex of abdomen, black with costal area and inner margin dark brown.

Comparative notes. – The bilobed posterolateral angle of metaacetabula, the sexual dimorphism of fore femur, asymmetrical parameres and small patch of black bristles on mesosternum of male place this species in the subgenus *Ventidoides* Hungerford & Matsuda. *V. xiphibion* differs from *V. pulai* Cheng, which has a very similar colour pattern, apart from being slightly larger on average, by lacking a tubercle on fore femur of male, having the patch of minute black bristles on male mesosternum developed, although not on a tubercle, and different parameres. The macropterous form of *V. pulai* has the light mesonotal spots fused so there is one large central spot. Other Malay species differ in head coloration.

Etymology. – *Xiphibion* (greek: small sword) a noun in apposition refers to the shape of left paramere.

Remarks. – This and the next are the first species of this genus to be reported from Sulawesi. The localities where *V. xiphibion* was taken are small to medium sized streams, all three had turbid water due to suspended loam. The species tends to aggregate at places with little current.

Ventidius xyele sp. n.

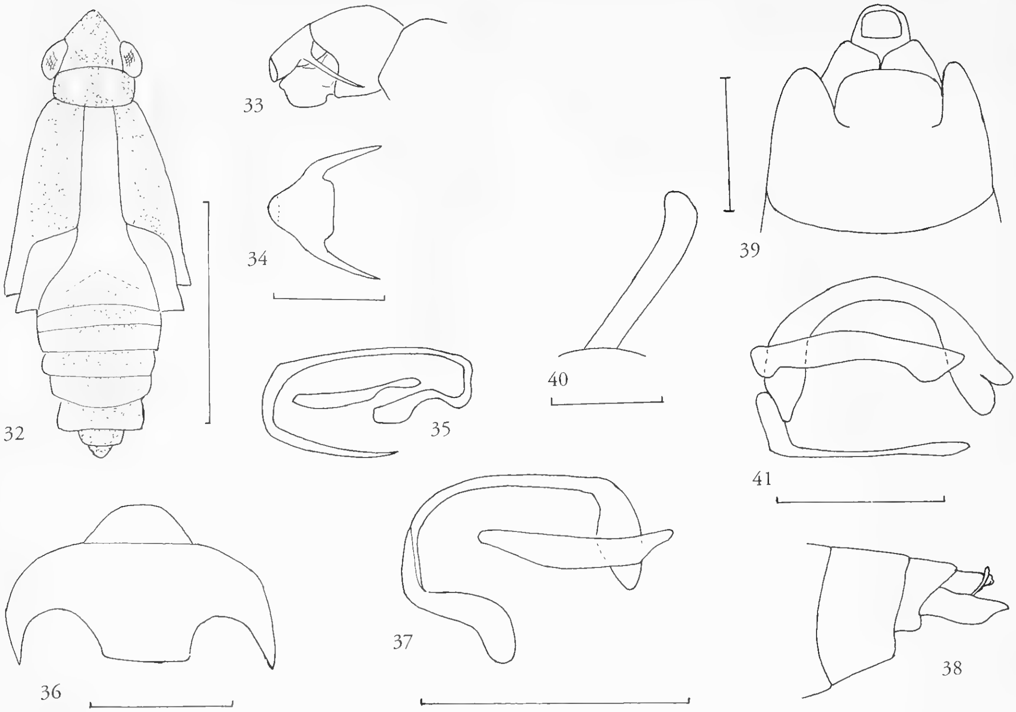
(figs. 27, 30)

Type material. - Holotype ♂, allotype ♀ (RMNH), Sulawesi Utara, Dumoga Bone National Park, R. Toraut, Maze, 16 Nov. 1985, leg. G. Zimmermann. – Paratypes (the adults only) same data as holotype, 3♂ 9♀; Dumoga Bone N. P. Base Camp, 16. X. 1986, 1♂ 1♀; Dumoga Bone River, downstream of bridge, 22. X. 1985, 1♀; Tumpah River, Beach, 19. X. 1985 8♂ 9♀, 28 lv III-V; Tumpah River, Staustufe (low barrier), 23. X. 7♂ 7♀: Malibagu Z. 8. XI. 1985, 5♂ 1♀ (2♂ 1♀ macropterous); Südküste, Strasse, Bach (S coast, road, rivulet), 18. XI. 1985, 4♂ 5♀ 5 lv IV-V, apterous unless otherwise indicated (ZC, 8♂ 8♀ NC, 1♂ 1♀ each in BPUH, JTPC, MBBJ, PCHC, ZMA, ZMC).

Description

Apterous specimens. - Dimensions. Length ♂ 2.9-3.0, ♀ 3.0-3. 2, width of thorax ♂ 2.0-2. 12, ♀ 2.20-2.33. Colour, as in *V. xiphibion* except: pronotum without yellow spots, meso/metanotal yellow mark, smaller (but essentially of the same shape), black area on border of notum and pleuron broader and not interrupted.

Antennae when folded back over venter as long as body in male, slightly shorter in female. Length of antennal segments I: II: III: IV, male 1.29: 0.50: 0.41: 0.46, female 1.22: 0.50: 0.52: 0.48. Eyes twice as long as head, overlapping lateral margin of prothorax and anterolateral angles of mesothorax. Anterior and posterior margins of pronotum medially concave. In



Figs. 32-41. – 32, *Rheumatometroides makraitos* sp. n. paratypes, dorsal view of body of ♀, scale 2 mm; 33, idem, apical abdominal segments of ♂ in lateral view; 34, idem, proctiger in dorsal view, scale 0.5 mm; 35, idem, endosomal sclerites in lateral view, scale 0. 2 mm; 36, *Rheumatometroides drepanephoros* sp. n., paratype ♂, scale 0.2 mm, proctiger in dorsal view; 37, idem, endosomal sclerite in lateral view; 38, *Potamometropsis anomalis* sp. n., apex of abdomen ♂ paratype in lateral view; 39, idem, apex of abdomen ♀ paratype in ventral view; 40, idem, ♂ paratype, paramere; 41, idem, ♂ paratype, endosomal sclerites, scales: 38, 39 1 mm; 41, 42 0.25 mm.

lateral view, mesonotum softly convex dorsally, metanotum declivent. Intersegmental suture between meso- and meta- notum as well as anterior margin of first tergite indistinct or lost. Lateral longitudinal suture of metanotum not reaching the level of meso/metanotal intersegmental suture. Posterolateral angle of metaacetabula bilobate. Ventral margin of front femora nearly straight and without ventral tooth in male, slightly concave in female; ratio length: width 5.5 in male, 6.7 in female. Leg measurements, see table 1.

Male. Parameres asymmetrical, fig. 27. In the centre of mesosternum is a small patch of minute black bristles which are not on a tubercle. Endosomal sclerites fig. 30.

Macropterous form as apterous except for development of pronotum and hemielytra. Length ♂ 3.1-3.2, ♀ 3.33; humeral width of pronotum ♂ 1.6-1.7, ♀ 1.74. Pronotum dark brown to black with a pair of clavate yellowish spots on the centre constricted posteriorly, in one male and the female with the light brown posterior margin of pronotum. Hemielytra extending beyond apex of abdomen, proximally blackish, apically dark brown with black veins, costal margin medium brown.

Comparative notes. – Very similar to *V. xiphibion* which has, however, a more extensive yellow pattern dorsally and different parameres. The colour pattern is intermediate between *V. pulai* and *V. kuiteri* Hungerford & Matsuda, which both have, however, a medioventral tubercle on fore femur in male and somewhat different parameres.

Etymology. – *Xyele* (greek: knife, falchion) a noun in apposition refers to the shape of left paramere.

Ventidius kurtokalami sp. n.
(figs. 24, 28, 31)

Type material. - Holotype ♂, allotype ♀ E. Malaysia, Sabah, Danum Valley, 70 km W Lahad Datu, 4 km S main trail W5 nr. Sungai Segama, 150m, middle sized stream and waterfall, 3 Dec. 1989, sample Sab. 54, M. J. & J. P. Duffels

(ZMA); paratype ♂ Sabah, Danum Valley, 70 km W Lahad Datu, main trail W 12, 180m, narrow creek, 2. XII. 1989, sample Sab. 52, M. J. & J. P. Duffels (NC). All apterous.

Description

Apterous specimens. - Dimensions. Length ♂ 2.8-3.0, ♀ 3.45; width of thorax ♂ 2.0, ♀ 2.60. Colour. Eyes and anterior half of interoculus blackish, posterior half of interoculus yellow. Pronotum black, meso- and metanotum with a large central bilobed yellow area. An irregular broad black longitudinal band on border of notum and pleuron. Posterior part of metanotum, basal half of abdominal dorsum black, caudal half largely yellow. Basal third of metapleuron black, apical part largely yellow. Venter yellow with a pair of very small black dots at anterior point of mesoacetabular suture. Apex of rostrum, antennae except for base of first segment, apex of fore femur and rest of fore leg, middle and hind leg blackish.

Antennae when folded back over venter as long as body in male, slightly shorter in female. Length of antennal segments I : II : III : IV, male 1.22 : 0.57 : 0.55 : 0.56, female unknown. Eyes twice as long as head, overlapping lateral margin of prothorax and anterolateral angles of mesothorax. Anterior and posterior margins of pronotum medially concave. In lateral view, mesonotum softly convex dorsally, metanotum declivent. Intersegmental suture between meso- and metanotum as well as anterior margin of first tergite not visible. Lateral longitudinal suture of metanotum not reaching the level of meso/metanotal intersegmental suture. Posterolateral angle of metaacetabula bilobate. Ventral margin of fore femora slightly concave, ventral margin of fore tibia nearly straight in female; fore femur with a low hump, fore tibia ventrally irregular in male (fig. 24). Leg measurements, see table 1.

Male. Parameres nearly symmetrical, fig. 28. In the centre of mesosternum is a small patch of minute black bristles which are not on a tubercle. Endosomal sclerites fig. 31.

Comparative notes. – Although the parameres are nearly symmetrical, this species fits best in subgenus *Venditioides*. *V. kurtakalami* differs from similar species by the form of fore tibia in male.

Etymology. – *Kurtakalami* is a Greek noun meaning 'curved shin' and refers to the structure of male fore tibia.

TREPOBATINAE Matsuda, 1960

Metrobatopsis Esaki, 1926

Representatives of this genus have so far only been found in Papua New Guinea and Solomon Isles.

Stenobates Esaki, 1927

Representatives of this genus have been reported from Singapore and Australia (an undescribed species Andersen 1982 fig. 366). *Stenobates* is very similar to *Rheumatometroides*, the main difference is in the location of the metasternal scent gland opening which in *Stenobates* lies near the anterior margin in the anterior extension, whereas in *Rheumatometroides* the opening lies in the centre of the metasternum.

Rheumatometroides Hungerford & Matsuda, 1958

Two species are known from Papua New Guinea and Solomon Isles (Lansbury 1992). Like *Stenobates* they live on the sea and in estuaries in mangrove and similar habitats. We add two new species from Sulawesi:

Rheumatometroides makraitos sp. n.

(figs. 32-35)

Type material. – Holotype ♂, allotype ♀ (RMNH) and 5♂ 2♀ paratypes: Sulawesi Tenggara, Teluk Kendari, 13 Mar. 1989, N8947 (NC, 1♂ 1♀ ZMA 1♂ ZMC), all apterous.

Description

Apterous specimens. – Dimensions. Length ♂ 3.7-4.3, ♀ 4.0-4.2; width of head ♂ 0.90-0.98, ♀ 0.93-0.98; width of thorax ♂ 1.32-1.48, ♀ 1.66-1.70. Colour, interoculus yellow with dark markings, eyes dark, antennae dark, ventral side of first antennal segment, yellowish. Thorax and dorsum of abdomen yellowish with dark markings (fig. 32). Venter yellow, legs light brown with dark stripes.

Eyes large, about two thirds as wide as interoculus. Antennae shorter (0.6) than length of body, first segment with about 10 stiff black setae. Length of antennal segments I : II : III : IV male 1.19 : 0.57 : 0.47 : 0.43; female 0.95 : 0.55 : 0.49 : 0.47. Rostrum relatively stout, reaching anterior quarter of mesosternum. Pronotum distinctly (0.8) narrower than width of head. Meso and metanotum in females with a very broad mesal, weakly chitinized, sulcus (fig. 32), this is not apparent in males. Fore femur of male only very slightly thicker than in female, ventral margin straight without modifications. Fore tibia flattened and somewhat widened apically in both sexes.

Mesosternum 6-7 times as long as metasternum, which is not produced anteriorly. Scent gland opening surrounded by a circular structure situated more or less in the centre of metasternum.

Male. Pregenital sternite three quarters as long as preceding abdominal sternites together. Sternite 8 slightly shorter than sternite 7, sternite 9 slightly shorter than 8. Proctiger with a pair of long thin rostroventrally directed horns (figs. 33, 34). Endosomal sclerites fig. 35.

Comparative notes. – There are two further species in the genus: *R. browni* Hungerford & Matsuda from Solomon Isles and New Britain and *R. serena* Lansbury from Papua New Guinea and New Britain (Lansbury 1992). *R. makraitos* differs from both by having the yellowish mark on pronotum larger, the female in spite of a broader mesonotal sulcus being relatively narrower and the horns of proctiger of male being relatively shorter.

Etymology. – *Makraitos*, a Greek adjective, meaning 'extended' and referring to the broad mesonotal sulcus.

Remarks. – The species was found on very small and shallow puddles between mangrove air roots. If disturbed they jumped over the wet mud to the next puddle. Despite their small size they are rather quick and, as the net is hampered by the air roots, difficult to catch.

Rheumatometroides drepanephoros sp. n.
(figs. 36-37)

Type material. – Holotype ♂, allotype ♀ (RMNH), and 9♂ 10♀ paratypes: Sulawesi Tenggara, Teluk Kendari, Pulau Nambo, 13 Mar 1989, N8945 (NC, 1♂ 1♀ MBBJ 1♀ BPUH 1♂ 1♀ JTPC 1♂ 1♀ ZMA 1♂ 1♀ ZMC), all apterous.

Description

Apterous specimens. – Length ♂ 3.0-3.5, ♀ 3.2-3.5; width of head ♂ 0.87-0.90, ♀ 0.89-0.91; width of thorax ♂ 1.15-1.20, ♀ 1.32-1.40. Colour, interoculus yellow with a broad median brown stripe, widened posteriorly with a small yellowish dot in the wide part. A pair of brown lines at inner margins of eyes also widened posteriorly and two sublateral brown lines converging anteriorly and fused there with the median stripe. Eyes dark, first antennal segment yellowish with a dorsal brown line, segments 2-4 ventrally light, dorsally medium brown. Pronotum brown with a pair of more or less circular yellow spots covered with pruinose silvery grey pubescence. Mesonotum yellowish with a pair of submesal and a pair of lateral longitudinal brown stripes, not fused with the broadly brown hind margin, posterior yellowish part covered with silvery grey pubescence. In females this pattern is split by the broad yellowish cutaneous part. Abdominal terga largely brown, in females alternating with yellow transverse stripes,connexiva dark yellowish. First genital tergite yellowish, second basally yellowish, apically brownish. Venter yellow, legs light brown with dark stripes.

Eyes large, about two thirds as wide as interoculus. Antennae shorter (0.7) than length of body, first segment with 7- 12 stiff black setae. Length of antennal segments I : II : III : IV male 0.71 : 0.51 : 0.48 : 0.49; female 0.67 : 0.49 : 0.48 : 0.51. Rostrum relatively stout, reaching anterior quarter of mesosternum. Pronotum distinctly (0.7) narrower than width of head. Meso and metanotum in females with a very broad mesal, weakly chitinized, sulcus, this is not apparent in males.

Fore femur of male not noticeably thicker than in female, ventral margin straight without modifications. Fore tibia flattened and somewhat widened apically in both sexes. Leg measurements, see tabel 1.

Mesosternum 6-7 times as long as metasternum, which is not produced anteriorly. Scent gland opening surrounded by a circular structure which is more distinct in males than in females, situated near the anterior margin of metasternum. Leg measurements, see table 1.

Male. Pregenital sternite one third as long as preceding abdominal sternites together. Sternites 8 and 9 of subequal length, about three quarters as long as sternite 7. Proctiger with a pair of relatively short crescent shaped rostroventrally directed horns (fig. 36). Endosomal sclerites fig. 37.

Comparative notes. – The appendages of the proctiger of male are similar in form, though somewhat shorter, as those in R. serena Lansbury and *R. browni* Hungerford & Matsuda, which both have a different pronotal pattern with a single median yellowish spot. *R. makraitos* sp. n. is larger has also a different colour pattern and the proctiger horns are more or less straight.

Etymology. – *Drepanephoros* (Greek adjective meaning bearing a sickle or scythe) refers to the form of the appendages of the proctiger in the male.

Remarks. – This species was found on a small stream with a sand/clay bottom flowing through a coconut planation into the bay of Kendari. The plantation is on a very small island, Pulau Nambo, in the bay. This habitat is structurally quite different from the one in which the preceding species was found.

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A NEW BUSHCRICKET OF THE GENUS *POECILIMON* FROM THE GREEK ISLANDS (ORTHOPTERA: PHANEROPTERINAE)

Heller, K.-G. & K. Reinhold, 1992. A new bushcricket of the genus *Poecilimon* from the Greek Islands (Orthoptera: Phaneropterinae). – Tijdschrift voor Entomologie 135: 163-168, figs 1-24. (ISSN 0040-7496). Published 1 December 1992.

Poecilimon paros sp. n. from the islands of Paros and Naxos, Greece, is described and illustrated. It differs distinctly in calling song and structure of male cercus from its closest relative, *Poecilimon hamatus.*

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Key words. – Orthoptera, Phaneropterinae, *Poecilimon,* taxonomy, bioacoustics, Greece.

The genus *Poecilimon* is the largest bushcricket genus in Europe, containing more than hundred species (including species in the East Mediterranean and around the Caspian Sea). Many species have restricted ranges in the mountains of the Balkan peninsula and Asia Minor, but only few are confined to islands in the Mediterranean: *P. cretensis* Werner, 1903 to Crete and Naxos, *ikariensis* Willemse, 1982 to Ikaria, *aegaeus* Werner, 1932 to some Aegean islands, *mytilenensis* Werner, 1932 to Lesvos and Limnos and *deplanatus* Brunner von Wattenwyl, 1891 to some islands of the Southern Sporadhes (Willemse 1984). Here we describe a new species, *Poecilimon paros,* known only from the islands of Paros and Naxos (Kikladhes, Greece) in the Aegean sea. Though closely related to *P. hamatus* Brunner von Wattenwyl, 1878, known from Rhodes and Asia Minor, the new species may be distinguished from the latter by slight differences in morphology, but is readily recognizable by its distinct song.

METHODS

Calling song and wing movement were registered as described in Heller (1988). For song terminology see Willemse & Heller (1992).

Poecilimon paros sp. n.
(figs. 1-5, 9, 11, 13, 15-19)

Type material. – Holotype ♂: Greece, Kikladhes, island of Paros, Ag. Ilias-Pantes, 500-600 m, above the village of Lefkes, 17.v.1991, collected as subadults, leg. K. Reinhold (collection Heller, University of Erlangen). – Paratypes: same data, 8♂ 7♀, including ♀ allotype (collection Heller, except 1♂ 1♀ paratypes in collection Willemse, Eygelshoven); Naxos: Sifones, 26.v.1976 (1♀)[& 2♂ 3♀ subadults]; Moutsouna, 10.vi.1982, 2♂ 1♀), both leg. A. Malicky (collection Willemse, Eygelshoven).

Description

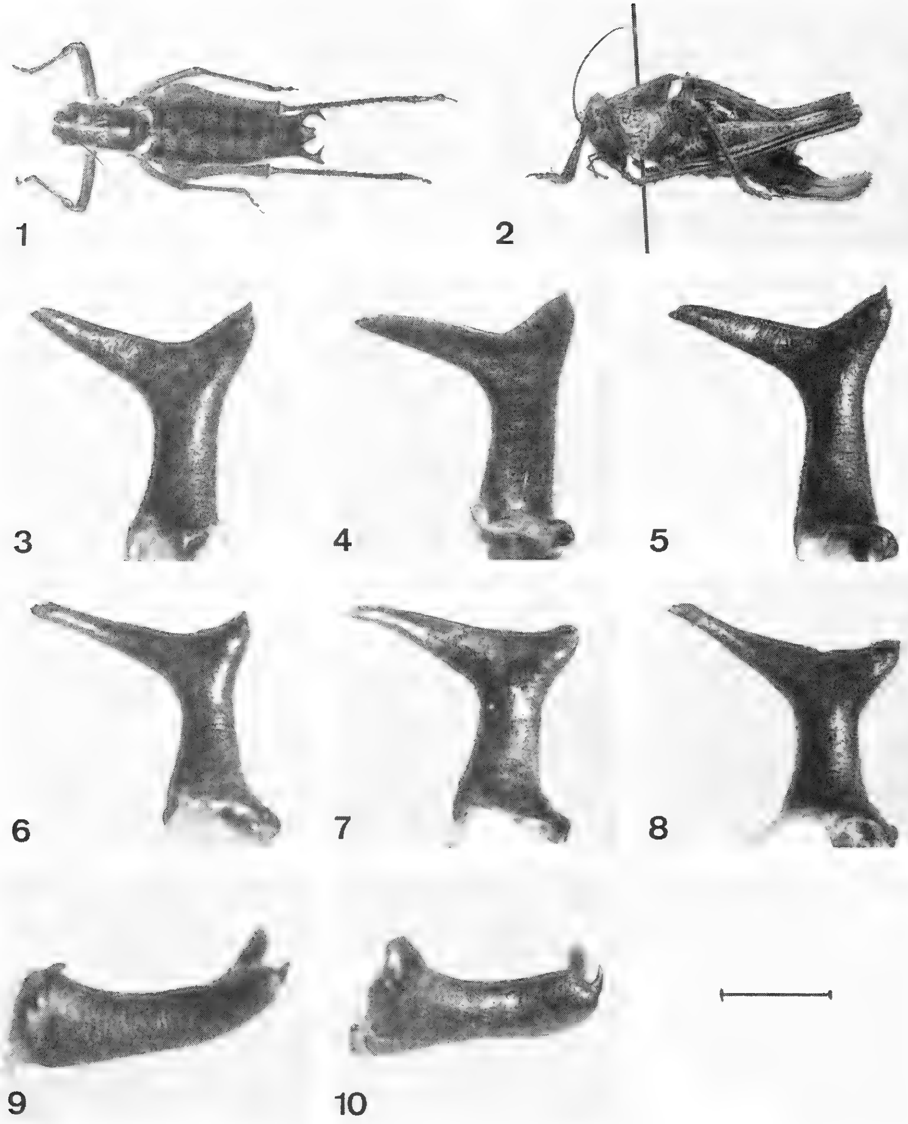
Male (fig. 1) medium sized, integument shiny.

Head: fastigium of vertex produced anteriorly, nearly twice as long as broad, narrow, as broad as third antennal segment or a little bit narrower, lateral margins parallel or slightly tapering anteriorly, from above longitudinally impressed.

Thorax: pronotum with V-shaped transverse sulcus cutting median line just behind middle of pronotal length; metazona not widening and very slightly inflated posteriorly; hind margin straight and ventral margin slightly convex in the prozona, sloping upwards in the metazona. Auditory spiracle large, more than half pronotal height. Elytra with basal two third covered by pronotum, apical margins reaching middle of first tergite; stridulatory file (fig. 11) of left elytron as seen from below distally not reaching hind margin of elytron, in profile slightly bulging distally of middle of length, shortest distance between proximal and distal most tooth 1.6 mm; in proximal two thirds about 55 well sclerotised teeth and in distal third about the same number, gradually decreasing in size to the margin of the elytron; in the middle of the file about 65 teeth/mm. Hind femur unarmed.

Abdomen: hind margins of tergites straight. Cercus strongly bifurcate; inner branch terminating into several small tubercles and distinctly longer than apical one; apical branch slightly curved outwards and upwards, terminating into a strong black tooth pointing upwards in a 45° angle relative to the basal part of the cercus (figs. 3-5, 9).

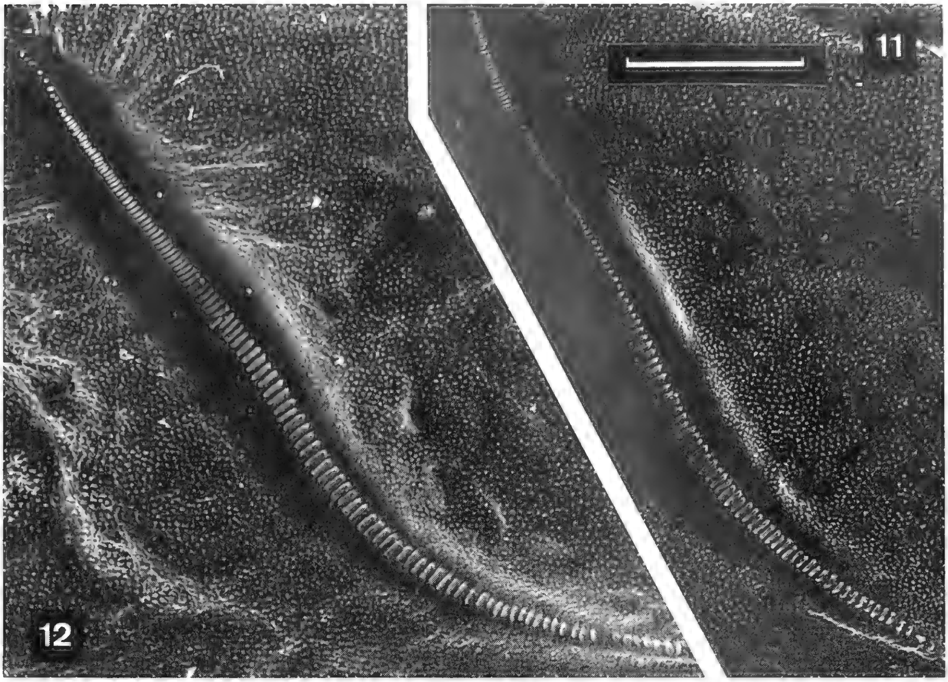
Subgenital plate reaching from mid to distal third

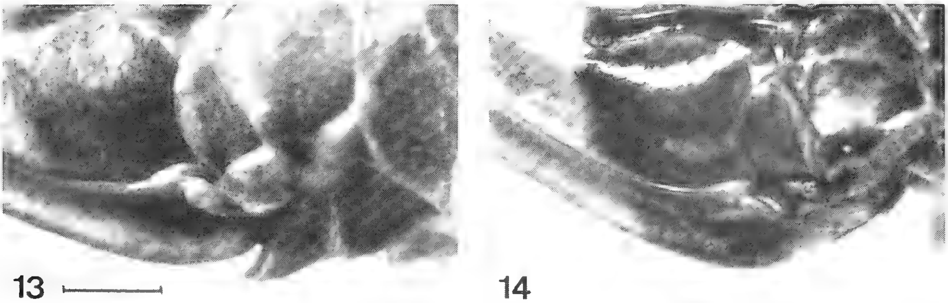


Figs. 1-2. *Poecilimon paros*. - 1, ♂, dorsal view (holotype); 2, ♀, lateral view (allotype). - Figs. 3-10. *Poecilimon*, ♂, left cercus (scale 1 mm). - 3-5, *P. paros*, dorsal view, three different specimens (paratypes); 6, *P. hamatus*, dorsal view (Dimilia, Rhodes); 7-8, *P. hamatus*, dorsal view, two different specimens (Lindos, Rhodes); 9, *P. paros*, lateral view (paratype); 10, *P. hamatus*, lateral view (Lindos, Rhodes).

of cercus, hind margin weakly incised, postero-lateral edges slightly protruding, apical part of ventral side with an obtuse median and on either side a more distinct lateral keel, extending into postero-lateral edges.

Coloration: in general appearance very similar to *P. hamatus* (see Heller 1988, jacket photograph); varicoloured, general colour yellowish red. Vertex, lateral and dorsal sides of prozona and pronotum, tergites and legs finely speckled rusty brown or blackish. Antennae black, finely annulated yellow-white. Dorsum of pronotum with short yellowish median line frontally and black markings laterally and in the



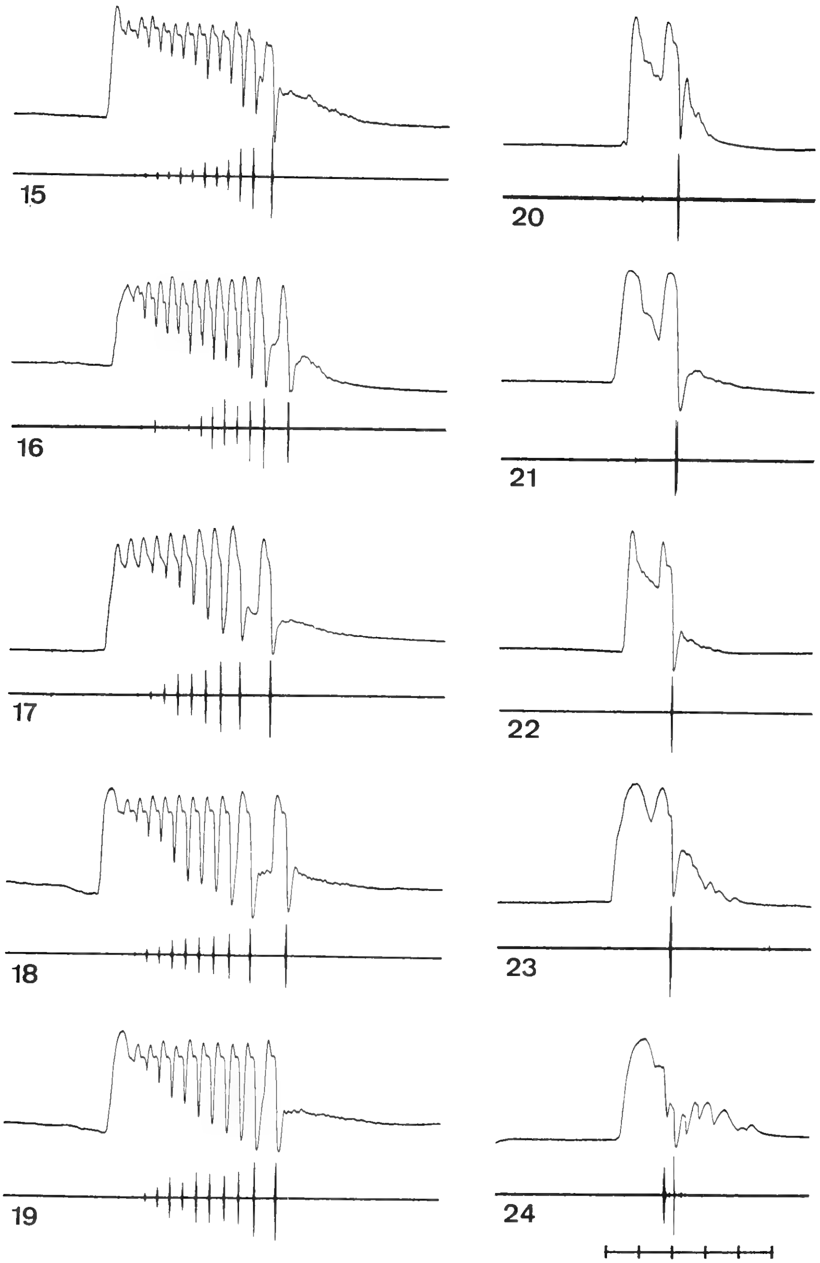


Figs. 11-12. *Poecilimon*, ventral view of stridulatory file of left ♂ elytron, distal end to the left (scale 300 µm). – 11, *P. paros* (paratype); 12, *P. hamatus*, (Lindos, Rhodes). - Figs. 13-14. *Poecilimon*, base of ovipositor, lateral view (scale 1 mm). - 13, *P. paros* (allotype); 14, *P. hamatus* (Lindos, Rhodes).

centre, metazona reddish brown. Elytra white laterally up to the apical parts contrasting with the black central areas. Abdomen from above yellow with broad, black midline and broad, black lateral lines; first and last two tergites nearly completely black; sternites yellowish, each with a reddish brown spot of various intensity. Cerci reddish brown, tips black. Subgenital plate yellowish to reddish brown. All femora with black stripes and between the yellow lower keels dark brown to black; auditory tympana of fore tibia each with a large black spot; hind tibiae dorsal with black spines; all tarsi dark brown to black.

Female (fig. 2). – Auditory spiracle large, but less than half pronotal height. Elytra: left overlapping right, clearly visible, strikingly coloured black and white as in male; stridulatory apparatus present, similar to that in females of *P. hamatus* (see fig. 1 in Heller & von Helversen 1986). Basal fold of ovipositor (fig. 13) with two pits and two lobes forming an oblique T-shaped structure as seen from above: one pit situated above the horizontal line of the T, the other in front of the vertical line of the T and opening ventroanteriorly. Coloration as male.

Measurements (length in mm). – Body ♂ 20-22,



Figs. 15-24. *Poecilimon*, ♂, synchronous registration of left elytron movement (above, upward = opening, downward = closing) and calling song (below) (scale 0.5 sec.). – 15-19, *P. paros* (body temperature ca. 32°C.). - 15, holotype; 16-18, three different paratypes; 19, specimen from fig. 18, variation. - 20-24, *P. hamatus* (body temperature ca. 26°C.). - 20-22, three different specimens (Lindos, Rhodes); 23, specimen from Dimilia, Rhodes, normal pattern; 24, specimen from fig. 23, rarely observed variation.

♀ no data (all females preserved in absolute ethanol); pronotum ♂ 4.7-5.5, ♀ 5.7-6.2; elytron (visible part) ♂ 1.0-2.2, ♀ 1.0-1.2; hind femur ♂ 14.0-14.7, ♂ 14.7-15.6; ovipositor 7.0-7.5.

Bioacoustics. – Male calling song consists of short echemes repeated at intervals of several seconds (mostly 3-5 s). Each echeme (figs. 15-19) consists of a series of wing movements (opening and closing) with increasing amplitude producing a series of syllables with increasing intensity; wing movements repeated regularly except the last movement cycle (and syllable) which is produced after a longer interval than between the previous cycles. Frequency of stridulatory movements within the central part of each echeme between 23 and 28 Hz (body temperature of the animals about 32°C). Number of movement cycles different between both individual males (most frequent numbers in different males: 9-10, 11, 11-13, 14; range 6-15) and circumstances (short echemes during acoustic interactions). The power spectrum of the song showed its peak at about 28 kHz (20 dB below peak 21-42 kHz).

Distribution. – Only known from the islands of Paros (500-600 m altitude) and Naxos.

Differential diagnosis

The new species can easily be distinguished from all other species of the genus except for *Poecilimon cervus* Karabag, 1950 and *P. hamatus*, which show also a strongly bifurcate shaped male cercus. In *P. cervus*, known from Central and North Anatolia, the tip of the apical branch of the male cercus has a series of strong spines instead of a single and smaller one in the new species and the inner branch is wider and apically widened instead gradually tapering as in *paros* (compare figs. 3-5 with fig. 25 in Karabag 1950). However, morphological distinction between the new species and *P. hamatus*, known from West Anatolia and some adjacent Aegean islands (Willemse 1984), is less obvious. Apparently they represent sister species. Their distinction is mainly restricted to the male cercus: the inner branch in *P. hamatus* being longer and somewhat more slender (figs. 6-8; Karabag 1950: fig. 26, Willemse 1988: fig. 127, Heller 1984: fig. 2) and the apical branch pointing more outwards with the terminal tooth being smaller and pointing straightly upwards (fig. 10) instead of upwards and at the same time obliquely inwards in the new species (fig. 9). In the female of *P.paros* the pit of the basal fold of the ovipositor that opens ventro-anteriorly is broader and the bordering lobe more prominent than in *hamatus*. Another difference between both species, present in both sexes, refers to the elytra which in the new species are less covered by the pronotum and to a greater extent visible than in *P. hamatus*. However, most obvious and reliable differences between the two species are found in the structure and duration of the calling songs, defined by the number of movement cycles (opening and closing). In *P. hamatus* two cycles at most have been registrated, the first one often producing only a very faint sound if detectable at all (figs. 20-24; Heller & von Helversen 1986: fig. 3, Heller 1988: fig. 36K). Rarely even a single opening and closing movement was recorded (fig. 24). These short echemes of *P. hamatus* differ strongly from those of *paros* in which at least 6 and commonly 9 to 14 successive opening and closing movements per echeme are produced (figs. 15-19).

Remarks

The type locality is the slope of the mountain Agios Ilias-Pantes and can be reached by car using the road from the village of Lefkes to the O. T. E. station (Greek Telegraph Station) on one of the summits. The subadult animals of *P. paros* were found mainly on *Cistus*. Their distribution was clustered with sometimes high population densities of up to 25 animals per m^2. Up to now *P. paros* is the only member of the genus known from Paros.

Etymology

A noun in apposition, named after the island of Paros.

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We thank Dr. Fer Willemse for his valuable comments.

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ECOLOGY, DISTRIBUTION AND VULNERABILITY OF *MACROTHELE CALPEIANA* (WALCKENAER) (ARANEAE, HEXATHELIDAE)

Helsdingen, P. J. van & A. E. Decae, 1992. Ecology, distribution and vulnerability of *Macrothele calpeiana* (Walckenaer) (Araneae, Hexathelidae). – Tijdschrift voor Entomologie 135: 169-178, figs. 1-2, tabs. 1-4. [ISSN 0040-7496]. Published 1 December 1992.

Data on distribution, habitats, local densities, and observations on the biology of *Macrothele calpeiana* (Walckenaer) are presented. A distribution-map (5 × 5 km UTM-grid) is provided. Our results confirm the earlier published distribution in Spain. Sites where the species was not found are also indicated. The occurrence in North Africa is discussed. The inclusion of this species in Appendix II of the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) is criticized.

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Keywords. – Araneae, Hexathelidae, *Macrothele calpeiana*, ecology, distribution, Spain, Bern Convention.

Macrothele calpeiana (Walckenaer, 1805) was described early in the 19th century as *Mygale calpeiana* after a male specimen from the Gibraltar region. Hardly any new records have been published since and Gibraltar (type locality of *M. calpeiana*), Algeciras (type locality of the junior synonym *Mygale luctuosa* Lucas, 1855), Malaga and Ronda in Spain, and El-Arouch in Algeria remained the recorded localities of this species until very recently. Then suddenly and for reasons unknown the species received new attention from two sides independently.

Blasco & Ferrandez (1986) produced a substantial morphological and taxonomical account on *M. calpeiana*, and settled the discussion on the synonymy of *M. luctuosa* with *M. calpeiana*. Blasco & Ferrandez (1986) also presented an updated distribution based largely on recently collected material.

Snazell & Allison (1989) published an important paper on the species in which they repeated the distributional and ecological data published earlier by Snazell (1986). They also included and discussed the distribution data of Blasco & Ferrandez (1986) and of others which were not available in 1986. Furthermore they, elegantly, corroborated the synonymy of *M. calpeiana* with *M. luctuosa*. It appeared that a subadult male of *M. calpeiana* had not been recognized as such and described as the female of a new species (*M. luctuosa*), an understandable mistake for any one who knows these animals. Snazell & Allison (1989) presented additional morphological details and information on the prey, a description of the nest and web, observations on courtship and mating in captivity, and finally a description of the second European representative of the genus, *M. cretica* Kulczyński 1903.

As to its ecology, Snazell (1986) emphasized the relationship of *M. calpeiana* with undisturbed Cork Oak (*Quercus suber* L.) woodland in the southernmost part of Spain, which he refers to as the optimum habitat for this species. He suggested an apparent inability of the spiders to survive in situations more than a few metres away from the woodland, although populations are said to survive on bare banks of roads and streams for some time even though the surrounding woodland has almost entirely degenerated. Extensive areas of Cork Oak woodland are still present in the region and, he says, there seems to be no immediate problem for *M. calpeiana* in Spain. However, according to him, intensive cultivation of the woodland and the development of housing projects currently undertaken in the area might become a serious threat. Collins & Wells (1987) picked up this message and, treating *M. calpeiana* as a bio-indicator for Cork Oak woodland, included the species in their selection of endangered invertebrate species to be listed in the Bern Convention. In the same year the species was placed on Appendix II of the Convention.

Not being convinced by Snazell's (1986) arguments for the strict habitat requirements of *M. calpeiana*, we decided to carry out an independent survey. The fieldwork was carried out in 1989 by A. E. Decae and A. Hallensleben during two trips to

Table 1. Synopsis of localities in Spain and their main characteristics where *M. calpeiana* was found. Density refers to the counted number of nests of adult spiders within an area of approximately 20 m^2 around the first nest observed; (number of collected specimens in brackets); no number means webs and/or spiders observed but not counted.

Locality	UTM grid-reference	date	altitude in m	site	vegetation type	density (number collected)
El Captan	UF 1846	30.iii	200	hillside	cork oak cult.	1 (1)
El Captan	UF 1847	30.iii	250	hillside	cork oak cult.	1 (0)
Guadiario	TF 9419	05.iv	20	coastal zone	olive cult.	10 (4)
Gaucin	TF 9445	17.ix	600	highlands	cork oak	6-7 (1)
Crestellina	TF 9242	17.ix	500	hilltop	oak/olive	3 (0)
Nuevo Castellar	TF 8220	18.ix	70	lowlands	dense oak	1 (1)
Almoriama	TF 8020	18.ix	80	lowlands	oak/eucal./pine	13 (1)
Castellar de la Frontera	TF 7923	19.ix	260	hilltop	castle wall	10-15 (2)
Sotogrande	TF 9218	20.ix	20	lowlands	cork oak cult.	0-5 (0)
Jimena de la Frontera	TF 8036	20.ix	200	hilltop	castle wall	
La Tienera Vieja	TF 7839	20.ix	200	hillside	shrubs/oak/pine	1-2 (0)
La Tienera Vieja	TF 7740	20.ix	300	highlands	oak/shrubs	6-8 (0)
Sambana	TF 8832	20.ix	100	hillside	shrubs	7 (1)
Ronda-Grazalema	TF 9773	23.ix	720	highlands	oak cult.	1-Ó (1)
Grazalema	TF 8770	23.ix	920	mountainside	grass/herbs	1 (0)
Puerto de la Boya	TF 8570	23.ix	1100	mountain pass	pine cult.	4-6 (1)
Sierra Grazalema	TF 8371	23.ix	960	highlands	oak/shrubs	
Benamahona	TF 7871	23.ix	900	highlands	pine	
El Bosque	TF 6972	23.ix	200	highlands	grass/olive	5 (1)
Arcos de la Frontera	TF 5470	23.ix	200	highlands	oak/pine	8 (1)
El Santiscal	TF 5172	23.ix	100	highlands	acacia cult.	1 (0)
San José del Valle	TF 5556	23.ix	120	hillside	olive cult.	
Tempul	TF 6058	23.ix	100	river valley	shrubs/gallery	1-2 (0)
Cortes de la Frontera	TF 7346	23.ix	500	highlands	oak forest	2-3 (0)
Puerto del Bujeo	TE 7596	26.ix	150	roadside	cork oak	
Jubrique	TF 9851	26.ix	300	hilltop	oak/pine/olive	10-14 (0)
Santuaria de la Luz	TF 6301	27.ix	30	lowlands	oak forest	8 (2)
Almodovar/Sierra del Niño	TF 6106	27.ix	50	roadside	oak/grass	1-3 (1)
Sierra del Niño	TF 6408	27.ix	150	hillside	oak forest	1 (1)
Sierra del Niño	TF 6504	27.ix	250	hillside	oak forest	1 (0)
Sierra del Niño	TF 6503	27.ix	250	hillside	oak forest	1-2 (0)
Puerto de Ojén	TF 6707	27.ix	350	hillside	oakforest	4-5 (1)
Los Barros	TF 7008	27.ix	200	hilltop	shrubs	4 (0)
Los Barros	TF 7109	27.ix	200	hillside	oak forest	7 (1)
Casares	TF 9935	28.ix	180	hillside	oak forest	7-9 (5)
Casares	TF 9636	29.ix	500	hilltop	shrubs	1-2 (1)
Casares	TF 9737	29.ix	400	hillside	olive cult.	11 (6)
Estepona	UF 0836	18.ix	80	hillside	eucalyptus cult.	1 (1)
Sierra Bermeja	UF 0738	18.ix	450	hilltop	oak/pine	1-3 (3)
Sierra Bermeja	UF 0240	18.ix	500	mountainside	pine/oak	1-2 (0)
Sierra Bermeja	UF 0642	18.ix	600	mountainside	chestnut	4 (0)
Sierra de Palmetera	UF 1749	25.ix	450	mountainside	shrubs	1 (1)
Sierra de Palmetera	UF 1755	25.ix	900	mountainside	roadside/pine	1-3 (0)
Acueducto	UF 1170	25.ix	700	highlands	grass/roadside	1-2 (0)
Puerto del Viento	UF 2073	25.ix	1180	mountain pass	shrubs/roadside	3-4 (2)
Genalguacin	UF 0048	26.ix	400	hillside	olive cult.	3-5 (0)
Buenas Noches	UF 0131	28.ix	20	lowlands	eucalyptus	15 (3)
Casares	UF 0033	28.ix	100	hillside	oak/olive	1-2 (0)
Puerto de Piñas Blancas	UF 0643	26.ix	700	hillside	oak/pine	6 (1)
Sierra Bermeja	UF 0642	21.ix	450	hilltop	oak/pine	4 (0)
Puerto de Piñas Blancas	UF 0643	21.ix	700	hillside	pine cult.	5 (2)
Jubrique	UF 0848	21.ix	500	hilltop	pine cult.	
Jubrique	UF 0448	21.ix	350	hilltop	oak/pine	
Jubrique	UF 0150	21.ix	300	highlands	cork oak cult.	6-8 (0)
Ronda	UF 0769	21.ix	750	canyon/ruins	almond cult.	12 (4)
Ronda	UF 0769	22.ix	750	city park	palmtrees	1 (0)
Estación de la Indiana	UF 0372	23.ix	750	roadside	cork oak	

Andalusia. They collected both ecological and distributional data.

Methods

A first trip was made in the period between 25 March and 8 April 1989. The coastal region, roughly bordered by the lines Gibraltar-Ronda in the West, Ronda-Lanjarón in the North and Lanjarón-Albuñol in the East, was surveyed for the presence of *M. calpeiana.* Twenty localities were investigated. In only three localities, all of them West of the city of Málaga, *M. calpeiana* was found (fig. 1). Approximately ten specimens were collected (females and juveniles) and taken home for further study.

A second trip was made in the period between 17 and 29 September 1989. During this trip attention was focussed on the ecology and natural history of *M. calpeiana* rather than on the geographical distribution. The region surveyed was largely the same as Snazell's (1986) study area. Eighty localities were surveyed, in 58 of which *M. calpeiana* was found.

In table 1 we have listed all localities where *Macrothele calpeina* has been found. We have included information on the relative population densities (number of nests within approximately 20 m^2). Fifty adult specimens were collected, among which three adult males. All specimens are deposited in the collection of the Rijksmuseum van Natuurlijke Historie (National Museum of Natural History) at Leiden, The Netherlands. Table 2 lists all the localities where the species could not be found, an equally important observation. In the tables we have listed our localities with a 1×1 km UTM-grid, but visualized the distribution on the map with a 5×5 km accuracy.

Results

Habitat

The most western localities visited during the first trip lie within the region where Snazell (1986) found *M. calpeiana* most commonly and predominantly in association with Cork Oak. The reported frequent occurrence of *M. calpeiana* in Cork Oak vegetations in that region (mainly cultivated and often fenced in forestland) was confirmed, although dense populations of *M. calpeiana* were also found in very different situations, such as along roadsides, in picnic areas, in fruit orchards, in pine- and *Eucalyptus* plantations, on recently burnt grassy slopes, on rubbish dumps, in old stone walls, on cliff faces and even in the Palmtrees of the city parks in Ronda. Further to the East, in the coastal region east of the city of Malaga, an area not surveyed by Snazell, *M. calpeiana* was not found. This seems to support Snazell's (1986) remark on the very restricted distribution of *M. calpeiana* in Spain.

During the second trip large and dense populations of *M. calpeiana* were found, in association with Cork Oak as well as in very different situations. It appeared that *M. calpeiana*, rather than being dependent on undisturbed Oak-wood, is a culture following species that profits from human modifications of the landscape.

Counts of nests showed that in some of these localities population densities reach higher levels than in Cork Oak forests (see tables 1 and 3). Population densities in the relatively undisturbed forests of the 'Parque Natural Sierra de Grazalema', the 'Reserva Nacional de Cortez de la Frontera' and the 'Reserva Torrecilla de Serranía' were found to be lower than in typically man-made habitats such as stone walls and rubbish dumps (see table 3).

Table 4 illustrates the relationship of the occurrence of *M. calpeiana* with more or less disturbed habitats. The following classification was designed for the purpose:

Category 1. – Non-cultivated/non-forested: includes the typical mediteranean Garigue with *Cistus* sp., *Thymus* sp., *Lavandula* sp., *Trifolium stellatum* L., *Quercus coccifera* L., *Chamaerops humilis* L., etc., barren mountain passes and exposed river beds;

Category 2. – Relatively undisturbed mixed forest: Maquis with *Pinus pinea* L., *Quercus ilex* L., *Q. suber* L., *Laurus nobilis* L., *Pistacia lentiscus* L., *Ruscus aculeatus* L., *Myrtus communis* L., etc., with a dense understorey;

Category 3. – Cultivated Cork Oak stands: a forest type of almost entirely Cork Oak (*Q. suber*) from which the understorey is cleared; most of these woods are apparently private property and all are in use for the production of cork;

Category 4. – Unmanaged culture land: includes road sides, old walls, rubbish dumps and generally polluted picnic grounds;

Category 5. – Managed culture land: includes city parks, gardens, parking lots and development areas.

The first two categories contain habitat types which have developed as a result of historical human activities and possible changes in climate but which are currently relatively free of human influences. Reproducing females of *M. calpeiana* were found in the typical 'garigue' (cat. 1) as well as in the dense, almost inpenetrable 'maquis' (cat. 2) type of habitat, but population densities in both these 'undisturbed' habitat types were relatively low. Population densities were even lower in the fifth recognized category (managed culture land), although nests of adult spiders were found even in such thoroughly maintained places as private gardens, city parks and parking lots.

The optimum habitat for *M. calpeiana* in Southern

Spain obviously lies in terrains that are easily accessible to man. These habitats, here placed in categories 3 and 4, are either man-made origin or to some extent exploited by man. As far as road sides, old walls and rubbish dumps are concerned this needs no further explanation. Cork Oak woodland is very common and regarded as a natural resource in the region. This leads to a careful management that, as far as our observations go, rarely has adverse effects on the *M. calpeiana* populations. In 20 out of the 22 Cork Oak forests thus managed *M. calpeiana* populations were found. In one case, where clearing went as far as bulldozing all the understorey, *M. calpeiana* apparently still managed to retain a foodhold by becoming arboreal. Here numerous webs of adult spiders were found more than 2.5 meters above the ground on the trunks of the Oak trees.

Summarizing we may conclude that *M. calpeiana* thrives on sites with open and accessible soil with some form of shade and cover.

Biology

Males

Adult males have a body length (excluding the spinnerets) of approximately 25 mm. In contrast to most mediterranean Mygalomorphae, males of *M. calpeiana* are present virtually all year round. Males were collected in the period February - June (Blasco & Ferrandez 1986 and Snazell 1986) and in September (this study).

It is not clear if there is a particular mating season. During September fully adult males were found to hunt actively from their own nests. Males of mediterranean mygalomorphs more usually abolish feeding to become reproductively active.

Females

Adult females of *M. calpeiana* range in body length (excluding the length of the spinnerets) from approximately 25 mm to 37 mm. The relatively large variation in body size of adult females indicates the existence of several year-classes in this group. This in turn would mean that, as is usual in Mygalomorphae, *M. calpeiana* females are reproductively active for several years after reaching adulthood.

Juveniles

In September several females were found to have young with a body length of approximately 3 mm in their nests. These juveniles were moving freely in their mothers' nests and presumably represented the generation which would disperse. Juvenile spiders of intermediate sizes were observed to inhabit individual nests.

Activity rythms

M. calpeiana, unlike most other mediterranean mygalomorphs, is not strictly nocturnal in its activities. Prey-capture was observed both at night and during daylight hours. At night some, but not all spiders in a colony took up positions in the entrance of their nests near the web. Occasionally spiders were observed in this position during daylight. Other activities such as dispersal, nestbuilding, or mating were not observed.

The nest

The nest of *M. calpeiana* is composed of an exposed 'sheetweb' and a set of underground silk tubes. Sometimes the sheetweb is absent and the exposed part of the nest is reduced to a densely woven closed silk cell. The web extends from the nest entrance and may cover an irregularly shaped area up to 1600 cm^2. It may be directly attached to the substrate or be suspended between low vegetation around the nest entrance. The web consists of a more or less dense mesh of very fine silk strands spun in an irregular criss-cross pattern. Some aerial strands may extend to some 20 cm above the nest entrance. In general smaller spiders spin smaller webs, although the size and density of the web may vary considerably within all spider size classes.

M. calpeiana spins silk continually as it moves. When the spider re-enters the nest after a short sally on the web, it covers the entrance behind itself with a few flimsy strands of silk.

The nest entrance may consist of one, two or more silk funnels converging towards the inside of the nest in one main nest tube. The main tube may have one or more flimsy side tubes and is suspended in a preexisting cavity. This cavity may be a deserted rodent burrow, a rock crevice or washout, a hollow tree etc. Depending on the conditions the main nest tube may extend more than fifty centimetres underground. Indigestible remains of prey are attached to the side tubes or to the outside of the main tube.

Prey-capture

Natural prey-capture behaviour was not observed. Prey-capture could only be induced in spiders having a sheetweb extending from the entrance of their nests. Those having a closed silkcell at the entrance were not actively hunting and were probably moulting. Skincasts were found both in sheetweb nests and in 'cellnests'.

A whole range of arthropods placed in the web of *M. calpeiana* induced prey-capture behaviour. The capture behaviour is rather straightforward and stereotyped, regardless of the type of prey. Movements of the prey in the web cause the spider to come to the entrance of the nest where it pauses for some time,

Table 2. Synopsis of localities and their characteristics where *M. calpeiana* could not be found in 1989.

Locality	UTM grid-reference	date	altitude in m.	site	vegetation type
Santuaria de la Luz	TE 6395	27.ix	30	lowlands	grass
Manilva	TF 9928	17.ix	50	lowlands	vine cult.
Manilva	TF 9632	17.ix	200	hilltop	shrubs
Casares	TF 9536	17.ix	400	highlands	shrubs
Crestellina	TF 9239	17.ix	400	highlands	olive/shrubs
Crestellina	TF 9341	17.ix	450	hilltop	olivebush
San Martin de Tesserillo	TF 9224	19.ix	20	river bed	gallery forest
San Martin de Tesserillo	TF 8624	19.ix	30	creek bed	shrub/gallery
Castelar/Ferro Caril	TF 8324	19.ix	40	river bed	gallery forest
Sotogrande	TF 8619	19.ix	50	undulating	cork oak cult.
Charco les Hurrones	TF 6757	23.ix	160	highlands	grass
Puerto de Galiz	TF 6750	23.ix	540	highlands	oak forest dense
Gibraltar	TF 8802	05.iv	40	hillside	maquis
Sotogrande	TF 9218	05.iv	10	coastal zone	cork oak cult.
Sierra Bermeja	UF 0738	21.ix	200	hillside	pine
Puerto del Viento	UF 1773	25.ix	1190	mountain pass	shrubs
Sierra de Palmetera	UF 1355	25.ix	1050	mountainside	barren
Paruta	UF 1260	25.ix	1000	highlands	pine forest
Sierra de Palmetera	UF 1655	25.ix	800	mountainside	pine forest
Estepona	UF 0534	24.ix	10	lowlands	shrubs
Puerto de Alija	UF 1647	25.ix	400	mountainside	barren
Yunquea	UF 3169	30.iii	700	highlands	maquis
Tolox	UF 3161	30.iii	300	highlands	olive cult.
Rio Grande	UF 3661	30.iii	250	highlands	garigue
Puerto de Abejas	UF 2969	30.ii	820	highlands	olive cult.
Mirador del Guarda Forestal	UF 2471	30.iii	1000	highlands	pine forest
El Burgo	UF 2872	30.iii	800	highlands	garigue
Moclinejo	UF 8869	03.iv	100	hillside	maquis
Benamargosa	UF 9377	03.iv	200	hillside	maquis
Puente Tablata	UF 9876	02.iv	100	highlands	olive cult.
Estepona	UF 0837	18.ix	150	hilltop	shrubs/pine
Frigliana	VF 1772	27.iii	300	highlands	olive cult.
Cueva de Nerja	VF 2369	29.iii	20	coastal zone	garigue
Motril	VF 5570	28.iii	20	coastal zon	road side
Pénon del Fraile	VF 6181	28.iii	900	highlands	garigue
Haza de Lino	VF 7275	28.iii	1250	highlands	cork oak cult.
Popolos	VF 7674	28.iii	600	hillside	olive cult.
Puerto Camacho	VF 6878	18.iii	1220	highlands	olive cult.
Frigliana	VF 1870	27.iii	250	highlands	olive cult.
Cueva de Nerja	VF 2471	7.iv	30	coastal zone	garigue

apparently to locate the source of disturbance. After a short interval it dashes straight at the prey, grabs it with the fangs and drags it in reverse back to the nest entrance.

Prey

Captures of the following arthropods were observed: Oniscoidea (two species), Orthoptera, Cerambycidae, Staphylinidae, Carabidae, Diplopoda, Scorpionida. Escaping from the web very quickly was a *Scolopendra* spec.

Snazell & Allison (1989) reported a very broad range of different arthropod prey being captured and consumed by *M. calpeiana*. This strongly indicates general or opportunistic feeding habits of this species and suggests that the availability of food is unlikely to limit the natural distribution.

Our investigations of prey remains found in ten webs support this idea. Oniscoidea, Coleoptera and Formicidae constitute the bulk of the prey both in biomass and number of individual prey. Interesting is the large discrepancy in the sizes of individual prey animals found in single webs. Remains of beetles with body lengths of approximately 20 mm were found together with the remains of ants of hardly 2 mm. It has still to be investigated if adult spiders catch this extraordinary range of prey sizes or that maybe the small prey is captured by juveniles actively hunting in their mother's web.

Very few mygalomorphs are known to capture flying prey. The presence of a bee (family Apidae) reported by Snazell & Allison (1989) and a Hymenopteron in one of our samples indicates that *M. calpeiana* is an exception.

Ectoparasites

Virtually all specimens collected were heavily infested with Acari which clung in large numbers to the carapace, usually concentrating in the fovea, and sometimes to the abdomen of the spiders. This is in agreement with what Snazell & Allison (1989) found. Numerous mites may be present on one individual without the spider seeming to suffer very much. Spiders kept in captivity were all very quickly free of mites. It is not known what caused the disappearance of the mites. The mite was described by Baker (1991) as a new species of parasitic mite (*Androlaelaps pilosus*) after specimens collected by Snazell.

Distribution in Spain

The recent work by others (Snazell 1986, Blasco & Ferrandez 1986, Snazell & Allison 1989) and oursel-

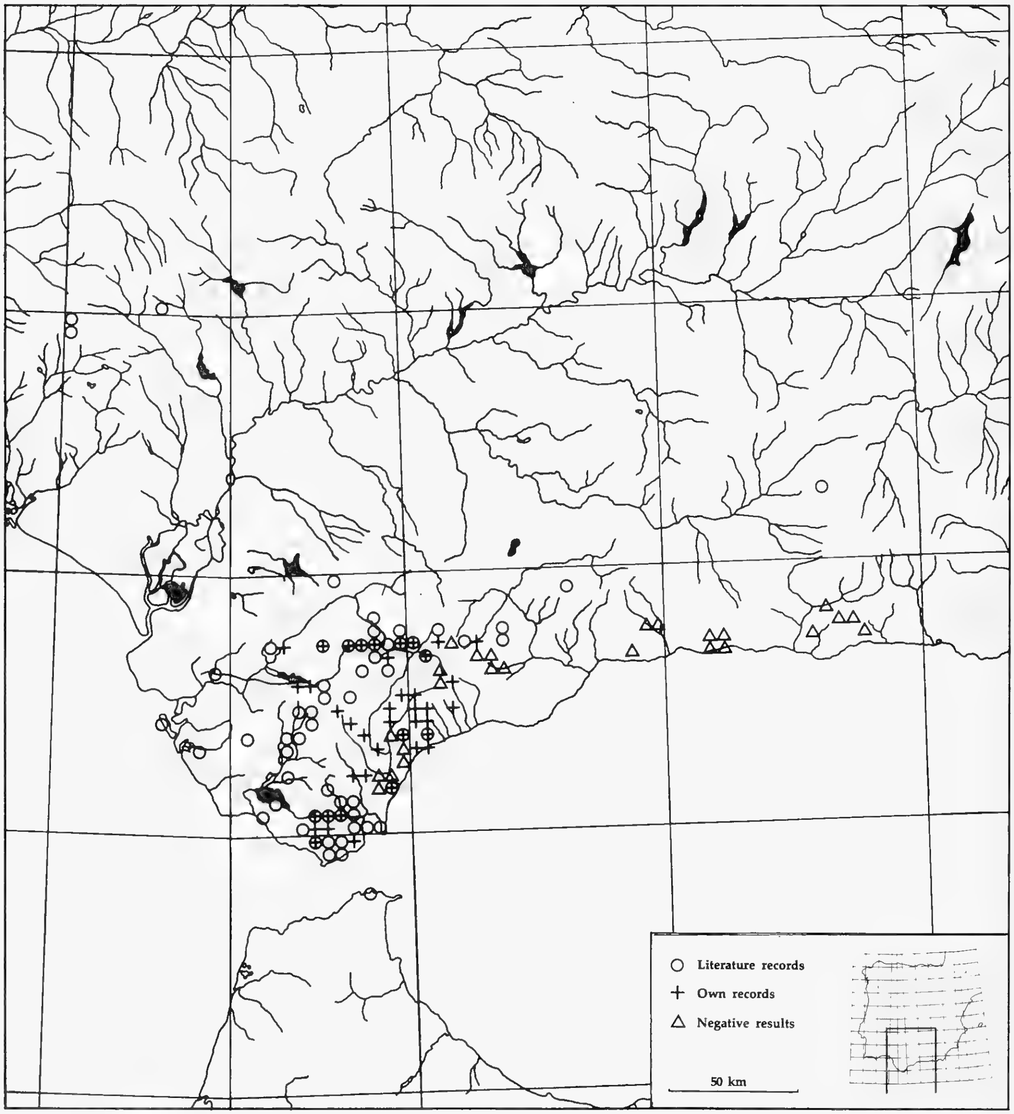

Fig. 1. Distribution map of *Macrothele calpeiana* (Walckenaer) with 5×5 km accuracy on UTM-grid; early record from Algeria indicated.

ves certainly has broadened our knowledge of *Macrothele calpeiana.* Our own investigations affirm and reinforce the distribution pattern which emerges from the literature. But science is exigent and never satisfied. Many questions remain yet unanswered.

In Europe *M. calpeiana* remains restricted to the South of Spain, the region of Andalusia, mainly in the provinces of Cadiz and Malaga. The occurrence in the province of Huelva, based on old and recent records (Blasco & Ferrandez 1986) demonstrates a disjunct distribution with the valley of the Guadalquivir as a possible lowland ecological barrier (open, unshaded, lowland area). The three Huelva records represents the northernmost as well as the westernmost finds so far.

The population to the southeast of the Guadalquivir reaches from Malaga in the East to the City of Cadiz in the West and from 37° North latitude down to Tarifa, the very southern tip of the peninsula. In this region we may call *M. calpeiana* a common species. Our attempts to find the species East of Malaga remained without success. However, Barbara York Main from Nedlands, Western Australia, has found a small population (a juvenile and some cast skins were collected) at Las Nimbres, 1.5 km E of Puento de la Mora, at an elevation of 1390 m, in the Sierra Harana north of Granada (Snazell & Allison 1989: 69; also pers. comm.), which means a considerable eastward extension of the known range. The presently known northern limit of the distribution in the province of Malaga at 37° N does not seem a very natural one at first sight and we may expect new records more to the north.

The three Huelva records indicate the occurrence on at least the southern slopes of the Sierra Morena. This region, the northern halves of the provinces of Huelva, Sevilla and Cordoba probably is undercollected.

Which factors limit the distribution of *M. calpeiana* is not known. The species seems to prefer cover and shade over exposed open soil. From this we may infer that the animal is sensitive to low and high temperature extremes. Humidity may also be a regulating factor. The discovery of populations at higher altitudes, where the temperature will be lower on the average, indicates a fair rate of tolerance. We have found a population at 1100 m in a pine forest, on a south-facing slope on a mountain pass at Puerto de la Boya (36°46′N, 5°24′W; province of Cadiz), and another one at 1180 m on a roadside bank on a north-facing slope on a mountain pass near Puerto del Viento (36°48′N, 5°01′W; province of Malaga). The population established by B. Y. Main at the Sierra Harana at ca 1400 m also proves the ability of *M. calpeiana* to survive under the climatic conditions at high altitudes.

Snazell & Allison (1989) stress the correlation of the distribution of *M. calpeiana* with the area of relatively high rainfall (80-200 cm), warm winters and high summer temperatures. They also link the species firmly to oakwoods with the Cork Oak (*Quercus suber* L.) as dominant species. The Cork Oak has a much wider distribution in Spain and certainly is not restricted to Andalusia. Other parts of Spain than the presently known distribution area of *M. calpeiana*, in particular the southern slopes of the Sierra Morena, have precipitations about as high as the Cadiz-Malaga mountainous region. This supports the hypothesis of a more extensive distribution along these slopes.

Distribution outside Spain

Two records from North Africa indicate a wider distribution South of the Mediterranean Sea. The first is an old record from Algeria, where it was found somewhere in the surroundings of El-Arouch in the province of Constantine (Lucas 1846). Our attempts to locate the original material have failed. According to Lucas the species was not common in that locality, where it was found under stones. The second record is of more recent date. A. Blasco collected a single male in 1981 at Ceuta in Spanish Morocco (Blasco & Ferrandez 1986). Even though these two records are spaced out geographically and in time they are suggestive of a much wider distribution in the West Mediterranean. The mediterranean zone of North Africa is grossly undercollected and hardly anything is known of the Mygalomorphae of that region.

If *M. calpeiana* would be more wide-spread in North Africa, the geographically restricted occurrence in southern Spain would be easier to understand. The restricted presence in Spain would only be a bridgehead on the European continent from a much larger population in North Africa. The Atlas mountains might offer suitable habitats. Further investigation of this region will throw more light on the distribution.

It would not at all be surprising if North Africa harboured a number of *Macrothele* species. The genus now comprises five species in West Africa, *calpeiana* and *cretica* in Europe, and seven more species in India, South-east Asia, China and Taiwan. Most species have been described after one sex only, usually the female, which shows the paucity of available material.

DISCUSSION

M. calpeiana, according to our observations, is not restricted to oak woodland. No undisturbed oak woodlands persist in southern Spain today. All oakwoods, with the Cork Oak (*Quercus suber* L.) as dominant tree species, or mixed woods are the result of human interference through mild exploitation during

Table 3. The ten highest densities of *Macrothele calpeiana* nests counted in plots of approximately 20 m^2 within different types of habitat in Southern Spain. Note the absence of relatively undisturbed Oak forest (maquis) in this ranking.

	type of habitat	location	number of nests per 20 m^2
1	castle wall	Castelar de la Frontera	15
2	rubbish dump	Buenas Noches	15
3	mixed forest	Jubrique	14
4	ruin wall	Ronda	12
5	Cork Oak (cult.)	Casares	9
6	picnic place	Santuaria de la Luz	8
7	picnic place	Arcos de la Frontera	8
8	Cork Oak (cult.)	Jubrique	8
9	Cork Oak (cult.)	La Tienera Vieja	8
10	castle wall	Jimena de la Frontera	8

the long Spanish history. In these semi-natural forests *M. calpeiana* occurs at low densities if compared to other (unnatural) habitats, such as semi-cultivated Cork Oak woodland with the understorey cleared away, rubbish dumps, roadsides and old walls (table 3).

The general impression is that the species benefits from the milder activities of man and makes use of the opportunities thus offered. These observations contradict the opinion expressed by Snazell & Allison (1989: 69), who describe the optimum habitat as undisturbed *Quercus suber* woodland with a light understorey and many large to medium-size stones. Snazell & Allison maintain this view despite the several contrasting opinions and observations by others and reported by themselves in the same publication. We have shown that the population densities outside the Cork Oak woodland are often higher than within. The suggestion of Snazell that *M. calpeiana* is characteristic of undisturbed Cork Oak woodland, and that of Collins & Wells (1987) that it could serve as bioindicator for that type of habitat has herewith become most unlikely.

Apparently the ecological spectrum of this species is very broad. It has been found in a wide variety of habitats. A species which invades new habitats and settles, temporarily or permanently, in man-made habitats is to some extent a culture follower. It is justified to call this species aggressive as to its ecological strategy. Biological strategies, such as the number of offspring, the dispersal of the young, the time and amount of food needed to reach adulthood, and the life-span are unknown so far. It is difficult, if not impossible, to analyse a possible extension of the distribution area in the past. The sequence of the earlier records may be suggestive of a recent colonization of the Iberian Peninsula. However, this is no proof of its speed of dispersal.

Table 4. Average densities of *Macrothele calpeiana* nests counted in plots of appproximately 20 m^2 within five distinguished categories of habitat in Southern Spain.

	distinguished categoriess of habitat	number of counts	average density	max density
1	non-cultivated/non-forested	22	1.4	5
2	relatively undisturbed forest	20	3.0	7
3	cultivated Cork Oak	21	5.8	14
4	unmanaged culture land	33	5.3	15
5	managed culture land	14	0.4	3

Nature conservation aspects

Snazell's earlier report (Snazell 1986) on the distribution, habitat and status of *M. calpeiana* in Spain came under the notice of the IUCN Conservation Monitoring Centre at Cambridge (UK) when compiling a list of invertebrates to be used in the Bern Convention. They placed the species on their provisional list (Collins & Wells 1987) and classified it as 'vulnerable', following Snazell's (1986) description of the species status as 'fairly secure' and 'in no immediate danger' but forseeing as major threat 'the improvement of the woodlands or the spread of housing developments'. In the same year (1987) the species was officially placed on Appendix II. This second appendix lists the endangered species the habitat of which should be protected. Most species listed come from the better known groups, such as Lepidoptera, Coleoptera, Odonata, Mollusca, etc. *Macrothele calpeiana* is the only spider.

In 1991 the Habitat Directive of the European Community has been accepted by the member states. When a country ratifies the Directive it compels itself to take relevant measures for the protection of the listed species and their habitats. *Macrothele calpeiana* is, again, in the appendix to this Directive because the Bern Convention list of Invertebrates served as an example and was copied without any criticism. Spain thus is obliged to protect the habitat of *M. calpeiana* as well as the spider itself. The Habitat Directive, in contrast with the Bern Convention, is obligatory: if a country does not satisfy the set rules it can be summoned before the European Court.

Collins & Wells developed a set of seven criteria for the selection of the species for their list (Collins & Wells 1987). First of all (1) the species should be under serious threat (endangered or vulnerable) or of widespread conservation concern. Since the list is to be used as an appendix to the Convention on the Conservation of European Wildlife and Natural Habitats, generally known as the Bern Convention, (2) the species' range in Europe should not be marginal to a much wider range outside Europe. The Bern Convention has political significance in the first place

Fig. 2. *Macrothele calpeiana* (Walckenaer) on its web

and this has led to the suggestion that (3) the species must be reasonable easy to identify, and preferably familiar to members of the general public. Even though challengeable on evolutionary grounds one can understand that (4) in line with other listings in the Appendices to the Convention only full species should be considered. This is not a criterion, but a practical rule. There are three more criteria which in fact are recommendations of the compilers of the lists for the different appendices: the final selection of species (5) should come from a wide range of habitats, particularly threatened ones, and (6) from a wide variety of phyla and classes, while it should also (7) embrace a wide geographical range.

When judging a single species on the list one has to consider criteria 1 to 3. If we do this with *M. calpeiana*, we easily arrive at the conclusion that the species should not at all be listed in the Bern Convention. We have pointed out that this spider is not under threat, endangered or vulnerable in its relatively small Spanish range of distribution. It is not strictly tied to any specific habitat, but can be found in a wide variety of, often man-made, habitats. We have presented arguments in support of the hypothesis that the species has also a wider distribution outside Europe. Thus we find the first two criteria not applicable to *M. calpeiana*.

Remains the third criterion. *M. calpeiana* is a large, black spider, upto to 7 cm long (legs included), with two conspicuous ‘tails’, the spinnerets, at the end of its abdomen (fig. 2). The general public at the most will know its large web. The animal itself leads a cryptic life in its burrow. It is the only spider of this size, shape and habits that lives in the area and is quite conspicuous when seen (e.g. by the people who manage the oak forests). We already indicated above that this criterion is a political rather than a scientific one. It has practical implications for the enforcement of any directives in relation to the Bern Convention. For a matter so serious as the protection of Invertebrates and their natural habitats, however, this criterion has no meaning.

A species becomes threatened with extinction usually through the activities of man. The threat is aimed either directly at the animal, e.g. by hunting, overfishing or the use of selective biocides; or indirectly through the many drastic changes in the environment, such as extensive drainage schemes, the bringing into cultivation of natural habitats, the use of unselective biocides, the cutting down of forests, the construction of motorways and town-development. In the case of Invertebrates the indirect factors are usually the cause of threat. Stenoecous species with very strict habitat or food requirements are more vulnerable than euryoecous species which can live nearly anywhere. When a habitat is scarce and deteriorates by one of the above influences all species narrowly adapted to that habitat are threatened. If one wishes to protect such a species one has to protect or restore the habitat in general or a site in particular by warding off the threatening forces. It is the general practice in nature conservation legislation to protect a habitat through the species, i.e. the species is named and the law compels that the habitat or site be protected or managed in such a way that the species can survive.

It is a good policy to select a species of which the biology and ecology are well known, the distribution is properly mapped, and the densities measured. It must be feasible to monitor the species and follow the developments and the results of the measures eventually taken. The selection of the species should be based on such (scientific) arguments, not on the possible recognition by the general public. The general public should be interested in the lasting biological diversity in general and support politicians to develop legislation and give priority to nature conservation. The general public must be kept informed in general terms of the progress made. In our view the third criterium should read as follows: 'The species must be taxonomically unambiguous and sufficiently defined as to its biology and ecology. At the same time the reasons for its decline should be fully understood'. Species such as *M. calpeiana* then would not be listed in the Bern Convention.

Future research

As we have pointed out the distribution in Spain is as yet not clearly established, especially in the East and Northwest. Further investigation should focus on these regions, in particular the southern slopes of the Sierra Morena and the Sierra Harana north of Granada, and possibly the Sierra Nevada as well. It would also be an enticing project to investigate the northern countries of Africa, from Morocco to Algeria, or even further to the East. Investigation in this region will throw more light on the distribution of *M. calpeiana.*

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NEW SPECIES AND COUNTRY RECORDS OF BRAZILIAN *CYCLOCEPHALA* (COLEOPTERA: SCARABAEIDAE: DYNASTINAE)

Ratcliffe, B. C., 1992. New species and country records of Brazilian *Cyclocephala* (Coleoptera: Scarabaeidae: Dynastinae). – Tijdschrift voor Entomologie 136: 179-190, figs. 1-34. [ISSN 0040-7496]. Published 1 December 1992.

Nine new species of *Cyclocephala* Latreille are described from Brazil: *C. amplitarsis, C. rondoniana, C. sarpedon,* and *C. schmitzorum* from Rondonia; *C. deltoides* from Para; and *C. iani, C. nodanotherwon, C. pseudoconfusa,* and *C. sarahae* from Amazonas. New country records for Brazil are given for *C. boulardi* Dechambre, *C. guianae* Endrödi, *C. longa* Endrödi, *C. munda* Kirsch, *C. ocellata* Burmeister, and *C. picipes* (Olivier). Finally, the female of *C. panthera* Dechambre is reported for the first time and briefly characterized.

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Key words. – Brazil, Neotropics, *Cyclocephala,* new species, new country records.

In this paper are described new species and records of *Cyclocephala* that I collected during my stay in Brazil from 1976-1978, from collecting trips taken in 1980 and 1991, and from specimens either given or loaned to me in the interim. Each new species has been correlated with the most recent key to the genus provided by Endrödi (1985) in order that the reader might know where they fall out in the key. Appropriate notations can then be made for future reference. The parameres of the males, diagnostic in virtually all cases, are illustrated and accompanied by photo habitus pictures or line drawings to clarify the descriptions of body morphology.

Several new country records are also listed. Although I and a few others have known of these occurrences for several years, they have never been formally placed into the literature. The purpose of listing these records is to provide an enhanced level of reliability concerning identification of taxa that fall outside of the previously published ranges.

Specimens have either been borrowed from or deposited in several collections. These collections are referred to by their four-letter acronyms as published in Arnett and Samuelson (1986) or as indicated here if not in Arnett and Samuelson:

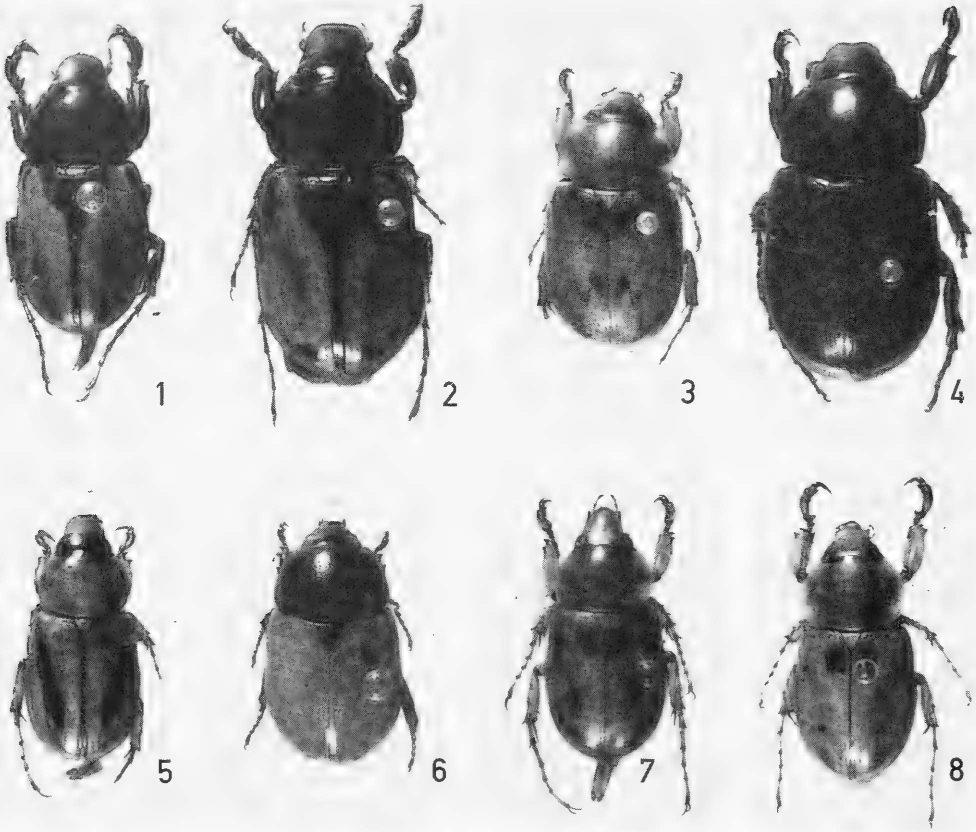
BCRC - Brett C. Ratcliffe, Lincoln, NE, USA; CASC - California Academy of Sciences, San Francisco, CA, USA; DERC - David E. Russell, Davis, CA, USA; HAHC - Henry and Anne Howden, Ottawa, Canada; INPA - Instituto Naçional de Pesquisas da Amazonia, Manaus, Brazil; LGBC - Larry G. Bezark, Sacramento, CA, USA; MAMC - Miguel A. Morón, Xalapa, Mexico; MZSP - Museo de Zoologia da Universidade de São Paulo, Brazil; PKLC - Paul K. Lago, University, MI, USA; UCDC - University of California, Davis, CA, USA; UNSM - University of Nebraska State Museum, Lincoln, NE, USA; USNM - U.S. National Museum, Washington, D. C., USA.

Cyclocephala amplitarsis sp. n.
(figs. 1, 9-12)

Type material. – Holotype ♂, allotype ♀, and eight paratypes labelled: 'BRAZIL: Rondonia, 62 km S. Ariquemes, Faz. Rancho Grande, 10° 32′ S, 62° 48′ W, XI-11-22-1991, B. C. Ratcliffe, taken at light;' 12 paratypes with same data except collected by L. G. Bezark and D. E. Russell; 4 paratypes with same data except 25.xi.1991, S. L. Heydon, Hg-vapor light; 5 additional paratypes with same data except dates of 27-xi-1991 (2), 29-xi-1991 (1), 4-xii-1991 (1), 5-xii-1991 (1); 1 paratype labelled BRASIL: Rondonia, Porto Velho, BR319, km 866, 28-1-1980, Jorge Arias, C.D.C., 6-M (eters); 1 paratype labelled BRASIL: Mato Grosso, Reserva Humboldt, 10° 11′ S, 59° 48′ W, 13-19-VII-1977, B. C. Ratcliffe, taken at light. Holotype and allotype deposited at UNSM. Paratypes deposited at MZSP, CASC, USNM, UNSM, UCDC, DERC, LGBC, and BCRC.

Description

Male holotype (fig. 1). – Length 12.9 mm; width across humeri 5.5 mm. Colour of head, pronotum, scutellum, pygidium, venter, and legs black; elytra testaceous with all margins, spots on humeral and apical umbones, and triangular area behind scutellum black.



Figs. 1-8. *Cyclocephala* spp., habitus of males. – 1, *C. amplitarsis*; 2, *C. deltoides*; 3, *C. iani*; 4, *C. nodanotherwon*; 5, *C. rondoniana*; 6, *C. sarahae*; 7, *C. sarpedon*; 8, *C. schmitzorum*.

Head: Surface moderately densely punctate; punctures on frons and basal half of clypeus small, punctures on apical half of clypeus minute and denser. Clypeus (fig. 9) with sides weakly converging, apex broadly truncate, narrowly reflexed. Interocular width 3.3 transverse eye diameters. Antenna with 10 segments, club subequal to segments 2-7.

Pronotum: Surface with punctation similar to that of frons. Base lacking marginal line. Prosternal process only moderate in length, obtusely rounded at apex.

Elytra: Surface minutely alutaceous, moderately densely punctate; punctures moderately large, shallow, with double rows on disc. Sparse, minute, pale setae present, especially in posterior half.

Pygidium: Surface completely, finely rugulose with sparse, minute, pale setae. In lateral view, surface weakly convex.

Legs: Foretibia bidentate, both teeth close to each other at apex of tibia. Foretarsus (fig. 10) with segment 4 expanded ventrally as a strong tooth; segment 5 greatly expanded for entire length, wider at base than at apex. Claw immensely expanded, subtriangular, apex entire. Posterior tarsus almost twice as long as posterior tibia.

Parameres: figs. 11-12.

Female allotype. – Length 12.6 mm; width across humeri 5.6 mm. As holotype except in the following respects: Head: Clypeus in apical half with punctures not smaller, instead subequal in size to those on rest of head. Elytra: Lateral margin slightly diluted at about middle and with strong, protuberant knob at about level of apical umbone. Pygidium nearly flat in lateral view. Legs: Foretibia tridentate, teeth equally spaced from one another. Foretarsi and claw not enlarged.

Variation. – Males (18 paratypes). Length 12.3-14.0 mm; width across humeri 5.5-5.9 mm. The paratypes do not differ significantly from the holotype.

Females (14 paratypes). – Length 12.1-13.5 mm; width across humeri 5.4-6.1 mm. The females are also remarkably similar to the allotype with no significant differences noted.

Distribution

Cyclocephala amplitarsis is known from primary lowland rainforests in central Rondonia and northwestern Mato Grosso in Brazil. All specimens were taken at lights, and one (collected by Jorge Arias) was taken at a CDC light trap suspended at a height of 6 m.

Remarks

The enlarged foretarsi and claws of *C. amplitarsis* bring to mind *C. longimana* Dechambre, 1980 and *C. tarsalis* Dechambre, 1979, but those species have a bordered pronotum as well as many other different character states. *Cyclocephala amplitarsis* will key only so far as couplet 239 (242) in Endrödi (1985) (if the surface is considered setose, couplet 221/272) where neither choice concerning foretibial teeth fits the clearly bidentate state of this species.

If the elytra are considered to have short setae (latter half of couplet 221/272), then *C. amplitarsis* will go as far as couplet 328/337 where neither choice (concerning tridentate foretibia) is acceptable.

Etymology

From the Latin *amplus*, meaning large and the Greek *tarsor*, meaning flat of the foot; large foot, a noun in apposition in reference to the greatly swollen foretarsi of the male.

Cyclocephala boulardi Dechambre

This species was described from Surinam, and the following *new country record* from Brazil is not surprising in view of the relative affinities between the fauna of northern Brazil and the Guianas.

Brazil: Amazonas, Reserva Ducke, 26 km NE Manaus, 1-xii-1976, B. C. Ratcliffe, at UV light (1 male in BCRC).

Cyclocephala deltoides sp. n.
(figs. 2, 13-15)

Type material. – Holotype ♂ labelled 'BRASIL: Pará, Urua, 65 km SW Itaituba on BR230, X-12-15-1977, B. C. Ratcliffe, habitat: tropical evergreen forest, collected at light.' (UNSM).

Description

Male holotype (fig. 2). – Length 18.0 mm; width across humeri 8.0 mm. Colour of clypeus, pronotum, scutellum, pygidium, legs, and venter piceous; frons black as well as all elytral margins (expanded into broad triangle behind scutellum), elongate spots on humeral and apical umbones, and punctures on elytra. Remainder of elytra testaceous.

Head: Frons and base of clypeus moderately densely punctate; punctures moderate in size. Frontoclypeal suture a distinctly impressed, biarcuate line. Clypeus in apical 2/3 finely and completely roughened; sides barely converging to very broad, truncate apex, apex reflexed. Interocular width 3.0 transverse eye diameters. Antenna 10-segmented, club subequal in length to segments 2-7.

Pronotum: Surface moderately punctate on disc, becoming a little denser on sides; punctures small on disc, becoming moderate in size on sides. Base lacking marginal line. Prosternal process short, mostly obscured by brush of long setae.

Elytra: Surface with moderate to large punctures in striate rows, double rows of punctures distinct; surface, especially posterior half, with minute, moderately dense, reddish brown setae. Pygidium: Surface coarsely shagreened, setigerous; setae reddish brown, minute at base, short on disc and moderately long near apex. In lateral view, surface evenly convex.

Legs: Foretibia bidentate, both teeth close to one another near apex of tibia. Foretarsus with segment 5 (claw segment) greatly expanded for its entire length (fig. 13), wider at base than at apex. Claw of foretarsus enlarged, apex entire. Posterior tarsus about twice as long as posterior tibia.

Parameres: figs. 14-15.

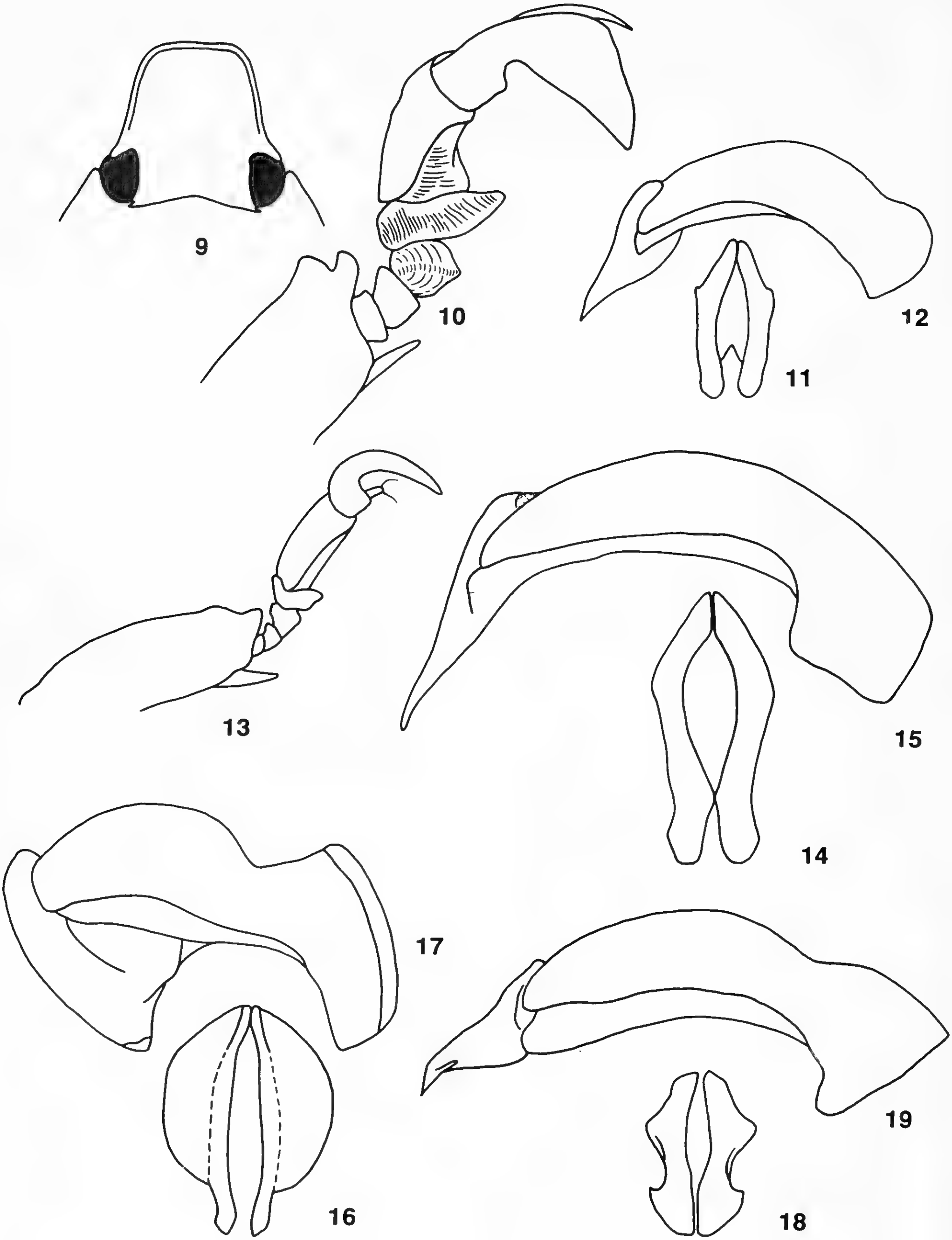
Distribution

Cyclocephala deltoides is known only from the Urua locality in Brazil's Amazon National Park, which was just being established in 1977. It was taken at lights on a road cut in primary lowland rainforest near the end of dry season.

Remarks

Like *Cyclocephala amplitarsis* described elsewhere in this paper, the enlarged foretarsi also resemble *C. longimana* Dechambre and *C. tarsalis* Dechambre, but those species have a margined base of the pronotum as well as other different character states. *Cyclocephala deltoides* most closely resembles *C. amplitarsis* but differs from it in greater body size, smaller size and different form of the foretarsal claw in males, different form to the parameres, tricoloured body (black, piceous, testaceous), larger eyes, longer and denser pygidial setae, and with larger and more distinctive elytral punctures.

If the elytra are considered setose (Endrödi's couplet 221/272), then *C. deltoides* will key only to couplet 239/242 where neither choice of foretibial teeth works. If the choice is made for the second part of couplet 221/272 (species with very short elytral setae), then this species keys to couplet 328/337 where neither choice (concerning tridentate foretibia) works.



Figs. 9-12. *Cyclocephala amplitarsis*. – 9, dorsal view of head; 10, dorsal view of left foretibia and tarsus; 11, 12, caudal and lateral views of parameres; Figs. 13-15. *C. deltoides*. – 13, dorsal view of left foretibia and tarsus; 14, 15, caudal and lateral views of parameres; Figs. 16-17. *C. iani*, caudal and lateral views of parameres; Figs. 18-19. *C. nodanotherwon*, caudal and lateral views of parameres.

Etymology

From the Greek *delta* meaning shaped like a delta or triangle; so named in reference to the large, black, postscutellar mark on the elytra.

Cyclocephala guianae Endrödi

Endrödi described *Cyclocephala guianae* from French Guiana. The records listed below are a *new country record* for Brazil.

Brazil: Amazonas, Reserva Ducke, 26 km NE Manaus, 14-ii-1977, B. C. Ratcliffe, taken at black light (3 males and 2 females in BCRC , 1 female at UNSM); same data but 14-i-1978 and A. Soares collector (1 male at UNSM); same data but 18-vi-1976 and A. Luna Dias collector (1 male at INPA, 1 male at UNSM); same data but 14-i-1978 and L. P. Albuquerque collector (1 female at INPA). Amazonas, 60 km N. Manaus, ZF3, km 23, 9-12-vi-1980, B. C. Ratcliffe (1 male and 2 females in BCRC).

Cyclocephala iani sp. n.

(figs. 3, 16-17)

Type material. – Holotype ♂ and allotype ♀ labelled 'BRASIL: Amazonas, Reserva Campinas, 60 mi N Manaus, II-10-1977, W. W. Benson, ex: *Annona nitida.*' Types deposited at UNSM.

Description

Male holotype (fig. 3). – Length 16.1 mm; width across humeri 8.0 mm. Colour testaceous with black frons and elytral markings; elytral marks consist of large postscutellar spot, small spot just mesad of humeral umbone, a smaller spot behind humerus, and a short, transverse zigzag band just behind middle; clypeus, pygidium, legs, and venter piceous.

Head: Surface of frons moderately densely punctate, punctures moderately large; clypeus densely punctate, punctures mostly moderate in size, surface becoming rugose in narrow band at apex. Clypeus with apex nearly semicircular, margins narrowly reflexed. Interocular width 2.4 transverse eye diameters. Antenna with 10 segments, club subequal in length to segments 2-7.

Pronotum: Surface with disc sparsely punctate, punctures small; sides with punctures moderately dense and moderately large, subequal in size to those of frons. Base without marginal line. Prosternal process long, posterior face at apex flattened.

Elytra: Surface finely alutaceous, moderately densely punctate; punctures large, shallow, double rows weak. Minute, testaceous setae present; setae moderate in density, most apparent on posterior half.

Pygidium: Surface sparsely punctate in centre, becoming denser on sides and rugose in lateral angles; punctures on centre small, becoming large on sides, setigerous; setae minute, testaceous. In lateral view, convexity moderate.

Legs: Foretibia tridentate, basal tooth small and greatly removed from other teeth. Foretarsus enlarged, larger claw with apex finely cleft. Posterior tarsus slightly longer than posterior tibia.

Parameres: figs. 16-17.

Female allotype. – Length 16.5 mm; width across humeri 8.1 mm. As holotype except in the following respects: Head: Frons with punctures sparser, instead only moderate in density; clypeus with surface more generally roughened so punctures not as distinct. Elytra: Lateral margin just behind middle weakly expanded. Pygidium: Surface slightly more flattened, small setae greatly reduced in size and number, barely discernible. Legs: Foretarsi not enlarged.

Distribution

Cyclocephala iani is known only from Reserva Campinas (Instituto Naçional de Pesquisas da Amazonia) north of Manaus. This region is characterized by lowland rainforest mixed with islands and peninsulas of white sand soils (campinas) and associated low vegetation (campinarana). This soil/ vegetation type, known as campinas amazonicas (Anderson et al. 1975), is where the reserve takes its name.

Remarks

In Endrödi (1985), both sexes of *C. iani* will key to *C. undata* (Olivier) in their respective parts of the *Cyclocephala* key (329/330 for males, 297/298 for females). The significant differences between them, however, clearly indicate they are not conspecific. The differences are primarily in the sculpturing of the clypeus, frons, and pronotum and especially in the form of the parameres of the male. The parameres, in fact, most closely resemble those of *C. picipes* (Olivier), but other characters of clypeal shape, surface sculpturing, and colour patterns separate the two.

Etymology

I am pleased to name this species after my youngest son, Ian, who has so faithfully assisted me in the field while collecting beetles.

Cyclocephala longa Endrödi

Endrödi (1963) described this species from Bolivia. The locality data listed below, actually just across the border from Bolivia, is a *new country record.*

Brazil, Rio Branco, 25-vi-1962, Hawarth collector (1 male in BCRC).

Cyclocephala munda Kirsch

Although widely scattered over northern South America (Surinam, Colombia, Peru; Endrödi 1985), *C. munda* has not been recorded from Brazil. The following is a *new country record.*

Brazil: Amazonas, Reserva Campinas, 60 mi N Manaus, 14-i-1977, B. C. Ratcliffe (1 male in BCRC); Amazonas, 15 km SE Barcelos, 14-i-1978, N.D. Penny (1 male in BCRC).

Cyclocephala nodanotherwon sp. n.
(figs. 4, 18-19)

Type material. – Holotype ♂ and allotype ♀ labelled 'BRAZIL: Amazonas, Lago Anama, 160 km WSW Manaus, XI-1981, R. Best.' Single paratype with same data but date of 1-v-1980. Holotype and allotype deposited at UNSM; paratype deposited in BCRC .

Description

Male holotype (fig. 4). – Length 15.6 mm; width across humeri 7.9 mm. Colour reddish brown except for black, triangular area mesad of each eye on frons.

Head: Surface finely alutaceous, moderately punctate; punctures moderate in size, shallow. Frontoclypeal suture distinct, weakly arcuate. Clypeus with apex broadly and deeply emarginate, narrowly reflexed. Interocular width 4.6 transverse eye diameters. Antenna 10-segmented, club subequal to segments 2-7.

Pronotum: Surface finely alutaceous, moderately punctate, punctures becoming denser on sides; punctures moderate in size, shallow, becoming a little larger and deeper on sides. Base without marginal line. Prosternal process long, apex flattened in posterior half.

Elytra: Surface finely alutaceous, moderately densely punctate; punctures moderately large, shallow, with 2 pair of double rows on disc; punctures in posterior fourth with minute setae.

Pygidium: Surface moderately densely punctate; punctures mostly large, shallow, setigerous; setae pale, minute. In lateral view, surface evenly convex.

Legs: Foretibia tridentate, basal tooth very small, well separated from other teeth. Foretarsus with 1 claw strongly enlarged, apex finely cleft, smaller ramus not widely diverging. Posterior tarsus about 1/3 longer than posterior tibia.

Parameres: figs. 18-19.

Female allotype. – Length 15.8 mm; width across humeri 7.9 mm. As holotype except in the following respects: Colour of elytra light reddish brown. Head: Clypeus with apex a little less emarginate. Pronotum: Punctures sparse on disc to moderate in density on sides. Elytra: Discal rows of punctures not distinct. Sparse setae near apices long. Lateral margin slightly expanded just behind middle with strongly expanded lateral flange just behind this. Pygidium: Sparse setae long. Convexity, in lateral view, weak. Legs: Claw of foretarsus not enlarged.

Variation. – Male (1 paratype). Length 16.2 mm; width across humeri 8.2 mm. Head: Surface a little more densely punctate. Clypeus with apex a little less emarginate. Elytra: Setae near apices short, distinct. Pygidium: Setae moderately dense, short to moderately long.

Distribution

Cyclocephala nodanotherwon is known only from Lake Anama WSW of Manaus.

Remarks

This species will key to either couplet 298 (*C. gravis* Bates) or 306 (*C. munda* Kirsch) in Endrödi (1985) depending on the interpretation of the degree of punctation on the pronotum (couplet 299). In either case, however, neither the parameres, vestiture, or surface sculpturing conforms to that of *C. nodanotherwon.*

The examples of this new species were collected by Robin Best (deceased), a colleague of mine at Brazil's National Institute of Amazonian Research (INPA), while conducting research on manatees at Lago Anama.

Etymology

This new species name is the result of an arbitrary combination of letters (hence, treated as an indeclinable noun) and results in a species name not inappropriate in such a large genus.

Cyclocephala ocellata Burmeister

Known previously from Ecuador and Peru (Endrödi 1985) and French Guiana (Dechambre, 1979), the following represents a *new country record.*

Brazil: Amazonas, 46 km N Manaus, 1-29-viii-1979, H. M. Savage (1 female in BCRC).

Cyclocephala panthera Dechambre

Dechambre (1979) described this distinctively marked species from a single male specimen taken in Para State, Brazil. I report here ten additional specimens from the Canadian National Collection of Insects that verify the valid status of Dechambre's species. The specimens (six males, three females) are labelled BRAZIL: Distrito Federal, Estacion Florestal Cabeca do Veado, 1100 m, 13-27 Oct. 1971, E. G., I. & E. A. Munroe.

The previously unknown females have the elytral margin in the posterior third slightly (but distinctly) thickened. In Endrödi's (1985) key to female *Cyclocephala*, it will key as far as couplet 261. Couplet 262 should be modified as follows:

262 (263) Surface bare.

262a. Head and pronotum piceous, elytra with variable pattern (Figs. 270, 273). Guyana, Peru, Brazil (Amazonas), Bolivia............. ....*pugnax* Arrow

262 b. Head with frons only black, pronotum and elytra with distinct pattern. Central Brazil.......................*panthera* Dechambre

Cyclocephala picipes (Olivier)

Previously known from French Guiana (Endrödi 1985), the following constitute a *new country record.* Brazil: Amazonas, Reserva Campinas, 60 km N Manaus, 15-i-1977 (1 male) and 18-i-1978 (1 female), B. C. Ratcliffe (both in BCRC).

Cyclocephala pseudoconfusa sp. n.
(figs. 20-24)

Type material. – Holotype ♂, allotype ♀, and two paratypes labelled 'BRASIL: Amazonas, Reserva Campinas, 60 km N Manaus, XI-22-1976, B. C. Ratcliffe.' Holotype and allotype deposited at UNSM. Paratypes deposited in BCRC .

Description

Male holotype. – Length 9.4 mm; width across humeri 4.8 mm. Body form short, oval. Colour testaceous except for black frons.

Head: Surface of frons coarsely alutaceous with moderately dense and moderately large punctures. Clypeus with similar punctation mostly obscured by surface roughness; sides subparallel, apex broadly truncate, narrowly reflexed (fig. 20). Interocular width 2.15 transverse eye diameters. Antenna 10-segmented, club subequal to segments 2-7.

Pronotum: Surface finely alutaceous with punctures moderate in density; punctures moderate in size along midline, becoming moderately large on disc and sides. Base without marginal bead. Prosternal process long, posterior face at apex flattened.

Elytra: Surface finely alutaceous with moderate to large, shallow punctures, double rows of punctures almost indistinct.

Pygidium: Surface densely punctate, punctures small. In lateral view, pygidium evenly convex.

Legs: Foretibia (fig. 21) tridentate, basal tooth slightly removed from other teeth. Claw of foretarsus with apex deeply split (fig. 22). Posterior tarsus subequal in length to posterior tibia.

Parameres: figs. 23-24.

Female allotype. – Length 10.6 mm; width across humeri 5.2 mm. As holotype except in the following respects: Elytra: Lateral margin slightly expanded just behind middle. Pygidium: Surface weakly convex, nearly flat. Legs: Foretarsus with claw not enlarged.

Variation. – Males (2 paratypes). Length 11.1-12.0 mm; width across humeri 5.5-5.8 mm. The paratypes do not differ appreciably from the holotype.

Distribution

Cyclocephala pseudoconfusa is known only from the type locality north of Manaus. This is an area of white sand soils (campinas) that occur in peninsulas or patches. This particular soil/vegetation type was characterized by Anderson et al. (1975).

Remarks

This small, oval species will key as far as couplet 405 (404) in Endrödi (1985) which is *C. confusa* Endrödi. While fitting in all respects to the characters listed in the couplet, the parameres are vastly different. The same can also be said for the similarity in external characters with *C. perconfusa* Dechambre, 1992. These three species should cluster together in any key and be separable only by the form of the parameres in the males and the presence or absence of an expanded elytral margin in females (margin simple in *C. perconfusa*, with slight expansion in *C. confusa* and *C. pseudoconfusa*).

Etymology

From the Greek *pseudes*, meaning false, i.e., the false *C. confusa.*

Cyclocephala rondoniana sp. n.
(figs. 5, 25-26)

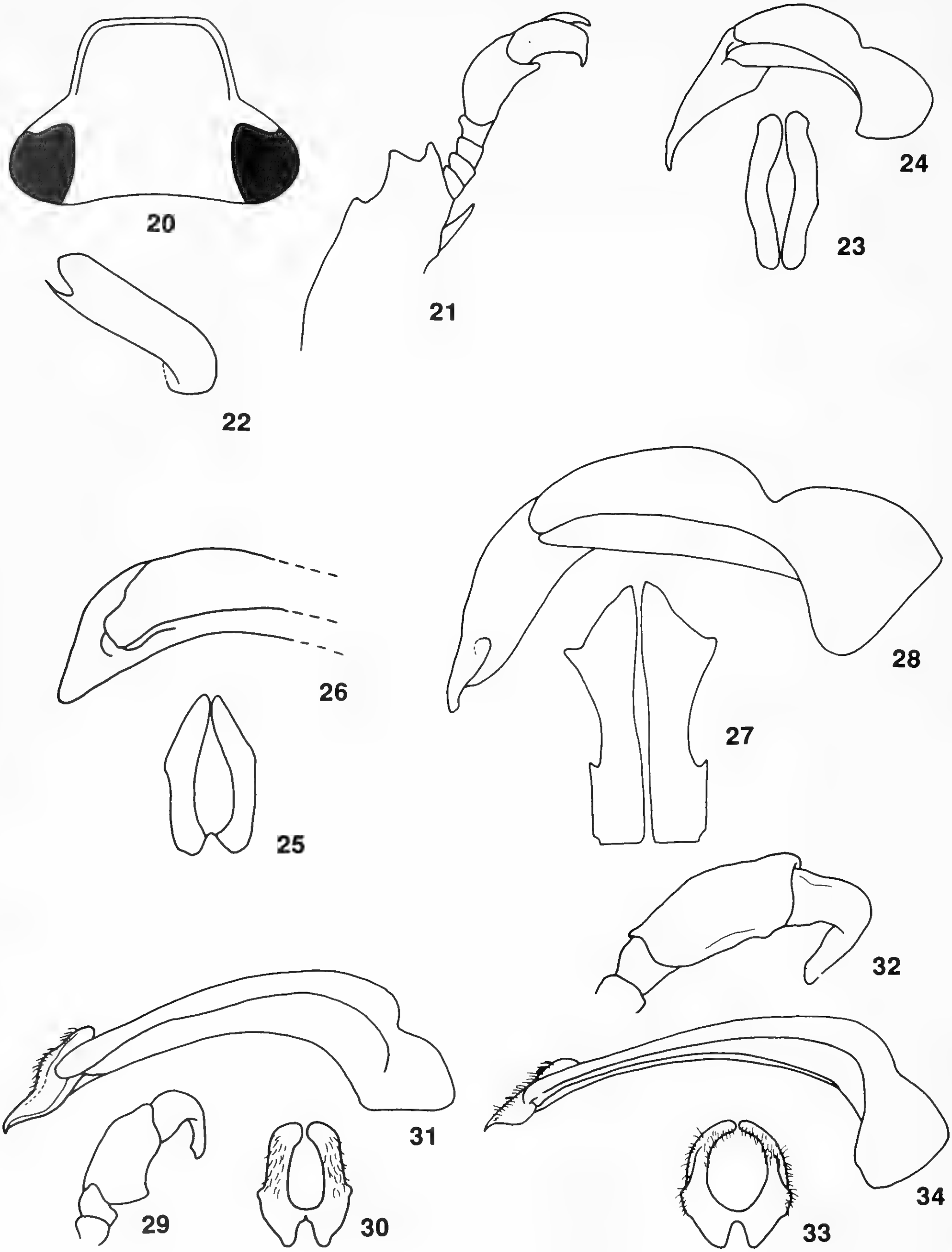
Type material. – Holotype ♂, allotype ♀, and one paratype labelled 'BRASIL: Rondonia, 62 km S. Ariquemes, Faz. Rancho Grande, 10° 32′ S, 62° 48′ W, XI-11-22-1991, B. C. Ratcliffe, collected at light.' Additional paratype with same data and date of 12-22-XI-1991 and collected by L. G. Bezark and D. E. Russell, Hg vapor light. Holotype and allotype deposited at UNSM. Paratypes deposited in LGBC and BCRC.

Description

Male holotype (fig. 5). – Length 9.1 mm; width across humeri 4.0 mm. Colour testaceous except for black frons, small spot on side of pronotum at middle, oblique elytral vitta, sutural margin of elytra, and base of elytra for short distance either side of scutellum.

Head: Surface finely alutaceous, moderately punctate; punctures small, becoming slightly less distinct toward apex of clypeus. Frontoclypeal suture impressed, arcuate. Clypeus with anterior angles rounded, apex truncate, margins thickened and reflexed. Interocular width 3.0 transverse eye diameters. Antenna with 10 segments, club subequal in length to segments 2-7.

Pronotum: Surface finely and weakly alutaceous, sparsely punctate on disc, punctures small; punctures



Figs. 20-24. *Cyclocephala pseudoconfusa*. – 20, dorsal view of head; 21, dorsal view of left foretibia and tarsus; 22, large ramus of left foreclaw; 23, 24, caudal and lateral views of parameres; Figs. 25-26, *C. rondoniana*, caudal and lateral views of parameres; Figs. 27-28, *C. sarahae*, caudal and lateral views of parameres; Figs. 29-31, *C. sarpedon*. – 29, dorsal view of left foretarsus; 30, 31, caudal and lateral views of parameres; Figs. 32-34. *C. schmitzorum*. – 32, dorsal view of left foretarsus; 33, 34, caudal and lateral views of parameres.

becoming slightly larger and denser on sides. Base with complete marginal line. Prosternal process short, apex simply rounded.

Elytra: Surface finely alutaceous, punctate; punctures moderate in density, small, shallow (often indistinct), some setigerous; setae sparse, small, stout, reddish brown. Double rows not evident.

Pygidium: Surface minutely shagreened, moderately punctate; punctures small, shallow to indistinct. Sparse setae present at base. In lateral view, surface regularly convex.

Legs: Foretibia tridentate, basal tooth simply a weak angulation, teeth subequally spaced. Foretarsus enlarged, large claw with apex entire. Posterior tarsus twice as long as posterior tibia.

Parameres: figs. 25-26.

Female allotype. – Length 8.7 mm; width across humeri 3.8 mm. As holotype except in the following respects: The black, elytral vitta reduced to 2 weakly connected, elongate spots. Head: Punctures strong and distinct over entire surface. Elytra: Punctures distinct. Margin slightly expanded at middle. Pygidium: In lateral view, surface nearly flat. Legs: Foretibia distinctly tridentate, teeth subequally spaced. Foretarsus and claw not enlarged.

Variation. – Females (2). Length 8.8 mm each; width across humeri 3.9 mm each. Except for the elytral markings being reduced to 2 small, separate spots, the females do not vary significantly from the allotype.

Distribution

Cyclocephala rondoniana is known only from the lowland rainforests on the Schmitz farm in Rondonia, Brazil.

Remarks

This species will key only so far as couplet 203 (202) in Endrödi (1985), after which nothing fits. The parameres appear closest to *C. quadripunctata* Höhne and *C. peruana* Endrödi, but those species lack a marginal line on the base of the pronotum. The oblique line on the elytra of the holotype is distinctive although this is reduced to two spots in the three females.

Etymology

The proper name of the territory of Rondonia has been converted into a noun in the genitive to indicate 'of Rondonia.'

Cyclocephala sarahae sp. n.
(figs. 6, 27-28)

Type material. – Holotype ♂, allotype ♀ and single paratype labelled 'BRASIL: Amazonas, Rio Demeni nr. equator, IV-10-1978, L. R. Lacey.' Holotype and allotype deposited at UNSM; paratype deposited in BCRC .

Description

Male holotype (fig. 6). – Length 11.4 mm; width across humeri 6.2 mm. Colour reddish brown except for black frons and testaceous elytra. Form short, oval.

Head: Surface of frons moderately punctate (more so in anterior half); punctures moderate in size, deep. Frontoclypeal suture distinct, sinuate. Clypeus with surface transversely rugopunctate; sides convergent to broad, subtruncate apex, apex reflexed. Interocular width 2.25 transverse eye diameters. Antenna 10-segmented, club a little longer than segments 2-7.

Pronotum: Surface moderately punctate, becoming densely punctate on sides; punctures deep, moderately large on disc, becoming large on sides. Posterior angles broadly rounded. Base without marginal line. Prosternal process long, flattened at apex on posterior half.

Elytra: Surface with large, shallow, umbilicate punctures; punctures not in distinct rows, surface between punctures minutely alutaceous and shining.

Pygidium: Surface similar to that of pronotum with moderately dense and moderately large punctures on disc, punctures becoming denser and larger on sides and base. In lateral view, pygidium strongly convex.

Legs: Foretibia tridentate, basal tooth distinctly removed from others. Foretarsus with 1 claw strongly enlarged, apex finely cleft; smaller ramus of claw not widely divergent from larger ramus. Posterior tarsus short, subequal in length to posterior tibia.

Parameres: figs. 27-28.

Female allotype. – Length 13.5 mm; width across humeri 7.4 mm. As holotype except in the following respects: Head: Frontoclypeal suture broader, deeper. Clypeus with surface more coarsely rugopunctate. Elytra: Lateral margin barely expanded at about middle. Pygidium: Surface densely punctate on disc, becoming rugopunctate on base and sides. Convexity weak. Foretarsus with claw not enlarged.

Variation. – Male (1 paratype). Length 10.3 mm; width across humeri 5.6 mm. The single paratype does not differ appreciably from the holotype.

Distribution

Cyclocephala sarahae is known only from the 'type locality' on the Rio Demini north of Barcelos (a tributary of the Rio Negro above Manaus).

Remarks

This species is externally similar to *C. bicolor* Castelnau (couplet 408/409 in Endrödi, 1985) except that the large foretarsal claw is finely split in *C.*

sarahae and broadly split in *C. bicolor*. The parameres are also vastly different; in fact, no known species of *Cyclocephala* has parameres even remotely resembling those of *C. sarahae*. *Cyclocephala sarahae* will key as far as couplet 404/405 in Endrödi (1985) which is *C. testacea* ab. *ovulum* Bates. *Cyclocephala testacea* ab. *ovulum* has much simpler parameres, has the basal tooth of the foretibia barely separated from the others, and is not distinctly bicoloured as in *C. sarahae*.

This new species was collected by a colleague, Larry Lacey, while we were both working for Brazil's National Institute for Amazonian Research (INPA). During a boat trip upriver by Lacey, periodic stops were made to spend the night, hence the imprecise locality information.

Etymology

I am pleased to name this species after my daughter, Sarah, who, even though she was not quite three years old at the time, nevertheless helped me to collect Amazonian insects during our stay in Brazil.

Cyclocephala sarpedon sp. n.

(figs. 7, 29-31)

Type material. – Holotype ♂, allotype ♀, and 13 paratypes labelled 'BRASIL: Rondonia, 62 km S. Ariquemes, Faz. Rancho Grande, 10° 32′ S, 62° 48′ W, XI-11-22-1991, B. C. Ratcliffe, collected at light.' Additional paratypes with same data (18) except collected by L. G. Bezark and D. E. Russell and BRASIL: Mato Grosso, Reserva Humboldt, 10° 11′ S, 59° 48′ W, 16-22-III-1977, B. C. Ratcliffe, collected at light (4); Venezuela: Aragua, Rancho Grande, 20-VII-1986, R. S. Miller colr. (1); Suriname, Raleigh Falls, 25-27-VII-75, Coll: D. Engleman, collected at lights (1). Holotype and allotype deposited at UNSM. Paratypes at CASC, MZSP, UCDC, UNSM, USNM, PKLC, DERC, LGBC, HAHC, MAMC, and BCRC .

Description

Male holotype (fig. 7). – Length 11.7 mm; width across humeri 5.0 mm. Colour testaceous with piceous tarsi and 3 small, black elytral spots (1 behind humerus, a larger, oblique, elongate spot mesad of that, and 1 in centre of elytron behind middle).

Head: Surface minutely alutaceous, moderately densely punctate; punctures small, becoming smaller and denser at clypeal apex. Clypeus with apex narrowly parabolic, reflexed. Interocular width 3.0 transverse eye diameters. Antenna with 10 segments, club subequal in length to segments 2-7.

Pronotum: Surface similar to that of frons except punctures slightly larger and sparser on disc. Base with marginal line. Prosternal process short, conical.

Elytra: Surface with moderately dense, large, very shallow punctures, double rows on disc barely evident; a few, short, pale setae present on apical half in barely discernible rows.

Pygidium: Surface roughened with moderately dense, short, reddish brown setae. In lateral view, surface convex.

Legs: Foretibia bidentate. Foretarsus expanded in size, claw bearing segment greatly enlarged at base on medial surface (fig. 29), larger claw with apex entire but bearing small tubercle subapically. Posterior tarsi about 1.8 times longer than posterior tibia. Meso- and metatibia with stout (not bristle-like) setae.

Parameres: figs. 30-31.

Female allotype. – Length 11.0 mm; width across humerus 4.8 mm. As holotype except in the following respects: Flared region of elytral margin black. Head: Punctures slightly larger and denser. Elytra: Lateral margin expanded just behind middle. Pygidium: Surface glabrous, less convex. Legs: Foretibia tridentate, basal tooth only a weak angulation, all teeth subequally spaced from one another.

Variation. – Males (13). Length 10.7-12.3 mm; width across humeri 4.8-5.2 mm. The paratypes are all similar to the holotype except that the size of the elytral spots varies slightly (1 example with spots nearly obsolete), and the Surinam specimen has the clypeal apex a little less narrowly rounded.

Females. (23). – Length 11.0-12.8 mm; width across humeri 4.8-5.5 mm. The female paratypes do not differ significantly from the allotype.

Distribution

Cyclocephala sarpedon is known from the lowland rain-forests of central Rondonia and northwestern Mato Grosso states in Brazil and from north-central Surinam and north-central Venezuela. All specimens were collected at lights.

Remarks

The specimens of the type series are remarkably consistent in expression of their character states. The narrowly parabolic clypeal apex, bidentate tibia, and the form of the male parameres are diagnostic for this species. It is very close in appearance to *C. schmitzorum*, but the size is generally smaller, the parameres differ in shape (usually difficult to see due to dense setae on the parameres), and the males have the fifth tarsomere greatly expanded at the base medially (fig. 29). Like *C. schmitzorum*, this species will key only so far as couplet 193 (196) in Endrödi (1985) where, after that, character states no longer fit.

Etymology

Named after Sarpedon, a son of Zeus and Europa and king of Lycia who was killed in the Trojan War ... and also because it was the very first epithet in a scientific name (*Graphium sarpedon*) that I learned as a boy. I've liked the *sound* of that word ever since.

Cyclocephala schmitzorum sp. n.
(figs. 8, 32-34)

Type material. – Holotype ♂, allotype ♀, and 5 paratypes labelled 'BRASIL: Rondonia, 62 km S. Ariquemes, Faz. Rancho Grande, 10° 32′ S, 62° 48′ W, XI-11-22-1991, B. C. Ratcliffe, collected at light.' Five additional paratypes with same data except collected by L. G. Bezark and D. E. Russell, and Brasil: Amazonas, Reserva Ducke, 26 km NE Manaus, 11-xi-1976, B. C. Ratcliffe (1); Suriname, Raleigh Falls, 25-27-vii-1975, Coll: D. Engleman (1). Holotype and allotype deposited at UNSM. Paratypes at USNM, CASC, DERC, and BCRC .

Description

Male holotype (fig. 8). – Length 13.1 mm; width across humeri 5.8 mm. Colour testaceous with piceous tarsi and small, black elytral spots (1 behind humerus, a smaller one mesad of that, and 1 in centre of elytron just behind middle).

Head: Surface minutely alutaceous, moderately densely punctate; punctures small, becoming smaller and denser at clypeal apex. Clypeus with apex narrowly parabolic, reflexed. Interocular width 3.0 transverse eye diameters. Antenna with 10 segments, club subequal in length to segments 2-7.

Pronotum: Surface similar in sculpturing to frons, punctures a little sparser on disc, becoming a little larger and denser in posterior angles. Base with complete marginal line. Prosternal process short, conical.

Elytra: Surface with moderately dense, large, shallow punctures, double rows on disc evident; 6 rows of setae present (1 sutural row, 2 rows on disc, 2 on side, 1 on lateral margin); setae short, stout (almost bristle-like), reddish brown, sparse.

Pygidium: Surface completely roughened, with moderately dense punctures; punctures small, setigerous; setae dense, long, reddish brown. In lateral view, surface weakly convex.

Legs: Foretibia bidentate. Foretarsus expanded in size (fig. 32), larger claw not split at apex. Posterior tarsi about 1.6 times longer than posterior tibia. Meso- and metatibia with bristle-like setae.

Parameres: figs. 33-34.

Female allotype. – Length 13.2 mm; width across humeri 6.0 mm. As holotype except in the following respects: Expanded region of elytral margin is black. Elytra: Only a few setae present in apical half, rows absent. Lateral margin dilated at level of first sternite with swollen tumosity on side just above margin. Pygidium: Surface glabrous. Legs: Foretibia tridentate, basal tooth only a weak angulation, all teeth subequally spaced from one another.

Variation. – Males (5). Length 11.2-13.2 mm; width across humeri 5.4-6.2 mm. The male paratypes do not differ significantly from the holotype. One specimen has the elytral setae reduced or abraded away on the anterior half.

Females (2). – Length 12.0-12.9 mm; width across humeri 5.8-6.0 mm. The female paratypes are similar to the allotype.

Distribution

Cyclocephala schmitzorum is known from primary lowland rainforests in central Rondonia and by a single specimen each from near Manaus, Brazil and north central Surinam. All specimens were taken at lights.

Remarks

Although apparently subject to some abrasion, the presence of almost bristle-like setae in rows on the elytra in combination with the narrowly parabolic clypeal apex, bidentate tibia in the male, and form of the parameres will distinguish this species. It is very close in overall appearance to *C. sarpedon*, but the size is slightly larger, the parameres differ (often difficult to see due to the dense pilosity on the parameres), and the enlarged claw joint in the males is not flared at the base (fig. 32). If the elytral surface is considered setose (couplet 183/174 in Endrödi 1985), then it will key to couplet 193 (196) and no further.

Etymology

I take great pleasure in naming this species after Harald, Barbara, Tomás, Uta, and Aike Schmitz of the Fazenda Rancho Grande in Rondonia, Brazil. Their efforts to preserve rainforest habitat and to encourage entomological explorations on their ranch not only brought to light this new species but also serves as a shining example of benevolent stewardship of tropical biota.

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RESUMO

Nove novas especies de *Cyclocephala* do Brasil são descritas. Estas são *C. amplitarsis*, *C. rondoniana*, *C. sarpedon*, e *C. schmitzorum* da Rondônia; *C. deltoides* do Pará; e *C. iani*, *C. nodanotherwon*, *C. pseudoconfusa*, e *C. sarahae* do Amazonas. Novos registros no Brasil são *C. boulardi* Dechambre, *C. guianae* Endrödi, *C. longa* Endrödi, *C. munda* Kirsch, *C. ocellata* Burmeister, e *C. picipes* (Olivier). Finalmente, a fêmea de *C. panthera* Dechambre é relatada pela primeira vez e caracterizada brevemente.

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REVISION OF THE GENERA *EUCHROMIUS* GUENÉE AND *MIYAKEA* MARUMO (LEPIDOPTERA: CRAMBIDAE: CRAMBINAE)

Schouten, R. T. A., 1992. Revision of the genera *Euchromius* Guenée and *Miyakea* Marumo (Lepidoptera: Crambidae: Crambinae). – Tijdschrift voor Entomologie 135: 191-274, figs. 1-198. [ISSN 0040-7496]. Published 1 December 1992.

The Palaearctic, Nearctic, Neotropical, Oriental and Australian species of the genus *Euchromius* Guenée, 1845 are revised. *Euchromius* is a senior synonym of *Pseudoancylolomia* Ahmad, Zaidi & Kamaluddin, 1982. Four new species are described: *E. circulus* (Burma), *E. confusus* (Afghanistan, Iran, Tadzhikistan), *E. minutus* (Brazil) and *E. ornatus* (India). The following synonymies are established: *E. pulverosus* (Christoph, 1887) is a senior synonym of *E. cochlearellus* (Amsel, 1949). *Pseudoancylolomia qadrii* Ahmad, Zaidi & Kamaluddin, 1982 is a junior synonym of *E. ocelleus* (Haworth, 1811). *E. viettei* Bleszynski, 1961 is a senior synonym of *E. karsholti* Ganev, 1987. The genus *Miyakea* Marumo, 1933 is revised, *M. sinevi* sp. n. (Mongolia) is described and *M. raddeellus* (Caradja, 1910) is reinstated as a valid species. *E. lushanus* Inoue, 1989 is transferred to *Miyakea*. *E. delicatalis* (Hampson, 1919) is transferred to the genus *Aurotalis* Bleszynski, 1970. A key is provided together with full (re)descriptions of all species, with notes on distribution and biology.

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Keywords. – Pyralidae; Crambinae; *Euchromius; Miyakea;* key; new species; checklist; tympanal organs.

The classification of the Pyralidae has been subjected to several changes during the last two decades. In the present paper the genera *Euchromius* Guenée, 1845 and *Miyakea* Marumo, 1933 are treated as belonging to the subfamily Crambinae of the Crambidae, regarding all 'pyralids' at superfamily level as proposed by Minet (1982, 1991) and confirmed by Solis & Mitter (1992).

The taxonomic position of *Euchromius* and *Miyakea* has never been the subject of much discussion. These taxa have always been placed in the Crambinae. Zeller (1863) subdivided the Crambinae as 'Crambos' and 'Chilones'. Bleszynski (1965) treated *Euchromius* and *Miyakea* close to *Metaeuchromius* Bleszynski, 1960, *Pseudargyria* Okano, 1962 and *Eschata* Walker, 1856. Gaskin (1975) redefined the tribus Crambini and erected the subtribus Crambina and Corynophorina with *Euchromius* included in the subtribus Crambina. Most of these subdivisions within the Crambinae are, however, ill-defined and still little understood.

This paper provides the revision of all species of the genera *Euchromius* and *Miyakea* are easily recognized within the Crambinae by their yellow medial fascia and the terminal black dots on the forewing. *Euchromius* has a worldwide distribution with the exception of Indonesia, the Philippines and the islands in the Pacific, while *Miyakea* is restricted to the eastern Palaeartic. Most species of *Miyakea* are known from a few specimens and a few localities only, probably since very few collectors have visited China and surrounding countries.

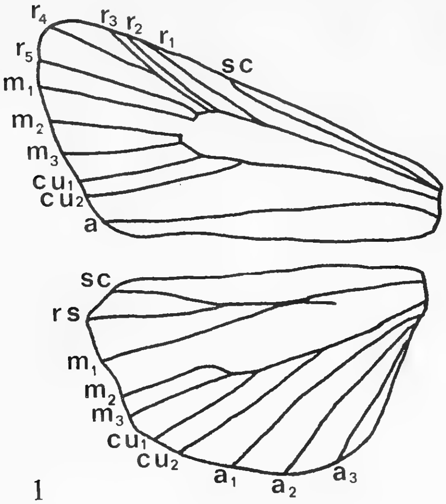
Euchromius and *Miyakea* are very similar in external characters. As a consequence, several species of *Miyakea* have been included erroneously in *Euchromius*. In this paper a new set of distinguishing characters is given.

For more information on the taxonomic history, distribution and biology of the genera I refer to the generic description.

MATERIAL AND METHODS

In the species descriptions the statement, 'labial palp two' stands for: the length of the labial palp is twice the diameter of the eye. The formula for the black terminal dots mentioned in the species descriptions is read as follows; 2-2-3-2 stands for: the black terminal dots closest to the apex start with a group of two, followed by a second group of two dots, a group of three dots and finally a group of two dots near the tornus (fig. 7).

Holotypes and lectotypes are referred to in both



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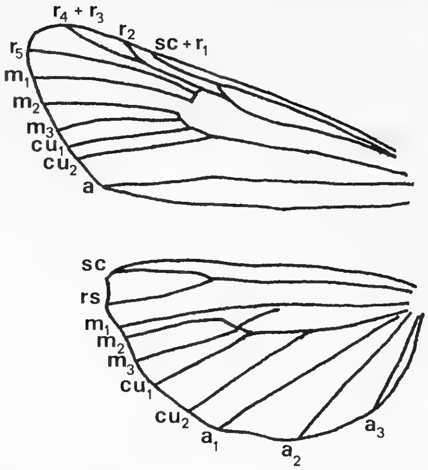

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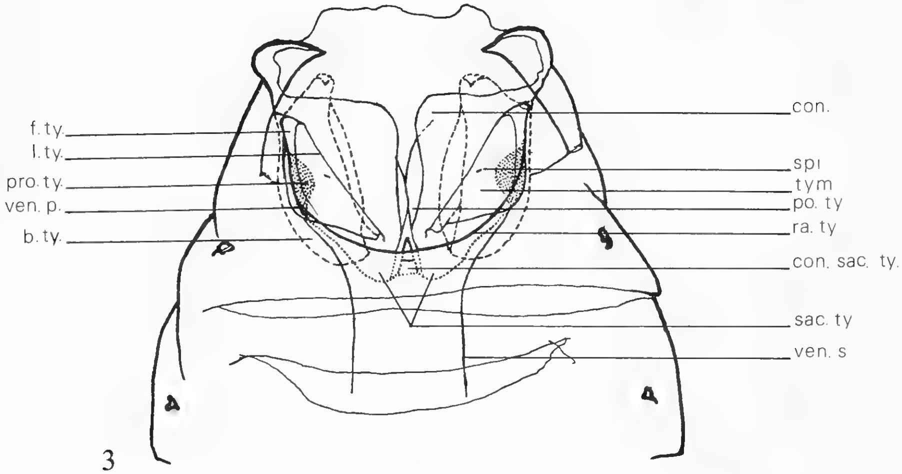

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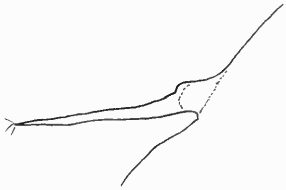

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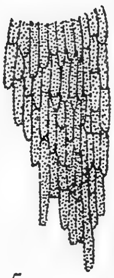

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Figs. 1-6. Morphological characters. – 1, venation in *Euchromius*; 2, venation in *Aurotalis delicatalis*; 3, tympanal organs in *Euchromius*. Abbreviations, b. ty. = bulla tympani; con. = conjunctivum; con. sac. ty. = conjunctivum saccus tympani; f. ty. = fornix tympani; l. ty. = ligna tympani; po. ty. = pons tympani; pro. ty. = processus tympani; ra. ty. = ramus tympani; sac. ty. = saccus tympani; spi. = spinula; tym. = tympanum; ven. p. = venula prima; ven. s. = venula secunda; 4, spinula in *Euchromius*; 5, tegula, evenly mottled, no dark patch; 6, tegula with dark patch in the middle.

the synonymy list and the paragraph 'material'. The spelling of the localities is taken literally from the labels to make tracing of the material easier. For Chinese material the Pinyin transcription is given.

Distribution maps are based on personally examined material only, except for *E. ocelleus*, where the North-European localities are mostly based on reliable literature references.

The sequence of the species followed here is based on overall similarity. No phylogenetic conclusions should be drawn from this sequence. The species of *Euchromius* which were revised and (re)described recently (Schouten 1988, 1990) are only briefly treated, but when available, new information has been added.

Dissections

Dissections and mounting of the genitalia, abdomina and tympanal organs were carried out in the way described by Robinson (1976) with some adjustments. The abdomen is completely separated from the thorax, taking care not to disrupt the tympanal organs. Then, the abdomen is macerated for three minutes in a KOH 10% solution at 100° Celsius and transferred to ethanol 70% for cleaning. Snipe feathers are used to descale the abdomen and micro-pins mounted into a match are used to remove remaining tissue. Genitalia are separated from the abdomen by cutting the posterior membrane of tergite and sternite VIII. The aedeagus of the male genitalia is separated from the anellus and treated separately. After staining with Chlorozol Black 1% (diluted in 70% ethanol), abdomen and genitalia are fixated in 96% ethanol. Male genitalia are fixated with the valvae spread. Abdomen and genitalia are preserved in Euparal together on one slide, but under separate cover-slips. The abdomen is placed under an elevated cover-slip to avoid accidental flattening of the tympanal organs. Since the Euparal essence will slowly evaporate, a vacuum underneath the coverslip may occur and airbubbles can arise, which can be avoided by putting the slide in a stove at 40 °C for three days. The edges of the coverslip are then sealed off with transparent nail-polish.

Distortions caused by manipulations during the preparation of the genitalia or by pressure of the coverslip may easily arise. The coverslip can change the orientation of the genitalia to a great extent. The angle in which the valvae, aedeagus or any other part of the genitalia, are bent upward or sideward can be far outside the usual range of variation of the species under consideration. Ignoring these artifacts easily leads to incorrect interpretations, which may be exemplified by the synonyms *E. siuxellus* Ganev & Hacker, 1986 and *E. gartheellus* Derra, 1985 being a result of a too narrow interpretation of differences observed in genital slides (see Hacker 1986, Derra 1987). Moreover, the differences observed are for some part caused by distortions.

Depositories

Abbreviations (codens) for depositories follow Arnett & Samuelson (1986), with the addition of: DERR (collection G. Derra, Bamberg, Germany); GIEL (collection C. Gielis, Lexmond, The Netherlands); GORD (collection A. D. Gordon Agriculture and Nature Study Institute, Degangya A, Israel); HUIS (collection K. J. Huisman, Wezep, The Netherlands); HULL (collection E. Hull, Helsby, Great Britain); INOU (collection H. Inoue, Tokyo, Japan); LAND (collection B. Landry, Ottawa, Canada); LUCA (collection J. A. W. Lucas, Rotterdam, The Netherlands); MAES (collection K. Maes, Gent, Belgium); PRIN (collection W. de Prins, Berchem/Antwerpen, Belgium); ROBI (collection R. Robineau, Tremblay-les-Gonesse, France); RTAS (author's collection); WOLF (collection H. W. van der Wolf, Nuenen, The Netherlands).

SYSTEMATIC PART

Euchromius Guenée, 1845

Euchromius Guenée, 1845: 324. Type species: *Tinea bella* Hübner, 1796: 29, designated by Desmarest (1857: 255).

Eromene Hübner, [1825]: 366. Type species: *Tinea bella* Hübner, 1796: 29, by monotypy [nomen praeoccupatum: *Eromene* Hübner, [1821]: 256., Noctuidae].

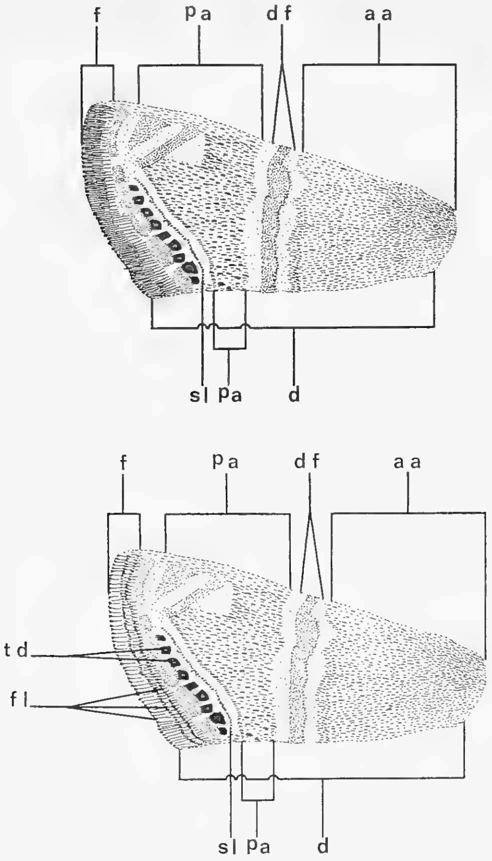
Araxes Stephens, 1834: 315, sensu Bleszynski (1963: 106), (nec *Araxes* Walker, 1863). Type species sensu Bleszynski (1963): *Palparia ocellea* Haworth, 1811: 486 [junior invalid designation].

Ommatopteryx Kirby, 1897: 274. Unnecessary replacement for *Euchromius* Guenée, 1845 [mistaken homonymy with *Euchromia* Hübner, 1819 and *Euchromia* Stephens, 1829].

Pseudoancylolomia Ahmad, Zaidi & Kamaluddin, 1982: 14. Type species: *Pseudoancylolomia qadrii* Ahmad, Zaidi & Kamaluddin, (1982: 15), by monotypy. **Syn. n.**

The taxonomic history at genus level has been thoroughly explained by Bleszynski (1961, 1963) and will not be repeated here. Ahmad, Zaidi & Kamaluddin (1982) erected the new monotypic genus *Pseudoancylolomia* for the new species *qadrii*. *Pseudoancylolomia qadrii*, however, is a junior synonym of *Euchromius ocelleus* (Haworth, 1811) as is pointed out under that species.

Pseudoancylolomia can be distinguished from other Crambinae genera (Ahmad et al. 1982) by the well developed proboscis and the anteriorly projecting frons. These characters are, however, represented in all species of *Euchromius* as well. Vein R5, mentioned as stalked with the partly fused R3-R4, is identical to that of all members of the genus *Euchromius* (see Ahmad et al 1982: 17, fig. 2). Therefore, *Pseudoancylolomia* Ahmad, Zaidi & Kamaluddin,



Figs. 7-8. Forewings. – 7, fringes whitish at base, then evenly coloured; 8, forewing, fringes with three dark lines. Abbreviations, f = fringes; pa = posterior area; df = double fascia; aa = anterior area; td = terminal dots; sl = subterminal line; d = dorsal edge; fl = fringes lines.

1982 is a junior synonym of *Euchromius* Guenée, 1845.

The firstly described species of the current genus *Euchromius* is *Tinea bella* Hübner, 1796. Subsequently, Haworth (1811) described the second species now in *Euchromius*: *Palparia ocellea*. Costa (1829), Treitschke (1832), Robinson (1870) and Turati (1924) described species, later to be synonymized with *ocelleus*. Until 1900 Zeller was the main author dealing with species now attributed to *Euchromius*. He described *anapiellus* (Zeller, 1847), *vinculellus* (Zeller, 1847), *zonellus* (Zeller, 1847) [= *ramburiellus* (Duponchel, 1836)], *superbellus* (Zeller, 1849), *wockeella* (Zeller, 1863) [= *superbellus* (Zeller, 1849)] and *cambridgei* (Zeller, 1867). After 1900 mainly three authors were dealing with *Euchromius* species. Caradja described four species in the period 1910-1937. Amsel described eight species in the period 1949-1961, of which five are now regarded as junior synonyms. Bleszynski in 1960-1967 made a serious effort to revise *Euchromius*, resulting in the discovery of many synonyms and the description of 13 new species, of which only one turned later to have a older synonym.

The Palaearctic species of *Euchromius* were revised by Bleszynski (1965a), the Neotropical and South-Nearctic ones (in part) by Capps (1966). Study of material in museum collections not seen by previous authors and material collected after the publication of the above mentioned articles, has revealed many new data. Study of material seen by Bleszynski and other authors lead me several times to conclusions conflicting with theirs. These conclusions and the new data resulted in the updated revision of the genus *Euchromius* presented in this paper.

The Oriental species are here revised for the first time. The species from the Afrotropical and Australian region were revised by Schouten (1988, 1990), but are included in the key. The present revision deals with 47 species, four of which are new to science. The females of *nivalis* (Caradja, 1937) and *malekalis* (Amsel, 1961) are described for the first time. Of two species the female and of three the male is unknown. Additional new species can be expected, especially from Africa, China and the Oriental region since large areas in these regions have never been visited by collectors of Lepidoptera.

Diagnosis

Dorsal insertion of ductus ejaculatorius is subterminal; gnathos is, in principle, armed with dorsal thorns; tergite VIII of males with sclerotized pattern; frons always projecting forward; M1 of hindwing located in the upper angle of the open cell; base of M2 and M3 of hindwing without basal pointing stalk (fig. 1); spinula present (except in *nivalis*), simple hairlike, without distinctly swollen base (fig. 4).

Morphology

The morphology is only discussed for features not treated by Schouten (1988).

Intraspecific variation

The species of *Euchromius* show little intraspecific variation. Only *cambridgei* (Zeller, 1867), *gratiosellus* (Caradja, 1910), *ramburiellus* (Duponchel, 1836), *superbellus* (Zeller, 1849) and *vinculellus* (Zeller, 1847) vary substantially in colouration. Variation in structure of the genitalia is limited as well; some variation is known in *tanalis* Schouten, 1988 and *vinculellus*.

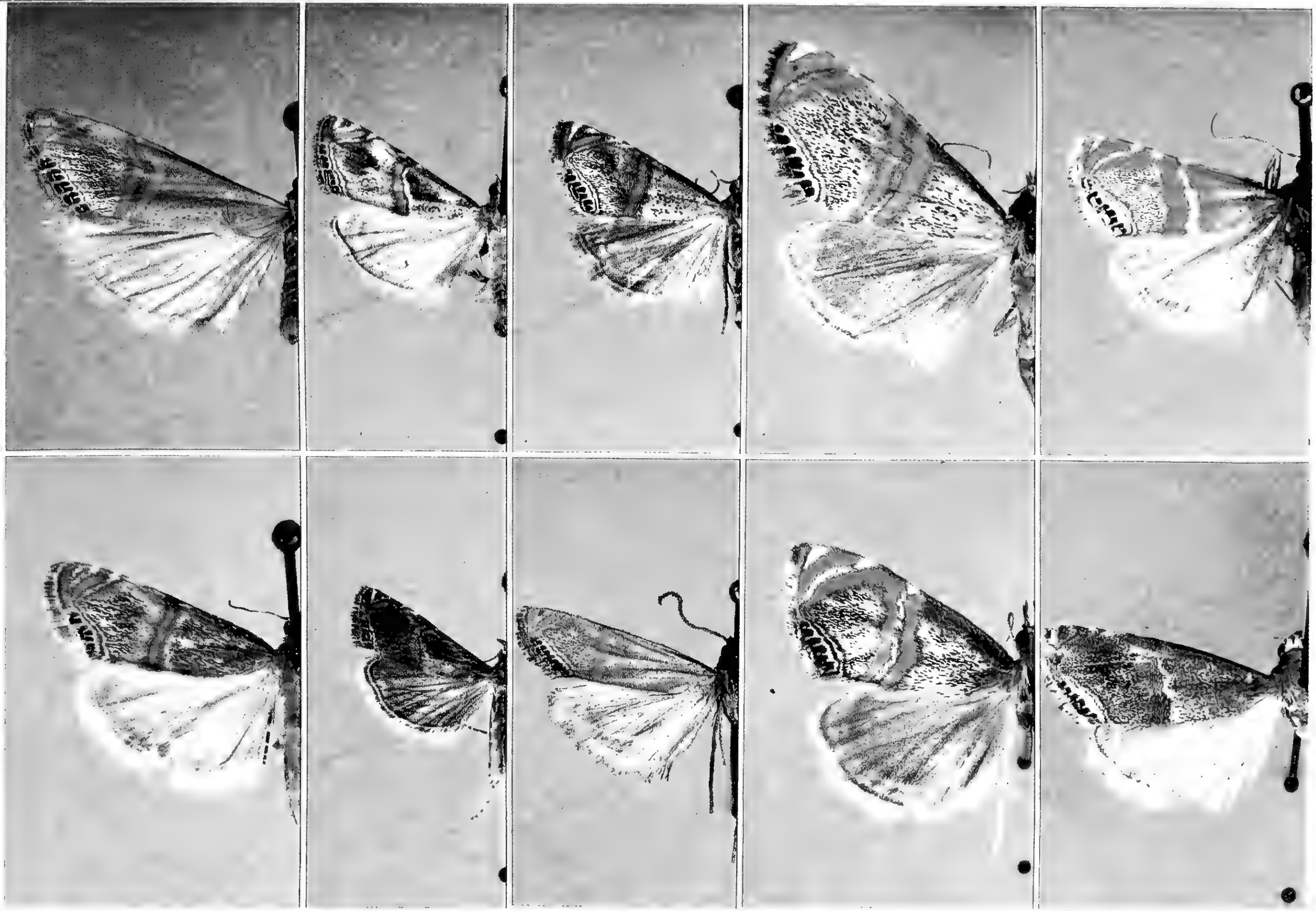


Fig. 9. Forewings in *Euchromius* and *Miyakea*. Upper row from left to right: *E. matador*, *E. cambridgei*, *E. rayatellus*, *M. raddeellus* and *E. bellus*. Lower row from left to right: *E. vinculellus*, *E. labellum*, *E. circulus*, *M. expansa* and *E. scobiolae*.

Tympanal organs

The tympanal organs (figs. 3, 4) have two functions, detection of bat-sounds and locating the sounds made the female (Minet 1983). The latter is deduced from the sexual dimorphism of *Catharia pyrenaelis* (Dup.) (Pyraloidea: Crambidae: Odontiinae). The male of this diurnal species has normally developed tympanal organs, whereas the female has atrophic tympanal organs. The dimorphism does not occur in night-flying species which are prone to be attacked by bats. This suggests that the male uses his tympanal organs to locate the female producing sounds by vibrating her wings. Dahm et al. (1971) demonstrated the use of the tympanal organs in the localization of partners in *Achroia grisella* (Fabricius) (Pyraloidea: Pyralidae: Galleriinae) in combination with the use of pheromones. The diagnostic value at subfamily and family level has been demonstrated by Minet (1982, 1983, 1985, 1991) and Maes (1985).

The terminology of the tympanal organs follows Maes (1985). In *Euchromius* the tympanum and conjunctivum make an angle and the bulla tympani are of the 'open' type. Consequently, *Euchromius* has tympanal organs of the 'Crambidae' type, as defined by Minet (1982) and Maes (1985). The tympanal organs are located ventrally on the anterior part of the abdomen.

Description of the tympanal organs in *Euchromius* (figs. 3, 4). – The praecinctorium is simple sac-shaped without a thorn-like sclerotization at the connection with the pons tympani. The bulla tympani are bean-shaped. The fornix tympani, supporting the conjunctivum, are well developed and clearly visible. The rami tympani are connected, forming a well defined semi-circle, enclosing the sacci tympani. At species level the sacci tympani vary in size and shape. Ventrally the two sacci tympani are connected by a membrane, the conjunctivum saccus tympani. In many cases, the width with which the two sacci tympani are connected, in combination with the position of the conjunctivum saccus tympani provide good diagnostic characters at the species level. The processi tympani vary in size and are largest in *ramburiellus*, occupying nearly half the breadth of the bulla tympani in that species. The processus tympani is orientated dorsal-ventrally and thus it is not always possible to measure their size.

The processus tympani is connected to the tympanum by the scoloparium and spinula. The scoloparium is a chordonotal nerve consisting of four scolopale cells (Minet 1983). In mounted specimens, the scoloparium is almost always lost, due to necessary cleaning of the interior of the bulla tympani. The scoloparium is connected to the spinula, a sclerite on the inside of the tympanum. At a magnification of 40 times it usually can be seen as a small point or minute line. In Crambinae spinulae have several distinct shapes. The spinula in *Euchromius* (fig. 4) is a simple hair-like structure, without a distinct swollen base, implantated at an oblique angle on a minute elevation and gradually tapering towards the distal end. The distal end can be clean and thus pointed, or may still have some remains of the scoloparium or tracheal tissue connected to it, giving it a frayed tip. To estimate the type of spinula of a genus or species usually many slides should be checked. The spinula must be viewed from several angles before a correct lateral drawing of it can be made. The venula prima, situated lateral to the fornix tympani, is always present. The venula secunda, posterior of the fornix tympani, is more or less an extension of the venula prima. In *Euchromius* the venula secunda is well developed.

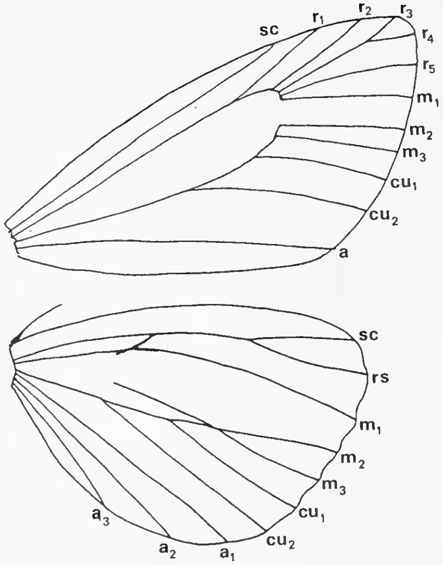


Fig. 10. Venation in *Miyakea*.

Distribution

The highest numbers of species occur in Africa (19), the Mediterranean (16) and the Near and Middle East (16). Australia has only one single species, North America two and South America four. No species are found on the islands of South-East Asia. *E. subcambridgei* has a disjunct distribution in the Sudan, Tunesia and the Cape Verdes. *E. ocelleus* with an almost cosmopolitic distribution seems to be a migratory species which establishes temporary populations in localities far outside its main distribution area from time to time.

Biology

E. ocelleus has been mentioned infesting food (Hinton 1943). I am not aware of any recent confirmation of larvae found in food-products and, therefore I am sceptical about this claim. The caterpillars of several species have been reared from dead leaves near the base of plants, accidently larvae attack living plants and flower-heads. Transportation of pupae with plant remains seems likely (Meyrick 1895). Dead leaves of mainly Compositae and one species of Dipsacaceae are recorded as foodplants (Millière 1868).

Euchromius species are found in various habitats, but most of them prefer dry and warm areas; no species really enters the tropical rain forest. *E. gnathosellus* and *zephyrus* have only been found in plantations mixed with remains of secondary forest in West-Africa, once covered with lowland tropical rain forest. Several species are restricted to mountain areas and plateaus e.g. *tanalis* and *hampsoni* in Africa, *nivalis* in China and *saltalis* in South America. Many species are found from sea-level up to more than 1000 m altitude. *E. ocelleus* is recorded from the highest altitude, 4200 m (Afghanistan).

Excluded species

E. brunnealis (Hampson, 1919), *micralis* (Hampson, 1919) and *pygmea* (Hering, 1903) do not belong to the genus *Euchromius* in the present sense. They should be classified in a separate genus to be described in a forthcoming paper (Schouten, in prep.).

E. delicatalis (Hampson, 1919) is transferred to *Aurotalis* Bleszynski, a genus not closely related to *Euchromius*. Bleszynski (1970) regards *Aurotalis* a close relative of *Conotalis* Hampson, 1919. The forewing of *E. delicatalis* (fig. 2) has the Sc partly fused with R1, whereas R2 is fused with R3+R4, a feature never encountered in *Euchromius* (fig. 1). The male genitalia of *delicatalis* lack any processus on the valvae, which are broad and of the same type as in *Aurotalis*.

E. kuphitincta (Lucas, 1898) was transferred from *Diptychophora* to *Euchromius* by Gaskin (1975a) . The type material of this species has not been located (Gaskin 1975a). The original description (Lucas 1898: 80), however, leaves no doubt that the species is not a member of *Euchromius*. Several dentate lines in the forewing are mentioned and the base of the hindwing is said to have up to six or seven fine violet fuscous transverse lines. Both features have never been found in *Euchromius*. Especially the description of the hindwing suggests attribution of this species to the Diptychorini or the Pyraustinae. As long as the holotype has not been located it will be impossible to classify this species with certainty.

Checklist of extant *Euchromius* Guenée

1. *ornatus* **sp. n.**
2. *circulus* **sp. n.**
3. *cornus* Schouten, 1990
4. *californicalis* (Packard, 1873)
5. *matador* Bleszynski, 1966
6. *gnathosellus* Schouten, 1988
7. *zephyrus* Bleszynski, 1962
8. *tanalis* Schouten, 1988
9. *mythus* Bleszynski, 1970
10. *geminus* Schouten, 1988
11. *galapagosalis* Capps, 1966
12. *limaellus* Bleszynski, 1967
13. *minutus* **sp. n.**
14. *saltalis* Capps, 1966
15. *ocelleus* (Haworth, 1811)
    - *cyrilli* (Costa, 1829)
    - *funiculella* (Treitschke, 1832)
    - *texana* (Robinson, 1870)
    - *gigantea* (Turati, 1924)
    - *qadrii* (Ahmad et al., 1982) **syn. n.**
16. *pulverosus* (Christoph, 1887)
    - *cochlaearellus* (Amsel, 1949) **syn. n.**
17. *confusus* **sp. n.**
18. *vinculellus* (Zeller, 1847)
    - *corsicalis* (Hampson, 1919)
    - *asbenicola* (Rothschild,1921)
    - *joiceyella* (Schmidt, 1934)
    - *bahrlutella* (Amsel, 1949)
19. *anapiellus* (Zeller, 1847)
20. *bellus* (Hübner, 1796)
21. *bleszynskiellus* Popescu-Gorj, 1964
    - *roxanus* Bleszynski, 1965
22. *bleszynskii* Roesler, 1975
23. *scobiolae* Bleszynski, 1965
24. *superbellus* (Zeller, 1849)
    - *wockeella* (Zeller, 1863)
    - *cypriusella* (Amsel, 1958)
25. *keredjellus* (Amsel, 1949)
26. *malekalis* (Amsel, 1961)
27. *mouchai* Bleszynski, 1961
28. *nivalis* (Caradja, 1937)
29. *rayatellus* (Amsel, 1949)
30. *gozmanyi* Bleszynski, 1961
31. *gratiosellus* (Caradja, 1910)
    - *gartheellus* Derra, 1985
    - *siuxellus* Ganev & Hacker, 1986
32. *jaxartellus* (Erschoff, 1874)
33. *ramburiellus* (Duponchel, 1836)
    - *zonellus* (Zeller, 1847)
    - *luteella* (Caradja, 1910)
    - *islamella* (Amsel, 1949)
34. *zagulajevi* Bleszynski, 1965
35. *donum* Schouten, 1988
36. *sudanellus* Bleszynski, 1965
37. *subcambridgei* Bleszynski, 1965
38. *cambridgei* (Zeller, 1867)
    - *luciella* (Chrétien, 1907)
    - *prototypa* (Meyrick, 1935)
    - *congruentella* (Amsel, 1958)
    - *szijjartoi* (Gozmany, 1959)
    - *ilkui* (Gozmany, 1959)
39. *viettei* Bleszynski, 1961
    - *karsholti* Ganev, 1987 **syn. n.**
40. *hampsoni* (Rothschild, 1921)

41. *klimeschi* Bleszynski, 1961
42. *discopis* (Hampson, 1919)
43. *labellum* Schouten, 1988
44. *aris* Schouten, 1988
45. *erum* Schouten, 1988
46. *locustus* Schouten, 1988
47. *nigrobasalis* Schouten, 1988

Key to the species of *Euchromius* and *Miyakea*

The key can only be used when specimens are in good condition. For a definite identification one should check the genitalia.

1. Eight, nine or ten black dots at termen of the forewing 2
– Four to seven black dots at termen of the forewing (in *E. rayatellus*, *E. superbellus* and *E. gozmanyi* an eighth dot in apical position may occur) .. 58
2. Medial fascia double, divided by a silvery or white line, inner fascia sometimes reduced 3
– Medial fascia single 28
3. Black terminal dots arranged according to the formula 2-2-2, 2-2-2-2-1 or 2-2-2-2-2, a group of three dots is never present 4
– Black terminal dots arranged to the formula 1-2-3-2, 2-2-3-2, or 2-3-1, a group of three dots is always present 6
4. Frons rounded without a point .... *M. sinevi*
– Frons pointed, with or without ridges 5
5. Frons pointed, slender with several ridges (fig. 14). Forewings slender, tapering at the apex .... *E. circulus*
– Frons produced forward, pointed, ridges absent. Forewings normal .... *E. matador*
6. Frons strongly produced forward, armed with several ridges .... *E. zephyrus*
– Frons produced forward, one point, a ventral ridge may be present or not (figs. 12, 21, 38) .. 7
7. Clypeus laterally lobbed, lobs produced forward (fig. 12) .... *E. ornatus*
– Clypeus not distinct laterally lobbed (figs. 21, 38) 8
8. The outer medial fascia ending at circa one-third of the dorsum; line between double fascia usually whitish, seldom only silvery 9
– The outer medial fascia ending at one-fourth to one-sixth of the dorsum; line between double fascia silvery 10
9. The outer medial fascia nearly always bent outward, especially near the inner margin. Forewing, area adjacent to black terminal dots broad and whitish .... *E. bellus*
– The outer medial fascia straight; inner medial fascia sometimes reduced; forewing, area adjacent to black terminal dots narrow and usually yellow .... *E. anapiellus*
10. Frons with clear ventral ridge, frons strongly conical with corneous point .... *E. gnathosellus*
– Frons without ventral ridge (figs. 21, 38), frons strongly conical or normally projecting, with corneous point 11
11. Forewing brownish grey from base to inner medial fascia, with no or little irroration by darker scales .... *E. galapagosalis*
– Forewing, groundcolour creamy white, irroration by darker scales from base to inner medial fascia 12
12. Males (the male of *E. geminus* is unknown) ... 13
– Females 20
13. Gnathos with two basal projections (figs. 99, 100) 14
– Gnathos without two basal projections (figs. 106, 109) 15
14. Juxta without two large dorsal projections (fig. 100) .... *E. californicalis*
– Juxta with two large dorsal projections (fig. 99) .... *E. cornus*
15. Aedeagus with one group of cornuti forming a packed row (figs. 106, 107) 16
– Aedeagus with three groups of cornuti (figs. 109-112) 17
16. Cucullus club-shaped. Processus basalis normal sized, not blade-like at base. Two clear processi inferior valvae (fig. 106) .... *E. tanalis*
– Cucullus pointed. Processus basalis long, broad, blade-like at base. One clear processus inferior valvae (fig. 107) .... *E. mythus*
17. The largest group of cornuti coiled, having a woodrasp appearance (fig. 109) .... *E. limaellus*
– The largest group of cornuti more or less straight, forming a double row (figs. 110-112) 18
18. Dorsal spine of processus basalis arising from middle of blade (fig. 112) .... *E. ocelleus*
– Dorsal spine of processus basalis arising from outer corner (figs. 110, 111) 19
19. Aedeagus with several cornuti at each side, pointing backwards giving the aedeagus a spear-like appearance (fig. 111) .... *E. saltalis*
– Aedeagus without backwards pointing cornuti at the sides (fig. 110) .... *E. minutus*
20. Ostium tooth-shaped (figs. 156, 157) 21
– Ostium toadstool or lip-shaped, not tooth-shaped (figs. 151, 160) 22
21. Ductus bursae with light sclerotizations near ductus seminalis. Sclerotization under ostium most prominent at the edges. Ostium longer than broad, circa 1.5 times, (fig. 156) .... *E. tanalis*
– Ductus bursae without sclerotizations near ductus seminalis. Sclerotization under ostium more in centre, less at edges. Ostium about as high as broad (fig. 157) .... *E. mythus*
22. Signa of equal size (figs. 151, 162, 163) 23

– Signa unequal in size (figs. 158, 160, 161) 25

23. Ductus bursae short, not clearly sclerotized (fig. 151) .... *E. cornus*

– Ductus bursae long, clearly sclerotized (figs. 162, 163) 24

24. Hook-like projections lateral of the ostium. Length ductus bursae circa two times that of bursa copulatrix. Edges of tergite VIII connected (fig. 162) .... *E. saltalis*

– Hook-like projections lateral of ostium absent. Length ductus bursae circa three times that of bursa copulatrix. Edges of tergite VIII not connected (fig. 163) .... *E. ocelleus*

25. Edges of tergite VIII connected or not, wrinkled (fig. 160) 26

– Edges of tergite VIII connected, not wrinkled (fig. 161) 27

26. Rim of ostium clearly dentate .... *E. limaellus*

– Rim of ostium not dentate .... *E. californicalis*

27. Larger signum three times as long as smaller signum (fig. 158) .... *E. geminus*

– Larger signum less than two times as long as smaller signum (fig. 161) .... *E. minutus*

28. Medial fascia broad, the entire length sprinkled with black scales, reminding of a fingerprint. Anterior area of the forewing for most part covered with black scales .... *E. nigrobasalis*

– Medial fascia normal, not or sprinkled with silvery scale. Anterior area of the forewing not covered with black scales, sometimes a few black scales present, anterior area usually greyish or brownish 29

29. Medial fascia clearly angled inwardly below the costa 30

– Medial fascia straight or gently arched, part near inner margin may be lost or faint 33

30. Males 31

– Females 32

31. Uncus with a dorsal thorn (fig. 137) .... *E. sudanellus*

– Uncus without a dorsal thorn (fig. 139) .... *E. cambridgei*

32. One long and one shorter signum, a somewhat triangular, broad sclerotized plate at the ventral site of membrane of tergite VIII (fig. 187) .... *E. sudanellus*

– Signa of equal size, two very small slender sclerotized plates at the ventral site of membrane of tergite VIII (fig. 189) .... *E. cambridgei*

33. Tegulae evenly mottled, no dark patch in the middle (fig. 5) 34

– Tegulae with dark patch in the middle (fig. 6) 44

34. Fringes of forewing whitish at base, then evenly ochreous brown (fig. 7) 35

– Fringes of forewing with up to three dark lines (fig. 8) 39

35. Males (male of *E. zagulajevi* is unknown) 36

– Females 37

36. Cucullus with slight constriction about halfway. Stalk of gnathos not terminally connected to basal part; stalk and basal part at right angle (fig. 113) .... *E. confusus*

– Cucullus without constriction. Stalk of gnathos terminally connected to basal part; no clear angle between stalk and basal part (fig. 114) .... *E. pulverosus*

37. Ostium without prominent projection (fig. 184) .... *E. zagulajevi*

– Ostium with prominent projection (figs. 164, 165) 38

38. Projection of ostium with parallel sides (fig. 164) .... *E. confusus*

– Projection of ostium without parallel sides, sides convex (fig. 165) .... *E. pulverosus*

39. Males 40

– Females 42

40. Processus of sacculus slender, slightly bent upward, not or slightly overlapping cucullus; processus inferior valvae rounded, not elongated (fig. 134) .... *E. gratiosellus*

– Processus of sacculus stout, clearly bent upward, overlapping cucullus; processus inferior valvae flat, elongated (fig. 135) 41

41. Processus of sacculus reaching almost halfway the cucullus, at least one and a half times as long as the breadth of cucullus (fig. 136) .... *E. ramburiellus*

– processus of sacculus at most reaching one-third of the cucullus, at most as long as breadth of cucullus (fig. 135) .... *E. jaxartellus*

42. Ductus bursae under ostium only slightly enlarged, with, only minor, second bulb-like projection (fig. 170) .... *E. gratiosellus*

– Ductus bursae under ostium enlarged, with clearly separated sac-like projection (figs. 183, 185) 43

43. Projection of ostium long, extending over membrane of tergite VIII (fig. 185) ... *E. ramburiellus*

– Projection of ostium short, broad, circa equal-sided, triangular, top just reaching membrane of tergite VIII (fig. 183) .... *E. jaxartellus*

44. Frons conical with a small point (figs. 44, 70). Fringes of the forewing with several dark lines (fig. 8) or evenly brownish-grey at the end (fig. 7) 45

– Frons bluntly produced forward, without point (figs. 88, 96). Fringes of the forewing evenly brownish-grey at the end (fig. 7) 47

45. Fringes of forewing with several dark lines (fig. 8) 46

– Fringes of forewing evenly brownish-grey (fig. 7) 80

46. Labial palp two; subterminal fascia of hindwing absent; fringes of forewing creamy white at base, then two brown lines ..... *E. donum*
– Labial palp three; subterminal fascia of hindwing present; fringes not clearly creamy white at base, up to three brown lines ..... *E. bleszynskiellus*
47. Males 48
– Females 53
48. Gnathos without two dorsal thorns and terminal part, processus basalis hardly visible or absent (figs. 145, 147, 148) 49
– Gnathos with two dorsal thorns and terminal part, processus basalis clearly visible (figs. 140, 143, 144) 51
49. Tegumen with appendix angularis (fig. 148) ..... *E. locustus*
– Tegumen without appendix angularis (figs. 145, 147) 50
50. Valvae with many heavy spines (fig. 147) ..... *E. erum*
– Valvae without heavy spines (fig. 145) ..... *E. aris*
51. Dorsal spike at base of processus of sacculus (fig. 144) ..... *E. discopis*
– Dorsal spike at base of processus of sacculus absent (figs. 140, 143) 52
52. Processus basalis narrowing abrupt, anterior part of aedeagus normal (fig. 140) ..... *E. viettei*
– Processus basalis narrowing soon, but gradual, anterior part of aedeagus very slender (fig. 143) ..... *E. hampsoni*
53. Bursa copulatrix with two signa (fig. 195) 54
– Bursa copulatrix with one signum (figs. 190, 193) 55
54. Projection formed by connected edges of tergite VIII broadest at its base (fig. 195) ..... *E. aris*
– Projection formed by connected edges of tergite VIII not broadest at base, but more posterior (fig. 197) ..... *E. locustus*
55. Ductus bursae for most part strongly sclerotized with large cornuti (fig. 196) ..... *E. erum*
– Ductus bursae not strongly sclerotized (figs. 190, 191, 193) 56
56. Ostium tooth-shaped (fig. 193) ..... *E. discopis*
– Ostium not tooth-shaped (figs. 190, 191) 57
57. Lamella antevaginalis without anterior fold (fig. 190) ..... *E. viettei*
– Lamella antevaginalis with clear anterior fold (fig. 191) ..... *E. hampsoni*
58. Groundcolour of the forewing pure white, usually a clear dark brown to black spot in posterior area ..... *E. nivalis*
– Groundcolour dirty to creamy white 59
59. Medial fascia double 60
– Medial fascia single 65
60. Yellow apical marking on forewing touching medial fascia ..... *M. expansa*
– Yellow apical marking clearly separated from medial fascia 61
61. Males 62
– Females 63
62. Processus basalis absent (fig. 118) ..... *M. lushanus*
– Processus basalis large, distinct (fig. 119) ..... *M. raddeellus*
63. Under the ostium an elongated pouch, clearly separated from the ductus bursae (fig. 199) ..... *M. sinevi*
– Elongated pouch under the ostium absent 64
64. Ostium without tongue-shaped projection (fig. 169) ..... *M. lushanus*
– Ostium with tongue-shaped projection (fig. 167) ..... *M. raddeellus*
65. Medial fascia clearly angled inward below costa (fig. 9: *E. labellum*, *E. cambridgei*) 66
– Medial fascia straight or slightly arched 68
66. Medial fascia not sharply bent, angle in the middle of the wing ..... *E. subcambridgei*
– Medial fascia more sharply bent, angle closely below the costa 67
67. Frons produced forward with point (fig. 90) ..... *E. cambridgei*
– Frons produced forward without point ..... *E. labellum*
68. Frons rounded, without point; area adjacent to black terminal dots white..... *E. klimeschi*
– Frons rounded or not, with, a sometimes very small, point, when absent then area to black terminal dots yellow 69
69. Tegulae evenly mottled, no dark patch in the middle (fig. 5) 70
– Tegulae with dark patch in the middle (fig. 6), if very faint then area adjacent to black terminal dots broad 74
70. Area adjacent to black terminal dots narrow, usually yellow; subterminal line about midway between terminal dots and termination of posterior area ..... *E. vinculellus*
– Area adjacent to black terminal dots broad, white; subterminal line closer to termination of posterior area than to terminal dots 71
71. Males 72
– Females 73
72. Dorsal edge of sacculus with pointed projection, stout spines at base of processus of sacculus absent (fig. 125) ..... *E. bleszynskii*
– Dorsal edge of sacculus without pointed projection, stout spines at base of processus of sacculus (fig. 126) ..... *E. scobiolae*
73. Ductus seminalis broad for some length, projection of ostium rectangular (fig. 174) ..... *E. bleszynskii*
– Ductus seminalis broad for a short length, projection of ostium rounded (fig. 175) ..... *E. scobiolae*

74. Fringes of forewing with one or two ochreous brown lines, most clearly at the apex 75
– Fringes of forewing highly shiny, evenly grey to grey-brown, no ochreous brown lines 80
75. Males 76
– Females 78
76. Aedeagus without cornuti (fig. 129) *E. malekalis*
– Aedeagus with two or three groups of cornuti (figs. 128, 130) 77
77. Aedeagus with two groups of cornuti, processus of sacculus short, but clearly free (fig. 128) .... *E. keredjellus*
– Aedeagus with three groups of cornuti, processus of sacculus indistinct (fig. 130) .... *E. mouchai*
78. Ostium bean-shaped (fig. 179) .... *E. malekalis*
– Ostium lip-shaped (figs. 177, 178) 79
79. Edges of tergite VIII connected, knot-shaped at point of connection (fig. 177) .... *E. keredjellus*
– Edges of tergite VIII not connected (fig. 178) ....*E. mouchai*
80. Males 81
– Females 83
81. Dorsal thorns of gnathos elongated, terminal part long (fig. 127) .... *E. superbellus*
– Dorsal thorns of gnathos normal, short, terminal part short (fig. 132) 82
82. Aedeagus with three groups of cornuti; processus of sacculus long, cucullus slender (fig. 132) .... *E. rayatellus*
– Aedeagus with one large ridged cornutus; processus of sacculus short, cucullus broad (fig. 133) ... . *E. gozmanyi*
83. Ductus bursae with sleeve-like structure above ductus seminalis (fig. 182) .... *E. gozmanyi*
– Ductus bursae without sleeve-like structure (figs. 176, 180) 84
84. Lamella antevaginalis large, shield-shaped, split in the middle; membrane of tergite VIII without thumb-like projection (fig. 180) ..... *E. rayatellus*
– Lamella antevaginalis small, not shield-shaped; membrane of tergite VIII with thumb-like projection (fig. 176) .... *E. superbellus*

1. *Euchromius ornatus* sp. n.
(figs. 11-13, 98)

Type material. – Holotype: ♂, [India] 'Dibidi, N. Coorg. Newcome 5.12.06', GS 17617 (BMNH).

Diagnosis. – Differs from all species in having the clypeus laterally lobed in combination with the presence of a group of three dots in the terminal black dots.

External characters male (fig. 11). – Wingspan 18 mm. Frons produced forward into very sharp point, creamy white to light brown, laterally lobed, ventral ridge large; vertex creamy white; labial palp two, sides creamy white at base, becoming brown, creamy white from above and below; maxillary palp creamy white, brown ringed at base of last segment; antenna creamy white. Thorax brown; patagia brown; tegulae brown, evenly mottled. Forewing, groundcolour white densely suffused with ochreous to dark brown scales; medial fascia double, slightly arched, running one-fourth to one-fifth of the dorsum; subterminal line dark brown, closer to termination of posterior area than to terminal dots; area adjacent to terminal dots white; eight black terminal dots, formula 2-2-3-1; fringes shiny, at least one brownish line, too worn to be described in more detail. Hindwing brown-grey, subterminal fascia inconspicuous, termen darkly bordered; fringes creamy white with brownish line.

Tergite VIII (fig. 12). – Sclerite normally sclerotized, only posteriormost part of posterior part visible.

Male genitalia (fig. 98). – Uncus basal-dorsal with crown-like projection armed with heavy spines, more posteriorly bearing tubercle; gnathos longer, two dorsal thorns large, terminal part long; tegumen without appendix angularis; sacculus normal, processus of sacculus absent, processus basalis small, bent inward, placed central on edge of valvae, processus inferior valvae very prominent, forming tuberkel, cucullus broad, sharply pointed upward; juxta triangular; vinculum normal; aedeagus small, two faint groups of very small cornuti-like sclerotizations.

Biology. – Unknown. Holotype caught in December.

Distribution (fig. 13). – Southern India.

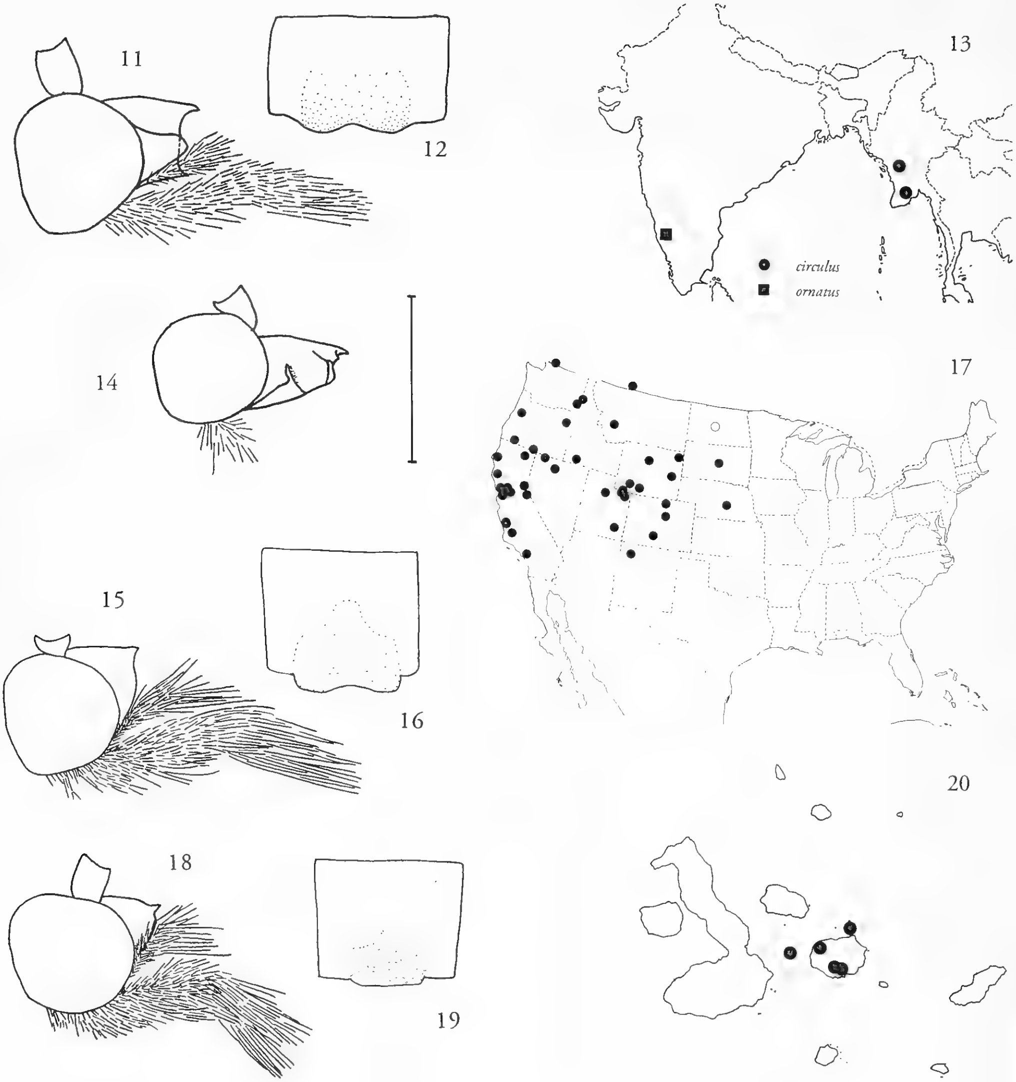
Etymology. – *Ornatus* (Latin) refers to the graceful ornamentation on the uncus.

2. *Euchromius circulus* sp. n.
(figs. 9, 13, 14, 150)

Type material. – Holotype: ♀, [Burma] 'Rangoon', GS 17618. Paratype: 1 ♀, [Burma] 'Thyetmyo', GS 17765 (holotype and paratype in BMNH).

Diagnosis. – Differs from all species with a double fascia, except *E. matador*, in lacking a group of three black terminal dots. Can be distinguished from *E. matador* by the conspicuous ridges on the frons.

External characters female (figs. 9, 14). – Wingspan 17 mm. Frons slender, sharply produced forward, clear point and several ridges, light brown, ventral ridge very small; vertex light brown; labial palp two, sides creamy white becoming light brown, creamy white from above and below; maxillary palp creamy white; antenna creamy white. Thorax light brown; patagia light brown to brown; tegulae light



Figs. 11-20. *Euchromius* species. – 11, *E. ornatus*, head: lateral aspect, scales removed; 12, idem, sclerite of tergite VIII; 13, distribution map of *E. ornatus* and *E. circulus*; 14. *E. circulus*, lateral aspect of head, scales removed, labial palp partly missing, maxillary palp completely missing; 15, *E. californicalis*, head: lateral aspect, scales removed; 16, idem, sclerite of tergite VIII; 17, idem, distribution map (open circle: exact locality not found); 18, *E. galapagosalis*, head, lateral aspect, scales removed; 19, idem, sclerite of tergite VIII; 20, idem, distribution map. Scale bar 0.5 mm to figs. 11-12, 14-16, 18-19.

brown to brown evenly mottled. Forewing, groundcolour creamy white only posterior area densely suffused with ochreous to dark brown scales; medial fascia double, nearly straight, running to one-fourth of the dorsum; subterminal line brown, about midway between terminal dots and termination of posterior area, area adjacent to terminal dots white, nine black terminal dots, formula 2-2-2-2-1; fringes shiny creamy white with two brown lines. Hindwing grey-brown, subterminal fascia present; termen darkly bordered; fringes creamy white with brownish line.

Female genitalia (fig. 150). – Papillae anales normal; membrane of tergite VIII with three narrow sclerotized bands, edges of tergite VIII around papillae anales many folded; ostium complex heavily sclerotized; ductus bursae long, narrow; ductus seminalis starting broad narrowing soon; bursa copulatrix oblong, two signa, club-shaped.

Male. – Unknown.

Biology. – Unknown.

Distribution (fig. 13). – Burma.

Etymology. – *Circulus* (Latin) refers to the circular, ring-like shape of tergite VIII.

3. *Euchromius cornus* Schouten, 1990
(figs. 99, 151)

Euchromius cornus Schouten, 1990: 265. Holotype: ♂, 'Sherlock R. W. Australia. E. Clements. 98-188', GS 17616 (BMNH) [examined].

Material. – 21 ♂, 16 ♀.

Diagnosis. – Externally almost indistinguishable from *Euchromius* species with a double medial fascia and frons with one point. Differs in male genitalia from all species in having the uncus armed with a short, double, dorsal projection. Differs in female genitalia from *E. geminus*, *E. californicalis*, *E. limaellus*, *E. ocelleus*, *E. saltalis*, *E. mythus* and *E. tanalis* by its short ductus bursae without clear sclerotizations.

Distribution. – Australia.

4. *Euchromius californicalis* (Packard, 1873)
(figs. 15-17, 100, 152)

Eromene californicalis Packard, 1873: 264. Lectotype (designated by Capps 1966: 5): ♂, 'Type 14297'. (MCZC) [examined].

Material. – 98 ♂, 11 ♀. Canada: Alberta: Manyberries, 1 ♀ (BMNH). British Columbia: Nicola, 1 ♂ (BMNH). USA: California: 2 mi SW of Moraga, 2 ♂ (CISC); 4 mi E of Petaluma, 1 ♂ (RTAS), 2 ♂ (UCDC); 8 km N of Tuckee, 1 ♂ (ICCM); 10 mi W of Simmler, 1 ♂ (CISC); Arcata, 1 ♂ (UCDC); Berkely, 1 ♂ (CASC), 1 ♂ (CISC), 1 ♂ (LACM); Bieber, 1 ♂ (UCDC); Cambria, 4 ♂ (AMNH), 1 ♂ (RTAS); Davis, 1 ♂ (CASC), 2 ♂ (UCDC); El Cerrito, 1 ♂ (CASC), 1 ♂ (CISC); Half Moon Bay, 1 ♂ (ICCM); Long Beach, 1 ♂ (AMNH); Moraga, 5 ♂ (CISC); Napa, 3 ♂ (BMNH), 3 ♂ (CASC), 5 ♂ (MCZC); Novata, 2 ♂ (CASC); Petaluma, 6 ♂ (LACM); Pinole, 1 ♂ (CISC); Sacromento, 1 ♂ (UCDC); San Simeon, 3 ♂ (AMNH), 1 ♂ (RTAS); Santa Rosa, 1 ♂ (LACM); Sonoma, 1 ♂ (CISC); Topaz, 1 ♂ (LACM); Ukiah, 1 ♂ (CISC); Vacaville, 1 ♂ (UCDC). Colorado: Denver, 6 ♂ (BMNH); Fort Collins, 2 ♂ (AMNH); Moffat, 2 ♂, 2 ♀ (ICCM), 1 ♂, 1 ♀ (RTAS). Idaho: East Fork Jarbidge, 1 ♂ (LACM); Moscow, 2 ♂ (AMNH). Montana: Butte, 1 ♀ (MNHN). Nebraska: Grand Island, 1 ♂ (ICCM). Nevada: 18 mi N of Paradise Valley, 1 ♂ (AMNH); 40 mi SW of Denio, 1 ♂ (CUIC). New Mexico; Chaca Canyon Nat. Mon., 1 ♂ (LACM). South Dakota: 15 km W of Gattysbury, 1 ♀ (GIEL). North Dakota: Slope Co. (locality not found), 1 ♂ (AMNH). Oregon: 2 mi S of Ukiah, 1 ♂ (CISC); Baker, 2 ♂ (AMNH); Corvallis, 1 ♂ (AMNH); Klamath, 2 ♂ (CISC); New Pine Creek, 1 ♂ (ZMAN). Utah: Hanksville, 1 ♂ (RTAS); Provo, 1 ♂, 1 ♀ (MCZC); Vernal, 1 ♂; 2 ♀ (ICCM), 1 ♂, 1 ♀ (RTAS). Washington: Pullman, 2 ♂ (ANSP); 1 ♂ (CUIC). Wyoming: 5 mi N of Sundance, 1 ♂ (AMNH); 25 mi S of Bitterkreek, 1 ♂ (ICCM); Douglas, 3 ♂ (CASC); Lone Tree, 1 ♀ (ICCM); Rock Springs, 1 ♀ (AMNH); South Fork of Crazy Woman Creek, 1 ♀ (CASC).

Diagnosis. – Externally difficult to separate from species with a double fascia and frons with one clear point. Differs from *E. ocelleus*, *E. galapagosalis*, *E. saltalis*, *E. minutus*, *E. limaellus*, *E. mythus* and *E. tanalis* in male genitalia by the basal projections on the gnathos, from *E. cornus* in lacking the projections of the juxta. *E. californicalis* can be distinguished in female genitalia by a mushroom-shaped ostium in combination with signa unequal in size and a drop-shaped sclerotization in the membrane of tergite VIII.

External characters male, female (fig. 15). – Wingspan 20-24 mm. Frons sharply produced forward into clear point, creamy white to light brown, no ventral ridge; vertex creamy white; labial palp two and a half to three, sides white at base, becoming creamy white to light brown, creamy white from above and below; maxillary palp white to creamy white, brown ringed at base of last segment; antenna creamy white, from about the middle very inconspicuous darkly ringed. Thorax creamy white; patagia creamy white; tegulae creamy white evenly mottled, sometimes with dark patch in the middle. Forewing, groundcolour white, densely suffused with ochreous to dark brown scales; medial fascia double, gently arched to nearly straight, running to one-fifth to one-sixth of the dorsum; subterminal line ochreous brown, inconspicuous, closer to termination of posterior area than to terminal dots; area adjacent to terminal dots broad, white; nine or eight black terminal dots, formula 2-2-3-2 or 2-2-3-1; fringes shiny creamy white with two or three brown lines. Hindwing creamy white to brown-grey, subterminal fascia present or not, termen darkly bordered; fringes white with brownish line.

Tergite VIII (fig. 16). – Sclerite normally sclerotized, posterior part rectangular, stalk broad ending abruptly, anterior pattern invisible.

Male genitalia (fig. 100). – Uncus slightly bent, with thin dorsal crest; gnathos longer, two dorsal-basal projections, two dorsal thorns, terminal part long; tegumen without appendix angularis; sacculus normal, processus of sacculus absent, processus basalis small, two processi inferiores valvae; cucullus bent upward, with strong basal fold forming clear lob-like projection; juxta small, triangular; vinculum long; aedeagus long, slender with three groups of cornuti, sometimes only two clearly visible.

Female genitalia (fig. 152). – Papillae anales small; membrane of tergite VIII with inconspicuous drop-shaped sclerotization, edges of tergite VIII grooved, not connected; ostium mushroom-shaped, not clear, roughly granulate; ductus bursae long, more strongly sclerotized in upper part; ductus seminalis narrow; bursa copulatrix oblong, with two long signa, unequal in size.

Biology. – Unknown. Specimens caught from March to September, with peaks in June, July and August. Recorded from 300 m up to 2500 m altitude.

Distribution (fig. 17). – A West-Neartic distribution. Canada: British Columbia and Alberta. USA: Washington, Idaho, Montana, North Dakota, Oregon, Wyoming, California, Nevada, Utha, Colorado, Nebraska and New Mexico.

Remarks. – The lectotype specimen in MCZC bears only the label 'Type 14297'. A second specimen without any label is presumably a paralectotype. The third specimen can almost certainly be excluded from the syntype series since it has not been collected by Edwards (Miller & Hodges 1990). The label reads: C.H.F. March 95 Cal Behr 17, indicating that the specimen was caught in March 1895 which is after the date of publication of *californicalis*. The female genitalia figured by Corbet and Tams (1943: 72, figs. 125 and 162) do not belong to *E. californicalis*.

5. *Euchromius matador* Bleszynski, 1966
(figs. 9, 101, 153)

Euchromius matador Bleszynski, 1966: 470. Holotype: ♂, 'Elisabethville Belgian Congo 4.V.1947 Ch. Seydel', GS 4342, type 8921 (CNCI) [examined]. Schouten (1988: 33) [redescription].

Material. – 20 ♂, 13 ♀.

Diagnosis. – Differs from all species, except *circulus*, in having a double medial fascia in combination with the lack of a group of three black terminal dots. Can be distinguished from *circulus* in lacking the ridges on the frons.

Distribution. – Tanzania and Zaire.

6. *Euchromius gnathosellus* Schouten, 1988
(figs. 102, 154)

Euchromius gnathosellus Schouten, 1988: 35. Holotype: ♂, 'Degbezere loc 7. 12 km E Bouafle 15-XII-1983 at light, Cote D'Ivoire Bouafle R. T. A. Schouten & J. R. M. Buijsen', GS RS 101 (RMNH) [examined].

Material. – 14 ♂, 32 ♀.

Diagnosis. – Differs from all species, except *ornatus*, by its double medial fascia in combination with a clear ventral ridge, a sharply pointed frons and the presence of a group of three black terminal dots. Can be distinguished from *ornatus* in lacking the lateral lobes.

Distribution. – Senegal, Sierra Leone, Ivory Coast, Ghana, Togo, Nigeria and the Central African Republic.

7. *Euchromius zephyrus* Bleszynski, 1962
(figs. 103-105, 155)

Euchromius zephyrus Bleszynski, 1962: 129. Holotype: ♂, 'Ilesha So. Nigeria (Capt. Humfrey)', GS 7201 (BMNH) [examined]. Schouten (1988: 36) [redescription].

Material. – 27 ♂, 30 ♀.

Diagnosis. – Differs from all other species in having a much ridged frons and vertex.

Distribution. – Senegal, Mali, Ivory Coast, Ghana and Nigeria.

8. *Euchromius tanalis* Schouten, 1988
(figs. 106, 156)

Euchromius tanalis Schouten, 1988: 30. Holotype: ♂, 'Tana R. B.E. Africa. 3800 ft. 2.i.99. R. Crawshay 99-216', GS 17482 (BMNH) [examined].

Material. – 13 ♂, 2 ♀.

Diagnosis. – Difficult to distinguish externally from other species with a double medial fascia. Differs in male genitalia from all other species in having a club-shaped cucullus in combination with a packed row of cornuti in the aedeagus. In female genitalia it is characterized by a tooth-like ostium, the edges directly under the ostium also sclerotized and two signa of unequal length.

Distribution. – Ethiopia and Kenya.

9. *Euchromius mythus* Bleszynski, 1970
(figs. 107, 157)

Euchromius mythus Bleszynski, 1970: 2. Holotype: ♂, 'Diego Suarez', GS 11310 (BMNH) [examined]. Schouten (1988: 32) [redescription].

Material. – 32 ♂, 19 ♀.

Diagnosis. – Difficult to distinguish externally from other species with a double medial fascia. Differs in male genitalia in having the long pointed processus basalis broad at base in combination with a slender long packed row of cornuti in the aedeagus. Differs in female genitalia in posessing a tooth-shaped ostium, the edges directly under the ostium not sclerotized and two signa of unequal length.

Distribution. – Kenya, Tanzania, Zaire, Malawi, Comoro Islands, Madagascar, Zimbabwe, Namibia and South Africa.

10. *Euchromius geminus* Schouten, 1988
(fig. 158)

Euchromius geminus Schouten, 1988: 29. Holotype: ♀, 'Nairobi, BEA. may 1927 (D. M. Hopkins)', GS 17483 (BMNH) [examined].

Material. – 1 ♀.

Diagnosis. – Male unknown. Differs from other species with double medial fascia in female genitalia: the two signa unequal in length in combination with the ductus bursae sclerotized, only for a short part, directly under the ostium and having the edges of tergite VIII connected.

Distribution. – Kenya.

11. *Euchromius galapagosalis* Capps, 1966
(figs. 18-20, 108, 159)

Euchromius galapagosalis Capps, 1966: 5. Holotype: ♀, 'South Seymour Galapagos April 23 1923', GS 12,115 (USNM) [examined].

Material. – 24 ♂, 63 ♀. Ecuador: Pinzon, 7 ♂, 2 ♀ (CASC), 2 ♂ (RTAS). Santa Cruz: Academy Bay, 7 ♂, 4 ♀ (BMNH), 4 ♂, 51 ♀ (CASC), 2 ♂, 4 ♀ (RTAS); Bella Vista Trail, 1 ♂ (CASC); Conway Bay, 1 ♂ (AMNH). South Seymour, 1 ♀ (AMNH), 1 ♀ (USNM).

Diagnosis. – Difficult to distinguish externally from *E. californicalis, E. cornus, E. tanalis, E. mythus, E. limaellus, E. ocelleus, E. saltalis, E. minutus.* Can be separated from these species in having the anterior area of the forewing brownish grey with little or no irroration by darker scales. In male genitalia it differs in having a long slender aedeagus with three groups of cornuti, no lateral cornuti, in combination with a broad elongated processus basalis provided with a small terminal spine which does not arise dorsally. *E. galapagosalis* can be distinguished in female genitalia by the edges of tergite VIII being connected in combination with a toad-stool or lipshaped ostium without lateral folds and signa unequal in size.

External characters male, female (fig. 18). – Wingspan 15-21 mm. Frons produced forward with point, creamy white to light brown, no ventral ridge; vertex creamy white; labial palp two, sides white at base, becoming light grey-brown, light grey-brown from above and below; maxillary palp light brown, dark ringed at base of last segment; antenna creamy white to light grey. Thorax creamy white to light brown; patagia creamy white to light brown, sometimes with two inconspicuous, broad, longitudinal darker stripes; tegulae creamy white to light brown, evenly mottled. Forewing, groundcolour creamy white, posterior area densely suffused with dark brown scales, anterior area evenly greyish coloured, without darker irroration or with but a few darker scales; medial fascia double, gently arched or straight, running to one-fifth of the dorsum; subterminal line brown, about midway between terminal dots and termination of posterior area; area adjacent to terminal dots white; eight, sometimes nine black terminal dots, formula 2-2-3-1 or 2-2-3-2; fringes shiny, with two, sometimes three brown lines. Hindwing grey, subterminal fascia faint, termen darkly bordered; fringes creamy white with brownish line.

Tergite VIII (fig. 19). – Sclerite normally sclerotized, posterior part rectangular, stalk ending abruptly, anterior part very faint, rounded.

Male genitalia (fig. 108). – Uncus normal, slightly bent; gnathos longer, two dorsal thorns, terminal part long; tegumen without appendix angularis; sacculus narrow, processus of sacculus absent, processus basalis broad, elongated, provided with small terminal spine, not arising dorsally, two processi inferiores valvae, cucullus very broad, bent upward, dorsal edge minutely dentate; juxta triangular with two small more strongly sclerotized dorsal projections; vinculum large; aedeagus long, three groups of cornuti, one of which consists of a double row of large cornuti.

Female genitalia (fig. 159). – Papillae anales normal; membrane of tergite VIII with inconspicuous sclerotized line, edges of tergite VIII only connected in middle part; ostium broad, lip-shaped, armed with minute spines; ductus bursae long, for most part strongly sclerotized; ductus seminalis narrow; bursa copulatrix oblong, two signa, unequal in size.

Biology. – Unknown. Specimens caught in January, February (top), April, May and July.

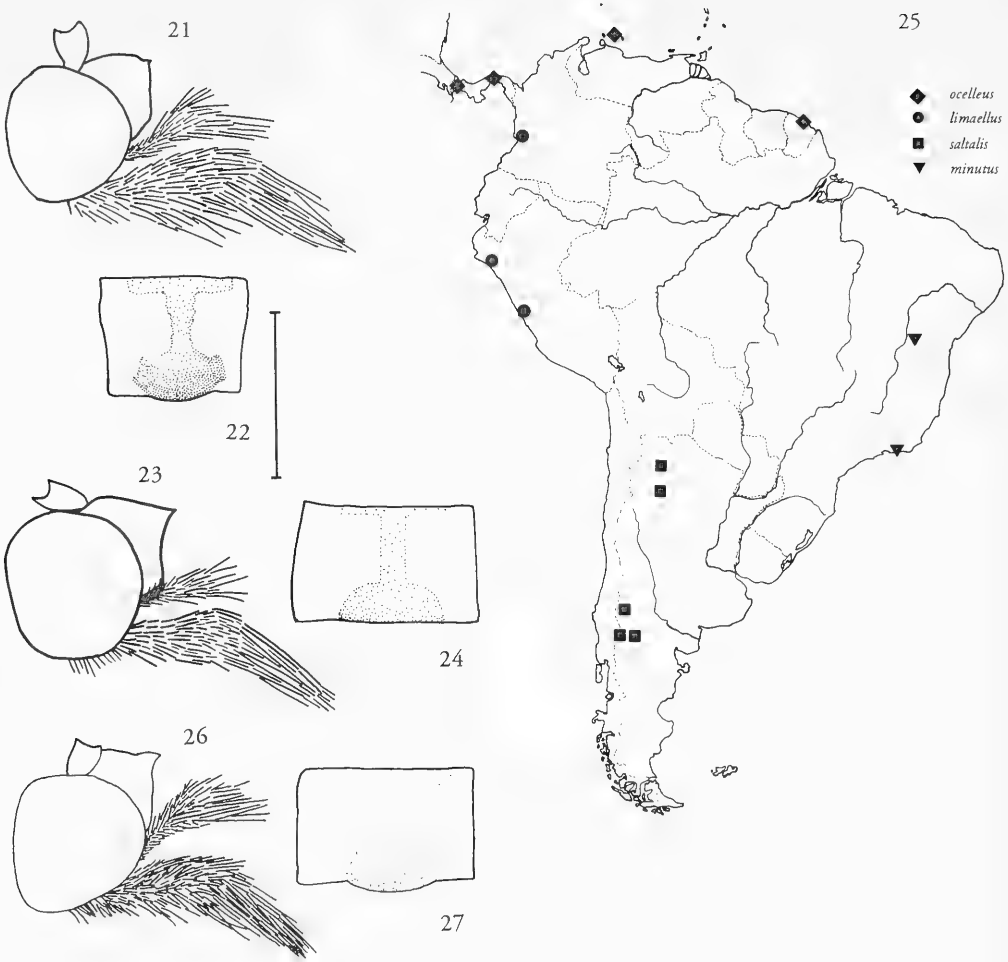
Distribution (fig. 20). – Endemic to the Galapagos Islands.

12. *Euchromius limaellus* Bleszynski, 1967
(figs. 21, 22, 25, 109, 160)

Euchromius limaellus Bleszynski, 1967: 43. Holotype: ♂, 'Lima Peru 20 May 1920 Cornell Univ. Expedition lot 607 sub 55', GS 5161 (CUIC) [examined].

Material. – 4 ♂, 6 ♀. Columbia: Buena Ventura, 1 ♂ (ZMAC). Peru: Callao, 1 ♀ (MNHN); Lima, 1 ♂ (BMNH), 1 ♂, 4 ♀ (CUIC), 1 ♂, 1 ♀ (RTAS).

Diagnosis. – Almost indistinguishable from species with a double medial fascia and frons with one point. Male genitalia differ from the other species in largest group of cornuti being coiled, giving it a wood-rasp appearance. Differs in female genitalia from *E. geminus, E. minutus, E. cornus, E. ocelleus, E. tanalis, E. mythus* in having a mushroom-shaped ostium without hooke-like projections, from *E. californicalis* in having the rim of the ostium clearly dentate.



Figs. 21-27. *Euchromius* species. – 21, *E. limaellus*, head, lateral aspect, scales removed; 22, idem, sclerite of tergite VIII; 23, *E. minutus*, head, lateral aspect, scales removed; 24, idem, sclerite of tergite VIII; 25, distribution map of *E. limaellus*, *E. minutus*, *E. saltalis* and *E. ocelleus*; 26, *E. saltalis*, head, lateral aspect, scales removed; 27, idem, sclerite of tergite VIII. Scale bar 0.5 mm to figs. 21-24, 26-27.

External characters male, female (fig. 21). – Wingspan 17-18 mm. Frons produced forward with point, creamy white to brown, no ventral ridge; vertex creamy white; labial palp two to two and a half, sides white at base, becoming brown, creamy white from above and below; maxillary palp creamy white to light brown, dark ringed at base of last segment, terminal part white; antenna creamy white. Thorax creamy white to light brown; patagia creamy white to light brown with two broad longitudinal light brown stripes; tegulae creamy white, evenly mottled. Forewing, groundcolour creamy white, densely suffused with ochreous to dark brown scales; medial fascia double, arched or nearly straight, running to one-fifth to one-sixth of the dorsum; subterminal line ochreous to dark brown, about midway between terminal dots and termination of posterior area; area adjacent to terminal dots white; nine black terminal dots, formula 2-2-3-2; fringes shiny, creamy white with two or three brown lines. Hindwing creamy white, subterminal fascia present or not, termen darkly bordered; fringes white to creamy white with brownish line.

Tergite VIII (fig. 22). – Sclerite normally sclerotized, posterior part rounded to rectangular, stalk quivered, anterior part faint.

Male genitalia (fig. 109). – Uncus tapering to sharp pointed tip; gnathos longer, two dorsal thorns, terminal part long; tegumen without appendix angularis, membrane of tegumen armed with minute spines; sacculus narrow, processus of sacculus absent, processus basalis small, sharply pointed, two processi inferiores valvae, one at base of processus basalis, cucullus very broad, bent upward, dorsal edge finely dentate in basal half; juxta triangular with two small points; vinculum long; aedeagus long, three groups of cornuti, largest group coiled, having a woodrasp appearance.

Female genitalia (fig. 160). – Papillae anales small; membrane of tergite VIII without sclerotizations, edges of tergite VIII strongly grooved, only connected in the middle forming a rectangular patch above the ostium; ostium large mushroom-shaped, with clear, roughly granulate lip; ductus bursae long, strongly sclerotized, armed with many minute cornuti; ductus seminalis narrow; bursa copulatrix oblong to rounded with two long signa, unequal in size.

Biology. – Unknown. Caught in February and May.

Distribution (fig. 25). – Columbia and Peru.

13. *Euchromius minutus* sp. n.
(figs. 23-25, 110, 161)

Type material. – Holotype: ♂, '19.3 Joazeiro Bras. Exped. Penther '03', GS 465 Naturhistorisches Museum, Wien. Paratypes: 1 ♂, same data as holotype, 1 ♂, 1 ♀, same data as holotype, but caught on 16 Mar and 17 Mar respectively. All in NHMW. 1 ♂, 1 ♀, same data as holotype, but caught on 3.3 and 29.3 respectively, (RTAS). 1 ♀ 'Brasilia Rio de Janeiro 23.XII.1961 (port) Gy. Topal', GS 582 (ZMUC).

Diagnosis. – Externally almost indistinguishable from species with a double medial fascia and frons with one point. Differs in male genitalia from *E. californicalis*, and *E. cornus* in lacking the basal projections of the gnathos, from *E. tanalis*, *E. mythus*, *E. limaellus* and *E. ocelleus* in having the dorsal edge of the processus basalis minutely dentate, from *E. saltalis* in lacking the lateral cornuti of the aedeagus. Differs in female genitalia from *E. tanalis* and *E. mythus* in lacking a tooth-shaped ostium, from *E. cornus*, *E. saltalis* and *E. ocelleus* in having signa unequal in size, from *E. californicalis*, *E. galapagosalis*, *E. limaellus* and *E. geminus* in having the ostium simple, with two hook-like projections.

External characters male, female (fig. 23). – Wingspan 16-20 mm. Frons produced forward with clear sharp point, creamy white to light brown, no ventral ridge; vertex creamy white to light brown; labial palp two, sides creamy white at base, becoming light brown to brown, creamy white from above and below; maxillary palp creamy white to light brown; antenna creamy white. Thorax creamy white to light brown; patagia creamy white; tegulae creamy white to light brown, evenly mottled. Forewing, groundcolour creamy white densely suffused with ochreous to dark brown scales; medial fascia double, gently arched to nearly straight, running to one-fifth to one-fourth of the dorsum; subterminal line ochreous brown, about midway between terminal dots and termination of posterior area; area adjacent to terminal dots white; eight, sometimes nine black terminal dots, formula 2-2-3-1 or 2-2-3-2; fringes shiny, creamy white with one to two brown lines. Hindwing creamy white to light brown, subterminal fascia absent, termen darkly bordered; fringes white with sometimes inconspicuous brownish line.

Tergite VIII (fig. 24). – Sclerite normally sclerotized, posterior part small, rounded, stalk long, anterior part narrow, faint.

Male genitalia (fig. 110). – Uncus normal, slightly bent, tapering to pointed tip; gnathos longer, two dorsal thorns, terminal part long; tegumen without appendix angularis; sacculus narrow, processus of sacculus absent, processus basalis large, broad, dorsal edge minutely dentate, outer corner with bent spine, two processi inferiores valvae, cucullus very broad, dorsal edge dentate; juxta small, triangular with two small dorsal projections; vinculum long; aedeagus slender, three groups of cornuti, one group consisting of a double row.

Female genitalia (fig. 161). – Papillae anales normal; membrane of tergite VIII with one, half-circular sclerotization, edges of tergite VIII connected, anterior edge waved; ostium simple, two hook-like projections, minutely dentate; ductus bursae long heavily sclerotized, armed with many cornuti in upper half; ductus seminalis narrow; bursa copulatrix roundish, signa unequal in size.

Biology. – Unknown. Specimens caught in March and December.

Distribution (fig. 25). – Brazil.

Etymology. – *Minutus* (Latin) refers to the minute dorsal dentation of the processus basalis.

14. *Euchromius saltalis* Capps, 1966
(figs. 25-27, 111, 162)

Euchromius saltalis Capps, 1966: 6. Holotype: ♂, 'Salta Argentina', GS 12,110 (USNM) [examined].

Material. – 14 ♂, 13 ♀. Argentine: Alumine, 1 ♂ (ZMUC); Arroyito, 1 ♂ (RTAS), 7 ♂, 10 ♀ (ZMUC); Chos Malal, 1 ♀ (RTAS), 1 ♂, 1 ♀ (ZMUC); Salta, 2 ♂, 1 ♀ (BMNH), 1 ♂ (USNM); Tucuman, 2 ♂ (ZMUN).

Diagnosis. – Externally almost indistinguishable from species with a double medial fascia and frons with one point. Differs in male genitalia from all species in having a group of lateral cornuti posterior of the anellus connection. Differs in female genitalia from *E. minutus*, *E. geminus*, *E. californicalis*, *E. limaellus*, *E. ocelleus*, *E. cornus*, *E. mythus* and *E. tanalis* in having the edges of tergite VIII connected in combination with signa equal in size.

External characters male, female (fig. 26). – 18-24 mm. Frons produced forward, with clear point, creamy white, no ventral ridge; vertex creamy white; labial palp two, sides creamy white to light brown, creamy white to light brown from above and below; maxillary palp light brown, terminal part lighter; antenna creamy white, from about halfway in conspicuous darkly ringed. Thorax light brown; patagia creamy white to light brown; tegulae creamy white to light brown, evenly mottled. Forewing, groundcolour creamy white densely suffused with ochreous to brown scales; medial fascia double, gently arched to straight, running to one-fifth of the dorsum; subterminal line ochreous brown, about midway between terminal dots and termination of posterior area; area adjacent to terminal dots white; nine or eight black terminal dots, formula 2-2-3-2 or 2-2-3-1; fringes shiny with two ochreous brown lines. Hindwing creamy white, subterminal fascia absent, termen darkly bordered; fringes white with creamy white line.

Tergite VIII (fig. 27). – Sclerite normally sclerotized, posterior part rectangular, stalk narrow, anterior part faint.

Male genitalia (fig. 111). – Uncus normal, slightly bent, tapering to pointed tip; gnathos longer, two dorsal thorns, terminal part long; tegumen without appendix angularis; sacculus narrow, processus of sacculus absent, processus basalis broad rectangular, dorsal edge smooth to very fine dentate, outer corner provided with inwardly bent small spine, two processi inferiores valvae, cucullus very broad, dorsal edge minutely dentate; juxta normal sized, triangular; vinculum long; aedeagus long, armed with group of large lateral cornuti posterior of anellus connection (these may be lost due to copulation, the holotype only has two lateral cornuti left), a double row of large cornuti and two groups of small cornuti.

Female genitalia (fig. 162). – Papillae anales normal; membrane of tergite VIII with very inconspicuous band-shaped sclerotization, edges of tergite VIII connected, forming a rectangular patch above the ostium; ostium simple, lateral with hook-shaped projections, projections minutely dentate; ductus bursae long, very strongly sclerotized with many cornuti in upper half; ductus seminalis narrow; bursa copulatrix oblong with two long equal-sized signa.

Biology. – Unknown. Caught in March, November and December from 850 m (Chos Malal) up to 2500 m (Salta) altitude.

Distribution (fig. 25). – Argentina.

15. *Euchromius ocelleus* (Haworth, 1811)
(figs. 25, 28-31, 112, 163)

Palparia ocellea Haworth, 1811: 486. Holotype: ♂, [United Kingdom] 'ocellea', GS 17541 (BMHN) [examined].

Crambus cyrilli Costa, 1829: 11 [type material presumably lost].

Phycis funiculella Treitschke, 1832: 200 [type material lost].

Eromene texana Robinson, 1870: 155 [type material presumably lost].

Eromene gigantea Turati, 1924: 63. Lectotype ♀ (here designated): 'Cyrenaica Bengasi 2.III.22 Geo. C. Kruger', GS 17540 (BMNH) [examined].

Pseudoancylolomia qadrii Ahmad, Zaidi & Kamaluddin, 1982: 15. Holotype: ♂, 'Kala Shan Kaku, on light'. (ESKK) [examined]. **Syn. n.**

Euchromius ocelleus (Haworth, 1811). Schouten (1988: 38) [redescription].

Material. – 1955 ♂, 1733 ♀.

Diagnosis. – Difficult to separate from other species with a double medial fascia and a pointed frons. Differs from these species in male genitalia by the very broad cucullus, the dorsal edge being finely dentate in basal half in combination with processus basalis large, broad, provided with strong dorsally bent spine, arising from middle of blade and the aedeagus with three groups of cornuti, one of which consists of a double row. Differs in female genitalia in having a small mushroom or lipshaped ostium in combination with the edges of tergite VIII separate and smooth and signa of equal length.

Biology. – *E. ocelleus* has been found in various habitats, viz. cultivated areas, macchia in the Mediterranean, dry savanna in Africa, salt-steppe in the Middle East and salt-areas in North-America. It lives from sea leavel up to high altitudes, viz. up to 3100 m in the La Sal Mountains in Utah, at 1700 m in the Greater Atlas, at 2600 m in Iran and 4200 m in Afghanistan and at 2300 m in the north-eastern part of Burma.

The larvae has been described by Hinton (1943: 202) from a single larva. It is said to be found on stored food-products and owes it wide distribution to human transportation with these products. Since Hinton only had a single larva, it is not certain that it was *E. ocelleus*, or it may be have been accidental that it was found associated with stored food-products. I agree with Hinton on the assumption that the wide distribution of *E. ocelleus* is, at least partly, very likely caused by human transportation. Lhomme (1935-1946) gives dead and decaying leaves, etc. as the food-source, Capps (1966) states that the larvae live on the roots of corn and Milo maize (*Sorghum*). It seem very plausible that *ocelleus*, as larvae or pupae, is transported with remains of plants and is not to be regarded as a pest. It is also certainly migratory since several specimens have been caught at sea as far as 50 miles out of the coast.

Distribution (figs. 25, 28-31). – Africa: Ethiopia, Somalia, Kenya, Tanzania, Central African Republic, Zaire, Uganda, Malawi, Seychelles, Madagascar, Mozambique, Zimbabwe, South Africa, Botswana, Namibia, Angola, Equatorial Guinea, Nigeria, Niger, Bourkina Fasso, Ghana, Senegal, Morocco, Algeria, Tunisia, Libya, Egypt, Sudan. – Europe: Portugal, Spain, France, Great Britain, Belgium, The Netherlands, Denmark, Norway, Sweden, Finland, Italy, Yugoslavia, Greece, Rumania, Bulgaria. – West and Central Asia: Ukraine (Krim). – Near and Middle East: Turkey, Israel, Jordan, Iraq, Saudi Arabia, Yemen, Oman, Kuwait, Iran, Afghanistan, Georgia, Turkmeniya, Tadzhikistan, Kirgiziya. – Southern Asia: Pakistan, India, Nepal, Burma. – Pacific: Hawaii. – Central and South America: Mexico, Panama, Surinam, Netherlands Antilles. – USA: California, Oregon, Washington, Nevada, Utah, Arizona, New Mexico, Kansas, Colorado, Texas, Oklahoma, Florida and Pennsylvania.

Remarks. – Ahmad et al. (1982: 15) published the new species and genus *Pseudoancylolomia qadrii*. Together with the description they figure the male genitalia and wing-venation. Since Ahmad et al. were clearly unaware of the existence of the genus *Euchromius* and all the species belonging to it, they make no reference as how to distinguish *P. qadrii* from *Euchromius* ssp. The characters in which *qadrii* differs from other species are therefore to be found under the genus description. Arguments to synonymize the genus *Pseudoancylolomia* with *Euchromius* have been summarized before, while *P. qadrii* is evidently a synonym of *E. ocelleus* (Haworth, 1811).

16. *Euchromius pulverosus* (Christoph, 1887)
(figs. 32-34, 114, 165)

Eromene pulverosus Christoph in Romanoff 1887: 47. Lectotype ♀ (designated by Bleszynski (1965a: 82)), 'Ordubad', GS 9538 (ZMAS) [examined].

Eromene cochlearella Amsel, 1949: 231. Holotype: ♂, 'Iran, Elbursgebirge Keredj 1936 Leg. Brandt', GS 317 (LNKD) [examined]. **Syn. n.**

Material. – 13 ♂, 14 ♀. Armenia: Ordubad, 1 ♀ (ZMAS). Iran: Demavend, 1 ♂ (INER); Derbend, 1 ♂ (BMNH); Keredj, 2 ♀ (BMNH), 1 ♂ (LNKD); Nesa, 1 ♀ (NHRS). Iraq: Rayat, 1 ♂ (BMNH). Lebanon: Bcharre, 2 ♂ (NHMW), 2 ♂ (ZSMC); Beyrouth, 1 ♂ (MNHN). Turkey: Aksehir, 1 ♂, 1 ♀ (ZSMC); Amanus, 1 ♂ (ZSMC); Artvin, 2 ♀ (LUCA); Ergani, 1 ♂, 2 ♀ (MHNG); Kagizman, 1 ♀ (ZMUC); Malatya, 1 ♀ (BMNH); Marash, 1 ♀ (INER), 1 ♀ (NHMW), 1 ♂, 1 ♀ (ZSMC).

Diagnosis. – Externally indistinguishable from *E. zagulajevi* and *E. confusus*, but can be distinguished from all other species by the eight terminal black dots, tegulae evenly mottled, fringes of the forewing without brown lines and a single medial fascia. Differs in male genitalia from *E. confusus* in having the stalk of the gnathos terminally connected to basal part. Basal part of gnathos and stalk without clear angle. Differs in female genitalia from *E. confusus* in having the projection of the ostium with convex sides. The projection of the ostium lacks in *E. zagulajevi*.

External characters male, female (fig. 32). – Wingspan 20-23 mm. Frons produced forward, with point, creamy white, no ventral ridge; vertex creamy white; labial palp two, sides creamy white at base, becoming brown, creamy white from above and below; maxillary palp brown, terminal part creamy white; antenna creamy white to grey brown. Thorax light to dark brown; patagia creamy white with two broad longitudinal brown stripes; tegulae creamy white to brown, evenly mottled. Forewing, groundcolour creamy white, densely suffused with ochreous to dark brown scales; medial fascia single, slightly arched, running to one-third of the dorsum; subterminal line brown, about midway between terminal dots and termination of posterior area; area adjacent to terminal dots white; eight black terminal dots, formula 2-2-3-1; fringes creamy white at base then evenly grey-brown. Hindwing grey-brown, subterminal fascia absent, termen darkly bordered; fringes creamy white with brownish line.

Tergite VIII (fig. 33). – Sclerite normally sclerotized, posterior part triangular, stalk short broad, anterior part faint.

Male genitalia (fig. 114). – Uncus normal, tapering to pointed tip; gnathos longer, at base with several dorso-lateral spines, dorsal thorns absent, terminal part short swollen; tegumen without appendix angularis; sacculus broad, processus of sacculus not reaching end of cucullus, tip slightly bent upward, strongly sclerotized, processus basalis stout, nearly straight, processus inferior valvae small, elongated, cucullus normal sized, bent upward; juxta triangular; vinculum normal; aedeagus long, slender one small row of cornuti.

Female genitalia (fig. 165). – Papillae anales normal; membrane of tergite VIII with broad tie-like sclerotization armed with node-like central projection, edges of tergite VIII connected; ostium complex with rounded finger-like projection, no parallel sides; ductus bursae long, slightly grooved in upper part; ductus seminalis narrow; bursa copulatrix oblong, no signa.

Biology. – Largely unknown. One long generation, starting in May ending in first half of September. Most abundant in May and June. This species has been caught up to 2100 m.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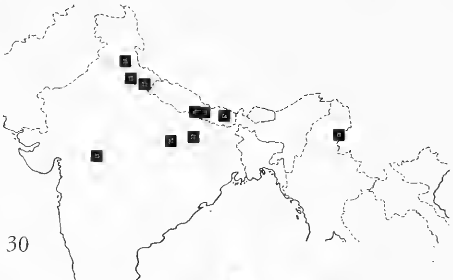
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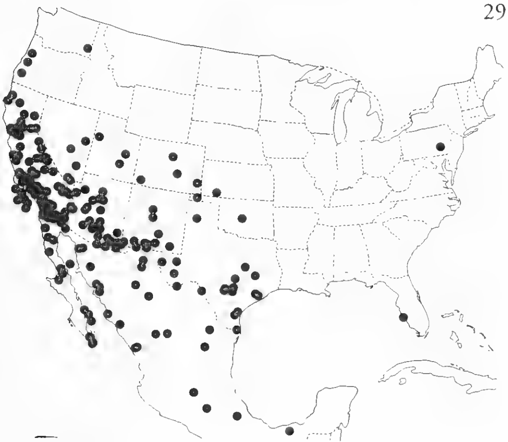
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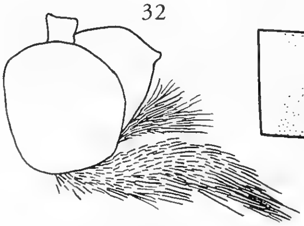
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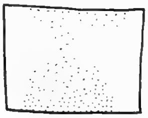
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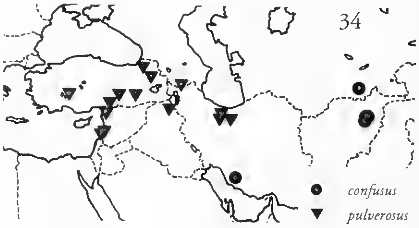
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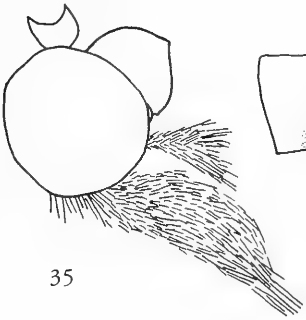
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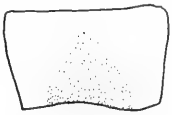
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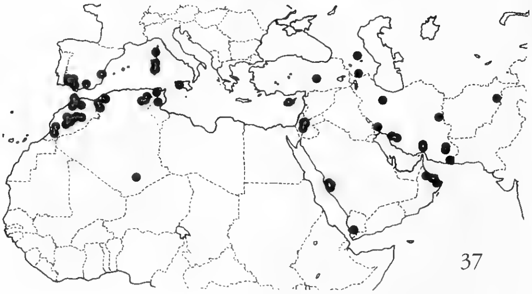
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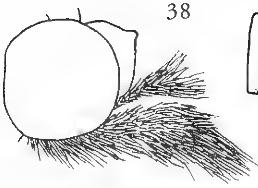
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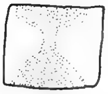
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Distribution (fig. 34). – Found in Turkey, Iran, Iraq, Armenia and Lebanon.

Remarks. – There has been much confusion about the identity of this species. *E. pulverosus* (Christoph, 1887) was originally described from female material only. Amsel (1949: 234) mentioned a male which he found somewhat different from *E. pulverosus*, which he conditionally named '*cochlearella*'. Bleszynski & Collins (1962: 305) first used the name *Euchromius cochlearellus* (Amsel, 1949). Bleszynski (1965a) recorded five male specimens not conspecific with the male of *E. cochlearellus* (Amsel, 1949), which he regarded the male of *E. pulverosus*. He also found two females, difficult to separate from the females of *E. pulverosus*, which he regarded the females of *E. cochlearellus*.

It appeared, however, that the males and females of the two species had been mixed up by Bleszynski. Due to the rearranging of the males and females, *E. cochlearellus* has become a junior synonym of *E. pulverosus*, leaving the other species without a name. The name for the latter is *Euchromius confusus*.

17. *Euchromius confusus* sp. n.

(figs. 34-36, 113, 164)

Euchromius cochlearellus auct., nec Amsel [misidentification].

Type material. – Holotype: ♀, '1-9.8.1962 Afghanistan. Paghman 30 km NW v. Kabul, 2100m E. & A. Vartian leg.', GS 17758 (BMNH). Paratypes: 2 ♂, '20.u.28.VI.1965 Afghanistan Paghman, 30 km NW v. Kabul, 2500m Kasy & Vartian', (NHMW). 1 ♀, '20.-30.7.1962 Afghanistan Paghman, 30 km NW v. Kabul, 2100m E. & A. Vartian leg.', (NHMW). 1 ♀, same data as holotype, (NHMW). 1 ♀, 'J. Klapperich Ghorbandtal 1900m 26.8.52 O-Afghanistan', (BMNH). 1 ♂, 1 ♀, same data as previous, (RTAS) respectively (LNKD). 3 ♂, Kondara Tadzhikistan Gissar-range 21.VII 946, (BMNH). 1 ♂, O-Afghanistan Gulbahar 1700m 2-9, (LNKD). 1 ♀, Zeitun, (BMNH). 2 ♀, 'Iran Taug-Ab nr. Firuzabad Fars 4000ft 6-IV-50 FF19 E.P. Wiltshire', GS 17761 (BMNH). 1 ♂, no locality label, GS 16600 (BMNH). 1 ♂, no locality label, (BMNH). 1 ♂, 1 ♀, Tadzhikistan Gissar 27.v.1985, (ZMAS).

Diagnosis. – Externally indistinguishable from *E. zagulajevi* and *E. pulverosus*, but can be distinguished from all other species by the eight terminal black dots, tegulae evenly mottled, fringes of the forewing without brown lines and a single medial fascia. Differs in male genitalia from *E. pulverosus* in having the stalk of the gnathos not terminally connected to basal part. Basal part of gnathos and stalk connected at right angle. Differs in female genitalia from *E. pulverosus* in having the projection of the ostium parallel-sided. The projection of the ostium lacks in *E. zagulajevi*.

External characters male, female (fig. 35). – Wingspan 20-23 mm. Frons produced forward, with point, creamy white to brown, no ventral ridge; vertex creamy white to brown; labial palp two, sides creamy white at base, soon becoming brown, creamy white from above and below; maxillary palp brown, terminal part creamy white; antenna grey to grey-brown. Thorax light to dark brown; patagia creamy white with two broad longitudinal light to dark brown stripes; tegulae light to dark brown, evenly mottled. Forewing, groundcolour creamy white densely suffused with ochreous to dark brown scales; medial fascia single, slightly bent, running to one-third of the dorsum; subterminal line brown, about midway between terminal dots and termination of posterior area; area adjacent to terminal dots white; eight black terminal dots, formula 2-2-3-1; fringes creamy white at base then evenly grey-brown. Hindwing grey-brown, subterminal fascia absent, termen darkly bordered; fringes creamy white with brownish line.

Tergite VIII (fig. 36). – Sclerite normally sclerotized, posterior part triangular, stalk and anterior pattern not visible.

Male genitalia (fig. 113). – Uncus normal, bent; gnathos longer, basal part enlarged, basal edge dentate with strong spines, terminal part short, connected at right angle to stalk; sacculus normal, processus of sacculus reaching up to half of cucullus, bent upward, strongly sclerotized, processus basalis long, slightly bent inward, dorsal edge inconspicuous roughly dentate in posterior part, processus inferior valvae elongated, cucullus long, slender, slightly constricted about halfway; juxta slightly triangular; vinculum normal sized; aedeagus normal sized, one small clear row of cornuti, posterior a second faint group of cornuti.

Female genitalia (fig. 164). – Papillae anales normal; membrane of tergite VIII with tie-like sclerotiza-

Figs. 28-40. *Euchromius* species. – 28, distribution of *E. ocelleus*, European and North African distribution (distribution in Mauritania, Mali, Niger, Tchad, the Central African Republic, Ethiopia and all other countries south of these are not depicted, but see Schouten 1988); 29, distribution of *E. ocelleus* in North America; 30, distribution of *E. ocelleus* in the Oriental region; 31, distribution of *E. ocelleus* in Hawaii; 32, *E. pulverosus*, head, lateral aspect, scales removed; 33, idem, sclerite of tergite VIII; 34, distribution of *E. confusus* and *E. pulverosus*; 35, *E. confusus*, head, lateral aspect, scales removed; 36, idem, sclerite of tergite VIII; 37, distribution of *E. vinculellus* (distribution in Niger and Kenya are ommited); 38, *E. anapiellus*, head, lateral aspect, scales removed; 39, idem, sclerite of tergite VIII; 40, distribution of *E. anapiellus*. Scale bar 0.5 mm to figs. 32, 35-36, 38-39.

tion, armed with small central projection, edges of tergite VIII connected; ostium complex, large tooth-shaped projection with parallel sides; ductus bursae long, minutely grooved in upper part; ductus seminalis narrow; bursa copulatrix oblong, no signa.

Biology. – Unknown. Collections from April, May, June, July, August and September. Most specimens in July and August, up to 2500 m altitude.

Distribution (fig. 34). – A Central-Asian species, found in Tadzhikistan, Afghanistan and Iran.

Remarks. – See under *E. pulverosus.*

18. ***Euchromius vinculellus*** **(Zeller, 1847)**
(figs. 9, 37, 115-117, 166)

Crambus vinculellus Zeller, 1847: 760. Neotype: ♂ (designated by Bleszynski (1960: 211)), GS 628 (ZMHB) [not examined].

Ommatopteryx corsicalis Hampson, 1919: 534. Holotype: ♂, 'Vizzavona Corsica 11.VI.1899 Wlsm 1910. 166', GS 5647 (BMNH) [examined].

Ommatopteryx asbenicola Rothschild, 1920: 220. Holotype: ♀, 'Auderas, Asben 26 July 20 (A. Buchanan)', GS 5675 (BMNH) [examined].

Eromene joiceyella Schmidt, 1934: 538. Holotype: ♂, '42.27. Timmel S.E. Slopes Great Atlas Morocco 20.V.27 at light Talbot & Le Cerf'. (BMNH) [examined].

Eromene bahrlutella Amsel, 1949: 236. Lectotype: ♂ (designated by Bleszynski (1965a: 82)), 'Sudende des Toten Meeres 15.-27.3.33 Aigner leg. H. Amsel', GS 320 (LNKD) [examined].

Euchromius vinculellus (Zeller, 1847) Schouten (1988: 26) [redescription].

Material. – 57 ♂, 67 ♀. Afghanistan: Sarobi, 2 ♂, 2 ♀ (LNKD). Algeria: 70 km NE of Tamanrasset, 1 ♀ (BMNH); El Kantara, 1 ♂, 1 ♀ (BMNH); Hammam-Meskoutine, 1 ♂ (BMNH); Lambese, 1 ♀ (BMNH); Marsa-ben-Mehidi, 1 ♂ (BMNH); Sebdou, 2 ♂ (BMNH); Sidi-bel-Abbes, 1 ♀ (BMNH). Cyprus: Ayios Joannis, 1 ♀ (NHMW); Limasol, 1 ♀ (NHMW). France: Ajaccio, 1 ♀ (NHMW); Vizzavona, 1 ♂ (BMNH). Georgia: Lagodekhi, 1 ♀ (ZMAS). Iran: 11 km NE of Karevandar, 1 ♂, 1 ♀ (LNKD); 22 km N of Bandar-Abbas, 3 ♂ (NHMW); 52 km S of Sirjan, 1 ♂, 1 ♀ (NHMW); Ahwas, 1 ♂ (BMNH); Bender Abbas-Sardabad, 1 ♂, 1 ♀ (NHRS); Bender Chahbahar, 1 ♀ (LNKD), 1 ♂ (NHRS); Bender Chahbahar-Iranshar, 1 ♀ (LNKD); Firouzabad, 1 ♂ (BMNH); Kazeroun-Bouchir, 1 ♀ (NHRS); Keredj, 1 ♀ (NHRS). Israel: Jericho, 1 ♂ (LNKD), 1 ♀ (NHMW); South end of Dead Sea, 1 ♂, 1 ♀ (LNKD). Italy: Arcu Neridu, 1 ♂ (LNKD); Bucherri, 1 ♂ (RTAS); Can Gutluru Mannu, 1 ♀ (LNKD); Musei, 1 ♂ (LNKD); Partenico, 1 ♀ (INER); Porto Santoru, 1 ♀ (INER); Putifigari, 1 ♂, 1 ♀ (IZUI); Sinecola, 1 ♂ (LNKD); Teulada, 1 ♀ (LNKD). Jordan: Amman, 2 ♀ (ZFMK); Zarqa, 2 ♀ (LNKD). Kenya: South Horr, 1 ♀ (LACM). Morocco: 15 km SW of Tazenakht, 1 ♀ (ZMUC); Barrage Cavagnac, 1 ♀ (MHNG); Chechaouen, 2 ♀ (NHMW), 1 ♂ (ZFMK); Demnate, 1 ♀ (BMNH); Goundafa, 1 ♀ (BMNH), 4 ♀ (NHMW); Ijoukak, 1 ♀ (MNHN); Ljourar, 1 ♀ (BMNH); Ketama, 1 ♀ (LNKD), 1 ♂ (MNMS); Quirgane, 1 ♂ (LNKD), 1 ♂, 1 ♀ (ZFMK); Tangier, 1 ♀ (MNMS); Taroudant, 1 ♂ (MNHN); Timmel, 1 ♂ (BMNH), 1 ♂ (MNHN); TINERhir, 1 ♀ (ZMUC); Zemmouro, 1 ♀ (BMNH). Niger: Aouderas, 1 ♀ (BMNH). Nikhichevan: Ordubad, 1 ♀ (ZMAS). Oman: Ghubra, 1 ♀ (BMNH); Misfah, 1 ♂ (BMNH); Muscat, 1 ♂, 1 ♀ (BMNH); Wadi al Khawb, 1 ♀ (BMNH); Wadi Bani Khalid, 2 ♂, 1 ♀ (BMNH); Wadi Fanjah, 1 ♀ (BMNH). Saoud Arabia: Buraiman, 1 ♀ (BMNH); Makakah, 1 ♀ (NHMB); Sadiyah, 5 ♂,5 ♀ (NHMB); Wadi Majarish, 2 ♂ (NHMB). Spain: Altea, 1 ♀ (ZFMK); El Rompido, 1 ♀ (LNKD); Nerva, 2 ♀ (HULL); Periane, 1 ♀ (GIEL), 1 ♂, 2 ♀ (HULL); Ronquilla, 1 ♂ (DERR), 3 ♂ (GIEL), 1 ♂ (HULL), 5 ♂ (RTAS); San Pablo, 1 ♂ (GIEL). Tunisia: 25 km SE of Ain Draham, 1 ♂ (ZMUC); Bou-Hedma, 1 ♂ (INER). Turkey: Malatya, 1 ♂ (BMNH). Yemen Arabic Republic: Suq as Sabi, 1 ♀ (RTAS).

Diagnosis. – Differs from all other species by its straight single medial fascia in combination with six or seven black terminal dots and having a yellow area adjacent to the black terminal dots.

Biology. – Largely unknown. Flight-periods can be split into three parts. Firstly south of the Mediterranean Sea (Morocco, Algeria and Tunisia), where this species has two generations and was caught from March to September, with peaks in May-June and August-September. Secondly the area north of the Mediterranean Sea (Spain, France and Italy), where there are two more or less continuous generations from April to October with peaks in May and August-September. Thirdly, east of the Mediterranean where specimens have been caught all year round, with peaks in March-April-May and September-October. Highest recorded altitude 1400 m in Morocco.

Distribution (fig. 37). – Spain, France, Italy, Cyprus, Turkey, Georgia, Afghanistan, Iran, Oman, Saudi Arabia, Jordan, Israel, Yemen Arabic Republic, Kenya, Niger, Tunisia, Algeria and Morocco.

Remarks. – Bleszynski (1965a: 81) and Schouten (1988: 26) incorrectly state the male with GS 628 Bl. as the lectotype; this should read 'neotype'.

19. ***Euchromius anapiellus*** **(Zeller, 1847)**
(figs. 38-40, 122, 171)

Crambus anapiellus Zeller, 1847: 757. Lectotype: ♀ (designated by Bleszynski (1960: 211)), 'Syracus Zell. coll. 1884', GS 5655 (BMNH) [examined].

Eromene bellus var. *minorella* Chrétien: in Lhomme (1935-1946: 84) [unavailable, manuscript name of Chrétien, specimens in Paris Museum under *minorella* belong to *E. anapiellus*].

Material. – 50 ♂, 57 ♀. Algeria: Bone, 1 ♂, 1 ♀ (-MNHN); Djebel-Aurés, 1 ♂ (BMNH); Guelt, 1 ♀ (MNHN); Hamman R'irha, 2 ♂, 1 ♀ (BMNH); Lambese, 4 ♂, 1 ♀ (BMNH), 1 ♂ (NHMB); St. Charles, 2 ♂ (MNHN); Qued Hamidou, 1 ♂ (BMNH); Tarfaia, 1 ♀ (MNHN). France: Anduse, 1 ♀ (MNHN); Bize, 4 ♂, 4 ♀ (MNHN); Bonnieux, 1 ♀ (RTAS), 1 ♀ (WOLF); Durban-Sigean, 2 ♀ (ZMUC); Feudu-Var, 1 ♂ (robi); La Penne-s-L'Ouvèze, 1 ♂, 2 ♀ (rtas), 4 ♀ (wolf); Le Mans, 1 ♂ (mhng); Les Carbonnes de Fleurs, 5km N. of Narbonne, 1 ♀ (huis); Nimes, 1 ♂ (mnhn); Pouzols, 1 ♂ (huis); Saignon, 1 ♀ (robi); Ste Croix, 1 ♂ (mnhn); Ste Guilhem, 1 ♀ (mnhn). Italy: Casel Daccia, 1 ♂ (iner); Sicilia, 1 ♀ (mczc), 1 ♂, 1 ♀ (nhmw); Syracus, 2 ♂, 6 ♀ (bmnh), 1 ♀ (lnkd), 4 ♂, 1 ♀ (nhmb), 7 ♂, 5 ♀ (nhmw), 1 ♂, 1 ♀ (nhrs), 1 ♂, 1 ♀ (zfmk), 1 ♀ (zsmc); Zappulla, 1 ♂ (nhmw). Morocco: Azzou, 1 ♂ (bmnh); Meknes, 1 ♂ (bmnh); Rabat, 1 ♂ (bmnh); Sebou, 1 ♂ (bmnh); Tangier, 3 ♂, 8 ♀ (bmnh), 1 ♂, 1 ♀ (zfmk). Spain: Jaca, 3 ♀ (bmnh); Korb, 1 ♀ (bmnh); San Antonia, 1 ♂ (nhrs); San Roque, 1 ♀ (hull); Tirade, 1 ♀ (hull). Tunisia: Ain Draham, 3 ♀ (bmnh); El Gounia 1 ♂ (zsmc); Sfax, 1 ♀ (bmnh).

Diagnosis. – Similar to *E. bellus*, but can be distinguished by the narrow yellow area adjacent to terminal dots, which is broad and white in *E. bellus*. The male of *E. anapiellus* differs from *E. bellus* in having a cornutus which is curved less than 180° (figs. 122, 123). Differs in female genitalia from *E. bellus* in having the sclerotization in ostium two times as long as broad, three times as long as broad in *E. bellus* (figs. 171, 172).

External characters male, female (fig. 38). – Wingspan 13-17 mm. Frons produced forward, with point, creamy white, no ventral ridge; vertex creamy white; labial palp two, sides white at base, becoming brown, creamy white from above and below; maxillary palp creamy white, brown ringed at base of last segment, terminal part creamy white; antenna creamy white to light grey, from about the middle inconspicuous darkly ringed. Thorax creamy white; patagia creamy white with two broad longitudinal light brown stripes; tegulae creamy white with dark patch in the middle. Forewing, groundcolour white densely suffused with ochreous to dark brown scales; medial fascia double, inner one usually reduced, outer fascia straight, running to one-third of the dorsum; subterminal line ochreous to dark brown, about midway between terminal dots and termination of posterior area; area adjacent to terminal dots narrow, yellow; nine or eight black terminal dots, formula 2-2-3-2 or 2-2-3-1; fringes shiny, evenly grey-brown. Hindwing light brown to dark grey, subterminal fascia present, termen darkly bordered; fringes creamy white with brownish line.

Tergite VIII (fig. 39). – Sclerite normally sclerotized, posterior part slightly larger than anterior part, stalk stout.

Male genitalia (fig. 122). – Uncus normal, tapering to sharp pointed tip; gnathos longer, with two dorsal thorns, terminal part long; tegumen without appendix angularis; sacculus swollen, swollen, partly armed with thin elongated crest, processus of sacculus short, blunt, dorsal processus of sacculus pointed, processus basalis broad at base, tapering soon, bent inward, ventral terminal part minutely dentate, processus inferior valvae at base of processus basalis, small, cucullus broad, slightly bent upward at tip; juxta broad triangular; vinculum rectangular; aedeagus small, one large pointed cornutus.

Female genitalia (fig. 171). – Papillae anales normal; membrane of tergite VIII without clear sclerotizations; edges of tergite VIII not connected; ostium simple, somewhat pointed, sclerotization two times as long as broad, ductus bursae posterior part broad; ductus seminalis narrow; bursa copulatrix elongated, signa absent.

Biology. – Unknown. Flies after sunset (Zeller 1847). One generation, the first specimens were caught in the first half of May. It continues through June, July, August to the end of September.

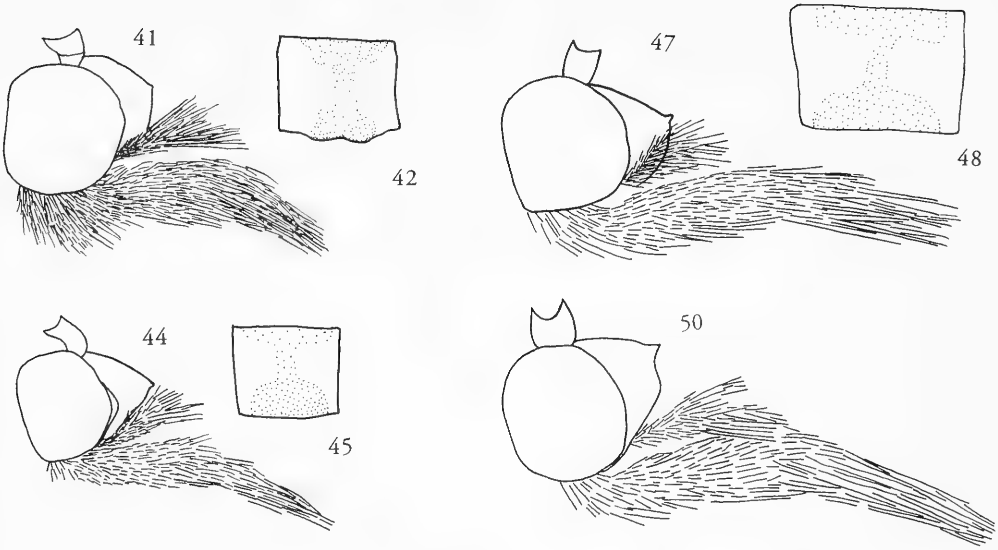
Distribution (fig. 40). – A West-Mediterranean species, occurring in Spain, France, Italy, Tunisia, Algeria and Morocco.

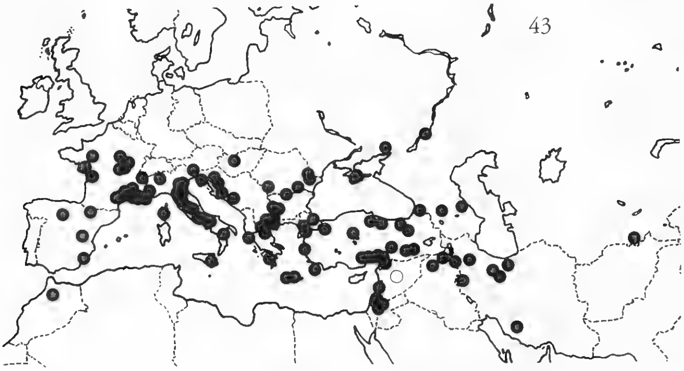
Remarks. – Roesler (1983: 12) records Sardinia. Records from Portugal (Mendes D'Azevedo 1904-1905: 226, Vieilledent 1905: 201, Zerkowitz 1946: 145) and Egypt and Asia Minor (Bleszynski 1965a: 69) seem to be based on misidentified material. Material under *E. anapiellus* in mzcp from Portugal turned out to belong to *E. gozmanyi*.

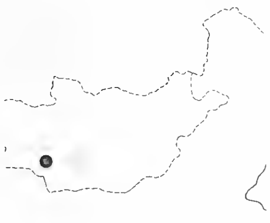
20. *Euchromius bellus* (Hübner, 1796)
(figs. 9, 41-43, 123, 172)

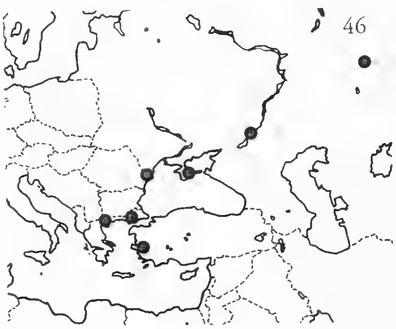
Tinea bella Hübner, 1796: 29. Syntypes: 'Hungary' [lost].
Eromene bellalis Hübner, [1825]: 366 [lapsus calami].
Euchromius bellus (Hübner, 1796); Guenée 1845: 324.
Ommatopteryx bellus (Hübner, 1796); Kirby 1897: 274.
Ommatopteryx bellus var. *minorella* Chrétien in Lhomme (1935-1946: 84) [name unavailable, manuscript name of Chrétien, incorrect identification, the specimens belong to *E. anapiellus*].

Material. – 253 ♂, 215 ♀. Armenia, 1 ♂, 1 ♀ (iccm). Bulgaria: Bunkera, 1 ♂ (rtas); Ichtyman, 1 ♂ (nhmw); Kozuch, 2 ♀ (rtas); Sistova, 2 ♂ (iner), 1 ♂ (smtd), 9 ♂, 7 ♀ (zsmc). France: Abries, 1 ♂ (mnhn); Aizenay, 1 ♀ (mnhn); Allauch La Clu, 1 ♀ (mnhn); Autun, 1 ♂, 1 ♀ (mnhn); Berre, 1 ♂, 1 ♀ (mnhn); Borgo, 1 ♀ (mnhn); Camargue, 1 ♀ (lnkd); Cannes, 1 ♂, 1 ♀ (bmnh); Chatebaillon, 1 ♂ (mnhn); Col de Homme Mort, 1 ♂ (robi); Corse, 1 ♀ (mnhn); Cravant, 2 ♀ (mnhn); Decoster, 1 ♀ (mnhn); Lantosque, 1 ♂ (mnhn); Digne, 1 ♂ (bmnh), 2 ♂ (iner), 1 ♀ (lnkd), 5 ♂, 5 ♀ (mnhn); Entrevaux, 2 ♂, 1 ♀ (bmnh); Florae, 1 ♀ (mnhn); Foret St. Baume, 9 ♂, 2 ♀ (wolf), 1 ♂ (rtas); Gemenos, 1 ♂ (wolf); La Banne, 1 ♂, 1 ♀ (mnhn); La Baume, 1 ♂, 2 ♀ (ansp); La Voulte sur Rhone, 6 ♂ (mnhn); Le Mans, 1 ♂, 1 ♀ (mhng); Le Restugaud, 12 ♂, 5 ♀ (robi); Le Rozier, 1 ♂ (mnhn); Montpellier, 1 ♂ (mnhn); Nans, 1 ♂, 1 ♀ (ansp); Nievre, 2 ♂, 2 ♀ (mnhn); Pelissanne, 2 ♂ (mnhn); Ste André les Alpes, 1 ♂ (mnhn); St Barnabe, 1 ♀ (mnhn); Ste-Croix, 3 ♀ (mnhn); St. Guilhem le Desert, 1 ♀ (mnhn); Vaucluse,









Figs. 41-51. *Euchromius* species. – 41, *E. bellus*, head, lateral aspect, scales removed; 42, idem, sclerite of tergite VIII; 43, idem, distribution map (open circle: exact locality not found); 44, *E. bleszynskiellus*, head, lateral aspect, scales removed; 45, idem, sclerite of tergite VIII; 46, idem, distribution map; 47, *E. bleszynskii*, head, lateral aspect, scales removed; 48, idem, sclerite of tergite VIII; 49, idem, distribution map; 50, *E. scobiolae*, head, lateral aspect, scales removed; 51, idem, distribution map. Scale bar 0.5 mm to figs. 41-42, 44-45, 47-48, 50.

2 ♀ (MNHN); Volonne, 1 ♂, 1 ♀ (NHMB). Georgia: Gonia, 1 ♀ (ZMAS); Tbilisi, 1 ♂ (ZMAS). Greece: Chalkidike, 4 ♀ (IZUI); Corfu, 1 ♂ (NHMW); Kournas, 2 ♀ (LNKD); Lithochoron, 1 ♂ (LNKD); Niki, 1 ♂ (LUCA); Lindos, 2 ♀ (RMNH); Spili, 1 ♀ (LNKD); Vrises, 1 ♂ (LNKD). Hungary: no locality, 1 ♂ (BMNH), 1 ♂ (LNKD), 1 ♂ (MCZC), 1 ♂ (MHNG), 3 ♂, 1 ♀ (NHMW), 6 ♂, 2 ♀ (RMNH), 1 ♂ (ZMUN), 2 ♂ (ZSMC); Budafok, 2 ♂ (BMNH). Iran: Keredj, 2 ♂, 1 ♀ (NHRS); Kermanshah, 2 ♂, 2 ♀ (LNKD); Persepolis, 1 ♂, 1 ♀ (LNKD); 100 km Mahabad-Sardascht, 2 ♀ (LNKD); 40 km S. of Shahabad, 1 ♀ (LNKD); 90 km S. of Teheran, 1 ♂ (LNKD); 53 km S. of Zanjan, 1 ♂ (LNKD). Iraq: Diana, 1 ♂ (BMNH); Mosul, 5 ♂, 2 ♀ (NHMW); Rowanduz, 1 ♂ (BMNH); Salahuddin, 1 ♂ (BMNH). Israel: Cesaree, 4 ♂ (MNHN); Haifa, 1 ♂ (LNKD), 1 ♀ (ZFMK); Tel Aviv, 1 ♂ (NHMW); Sedom, 1 ♂, 1 ♀ (BMNH). Italy: Albano, 1 ♀ (ZSMC); Anagui, 2 ♂, 3 ♀ (MNHN); Bologna, 4 ♂, 2 ♀ (BMNH); Brummana, 1 ♂, 3 ♀ (BMNH); Campo Basso, 1 ♂, 1 ♀ (BMNH); Fondi, 1 ♂, 1 ♀ (INER); Furbara, 5 ♂, 8 ♀ (INER); Maiella, 3 ♂, 1 ♀ (INER); Montagnana, 1 ♂ (MNSM); Monte Autore, 1 ♂ (NHMB); Monte Vernita, 1 ♂ (CASC), 1 ♀ (PRIN), 10 ♂, 9 ♀ (RTAS), 1 ♂, 1 ♀ (TMSA), 1 ♂, 1 ♀ (ZMAN); Mtgna Grande, 1 ♂, 3 ♀ (BMNH), 1 ♂ (LNKD), 14 ♂, 8 ♀ (ZSMC); Ovindoli, 1 ♂, 2 ♀ (BMNH); Orvieto, 1 ♂, 1 ♀ (INER); Prato, 1 ♂ (NHMW); Ravone, 1 ♀ (ZSMC); San Pietro, 4 ♂, 8 ♀ (MNSM); Sestola, 1 ♂, 1 ♀ (BMNH), 1 ♂ (LNKD), 1 ♀ (NHMB); Spoleto, 1 ♂, 1 ♀ (NHMB); Syracus, 1 ♂ (NHMW); Tivoli, 3 ♂, 4 ♀ (ZSMC); Toscane, 1 ♂ (NHMB); Tradone, 1 ♂ (ZSMC). Jordan: Amman, 1 ♂ (ZFMK); Dehbeen, 1 ♀ (LNKD); Zarqa, 1 ♂ (LNKD). Lebanon: Beirut, 4 ♂, 1 ♀ (MNHN), 1 ♀ (NHMB), 1 ♂, 2 ♀ (NHMW), 1 ♂ (ZMAN). Morocco: Ifrane, 1 ♀ (LNKD). Rumania: Bucuresti, 1 ♀ (BMNH), 1 ♀ (MNHN); Mehadia, 1 ♀ (BMNH); Rimnicu Sarat, 1 ♂ (MNHN); Tecuci, 1 ♂ (BMNH). Russia: Rubas, 1 ♂ (ZMAS); Sarepta, 1 ♂, 1 ♀ (MNHN); Taganrog, 2 ♂, 2 ♀ (ZMAS). Spain: Andalusia, 1 ♂, 1 ♀ (CUIC); Burgos, 1 ♂ (MNHN); Jaca, 12 ♂, 9 ♀ (BMNH); Murcia, 1 ♂ (BMNH), 1 ♂ (NHRS); Tragacete, 1 ♂ (GIEL). Syria: no locality, 1 ♀ (BMNH), 1 ♀ (MHNG), 1 ♀ (RMNH). Tadzhikistan: Kurgan-Tjube, 1 ♂ (NHMW). Turkey: Adana, 2 ♂ (MNHN); Aksehir, 2 ♂, 1 ♀ (NHMW), 1 ♀ (ZSMC); Alexandrette, 1 ♂ (MNHN); Amassia, 1 ♂, 3 ♀ (MNHN); Ankara, 2 ♂, 1 ♀ (MHNG), 2 ♂, 1 ♀ (NHMW); Bursa, 1 ♂ (BMNH), 2 ♂, 6 ♀ (INER), 1 ♀ (NHMW); Diyarbakir, 1 ♂ (BMNH), 1 ♂, 1 ♀ (ZFMK); Gallipoli, 1 ♂, 1 ♀ (BMNH); Gümüshane, 1 ♂ (ZMUC); 7 km W. of Horasan, 1 ♂ (LUCA); Konya, 2 ♂, 6 ♀ (LUCA); Malatya, 1 ♀ (BMNH); Marasch, 1 ♂ (BMNH), 1 ♂, 1 ♀ (INER), 1 ♂, 3 ♀ (SMTD), 1 ♂, 5 ♀ (ZSMC); Palandoken, 1 ♂ (LUCA); Pontus, 1 ♂, 1 ♀ (BMNH); Smyrna, 1 ♀ (BMNH); Tekirdech, 1 ♀ (MAES); Yenisehir, 1 ♂, 2 ♀ (MAES); Yuksek Dagh, 2 ♀ (ZSMC); Zanapa, 5 ♂, 6 ♀ (MAES). Ukraine: Kara-dag, 1 ♂, 4 ♀ (ZMAS); Stevastopol, 1 ♂ (ZMAS). Yugoslavia: Drenovo, 2 ♀ (ZSMC); Gruz, 1 ♀ (NHMW); Istria, 1 ♂ (NHMW); Radobje, 1 ♂ (NHMW); Ragusa, 1 ♂, 1 ♀ (NHMW); Rovinj, 1 ♂ (LNKD); Spalato, 2 ♂ (NHMW).

Diagnosis. – Resembling *E. anapiellus* for differences see under diagnosis of that species.

External characters male, female (figs. 9, 41). – Wingspan 14-19 mm. Frons produced forward with small point or without, creamy white, usually with darker centre, no ventral ridge; vertex creamy white to light brown; labial palp two and a half, sides creamy white at base, becoming light brown to dark grey-brown, creamy white from above and below; maxillary palp creamy white to light brown, light brown to dark grey at base of last segment; antenna creamy white, inconspicuous greyish ringed. Thorax creamy white to grey-brown; patagia creamy white with two broad longitudinal light brown to grey-brown stripes; tegulae creamy white with dark patch in the middle. Forewing, groundcolour creamy white, densely suffused with ochreous to dark brown scales, anterior area yellow to brown-grey; medial fascia double, arched to nearly straight, inner fascia reduced or not, line between double fascia white, seldom silvery, outer fascia running to one-third of the dorsum; subterminal line ochreous to dark brown, closer to termination of posterior area than to terminal dots; area adjacent to terminal dots broad, white; nine or eight black terminal dots, formula 2-2-3-2 or 2-2-3-1; fringes shiny, evenly greyish. Hindwing creamy white to dark grey, subterminal fascia present, termen darkly bordered; fringes creamy white with grey to brownish line.

Tergite VIII (fig. 42). – Sclerite normally sclerotized, posterior part large, rectangular, anterior part small.

Male genitalia (fig. 123). – Uncus normal, tapering to sharp pointed tip; gnathos longer, two dorsal thorns, terminal part long; tegumen without appendix angularis; sacculus swollen, processus of sacculus short, blunt, two dorsal processi, processus basalis broad at base tapering soon, bent inward, ventral terminal part minutely dentate, processus inferior valvae small, at base of processus basalis, cucullus broad, pointed tip bent upward; juxta broad triangular; vinculum normal; aedeagus large, one large curved cornutus.

Female genitalia (fig. 172). – Papillae anales normal; membrane of tergite VIII without clear sclerotizations; edges of tergite VIII not clearly connected; ostium simple, large rectangular sclerotization continued into ductus bursae, three times as long as broad, ductus bursae posterior part very broad, sac-shaped, partly wrinkled, anterior part more narrow, ductus seminalis narrow, bursa copulatrix elongated, very lightly sclerotized, signa absent.

Biology. – The single generation flies from May up to the end of August. The flight reaches its peak in July. In Israel a specimen has been caught on the 30th of March. In Italy *E. bellus* has been caught up to 1400 m, in Turkey up to 2200 m and in Iran up to 2000 m. Hogenes (pers. comm.) caught the moths in Italy at very hot and dry localities, with scarce herbal vegetation with very few grasses. The larva is mentioned to live on dry leaves of *Picris* and *Scabiosa*, also recorded to attack the roots and flower heads (Millière 1868: 219).

Distribution (fig. 43). – This species is one of the commonest of the genus. It occurs in Spain, France, Italy, Yugoslavia, Hungary, Rumania, Bulgaria, Greece, Turkey, Russia, Ukraine (Krim), Georgia, Tadzhikistan, Iraq, Iran, Syria, Jordan, Lebanon, Israel and Morocco. Bleszynski (1965A: 69) also records Czechoslovakia.

Remarks. – Butler (1882: 42) mentions *E. bellus* from Honolulu. This reference refers to *E. ocelleus.*

21. *Euchromius bleszynskiellus* Popescu-Gorj, 1964
(figs. 44-46, 124, 173)

Euchromius bleszynskiellus Popescu-Gorj, 1964: 13. Holotype: ♀, 'Periprava, pad. Letea, 29.VII.1963, leg. Dr. A. Popescu-Gorj', GS 12.331/637 (MGAB) [not examined]. Bleszynski (1969: 25) [synonymization of *roxanus*].

Euchromius roxanus Bleszynski, 1965a: 73. Holotype: ♂, 'Guberli', GS 9432 (ZMAS) [examined].

Material. – 6 ♂, 11 ♀. Rumania: Periprava, 1 ♀ (LNKD); Sulina, 1 ♀ (BMNH), 1 ♂ (RMNH). Russia: Guberli, 1 ♂ (ZMAS); Sarepta, 1 ♂ (ZMAS). Turkey: Dalyan, 2 ♀ (BMNH); Kusadasi, 2 ♂, 4 ♀ (BMNH), 1 ♂, 2 ♀ (ZFMK). Ukraine: Sem-Kolodezej, 1 ♀ (ZSMC).

Diagnosis. – Differs from *E. erum, E. locustus, E. discopis, E. viettei, E. hampsoni* and *E. aris* by the conical frons with a small point. Can be distinguished from *E. donum* in having labial palp three, two in *E. donum.* Male genitalia of *E. donum* unknown. Female genitalia of *E. donum* without signa, *E. bleszynskiellus* with two signa.

External characters male, female (fig. 44). – Wingspan 15-17 mm. Frons produced forward with clear point, creamy white to light brown, no ventral ridge; vertex creamy white to light brown; labial palp three, sides creamy white at base, becoming brown, creamy white from above and below; maxillary palp creamy white to light brown; antenna creamy white, greyish ringed. Thorax creamy white to brown; patagia creamy white with two broad longitudinal light brown stripes; tegulae creamy white with dark patch in the middle. Forewing, groundcolour creamy white densely suffused with ochreous to dark brown scales, posterior area with up to three small dark brown streaks; medial fascia single, straight or nearly so, running to one-third of the dorsum; subterminal line brown, about midway between terminal dots and termination of posterior area; area adjacent to terminal dots white to yellow; eight or nine black terminal dots, formula 2-2-3-1 or 2-2-3-2; fringes shiny with up to three brown lines. Hindwing creamy white to light brown, subterminal fascia present, termen darkly bordered; fringes creamy white with brownish line.

Tergite VIII (fig. 45). – Sclerite normally sclerotized, anterior part small, posterior part larger.

Male genitalia (fig. 124). – Uncus normal, tapering to sharp pointed tip; gnathos longer, with two dorsal thorns, terminal part short; tegumen without appendix angularis; sacculus swollen, processus of sacculus short, blunt, dorsal processus more or less straight, processus basalis short, broad at base tapering soon, processus inferior valvae small, cucullus relatively stout, bent upward; juxta triangular; vinculum small; aedeagus normal, one elongated group of small cornuti.

Female genitalia (fig. 173). – Papillae anales normal; membrane of tergite VIII without sclerotizations, edges of tergite VIII connected; ostium small; ductus bursae short, enlarged under ostium, halfway with small sac-like projection; ductus seminalis narrow; bursa copulatrix oblong, two thorn-shaped signa.

Biology. – Popescu-Gorj (1970) has caught *bleszynskiellus* in the dunes of the Donau river-delta. The specimens were caught in May, June, July and August.

Distribution (fig. 46). – Greece, Rumania, Turkey, Russia and Ukraine.

Remarks. – The holotype of *bleszynskiellus* could not be studied since the collections in Bucarest were closed for research during my visit to the museum.

22. *Euchromius bleszynskii* Roesler, 1975
(figs. 47-49, 125, 174)

Euchromius bleszynskii Roesler, 1975: 233. Holotype: ♂, 'Mongolia, Gobi Altaj aimak, Zachuj Gobi 10 km N von Chatan chajrchan Gebirge, 1150 m, Exp. Dr. Z. Kaszab, 1966'. – 'Nr.594, 27.VI.1966', GS 6556 (HNHM) [examined].

Material. – 3 ♂, 13 ♀. Mongolia: Gobi Altaj aimak, 10 ♀ (BMNH), 2 ♂, 1 ♀ (HNHM), 2 ♀ (LNKD), 1 ♂ (RTAS).

Diagnosis. – See under *E. scobiolae.*

External characters male, female (fig. 47). – Wingspan 18-22 mm. Frons produced forward, with clear point, brown, no ventral ridge; vertex creamy white to light brown; labial palp two to two and a half, sides white at base, becoming brown, creamy white from above and below; maxillary palp brown, terminal part creamy white; antenna light brown, darker ringed. Thorax light to dark brown; patagia light brown with two broad longitudinal dark brown stripes; tegulae light brown, evenly mottled. Forewing, groundcolour creamy white, densely suffused with ochreous to dark brown scales, posterior area usually with dark spot; medial fascia single, slightly arched, running to one-third to one-fourth of the dorsum; subterminal line brown, closer to termination of posterior area than to terminal dots; area adjacent to terminal dots broad, white; six or seven black terminal dots, very seldom an eighth vestigial dot, formula 2-3-1 or 2-3-2, very seldom 1-2-3-1; fringes shiny evenly grey-brown. Hindwing grey-brown, subterminal fascia present, termen darkly bordered; fringes white with brownish line.

Tergite VIII (fig. 48). – Sclerite normally sclerotized, anterior part small, rectangular, posterior part larger, rounded, stalk normal.

Male genitalia (fig. 125). – Uncus normal, tapering to sharp pointed tip; gnathos longer, two dorsal thorns, terminal part short; tegumen without appendix angularis; sacculus very broad, rounded, dorsal edge with pointed projection, processus of sacculus short, processus basalis short, broad at base narrowing soon, bent inward, processus inferior valvae inconspicuous, cucullus long, bent upward with anterior fold; juxta broad triangular; vinculum normal sized, pointed; aedeagus stout, most anterior part constricted.

Female genitalia (fig. 174). – Papillae anales large rounded, hairs long, bent at top; membrane of tergite VIII without sclerotizations, edges of tergite VIII connected; ostium with rectangular projection; ductus bursae short; ductus seminalis first part broad then narrowing; bursa copulatrix rounded to oblong, with inconspicuous more sclerotized part.

Biology. – Unknown. All specimens were caught in June at 950-1200 m altitude.

Distribution (fig. 49). – Mongolia.

Remarks. – Roesler (1975) figures the female genitalia with a distinct signum. There is no real signum present in the bursa copulatrix, only a faint more strongly sclerotized area.

23. *Euchromius scobiolae* Bleszynski, 1965
(figs. 9, 50, 51, 126, 175)

Euchromius scobiolae Bleszynski, 1965a: 79. Holotype: ♂, 'Kuschk', (MGAB) [not examined].

Material. – 1 ♂, 4 ♀. Afghanistan: Kuschk, 1 ♂ (BMNH). Tadzhikistan: Kurgan-Tjube, 1 ♀ (BMNH). Turkmeniya: Dort-Kuju, 1 ♀ (ZMAS); Peski, 1 ♀ (ZMAS); Sumbar, 1 ♀ (ZMAS).

Diagnosis. – Externally indistinguishable from *E. bleszynskii.* Differs in male genitalia in lacking the pointed projection of the dorsal edge of sacculus. Differs in female genitalia in having the ductus seminalis broad for a short length and the projection of the ostium rounded, not rectangular.

External characters male, female (figs. 9, 50). – Wingspan 16-21 mm. Frons produced forward with clear point, creamy white to light brown, no ventral ridge; vertex creamy white; labial palp two and a half, sides creamy white at base, becoming brown, creamy white from above and below; maxillary palp creamy white to brown, dark ringed at base of last segment; antenna creamy white inconspicuous darkly ringed. Thorax brown; patagia light brown with two broad longitudinal brown stripes; tegulae brown, evenly mottled. Forewing, groundcolour creamy white, very densely suffused with ochreous to dark brown scales, posterior area sometimes with dark spot; medial fascia single, very faint, slightly arched, running to one-third of the dorsum; subterminal line ochreous to dark brown, closer to termination of posterior area than to terminal dots; area adjacent to terminal dots broad, white; seven or six terminal black dots, 2-3-2, 1-2-3-1 or 2-3-1; fringes shiny, grey-brown, no clear lines. Hindwing grey-brown, subterminal fascia faintly present, termen darkly bordered; fringes creamy white with brownish line.

Tergite VIII not seen due to bad dissection.

Male genitalia (fig. 126). – Uncus normal, tapering to sharp pointed tip; gnathos longer, two dorsal thorns, terminal part short; tegumen without appendix angularis; sacculus very broad, rounded, processus of sacculus stout, pointed upward, several stout spines at base, processus basalis short, broad at base, narrowing soon, bent inward, processus inferior valvae prominent, cucullus slender; juxta triangular; vinculum normal; aedeagus stout, most anterior part restricted.

Female genitalia (fig. 175). – Papillae anales large rounded, hairs long, bent at top; membrane of tergite VIII without sclerotizations, edges of tergite VIII connected; ostium with rounded projection; ductus bursae short; ductus seminalis starting broad, narrowing soon; bursa copulatrix oblong, roundish more sclerotized patch in centre, no signa.

Biology. – Unknown. Specimens caught in April.

Distribution (fig. 51). – Turkmeniya, Tadzhikistan and Afghanistan.

Remarks. – The holotype could not be studied since the collections in Bucarest were closed for research during my visit to the museum.

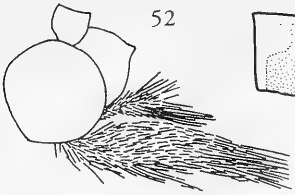
24. *Euchromius superbellus* (Zeller, 1849)
(figs. 52-54, 127, 176)

Crambus superbellus Zeller, 1849: 314. Holotype: ♂, '*superbella* m n 1/1 81', GS 2835 (BMNH) [examined].

Eromene wockeella Zeller, 1863: 53. Lectotype: ♂ (designated by Bleszynski (1961: 458)), '44', GS 5654 (BMNH) [examined].

Ommatopteryx cypriusella Amsel, 1958: 51. Holotype: ♂, '6.4.47 Kyrenia'. (LNKD) [examined].

Material. – 62 ♂, 52 ♀. Albania: no locality, 1 ♀ (NHNW). Austria: no locality, 2 ♂ (MCZC). Armenia: Yerewan, 2 ♀ (NHMW). Bulgaria: Blagoevaradski, 2 ♀ (MNHN), 2 ♂, 1 ♀ (RTAS); Kuzuch, 1 ♂ (RTAS); Nessebar, 1 ♂ (BMNH). France: Corsica, 1 ♂ (LNKD). Greece: 5 km S of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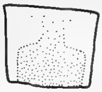
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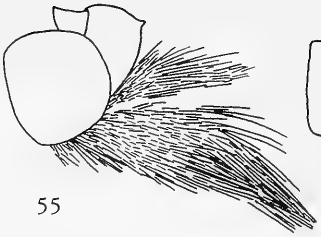
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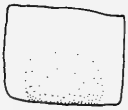
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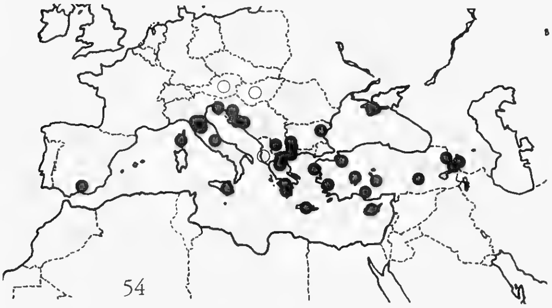
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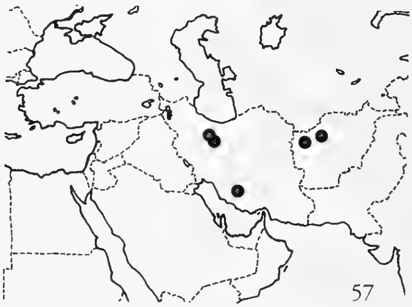
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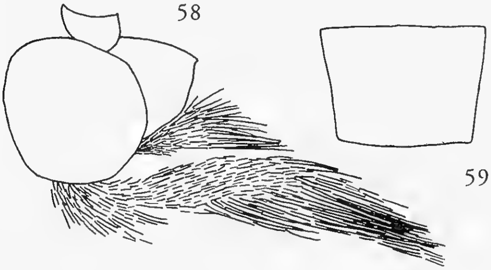
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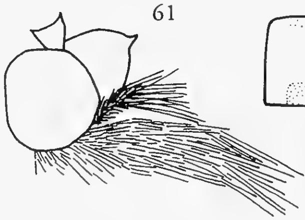
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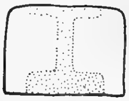
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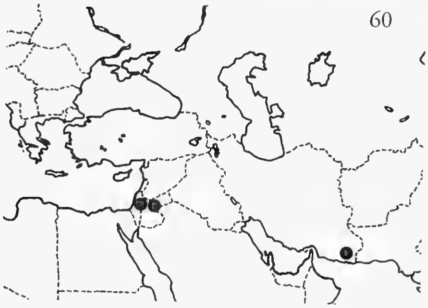
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Figs. 52-63. *Euchromius* species. – 52, *E. superbellus*, head, lateral aspect, scales removed; 53, idem, sclerite of tergite VIII; 54, idem, distribution map (open circles: exact locality not found); 55, *E. keredjellus*, head, lateral aspect, scales removed; 56, idem, sclerite of tergite VIII; 57, idem, distribution map; 58, *E. malekalis*, head, lateral aspect, scales removed; 59, idem, sclerite of tergite VIII; 60, idem, distribution map; 61, *E. mouchai*, head, lateral aspect, scales removed; 62, idem, sclerite of tergite VIII; 63, idem, distribution map. Scale bar 0.5 mm to figs. 52-53, 55-56, 58-59, 61-62.

Monemvasia, 1 ♀ (RMNH); Heraklion, 1 ♂, 1 ♀ (LUCA); Iria, 1 ♀ (RTAS); Kallonis, 2 ♂, 2 ♀ (HULL); Kassandra, 1 ♂ (LNKD); Katerini, 1 ♀ (ZFMK); Kyrenia, 1 ♀ (BMNH), 2 ♂ (LNKD); Meteora, 1 ♂, 1 ♀ (RTAS), 4 ♂, 4 ♀ (IZUI). Hungary: no locality, 3 ♂, 1 ♀ (NHMW). Italy: Catania, 1 ♂, (LUCA); Fano, 3 ♂, 5 ♀ (BMNH), 1 ♂ (LNKD), 1 ♂, 1 ♀ (ZSMC); Ficuzza, 1 ♀ (BMNH); Livorno, 1 ♂, 1 ♀ (BMNH), 1 ♂ (INER), 1 ♂, 1 ♀ (LNKD), 3 ♂, 4 ♀ (NHMW), 1 ♀ (ZSMC); Pescara, 1 ♀ (INER); Sicily, 3 ♂ (BMNH), 1 ♂ (LNKD); Toscane, 4 ♂, 1 ♀ (BMNH), 1 ♂ (NHMW). Spain: Malaga, 1

♂ (BMNH), 1 ♂ (NHMB). Turkey: Aksaray, 1 ♀ (ZMUC); Akshehir, 1 ♂ (ZSMC); Alanya, 1 ♂ (LUCA); Aralik 10 km N, 2 ♀ (ZMUC); Brusa, 1 ♂ (NHMW); Hazar Gölü, 1 ♀ (ZMUC); Kagizman 14 km E, 1 ♀ (ZMUC); Konya, 1 ♂ (LUCA); Kusadasi, 1 ♂ (BMNH). Ukraine: Jalta, 2 ♀ (ZMAS); Karadag, 8 ♂, 1 ♀ (ZMAS). Yugoslavia: Rabac, 2 ♂ (LNKD); Saraj, 1 ♂ (LUCA); Skopje, 1 ♀ (IZUI); Spalato, 4 ♂, 2 ♀ (NHMW); Split, 1 ♂, 6 ♀ (MHNG), 1 ♀ (RTAS); Sucurac, 2 ♀ (NHMW).

Diagnosis. – *E. superbellus* externally resembles *E. gozmanyi*, *E. rayatellus*, *E. malekalis*, *E. keredjellus* and *E. mouchai*. Differs from the latter three in lacking the one or two brown lines on the fringes of the forewing. Differs in male genitalia from *E. gozmanyi* and *E. rayatellus* by the dorsal thorns on the gnathos being elongated. Differs in female genitalia in having the ostium armed with a thumb-shaped projection.

External characters male, female (fig. 52). – Wingspan 13-15 mm. Frons produced forward with point, creamy white to brown, no ventral ridge; vertex creamy white; labial palp two, sides white at base, becoming brown to dark lead-grey, brown from above, creamy white from below; maxillary palp creamy white to dark brown-grey, terminal part lighter; antenna creamy white to grey, from about halfway darkly ringed. Thorax creamy white to brown-grey; patagia creamy white with two broad longitudinal light brown to lead-grey stripes; tegulae creamy white with dark patch in the middle. Forewing, groundcolour creamy white densely suffused with ochreous brown to dark grey scales; medial fascia single, straight or nearly so, running to one-third of the dorsum; subterminal line ochreous brown, about midway between terminal dots and termination of posterior area, sometimes closer to termination of posterior area than to terminal dots; area adjacent to terminal dots white; seven or six, seldom eight, black terminal dots, formula 2-3-2, 2-3-1 or seldom 1-2-3-2; fringes highly shiny evenly silver-grey. Hindwing light to dark grey, subterminal fascia present, termen darkly bordered; fringes creamy white to dark grey with one or two greyish lines. Specimens with very lightly coloured wings do occur, mainly from Italy.

Tergite VIII (fig. 53). – Sclerite normally sclerotized, posterior part large, rectangular, stalk and anterior part not distinguishable.

Male genitalia (fig. 127). – Uncus bent, tapering to sharp pointed tip, usually armed with thin dorsal crest; gnathos longer, two elongated dorsal thorns, terminal part long; tegumen without appendix angularis; sacculus broad, dorsal edge armed with dentate projection, processus of sacculus absent, processus basalis short, sharply bent inward, processus inferior valvae small, cucullus normal, bent upward; juxta triangular; vinculum normal; aedeagus normal, two patches of small cornuti.

Female genitalia (fig. 176). – Papillae anales normal; membrane of tergite VIII with rounded sclerotization near papillae anales, second sclerotization thumb-shaped, projecting near ostium, edges of tergite VIII not connected; ostium simple; ductus bursae normal; ductus seminalis starting broad, narrowing soon; bursa copulatrix oblong, one inconspicuous roundish area slightly more sclerotized.

Biology. – Found in gras- and weed-areas directly bordering the beach, but specimens are also caught up to 1700 m. There is one more or less continuous generation from April to September. The flight reaches its peak in June and July.

Distribution (fig. 54). – Confined to the northern part of the Mediterranean, and recorded from Spain, France, Italy, Austria, Yugoslavia, Hungary, Albania, Greece, Bulgaria, Turkey, Ukraine and Armenia. Possibly also in Portugal (Zerkowitz 1946, but see Monteiro 1982). Records of Leech (1901), Caradja (1925), Caradja & Meyrick (1933) from various parts of China refer to *Metaeuchromius* species or *E. raddeellus*. Records for Mozambique (Joannis 1927, Vari & Kroon 1986)) refer to *E. klimeschi*.

Remarks. – The paralectotypes of *wockeella* Zeller, 1863 are lost, none have been found in BMNH or any other museum.

25. *Euchromius keredjellus* (Amsel, 1949)
(figs. 55-57, 128, 177)

Eromene keredjellus Amsel, 1949: 233. Holotype: ♂, 'Iran, Elbursgebirge Keredj 4.6.1936 leg Brandt', GS 318 (LNKD) [examined].

Material. – 6 ♂, 6 ♀. Afghanistan: Herat, 2 ♀ (BMNH), 2 ♂ (LNKD); Kasi, 1 ♂ (BMNH). Iran: 90 km S. of Teheran, 1 ♂ (LNKD), 1 ♀ (RTAS); Keredj, 2 ♂ (LNKD), 2 ♀ (NHRS); Shiraz, 1 ♀ (NHRS).

Diagnosis. – *E. keredjellus* externally resembles *E. malekalis*, *E. mouchai*, *E. superbellus*, *E. rayatellus*, *E. gozmanyi*. Differs from the latter three in having one or two brown lines on the fringes of the forewing near the apex. *E. keredjellus* differs in male genitalia in having two cornuti in the aedeagus in combination with a short terminal part of the gnathos and a clear processus of the sacculus. In female genitalia *E. keredjellus* can be separated in having the edge of tergite VIII connected and forming a little knot-shaped sclerotization at point of connection.

External characters male, female (fig. 55). – Wingspan 13-21 mm. Frons produced forward, with clear point, creamy white, no ventral ridge; vertex creamy white; labial palp two and a half, sides white to creamy white at base, becoming light brown to brown, creamy white from above, light brown from below; maxillary palp creamy white to light brown,

brown ringed at base of last segment; antenna creamy white, in some grey-brown ringed. Thorax light brown to brown; patagia creamy white with two broad longitudinal light brown stripes; tegulae creamy white with, sometimes very faint, dark patch in the middle. Forewing, groundcolour white, densely suffused with ochreous to dark brown scales, anterior area with faint streaks, posterior area sometimes with up to three dark brown streaks; medial fascia single slightly arched to nearly straight, running to one-third of the dorsum; subterminal line ochreous to dark brown, closer to termination of posterior area than to terminal dots; area adjacent to terminal dots broad, white; seven black terminal dots, formula 2-3-2; fringes shiny, with up to three ochreous brown lines, most clearly at apex. Hindwing creamy white to light brown, subterminal fascia present or not, termen darkly bordered: fringes pure white no brownish line.

Tergite VIII (fig. 56). – Sternite lightly sclerotized, only posterior part partly visible.

Male genitalia (fig. 128). – Uncus normal, slightly bent; gnathos longer, two dorsal thorns, terminal part short; tegumen without appendix angularis; sacculus broad, dorsal edge with strongly sclerotized ridge, processus of sacculus stout, short, straight, processus basalis small, bent inward, processus inferior valvae normal, cucullus large, slightly bent upward; juxta triangular; vinculum rectangular; aedeagus stout, anterior one group of small cornuti, posterior second group of large, circa five, cornuti.

Female genitalia (fig. 177). – Papillae anales large, hairs long; membrane of tergite VIII with inconspicuous band-shaped sclerotization, edges of tergite VIII connected, knot-like at point of connection; ostium slightly toad-stool shaped; ductus bursae short, broad under ostium; ductus seminalis starting broad narrowing soon; bursa copulatrix oblong, inconspicuous patch of stronger sclerotization visible.

Biology. – Collected in April, May and June. Occurs up to 1600 m.

Distribution (fig. 57). – Only found in Iran and Afghanistan so far.

Remarks. – Bleszynski (1965a) mentions NHRS as the museum where the holotype is deposited, but it was found in LNKD.

26. *Euchromius malekalis* (Amsel, 1961)
(figs. 58-60, 129, 179)

Eromene malekalis Amsel, 1961: 330. Holotype: ♂, 'Iran, Baloutchistan Bender Tchahbahar-Iranchar. Tahte Malek 750 m leg. Brandt, 1938', GS 3559A (NHRS) [examined].

Material. – 2 ♂, 3 ♀. Iran: Tahte Malek, 1 ♂ (NHRS). Jordan: Azraq ed Druz, 1 ♀ (BMNH); Wadi er Retem, 1 ♂, 2 ♀ (BMNH).

Diagnosis. – *E. malekalis* externally resembles *E. mouchai, E. keredjellus, E. superbellus, E. rayatellus* and *E. gozmanyi*. Differs from the later three in having fringes of the forewing with one or two brown lines, most clearly at the apex. Differs in male genitalia from *E. mouchai* and *E. keredjellus* in lacking a group of cornuti in the aedeagus. Differs in female genitalia by the bean-shaped ostium.

External characters male, female (fig. 58). – Wingspan 20-21 mm. Frons produced forward, with clear point, creamy white to light brown, no ventral ridge; vertex creamy white; labial palp three, white at base, becoming light brown, white from above and below; maxillary palp brown, terminal part white; antenna creamy white, from about the middle greyly ringed. Thorax white to light brown; patagia white with two broad longitudinal brown stripes; tegulae with dark patch in the middle. Forewing, groundcolour white densely suffused with ochreous to brown scales; medial fascia single, slightly arched to straight, running to one-fourth of the dorsum; subterminal line ochreous brown, about midway between terminal dots and termination of posterior area; area adjacent to terminal dots white; seven black terminal dots, formula 2-3-2; fringes with one to two brown lines at apex. Hindwing creamy white to brown, subterminal fascia present, termen darkly bordered; fringes white with brownish line.

Tergite VIII (fig. 59). – Sclerite normally sclerotized, pattern only visible at posterior part.

Male genitalia (fig. 129). – Uncus normal, tapering to pointed tip; gnathos longer, dorsal thorns normal, terminal part short; tegumen without appendix angularis; sacculus very broad, rounded, processus of sacculus short, bent upward, strongly sclerotized, processus basalis short, bent inward, processus inferior valvae at base of processus basalis, cucullus normal sized, slightly bent upward; juxta triangular, two small dorsal projections; vinculum normal sized; aedeagus normal sized, no cornuti.

Female genitalia (fig. 179). – Papillae anales large rounded, hairs long, bent at top; membrane of tergite VIII without sclerotizations; ostium bean-shaped, strongly sclerotized; ductus bursae lightly sclerotized; ductus seminalis starting broad narrowing soon; bursa copulatrix broad, with inconspicuous more sclerotized patch.

Biology. – Unknown. Caught in April and May. In Iran at 750 m altitude.

Distribution (fig. 60). – Jordan and Iran.

27. *Euchromius mouchai* Bleszynski, 1961
(figs. 61-63, 130, 178)

Euchromius mouchai Bleszynski, 1961: 464. Holotype: ♂, '1865 Rossia m., Sarepta, Chr.', GS 1142 [presumably lost].

Material. – 4 ♂, 4 ♀. France: Corsika, 1 ♀ (MNHN). Georgia: Lagodechi, 1 ♀ (ZMAS). Italy: Syracus, 1 ♂ (BMNH). Russia: Sarepta, 3 ♂, 1 ♀ (BMNH). Turkey: Konya, 1 ♀ (MNHN).

Diagnosis. – Externally resembling *E. keredjellus, E. malekalis, E. superbellus, E. rayatellus* and *E. gozmanyi,* but differs from the latter three in having the fringes of the forewing with one or two brown lines, most clearly at the apex; male genitalia have three groups of cornuti in the aedeagus. Differs in female genitalia in having a lip-shaped ostium in combination with free edges of tergite VIII.

External characters male, female (fig. 61). – Wingspan 14-16 mm. Frons sharply produced forward with clear point, creamy white, brown in middle, no ventral ridge; vertex creamy white; labial palp two and a half to three, sides white at base, becoming brown, white from above, creamy white from below; maxillary palp brown terminal part creamy white; antenna creamy white to light brown-grey, from about middle inconspicuously dark ringed. Thorax creamy white; patagia creamy white with two broad longitudinal brown stripes; tegulae creamy white with dark patch in the middle. Forewing, groundcolour creamy white densely suffused with ochreous to dark brown scales, anterior area with inconspicuous brown spot near medial fascia; medial fascia single, straight or nearly so, running to one-third of the dorsum; subterminal line ochreous to dark brown, sometimes inconspicuous, closer to termination of posterior area than to terminal dots; area adjacent to terminal dots broad, white; seven black terminal dots, formula 2-3-2; fringes shiny creamy white with two brown lines. Hindwing grey-brown, subterminal fascia present, termen darkly bordered; fringes white with brownish line.

Tergite VIII (fig. 62). – Sclerite normally sclerotized, posterior part rectangular larger than anterior part, stalk normal.

Male genitalia (fig. 130). – Uncus normal, tapering to sharp pointed tip; gnathos longer, two dorsal thorns, terminal part short; tegumen without appendix angularis; sacculus broad, dorsal edge with transparent narrow ridge, processus of sacculus very short, processus basalis short, broad at base, narrowing soon, processus inferior valvae small, cucullus very long, slender; juxta broad triangular; vinculum rectangular; aedeagus stout, three groups of cornuti.

Female genitalia (fig. 178). – Papillae anales normal; membrane of tergite VIII with two horizontal sclerotizations enclosing a square part of membrane, edges of tergite VIII not connected; ostium simple, no clear projections; ductus bursae short, broad near ostium; ductus seminalis starting broad at base, narrowing soon, bursa copulatrix oblong, inconspicuous more strongly sclerotized area in lower part.

Biology. – Unknown. Very rare species.

Distribution (fig. 63). – France, Italy, Turkey, Georgia and Russia.

Remarks. – The holotype seems to be lost. Dr. Razowski informed me, that there is no Crambinae material in ZMPA.

28. *Euchromius nivalis* (Caradja, 1937) (figs. 64-66, 131, 181)

Eromene nivalis Caradja in: Caradja & Meyrick, 1937: 151. Lectotype: ♂ (designated by Bleszynski (1965a: 83)), 'Li-Kiang Provinz Nord Yuennan 20.VII.1935 Höne' GS 1741 (MGAB) [not examined].

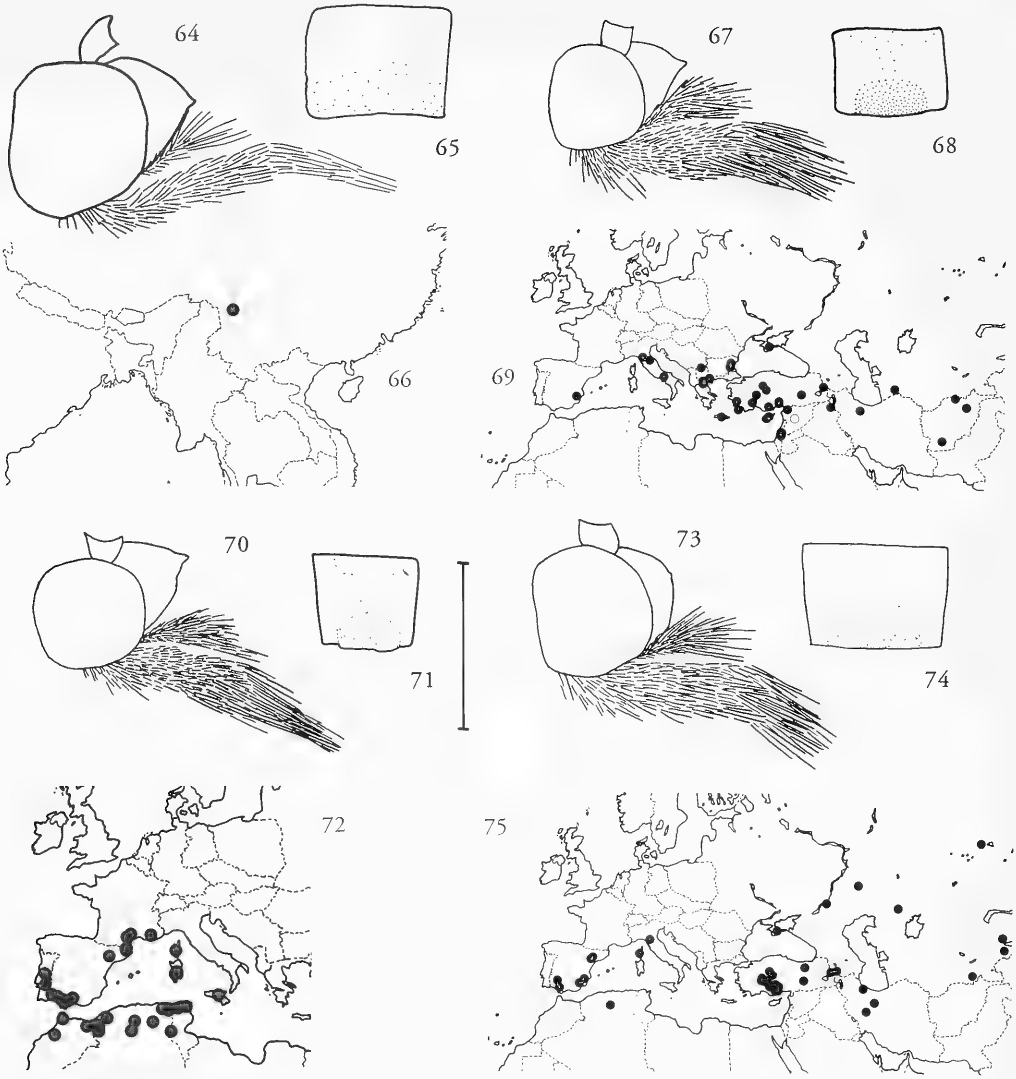
Material. – 4 ♂, 1 ♀. China: Lijiang [Li-kiang], 1 ♂ (BMNH), 1 ♂ (RTAS), 1 ♂, 1 ♀ (ZFMK); Yunnan, 1 ♂ (BMNH).

Diagnosis. – *E. nivalis* can be distinguished from all other species by it pure white groundcolour of the wings.

External characters male, female (fig. 64). – Wingspan 15-19 mm. Frons produced forward with inconspicuous point, pure white, no ventral ridge; vertex pure white; labial palp two and a half, sides yellow-white at base, becoming yellow, then yellow-grey, white from above, yellow from below; maxillary palp pure white, yellow at base; antenna creamy white, darkly ringed. Thorax pure white; patagia pure white with two broad longitudinal yellow stripes; tegulae pure white. Forewing, groundcolour pure white, anterior area not suffused with dark scales, posterior area densely suffused with ochreous to dark brown scales, posterior area with distinct dark brown spot near medial fascia; medial fascia single, bent outward, running to half to one-third of the dorsum; subterminal line ochreous to dark brown, inconspicuous to absent, closer to termination of posterior area than to terminal dots; area adjacent to terminal dots broad, white; seven or six black terminal dots, formula 2-3-2 or 2-3-1; fringes shiny, evenly yellow-grey. Hindwing grey-white, subterminal fascia absent, termen darkly bordered; fringes white, no clear line.

Tergite VIII (fig. 65). – Sclerite normally sclerotized, no pattern visible.

Male genitalia (fig. 131). – Uncus slender, tapering to sharp pointed tip; gnathos longer, with two large dorsal thorns, terminal part short; tegumen without appendix angularis; sacculus normal, processus of sacculus absent, processus basalis more or less free from back of valvae, swollen, ending in small point, processus inferior valvae elongated, cucullus slender, dorsal edges slightly more sclerotized; juxta triangular with two dorsal projections; vinculum very long; aedeagus long, slender, with set of short strongly bent cornuti,



Figs. 64-75. *Euchromius* species. – 64, *E. nivalis*, head, lateral aspect, scales removed; 65, idem, sclerite of tergite VIII; 66, idem, distribution map; 67, *E. rayatellus*, head, lateral aspect, scales removed; 68, idem, sclerite of tergite VIII; 69, idem, distribution map (open circle: exact locality not found); 70, *E. gozmanyi*, head, lateral aspect, scales removed; 71, idem, sclerite of tergite VIII; 72, idem, distribution map; 73, *E. gratiosellus*, head, lateral aspect, scales removed; 74, idem, sclerite of tergite VIII; 75, distribution map *E. gratiosellus* in the West Palaearctic. Scale bar 0.5 mm to figs. 64-65, 67-68, 70-71, 73-74.

second, more anteriorly located group of long cornuti.

Female genitalia (fig. 181). – Papillae anales small; membrane of tergite VIII without sclerotization, edges of tergite VIII faintly connected; ostium simple, grooved; ductus bursae long; ductus seminalis narrow; bursa copulatrix roundish, no signa.

Biology. – Unknown. Specimens were caught in July and September at an altitude of 2800 to 3200 m.

Distribution (fig. 66). – Only known from the type locality, China, Province of Yunnan.

Remarks. – The lectotype of *nivalis* could not be studied since the collections in Bucarest were closed for research during my visit to the museum.

29. *Euchromius rayatellus* (Amsel, 1949)
(figs. 9, 67-69, 132, 180)

Eromene rayatellus Amsel, 1949: 278. Holotype: ♂, '13.7.35 Rayat', GS 12384 (BMNH) [examined].

Material. – 42 ♂, 55 ♀. Afghanistan: Balkh, 1 ♀ (LNKD); Derweshan, 1 ♂ (BMNH); Polichomri, 1 ♀ (BMNH), 1 ♂, 1 ♀ (LNKD). Bulgaria: Burgas, 1 ♂ (NHMW), Nessebar, 6 ♂, 8 ♀ (BMNH), 1 ♂, 1 ♀ (IZUI), 1 ♀ (LNKD), 1 ♂ (RTAS), 1 ♀ (ZFMK). Cyprus: Kolossi, 2 ♂, 2 ♀ (BMNH); Lanarca, 1 ♀ (BMNH). Greece: Chalkidike, 1 ♂, 3 ♀ (IZUI); Drepanon, 1 ♂ (PRIN); Ialyssos, 1 ♀ (ZMUC); Lithokhoran, 1 ♂ (LNKD); Malia, 1 ♂ (ZMUC); Neapolis, 5 ♂, 1 ♀ (NHMW); Phaistos, 1 ♂ (ZMAN); Pitsidia, 1 ♂ (LNKD); Platamon, 1 ♀ (ZFMK); Rhodos, 1 ♀ (ZFMK). Iran: Kendavan, 1 ♀ (INER). Iraq: Rayat, 1 ♂ (BMNH), 1 ♂ (LNKD). Israel: Hulch Swamp, 2 ♀ (BMNH); Daphne Settlement, 1 ♂ (BMNH); Deganya, 1 ♂, 1 ♀ (GORD). Italy: Fondi, 1 ♂ (INER); Fano, 1 ♀ (BMNH); Livorno, 1 ♂ (RMNH). Spain: Murcia, 1 ♀ (NHRS). Syria: no locality, 1 ♀ (MNHN). Turkey: Adana, 1 ♀ (INER), 1 ♂, 3 ♀ (MNHN); Aksehir, 1 ♀ (LUCA); Amanus, 1 ♀ (ZSMC); Ankara, 1 ♀ (LUCA); Diyadin 10 km NE, 1 ♂, 1 ♀ (ZMUC); Diyarbakir, 1 ♀ (ZFMK); Ergani, 1 ♀ (MHNG); Karatas, 1 ♂, 1 ♀ (LNKD), 1 ♂ (MNHN); Kusadasi, 3 ♂, 1 ♀ (BMNH), 5 ♀ (ZFMK); Mut, 1 ♂, 2 ♀ (NHMW); Sarkikaagas, 1 ♀ (INER); Tuz Gölü N., 1 ♀ (ZMUC). Turkmeniya: Kara-Kala, 2 ♀ (ISNB). Ukraine: Kara-dag, 4 ♂ (ZMAS). Yugoslavia: Crna Gora, 1 ♀ (LNKD).

Diagnosis. – *E. rayatellus* externally resembles *E. gozmanyi*, *E. superbellus*, *E. malekalis*, *E. keredjellus* and *E. mouchai*. Differs from the latter three in lacking one or two brown lines in the fringes of the forewing. *E. rayatellus* differs in male genitalia from *E. gozmanyi* and *E. superbellus* by its aedeagus with three groups of cornuti. Differs in female genitalia by the large shield-like lamella antevaginalis which is split in the middle.

External characters male, female (figs. 9, 67). – Wingspan 13-16 mm. Frons produced forward, with clear point, creamy white to brown, dorsal part darker, no ventral ridge; vertex creamy white to light brown; labial palp two and a half, sides creamy white at base, becoming brown, creamy white from above and below; maxillary palp creamy white, sometimes brown ringed at base of last segment; antenna creamy white. Thorax creamy white to brown; patagia creamy white with two broad longitudinal light brown stripes; tegulae creamy white with dark patch in the middle. Forewing, groundcolour creamy white, densely suffused with brown to dark brown scales; medial fascia single, nearly straight, running to one-third of the dorsum; subterminal line ochreous brown, about midway between terminal dots and termination of posterior area, seldom closer to termination of posterior area; area adjacent to terminal dots white, seldom broad; seven black terminal dots, formula 2-3-2, in some specimens an additional eighth dot occurs, formula 1-2-3-2; fringes shiny, evenly grey-brown. Hindwing light brown to grey-brown, subterminal fascia present, termen darkly bordered; fringes creamy white with brownish line.

Tergite VIII (fig. 68). – Sclerite normal sclerotized, posterior part convex, stalk and anterior part very faint.

Male genitalia (fig. 132). – Uncus normal, tapering to sharp pointed tip; gnathos longer, two dorsal thorns, terminal part short; tegumen without appendix angularis; sacculus normal, processus of sacculus long, straight, processus basalis small, broad at base, tapering soon, strongly bent inward, processus inferior valvae slightly projecting, cucullus slender, bent upward; juxta broad triangular; vinculum rectangular; aedeagus small, stout, three groups of cornuti.

Female genitalia (fig. 180). – Papillae anales normal; membrane of tergite VIII with rounded punctate sclerotization, edges of tergite VIII connected; ostium small, lamella antevaginalis shield-like, split in the middle; ductus bursae short; ductus seminalis starting broad narrowing soon; bursa copulatrix oblong, with inconspicuous more sclerotized part in the centre.

Biology. – There is one long flight-period, starting in April, May and continuing until mid September, peak in July, August. This species ranges in altitude from sea-level up to 3000 m.

Distribution (fig. 69). – Spain, Italy, Yugoslavia, Greece, Bulgaria, Turkey, Ukraine, Turkmeniya, Afghanistan, Iran, Iraq, Syria and Israel.

30. *Euchromius gozmanyi* Bleszynski, 1961
(figs. 70-72, 133, 182)

Euchromius gozmanyi Bleszynski, 1961: 462. Holotype: ♂, 'Hispania Korb Chiclana 1912. IV.V', GS 1204 (HNHM) [examined]. Glaser, 1975: 50 [description of female].

Material. – 36 ♂, 46 ♀. Algeria: Aflou, 1 ♀ (BMNH); Aōn Fezza, 1 ♂ (BMNH); Biskra, 1 ♂ (BMNH); El Tarf, 1 ♀ (MNHN); Foret de Tenira, 1 ♂ (BMNH); Hassi-Babah, 1 ♂ (INER), 1 ♂ (MNHN); Marsa-Ben-Mehidi, 2 ♂, 2 ♀ (BMNH); Sebdou, 1 ♀ (BMNH); Sidi-bel-Abbes, 2 ♀ (BMNH); St. Charles, 1 ♀ (MNHN). France: Bormes, 1 ♀ (MNHN); Corse, Tour de Vignate, 1 ♀ (IZUI); Durban-Sigean, 1 ♂ (ZMUC); Ile du Levant, 1 ♂ (MNHN); L'Almanarres, 2 ♂ (MNHN); Les Carbannes de Fleury, 1 ♂ (HUIS); Petit Bagnes, 3 ♂, 1 ♀ (MNHN); Port La Nouvelle, 2 ♂ (MNHN). Italy: Licata, 6 ♂ (BMNH); Musei, 1 ♀ (LNKD); Sailletta, 1 ♂ (INER). Morocco: Tangier, 3 ♀ (BMNH), 1 ♀ (LNKD), 2 ♀ (MNHN), 5 ♀ (ZFMK); Taourirt, 1 ♀ (BMNH); Thami, 1 ♀ (MNHN); no locality, 4 ♀ (BMNH). Portugal: Coimbra, 2 ♂ (MNHN); Setubal, 1 ♂ (MNHN). Spain: Aljarque, 1 ♀ (ZMUC); Cadiz, 2 ♂, 2 ♀ (GIEL), 1 ♀ (PRIN), 2 ♂, 5 ♀ (RTAS); Chiclana, 1 ♂ (BMNH); El Rampido, 1 ♂ (LNKD); La Escala, 1 ♀ (LNKD); Penalba, 1 ♂ (ZMUC); Periane, 1 ♂ (GIEL); Puerto de Sta. Maria, 5 ♂, 9 ♀ (HULL); Rosas, 2 ♀ (LNKD); San Lucar, 2 ♀ (BMNH); Trebujena, 2 ♀ (BMNH). Tunisia: Ain Draham, 1 ♂ (BMNH); Cap Bon, 1 ♂ (MNHN); Tozeur, 1 ♀ (INER).

Diagnosis. – *E. gozmanyi* resembles *E. superbellus*, *E. rayatellus*, *E. mouchai*, *E. keredjellus* and *E. malekalis*. Can be distinguished from the latter three species in lacking brown lines on the fringes of the forewing. Differs from above mentioned species in male genitalia in having one large cornutus. In female genitalia *E. gozmanyi* is distinguished by a sleeve-like structure above the ductus seminalis.

External characters male, female (fig. 70). – Wingspan 14-21 mm. Frons sharply produced forward, with clear point, creamy white to light brown, no ventral ridge; vertex creamy white; labial palp two and a half, sides white to creamy white at base, becoming light brown to brown from above and below; maxillary palp light brown, terminal part creamy white; antenna creamy white, from about the middle inconspicuous darkly ringed. Thorax creamy white to light brown; patagia creamy white to brown with two broad longitudinal brown stripes; tegulae creamy white to light brown with dark patch in middle. Forewing, groundcolour white densely suffused with ochreous to dark brown scales, anterior area sometimes with inconspicuous brown spot near medial fascia; medial fascia single, straight or nearly so, running to one-third to one-fourth of the dorsum; subterminal line ochreous brown, faint, about midway between terminal dots and termination of posterior area; area adjacent to terminal dots white; seven or six black terminal dots, formula 2-3-2 or 2-3-1; fringes highly shiny, evenly grey to brown-grey. Hindwing creamy white to grey, subterminal fascia present or not, termen darkly bordered; fringes creamy white with brownish line.

Tergite VIII (fig. 71). – Sclerite normally sclerotized, posterior part rectangular, stalk broad, anterior part inconspicuous.

Male genitalia (fig. 133). – Uncus normal, tapering to sharply pointed tip; gnathos longer, two dorsal thorns normal sized, terminal part short; tegumen without appendix angularis; sacculus very broad, processus of sacculus short but free, strongly sclerotized, processus basalis short, sharply bent inward, processus inferior valvae small, at base of processus basalis, cucullus relatively broad, bent upward; juxta normal; aedeagus normal sized, slender, tapering anterior of anellus connection, one ridged cornutus.

Female genitalia (fig. 182). – Papillae anales normal; membrane of tergite VIII with strongly sclerotized horizontal patch near papillae anales, second patch less clear, rounded, more towards the ostium, edges of tergite VIII connected; ostium simple, rounded; ductus bursae long with clear sleeve-like structure above ductus seminalis; ductus seminalis starting broad, narrowing soon; bursa copulatrix elongated with two, not clear, sclerotized patches in the middle.

Biology. – This species seems to prefer the shores of salt-lakes and is reported to live on tidal shores. The caterpillar is said to survive temporary floods by the sea and live on *Salicornia* spec. (Luquet, pers. comm.). There are two, more or less continuous, generations from half April up to half October. The peaks in the flight-periods are June-July and September.

Distribution (fig. 72). – A West-Mediterranean species, occurring in Portugal, Spain, France, Italy, Tunisia, Algeria and Morocco.

Remarks. – From Biskra (Algeria) 1 ♂ is known with eight and nine terminal dots on its forewing, GS BM 17612, BMNH. Upon checking, the genital slide number of the holotype proved to be 1204 instead of 1075 (Bleszynski 1961).

31. *Euchromius gratiosellus* (Caradja, 1910)
(figs. 73-76, 134, 170)

Eromene ramburiella gratiosellus Caradja, 1910: 116. Lectotype: ♂ (designated by Bleszynski (1965a: 76)), 'Lob-Noor, 1909, B.H.', (MGAB) [not examined].

Euchromius rambutiellus, Bleszynski (nec Duponchel), (1960: 204).

Euchromius gartheellus Derra, 1985: 237. Holotype: ♂, 'Türkei, Prov. Ankara Tuz Gölu 900 m, Leg. G.Derra 3.8.1984', GS 2284 (DERR) [not examined]. Ganev & Hacker (1986: 329) [new localities]. Derra (1987: 31) [synonymization with *gratiosellus*].

Euchromius siuxellus Ganev & Hacker, 1986a: 82. Holotype: ♂, 'Türkei, Prov. Ankara, 39°10'N/33°20'E, Tuz Gölu N-Ufer, 900 m, 3.8.1984', GS 911 Ganev, Sofia [not examined]. Hacker (1986: 62) [synonymization with *gartheellus* Derra, 1985].

Material. – 85 ♂, 67 ♀. Algeria: El Mesrane, 1 ♀ (LNKD); Hassi Bahbah, 1 ♀ (BMNH); 3 ♀ (INER); 1 ♂, 5 ♀ (NHMW). Armenia: Chiva Urgene, 1 ♀ (BMNH). France: Corsika, 1 ♂ (MNHN). Iran: 90 Km S of Teheran, 1 ♂, 1 ♀ (LNKD); Shaku, 1 ♀ (BMNH). Italy: Livorno, 1 ♂ (NHMW). Kazakhstan: Emba, 2 ♂ (NHRS); Uralsk, 1 ♂, 3 ♀ (MNHN); Uzun-Agach, 2 ♀ (ZMAS). Kirgiziya: Naryn, 30 km E., 1 ♂ (ZMAS). Mongolia: 10 km NNE of Dalanzadgad, 3 ♂, 6 ♀ (BMNH); Talaiin Bulag, 2 ♂ (BMNH). Russia: Katunda, 10 km W., 1 ♂ (ZMAS); Sarepta, 2 ♀ (BMNH), 1 ♂ (INER), 4 ♂ (NHMW), 1 ♀ (ZFMK); Troikoe, 2 ♀ (RTAS). Spain: Alcaniz, 1 ♀ (GIEL); Dolores, 1 ♂, 1 ♀ (GIEL), 1 ♂, 1 ♀ (RTAS), 1 ♂ (TMSA); El Ronquillo, 1 ♀ (HULL); Penalba, 1 ♂ (ZMUC); Puerto de Sta. Maria, 1 ♀ (HULL); Puerto Lambreras, 1 ♂ (PRIN). Tadzhikistan: Dusti, 1 ♂ (RTAS). Turkey: 20 km NO of Konya, 2 ♀ (LNKD), 5 ♂ (NHMW); 40 km SW of Elazig; Aksehir, 1 ♂, 1 ♀ (NHMW); Ankara, 4 ♂, 1 ♀ (BMNH), 1 ♂, 3 ♀ (MHNG), 1 ♂ (NHMW); Cay, 10 ♂, 4 ♀ (MAES); Diyadin 10 km NE, 1 ♂, 2 ♀ (ZMUC); Eregli, 2 ♂, 1 ♀ (ZSMC); Karapinar, 2 ♂ (LNKD), 2 ♂, 2 ♀ (NHMW); Kelkit, 4 ♂, 4 ♀ (BMNH); Konya, 1 ♂, 1 ♀ (LNKD); Tuz Golu, 6 ♂, 2 ♀ (BMNH), 2 ♂ (CASC); 3 ♂, 3 ♀ (DERR), 2 ♂, 1 ♀ (RTAS), 1 ♂ (TMSA); Tuz Golu N.shore, 2 ♂, (LNKD), 3 ♂ (NHMW), 2 ♂, 2 ♀ (RTAS), 1 ♂, 2 ♀ (ZMUC), 4 ♂, 3 ♀ (ZSMC). Ukraine: Karadag, 1 ♂ (ZMAS).

Diagnosis. – Externally undistinguishable from *E. jaxartellus* and *E. ramburiellus*. On the average *E. gratiosellus* is slightly larger and lighter coloured. *E. gratiosellus* differs from *E. superbellus*, *E. rayatellus* and *E. gozmanyi* in having nine or eight black terminal dots whereas the former species almost always have six or seven dots. In male genitalia *E. gratiosellus* differs from *E. jaxartellus* and *E. ramburiellus* in the having sacculus less broad and processus of sacculus more straight and slender. Processus inferior valvae of *E. gratiosellus* is rounded, elongated in *E. ramburiellus*. In female genitalia the ostium of *E. gratiosellus* is broadly rounded with parallel sides, longer and pointed in *E. ramburiellus*, broader and dilated in *E. jaxartellus*. Spined sack-like terminal part of ductus bursae much smaller in *E. gratiosellus* than in *E. jaxartellus* and *E. ramburiellus*.

External characters male, female (fig. 73). – Wingspan 17-23 mm. Frons produced forward with point, creamy white to light brown, no ventral ridge; vertex creamy white to light brown; labial palp two and a half, sides white to creamy white at base becoming light brown to brown, white from above and below; maxillary palp creamy white, dark ringed at base of last segment, terminal part creamy white; antenna creamy white, darkly ringed, sometimes with dorsal grey line. Thorax creamy white to light brown; patagia creamy white, no clear broad longitudinal brown stripes; tegulae creamy white to light brown, evenly mottled. Forewing, groundcolour white, densely suffused with grey to dark brown scales, anterior area more or less evenly coloured, posterior area with a yellowish to dark brown spot in the middle; medial fascia single, gently arched to nearly straight, running to one-third of the dorsum; subterminal line ochreous brown, sometimes only faintly visible, about midway between terminal dots and termination of posterior area; area adjacent to terminal dots white; eight or nine black terminal dots, formula 2-2-3-1 or 2-2-3-2; fringes shiny creamy white, three or four brown lines. Hindwing creamy white to grey, subterminal fascia present; termen darkly bordered, fringes white with or without a brownish line.

Tergite VIII (fig. 74). – Sclerite normally sclerotized, posterior part triangular, stalk short inconspicuous, anterior part narrow, very faint.

Male genitalia (fig. 134). – Uncus normal, tapering to sharply pointed tip; gnathos longer, two dorsal thorns normal sized, terminal part short; tegumen without appendix angularis; sacculus narrow, processus of sacculus slender, slightly bent upward, not or just slightly overlapping cucullus (watch out for distortions caused by the coverslip), strongly sclerotized, processus basalis short, broad at base narrowing soon, pointing inward, strongly sclerotized, processus inferior valvae large, distinctly projecting, rounded, cucullus very slender more or less bent upward; juxta normal; vinculum normal; aedeagus short, broad, three groups of cornuti.

Female genitalia (fig. 170). – Papillae anales normal; membrane of tergite VIII without sclerotizations, edges of tergite VIII connected; ostium thumb-shaped, broadly rounded, with parallel sides; ductus bursae under ostium enlarged armed with many small spines. very small sac-like pouch connected to enlarged part of ductus bursae; ductus seminalis narrow; bursa copulatrix oblong with two thorn-shaped signa.

Biology. – Several times recorded from salt deserts. Caught in April up to October at an altitude of up to 1450 m.

Distribution (figs. 75, 76). – Algeria, Spain, France, Italy, Turkey, Iran, Ukraine, Russia, Armenia, Kazakhstan, Kirgiziya, Tadzhikistan and Mongolia.

Remarks. – The holotype of *gratiosellus* could not be studied since the collections in Bucarest were closed for research during my visit to the museum.

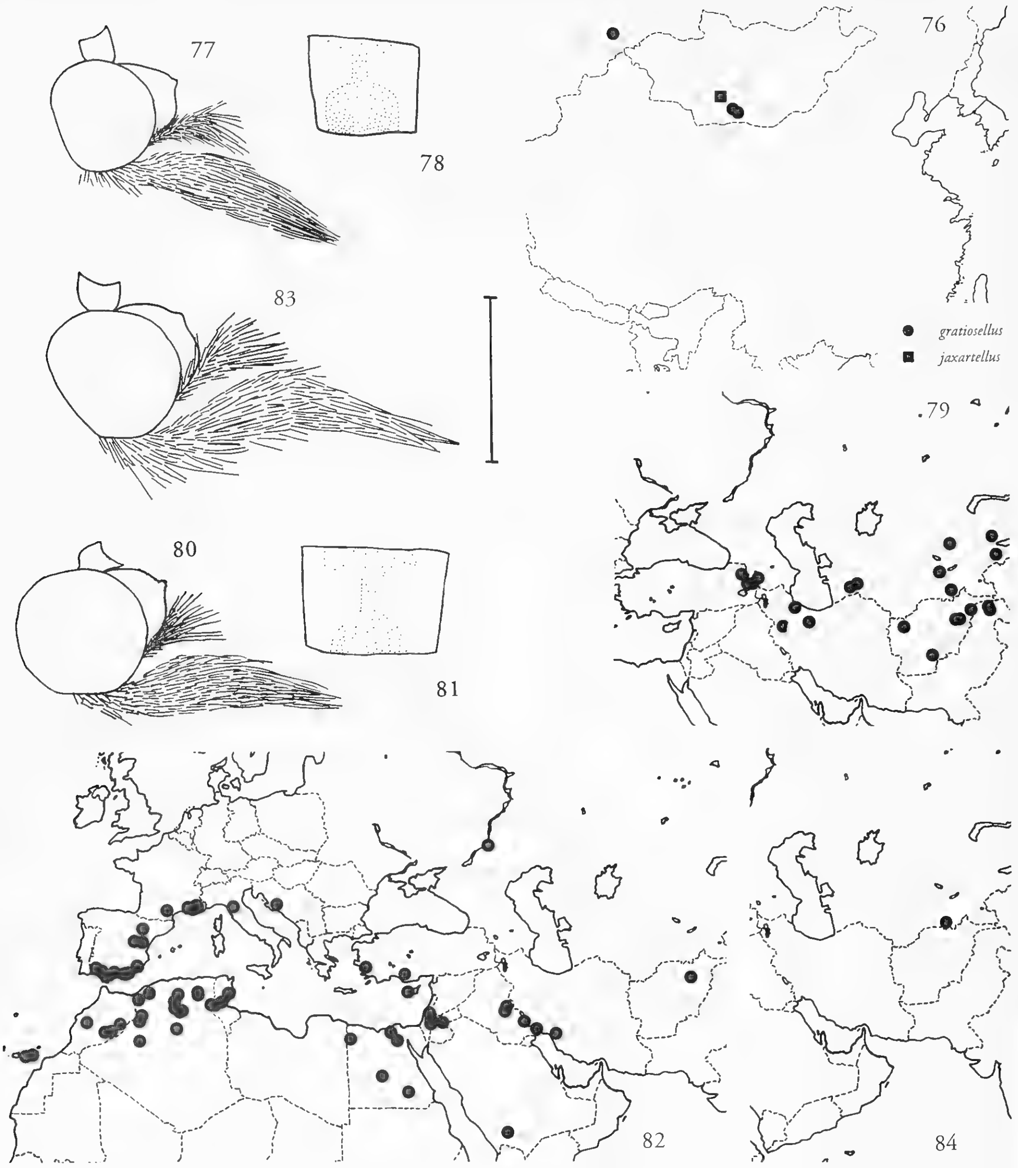
32. *Euchromius jaxartellus* (Erschoff, 1874)
(figs. 76-79, 135, 183)

Eromene jaxartella Erschoff, 1874: 82. Holotype: ♀, no label, GS 7602 (ZMAS) [examined].

Material. – 45 ♂, 60 ♀. Afghanistan: 22 km E of Kabul, 1 ♀ (LNKD); Bashgul, 1 ♀ (LNKD); Kabul, 1 ♀ (LNKD); Kandahar, 1 ♀ (ZSMC); Kuschk, 1 ♀ (BMNH); Pol-i-Charchi, 1 ♀ (LNKD), 1 ♀ (RTAS); Sarobi, 1 ♂ (LNKD). Armenia: Chiva Urgene, 1 ♂, 1 ♀ (BMNH). Iran: 95 km N of Kermanschah, 1 ♀ (LNKD); Keredj, 1 ♂ (LNKD), 1 ♀ (NHRS); Shaku, 1 ♀ (NHMW). Kazakhstan: Aulie Ata, 1 ♂ (BMNH); Dzambulskaya, 35 ♂, 36 ♀ (ZMAS). Kirgiziya: Naryn, 1 ♀ (ZMAS). Mongolia: Bayan Hongor, oase Echin gol [exact locality not found], 1 ♂ (BMNH). Pakistan: Gilgit, 4 ♀ (ZSMC); Hunza-Nagar, 1 ♀ (ZSMC). Tadzhikistan: Kurgan-Tjube, 1 ♂ (NHMW). Turkey: Aralik 10 km NW, 2 ♀ (ZMUC); Diyadin 10 km NE, 2 ♂ (ZMUC); Kagizman 14 km E, 2 ♂, 1 ♀ (ZMUC). Turkmeniya: Kara-Kala, 1 ♀ (BMNH), 1 ♂, 2 ♀ (ISNB), 1 ♀ (RTAS).

Diagnosis. – *E. jaxartellus* externally resembles *E. ramburiellus*, *E. gratiosellus*, *E. confusus*, *E. pulverosus*, *E. zagulajevi*. Differs from latter three species in having up to three dark lines on the fringes of the forewing. *E. jaxartellus* differs in male genitalia from *E. confusus* and *E. pulverosus* in having three cornuti in the aedeagus, differs from *E. gratiosellus* and *E. ramburiellus* in the processus of sacculus, at the most, reaching one-third of the cucullus and the processus is not longer than the breadth of cucullus. Differs in female genitalia in having the projection of the ostium broad triangular.

External characters male, female. (fig. 77). – Wingspan 14-17 mm. Frons produced forward with



Figs. 76-84. *Euchromius* species. – 76, distribution map of *E. gratiosellus* and *E. jaxartellus*; 77, *E. jaxartellus*, head, lateral aspect, scales removed; 78, sclerite of tergite VIII; 79, distribution map of *E. jaxartellus* in the West Palaearctic; 80, *E. ramburiellus*, head, lateral aspect, scales removed; 81, idem, sclerite of tergite VIII; 82, idem, distribution map; 83, *E. zagulajevi*, head, lateral aspect, scales removed; 84, idem, distribution map. Scale bar 0.5 mm to figs. 77-78, 80-81, 83.

minute point, creamy white, dorsal slightly darker, no ventral ridge; vertex creamy white; labial palp two and a half, sides creamy white at base, becoming brown, creamy white from above and below; maxillary palp creamy white, brown at base of last segment; antenna creamy white, from about the middle greyish ringed. Thorax creamy white to light brown; patagia creamy white with two broad longitudinal brown stripes; tegulae creamy white, evenly mottled. Forewing, groundcolour creamy white, densely suffused with ochreous to dark brown scales, posterior area sometimes with small dark brown streaks; medial fascia single, arched to nearly straight, running to one-third of the dorsum; subterminal line brown, about midway between terminal dots and termination of posterior area; area adjacent to terminal dots white to yellowish; nine or eight black terminal dots, formula 2-2-3-2 or 2-2-3-1; fringes slightly shiny with up to four brown lines. Hindwing creamy white to brown-grey, subterminal fascia present, termen darkly bordered; fringes creamy white with brownish line.

Tergite VIII (fig. 78). – Sclerite normal sclerotized, anterior part small, very faint, posterior part large, rectangular.

Male genitalia (fig. 135). – Uncus normal, tapering to sharp pointed tip; gnathos longer, two dorsal thorns, terminal part short; tegumen without appendix angularis; sacculus narrow, processus of sacculus short, bent upward, processus basalis short bent downward, processus inferior valvae large, elongated, cucullus normal, bent upward; juxta triangular; vinculum rectangular; aedeagus short, swollen, three groups of cornuti.

Female genitalia (fig. 183). – Papillae anales normal; membrane of tergite VIII without sclerotizations, edges of tergite VIII connected; ostium with broad equal-sided triangular projection, top narrow, not broad rounded; ductus bursae under ostium enlarged, armed with many spines, small sac-like appendix connected to enlarged part of ductus bursae; ductus seminalis narrow; bursa copulatrix rounded, armed with two thorn-shaped signa.

Biology. – Unknown. One flight-period from April up to half September, peak in July and August. Caught up to 2200 m altitude.

Distribution (figs. 76, 79). – Armenia, Turkmeniya, Tadzhikistan, Kirgiziya, Kazakhstan, Iran, Afghanistan, Pakistan and Mongolia.

Remarks. – Ganev & Hacker's (1984: 238) record from Turkey is very doubtful and may concern *Euchromius gratiosellus* or *Euchromius ramburiellus*. Mariani's (1938: 160) records from Sicily may refer to *E. gratiosellus* or *E. ramburiellus*.

33. *Euchromius ramburiellus* (Duponchel, 1836)
(figs. 80-82, 136, 185)

Crambus ramburiellus Duponchel, 1836: 83. Holotype: ♀, '*Crambus ramburiellus*', GS 3778 (MNHN) [examined].

Crambus zonellus Zeller, 1847: 758. Holotype: ♀, [Italien, Sicilien, type lost].

Eromene ramburiellus var. *luteella* Caradja, 1910: 116. Lectotype: ♂ (designated by Bleszynski (1965a: 74)), 'Biskra 8.VI.07, Chrétien', (MGAB) [not examined].

Eromene islamella Amsel, 1949: 235. Lectotype: ♂ (designated by Bleszynski (1965a: 74)), 'Iran, Fars, 1937 Strasse Kazeroun-Bouchir Tchouroum 1000 m. leg. Brandt 17.III', GS 319 (LNKD) [examined].

Material. – 145 ♂, 150 ♀. Afghanistan: Polichomri, 1 ♂ (LNKD). Algeria: Aflou, 1 ♀ (BMNH); Aõn Sefra, 1 ♂, 3 ♀ (BMNH); Beni Ounif, 1 ♂, 2 ♀ (MHNG), 1 ♂ (NHMB); Biskra, 7 ♂ (BMNH), 1 ♀ (ZSMC); Bou-Saada Faroult, 1 ♀ (BMNH); El Golea, 1 ♂, 2 ♀ (INER), 3 ♂, 2 ♀ (MNHN), 1 ♂ (ZSMC); El Kantara, 6 ♂, 6 ♀ (BMNH); El Outaya, 1 ♀ (BMNH); Ghardaõa, 2 ♂ (BMNH); Hammam-es-Salahin, 1 ♀ (BMNH); Hassi Babak, 1 ♂ (NHMW); Hassi Bahbah, 1 ♀ (INER), 1 ♂ (NHMW); Laghouat, 3 ♂, 1 ♀ (MNHN); Oued Nssa, 1 ♂ (BMNH); Sebdou, 1 ♂, 3 ♀ (BMNH); Sidi-bel-Abes, 1 ♂, 3 ♀ (BMNH); Sidi-Okba, 1 ♀ (BMNH). Cyprus: Kolossi, 2 ♂, 1 ♀ (BMNH); Limasol, 2 ♀ (BMNH). Egypt: Alexandria, 1 ♂ (MNHN); Aswan, 1 ♂, 1 ♀ (BMNH); Caõro, 2 ♀ (NHMW); Khamissa, 2 ♂, 2 ♀ (BMNH); Siwa, 6 ♂, 12 ♀ (BMNH). France: Camargue, 1 ♀ (LNKD), 1 ♀ (ZFMK); Digne, 2 ♂, 2 ♀ (BMNH); Ile du Levant, 1 ♂ (MNHN); MINERvois, 1 ♂ (HUIS); Oraison, 2 ♀ (LNKD); Sorgues, 1 ♀ (LNKD); Volonne, 6 ♂, 2 ♀ (ISNB). Iran: Kazeroun-Bouchir Tchouroum, 1 ♂ (LNKD), 2 ♂, 2 ♀ (NHRS); Shadegan, 1 ♂ (LNKD); Tchouroum, 1 ♀ (NHRS). Iraq: Amarah, 3 ♂, 5 ♀ (BMNH); Bagdad, 5 ♂, 4 ♀ (BMNH), 1 ♂, 1 ♀ (LNKD); Karradah, 1 ♂ (BMNH). Israel: Haõfa, 5 ♂, 4 ♀ (NHMW); En Gedi, 1 ♂, 1 ♀ (BMNH). Italy: Livorno, 1 ♀ (BMNH), 2 ♂, 1 ♀ (NHMW). Jordan: Azraq ed Druz, 2 ♂, 5 ♀ (BMNH); Dead Sea, 1 ♀ (LNKD), 1 ♀ (ZFMK); Fuhes, 1 ♂, 1 ♀ (LNKD); Qa el Umari, 1 ♀ (BMNH); Wadi er Retem, 1 ♂, 2 ♀ (BMNH). Libya: Sidi Mesri (locality not found), 1 ♂, 1 ♀ (BMNH). Morocco: Asni, 1 ♀ (LNKD); Erfoud area, 9 ♂, 7 ♀ (ZMUC); Ksar es Souk, 1 ♂ (LNKD); Tafilalt, 1 ♀ (MNHN); Tansikht, 1 ♀ (LNKD). Russia: Sarepta, 3 ♂ (BMNH). Saudi Arabia: 150-600 km SSW of Riad, 1 ♀ (LNKD). Spain: Albarracin, 1 ♂ (INER); Alhama de Murcia, 1 ♂ (ZFMK); Huelva, 1 ♀ (BMNH); Jandia, 1 ♀ (ZFMK); Orgiva, 1 ♀ (BMNH); Malaga, 1 ♀ (GIEL); Maspalomas, 1 ♂, 1 ♀ (LNKD), 1 ♂, 5 ♀ (NHMW); Mazagon, 1 ♂ (LNKD); Motril, 1 ♀ (ZFMK); Murcia, 1 ♂ (GIEL); Periana, 1 ♂ (DERR), 2 ♂, 2 ♀ (GIEL), 2 ♂, 1 ♀ (RTAS); Rio de Baza, 1 ♂, 2 ♀ (ZMUC); Ronquillo, 1 ♀ (GIEL); San Roque, 1 ♀ (GIEL); Valdeltormo, 1 ♂, 1 ♀ (GIEL); Zaragosa, 1 ♀ (MNHN); Zujar, 3 ♂ (GIEL), 1 ♀ (PRIN), 1 ♂ (TMSA), 2 ♂ (RTAS). Tunisia: 65 km NW of Tozeur, 2 ♂ (ZMUC); Maknassy, 1 ♀ (INER); Nefta, 1 ♂ (INER), 1 ♀ (ZMUC); Sfax, 10 ♂, 15 ♀ (BMNH), 16 ♂, 7 ♀ (HNHM); Tozeur, 1 ♀ (INER), 2 ♀ (MNHN). Turkey: Alanya, 1 ♀ (LUCA); Kusadasi, 1 ♂ (LUCA). Yugoslavia: Sucurac, 1 ♀ (BMNH), 1 ♂ (NHMW).

Diagnosis. – See under *E. gratiosellus*.

External characters male, female (fig. 80). – Wingspan 16-20 mm. Frons produced forward with point, creamy white to light brown, no ventral ridge; vertex creamy white; labial palp two, sides white at base, becoming brown, white to creamy white from above and below; maxillary palp creamy white, brown ringed at base of last segment, terminal part white; antenna creamy white, from about the middle darkly ringed. Thorax creamy white to brown; patagia creamy white to brown-grey; tegulae creamy white to brown-grey, evenly mottled. Forewing, groundcolour creamy white densely suffused with ochreous to dark brown scales, usually with dark brown spot in middle of posterior area; medial fascia single, gently arched or nearly straight, running to one-third of the dorsum;

subterminal line ochreous to dark brown, about midway between terminal dots and termination of posterior area; area adjacent to terminal dots white; nine or eight black terminal dots, formula 2-2-3-2 or 2-2-3-1; fringes shiny, creamy white with two or three brown lines. Hindwing creamy white to grey-brown, subterminal fascia present or not, termen darkly bordered; fringes creamy white with brownish line.

Tergite VIII (fig. 81). – Sternite normally sclerotized, posterior part rounded, stalk normal, anterior part narrow.

Male genitalia (fig. 136). – Uncus normal, tapering to sharply pointed tip; gnathos longer, two dorsal thorns normal sized, terminal part short; tegumen without appendix angularis; sacculus broad, processus of sacculus stout, clearly bent upward overlapping cucullus, strongly sclerotized, processus basalis short, sharply bent inward, gradually tapering, strongly sclerotized, processus inferior valvae large, flat, elongated, cucullus slender, bent upward; juxta normal; vinculum normal; aedeagus short, relatively broad, three or four groups of cornuti.

Female genitalia (fig. 185). – Papillae anales small; membrane of tergite VIII with very faint sclerotization above ostium, edges of tergite VIII connected; ostium thumb-shaped, more or less pointed; ductus bursae enlarged and armed with many cornuti near ostium, small sac-like pouch at middle of ductus bursae; ductus seminalis narrow; bursa copulatrix rounded to oblong, two thorn-shaped signa.

Biology. – Lhomme (1935-1946) mentions the dead leaves of *Cirsium* spec., *Hieracium* spec. and *Cichorium* spec. (all Compositae) at the base of the plants as the food for the larvae. The larvae can be found in silk tunnels until October.

Flight-periods: south of the Mediterranean Sea, Canary Islands eastward including Egypt from February to early November (peaks April-May-June and August); north of the Mediterranean Sea, Spain eastward including Turkey from March till the end of September (peak July to September); and the area east of the Mediterranean Sea, Israel and eastwards the specimens were caught from March up the first week of July and in September up to the first week of November, with peaks in March, April and May.

This species only occurs at lower altitudes (highest record Morocco 1200 m).

Distribution (fig. 82). – Spain, France, Italy, Yugoslavia, Turkey, Cyprus, Russia, Afghanistan, Iran, Iraq, Jordan, Israel, Egypt, Libya, Tunisia, Algeria and Morocco. Also recorded from Portugal (Monteiro 1972: 13) and Bulgaria (Ganev 1985: 172).

Remarks. – The lectotype of *Euchromius islamellus* (Amsel, 1949) is not in NHRS as stated by Bleszynski (1965a: 74), but in LNKD.

34. *Euchromius zagulajevi* Bleszynski, 1965
(figs. 83, 84, 184)

Euchromius zagulajevi Bleszynski, 1965a: 80. Holotype, ♀, 'Kafirnigan, 31-VII.', GS 3983 (ZMAS) [examined].

Material. – 1 ♀. Tadzhikistan: Kafirnigan, 1 ♀ (ZMAS).

Diagnosis. – See under *Euchromius pulverosus.*

External characters female (fig. 83). – Wingspan 17 mm. Frons slightly produced forward with very minute point, creamy white, no ventral ridge; vertex creamy white; labial palp two, sides creamy white at base, becoming brown, creamy white from above and below; maxillary palp creamy white, dark brown ringed at base of last segment; antenna creamy white, from about halfway inconspicuous dark ringed. Thorax creamy white; patagia creamy white with two broad longitudinal light brown stripes; tegulae creamy white to light brown, evenly mottled. Forewing, groundcolour creamy white densely suffused with ochreous to dark brown scales; medial fascia single, straight or nearly so, running to one-third of the dorsum; subterminal line ochreous to dark brown, about midway between terminal dots and termination of posterior area; area adjacent to terminal dots white, eight black terminal dots, formula 2-2-3-1, fringes white at base then one broad ochreous brown line. Hindwing creamy white, subterminal fascia faintly present, termen darkly bordered; fringes creamy white with faint brownish line.

Female genitalia (fig. 184). – Papillae anales normal; membrane of tergite VIII without sclerotizations; tergite VIII with inconspicuous collar, edges connected; ostium simple, ductus bursae strongly sclerotized, especially at edge in middle part, ductus seminalis narrow, bursa copulatrix oblong, drop-shaped, no signa.

Biology. – Unknown. The unique holotype was caught at the end of July.

Distribution (fig. 84). – Tadzhikistan.

Remarks. – This species is only known from the female holotype.

35. *Euchromius donum* Schouten, 1988
(fig. 186)

Euchromius donum Schouten, 1988: 28. Holotype: ♀, 'Haro-Ali, Gurra 6. April 01. (C. V. Erlanger).' GS 12111 (BMNH) [examined].

Material. – 1 ♀.

Diagnosis. – Differs from all species by its single medial fascia in combination with nine or eight black terminal dots, the bursa copulatrix without a signum and the ostium simple tongue-shaped.

Distribution. – Ethiopia.

36. *Euchromius sudanellus* Bleszynski, 1965
(figs. 85-87, 137, 187)

Euchromius sudanellus Bleszynski, 1965a: 79. Holotype: ♂, 'Sudan sept. or. Port Sudan Rhoz Arbaat 23.VI.1962 leg R. Remane', GS 1308 (ZSMC) [examined].

Material. – 1 ♂, 1 ♀. Sudan: Port Sudan, 1 ♂, 1 ♀ (ZSMC).

Diagnosis. – Externally almost indistinguishable from *E. cambridgei* see under that species.

External characters male, female (fig. 85). – Wingspan 13 mm. Frons produced forward with small point, creamy white, no ventral ridge; vertex creamy white; labial palp two and a half, sides white to creamy white at base, becoming brown to dark lead-grey, white from above and below; maxillary palp white to creamy white, dark brown ringed at base of last segment, terminal part white; antenna creamy white, from about the middle inconspicuous darkly ringed. Thorax creamy white to light brown; patagia creamy white with two broad longitudinal brown stripes; tegulae creamy white with dark patch in the middle. Forewing, groundcolour white densely suffused with ochreous to dark brown scales, anterior area with dark brown spot of various size near medial fascia, posterior area with dark brown spot in middle; medial fascia single, clearly angled under costa, not broadening at inner margin, running to one-third of the dorsum; subterminal line ochreous brown, about midway between terminal dots and termination of posterior area; area adjacent to terminal dots white to yellow; eight or nine black terminal dots, formula 2-2-3-1 or 2-2-3-2; fringes shiny, creamy white with three brown lines. Hindwing light brown, subterminal fascia present, termen darkly bordered; fringes creamy white with brownish line.

Tergite VIII (fig. 86). – Sclerite strongly sclerotized, posterior part small, rectangular, stalk long, slender, anterior part clearly visible, narrow, rectangular.

Male genitalia (fig. 137). – Uncus rather broad, clearly bent, big dorsal thorn at two-fifth of pointed tip; gnathos longer, broad dorsal thorn elongated, terminal part short; tegumen with very small appendix angularis; sacculus narrow, processus of sacculus slender reaching to about the end of cucullus, processus basalis broad at base tapering soon, bent inward, strongly sclerotized, processus inferior valvae slightly pointing inward, cucullus very slender, nearly straight; juxta broad; vinculum with small basal projections; aedeagus small, tapering ventral and dorsally posterior of anellus connection, one patch of minute cornuti.

Female genitalia (fig. 187). – Papillae anales normal; membrane of tergite VIII with broad triangular sclerotized patch; ostium rounded at top, heavily sclerotized; ductus bursae lightly sclerotized, widening proximal; ductus seminalis narrow; bursa copulatrix large, roundish, small signum without, larger signum with median ridge.

Biology. – Unknown. The two specimens were caught at the end of June.

Distribution (fig. 87). – One of the rarest species of *Euchromius*, only known from North East Sudan.

Remarks. – In his original description Bleszynski (1965a: 79) mingled the external characters of the male and female of *E. sudanellus* and *E. subcambridgei* concerning the medial fascia. Only in *E. subcambridgei* the medial fascia is dilating at the inner margin and not in *E. sudanellus* as stated by Bleszynski. Bleszynski (1965b: 1-4) depicts the female genitalia of *E. sudanellus* with the legends of *E. subcambrigei* and vice versa.

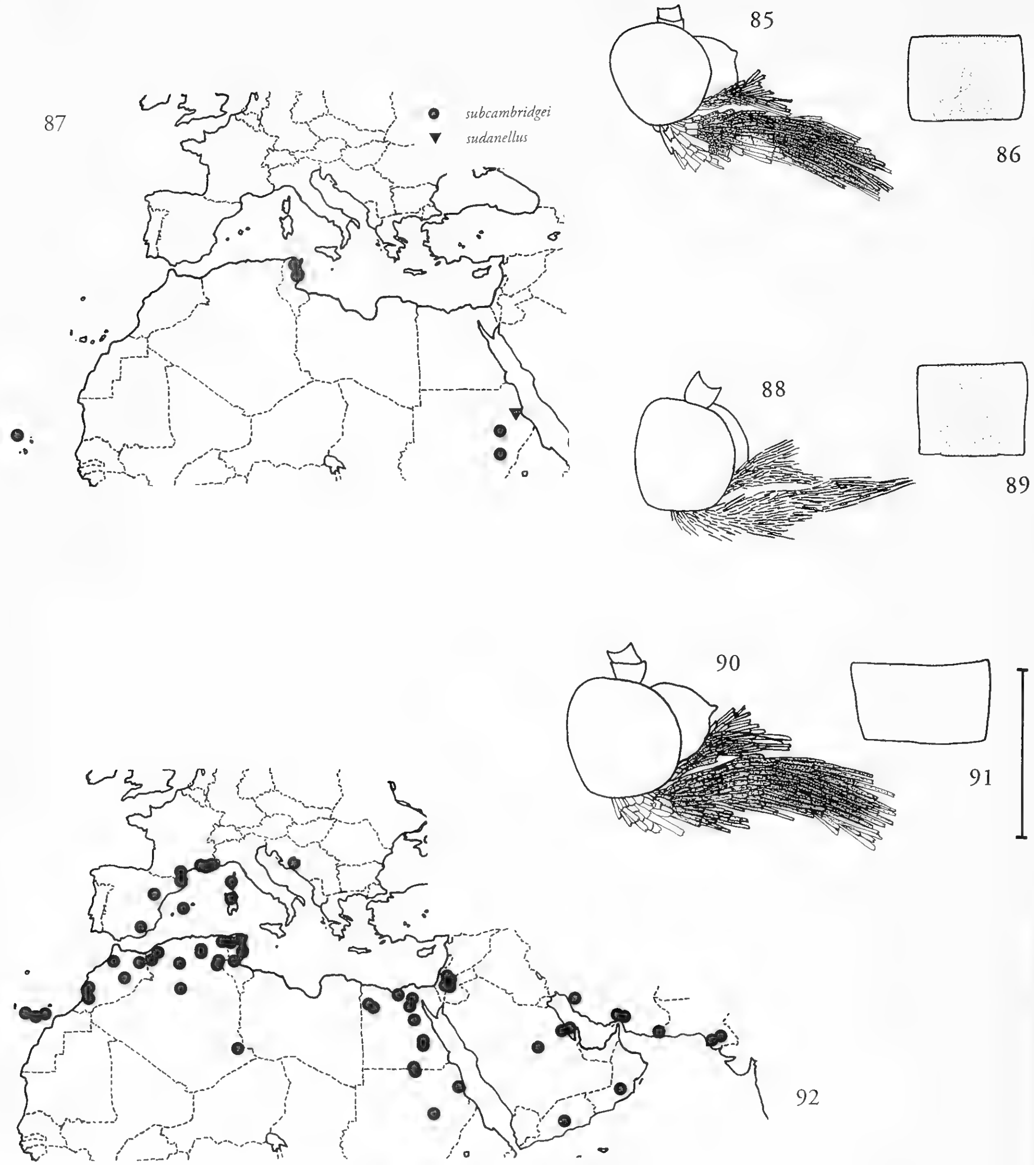
37. *Euchromius subcambridgei* Bleszynski, 1965
(figs. 87-89, 138, 188)

Euchromius subcambridgei Bleszynski, 1965a: 78. Holotype: ♂, 'Sudan Ed Damer Hudeiba 29.V.1962 leg R.Remane', GS 1315 (ZSMC) [examined].

Material. – 14 ♂, 20 ♀. Cape Verde: St. Vincent, 1 ♂ (BMNH). Sudan: Hudeiba, 1 ♀ (BMNH), 2 ♂, 1 ♀ (ZSMC). Tunisia: Sfax, 8 ♂, 12 ♀ (BMNH), 1 ♀ (CUIC), 2 ♂, 4 ♀ (RTAS), 1 ♂, 1 ♀ (ZFMK).

Diagnosis. – Externally very similar to *E. cambridgei* and *E. labellum.* Differs from these species in having the medial fascia not sharply bent, and the angle in the middle of the forewing and the fascia broadening at the inner margin.

External characters male, female (fig. 88). – Wingspan 14-15 mm. Frons produced forward, rounded without point, creamy white, darker in centre, no ventral ridge; vertex creamy white; labial palp two to two and a half, sides white at base, becoming light brown, creamy white from above and below; maxillary palp light brown, dark ringed at base of last segment, terminal part white; antenna creamy white, from about the middle inconspicuous darkly ringed. Thorax creamy white to light brown; patagia creamy white with two broad longitudinal brown stripes; tegulae creamy white with dark patch in the middle. Forewing, groundcolour white densely suffused with ochreous to dark brown scales, anterior area with dark brown basal patch; medial fascia single, clearly angled in middle of wing, broadening at inner margin, running to one-third of the dorsum; subterminal line ochreous brown, about midway between terminal dots and termination of posterior area; area adjacent



Figs. 85-92. *Euchromius* species. – 85, *E. sudanellus*, head, lateral aspect, scales removed; 86, idem, sclerite of tergite VIII; 87, distribution map of *E. sudanellus* and *E. subcambridgei*; 88, *E. subcambridgei*, head, lateral aspect, scales removed; 89, idem, sclerite of tergite VIII; 90, *E. cambridgei*, head, lateral aspect, scales removed; 91, idem, sclerite of tergite VIII; 92, idem, distribution map. Scale bar 0.5 mm to figs. 85-86, 88-89, 90-91.

to terminal dots white to yellow; six or seven black terminal dots, formula 2-3-1 or 2-3-2; fringes shiny, evenly yellowish. Hindwing creamy white to brown-grey, subterminal fascia present, termen darkly bordered; fringes white with brownish line.

Tergite VIII (fig. 89). – Sclerite clearly visible, posterior part more or less square, anterior part smaller, with two rounded caudal pointing tips, stalk normal.

Male genitalia (fig. 138). – Uncus slender, slightly bent, tapering to sharp pointed tip; gnathos longer, slender, dorsal thorns normal sized, terminal part long, lightly sclerotized; tegumen with clearly visible appendix angularis; sacculus normal, processus of sacculus slender, bent, reaching to three-fifth of cucullus, processus basalis broad at base tapering soon, tips bent inward, strongly sclerotized, processus inferior valvae slightly pointing inward, cucullus normal sized, bent upward; juxta normal; vinculum angled; aedeagus small, relatively broad, tapering ventral, tip overhanging, one large patch of minute cornuti containing one larger cornutus.

Female genitalia (fig. 188). – Papillae anales small; membrane of tergite VIII with small triangular medium sclerotized spot; ostium straight at top, strongly sclerotized, lamella antevaginalis shield-like, split in the middle; ductus bursae moderately broad; ductus seminalis broad at base; bursa copulatrix large, elongated, two round signa, one small other normal sized.

Biology. – In Tunisia this species flies from half June to half October with a peak in August-September. In Sudan it has been caught in the end of May, August and November. On the Cape Verde Islands it was caught in August.

Distribution (fig. 87). – A rather disjunct distribution, Cape Verde Islands, Tunisia and the Sudan.

Remarks. – See under *E. sudanellus.*

38. *Euchromius cambridgei* (Zeller, 1867)
(figs. 9, 90-92, 139, 189)

Eromene cambridgei Zeller, 1867: 370. Holotype: ♂, 'Egypte O.P.C. 1864', GS 5653 (BMNH) [examined].

Eromene luciella Chrétien, 1907: 178. Lectotype: ♂ (designated by Bleszynski (1965a: 77)), 'Ste Lucíe Aude France 8.7.86', GS 3646 (MNHN) [examined].

Argyria prototypa Meyrick, 1935: 571. Holotype: ♂, 'Ksar el Souk Morocco R.12.5.33', GS 5668 (BMNH) [examined].

Ommatopteryx congruentella Amsel, 1958a: 64. Holotype: ♂, 'Dhahran 24.8.57 A.S. Talhouk coll.', GS 3325 (LNKD) [examined].

Ommatopteryx szijjartoi Gozmany, 1959: 364. Holotype: ♀, 'Idfu, Egypt 28.x.1957 Exc. Egypt. Mus. Nat. Hung. leg. Dr. Gozmány', GS 1002 (HNHM) [examined].

Ommatopteryx ilkui Gozmany, 1959: 366. Holotype: ♀, 'Komosin, Egypt Distr. Fayum 9.x.1957 Exc. Egypt. Mus. Nat. Hung. leg. Dr. Gozmany', GS 1003 (HNHM) [examined].

Material. – 207 ♂, 169 ♀. Algeria: Biskra, 5 ♂, 4 ♀ (BMNH), 1 ♂ (INER), 4 ♂, 1 ♀ (MNHN); Djanet, 1 ♂ (BMNH); El Golea, 1 ♀ (INER), 6 ♂, 8 ♀ (MNHN), 2 ♂ (ISNB), 2 ♂ (ZSMC); El Kantara, 1 ♂ (BMNH); Hammam-es-Salahim, 1 ♂ (BMNH); Laghouat, 2 ♂, 2 ♀ (MNHN); Le Tarf, 1 ♂, 3 ♀ (MNHN); Sebdou, 1 ♂ (BMNH); Sidi-bel-Abbes, 1 ♂ (BMNH), 1 ♂ (MNHN). Bahrain: Al Jupair, 1 ♂ (ZMUC); Manama, 5 ♂ (BMNH). Egypt: Aswan, 3 ♂, 2 ♀ (BMNH); Cairo, 2 ♂, 2 ♀ (NHMW), 1 ♀ (MNHN); Idfu, 1 ♂ (HNHM); Komosin, 1 ♀ (BMNH), 1 ♀ (HNHM), 1 ♂ (ISNB); Minyeh, 1 ♂ (BMNH); Niltakarakt, 2 ♂, 2 ♀ (NHMW); Maryut, 2 ♂ (BMNH), 1 ♂ (LNKD); Sids, 1 ♂ (HNHM); Siwa, 4 ♀ (BMNH); Zeitoun, 1 ♂, 4 ♀ (BMNH). France: Bastia, 2 ♂ (LNKD); Boulouris, 1 ♂ (MNHN); Camarque, 1 ♂ (BMNH), 1 ♀ (HUIS), 1 ♂, 1 ♀ (LNKD), 1 ♂ (ZMFK); Cannes, 1 ♂ (MNHN); Le Canet, 1 ♀ (BMNH); Les Carbonnes de Fleurs, 5 km N. of Narbonne, 4 ♂, 1 ♀ (HUIS); Pinarello, 4 ♂, 4 ♀ (IZUI); Sole Nzara, 1 ♂ (IZUI); St. Lucie, 2 ♂, 1 ♀ (MNHN); Tour de Vignale, 1 ♂ (IZUI). Iran: Bander Abbas, 5 ♂, 2 ♀ (NHMW); 30 km E of Bander Abbas, 2 ♂, 1 ♀ (NHMW); Bender Tchahbahar, 1 ♀ (NHRS); Dalaki, 2 ♀ (LNKD); 35km N. of Minab, 1 ♂ (LNKD); street Bander Abbas-Sirjan, 1 ♂, 1 ♀ (LNKD). Israel: Dead Sea, 1 ♀ (BMNH); Deganya, 2 ♂ (GORD); Sedom, 6 ♂, 1 ♀ (BMNH); South end Dead Sea, 1 ♂ (INER), 1 ♂, 1 ♀ (LNKD), 1 ♂, 1 ♀ (MNHN), 1 ♀ (NHMW), 1 ♀ (MHNG), 3 ♀ (ZSMC). Italy: Siniscola, 2 ♂ (LNKD). Jordan: Fühes, 1 ♀ (LNKD); Karak, 1 ♀ (LNKD); Zarqa, 1 ♂, 2 ♀ (BMNH). Morocco: Aōt Melloul, 2 ♂ (MNHN); Ksar el Souk, 1 ♂ (BMNH); Mehedya, 1 ♂ (MNHN); Si Aebal Tazi, 1 ♀ (MNHN); Taourirt, 1 ♂ (BMNH). Oman: Jiddat al Harasis, 1 ♂, 1 ♀ (BMNH). Pakistan: Hydrarabad, 3 ♀ (BMNH); Karachi, 1 ♂ (BMNH), 1 ♀ (LNKD), 1 ♂, 1 ♀ (MNHN), 1 ♀ (NHMW). Saudi Arabia: Dhahran, 1 ♂ (LNKD); Riad, 3 ♀ (LNKD). Spain: Bajamar, 3 ♂ (BMNH); Cruz, 1 ♂ (NHMW); El Medano, 1 ♀ (LNKD); Fuerteventura, 1 ♂, 1 ♀ (ZMFK); Hildago, 1 ♀ (LNKD), 1 ♂, 1 ♀ (MNMS); La Escala, 2 ♂ (LNKD); Las Palma, 1 ♀ (NHMW); Maspalomas, 1 ♀ (LNKD), 2 ♂ (NHMW); Palma, 1 ♀ (NHMW); Port Orotava, 1 ♀ (BMNH), 1 ♂ (RMNH); Rio de Baza, 1 ♂ (ZMUC); Rosas, 2 ♂ (ZSMC); Sta. Cruz, 3 ♂, 2 ♀ (BMNH); Tafira, 1 ♂ (MNHN); Tejina, 1 ♂ (MNMS); Zaragosa, 1 ♀ (MNHN). South Yemen: Wadi Maseila, 1 ♀ (BMNH). Sudan: Ed Damer, 6 ♂, 11 ♀ (ZSMC); Faras, 1 ♀ (NHMW); Wadi Halfa, 1 ♂, 1 ♀ (BMNH), 1 ♂, 1 ♀ (NHMW); Toshka, 1 ♂, 1 ♀ (NHMW). Tunisia: Ain Draham, 1 ♂ (ZMUC); Bou-Hedna, 1 ♂ (INER); El Gouina, 2 ♂ (ZSMC); Gafou, 1 ♂ (MNHN); Metlaoui, 1 ♂ (MNHN); Sfax, 50 ♂, 55 ♀ (BMNH), 1 ♂ (CASC), 1 ♀ (CUIC), 5 ♂, 4 ♀ (HNHM), 5 ♂ (ISNB), 1 ♂ (LNKD), 10 ♂, 7 ♀ (MNHN); Tozeur, 1 ♂ (MNHN). Yugoslavia: Spalato, 1 ♀ (BMNH), 1 ♀ (NHMW).

Diagnosis. – Externally very similar to *E. sudanellus, E. subcambridgei* and *E. labellum.* Differs from the last two species by a small point on the frons. In male genitalia *E. cambridgei* can be distinguished from *E. sudanellus* in lacking the dorsal thorn on the uncus. The female genitalia have two equally sized signa and two very small slender sclerotized plates at the ventral site of the membrane of tergite VIII. The signa are unequal in size in *E. sudanellus* and the single plate at the ventral part of membrane of tergite VIII is triangular.

External characters male, female (figs. 9, 90). – Wingspan 12-17 mm. Frons produced forward with small point, creamy white to light brown, more dark in centre, no ventral ridge; vertex creamy white to light brown; labial palp two and a half, sides white to creamy white at base, becoming creamy white to brown, white from above and below; maxillary palp white to creamy white, darker ringed at base of last segment; antenna creamy white, ringed grey. Thorax light brown to brown; patagia light brown to brown with two very inconspicuous longitudinal brown stripes; tegulae light brown to brown with a not to clear dark patch in the middle. Forewing, groundcolour creamy white densely suffused with ochreous to dark brown scales, anterior area usually with dark brown streak, in dark specimens anterior area entirely dark brown, posterior area usually with dark brown streak and a yellowish to dark brown spot, in dark specimens posterior area entirely dark brown, also very light specimens occur; medial fascia single, clearly angled under costa, not broadening at inner margin, running to halfway of the dorsum; subterminal line ochreous brown sometimes only faintly visible, about midway between terminal dots and termination of posterior area; area adjacent to terminal dots white to yellow; eight to four black terminal dots, group three usually present; fringes shiny, creamy white to yellow-brown, sometimes with, not clearly separated, darker lines. Hindwing grey to light brown, subterminal fascia present, termen darkly bordered; fringes creamy white with brownish line.

Tergite VIII (fig. 91). – Sclerite normally sclerotized, posterior part broad, rounded, faint, stalk faint, short, anterior part very faint and narrow.

Male genitalia (fig. 139). – Uncus tapering to sharply pointed tip, inconspicuous dorsal crest present; gnathos longer, two small dorsal thorns, terminal part short; tegumen without appendix angularis; sacculus broad, processus of sacculus slender, slightly bent upward, reaching to circa three-fifth of cucullus, processus basalis slender, sharply bent, processus inferior valvae small, flattened, cucullus normal, more or less bent upward; juxta triangular; vinculum normal; aedeagus small, one group of cornuti.

Female genitalia (fig. 189). – Papillae anales normal; membrane of tergite VIII with collar-like sclerotization, edges of tergite VIII not connected; ostium small; ductus bursae normal; ductus seminalis narrow; bursa copulatrix roundish, two long signa.

Biology. – Recorded from inland-dune landscape mixed with salt-areas (Amsel, 1958). Flies in Spain, France, Italy, Yugoslavia, Tunisia, Algeria and Morocco in two more or less continues generations from April until November with peaks in April-May and September-October. On the Canary Islands it is also present in November up to April. In Pakistan, Iran, Oman, South Yemen, Saudi Arabia, Jordan, Israel, Egypt and Sudan it has been caught throughout the year, with peaks in February-May and October-November.

Distribution (fig. 92). – Spain, France, Italy, Yugoslavia, Iran, Pakistan, Bahrain, Oman, South Yemen, Saudi Arabia, Jordan, Israel, Egypt, Sudan, Tunisia, Algeria and Morocco.

Remarks. – Most variable species in the genus, in size as well as in colour. The darkest coloured specimens occur on the Canary Islands and in the West-Mediterranean countries. The palest and smallest specimens are found in Iran.

39. *Euchromius viettei* Bleszynski, 1961
(figs. 93, 140, 141, 190)

Euchromius viettei Bleszynski, 1961: 455. Holotype: ♂, 'Arabia: Hejaz, Jidda. 22.XI.1926 H. St. J. B. Philby', GS 5091 (BMNH) [examined]. Schouten (1988: 24) [redescription].

Euchromius karsholti Ganev, 1987: 44. Holotype: ♂, 'Saudi Arabia FEB 1980 Djidda, Northern Creek U. Seneka Nielsen leg.', GS 968 (ZMUC) [examined]. **syn. n.**

Material. – 10 ♂, 4 ♀. Chad: Binni Erdi, 4 ♂, 2 ♀ (BMNH). Oman: Khubayt, 1 ♂ (BMNH); Qurm, 1 ♂ (BMNH). Saudi Arabia: Burayman, 1 ♂, (BMNH); Djidda, 1 ♀ (ZMUC); Hejaz, 3 ♂, 1 ♀ (BMNH).

Diagnosis. – Difficult to distinguish externally from other species with a single medial fascia. Differs in male genitalia in having the processus of sacculus forming a heavily spined lobe in combination with the processus basalis broad at base, narrowing very abruptly. Differs in female genitalia in a roundish bursa copulatrix with one round signum in combination with edges of tergite VIII connected forming a minute projection and having the lamella postvaginalis rectangular.

Biology. – Unknown. Specimens caught in February, November and December in Saudi Arabia and Oman, in August in Chad.

Distribution (fig. 93). – Occurs in the Saudian Peninsula and the Tibesti Mountains of Chad.

Remarks. – Ganev (1987: 44) describes the species *Euchromius karsholti* based on a single female from Saudi Arabia. In the diagnosis he gives no distinct differences between *E. viettei* Bleszynski, 1961 and *karsholti*. He only states: 'VIII. tergite very complicated, however differing from those of *Euchromius hampsoni* and *Euchromius viettei*'. The quality of the drawing of the female genitalia is too poor to make any statement on the degree of difference between the species concerned. Study of the holotypes proved no differences between *E. karsholti* Ganev, 1987 and *E. viettei* Bleszynski, 1961. *E. karsholti* Ganev, 1987 is therefore a junior synonym of *E. viettei* Bleszynski, 1961.

40. *Euchromius hampsoni* (Rothschild, 1921)
(figs. 143, 191)

Ommatopteryx hampsoni Rothschild, 1921: 220. Holotype: ♂, 'Azzal N. of Agades 13. July 20. (A. Buchanan)', GS 5676 (BMNH) [examined]. Schouten (1988: 25) [redescription].

Material. – 1 ♂, 1 ♀.

Diagnosis. – Difficult to distinguish externally from other species with a single medial fascia. Differs in male genitalia in having the processus of sacculus forming a heavily spined lobe in combination with the processus basalis broad at base, narrowing gradually. Differs in female genitalia in a roundish bursa copulatrix with one round signum in combination with lamella postvaginalis square, lamella antevaginalis with clear anterior fold.

Distribution. – Niger.

41. *Euchromius klimeschi* Bleszynski, 1961
(figs. 142, 192)

Euchromius klimeschi Bleszynski, 1961: 467. Holotype: ♂, 'Natal Weenen 1-iii-1927 H. P. Thomasset', GS 5096 (BMNH) [examined]. Schouten (1988: 14) [redescription].

Material. – 14 ♂, 30 ♀.

Diagnosis. – Differs from all other species by a rounded frons without a point, a single medial fascia, six or seven black terminal dots and a white area adjacent to terminal dots.

Distribution. – Ethiopia, Somalia, Kenya, Tanzania, Zaire, Zambia, Zimbabwe, Madagascar, Mozambique, South Africa, Namibia and Burkina Faso [=Upper Volta]. B. Landry collected the first specimen for West Africa in Burkina Faso: Kompienbiga, 15 km W. of Pama, 5-13.VIII.1988 (LAND).

Remark. – Due to an incorrectly positioned female genitalia the ductus seminalis was wrongly interpreted and recorded as narrow (Schouten 1988). In contrast to this the ductus seminalis starts broad and narrows soon, the sclerotized ring starts in the broad part of the ductus seminalis.

42. *Euchromius discopis* (Hampson, 1919)
(figs. 144, 193)

Ommatopteryx discopis Hampson, 1919: 534. Holotype: ♀, 'Transvaal 1907-122 Pretoria 21.10.06 A. J. T. Janse II' GS 7049 (BMNH) [examined].

Euchromius discopis (Hampson, 1919). Schouten (1988: 16) [redescription].

Material. – 23 ♂, 24 ♀.

Diagnosis. – Difficult to distinguish from other species with eight or nine black terminal dots and a single medial fascia. Differs from these species in male genitalia in having the processus of sacculus long and slender, nearly reaching the end of the cucullus, a dorsal spike at base of the processus. Differs in female genitalia in having a tooth-shaped ostium in combination with a oblong bursa copulatrix with one faint signum.

Distribution. – Zimbabwe, Botswana, South Africa and Namibia.

43. *Euchromius labellum* Schouten, 1988
(figs. 9, 146, 196)

Euchromius labellum Schouten, 1988: 17. Holotype: ♀, 'Afrika Kenya Samburu Game Reserve, Lodge 15.2.1975 LF leg. D. Buckh.', GS 393 (MHNG) [examined].

Material. – 8 ♂, 6 ♀.

Diagnosis. – Differs from most species in having the single medial fascia angled under the costa. Differs in male genitalia in having a lip-shaped bilobed uncus. Differs in female genitalia in having a broad tongue-shaped ostium in combination with a roundish bursa copulatrix with one signum and a broadly starting ductus seminalis which narrows soon.

Biology. – The author collected material of this species in Samburu National Park. The specimens were caught at 925 m altitude, approximately 50 m from the river, in an area with scattered *Acacia* spp. trees with some shrubs and patches of grass.

Distribution. – Kenya.

44. *Euchromius aris* Schouten, 1988
(figs. 145, 195)

Euchromius aris Schouten, 1988: 22. Holotype: ♂, 'Samburu Res. KENYA 2800' 6 March '86 R. Leuchner', GS 420 (LACM) [examined].

Material. – 10 ♂, 20 ♀.

Diagnosis. – Difficult to separate from species with a single medial fascia and nine (or eight) black terminal dots and a bluntly produced rounded frons. Differs from these species in male genitalia in having a gnathos without a terminal part in combination with a slender, sharply pointed cucullus and a aedeagus with one group of cornuti. Differs in female genitalia in having the bursa copulatrix with two rounded signa in combination with a small dorsally bent lip-shaped projection and the lamella postvaginalis square.

Distribution. – Kenya.

45. *Euchromius erum* Schouten, 1988
(figs. 147, 196)

Euchromius erum Schouten, 1988: 21. Holotype: ♀, 'Kenya: 5 mi NE Kargi Marsabit District elev. ca 1500 feet 28 Jan.-3 Feb. 1973 Julian Donahue', GS 365 (LACM) [examined].

Material. – 3 ♂, 11 ♀.

Diagnosis. – Difficult to separate from species with a single medial fascia and a bluntly projecting rounded frons. Differs from these species in male genitalia in lacking the two dorsal thorns of the gnathos and the appendix angularis in combination the presents of heavy spines on the valvae. Differs in female genitalia by the upper two-third of the ductus bursae being evenly sclerotized by small spots.

Biology. – See under *E. labellum*.

Distribution. – Ethiopia and Kenya.

46. *Euchromius locustus* Schouten, 1988
(figs. 148, 197)

Euchromius locustus Schouten, 1988: 18. Holotype: ♀, 'Zambia Mbala 3-8.x.1974 Locust Cont. Ctr. BM.1975-92.', GS 12986 (BMNH) [examined].

Material. – 2 ♂, 4 ♀.

Diagnosis. – Difficult to separate from species with a single medial fascia and a bluntly projecting rounded frons and nine (or eight) black terminal dots. Differs from these species in male genitalia in having a broad, triangular appendix angularis in combination with the absence of the two dorsal thorns of the gnathos.

Distribution. – Tanzania, Zaire and Zambia.

47. *Euchromius nigrobasalis* Schouten, 1988
(figs. 149, 198)

Euchromius nigrobasalis Schouten, 1988: 20. Holotype: ♂, 'Pretoria 11.x.1958 L. Vari', GS 155 (TMSA) [examined].

Material. – 3 ♂, 4 ♀.

Diagnosis. – Differs from all other species in having a broad single medial fascia which is sprinkled with black scales giving it a fingerprint impression.

Distribution. – Zimbabwe and South Africa.

Miyakea Marumo, 1933

Miyakea Marumo, 1933: 48. Type species: *Eromene expansa* Butler, 1881: 590, by monotypy.

The genus *Miyakea* was described by Marumo in 1933 to accommodate *Eromene expansa* Butler, 1810. Caradja (1910) described a new form of *Eromene bella* (= *Euchromius bellus*) from Russia: Radde and named it *raddeellus*. Bleszynski & Collins (1962) made it a synonym of *M. expansa* (Butler, 1881). The third species has only recently been described from Taiwan: *Euchromius lushanus* Inoue, 1989. It is now transferred to *Miyakea*. The female genitalia of *M. expansa* are depicted and described for the first time. *M. sinevi* sp. n. is described from Mongolia.

Diagnosis of *Miyakea*

Ductus ejaculatorius enters the aedeagus terminally; dorsal thorns on the gnathos absent; tergite VIII without sclerotized pattern; frons projecting or not; M1 of hindwing located in the lower part of the more or less closed cell; base of M2 and M3 of hindwing with a basal pointing vein, more or less closing the cell (fig. 10); spinula not visible.

Morphology

Head. The frons has no diagnostic characters at species level, it is projection or not, without point, creamy white to brown without a ventral ridge. The relative size of the labial palp compared to the eye diameter can be used to separate the species. The antenna are serrate in males and setaceous in females. The scales on the antenna are creamy white, sometimes inconspicuous darkly ringed.

Thorax. Thorax uniformly coloured, creamy white to brown. Patagia light brown to brown. Tegulae creamy white with a dark patch in the middle.

Venation (fig. 10). Very similar to that of the genus *Euchromius*. The differences with the latter genus are listed under 'Diagnosis'.

Wing pattern. The ground-plan of the pattern is similar to that of *Euchromius* (fig. 7), but there are no species with a single medial fascia. The formula of the black terminal dots usually offers a good character to distinguish the species. The position of the double medial at the costa is in some cases diagnostic.

Genitalia. The male genitalia offer excellent diagnostic characters. The uncus is rather uniform, slender and tapering to a sharply pointed tip. The gnathos is of equal length, the tip is minutely dentate. The sacculus is reduced to absent. The processus basalis is reduced to very prominent. The costal edge of the valvae forming a prominent projection or not, the cucullus is truncate. Processus inferior valvae inconspicuous to absent. Juxta small, rounded. Vinculum long. Aedeagus highly diagnostic, usually with cornuti. Female genitalia, papillae anales uniformly small. Ostium armed with variously shaped projections. Ductus bursae short, with or without a pouch-like enlargement under the ostium. Ductus seminalis always narrow. Bursa copulatrix oblong without signa.

Intraspecific variation

The intraspecific variation of *Miyakea* is limited, the male genitalia in *raddeellus* show some variation.

Tympanal organs

In *Miyakea* the tympanal organs are similar to those of *Euchromius*, but the spinula on the tympanum is not sclerotized.

Distribution

The four species are confined to Asia, China, Taiwan and Japan. *M. expansa* is endemic to Japan, *lushanus* is endemic to Taiwan. *M. sinevi* has been found in Mongolia. *M. raddeellus* has the most extensive distribution, occurring in China, Russia and Korea.

Biology

Unknown. *Raddeellus* has been caught at an altitude of 1800 m.

Checklist of extant *Miyakea* Marumo

1. *lushanus* (Inoue, 1989)
2. *raddeellus* (Caradja, 1910)
3. *expansa* (Butler, 1881)
4. *sinevi* **sp. n.**

1. *Miyakea lushanus* (Inoue, 1989) comb. n.

(figs. 94, 95, 118, 169)

Euchromius lushanus Inoue, 1989: 2. Holotype: ♂, 'Lushan Nantou Formosa 29.VII.1973 Y. Shibata', GS 13229 (INOU) [examined].

Material. – 1 ♂, 1 ♀. Taiwan: Nantou, 1 ♂, 1 ♀ (INOU).

Diagnosis. – Differs from *M. sinevi* by the present of a group of three black terminal black dots. Differs from *M. expansa* in not having the medial fascia connected with the yellow apical marking. Differs from *M. raddeellus* in male genitalia lacking the processus basalis, in female genitalia in lacking the tongue-shaped projection of the ostium.

External characters male, female (fig. 94). – Wingspan 20-26 mm. Frons produced forward, rounded without point, light brown to creamy white, no ventral ridge; vertex creamy white, light brown in the middle; labial palp three, creamy white at base, very soon brown, becoming brown lead-grey, brown from above, creamy white from below; maxillary palp brown, terminal part creamy white; antenna creamy white. Thorax brown; patagia light brown to brown; tegulae creamy white with brown patch in middle. Forewing, groundcolour creamy white densely suffused with ochreous to dark brown scales, costa of anterior area brown; medial fascia double slightly arched, running to one-fourth of the dorsum; subterminal line brown, about midway between terminal dots and termination of posterior area; area adjacent to terminal dots yellow to white; seven black terminal dots, formula 2-3-2; fringes shiny, evenly lead-grey. Hindwing grey-brown, subterminal fascia present, termen darkly bordered; fringes creamy white.

Male genitalia (fig. 118). – Uncus normal; gnathos equal in length tip minutely dentate, dorsal thorns absent; tegumen slender, appendix angularis absent; sacculus inconspicuous, processus of sacculus absent, processus basalis reduced to elongated rim, processus inferior valvae absent, cucullus slightly concave, blunt; juxta roundish; vinculum elongated; aedeagus curved, no cornuti.

Female genitalia (fig. 169). – Papillae anales small; membrane of tergite VIII without sclerotizations; ostium small with very small low projecting tooth; ductus bursae short with more sclerotized lines; ductus seminalis narrow; bursa copulatrix oblong, signum absent.

Biology. – Unknown. Specimens were caught in July and August at 1200 m altitude.

Distribution (fig. 95). – Taiwan.

Remarks. – *M. lushanus* is the sister species of *raddeellus* and/or *expansa* judging to the male genitalia and falls within the genus diagnosis of the genus *Miyakea*. Leaving this species in *Euchromius* would cause a polyphyletic genus. Therefore *lushanus* is transferred to *Miyakea* Marumo, 1933.

In the original description slide number 13230 is given as belonging to the holotype, but upon checking the type material this turns out to be the female paratype slide number. The holotype slide number is 13229.

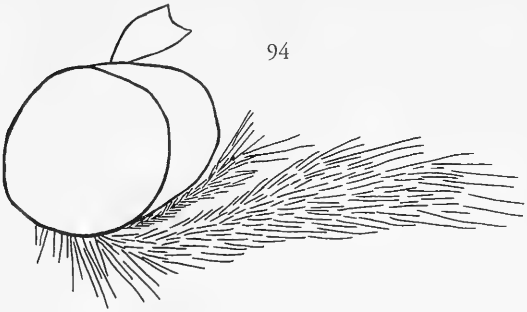
2. *Miyakea raddeellus* (Caradja, 1910) sp. rev.

(figs. 9, 95, 96, 119, 120, 167)

Eromene bellus form *raddeella* Caradja, 1910: 115. Lectotype: ♂ (designated by Bleszynski (1965a: 89)), [Russia] 'Radde Amur 1903 Korb'. (MGAB) [not examined].

Miyakea expansa sensu Bleszynski & Collins (nec Butler, 1881) 1962: 325 [status nov. for *Eromene bellus* form *raddeellus* Caradja, 1910 and synonymization with *Miyakea expansa* (Butler, 1881)].

Material. – 10 ♂, 14 ♀. China: Changyang, 1 ♂ (BMNH), 1 ♂ (TMSA); Chung Kiang [=Zhongjiang], 1 ♀ (BMNH); Chung King, 1 ♂, 5 ♀ (BMNH); Foochow [=Fuzhou], 2 ♂, 2 ♀ (BMNH), 1 ♂ (RTAS), 1 ♀ (TMSA); Siang-Yang-Fu [=Xiangfan], 1 ♂ (BMNH); Wenchow [=Wenzhou], 1 ♀ (RTAS), 3 ♂, 3 ♀ (ZFMK). Korea: Ryong Hpieng [locality not found], 1 ♀ (MNHN).



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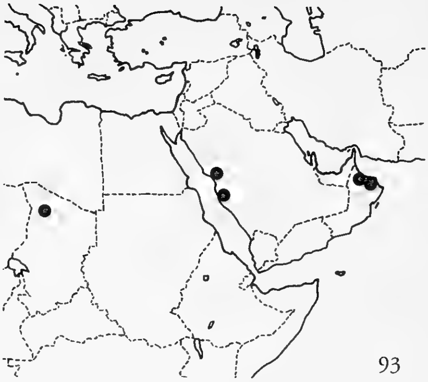
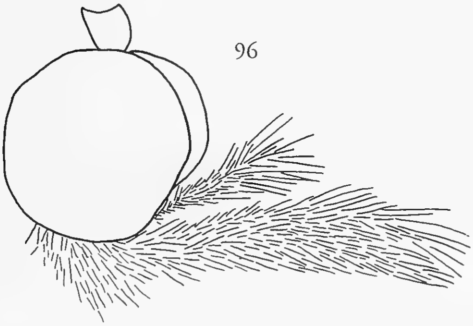


93



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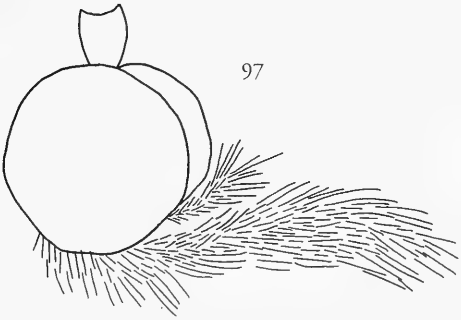

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Figs. 93-97. *Euchromius* and *Miyakea*. – 93, *E. viettei*, distribution map; 94, *M. lushanus*, head, lateral aspect, scales removed; 95, distribution map of *M. lushanus*, *M. raddeellus*, *M. expansa* and *M. sinevi*; 96, *M. raddeellus*, head, lateral aspect, scales removed; 97, *M. expansa*, head: lateral aspect, scales removed. Scale bar 0.5 mm to figs. 94, 96-97.

Diagnosis. – *M. raddeellus* can be separated from *M. expansa* by a double medial fascia which does not touch the yellow apical marking in combination with seven black terminal dots. Differs from *M. sinevi* in having a group of three black terminal dots. Differs from *M. lushanus* in male genitalia by the presence of a processus basalis, in female genitalia by a tongue-shaped projection of the ostium.

External characters male, female (figs. 9, 96). – Wingspan 19-28 mm. Frons not produced forward, rounded without point, light brown, darker in centre, no ventral ridge; vertex light brown; labial palp two, sides creamy white at base, becoming lead-grey, brown from above, light brown from below; maxillary palp light brown, dark brown ringed at base of last segment, terminal part light brown; antenna creamy white. Thorax creamy white to light brown; patagia light brown; tegulae creamy white with dark patch in the middle. Forewing, groundcolour creamy white, densely suffused with ochreous to dark brown scales, posterior area with, sometimes inconspicuous, spot near medial fascia; medial fascia double, concave to nearly straight, running to one-fourth to one-third of the dorsum; subterminal line ochreous to dark brown, about midway between terminal dots and termination of posterior area; area adjacent to terminal dots white; seven black terminal dots, formula 2-3-2; fringes highly shiny, evenly grey. Hindwing creamy white to light brown, subterminal fascia usually clearly present, termen darkly bordered; fringes creamy white with faint brownish line.

Male genitalia (figs. 119, 120). – Uncus slender, tapering to sharply pointed tip; gnathos equal in length, tip minutely dentate, dorsal thorns absent; tegumen slender, appendix angularis absent; sacculus inconspicuous, narrow, processus of sacculus absent, processus basalis large, broad, various in length, tip elongated, bent inward, second strongly sclerotized projection with dentated dorsal edge formed by costal edge of valvae, reaching beyond cucullus, processus inferior valvae small, inconspicuous, cucullus broad, ending truncate; juxta small, rounded, fringed with hairy membrane; vinculum long, elongated; aedeagus large with three to five cornuti.

Female genitalia (fig. 167). – Papillae anales small; membrane of tergite VIII without sclerotizations; ostium with bifurcate projection, projection covered with minute spines; ductus bursae short, broad, strongly sclerotized in upper part, armed with small spines; ductus seminalis narrow; bursa copulatrix large, oblong, no signa.

Biology. – Unknown. This species has been caught in April, May, June, July and September. Altitude mentioned: 1800 m.

Distribution (fig. 95). – China, Korea and USSR.

Remarks. – All previous literature concerning material of *Miyakea expansa* outside Japan refers to *M. raddeellus* or *M. lushanus.* The type material of this species could not be studied since the collections in Bucarest were closed for research during my visit to the museum.

3. *Miyakea expansa* (Butler, 1881)
(figs. 9, 95, 97, 121, 168)

Eromene expansa Butler, 1881: 590. Lectotype: ♀ (designated by Bleszynski (1965a: 89)), 'Tokei 80.97', GS 18213 (BMNH) [examined].
Miyakea expansa (Butler, 1881) Marumo (1933: 49).
Euchromius expansa (Butler, 1881) Inoue (1982: 225).
Miyakea raddeellus sensu Bleszynski & Collins (1962: 325) (nec Caradja, 1910).

Material. – 1 ♂, 1 ♀. Japan: Otaru, 1 ♂ (BMNH); Tokei, 1 ♀ (BMNH).

Diagnosis. – *M. expansa* is easily distinguished from all other species by its six black terminal dots in which a group of three dots is present in combination by the outer medial fascia touching the yellow apical marking of the forewing.

External characters male, female (figs. 9, 97). – Wingspan 21-30 mm. Frons not produced forward, rounded without point, light brown to creamy white, no ventral ridge; vertex yellow-brown; labial palp two, sides brown, brown from above, creamy white from below; maxillary palp brown, terminal part creamy white; antenna creamy white, inconspicuous darkly ringed. Thorax light brown; patagia light brown; tegulae creamy white with dark brown patch in the middle. Forewing, groundcolour creamy white densely suffused with ochreous to dark brown scales; medial fascia double, slightly arched, running to one-fourth of the dorsum; subterminal line dark brown, about midway between terminal dots and termination of posterior area; area adjacent to terminal dots yellow to white; six black terminal dots, formula 2-3-1, central dots of group 'three' sometimes very large, nearly double; fringes shiny, evenly lead-grey. Hindwing grey, subterminal fascia present, termen darkly bordered; fringes creamy white.

Male genitalia (fig. 121). – Uncus slender, tapering to pointed tip; gnathos equal in length, tip minutely dentate, dorsal thorns absent; tegumen slender, appendix angularis absent; sacculus narrow, processus of sacculus absent, processus basalis large, swollen in basal half; dorsal edge very roughly dentate, processus inferior valvae small, inconspicuous, cucullus slender ending truncate; juxta normal sized, rounded; vinculum long, elongated; aedeagus relatively large, one elongated group of cornuti.

Female genitalia (fig. 168). – Papillae anales small; membrane of tergite VIII without sclerotizations, edges of tergite VIII free; ostium simple, with tongue-shaped projection; ductus bursae grooved in upper half, small pouch-like enlargement direct under ostium; ductus seminalis narrow; bursa copulatrix oblong, no signa.

Biology. – Unknown. Caught in June.

Distribution (fig. 95). – Japan.

Remarks. – *M. expansa* is restricted to Japan. All references concerning material of the mainland of Asia are most likely to belong to *M. raddeellus.* Bleszynski (1965a) erroneously depicted the female genitalia of *M. raddeellus* and stated it to be those of *expansa.*

4. *Miyakea sinevi* sp. n.
(figs. 95, 97a)

Type material. – Holotype: 1 ♀, 'Mongoli', GS R.S. 767 (ZMAS).

Diagnosis. – *M. sinevi* is easily distinguished from all other species by lacking a group of three black terminal dots.

External characters female – Wingspan 20 mm. Frons not produced forward, rounded without point, brown with some creamy white scales, no ventral ridge; vertex creamy white with brown scales; labial palp three, sides brown, brown from above, brown from below; maxillary palp brown; antenna creamy white, inconspicuous darkly ringed. Thorax brown; patagia brown; tegulae creamy white with a broad dark brown patch in the middle. Forewing, groundcolour creamy white densely suffused with ochreous to dark brown scales; costal area of anterior part brown; medial fascia double, slightly arched, running to one-fourth of the dorsum; subterminal line dark brown, about midway between terminal dots and termination of posterior area; area adjacent to terminal dots white; eight or seven black terminal dots, formula 2-2-2-2 or 2-2-2-1; fringes shiny, evenly lead-grey. Hindwing grey-brown, subterminal fascia absent; fringes too worn to be described.

Female genitalia (fig. 97a). – Papillae anales small; membrane of tergite VIII without sclerotizations, edges of tergite VIII free; ostium simple, with a broad tongue-shaped projection, under the ostium a pouch with a strong sclerotized part is clearly separated from the ductus bursae; ductus bursae long; ductus seminalis narrow; bursa copulatrix small, no signa.

Biology. – Unknown. Caught in June.

Distribution (fig. 95). – Mongolia.

Etymology. – This species is named in honour of Dr. Sinev of St. Petersburg a highly esteemed specialist of Momphidae.

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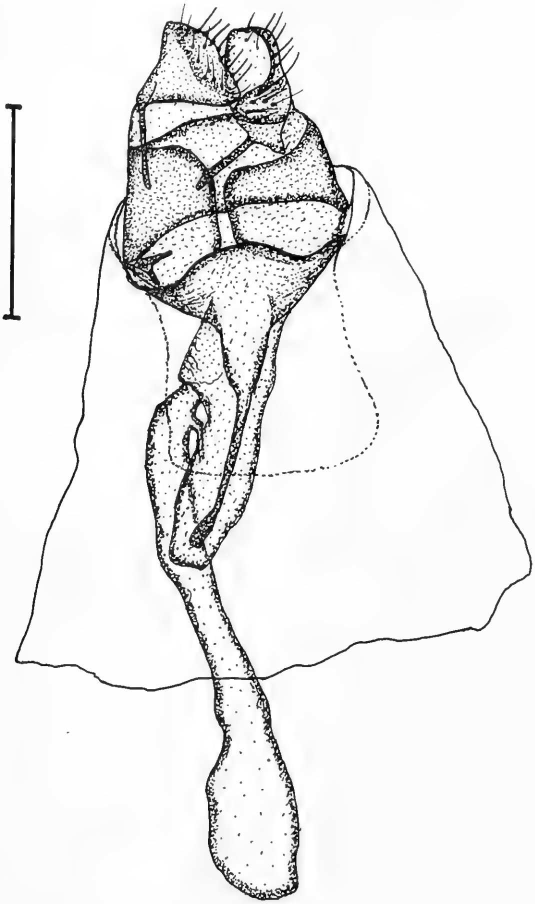
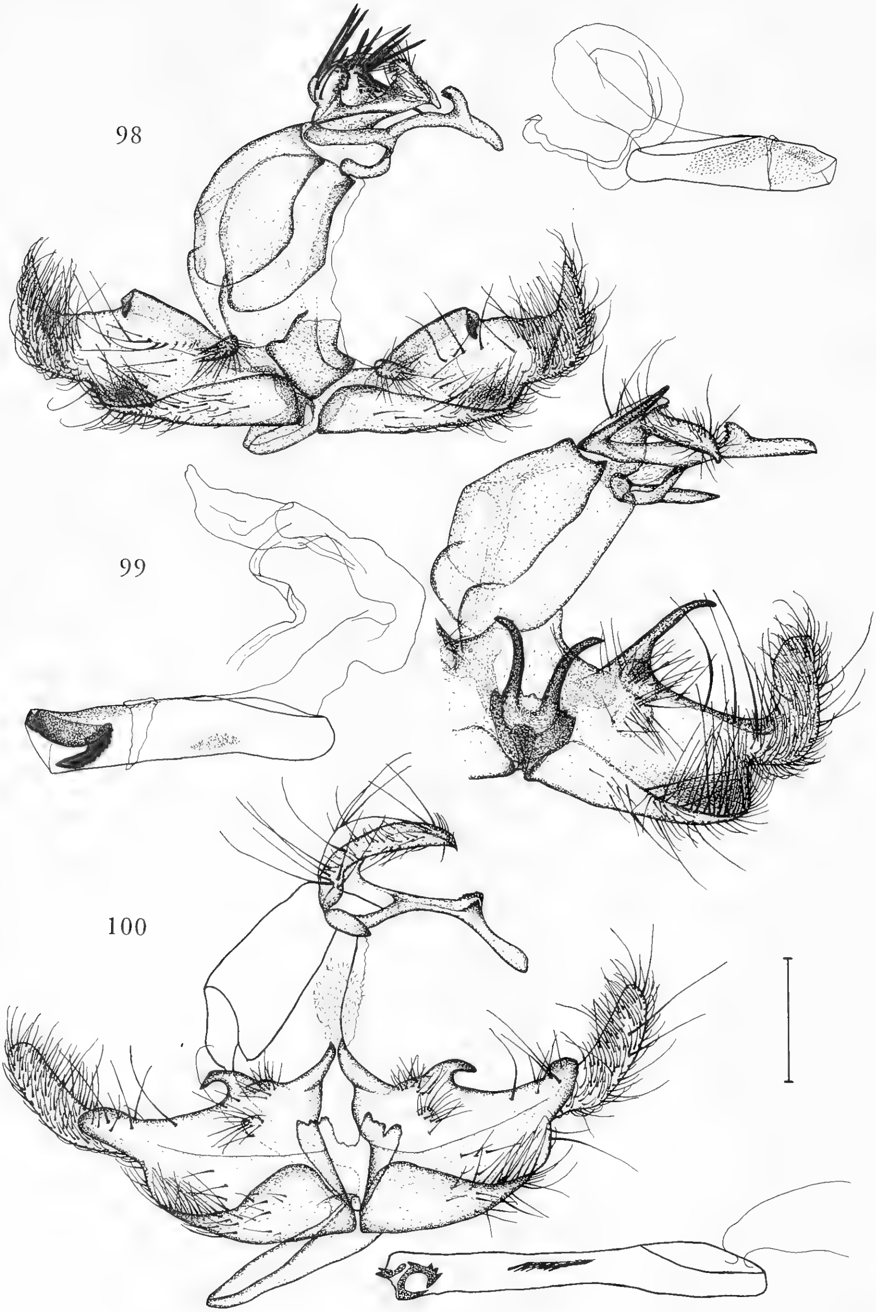
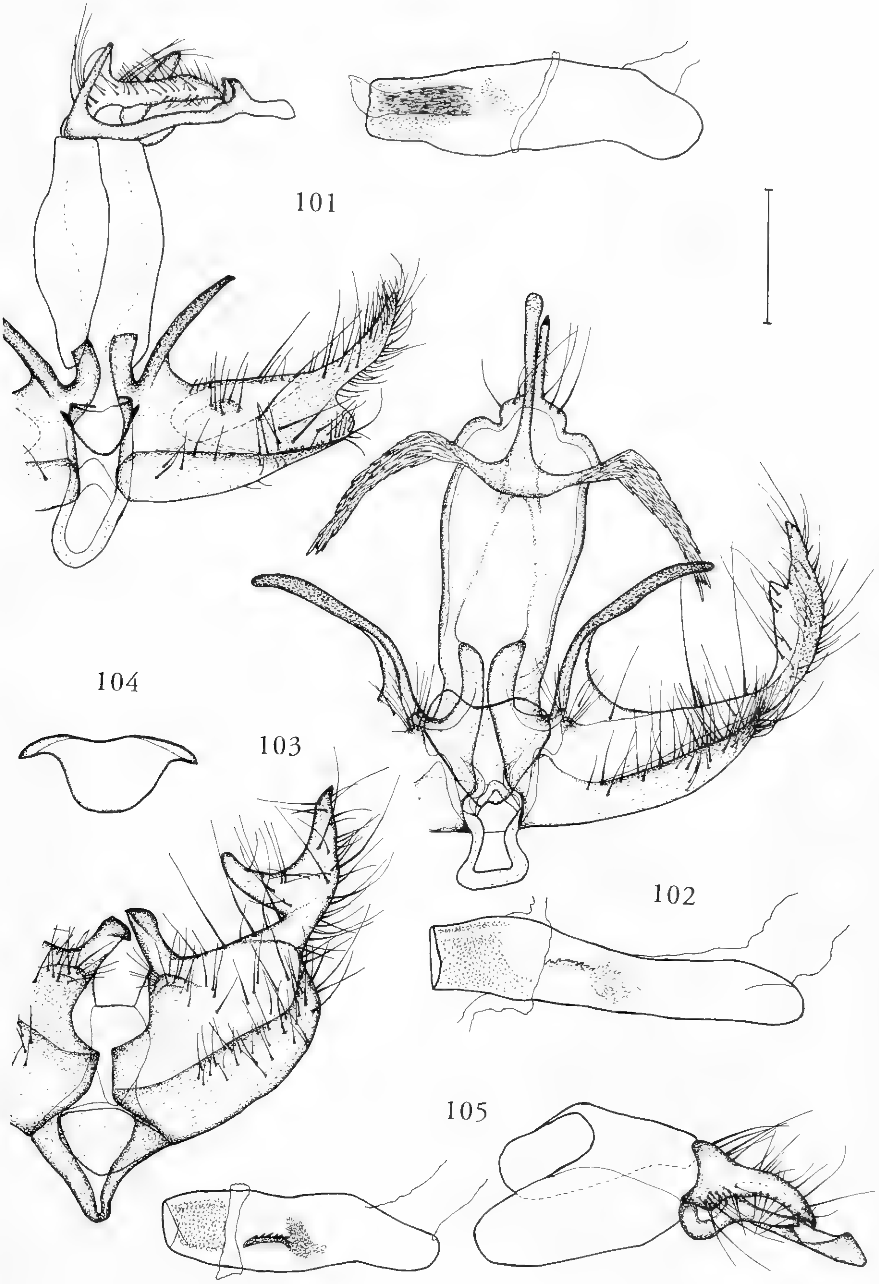


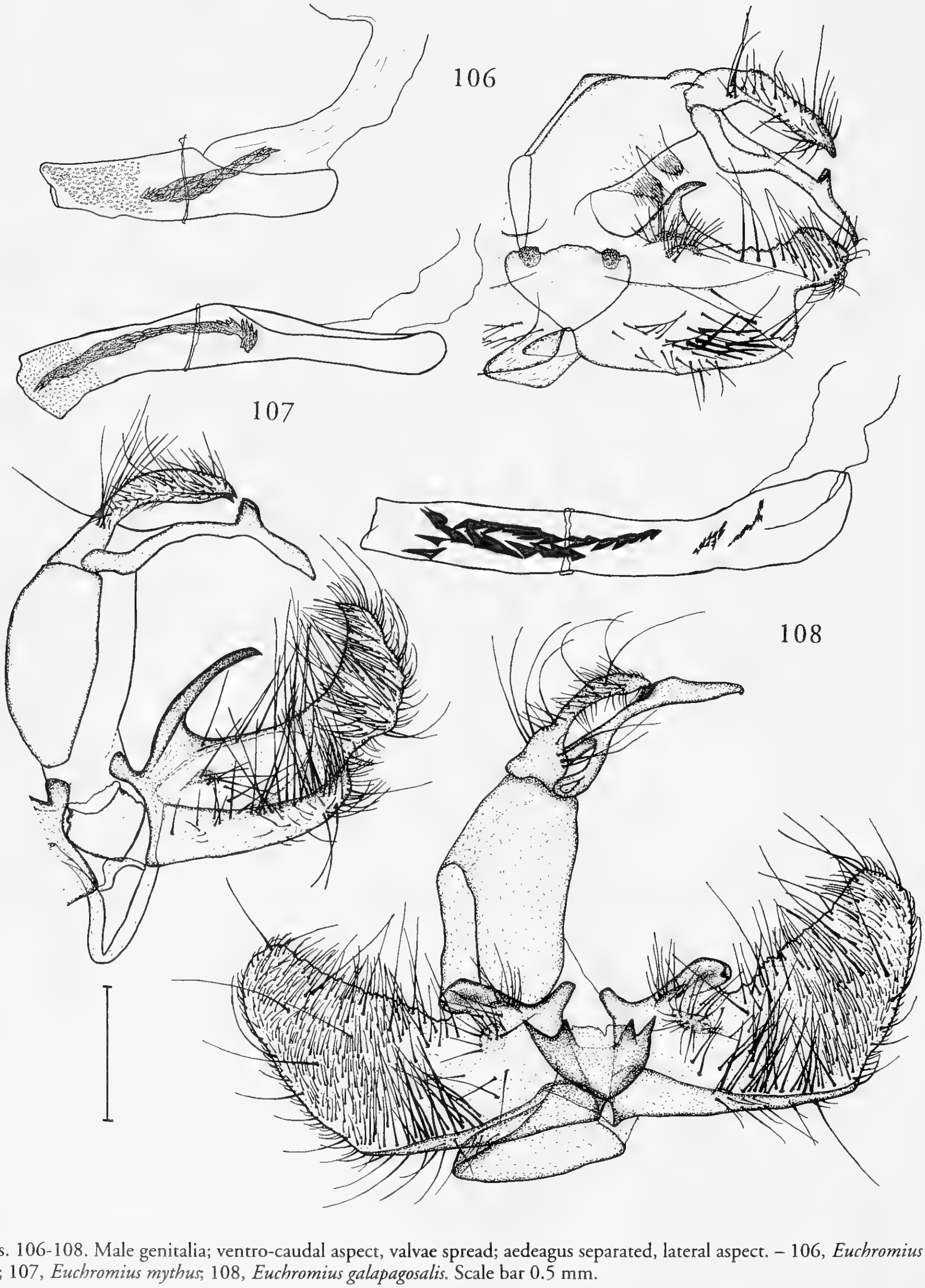
Fig. 97a. Female genitalia; ventral aspect. *Miyakea sinevi.* Scale bar 1 mm.



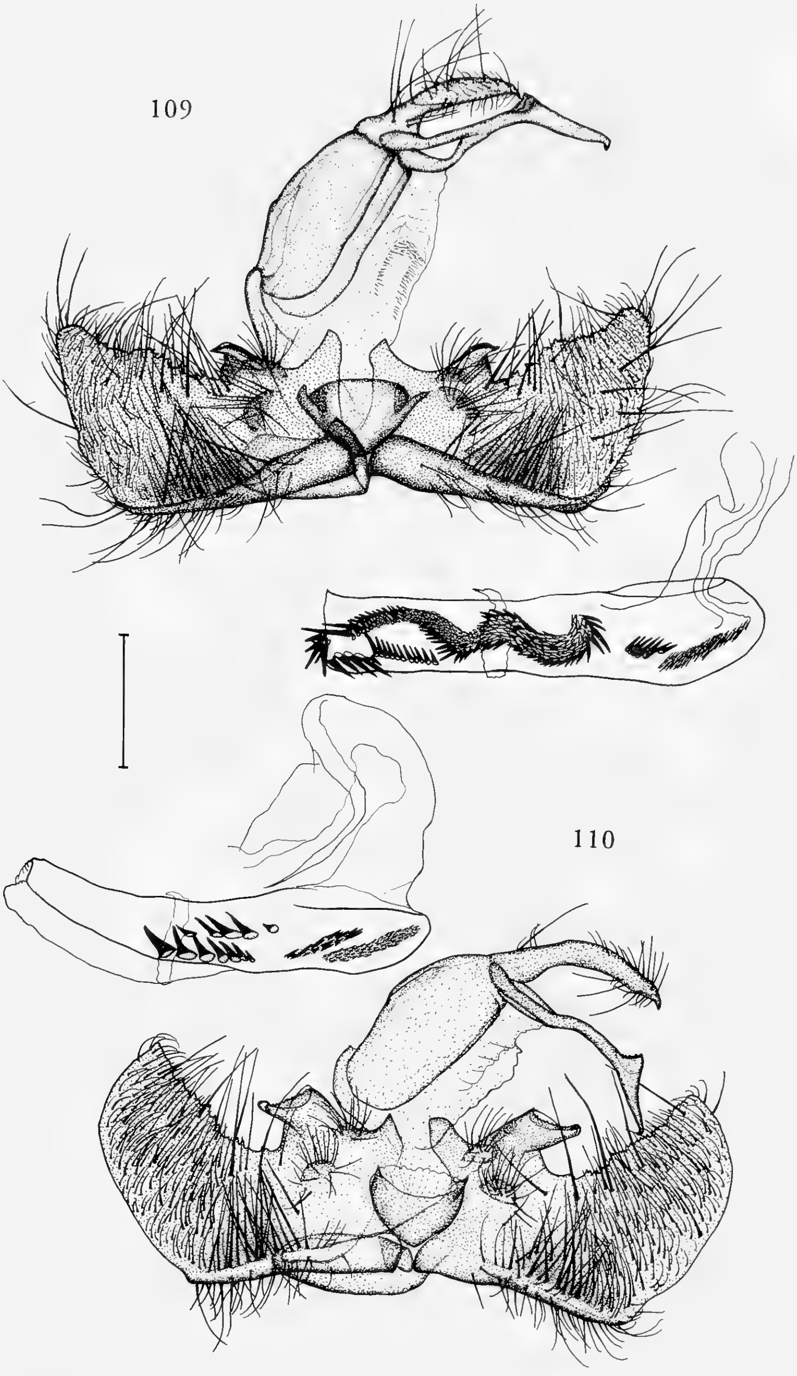
Figs. 98-100. Male genitalia; ventro-caudal aspect, valvae spread; aedeagus separated, lateral aspect. – 98, *Euchromius ornatus*; 99, *Euchromius cornus*; 100, *Euchromius californicalis*. Scale bar 0.5 mm.



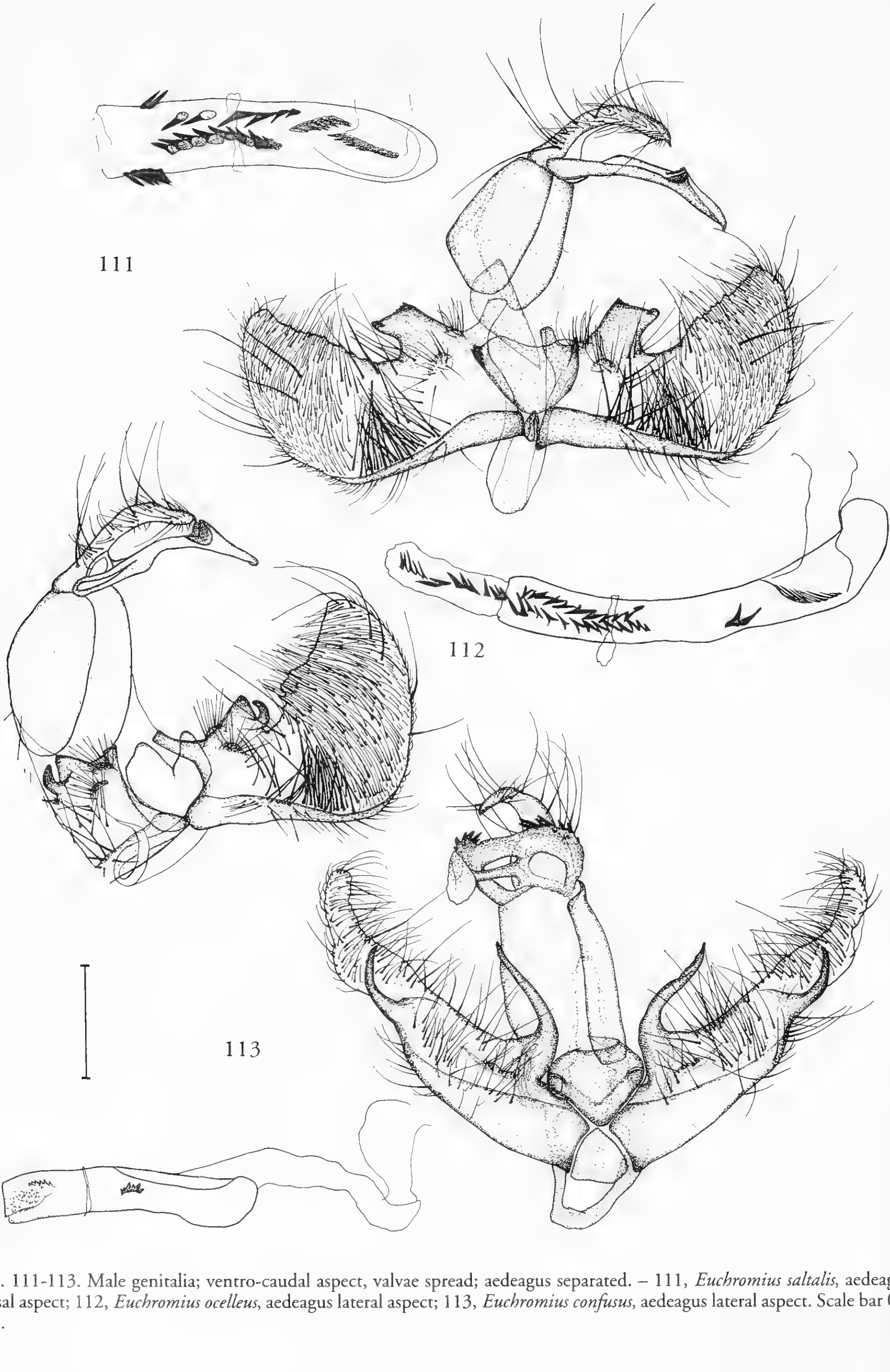
Figs. 101-105. Male genitalia; ventro-caudal aspect, valvae spread; aedeagus separated, lateral aspect. – 101, *Euchromius matador*; 102, *Euchromius gnathosellus*; 103-105, *Euchromius zephyrus*, 103, valvae, 104, juxta separated, 105, tegumen, uncus and gnathos separated. Scale bar 0.5 mm.



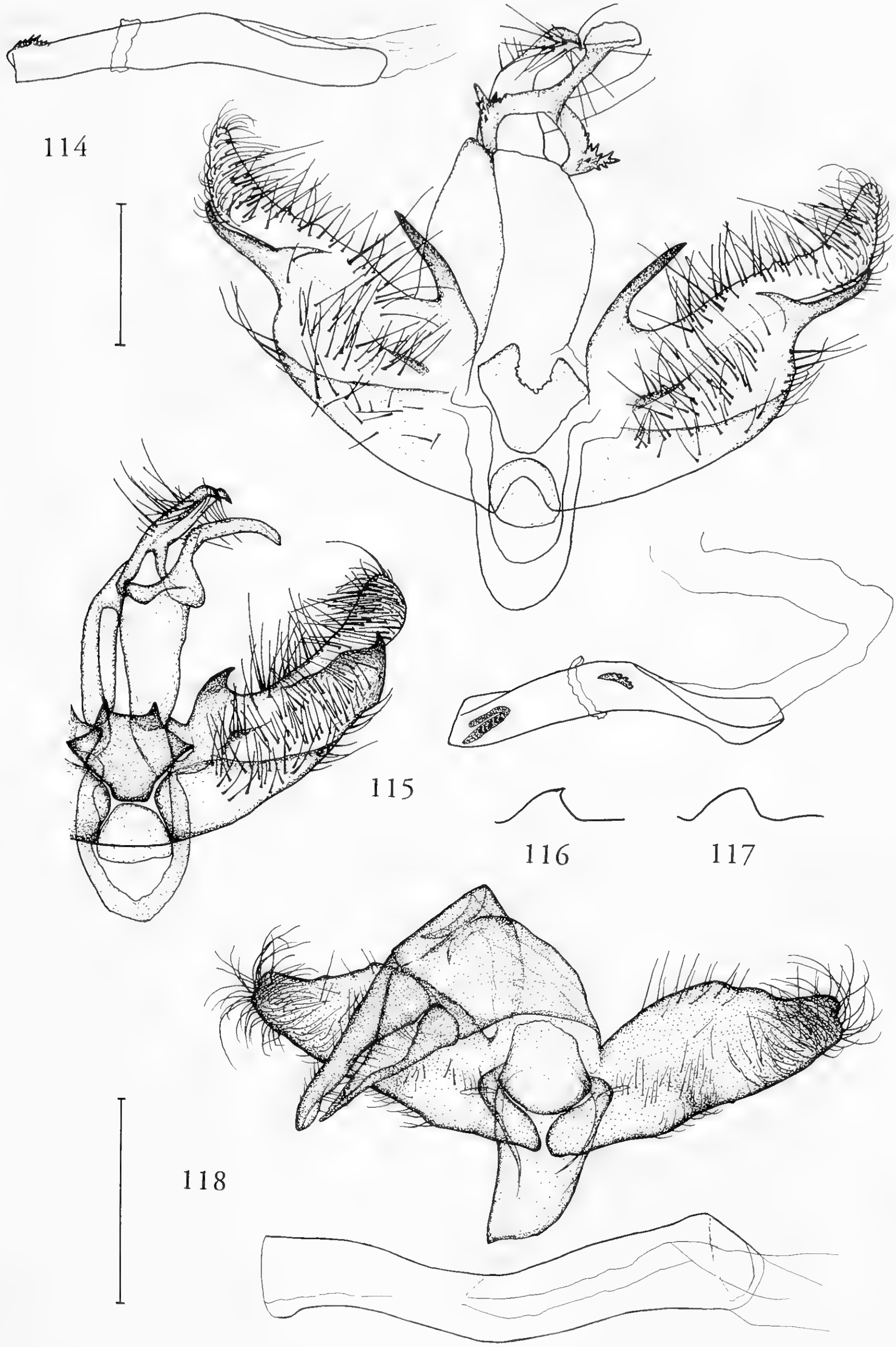
Figs. 106-108. Male genitalia; ventro-caudal aspect, valvae spread; aedeagus separated, lateral aspect. – 106, *Euchromius tanalis*; 107, *Euchromius mythus*; 108, *Euchromius galapagosalis*. Scale bar 0.5 mm.



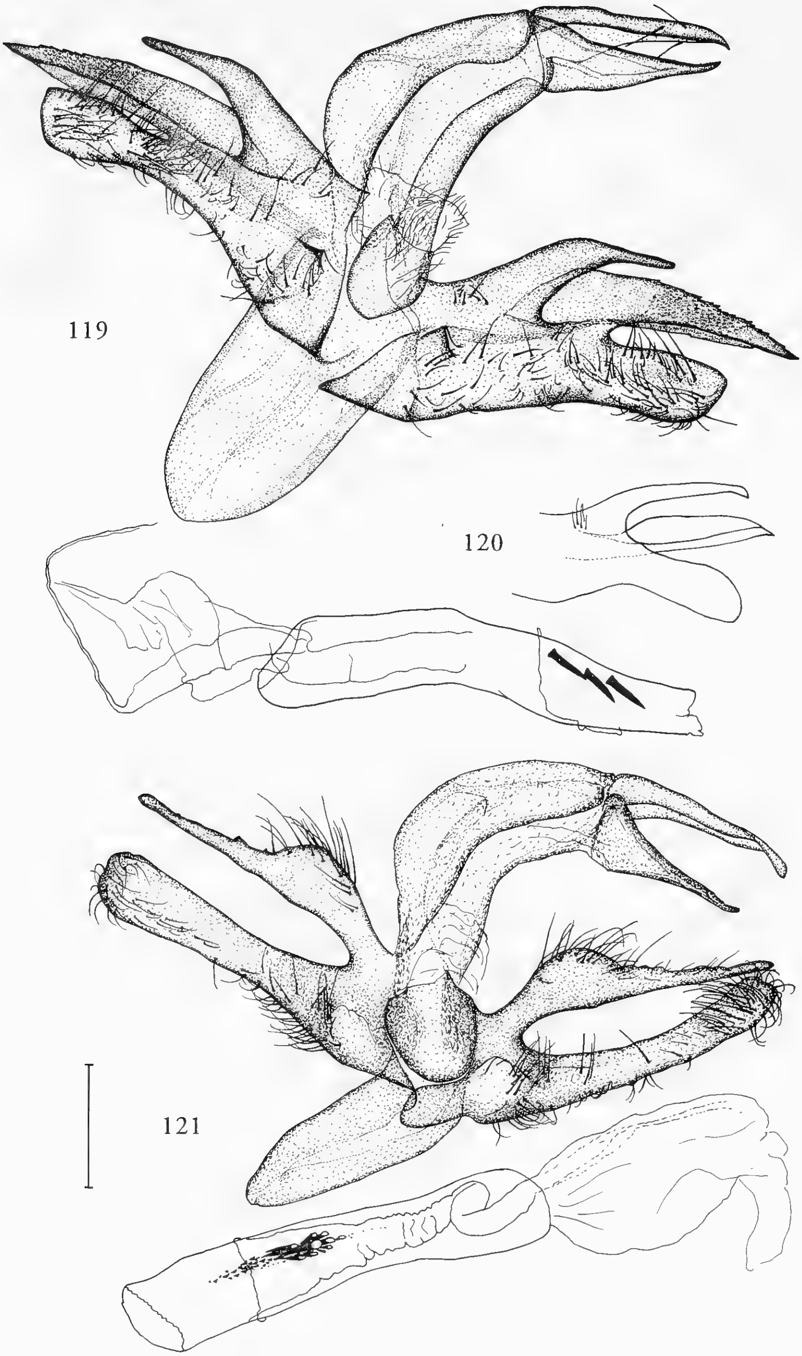
Figs. 109-110. Male genitalia; ventro-caudal aspect, valvae spread; aedeagus separated, lateral aspect. – 109, *Euchromius limaellus*; 110, *Euchromius minutus.* Scale bar 0.5 mm.



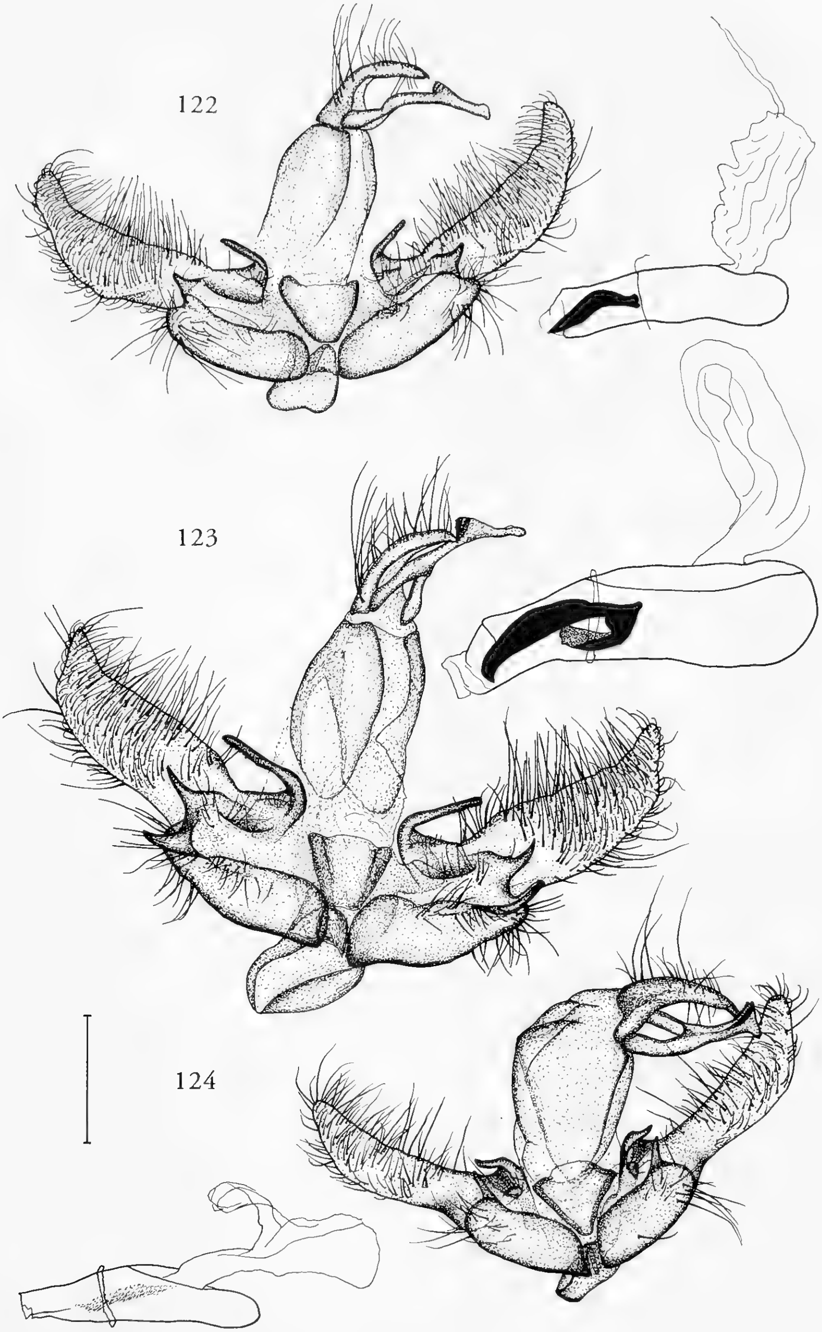
Figs. 111-113. Male genitalia; ventro-caudal aspect, valvae spread; aedeagus separated. – 111, *Euchromius saltalis*, aedeagus dorsal aspect; 112, *Euchromius ocelleus*, aedeagus lateral aspect; 113, *Euchromius confusus*, aedeagus lateral aspect. Scale bar 0.5 mm.



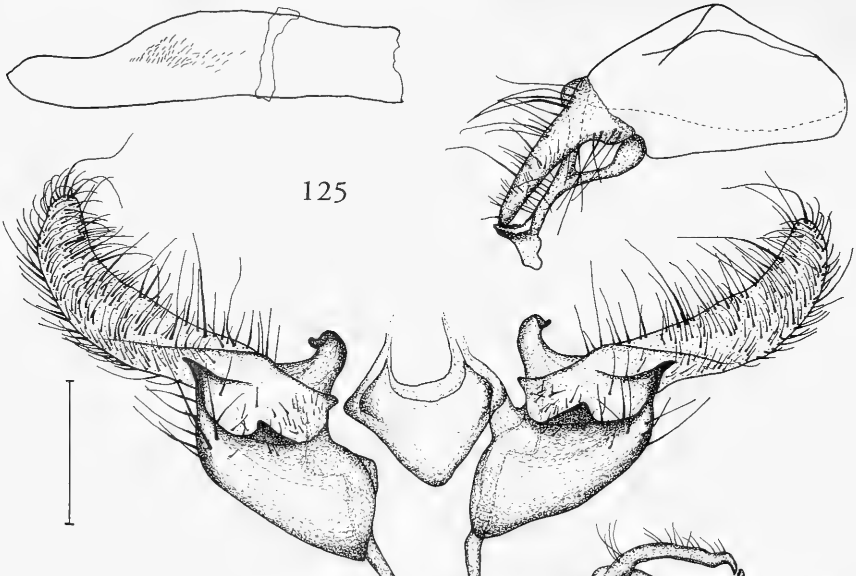
Figs. 114-118. Male genitalia; ventro-caudal aspect, valvae spread; aedeagus separated, lateral aspect. – 114, *Euchromius pulverosus*; 115-117, *Euchromius vinculellus*, 115, male genitalia, 116-117, processus basalis; 118, *Miyakea lushanus*. Scale bar 0.5 mm.

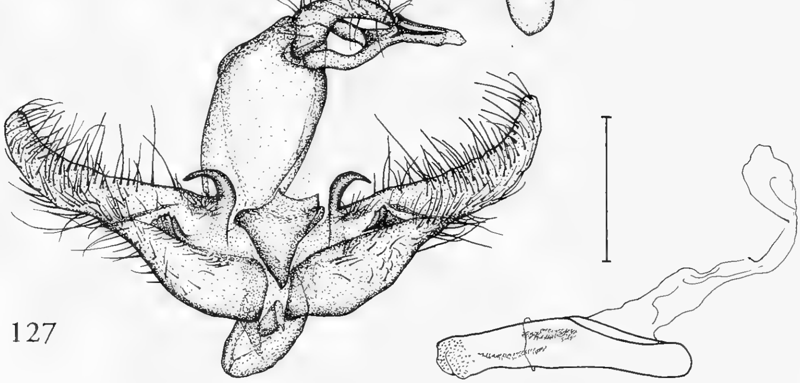


Figs. 119-121. Male genitalia; ventro-caudal aspect, valvae spread; aedeagus separated. – 119-120, *Miyakea raddeellus*, 119, male genitalia, aedeagus lateral aspect, 120, processus basalis and valve; 121, *Miyakea expansa*, aedeagus dorsal aspect. Scale bar 0.5 mm.

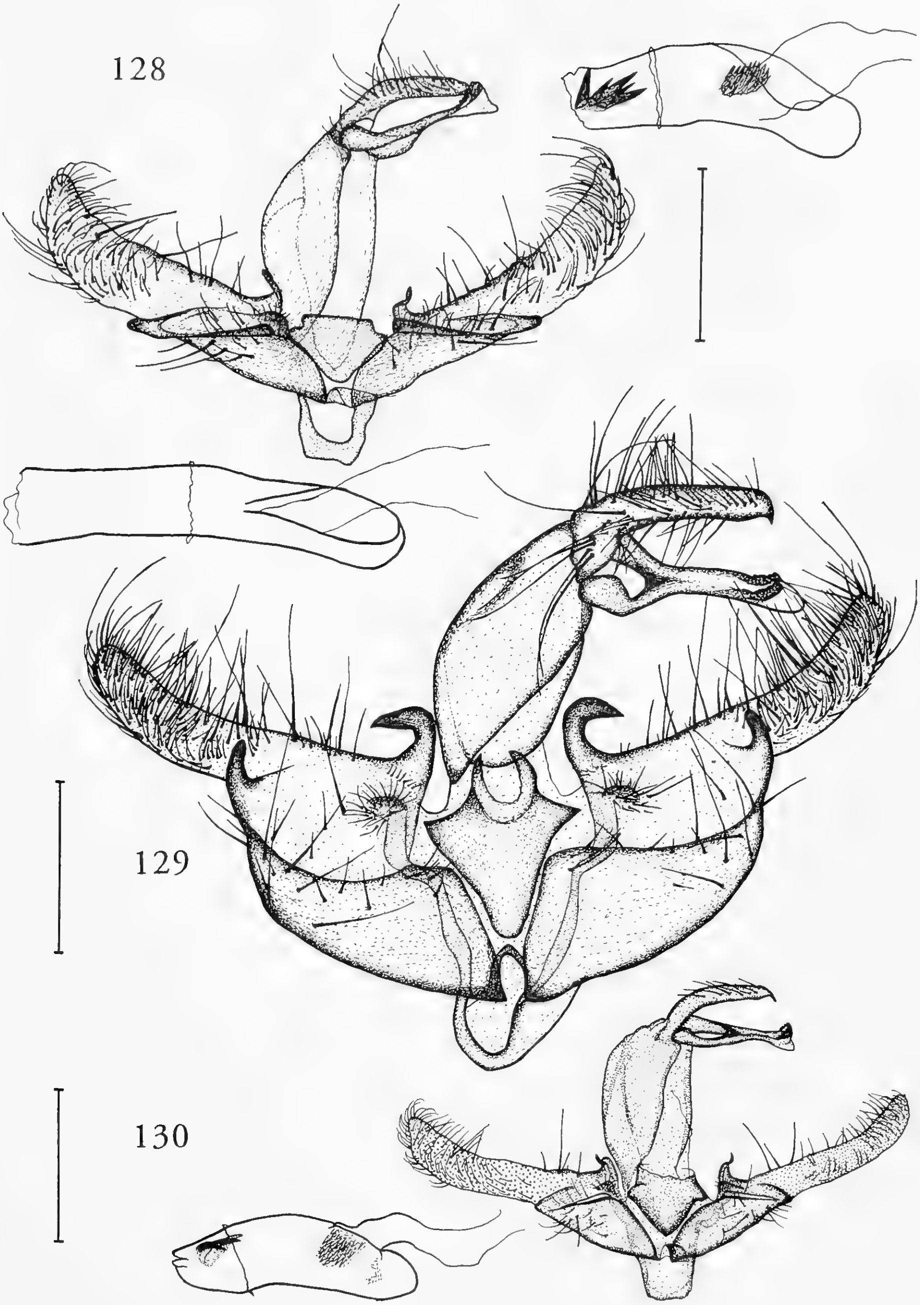


Figs. 122-124. Male genitalia; ventro-caudal aspect, valvae spread; aedeagus separated, lateral aspect. – 122, *Euchromius anapiellus*; 123, *Euchromius bellus*; 124, *Euchromius bleszynskiellus*. Scale bar 0.5 mm.

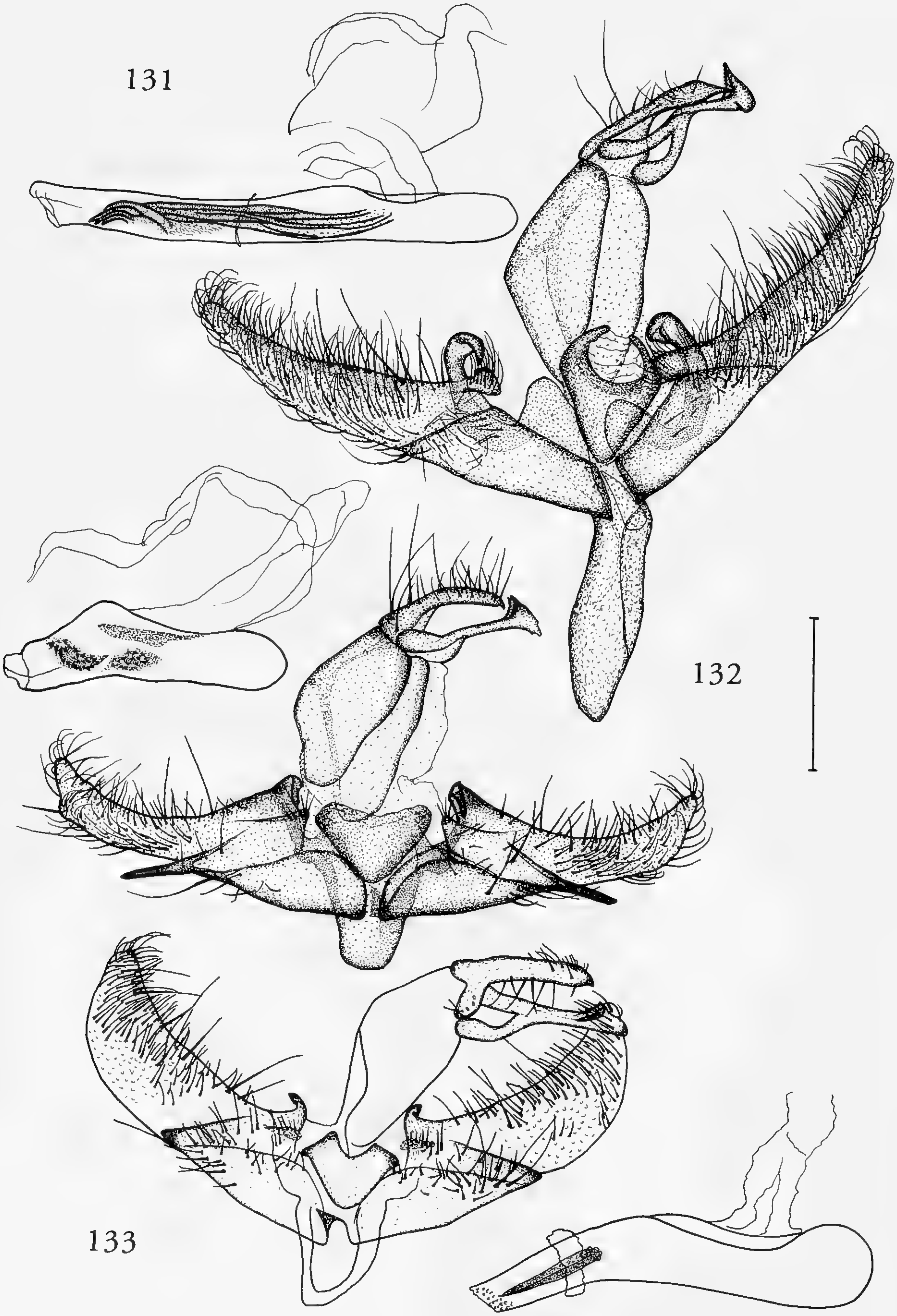




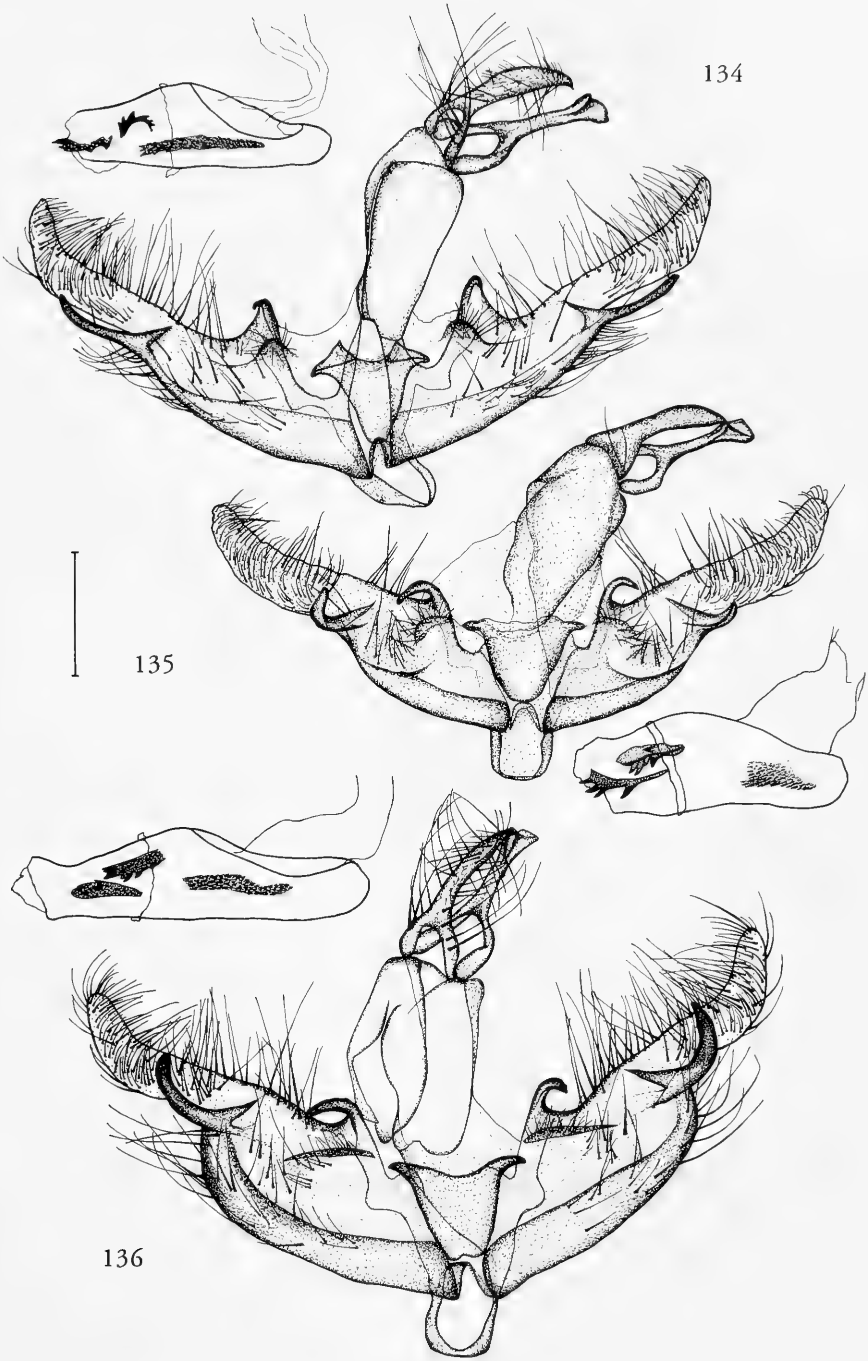
Figs. 125-127. Male genitalia; ventro-caudal aspect, valvae spread; aedeagus separated, lateral aspect. – 125, *Euchromius bleszynskii*, tegumen, uncus and gnathos separated. Scale 0.5 mm. 126, *Euchromius scobiolae*. Scale 1 mm. 127, *Euchromius superbellus*. Scale bar 0.5 mm.



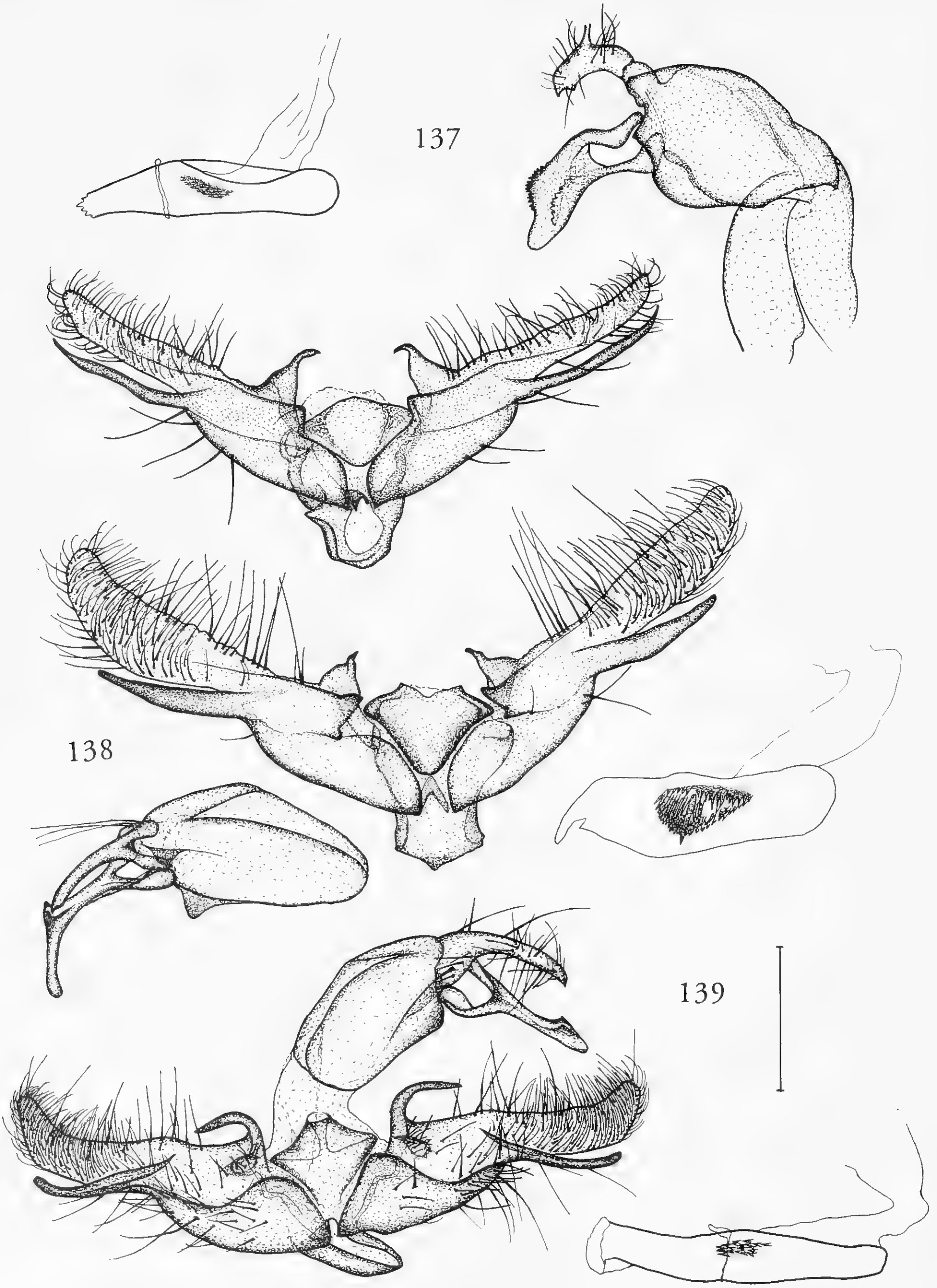
Figs. 128-130. Male genitalia; ventro-caudal aspect, valvae spread; aedeagus separated, lateral aspect. – 128, *Euchromius keredjellus*; 129, *Euchromius malekalis*; 130, *Euchromius mouchai*. Scale bar 0.5 mm.



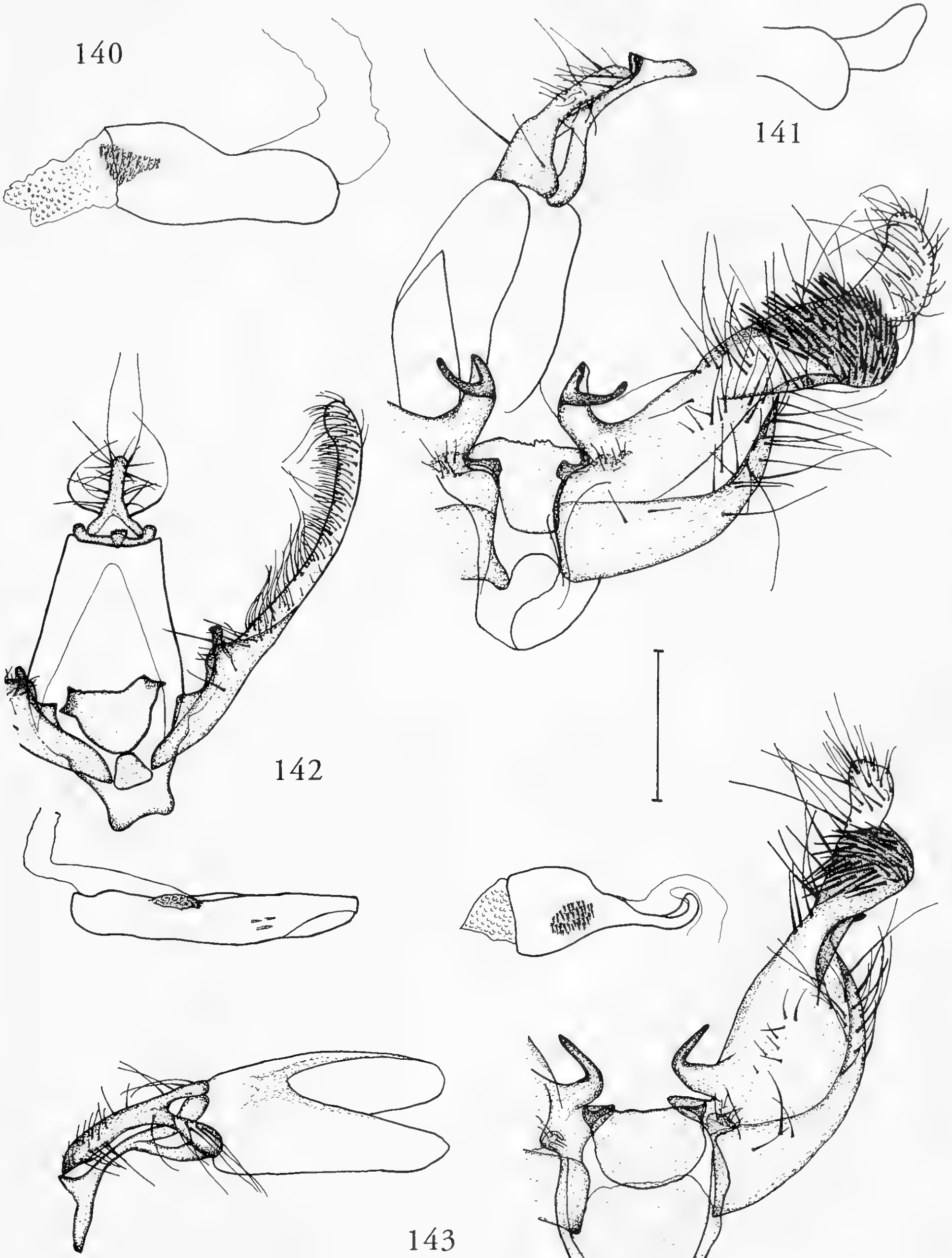
Figs. 131-133. Male genitalia; ventro-caudal aspect, valvae spread; aedeagus separated, lateral aspect. – 131, *Euchromius nivalis*; 132, *Euchromius rayatellus*; 133, *Euchromius gozmanyi*. Scale bar 0.5 mm.



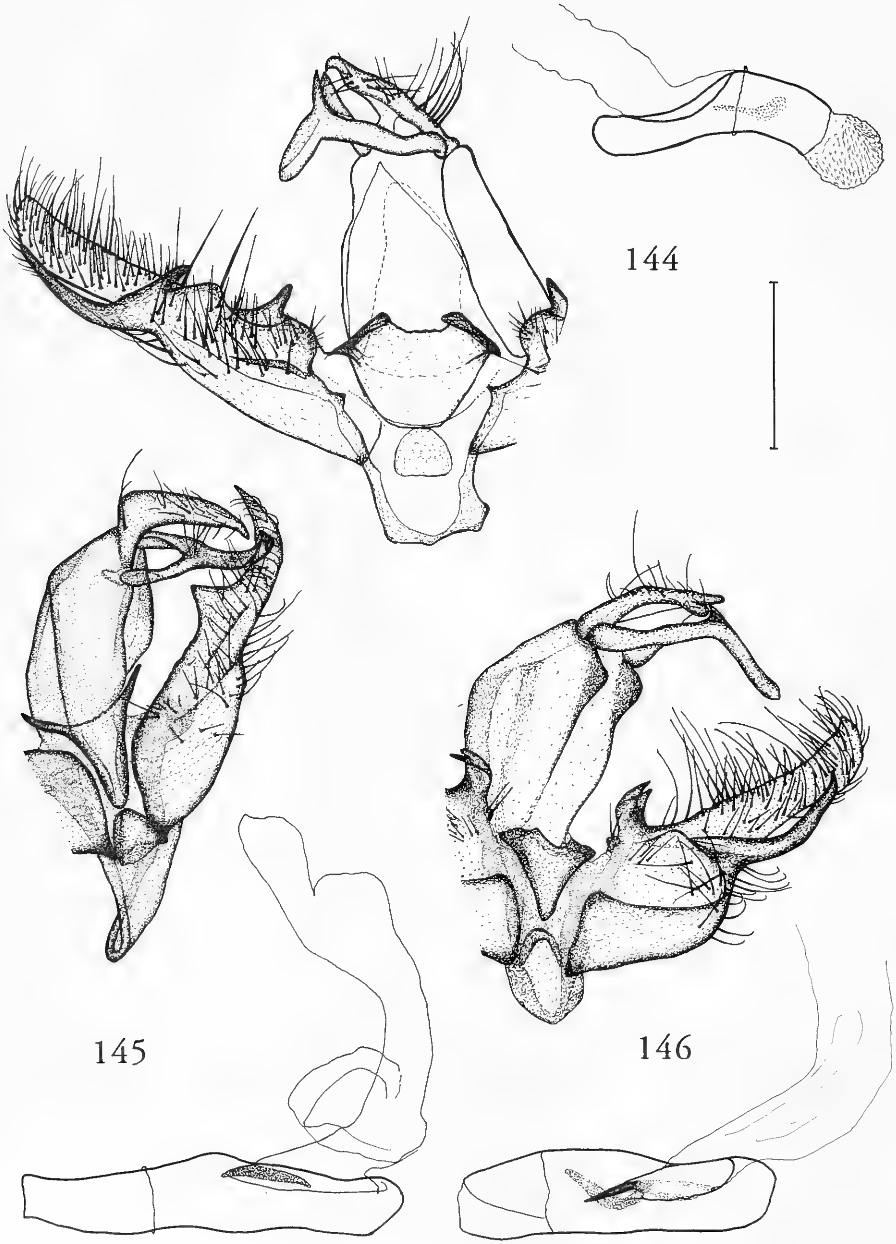
Figs. 134-136. Male genitalia; ventro-caudal aspect, valvae spread; aedeagus separated, lateral aspect. – 134, *Euchromius gratiosellus*; 135, *Euchromius jaxartellus*; 136, *Euchromius ramburiellus*. Scale bar 0.5 mm.



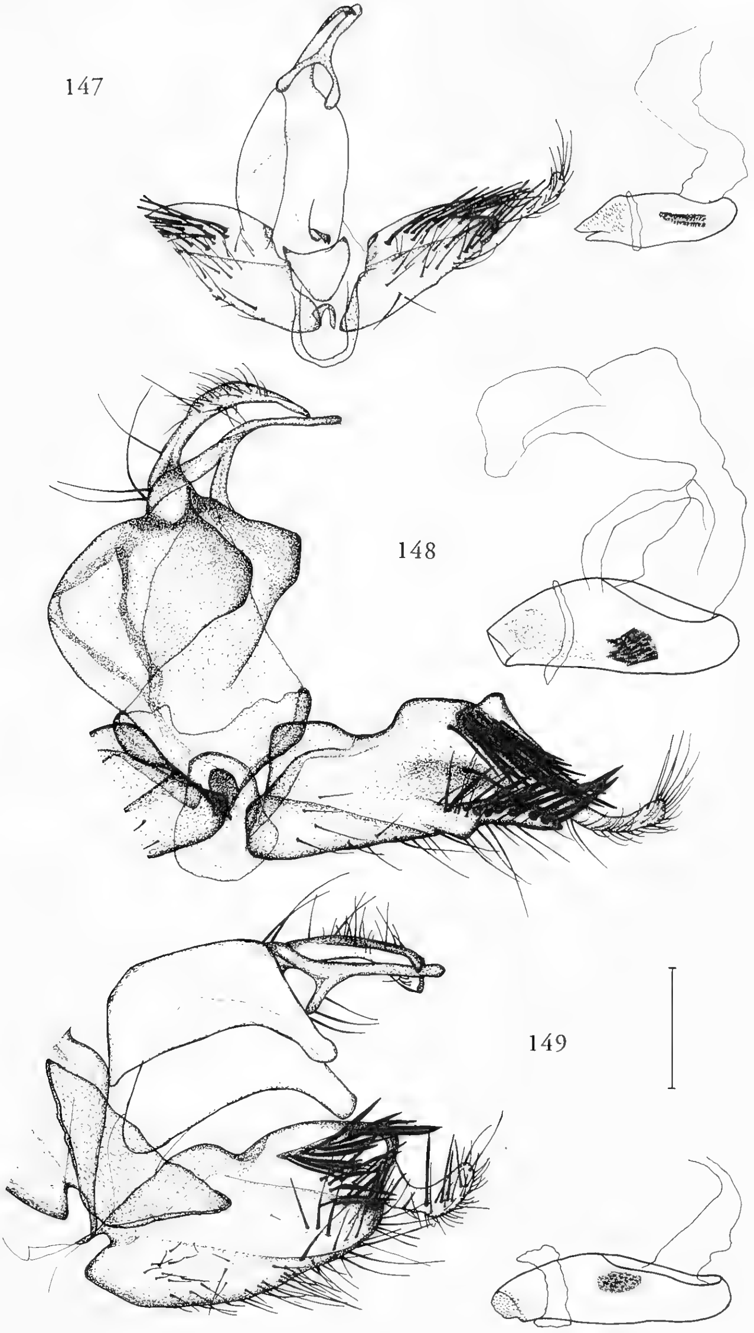
Figs. 137-139. Male genitalia; ventro-caudal aspect, valvae spread; aedeagus separated, lateral aspect. – 137, *Euchromius sudanellus*, tegumen, uncus and gnathos separated; 138, *Euchromius subcambridgei*, tegumen, uncus and gnathos separated; 139, *Euchromius cambridgei*. Scale bar 0.5 mm.



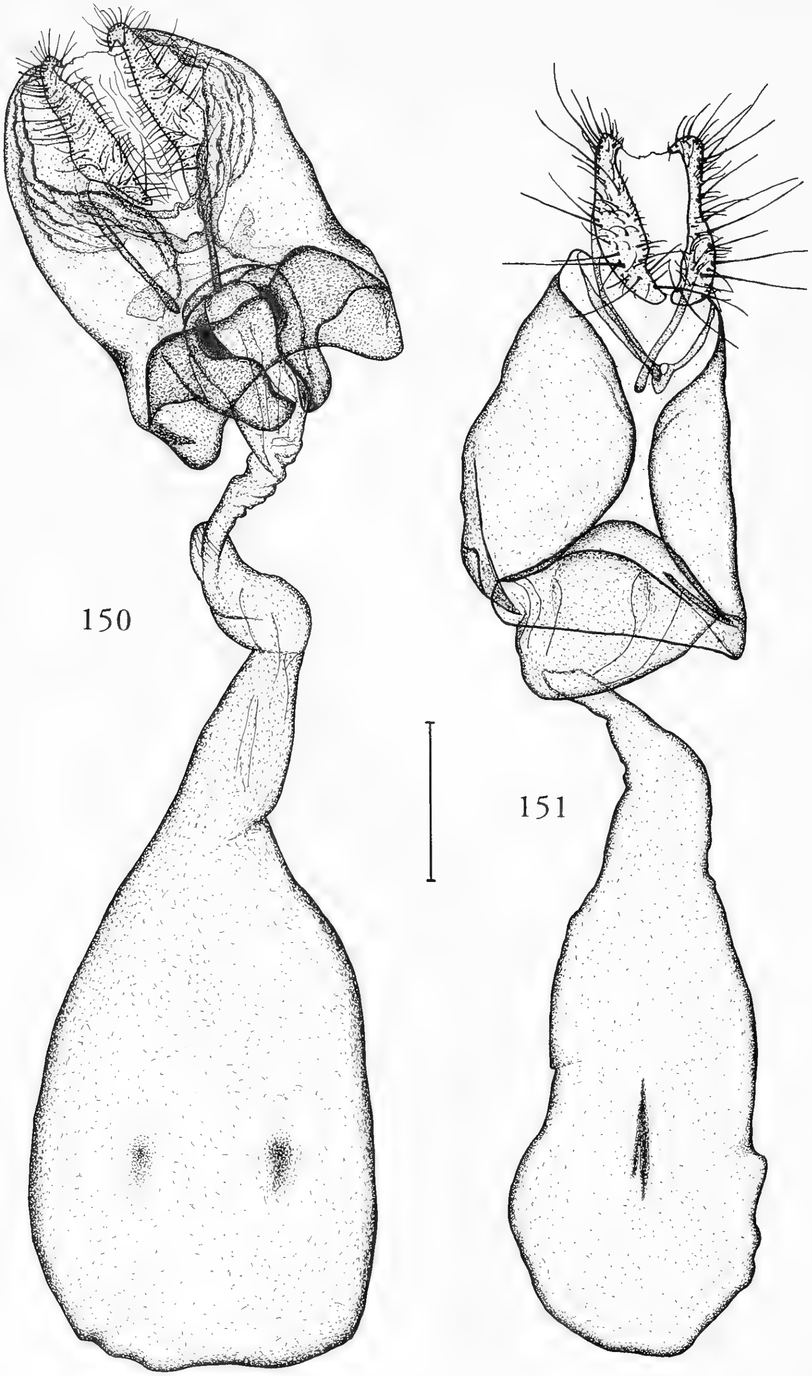
Figs. 140-143. Male genitalia; ventro-caudal aspect, valvae spread; aedeagus separated, lateral aspect. – 140-141, *Euchromius viettei*, 140, male genitalia, aedeagus lateral aspect, 141, valve and lobe; 142, *Euchromius klimeschi*; 143, *Euchromius hampsoni*, tegumen, uncus and gnathos separated. Scale bar 0.5 mm.



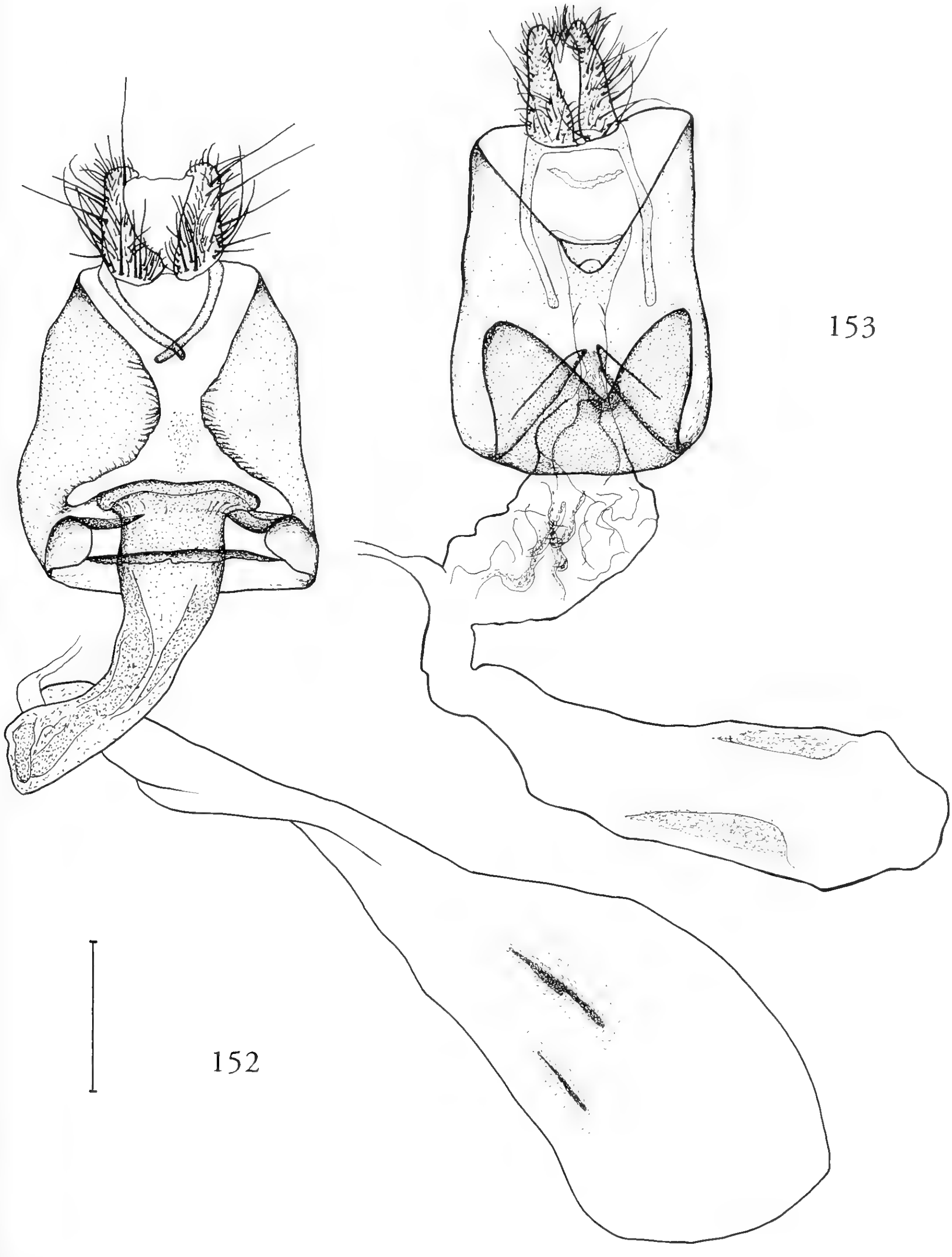
Figs. 144-146. Male genitalia; ventro-caudal aspect, valvae spread; aedeagus separated, lateral aspect. – 144, *Euchromius discopis*; 145, *Euchromius aris*; 146, *Euchromius labellum*. Scale bar 0.5 mm.



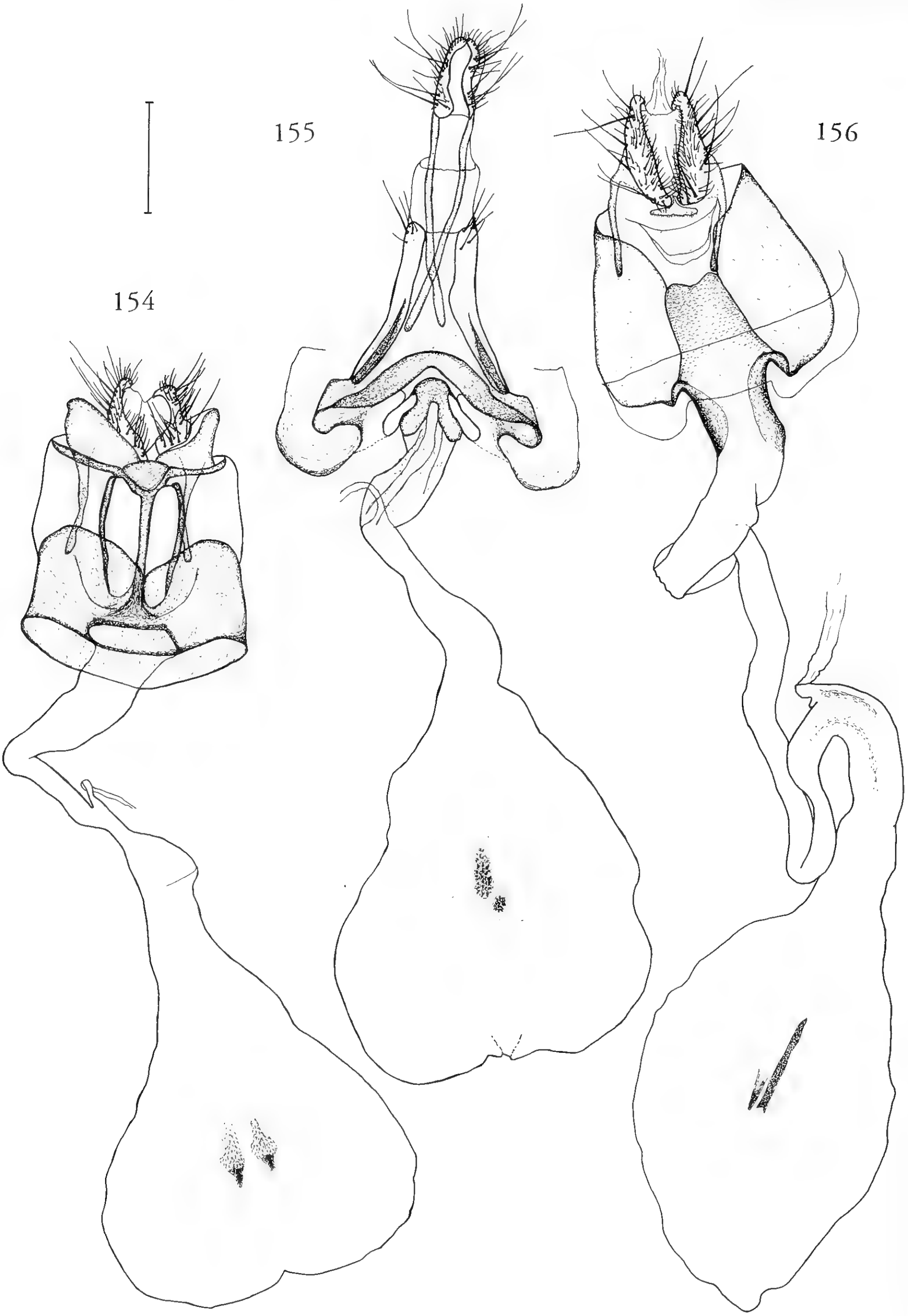
Figs. 147-149. Male genitalia; ventro-caudal aspect, valvae spread; aedeagus separated, lateral aspect. – 147, *Euchromius erum*; 148, *Euchromius locustus*; 149, *Euchromius nigrobasalis*. Scale bar 0.5 mm.



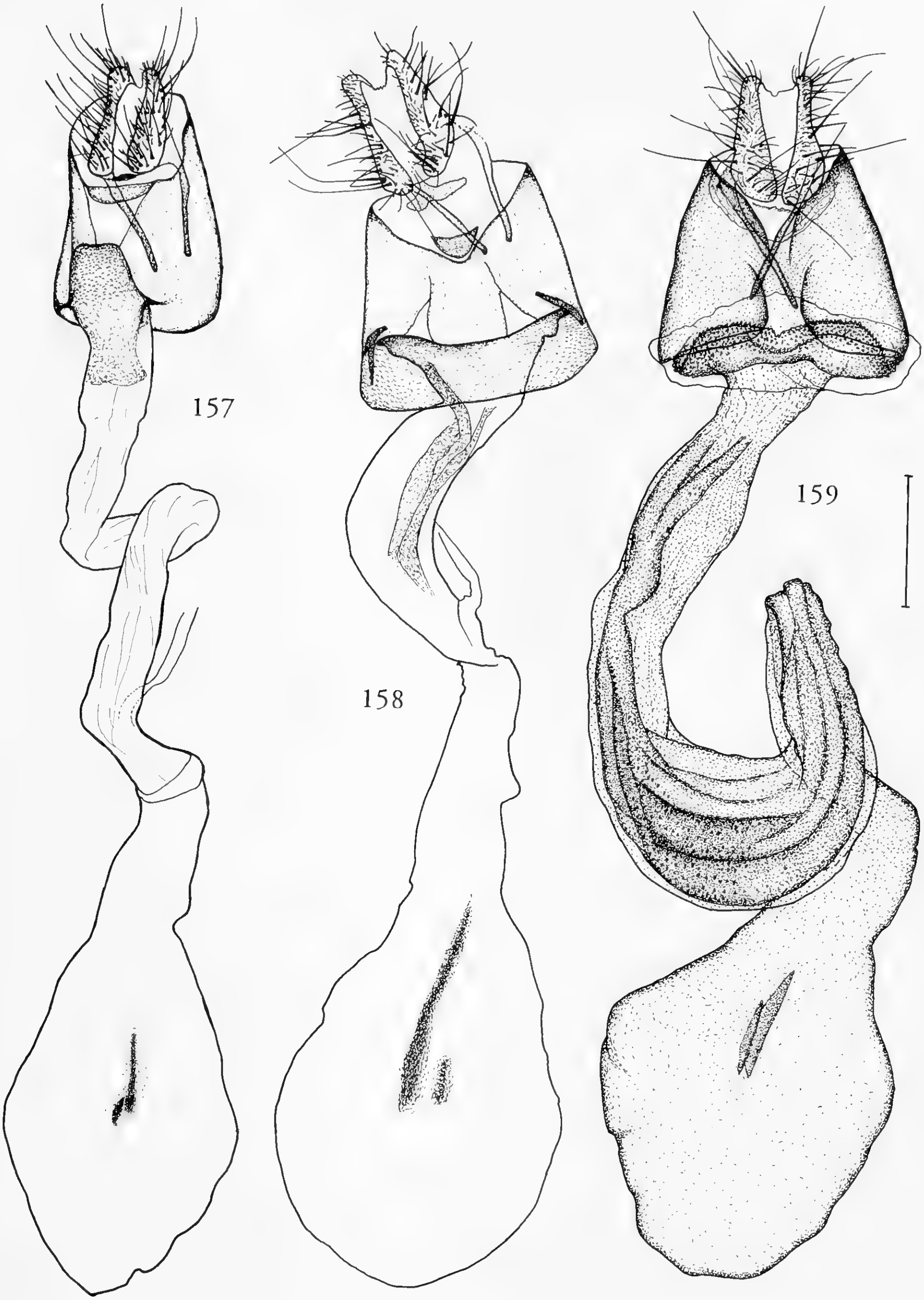
Figs. 150-151. Female genitalia; ventral aspect. – 150, *Euchromius circulus*; 151, *Euchromius cornus*. Scale bar 0.5 mm.



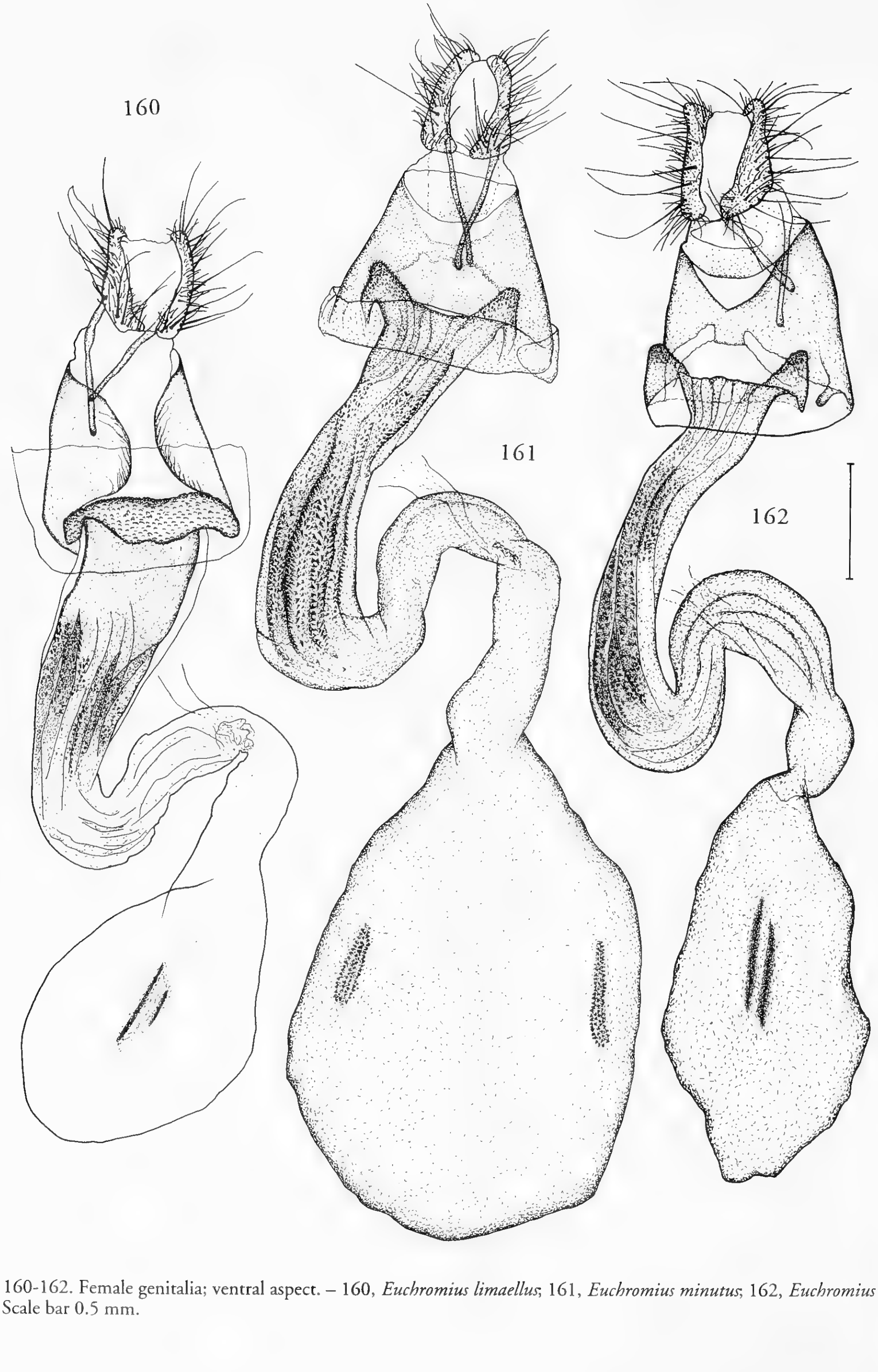
Figs. 152-153. Female genitalia; ventral aspect. – 152, *Euchromius californicalis*; 153, ***Euchromius matador***. Scale bar 0.5 mm.



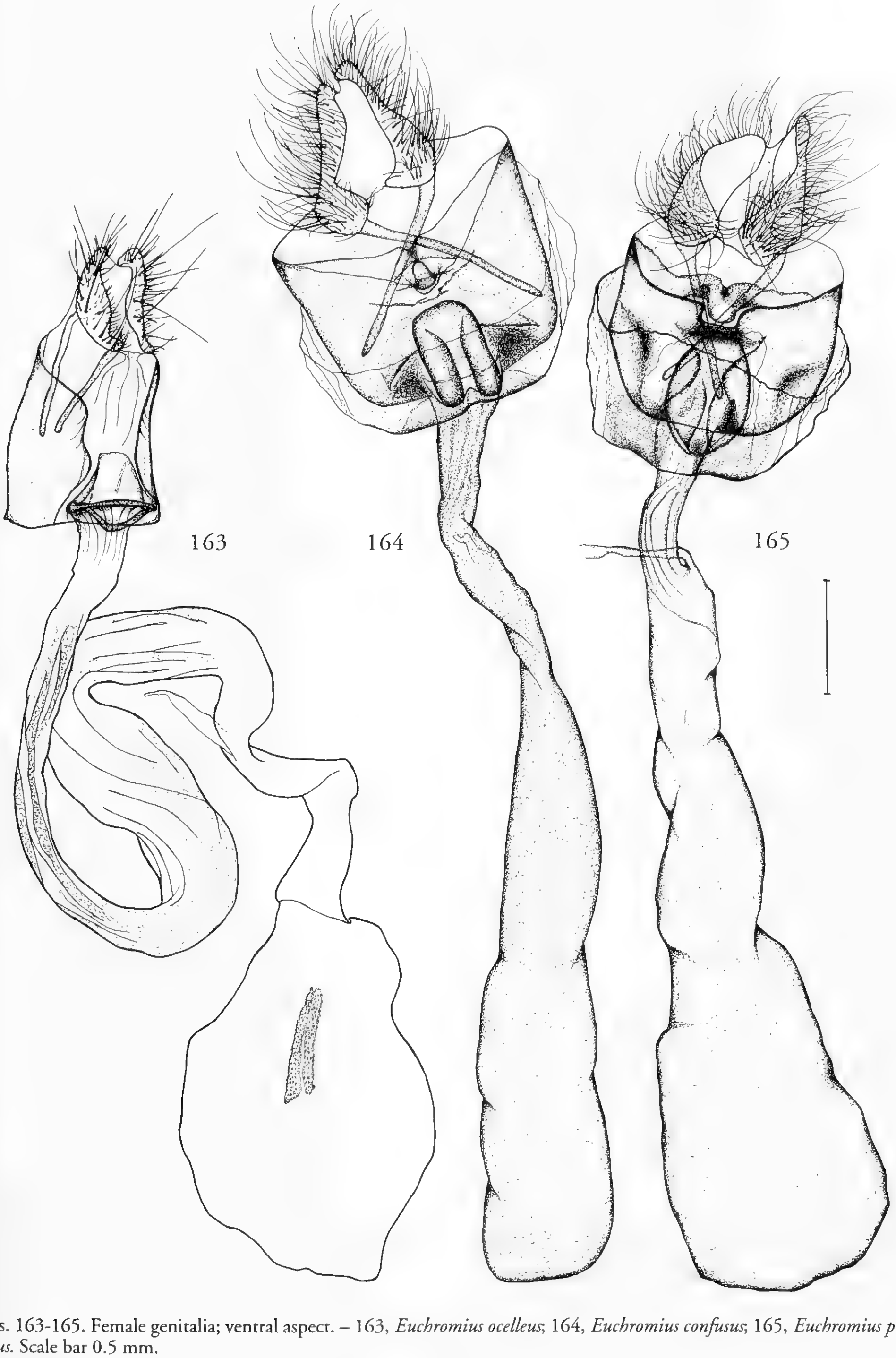
Figs. 154-156. Female genitalia; ventral aspect. – 154, *Euchromius gnathosellus*; 155, *Euchromius zephyrus*; 156, *Euchromius tanalis*. Scale bar 0.5 mm.



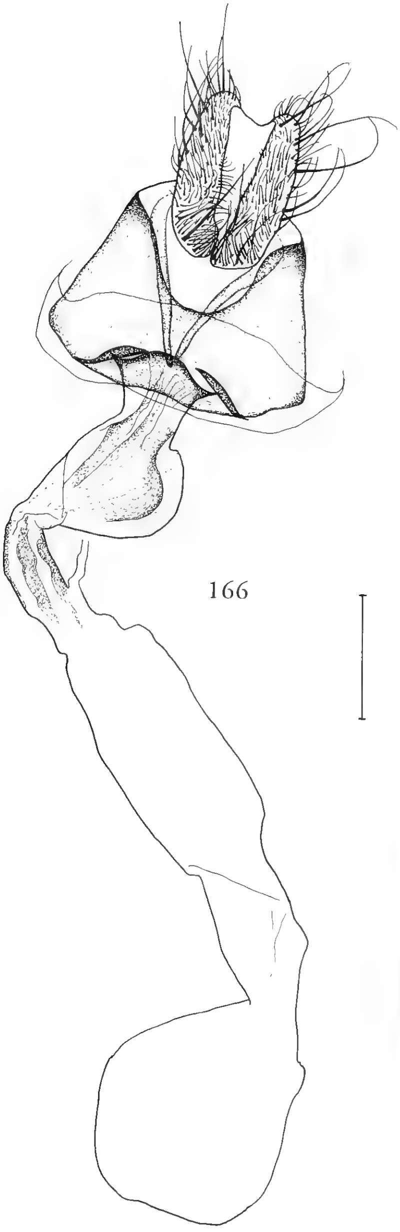
Figs. 157-159. Female genitalia; ventral aspect. – 157, *Euchromius mythus*; 158, *Euchromius geminus*; 159, *Euchromius galapagosalis*. Scale bar 0.5 mm.



Figs. 160-162. Female genitalia; ventral aspect. – 160, *Euchromius limaellus*; 161, *Euchromius minutus*; 162, *Euchromius saltalis*. Scale bar 0.5 mm.



Figs. 163-165. Female genitalia; ventral aspect. – 163, *Euchromius ocelleus*; 164, *Euchromius confusus*; 165, *Euchromius pulverosus*. Scale bar 0.5 mm.



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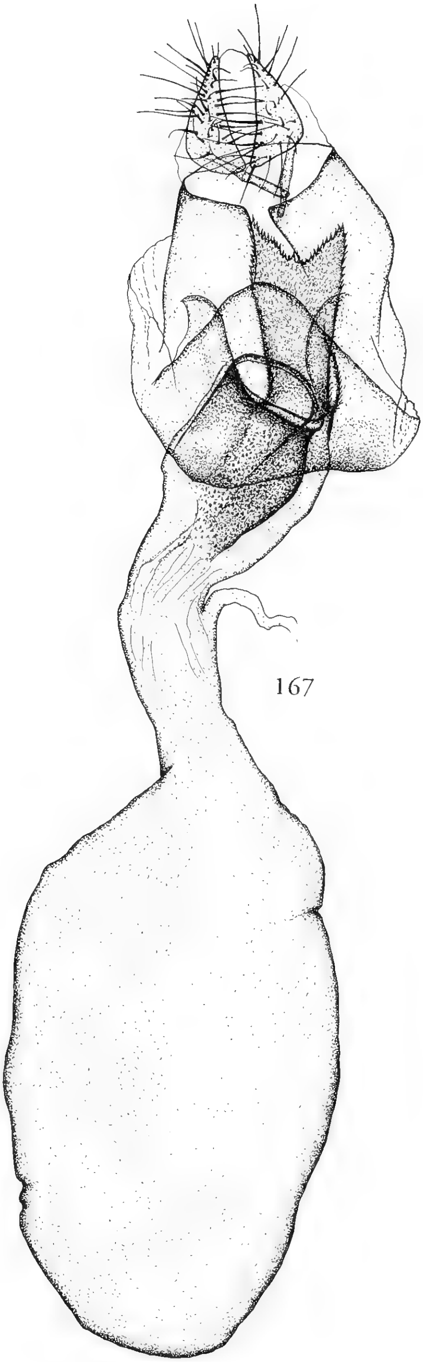

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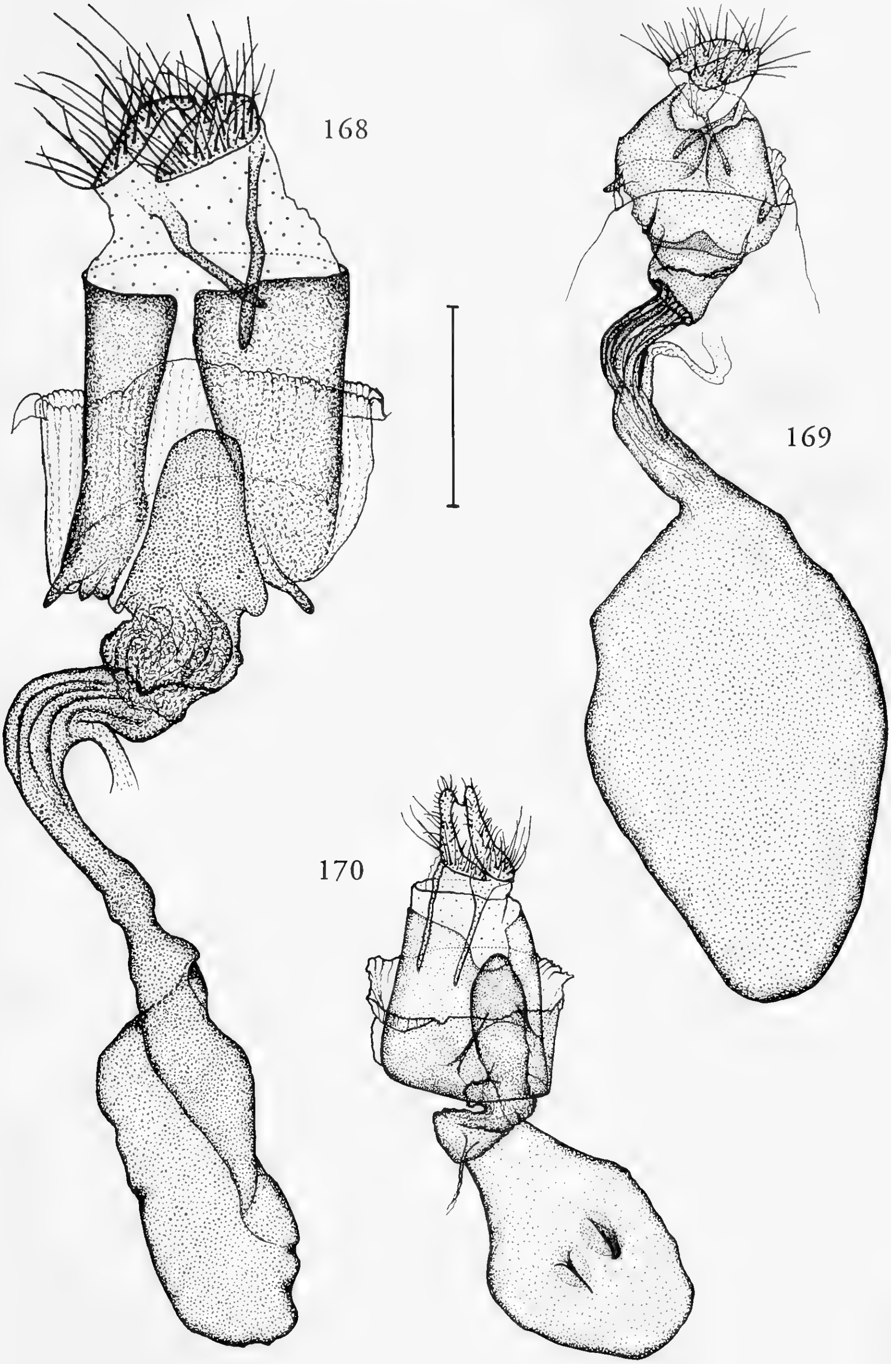
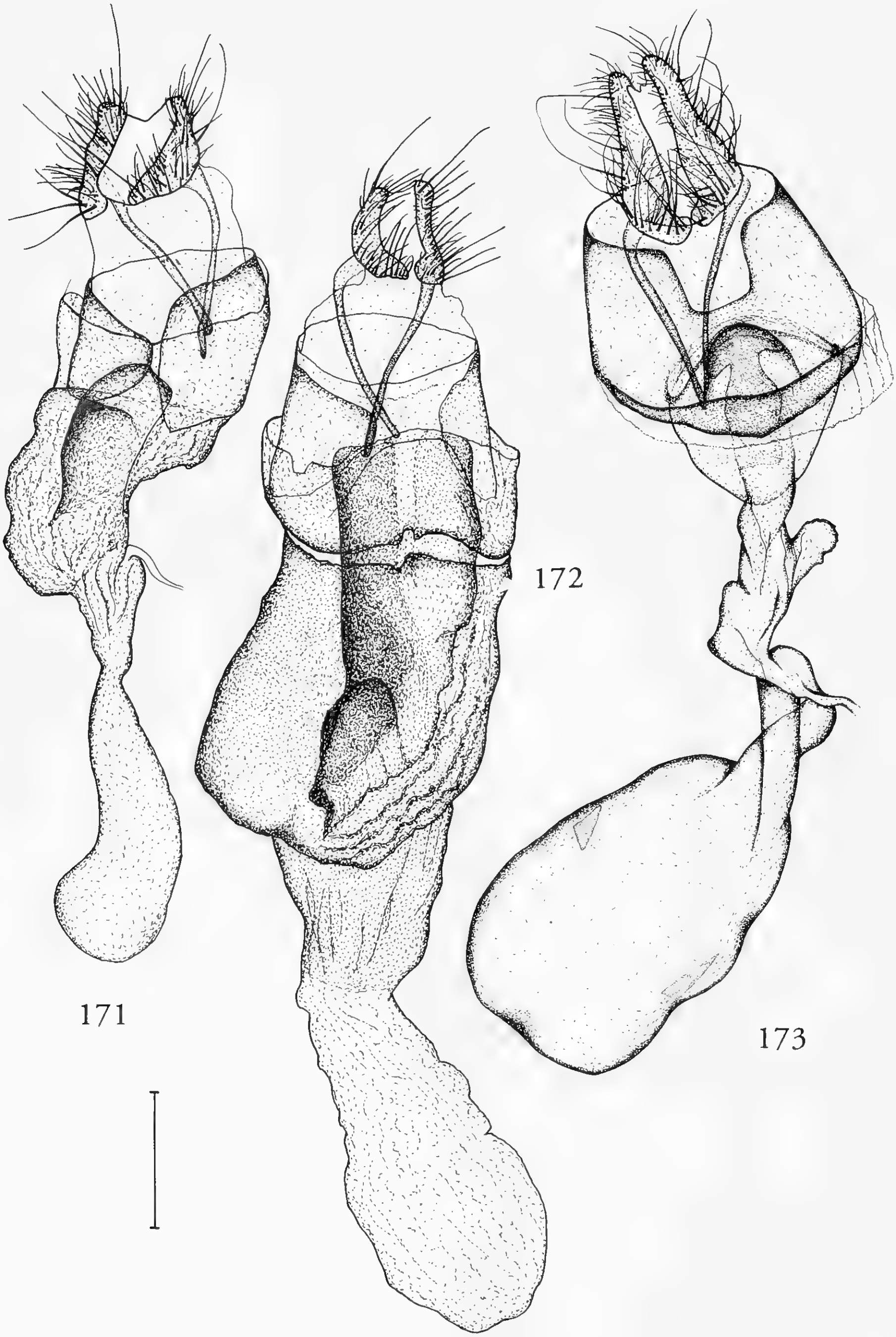
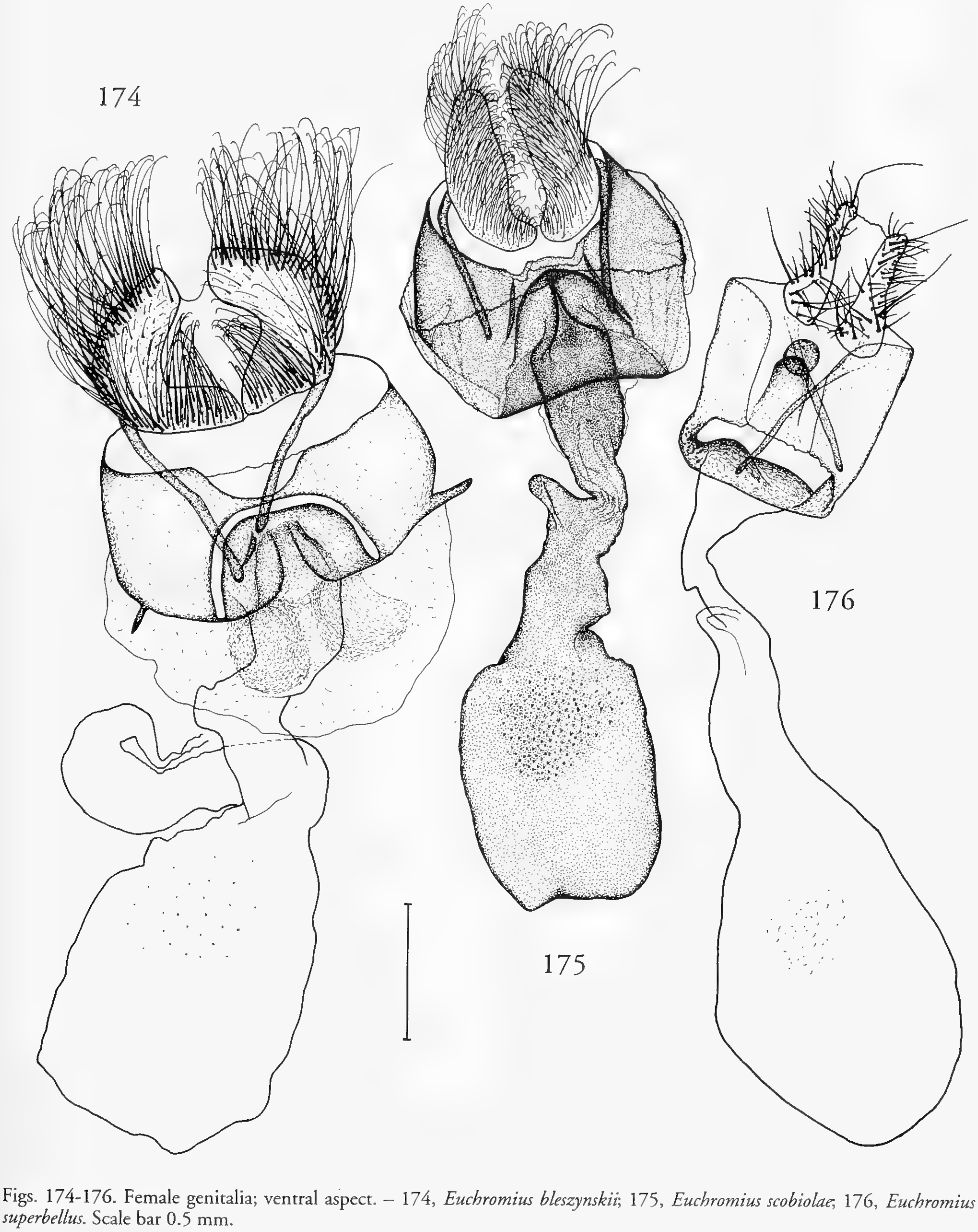
Figs. 166-167. Female genitalia; ventral aspect. – 166, *Euchromius vinculellus*; 167, *Miyakea raddeellus*. Scale bar 0.5 mm.



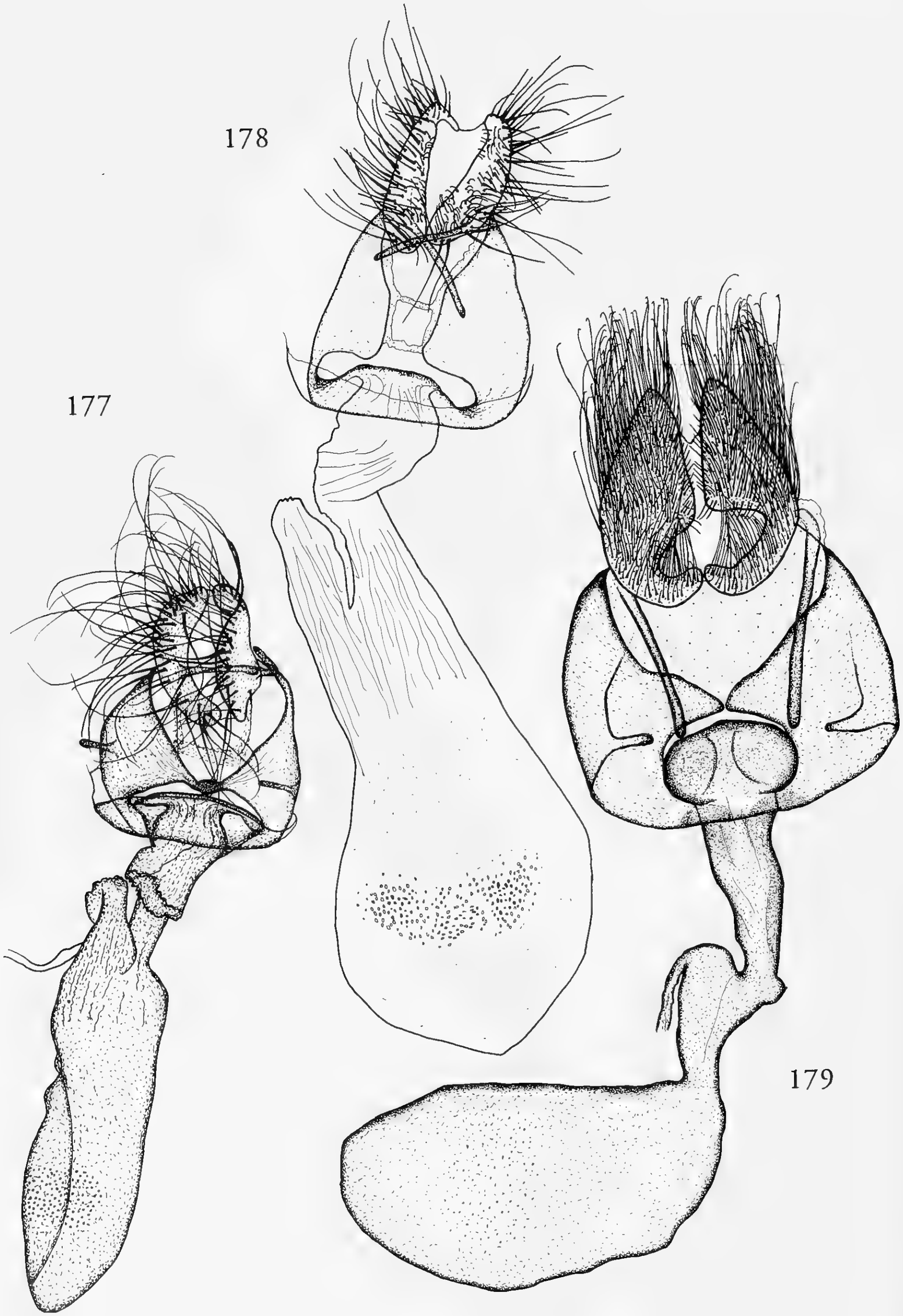
Figs. 168-170. Female genitalia; ventral aspect. – 168, *Miyakea expansa*; 169, *Miyakea lushanus*; 170, *Euchromius gratiosellus*. Scale bar 1 mm.



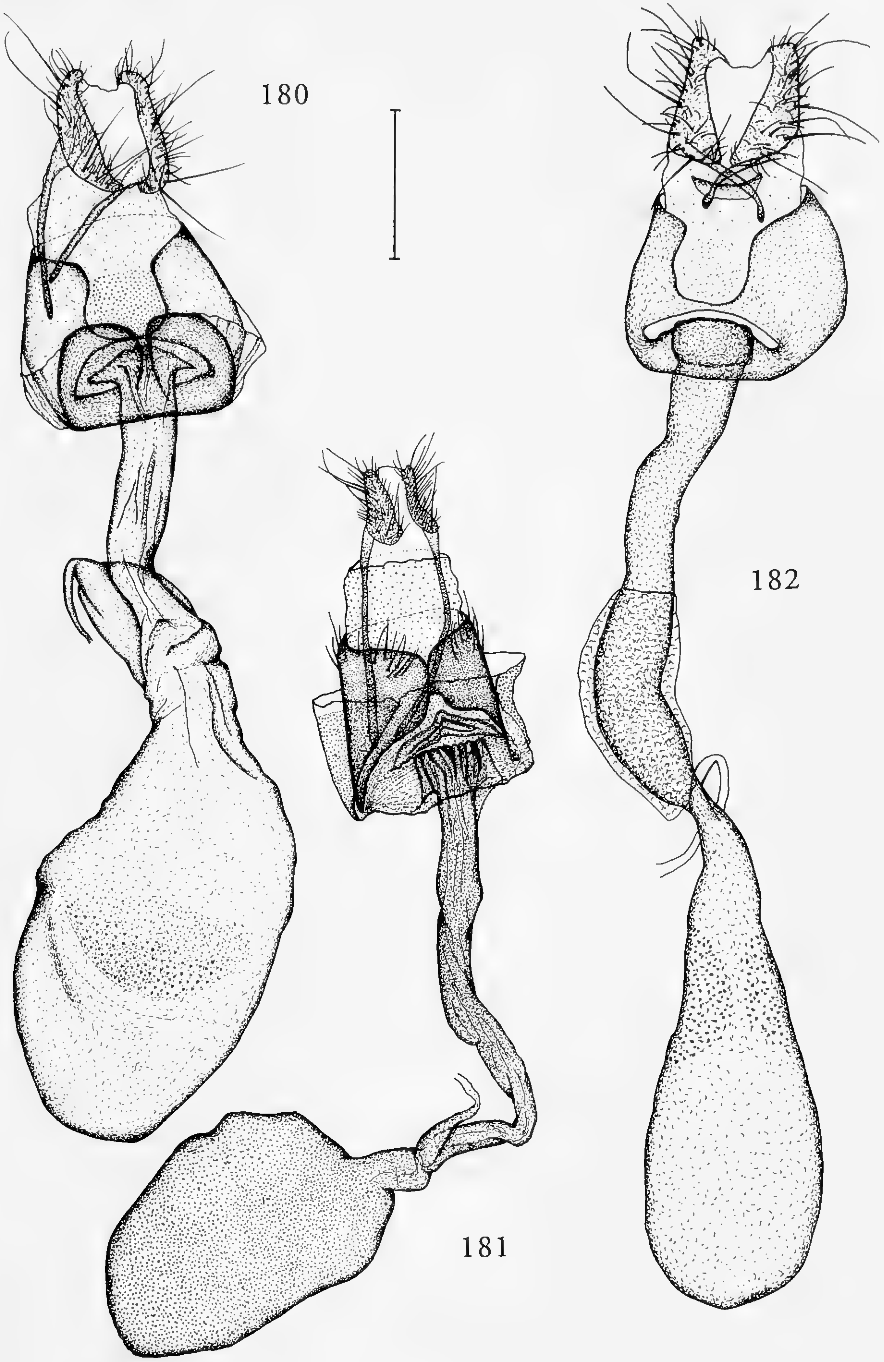
Figs. 171-173. Female genitalia; ventral aspect. – 171, *Euchromius anapiellus*; 172, *Euchromius bellus*; 173, *Euchromius bleszynskiellus*. Scale bar 0.5 mm.



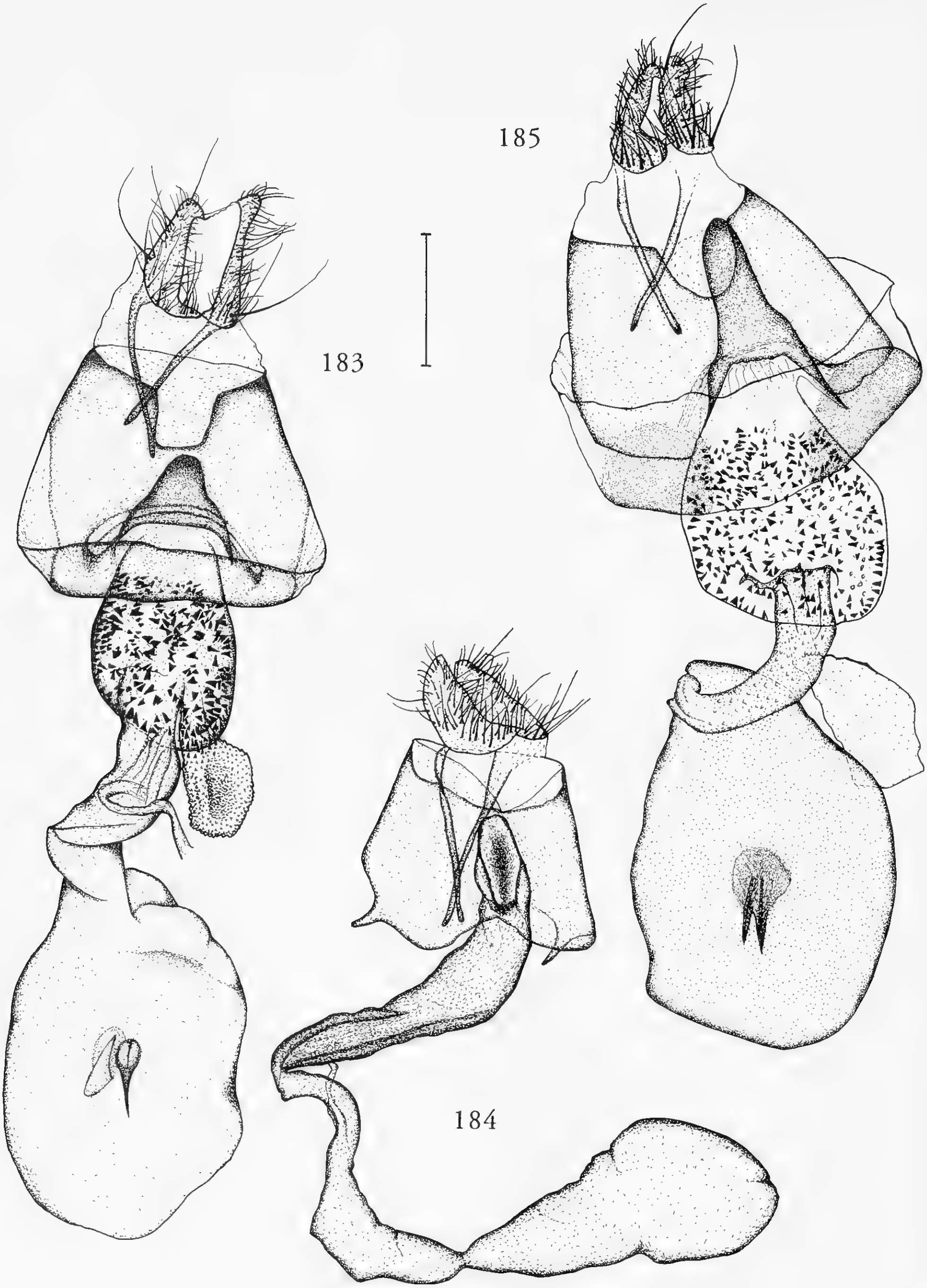
Figs. 174-176. Female genitalia; ventral aspect. – 174, *Euchromius bleszynskii*; 175, *Euchromius scobiolae*; 176, *Euchromius superbellus*. Scale bar 0.5 mm.



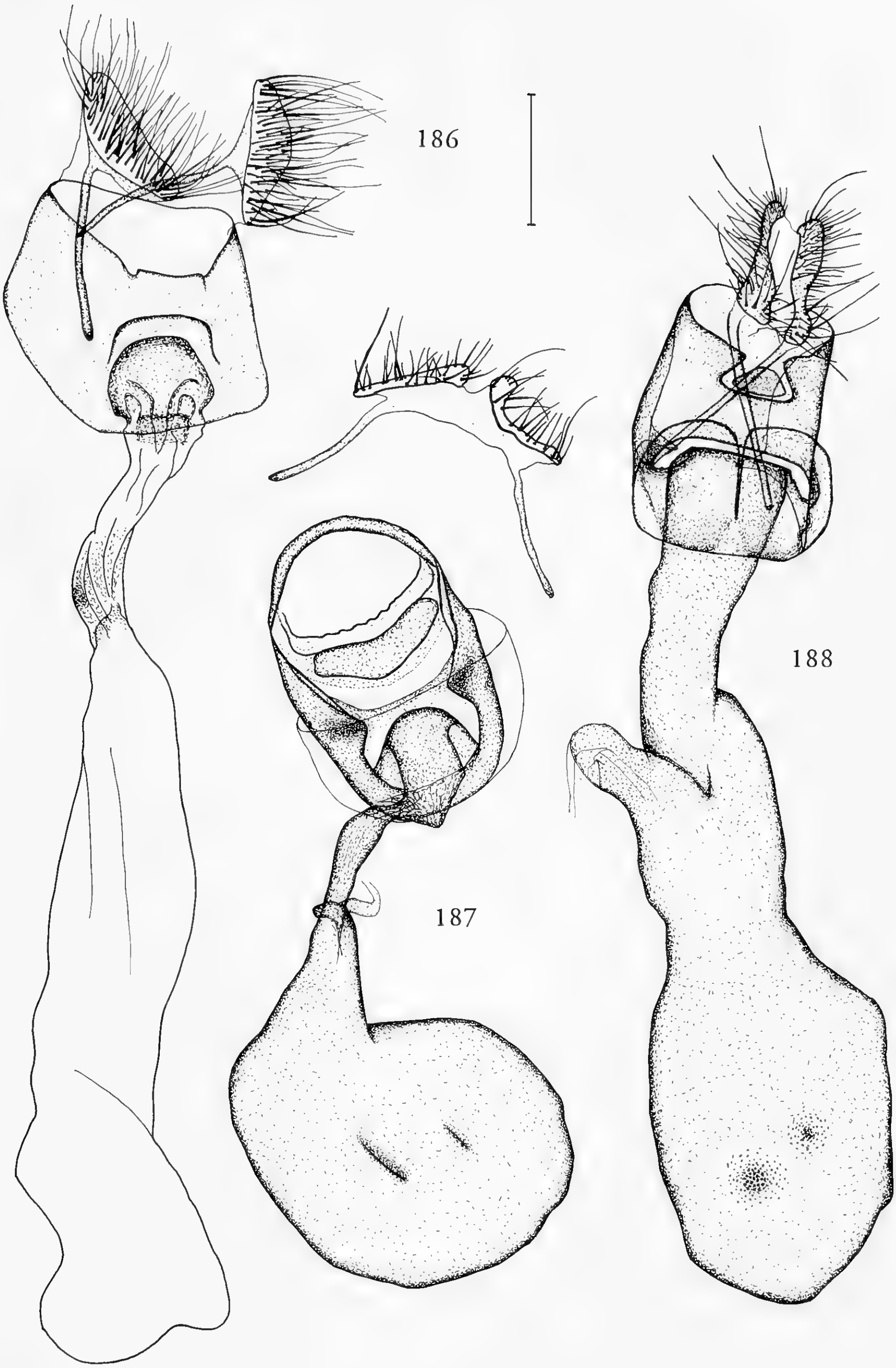
Figs. 177-179. Female genitalia; ventral aspect. – 177, *Euchromius keredjellus*; 184, *Euchromius mouchai*; 185, *Euchromius malekalis*. Scale 0.5 mm.



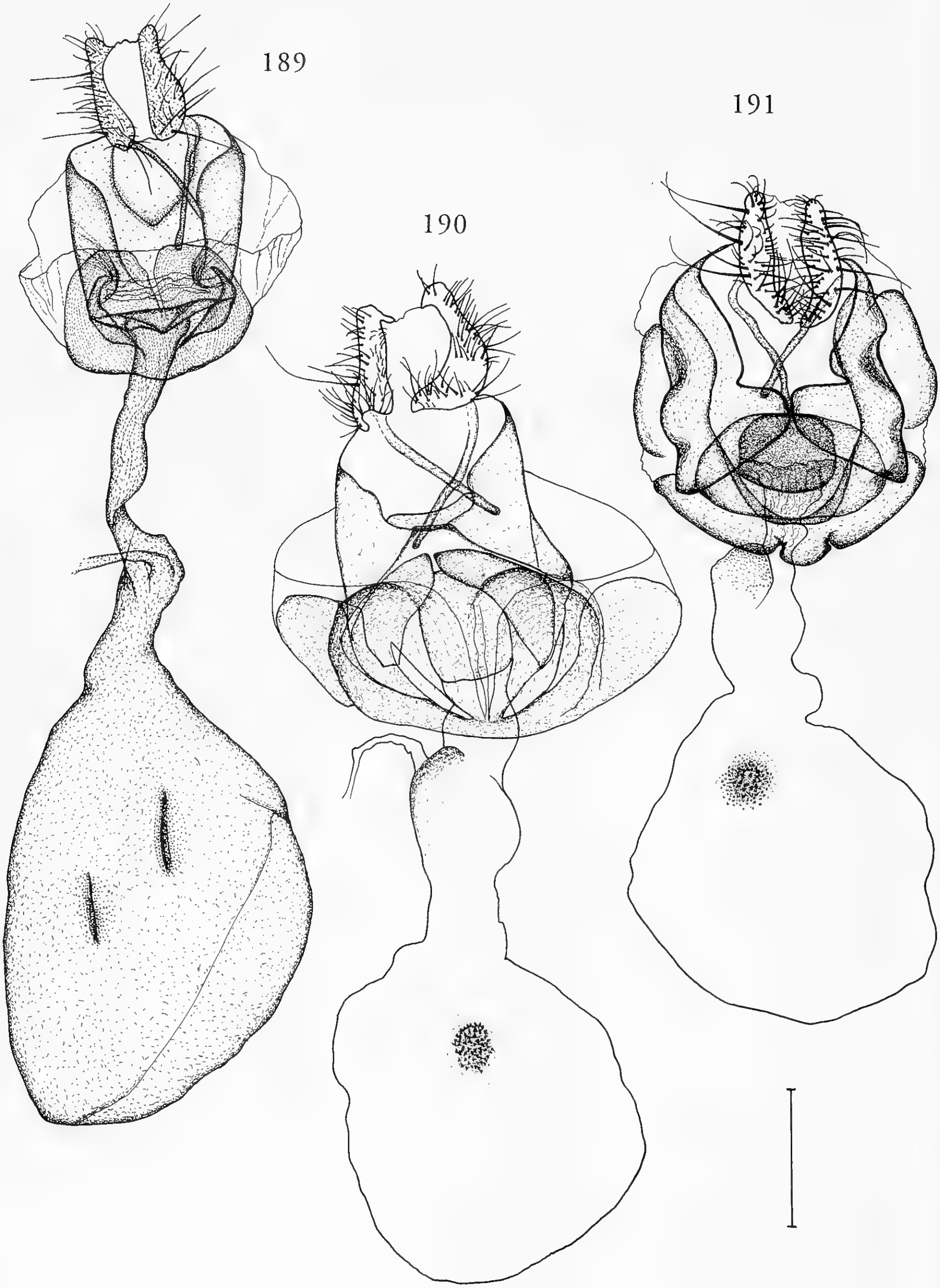
Figs. 180-182. Female genitalia; ventral aspect. – 180, *Euchromius rayatellus*; 181, *Euchromius nivalis*; 182, *Euchromius gozmanyi*. Scale bar 0.5 mm.



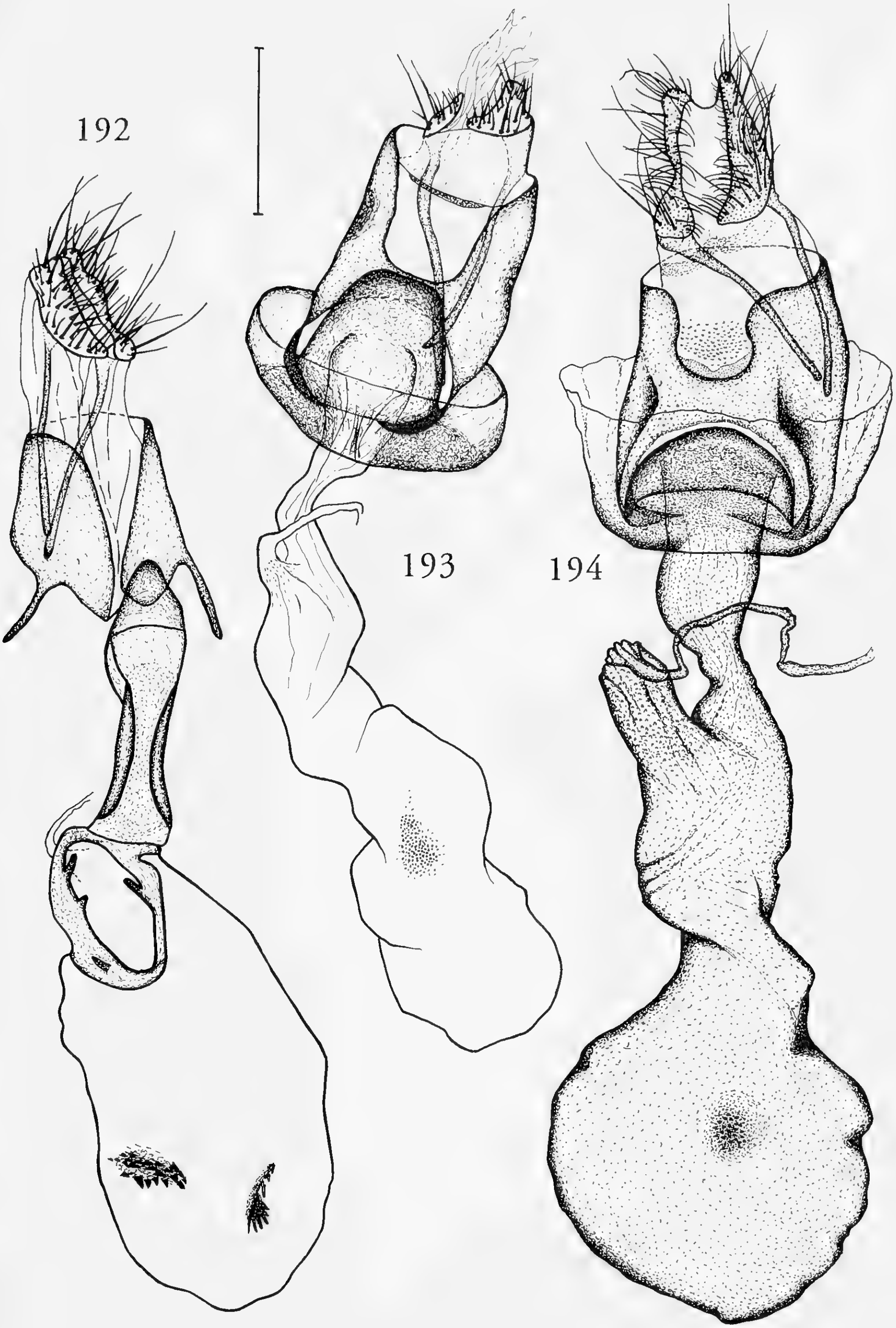
Figs. 183-185. Female genitalia; ventral aspect. – 183, *Euchromius jaxartellus*; 184, *Euchromius zagulajevi*; 185, *Euchromius ramburiellus*. Scale 0.5 mm.



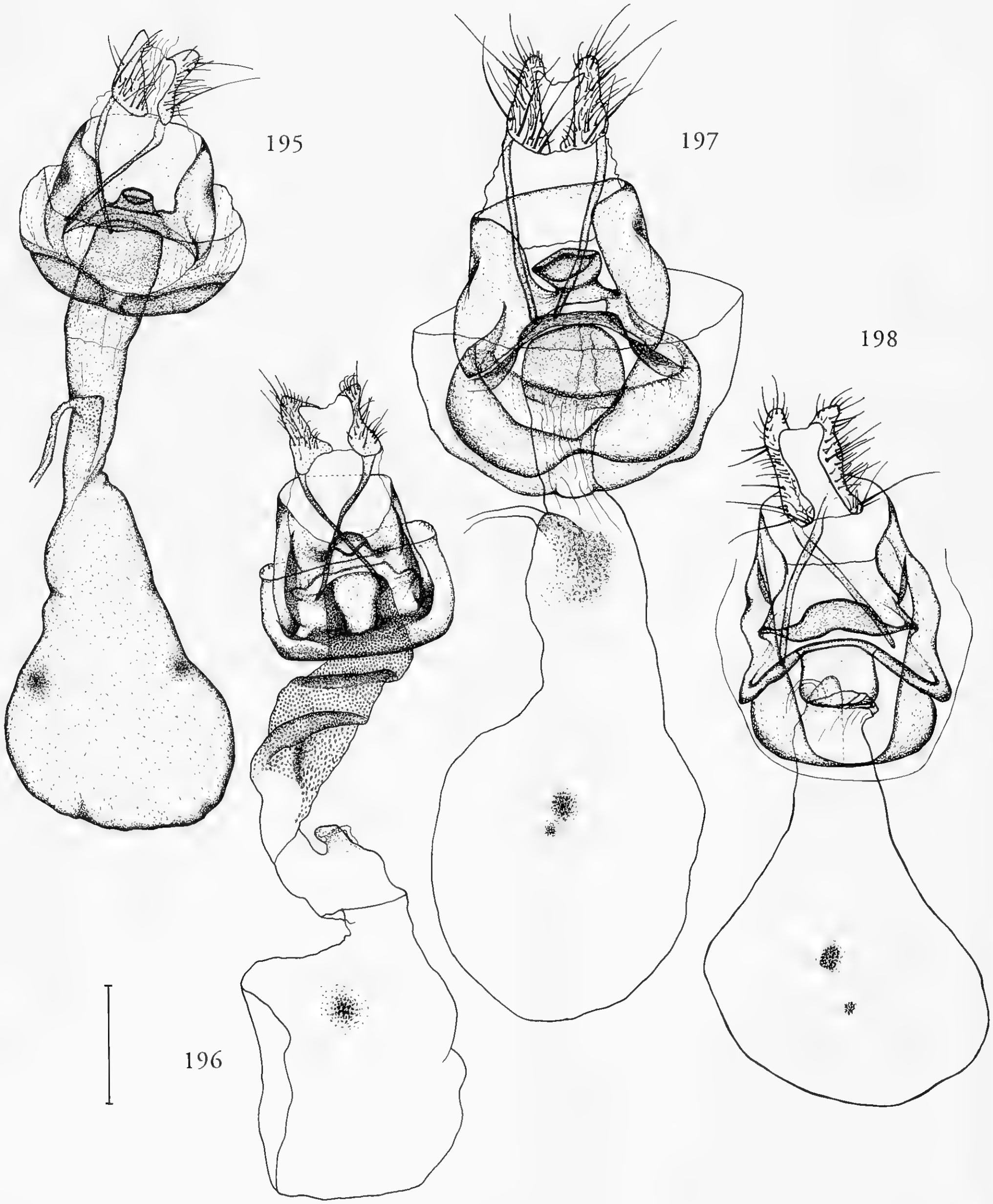
Figs. 186-188. Female genitalia; ventral aspect. – 186, *Euchromius donum*; 187, *Euchromius sudanellus*; 188, *Euchromius subcambridgei*. Scale bar 0.5 mm.



Figs. 189-191. Female genitalia; ventral aspect. – 189, *Euchromius cambridgei*; 190, *Euchromius viettei*; 191, *Euchromius hampsoni*. Scale bar 0.5 mm.



Figs. 192-194. Female genitalia; ventral aspect. – 192, *Euchromius klimeschi*; 193, *Euchromius discopis*; 194, *Euchromius labellum*. Scale bar 0.5 mm.



Figs. 195-198. Female genitalia; ventral aspect. – 195, *Euchromius aris*; 196, *Euchromius erum*; 197, *Euchromius locustus*; 198, *Euchromius nigrobasalis*. Scale bar 0.5 mm.

BERNHARD J. VAN VONDEL

Natuurmuseum Rotterdam

REVISION OF THE PALAEARCTIC AND ORIENTAL SPECIES OF *PELTODYTES* RÉGIMBART (COLEOPTERA: HALIPLIDAE)

Vondel, B. J. van, 1992. Revision of the Palaearctic and Oriental species of *Peltodytes* Régimbart (Coleoptera: Haliplidae). – Tijdschrift voor Entomologie 135: 275-297, figs 1-101. [ISSN 0040-7496]. Published 1 December 1992.

The eight Palaearctic and Oriental species of the genus *Peltodytes* Régimbart are revised. *P. pekinensis* is described as new. Most primary types have been studied. *P. wui* Gschwendtner is considered a junior synonym of *P. coomani* Peschet. Lectotypes are designated for *P. coomani* Peschet, *P. intermedius* (Sharp), *P. variabilis* (Clark) and *P. wui* Gschwendtner. A key to the species is provided, as are distribution-maps.

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Key words. – *Peltodytes*, palaearctic region, oriental region, new species.

Since Zimmermann (1924) published his key to the Haliplidae of the world, only little attention has been payed to the East Palaearctic and Oriental species of *Peltodytes*, with only four new species described since. Doubts about the status of these species warranted a revision. The type material of most nominal taxa was studied, but the identity of some others was sufficiently established. Unfortunately a few types could not be located.

Female genitalia are not described, because they usually appear very uniform. Further research is necessary to check if there are characters sufficiently reliable to separate the species.

MATERIAL

About 1700 specimens, including type-material were studied from the following collections:

British Museum (Natural History), London, UK (BMNH); B.P. Bishop Museum, Honolulu, Hawaii, USA (BPBM); Fries Natuurhistorisch Museum, Leeuwarden, Netherlands (FNML); IES Laboratory, Hebrew University of Jerusalem, Israel (HUJI); Institut Royal des Sciences Naturelles, Brussels, Belgium (ISNB); Muséum National d'Histoire Naturelle, Paris, France (MNHN); Museon, The Hague, Netherlands (MOG); Naturhistorisches Museum Wien, Vienna, Austria (NHMV); Natuurmuseum Rotterdam, Rotterdam, Netherlands (NHMZ); Oberösterreichisches Landesmuseum, Linz, Austria (OLML); Instituut voor Bos- en Natuuronderzoek (Rijksinstituut voor Natuurbeheer), Leersum, Netherlands (RIN); Nationaal Natuurhistorisch Museum (Rijks Museum van Natuurlijke Historie), Leiden, Netherlands (RMNH); Instituut voor Taxonomische Zoölogie (Zoologisch Museum), Amsterdam, Netherlands (ZMAN); Zoologiska Museet, Helsinki, Finland (ZMH); Museum für Naturkunde der Humboldt-Universität, Berlin, Germany (ZMHB); Universitetets Zoologiske Museum, Copenhagen, Denmark (ZMUC); Zoologische Staatssammlung, Munich, Germany (ZSMC).

private collections:

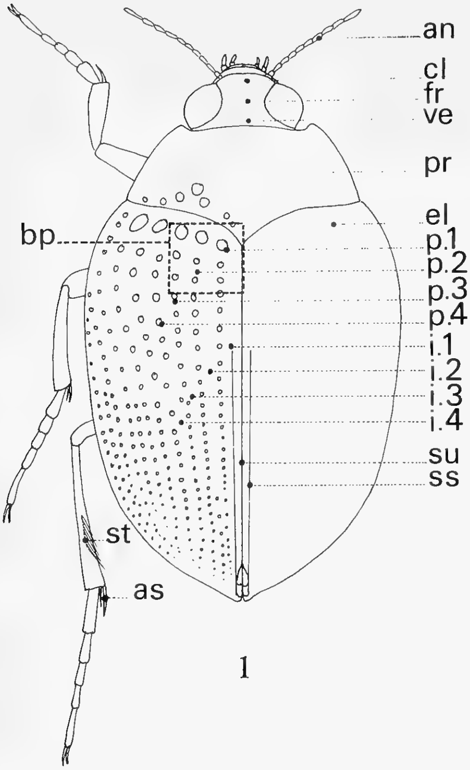
A. L. van Berge Henegouwen (Zoetermeer), J. G. M. Cuppen (Ede), M. B. P. Drost (Wadenoijen), Th. G. Giessen (Gaanderen), M. Hielkema (Gouda), J. Huijbregts (Leiden), Y. Jongema (Wageningen), P. Kanaar (Leiderdorp), N. Nieser (Tiel), J. C. P. M. van de Sande (Nijmegen), M. Schilthuizen (Leiden), M. Schreijer (Alkmaar), H. J. Vallenduuk (Boxtel), B. J. van Vondel (Hendrik Ido Ambacht), all in The Netherlands.

METHODS

Dissecting, preparing and drawing the aedaegi follows the methods described by Vondel (1991: 76). Morphological terms are exemplified in figs. 1 and 2.

The Palaearctic and Oriental regions are treated here together because some species are common to both regions. *Peltodytes* is not known from the Australasian region east of Sulawesi.

Locality-names are spelled, as far as possible, according to the Times Atlas of the World (Comprehensive edition, 1983), but when different from original labels, the modern name is given in parentheses. Names of countries are used with their present-day boundaries.



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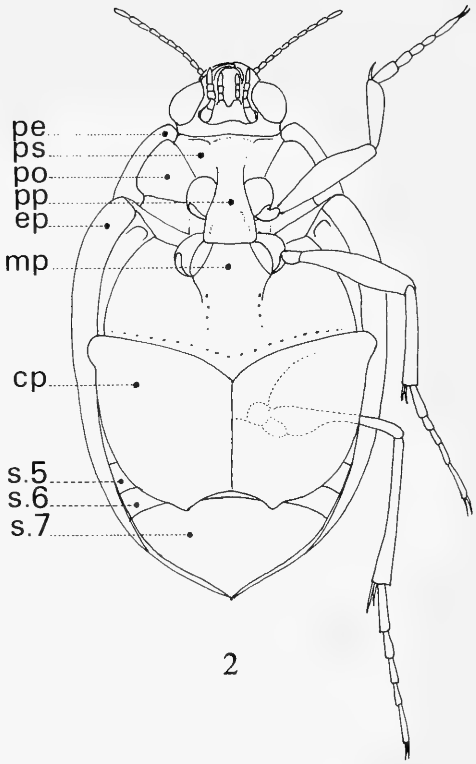


2

Fig. 1. *Peltodytes caesus*, dorsal view. – an, antenna; as, apical spur; bp, location of basal punctures, illustrated for each species; cl, clypeus; el, elytron; fr, frons; i.1, i.2, i.3, etc., first, second, third etc. interval; pr, pronotum; p.1, p.2, p.3, etc., first, second, third, etc puncture-row; ss, sutural stria; st, setiferous striole; su, suture; ve, vertex.

Fig. 2. *Peltodytes caesus*, ventral view. – cp, metacoxal plate; ep, elytral epipleuron; mp, metasternal process; pe, pronotal epipleuron; po, proepisternum; pp, prosternal process; ps, prosternum; s.5, fifth sternite; s.6, sixth sternite; s.7, seventh (last) sternite.

Distribution maps are based on material examined. Reliable literature records are included using different symbols.

Notes on the biology are mainly based on literature and the author's experience.

SYSTEMATIC SECTION

Genus *Peltodytes* Régimbart

Peltodytes Régimbart, 1878: 450. Type-species: *Dytiscus caesus* Duftschmid, 1805, by subsequent designation (Balfour-Browne 1936: 68).

Cnemidotus sensu Erichson, 1832: 48 (nec *Cnemidotus* Illiger, 1802: 373). [Type-species not validly fixed (Holmen, 1987: 86)].

Neopeltodytes Satô, 1963a: 21. Type-species: *Peltodytes callosus* (Leconte), by original designation [see note below].

Cnemidotus; Aubé 1836: 36, Seidlitz 1887: 35.

Peltodytes; Zimmermann 1920: 298, Zimmermann 1924: 6, Balfour-Browne 1936: 68, 1938: 5, 1940: 157, Guignot 1947: 34, Zaitsev 1953: 32, Satô 1963a: 21, 1963b: 23, Franciscolo 1979: 67, Holmen 1987: 86, Beutel & Ruhnau 1990: 4.

Remarks

Satô referred to the division of *Peltodytes* into two groups by Zimmermann (1924) and defined the subgenus *Neopeltodytes* by the absence of the posterior teeth on the metacoxal plates as present in the species of *Peltodytes* s. str. Zimmermann used another character: an in the middle impressed metasternal process in group I (=*Peltodytes* s. str. in Palaearctic, Ethiopean and Oriental regions) or a not impressed metasternal process in group II (=*Neopeltodytes*, in Nearctic and most northern part of Neotropical regions).

Assignment of *Peltodytes*-specimens to one of the subgenera meets some problems as there are Nearctic species having a weak tooth on the metacoxal plates or a more or less impressed metasternal process, while some Palaearctic species sometimes show hardly developed teeth on the metacoxal plates. A more extensive character-set is needed to support the subgeneric division.

The phylogenetic position of *Peltodytes* is discussed by Beutel & Ruhnau (1990).

The genus *Peltodytes* is represented in all faunal regions, excepting the Australasian and the Neotropical regions apart from Mexico and Cuba (Roberts 1913, Zimmermann 1924, Guignot 1959).

Differential diagnosis

The genus *Peltodytes* is defined by the following combination of characters:

Head: Labial and maxillar palpi with ultimate segment clearly longer than penultimate segment. Behind the eyes only one genal line (fig. 51).

Elytra: along suture a stria over at least posterior half. All puncture-rows relatively equal in strength, no weaker secondary puncture-rows present. If intermediate (secondary?) puncture-rows are present, these are restricted to apical part and about as strong as adjacent rows. Apical part of suture incised, exposing inner margin of suture.

Underside: Epipleura reaching last abdominal segment. Metacoxal plates reaching at least sixth sternite, laterally bordered to halfway posterior edge. Posterior edge of each plate produced into a strong tooth, except or hardly in nearctic species.

The wings were figured by Griffini (1897).

Sexual characters: Males have the first two tarsal segments of fore and midlegs widened and ventrally provided with sucker-hairs.

Within the Haliplidae *Peltodytes* can be recognized by means of the following key.

Key to the genera of Haliplidae:

1. Last segment of palpi longer than penultimate segment (fig. 6 and 7). Metacoxal plates at least covering part of sixth abdominal sternite (fig. 2) ....*Peltodytes* Régimbart
- Last segment of palpi clearly shorter than penultimate segment. Last three abdominal sternites freely visible. 2
2. Head as wide as pronotum. Elytra strongly punctured, not in rows. ....*Algophilus* Zimmermann
- Head not as wide as pronotum. Elytra with clear rows of punctures...3
3. Pronotum almost square, front-corners strongly rounded. Elytra with or without longitudinal ridges in first six intervals. ....*Brychius* Thomson
- Pronotum widest at base, sides converging anteriorly. Elytra without longitudinal ridges in first six intervals. ....*Haliplus* Latreille or ....*Apteraliplus* Chandler

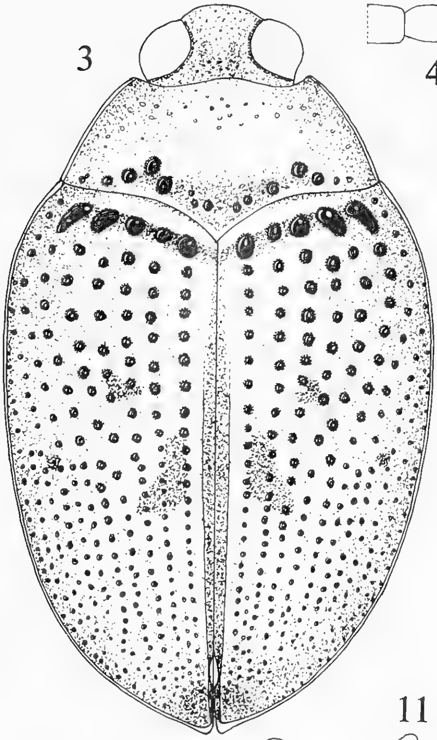
Note: *Algophilus* is restricted to Southern Africa. *Apteraliplus* is only known from North America with a single species: *Apteraliplus parvulus* (Roberts). The separate generic status of the latter is subject to further research.

Checklist of palaearctic and oriental *Peltodytes*

Peltodytes Régimbart, 1878
caesus (Duftschmid, 1805)
  ?*curculinus* (O. F. Müller, 1776)
  quadrimaculatus (Drapiez, 1820)
  caesus var. *levantinus* (Sahlberg, 1902a)
  delhermi (Mazéret, 1923)
  [*impressus* Fabricius sensu Panzer, 1794; nec Fabricius, 1787. Misidentification]
coomani Peschet, 1923
  wui Gschwendtner, 1934 **syn. n.**
dauricus Zimmermann, 1924
intermedius (Sharp, 1873)
rotundatus (Aubé, 1836)
  conifer (Seidlitz, 1887)
pekinensis **sp. n.**
sinensis (Hope, 1845)
  variabilis (Clark, 1863)
  koreanus Takizawa, 1931
sumatrensis Régimbart, 1885

Key to species

1. Margins of pronotum narrow, not thicker than antennae, hind corners hardly protruding (fig. 3) 2
- Margins of pronotum broad, clearly thicker than antennae, hind corners strongly protruding (fig. 16)...7
2. Hind margin of metacoxal plates with a weak blunt tooth (fig. 10)..3
- Hind margin of metacoxal plates with a sharp long tooth (fig. 43). 4
3. Fourth elytral puncture-row complete or at most slightly interrupted in the middle. Base of pronotum strongly impressed, in the impression a transverse row of strong darkened punctures. Not with basal marks on pronotum, larger than darkened punctures. Vertex at most with two vague marks (fig. 3). Males: surface of apical parts of parameres hairy (fig. 15) ....*P. caesus*
- Fourth elytral puncture-row only clearly present in basal part, represented by about 3-5 punctures. Base of pronotum hardly impressed, on both sides of impression two joined strong punctures and about three small ones, connected by a dark mark. Vertex with two small distinct marks (fig. 74). Males: surface of apical parts of parameres areolate (fig. 84).................................*P. sinensis*
4. Antennae slender, segments longer than wide (fig. 28)...5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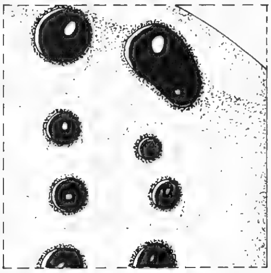
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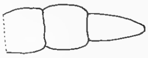
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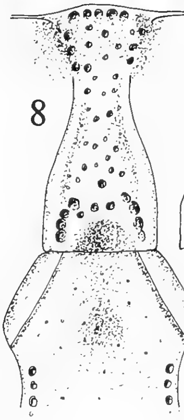
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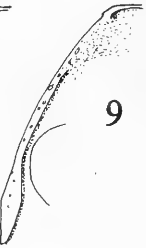
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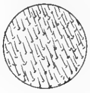
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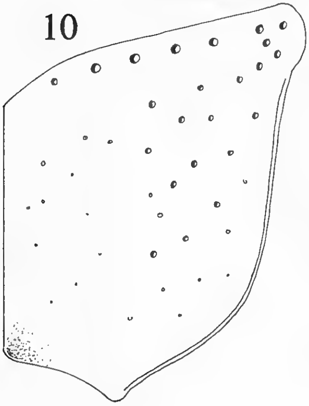
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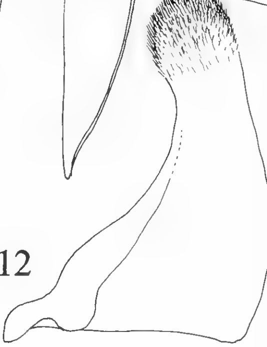
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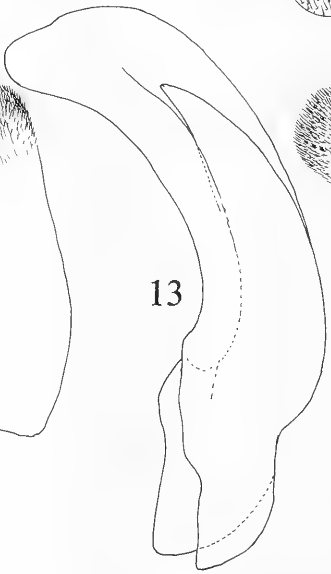
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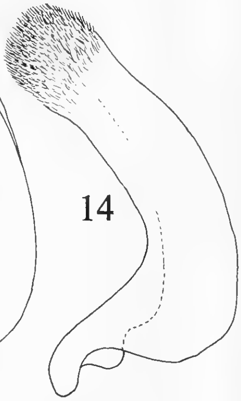
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- Antennae short, segments 2-9 about as long as wide (fig. 62). Males: surface of apical parts of parameres hairy (fig. 73). .... *P. rotundatus*

5. Punctures on elytral epipleura black. Prosternal process clearly bordered in anterior half (fig.41). Males: surface of apical parts of parameres areolate (fig. 48). 6
- Punctures on elytral epipleura not black. Prosternal process usually not completely and clearly bordered in anterior half (fig. 30). Surface of apical parts of parameres hairy (fig. 37).......... ....*P. dauricus*

6. Pronotum without black punctures in posterior corners between margin and widened basal punctures (fig. 49). Proepisternum without strong dark punctures, when very weak punctures present these are not darkened. Teeth of coxal plates usually long but with a blunt point, especially in lateral view (fig. 55 and 56). Head with a black collar behind eyes (fig. 51)......*P. pekinensis*
- Pronotum with black punctures in posterior corners between margin and widened basal punctures (fig. 38). Proepisternum with strong darkened punctures. Teeth of coxal plates long and sharp (fig. 43 and 44). Head without a black collar directly behind eyes.................*P. intermedius*

7. Elytra with large dark marks and usually with black band connecting basal punctures. Two clear sharp dark spots on vertex (fig. 85). ....*P. sumatrensis*
- Elytra with at most a few small marks and base usually not black. Vertex with at most two vague spots (fig. 16)................................... *P. coomani*

Description of species

Peltodytes caesus (Duftschmid)
(figs. 3-15)

?*Dytiscus curculinus* O. F. Müller, 1776: 73. Syntypes: [Denmark or Norway]. [probably destroyed].

Dytiscus caesus Duftschmid, 1805: 284. Syntypes: Austria. Typematerial probably in OLML [not examined].

Haliplus quadrimaculatus Drapiez, 1820: 349. Location of types unknown [not examined].

Cnemidotus caesus var. *levantinus* Sahlberg, 1902-1903a: 17. Syntypes: 1 ex., Israel, Jaffa, J. Sahlberg; 6 ex., Greece, Corfu, J. Sahlberg (ZMH)(Biström 1987: 33) [not examined].

Cnemidotus delhermi Mazéret, 1923: 67. Syntypes: France, Armagnac, étangs à Espas, L. Mazéret. Location of types unknown [not examined].

[*Dytiscus impressus* sensu Panzer 1794: t. 7. nec Fabricius, 1787. [Misidentification]. Lectotype ♀ of *D. impressus* Fabricius, which is identical to *Haliplus ruficollis* (De Geer, 1774) was designated by Holmen (1987: 133)].

Peltodytes curculinus; Zimmermann 1920: 299, 1924: 7.

Cnemidotus impressus; Seidlitz 1887: 35.

Peltodytes impressus; Zimmermann 1920: 299, 1924: 7.

Dytiscus caesus; Erichson 1832: 48.

Peltodytes quadrimaculatus; Zimmermann 1920: 299, 1924: 7.

Haliplus caesus; Gyllenhal 1827: 234.

Cnemidotus caesus; Aubé 1836: 38, Régimbart 1877: 354, Seidlitz 1887: 35.

Peltodytes caesus; Bedel 1881: 223, Escalera 1914: 56, Zimmermann 1920: 299, 1924: 7, Balfour-Browne 1940: 157, Csiki 1946: 571, Guignot 1947: 36, 1959: 21, Lagar Mascaro 1951: 76, Zaitsev 1953: 34, Freude 1971: 9, Hosseinie 1974: 242, 1978: 167, Ienistea 1974: 204, Minoransky & Dzumailo 1974: 26, Ali 1976: 91, Galewski 1976: 8, Konev 1976: 56, Mateleshko 1977: 68, Franciscolo 1979: 70, Guéorguiev 1958: 44, 1963: 215, 1981: 399, Foster 1981: 4, Angelini 1984: 48, Holmen 1987: 88, Zakharenko & Moroz 1988: 282, Belyashevskiy 1989: 124, Leblanc 1990: 1.C.3.

Cnemidotus caesus var. *levantinus*; Sahlberg 1902-1903b: 6.

Peltodytes caesus var. *levantinus*; Zimmermann 1920: 299, 1924: 7, Guignot 1959: 21, Zaitsev 1953: 35, Franciscolo 1979: 71.

Peltodytes caesus ssp. *levantinus*; Guéorguiev 1958: 44.

Remarks

P. caesus was described from Austria. Since no other species of *Peltodytes* are known from Austria, the description by Duftschmid leaves hardly any doubt about the identity of the species.

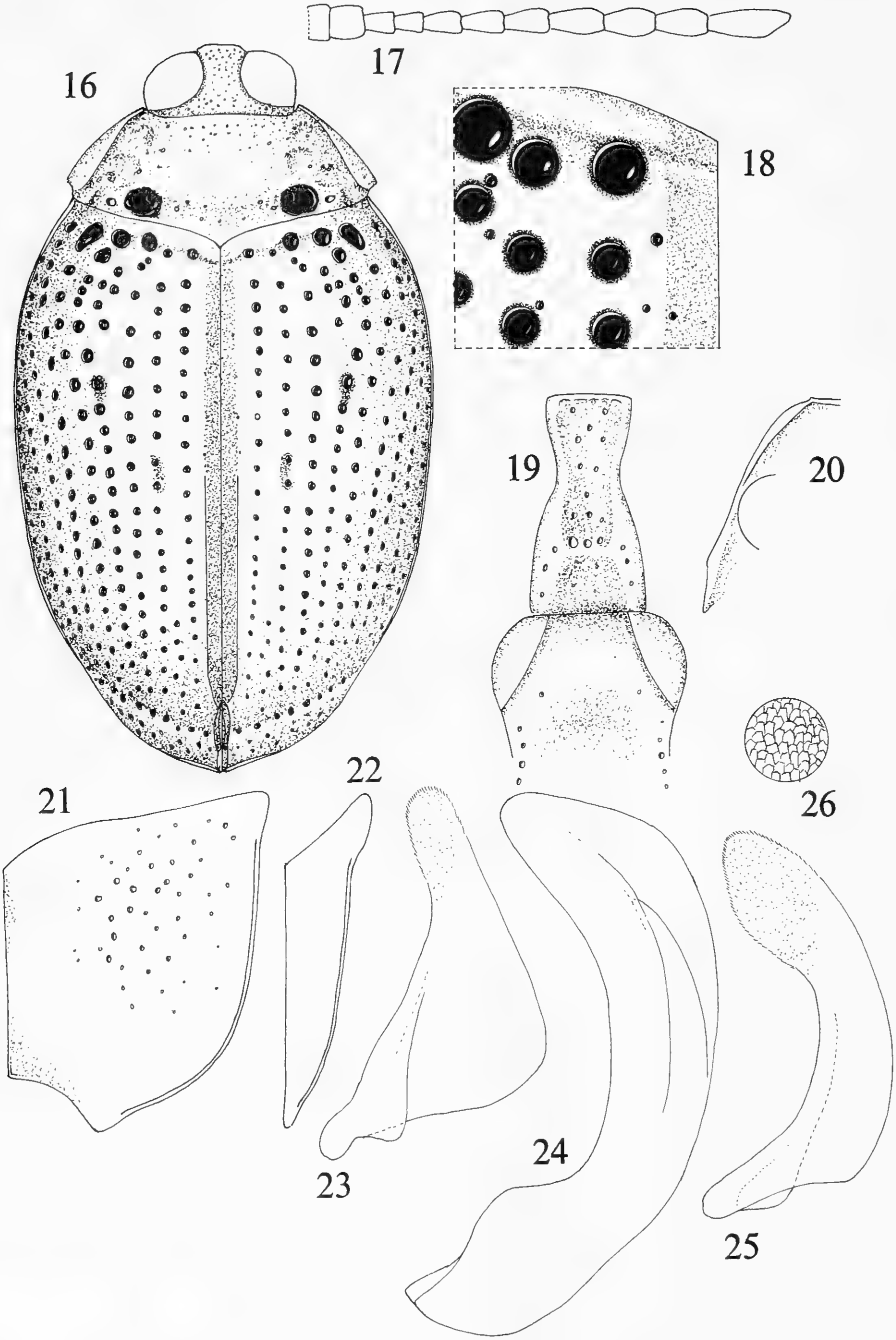
Schönherr (1808: 26) gives *Dytiscus curculinus* O. F. Müller as a synonym of *D. impressus* Fabricius, which is not conspecific with *P. caesus*. Zimmermann (1920) gives it again (with a questionmark) as a possible synonym of *P. caesus*. As Müllers' collection does not exist anymore it seems impossible to settle the identity of this name.

Description

Length 3.3-3.8 mm, width 1.7-2.0 mm. Body subparallel to parallel, widest in the middle (fig. 3).

Head: Yellow to brown, two large, sometimes vague, dark blotches between eyes, sometimes confluent with slight darkening on vertex. Moderately strongly and densely punctured, punctures on vertex darkened. Distance between eyes 0.9-1.0× width of one eye. Antennae yellow to yellow-red, segment 4-6 about as long as wide (fig. 4). Palpi yellow to yellow-red.

Figs. 3-15. *Peltodytes caesus*, Netherlands. – 3, dorsal view; 4, antenna; 5, punctures near elytral base and suture; 6, maxillair palpus; 7, labial palpus; 8, prosternal process; 9, lateral view of prosternal process; 10, metacoxal plate; 11, lateral view of metacoxal plate; 12, left paramere; 13, penis; 14, right paramere; 15, surface of apical part of parameres.



Figs. 16-26. *Peltodytes coomani*, lectotype. – 16, dorsal view; 17, antenna; 18, punctures near elytral base and suture; 19, prosternal process; 20, lateral view of prosternal process; 21, metacoxal plate; 22, lateral view of metacoxal plate; 23, left paramere; 24, penis; 25, right paramere; 26, surface of apical part of parameres.

Pronotum: Yellow. Along base a row of widened darkened punctures, of which strongest ones are opposite third elytral puncture-rows. Rest of pronotum with sparse uncoloured punctures. Base impressed. Lateral margin finer than antennae, not narrowed anteriorly, straight with convex anterior part.

Elytra: Yellow, darkened suture, discal, sometimes vague, mark not connected to suture, vague marks on intervals sometimes missing. Margined completely, posteriorly not clearly concave. Posterior part not bulbous, evenly rounded as rest of elytra. Punctures moderately strong, about 30 punctures in first row. Posteriorly about 6-15 punctures in second interval. Fourth row in middle not or over a distance of at most 5 punctures interrupted. Puncture-rows in seventh and ninth interval stretched out over about posterior half or even exceeding the middle. Basal punctures widened(fig. 5). All punctures darkened. Sutural striae stretched out over posterior 2/3.

Underside: Yellow to yellow-red, legs yellow to brown, darkened towards coxae. Epipleura with uncoloured punctures, reaching to 1/4 of last sternite. Prosternal process posteriorly grooved in the middle and with marginal plicae, strongly and coarsely punctured, anteriorly hardly margined (fig. 8 and 9). Metasternal process strongly grooved in the middle, hardly punctured, plicae along coxae (fig. 8). Metacoxal plates with a blunt tooth, just reaching last sternite, sparsely punctured (fig. 10 and 11). Last sternite unpunctured, strongly impressed in front corners. Setiferous striole on dorsal face of hind tibia about 1/3× length of tibia, longest of two tibial spurs 3/4× length of first tarsal segment.

Male: Penis and parameres as in figs. 12-14, surface of apical part of parameres hairy (fig.15).

Immature stages: Third stage larvae described by Schiødte (1872: 203).

Biology

In fresh or occasionally brackish stagnant water of ponds or ditches and slowly running streams. Among vegetation of *Ranunculus*, *Callitriche*, *Elodea*, *Chara* and other waterplants. Feeding on filamentous algae and probably Characeans. The eggs are laid on the surface of waterplants. The adults are attracted to light (Konev 1976 and pers. obs.).

Distribution (fig. 96)

Europe northward to southern England, Denmark and southern Sweden, eastward to Belorussia and the Ukraine, southward to Portugal, Spain, Italy and Greece. Asia: Turkey, Kazakhstan, southern part of the Russian Federation, Afghanistan, Iran, Syria, Israel. Africa: Morocco. Ali (1976) records a *Peltodytes* sp. from Irak. It probably concerns *P. caesus.*

Material examined. – Albania: 2 ex. (NHMV) • Austria: 76 ex. (NHMV, RMNH, ZMAN) • Belgium: 1 ex. (Lodewijcks).- Czechoslovakia: 3 ex. (NHMV) • Denmark: 1 ex. (ZMAN) • France: 33 ex. (BMNH, MOG, NHMV, RMNH, ZMAN, Jongema, Huijbregts, Vondel) • Germany: 16 ex. (NHMV) • Great Britain: 3 ex. (ZMAN) • Greece: 11 ex. (NHMV, ZMAN, Berge Henegouwen) • Hungary: 6 ex. (NHMV, RMNH, ZMAN) • Iran: 3 ex. (BMNH) • Italy: 4 ex. (NHMV, Jongema) • Jugoslavia: 19 ex. (NHMV, ZMAN) • Kazakhstan: 1 ex. (NHMV) • Morocco: 10 ex. (BMNH) • Netherlands: 750 ex., all provinces • Poland: 9 ex. (NHMV, RMNH) • Portugal 11 ex. (RMNH, ZMAN, Nieser) • Rumania: 1 ex. (NHMV) • Russian Federation: 1 ex. (NHMV) • Switzerland: 1 ex. (Jongema) • Turkey: 31 ex. (NHMV, RMNH) • Ukraine: 6 ex. (NHMV, RMNH).

Peltodytes coomani Peschet

(figs. 16 -26)

Peltodytes coomani Peschet, 1923: 178. Lectotype ♂ (here designated), Hoa Binh, Tonkin [Vietnam], V.VI.1922, A. de Cooman, TYPE, Museum Paris, 1945, Coll. R. Peschet, *Peltodytes coomani* n. sp. R. Peschet (MNHN) [examined].

Peltodytes wui Gschwendtner, 1934: 107. Lectotype ♂ (here designated), Canton [China], Collector C. F. Wu, Type Gsch., Hal. 42, Coll. Gschwendtner, *Peltodytes wui* Gsch., det. Gschwendt., Type. (OLML) [examined]. **syn. n.**

Peltodytes coomani; Zimmermann 1924: 208.

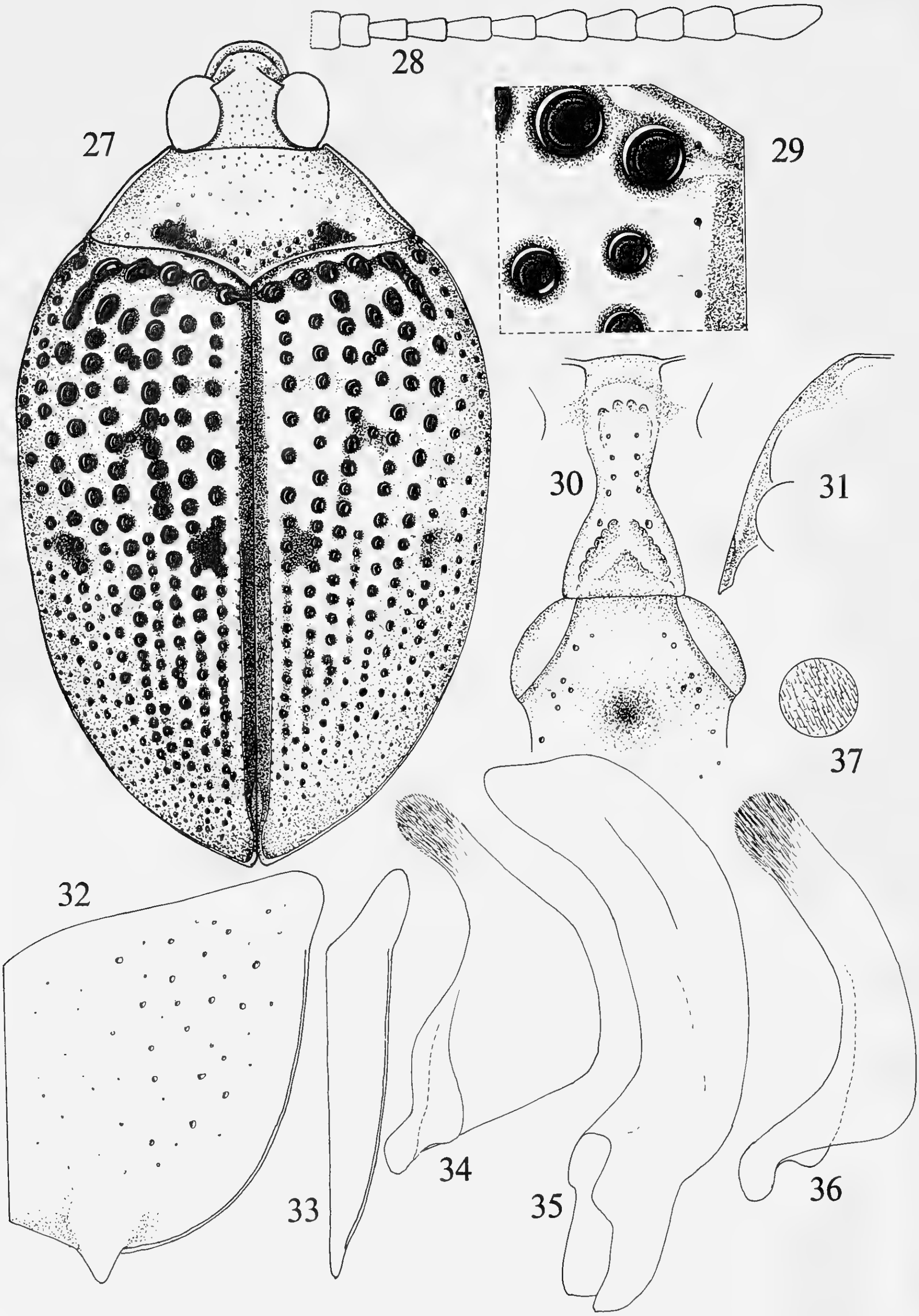
Description

Length 3.2-3.5 mm, width 1.9-2.1 mm. Body wide, subparallel in the middle (fig. 16).

Head: Yellow-brown to yellow-red, seen from beside brown marks behind eyes, sometimes two small vague spots on vertex. Weakly to moderately strongly punctured. Distance between eyes 0.7-0.8× width of one eye. Antennae yellow to yellow-brown, last segment usually darkened at top, segment 3-6 longer than wide, segment 7-10 more than twice as long as wide (fig.17). Palpi yellow to yellow-brown.

Pronotum: Yellow to yellow-brown, dark mark opposite third elytral puncture-rows, slightly impressed between these marks. Lateral borders slightly to clearly convex, margins from very strong posteriorly to narrow anteriorly, posterior corner clearly protruding. Sparsely, but in marginal parts sometimes coarsely punctured, in basal dark marks one very large and sometimes a few smaller punctures recognizable.

Elytra: Yellow to yellow-brown, suture completely dark, towards base slightly narrowed, usually dark mark between first and second and between third and fifth puncture-row, sometimes without marks. Posterior part bulbous, covering margins when seen from above. Apical part of margin concave. Puncture-rows moderately strong, basal punctures widened and connected by a slight impression (fig. 18). Additional puncture-row in second interval restricted to about 6 punctures in posterior part. Fourth puncture-row on-



Figs. 27-37. *Peltodytes dauricus*, figs. 27-33, holotype, figs. 34-37, Harbin. – 27, dorsal view; 28, antenna; 29, punctures near elytral base and suture; 30, prosternal process; 31, lateral view of prosternal process; 32, metacoxal plate; 33, lateral view of metacoxal plate; 34, left paramere; 35, penis; 36, right paramere; 37, surface of apical part of parameres.

ly represented by 1 to 4 punctures in basal part. No recognizable additional puncture-rows in seventh and ninth interval. In impression in front of bulbous apex a clear puncture-row from suture to lateral margin. All punctures darkened, sometimes marginal and epipleural punctures not darkened.

Underside: Yellow to yellow-brown, legs yellow-brown, darkened near coxae. Epipleura punctured, punctures usually brown, not as dark as elytral puncture-rows. Prosternal process grooved, groove interrupted in posterior part, strongly punctured (fig. 19 and 20). Prosternum with uncoloured punctures, anteriorly only margined close to prosternal process. Metasternal process slightly impressed anteriorly and strongly posteriorly, weakly punctured (fig. 19). Metacoxal plates with a weak tooth, posterior sutural corner weakly margined, strongly punctured except in sutural area (fig. 21 and 22). Setiferous striole on dorsal face of hind tibia about 1/4× length of tibia, longest of two tibial spurs about 2/3× length of first tarsal segment.

Male: Penis and parameres as in figs. 23-25. Surface of apical parts of parameres areolate (fig. 26).

Immature stages: Unknown.

Distribution (fig. 101)

Vietnam, China (prov. of Guangdong)

Material examined. – Vietnam: 1 ♂, lectotype, 8 paralectotypes with same labels as lectotype (4 in MNHN and 4 in RMNH); 29 ex., Tonkin, Hoa Binh, leg. A. de Cooman (dates, if present, varying from 1932 to 1934) (ISNB, RMNH, MNHN); 3 ex., Annam, Rég. de An-ninh. R. P. M. Mannier, dr. Régimbart vidit 1903, ex. coll. Oberthür (1 ex. labelled: *Peltodytes variabilis* Clk.) (MNHN) • China: 1 ♂, lectotype of *P. wui* (OLML); 2 ex., Canton [Guangzhou], Mell S. V. (1 ex. with date x.10)(ZMHB); 2 ex., Hainan Id., S. China, SW of Nodoa, Tan-hsien (Distr.), 17.vii.1929. Lingnan University, Fifth Hainan Expedition (BPBM).

Peltodytes dauricus Zimmermann

(figs. 27-37)

Peltodytes dauricus Zimmermann, 1924: 8. Holotype ♀ (by monotypy), Nikolsk, Ussurijsk, Mandl, Type, Holotypus Staatssamml. München (ZSMC) [examined].

Peltodytes dauricus; Wu 1932: 341, J. Balfour-Browne 1946: 436, Zaitsev 1953: 36 (as jun. syn. of *intermedius*).

Description

Length 4.2 mm, width 2.4 mm. Body wide, subparallel. (fig. 27).

Head: Yellow-brown, weakly punctured. Distance between eyes 0.9× width of one eye. Antennae (fig. 28) and palpi yellow-brown.

Pronotum: Yellow-brown, basal dark marks opposite third elytral puncture-row. Impressed between basal marks. Weakly punctured, three or four strong dark punctures in basal marks clearly smaller than elytral basal punctures, about 15 dark punctures in impression between basal marks. Lateral borders convex, margins widest in the middle, not wider than antennae.

Elytra: Yellow-brown, very strong puncture-rows, although punctures are usually separately darkened, the strong darkening gives the elytra a striped appearance. Suture darkened, small marks between first and second, between third and fifth and between eighth and tenth row. Fourth row missing about five punctures in the middle. Additional puncture-rows present in posterior half of seventh and ninth interval. No or only few additional punctures in apical part of second interval. Basal punctures in a common transverse impression (fig.29). All punctures ringlike impressed: centre of puncture is slightly raised. Very small punctures along suture. Sutural stria in posterior half.

Underside: Yellow-brown to brown, legs yellow-brown to brown around coxae. Elytral epipleura yellow-brown, weak punctures uncoloured. Prosternal process strongly narrowed near coxae, in anterior part usually without a clear margin, with various impressions and coarse punctures (fig. 30, 31). Prosternum margined anteriorly, except near epipleura, at most very weakly and sparsely punctured. Metasternal process flat with a pit in the middle, sparsely punctured, the part covering the mesocoxae separated by a clear plica (fig. 30). Metacoxal plates with a strong but not very sharp tooth (fig. 32, 33). Setiferous striole on dorsal face of hind tibia about 1/5× length of tibia, longest of two tibial spurs about 2/3× length of first tarsal segment.

Male: Penis and parameres as in figs. 34-36. (illustrated for the first time by J. Balfour-Browne (1946). Surface of apical parts of parameres hairy (fig. 37).

Immature stages: Unknown

Distribution (fig. 98)

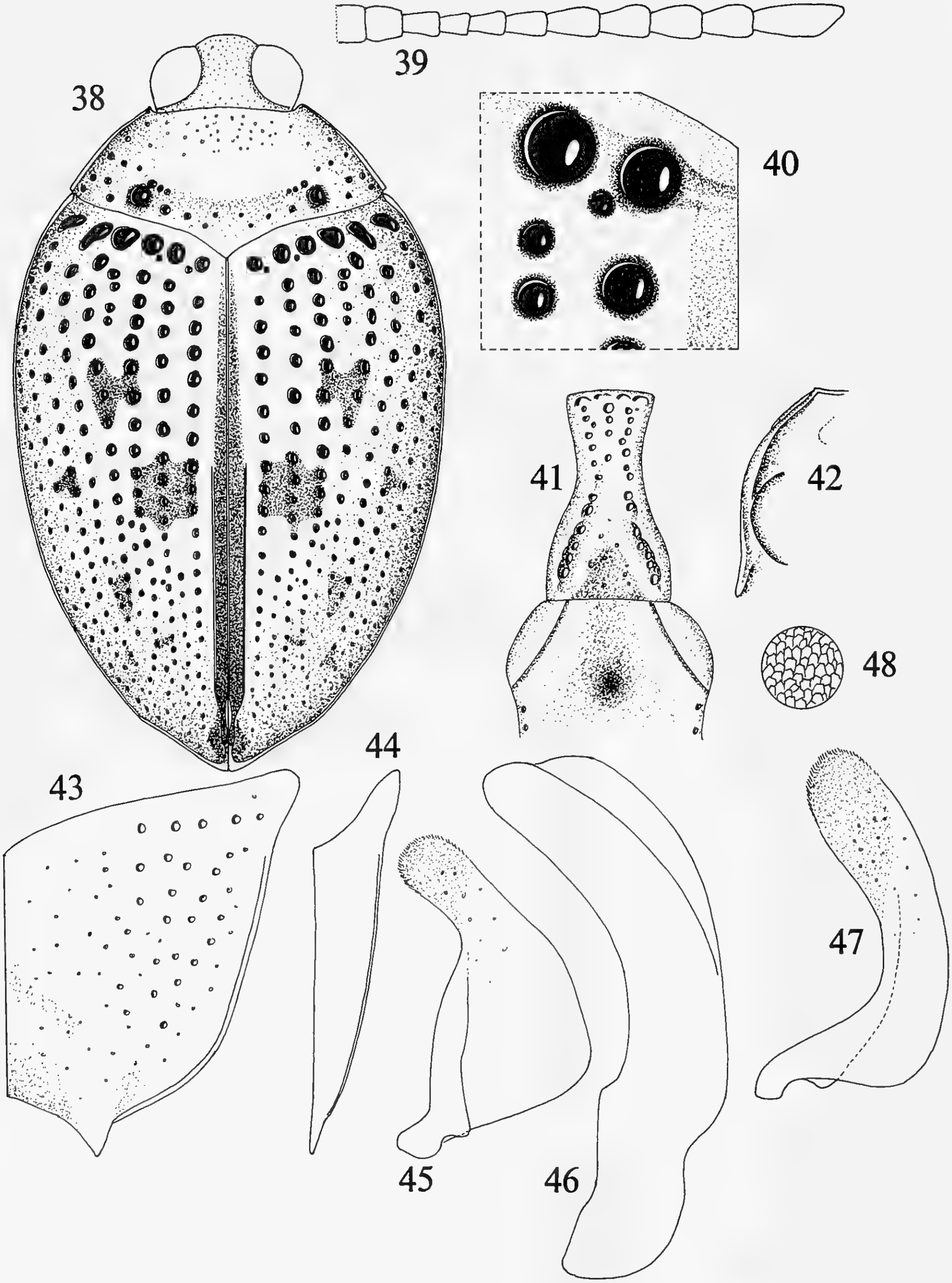
Russian Federation near Wladiwostok, China province Heilongjiang.

Material examined. – Russian Federation: ♀ Holotype (ZSMC) • China: 1 ♂, Weishaha [Weihe], Manch, 20.vii.1939, M. Weymarn; 3 ex., Hsiaoling [?], Manchuria, vii.1939, M. Weymarn; 1 ex., Harbin, Manchuria, 22.ix.1940, M. Weymarn, *Peltodytes dauricus* Zimm., J. Balfour-Browne det. 1944; 4 ex., Charbin [Harbin], 5.-viii.1952, BM.1953-715; 3 ex., Charbin [Harbin], 2.x.1952, BM.1953-715; 2 ex., Heilungkiang [Heilongjiang], Harbin, 13.vi.1965 & 26.vi.1966, P.M. Hammond, BM 1967-215 (BMNH).

Peltodytes intermedius (Sharp)

(figs. 38-48)

Cnemidotus intermedius Sharp, 1873: 55. Lectotype ♀ (here designated), "Type [round label with red margin], Japan



Figs. 38-48. *Peltodytes intermedius*, Japan: Yokoshima. – 38, dorsal view; 39, antenna; 40, punctures near elytral base and suture; 41, prosternal process; 42, lateral view of prosternal process; 43, metacoxal plate; 44, lateral view of metacoxal plate; 45, left paramere; 46, penis; 47, right paramere; 48, surface of apical part of parameres.

Lewis [label with yellow middleband], Japan [yellow oval label], Sharp coll. 1905-313, *Cnemidotus intermedius* type DS. [according to description abundant at Nagasaki] (-BMNH) [examined].

Peltodytes intermedius; Régimbart 1899: 191, Peschet 1923: 179, Zimmermann 1919: 75, 1920: 300, 1924: 7, Takizawa 1931: 138, Wu 1932: 341, Zaitsev 1953: 36, Nakane 1963: 55, 1987: 27, Satô 1963b: 23, 1984: 3, Yoon 1988: 620.

Description

Length 3.2-3.7 mm, width 1.9-2.2 mm. Body wide, subparallel, widest in the middle. (fig. 38)

Head: Yellow to yellow-brown, moderately strongly and densely punctured. Sometimes with a slightly darkened collar, which does not reach the eyes. Distance between eyes 0.8-1.0× width of one eye. Antennae (fig. 39) and palpi yellow.

Pronotum: Yellow, basal dark marks opposite fifth elytral puncture-row, containing 2 or 3 widened punctures. Slightly impressed between basal marks. Strong darkened punctures along base and in hind corners, weak not or only sligthly darkened punctures in anterior and discal part. Lateral borders straight to convex, margin not wider than antennae, narrowed anteriorly.

Elytra: Yellow, suture darkened, four larger and some small dark marks on each elytron, of which discal one is separated from suture. Puncture-rows strong. Fourth puncture-row widely interrupted, usually only one to three punctures remaining near base and at most about five apically. Basal punctures of first five rows strongly widened. Apically about 10-15 punctures in second interval. Apically remains of additional puncture-rows in seventh and ninth interval. All punctures darkened. Apical margin not clearly concave. Completely margined. Striae along suture in posterior half. Along suture weak and dense darkened punctures. Apical part slightly bulbous.

Underside: Yellow to yellow-red, legs yellow to yellow-red, darkened towards coxae. Elytral epipleura yellow, anterior part with dark punctures, reaching middle of last sternite. Prosternal process narrowed near coxae, moderately strongly punctured, slightly impressed in the middle, posteriorly with a central impression and a punctured stria on each side, anteriorly weakly margined (fig. 41, 42). Metasternal process with deep pit in the middle, hardly punctured, weak striae along coxae (fig. 41). Metacoxal plates with small sharp tooth, not reaching last sternite, in lateral view also sharp, posterior part between teeth bent down to the body, densely punctured, all punctures about equal in strength and uncoloured (fig. 43, 44). Setiferous striole on dorsal face of hind tibia 1/2-1/3× length of tibia, longest of two tibial spurs about 3/4× length of first tarsal segment. Last sternite unpunctured, impressed beside the middle.

Male: Penis and parameres as in figs. 45-47. Surface of apical part of parameres areolate (fig. 48).

Immature stages: According to Bertrand (1972) the larva was described by Fukuda, Kurosa and Hayashi (publication unknown to me).

Biology

Found in ponds and in a river.

Distribution (fig.99)

Japan, China, Korea. Zimmermann (1919) gives Taiwan, Zaitsev (1953) gives the most eastern part of the Russian Federation.

Material examined. – Japan: Kyushu: Lectotype (BMNH); 4 ex., Nagasaki, Hilsendorf (ZMHB); 10 ex., Ikenosono, Konyama T, Kagoshima Pref., 6.x.1985, leg. E. Matsui; 10 ex., Yokoshima T, Taman-gun, Kumamoto Pref., 9.vi.1986, leg. E. Matsui (Vondel); Tsushima: 1 ex., P. Holst; 1 ex., Tsu-sima, vii-x.1891 (BMNH); Honshu: 4 ex., Tokio, 25-27.ix.1881, G. Lewis; 1 ex., Yokohama,1.i-9.ii.1881, G. Lewis (BMNH); 1 ex., Kobe, 20.vii.1916, leg. J. E. A. Lewis (-BPBM); 3 ex., Surr. Tokio, Bodemeyer (RMNH); 2 ex., Tokio; 8 ex., Yedo [river Edo], vii.1875, leg. Hilsendorf (ZMHB); Hokkaido: 1 ex., Sapporo, 5-16.viii.1880, G. Lewis (BMNH); 5 ex., Obihiro, 24.vii.1906, H. Schoede S. G. (ZMHB); 1 ex., Hakodate, 1897, R.P. Faurie (MNHN); Japan (Island unknown): 1 ♀, Japon, Det. Sharp, Lewis, *intermedius*, det. Sharp 1873, *Peltodytes intermedius* Shp, Type (-ISNB); 2 ex., Okitsu [?], iv+v.1913, F. Muir (BPBM); 7 ex., Chiuzenji [?], 19-24.viii.1881, G. Lewis; 15 ex., Chiuzenji, G. Lewis; 1 ex., Chuzai, Chiuzenji, G. Lewis; 2 ex., Sarsiew [?], 20.ix.1909, J.E.A. Lewis; 25 ex., Lewis, 15.ix.1881 or 29.x.1881; 8 ex., G. Lewis, (some 9.iii.1881); 1 ex, G. Lewis; 1 ex., 1896, Lord Dormer (BMNH); 2 ex., Hiller S.; 2 ex., Hilsendorf (ZMHB) • China: 1 ex., 5. Shanghai (RMNH); 1 ex., Peping [Beijing], C.F. Wu (OLML) • Korea: Kangwon-do: 3 ex., Wonsong-kun, Kyangkyok, pond, 3.viii.1988; Chungpuk-do: 1 ex, Chunchon-city, Chiljon-dong, 5.-viii.1988; 3 ex., Chungwon-kun, Chisil-pond, 16.viii.1987; 4 ex., Poun-kun, Chisan-ri, 17.viii.1989; 3 ex., Sintanjin-city, 21.vii.1987; Kyongnam-do: 2 ex., Yangson-kun, Taesok-pond, 22.x.1988; 2 ex., Chinryang-kun, Kumsan-pond, 11.viii.1989; Kyongki-do: Kwangju-kun, Chungang-pond, 20.viii.1989; Chonnam-do: 2 ex., Imsil-kun, Samgye-ri, 14.viii.1989; 5 ex., Namwon-kun, Okrim-pond, 13.viii.1989; Kyongpuk-do: 3 ex., Yongpung-kun, Hway-on-pond, 2.viii.1988 (Vondel, ex coll. Sung Hwa Lee).

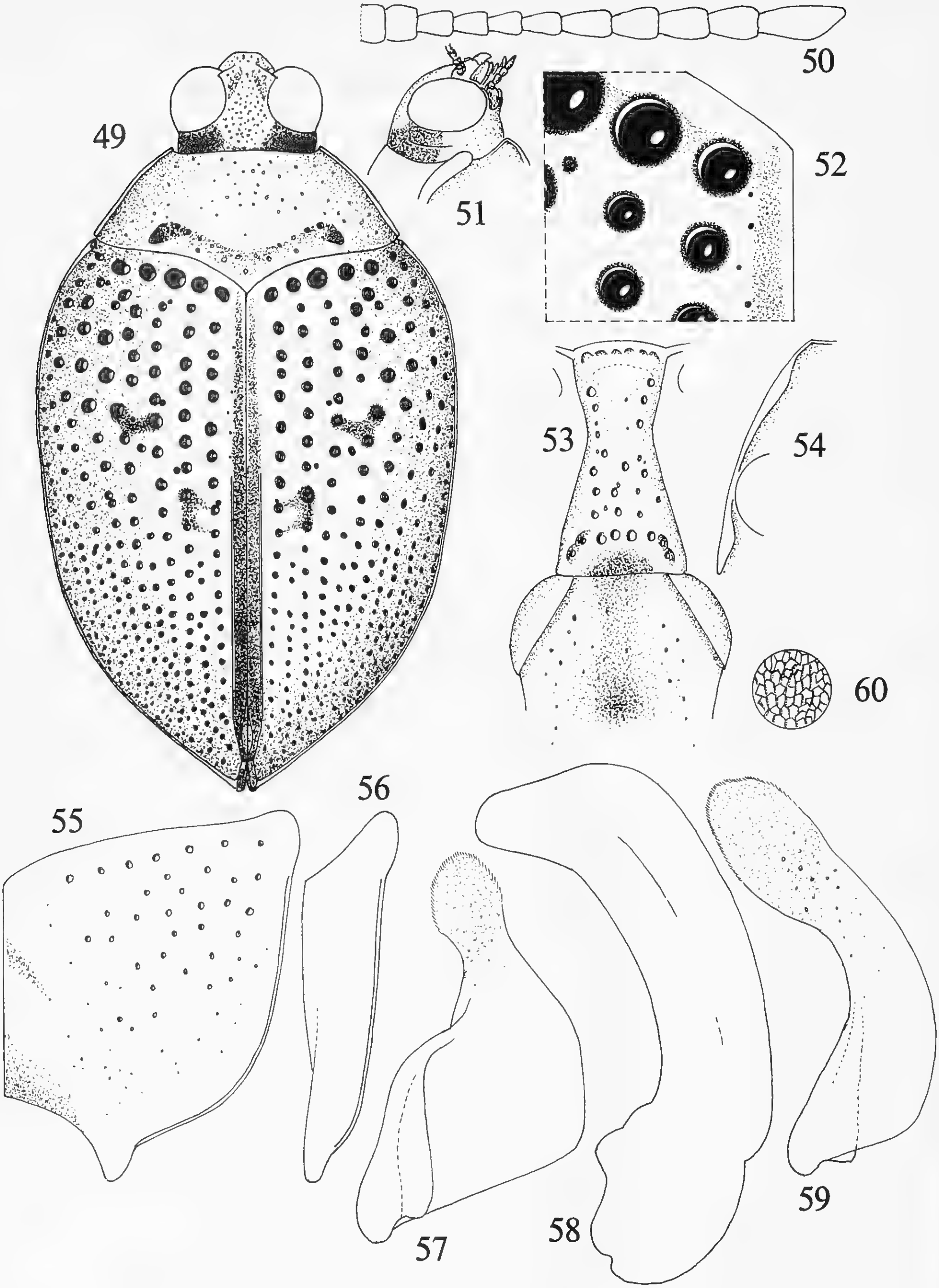
Peltodytes pekinensis sp. n.
(figs. 49-60)

Type material. – Holotype ♂, "Peping [Beijing], Collector C. F. Wu, coll. Gschwendtner, *intermedius* Shp, det. Gschwendtner" (OLML). – Paratypes, 1♂, 1♀: 1 ♀, data as holotype (coll. Vondel); 1 ♂, "China, Peking [Beijing], vii.[19]13 (ZMHB)

Description

Length 3.6-3.9 mm, width 2.1-2.2 mm. Body widest just behind shoulders, in the middle subparallel (fig. 49).

Head: Yellow to yellow-brown, dark mark on neck reaching downwards to halfway height of eyes (fig.



Figs. 49-60. *Peltodytes pekinensis*, Holotype. – 49, dorsal view; 50, antenna; 51, lateral view of head; 52, punctures near elytral base and suture; 53, prosternal process; 54, lateral view of prosternal process; 55, metacoxal plate; 56, lateral view of metacoxal plate; 57, left paramere; 58, penis; 59, right paramere; 60, surface of apical part of parameres.

51). Strongly and densely punctured, slightly impressed behind front margins near antennae. Distance between eyes 0.6-0.8× width of one eye. Antennae yellow to yellow-brown, top of last segment slightly darkened (fig. 50). Palpi yellow-brown to brown.

Pronotum: Yellow. Lateral borders convex in anterior third part, clear margins not wider than antennae, slightly narrowed anteriorly. Sparsely punctured, basally opposite each fifth elytral puncture-row one strong deep puncture together with two or three smaller punctures included in a dark mark, impression between these marks with few sometimes slightly darkened punctures.

Elytra: Yellow, usually small marks in second and fourth interval, dark suture narrowed towards base. Strong puncture-rows, basal punctures of row 1, 2, 3 and 5 widened and connected by a weak impression (fig. 52). Additional posterior puncture-row in second interval reaching about as far as the middle, additional posterior puncture-rows in seventh and ninth interval clearly present. Sutural stria in posterior half reaching the middle, along suture small sparse punctures.

Underside: Yellow, legs yellow, hind femura, coxae and tarsi of all legs yellow-brown to brown. Prosternal process narrowed near coxae, sharp halfcircular impression at posterior margin, strongly and coarsely punctured (fig. 53 and 54). Metasternal process grooved and with a pit in the middle, weakly and sparsely punctured (fig. 53). Metacoxal plates with a strong blunt tooth easily reaching last sternite, tooth in lateral view also strong and blunt, suture of coxal plates posteriorly only bending weakly towards body (fig. 55 and 56). Last sternite unpunctured. Epipleura with clear darkened punctures. Setiferous striole on dorsal face of hind tibia about 1/4× length of tibia, longest of two tibial spurs about 3/4× length of first tarsal segment. Male: Penis and parameres as in figs. 57-59. Surface of apical parts of parameres areolate (fig. 60).

Immature stages: Unknown

Distribution (fig. 98)

Only known from Beijing, China.

Peltodytes rotundatus (Aubé)

(figs. 61-73)

Cnemidotus rotundatus Aubé, 1836: 40. Syntypes: Southern France and Italy (probably in MNHN) [not examined].

Cnemidotus conifer Seidlitz, 1887: 35. Syntypes: Sicily. (probably in ZSMC) [not examined].

Cnemidotus rotundatus; Seidlitz 1887: 35.

Peltodytes rotundatus; Zimmermann 1920: 300, 1924: 8, Falkenström 1939: 2, Guignot 1947: 37, 1959: 23, Lagar Mascaro 1951: 76, Zaitsev 1953: 36, Freude 1971: 10, Franciscolo 1972: 63, 1979: 70, Ienistea 1974: 204, Angelini 1984: 48, Ferreras Romero 1987: 20, Leblanc 1990: 1.C.5.

Peltodytes conifer; Escalera 1914: 56, Zimmermann 1920: 299.

Peltodytes rotundatus var. *conifer*; Zimmermann 1924: 8, Guignot 1947: 37, 1959: 23.

Peltodytes rotundatus ssp. *conifer*; Zaitsev 1953: 37, Franciscolo 1979: 70, Guéorguiev 1981: 400, Angelini 1984: 48.

Remarks

Aubé's original description of *rotundatus*, in which the specific character of the sharp tooth on the metacoxal plate is mentioned, leaves no doubt about the identity of this species.

The species or subspecies or variety *conifer* differs from *rotundatus* in having weaker elytral punctures and a less interrupted fourth elytral puncture-row. These characters, however, are very variable and all kind of intermediate forms may be met with.

Description

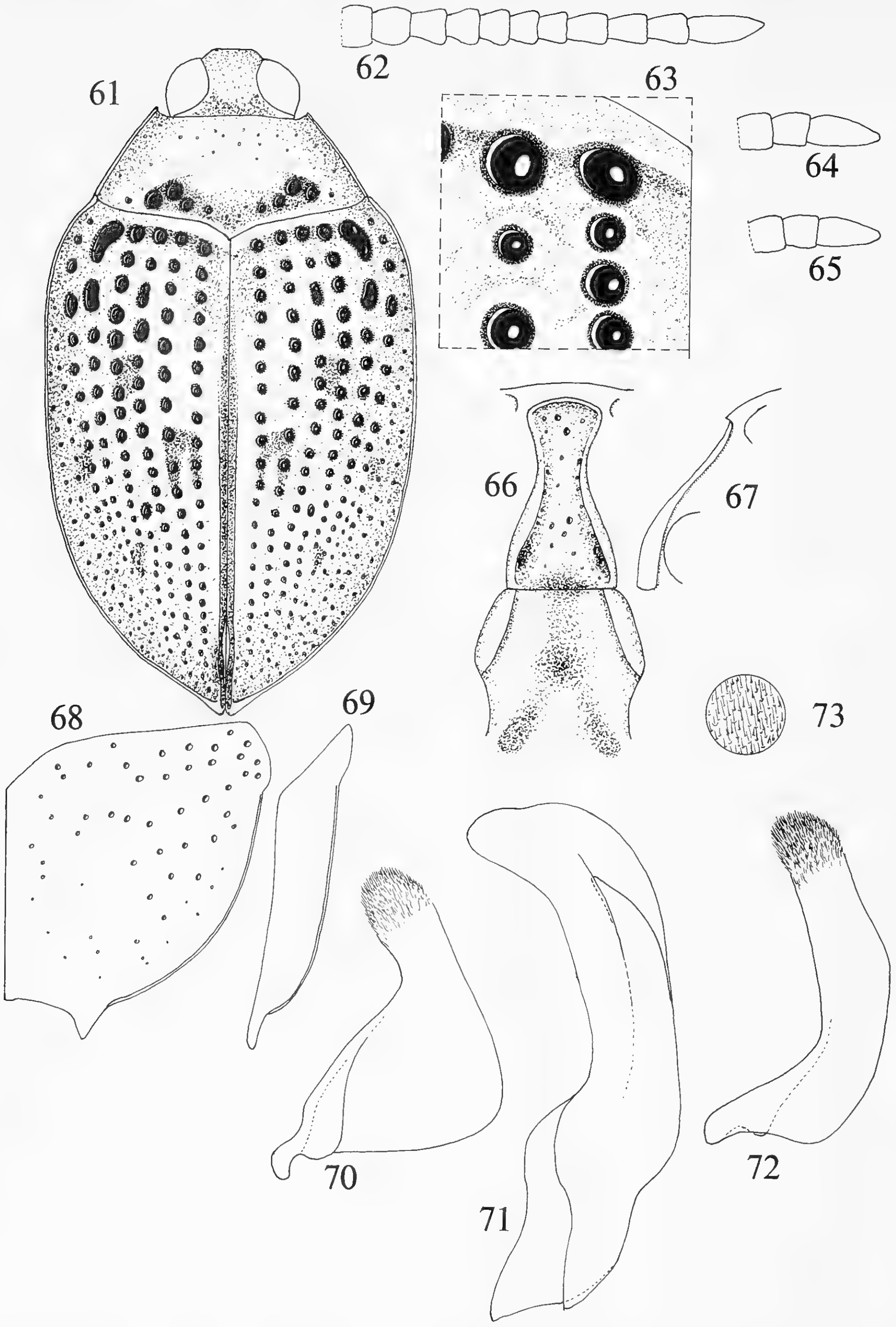
Length 3.3-3.9 mm, width 2.0-2.2 mm. Body wide, subparallel, widest in the middle (fig. 61).

Head: Yellow to yellow-brown, vertex slightly darkened. Moderately strongly punctured, on vertex with strong dense darkened punctures. Distance between eyes 0.7-1.1× width of one eye. Antennae yellow, first six segments wider than long (fig. 62). Palpi yellow to yellow-brown (fig. 64 and 65).

Pronotum: Yellow to yellow-red. Along base a row of darkened punctures, of which the ones opposite fifth elytral puncture-row are widened, base between these widened punctures strongly impressed. Lateral and anterior part with sparse uncoloured punctures. Lateral margins slightly concave to slightly convex, not wider than antennae.

Elytra: Yellow with or without vague marks on intervals, narrowly darkened suture faded towards base, sutural striae on about posterior half. Completely margined, margin apically abruptly bent. Puncture-rows weak to very strong, 24-28 punctures in first row. Posteriorly between first and second row usually no punctures, but occasionally some punctures present, remains of additional rows on posterior part of seventh and ninth interval present. Fourth row widely interrupted, anterior part varying from 0-4 punctures. Widened basal punctures in a clear transverse impression (fig. 63). All punctures darkened.

Underside: Yellow to yellow-red, legs yellow to yellow-red, coxae brown, elytral epipleura yellow with darkened or uncoloured punctures. Prosternal process narrowed near coxae, posteriorly impressed, laterally with plicae formed by coarse punctures, anterior side clearly margined, usually strongly punctured



Figs. 61-73. *Peltodytes rotundatus*, Portugal: Algarve. – 61, dorsal view; 62, antenna; 63, punctures near elytral base and suture; 64, maxillair palpus; 65, labial palpus; 66, prosternal process; 67, lateral view of prosternal process; 68, metacoxal plate; 69, lateral view of metacoxal plate; 70, left paramere; 71, penis; 72, right paramere; 73, surface of apical part of parameres.

(fig. 66 and 67). Metasternal process with strong impression in the middle, weakly punctured, plicae along coxae (fig. 66). Metacoxal plates with long sharp tooth, reaching last sternite, moderately strongly punctured, near suture weakly punctured (fig. 68, 69). Last sternite unpunctured, apex with micropunctuation. Setiferous striole on dorsal face of hind tibia 1/4× length of first tarsal segment.

Males: Penis and parameres as in figs. 70-72. Surface of apical part of parameres hairy (fig. 73).

Immature stages: Third stage larvae described by Bertrand (1951: 76)

Biology

Living between filamentous algae in lakes, pools, ponds, rivers, marshes, brooks, streamlets. Among vegetation of *Utricularia*, *Nuphar* and other waterplants. Attracted to light.

Distribution (fig. 97)

Mediterranean area: Portugal, Spain including the Baleares, France including Corsica, Italy including Sardinia, Jugoslavia, Albania, Greece including Crete, Morocco. Escherich (1897) gives Turkey.

Material examined. – Albania: 3 ex., Elbasan, 10+15.ix.1918, Priesner (NHMV) • France: 1 ex., Castelnau-le-Lez; 1 ex., Toulouse; 1 ex., Biaritz; 1 ex., Chatellerault; 4 ex., Carcassonne; 3 ex., Pau; 1 ex., Gers; 1 ex., Ripaud, Aude, 12.vii.1973, Davidson, at light; 2 ex., Narbonne, Etang de Leucate, 5.viii.1956, Eckerlein; 2 ex., Bruges, Pyr. Atl., 27.vii.1990; 11 ex., Corsica, Porto, 8.vi.1976, stream in alder-marsh nr sea, van Nieukerken; 3 ex., Corsica, Ghisonaccia, Fium Orbo River, 23.vi.1976, van Nieukerken; 8 ex., Corsica, Miomo, 5km N. of Bastia, 24.vi.1976, van Nieukerken; 2 ex., Lyon; 1 ex., Lac d'Hourtin, Medoc, 28.ix.1973, Jongema; 1 ex., Near Uzès, Gard, 11.vii.1987, Schilthuizen; 16 ex., from unknown locality (BMNH, NHMV, RMNH, ZMAN, Jongema, Schilthuizen, Vondel) • Greece: 5 ex., Attika; 1 ex., Kreta [Kriti], Kroeses, 14.iv.1933; 1 ex., Morea, Parnon Mt.; 1 ex., Athinai; 33 ex., Lakonia, 5 km SE Sparti, 27.ix.1962; 4 ex., Ilia, Olympia, 2-3.x.1962; 18 ex., Corfu [Kérkira], Sindari, brook, 15.vii.1972, Berge Henegouwen (NHMV, RMNH, ZMAN, Berge Henegouwen) • Italy: 4 ex., Sardinia, Nuoro, R. d'Oliena nr. St. Giovanni, 24.viii.1987, Berge Henegouwen; 2 ex., Sardinia, Muravera, 24.v-20.vi.1965, Budberg; 2 ex., Pieris, Friaul, Müller; 7 ex., Riva, Tirol; 1 ex., Genova; 1 ex., Lucania face F. Basento, 22.iv.1970, Angelini; 2 ex., from unknown locality (NHMV, RMNH, Berge Henegouwen) • Jugoslavia: 1 ex., Hercegovina, Dracevo, v.1911; 4 ex., Castelnuovo [Herzeg Novi], Dalmatia (NHMV) • Morocco: 1 ex., Defilia, nr. Figuig, 5-20.iv.1966(BMNH); 1 ex., Tiznit, 27.vii.1959, Eckerlein (NHMV); 1 ex., Haute Atlas, Tamanar, 100 km N. of Agadir, 25.iv.1961, Dorgelo (ZMAN) • Portugal: 1 ex., betw. Setubal and Marateca, 18.ix.1976, Berge Henegouwen;1 ex., betw. Palma and Marateca, 13.vii.1973, stagnant ditch with *Utricularia* and *Nuphar*, muddy water, Berge Henegouwen; 1 ex., Palma, Rio San Martinho, 18.ix.1976, Berge Henegouwen; 1 ex., Alentejo, Rio Mira, nr. S. Ana da Serva, 21.ix.1976, Berge Henegouwen; 5 ex., Algarve, 10 km S. Sao Marcos da Serva, 21.ix.1976, Berge Hennegouwen; 7 ex., Alentejo, 15 km N. Santa Clara a Velho, 18.ix.1976, Berge Henegouwen; 3 ex., Veiros, Riba d'Ana Laura, 25.ix.1976, Berge Henegouwen; 7 ex., Algarve, Guerenca, Riba, Algibre, 16.iv.1981, Berge Henegouwen; 1 ex., Evora, 19.viii.1967; 1 ex., Evora, 4 km N. Arraiolos, 3.v.1986, Kanaar; 6 ex., Evora, streamlet of Quintel, Pera Manca, 19.-viii.1967, Nieser; 7 ex., Algarve, Quanteira, 24-29.xii.1967, Nieser; 4 ex., Algarve, nr. Estof, 19.vii.1971, Nieser; 3 ex., Rio Antua, S. Estaroja, 22.iv.1976, Nieser (RMNH, ZMAN, Berge Henegouwen, Kanaar, Nieser) • Spain: 4 ex., Cost Brava, vi.1966 & vi.1967, Budberg; 1 ex., Llambillas, Gerona, 4-5.viii.1956, Eckerlein; 7 ex., Posadas, 18-19.iv.1925; 3 ex., Pollensa, Mallorca; 14 ex., Albufeira, Mallorca (partly 15.vi.1913); 1 ex., Valencia; 1 ex., Palencia; 2 ex., Abadia, prov. Caceres, alt. 700 m., 5.v.1960; 1 ex., nr. Rosal de la Frontera, Rio Chanca, stagnant pools in dry river course, vii.1973, Berge Henegouwen; 2 ex., Caceres, Puerto Roque, Rivera David, 26.ix.1976; 1 ex., Baleares, Pont de Giretto, S. Soller, 6.v.1983, Stock; 1 ex., Pyrenes, San Jaume de Llierca, riv. Fluvia, 12.viii.1987, Vallenduuk (NHMV, RMNH, ZMAN, Vallenduuk) • Unknown country: 9 ex. (NHMV, RMNH).

Peltodytes sinensis (Hope)
(figs. 74 -84)

Haliplus sinensis Hope, 1845: 15. Lectotype ♀ (here designated), [China, Canton] Dr. Cantor Penang, Type, 60.15, E.I.C., *Sinensis.* Hope (BMNH) [examined]

Haliplus variabilis Clark, 1863: 417. Lectotype ♂ (here designated), China, 2056, 6756, Cotype, *Peltodytes variabilis* Clk (=*sinensis* Hope) (BMNH) [examined].

Peltodytes koreanus Takizawa, 1931: 138. Syntypes: Korea: 18 ex., Suigen, 5-15.vii.1922, T. Uchida & S. Takano; 1 ex., Eitoho, 13.vi.1923, Yuuki. (not located) [not examined].

Peltodytes sinensis; Régimbart 1899: 192, Peschet 1923: 179, Zimmermann 1920: 300, 1924: 7, Takizawa 1931: 139, Wu 1932: 341, Gschwendtner 1934: 107, Falkenström 1936a: 2, 1936b: 79, Zaitsev 1953: 36, Satô 1960: 252, 1963b: 24, 1984: 3, Cho 1969: 165, Nakane 1987: 27, Yoon 1988: 620.

Peltodytes variabilis; Zimmermann 1920: 300, 1924: 7, Satô 1963b: 24.

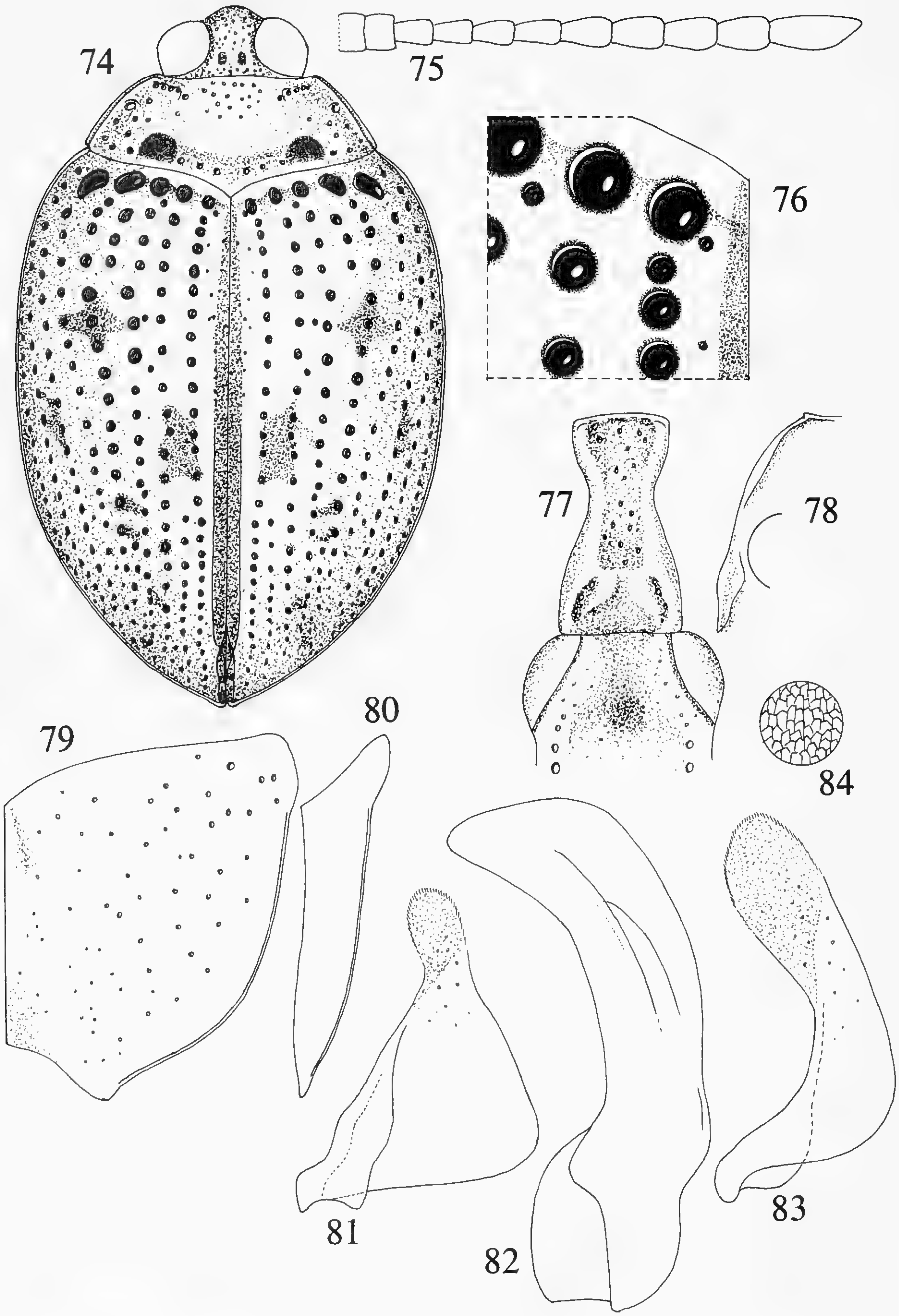
Peltodytes koreanus; Satô 1963b: 24 (synonimised with *P. sinensis*), Yoon 1988: 620.

Description

Length 3.4-3.8 mm, width 1.9-2.2 mm. Body oval, subparallel, widest in the middle (fig. 74).

Head: Yellow-brown to brown, two dark marks between eyes, usually vaguely darkened behind eyes. Moderately strongly punctured. Distance between eyes 0.6-0.7× width of one eye. Antennae (fig. 75) and palpi yellow to yellow-brown.

Pronotum: Yellow to yellow-red, dark marks opposite fifth elytral puncture-rows, containing 2-4 widened strongly impressed punctures, between basal marks impressed and with a few, sometimes darkened punctures. In hind corners 2-5 darkened punctures, else with uncoloured punctures, in front corners with



Figs. 74-84. *Peltodytes sinensis*, 74-80, holotype, 81-84, Korea.-74, dorsal view; 75, antenna; 76, punctures near elytral base and suture; 77, prosternal process; 78, lateral view of prosternal process; 79, metacoxal plate; 80, lateral view of metacoxal plate; 81, left paramere; 82, penis; 83, right paramere; 84, surface of apical part of parameres.

coarse punctures. Lateral margin not clearly wider than antennae, narrowed anteriorly.

Elytra: Yellow to yellow-red, darkened suture, four sometimes vague marks on each elytron, discal mark separated from suture, sometimes a slight narrow darkening along central part of base. Posterior part slightly bulbous, apical margin at most slightly concave. Margined completely. Punctures moderately strong and all darkened. Additional posterior row on second interval with 10-12 punctures. Fourth puncture-row widely interrupted, about 3-5 punctures anteriorly and 1 or 2 posteriorly. Short additional posterior puncture-rows in seventh and ninth intervals. Basal punctures of especially fifth and sixth row widened, connected by a transverse impression (fig. 76). Stria along posterior half of suture, in anterior half a few small darkened punctures.

Underside: Yellow to yellow-red, legs yellow to yellow-brown, metafemur, metatarsi and all coxae darkened. Elytral epipleura yellow with darkened punctures, reaching to halfway last sternite. Prosternal process narrowed near coxae, anteriorly and in posterior part impressed, posteriorly with lateral striae, strongly and sometimes coarsely punctured (fig. 77 and 78). Metasternal process with deep pit in the middle, hardly punctured, clear striae along coxae (fig. 77). Metacoxal plates with a dull tooth, reaching last sternite, strongly punctured except in weakly punctured sutural area (fig. 79 and 80). Last sternite unpunctured, impressed near front corners. Setiferous striole on dorsal face of hind tibia about 1/5× length of tibia, longest of two tibial spurs 3/4× length of first tarsal segment.

Male: Penis and parameres as in figs. 81-83. Surface of apical part of parameres areolate (fig. 84).

Immature stages: The third-stage larva is figured by Yoon (1988).

Biology

In stagnant water, in rivers. Up to an altitude of 2100 m.

Distribution (fig. 100)

China, provinces Beijing, Fujian, Guangdong, Henan, Hunan, Hupeh, Jiangsu, Jiangxi, Shanghai, Sichuan, Yunnan, Zhejiang. Korea. Japan, Ryukyu Islands. Vietnam. Taiwan. Philippines.

Material examined. – China: lectotype ♀ of *Haliplus sinensis*; lectotype of *Haliplus variabilis*; 2 paralectotypes of *Haliplus variabilis*, same labels as lectotype; 1 ex., Kwantung, Tai-ping, Lo-ting [Luoding, Guangdong], 6.vii.1932, W. E. Hoffman; 1 ex., Kwantung [Guangdong], Yim-na, Shan [?], 1200 m., 15.vi.1936, L. Gressitt; 1 ex., Yunnan, Western Hills nr. Kunming, 2100 m., 7.vii.1940, J. L. Gressitt; 1 ex., Hunan, Li, Tsinshih, T.C. Maa, 29.v.1937 (BPBM); 1 ex., Tali [Dali], Haut Yunnan; 1 ex., Nanking [Nanjing], v.1928, J.G. Needham; 3 ex., Yunnan Fou [Kunming], H. Perrot; 5 ex., Ning-po [Ningbo, Zhejiang], vii.1937 (ISNB); 4 ex., Foochow [Fuzhou, Fujian], vi.1935 & 1937-1938, M. S. Yang; 8 ex., Chusan Isl. [Zhoushan], J. J. Walker; 2 ex., Honan, Loyang [Henan, Luoyang], 6.viii.1966, P.M. Hammond (BMNH); 3 ex., Shanghai (ZMUC); 3 ex., Yunnan-Sen, 1898, Excoffier; 1 ex., Kouy Tchéou [?], 1910, P.Cavaleria; 2 ex., Shanghai; 1 ex., Dohnu [?] (MNHN); 10 ex., Yunnan-Sen; 14 ex., Tschekiang, Ning-po [Zhejiang, Ningbo]; 2 ex., Canton [Guangzhou, Guangdong], Nordfluss, v.1909, Mell (ZMHB); 2 ex., Shanghai (RMNH) • Taiwan: 1 ex., Puli (Mori), vi.1954, native collector; 35 ex., Taihoku, 4.iv+6.v+22.v.1928, F. C. Hadden (BPBM); 2 ex., Taipe City, 16.viii.191, C. F. Lee (NHMV); 1 ex., Takau, Sauter (ISNB); 35 ex., Anping, iv.1910, Sauter (ZMHB) • Korea: 7ex., Kyongki-do, Ichon-kun, Solsong-pond, 19.viii.1989; 6 ex., Chungpuk-do, Chongwon-kun, Doldari (stone-bridge)-pond, 17.viii.1989; 1 ex., Chungpuk-do, Sintanjin-city, 21.vii.1987; 2 ex., Chonnam-do, Yongam-kun, Kumho-pond, 22.vii.1988; 2 ex., Kyongki-do, Kwangju-kun, Chungang-pond, 20.viii.1989; 3 ex., Chonnam-do, Yongam-kun, Taegan-pond, 22.vii.1988; 3 ex., Chonnam-do, Imsil-kun, Samgye-ri, 14.viii.1989 (Vondel, ex. coll. Sung Hwa Lee); 1 ex., Hede Quelpaert [?], 1908 (MNHN) • Japan (Ryukyu-Islands): 3 ex., Dana, Iheya Is., Okinawa Pref., 20.viii.1989, leg. E. Matsui (Vondel).-Philippines: 5 ex., N. Luzon, Prov. Ifugao, Banaue, 22.vi.1988, K. Martin (NHMV) • Without locality: 1 ex., Boyer 800 (NHMV).

Peltodytes sumatrensis Régimbart
(figs. 85-95)

Peltodytes sumatrensis Régimbart, 1885: 55. Holotype ♀: 'Ed. Everts, (W. Dates), Medan, Deli, Sumatra; *Peltodytes sumatrensis* Régb., *type*; Type; Museum Leiden, *Peltodytes sumatrensis* Rég.' (RMNH) [examined].

Peltodytes sumatrensis; Peschet 1923: 179, Zimmermann 1920: 300, 1924: 9, 1927: 1.

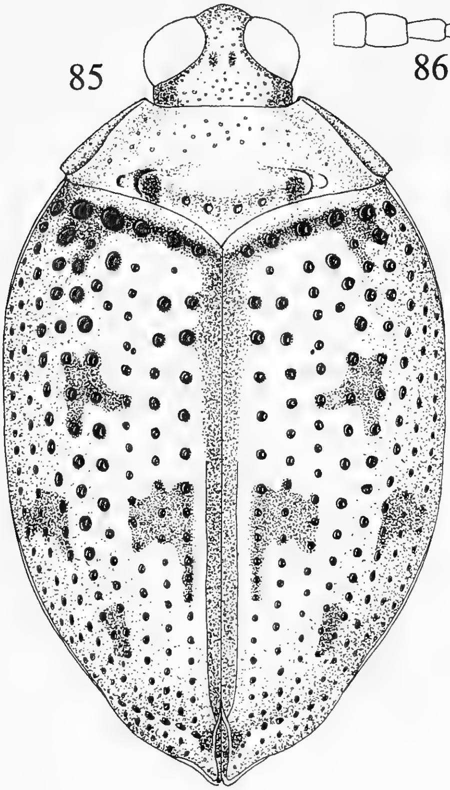
Description

Length 3.4-3.7 mm (in original description eronously given as 4.75 mm), width 1.9-2.1 mm. Body subparallel, widest in the middle (fig. 85).

Head: Yellow to yellow-brown, behind eyes, on posterior part of vertex, round eyes and on clypeus darkened, between eyes two small spots. Sparsely punctured. Distance between eyes 0.5-0.6× width of one eye. Antennae yellow to yellow-brown (fig. 86). Palpi yellow to brown.

Pronotum: Yellow, basal dark marks opposite fifth elytral puncture-row. Lateral borders slightly convex, very strong margins narrowed anteriorly. Hind corners clearly protruding. Strongly and coarsely punctured along margins, opposite third to fifth elytral puncture-row a group of two or three very large punctures, between these groups some smaller punctures in a slight impression. Except in the two basal marks all punctures colourless. Anteriorly moderately strongly punctured.

Elytra: Yellow to yellow-brown, darkened along su-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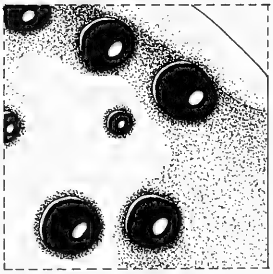
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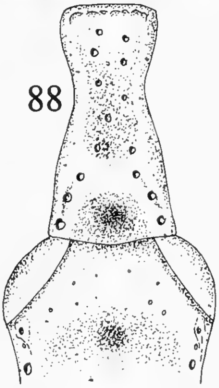
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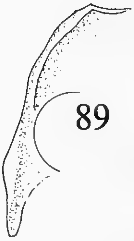
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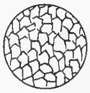
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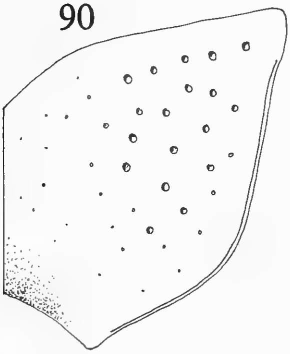
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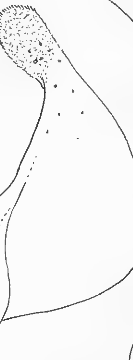
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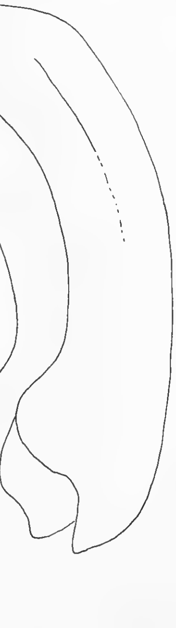
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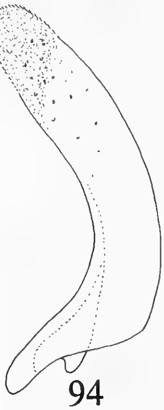
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ture, along base as far as sixth punture-row (fig. 85, 87), mark on disc and three other marks on about fifth and seventh interval. Apical part bulbous, margin near apex concave. Completely margined. Strong puncture-rows, first three rows generally weaker than following three rows, fourth puncture-row only recognizable by a few punctures in basal part. Between first and second row about five punctures in apical part. All punctures darkened. Sutural stria in posterior half.

Underside: Yellow to yellow-brown, legs yellow, hind femora, coxae, knees and tarsi yellow-brown to brown. Prosternal process narrowed near coxae, deep half circular impression at posterior margin, clearly impressed in anterior 3/4, sparsely punctured (fig. 88, 89). Metasternal process strongly impressed behind the almost flat anterior part, clear striae along mesocoxae, weakly and sparsely punctured (fig.88). Metacoxal plates with a weakly developed blunt tooth reaching last sternite, in lateral view also blunt, strongly punctured except near middle- and anterior suture (fig. 90, 91). Last sternite impressed on both sides, unpunctured. Epipleura reaching to halfway last sternite, with darkened punctures in anterior half. Setiferous striole on dorsal face of hind tibia about 1/4× length of tibia, longest of two tibial spurs about 3/4× length of first tarsal segment.

Male: Penis and parameres as in figs. 92-94. Surface of apical part of parameres areolate (fig. 95).

Immature-stages: Unknown

Biology

In stagnant water.

Distribution (fig. 101)

Indonesia, Sumatra; Thailand. Zimmermann (1924) gives Celebes (Indonesia, Sulawesi).

Material examined. – Indonesia: Holotype ♀ (RMNH); 22 ex., Sumatra, East coast, Medan, dated: 1904, 1906, vii.1920, 29.ix.1921, x.1921 (RMNH, ZMAN); 2 ex., Sumatra, Deli (ZMAN); 2 ex., Sumatra, det Régimbart 1885, *Peltodytes sumatrensis* Rég. Type [does not belong to a syntype-series as there is only the holotype] (ISNB); 1 ex., Sumatra, Samosir Isl., 2°28'N 98°49'E, Tuk-Tuk, L.Toba, 2800 ft. 4.iii.1978, M. Holmen, 13 (ZMUC); 1 ex., East coast Sumatra, Perbaoengan; 1 ex., Sumatra, Medan, Bindjai; 1 ex., Bandar, Sumatra, 23.ix.1919 (RMNH); 2 ex., N. Sumatra, Tigibinanga, West of Kabanjahe, 21.ii.1990 (16), leg. Schödl (NHMV) • Thailand: 1 ex., Bangkok, Siam, *Cnemidotus sumatrensis* Rég. R. I. Sc. N. B., coll. v. Dorsselaer, L.G.25622, *Peltodytes sumatrensis* var.?, det. B. J. v. Vondel 1989 (ISNB); 1 ex., NW-Thailand, Chiangmai Prov., Chiangdao [Ban Chiang Dao], 450 m., 5.xi.1958, in standing stagnant water (BPBM).

ACKNOWLEDGEMENTS

I wish to express my sincere thanks to the following persons for placing material or information at my disposal: L. Baert (Brussels, ISNB), A. L. van Berge Henegouwen (The Hague, MOG), M. J. D. Brendell (London, BMNH), B. Brugge (Amsterdam, ZMAN), J. G. M. Cuppen (Ede), K. Desender (Brussels, ISNB), M. B. P. Drost (Wadenoijen), H. Duffels (Amsterdam, ZMAN), Th. G. Giessen (Gaanderen), F. Gusenleitner (Linz, OLML), M. Hansen (Copenhagen, ZMUC), F. Hieke (Berlin, ZMHB), M. Hielkema (Gouda), S. J. Hine (London, BMNH), M. Holmen (Copenhagen, ZMUC), J. Huijbregts (Leiden, RMNH), M. Jäch (Vienna, NHMV), Y. Jongema (Wageningen), P. Kanaar (Leiderdorp); J. Krikken (Leiden, RMNH), P. Leblanc (Piney), Sung Hwa Lee (Taegu), E. Matsui (Hondo City), T. Nakane (Chiba), N. Nieser (Tiel), R. Ortal (Jerusalem, HUJI), H. Perrin (Paris, MNHN), G. A. Samuelson (Honolulu, BPBM), J. C. P. M. v.d. Sande (Nijmegen), G. Scherer (Munich, ZSMC), M. Schilthuizen (Leiden); M. Schreijer (Alkmaar), H. Vallenduuk (Boxtel). The Uyttenbogaart-Eliasen Foundation is acknowledged for financial support.

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Figs. 85-95. *Peltodytes sumatrensis*, 85-91, holotype, 92-95, Medan. – 85, dorsal view; 86, antenna; 87, punctures near elytral base and suture; 88, prosternal process; 89, lateral view of prosternal process; 90, metacoxal plate; 91, lateral view of metacoxal plate; 92, left paramere; 93, penis; 94, right paramere; 95, surface of apical part of parameres.

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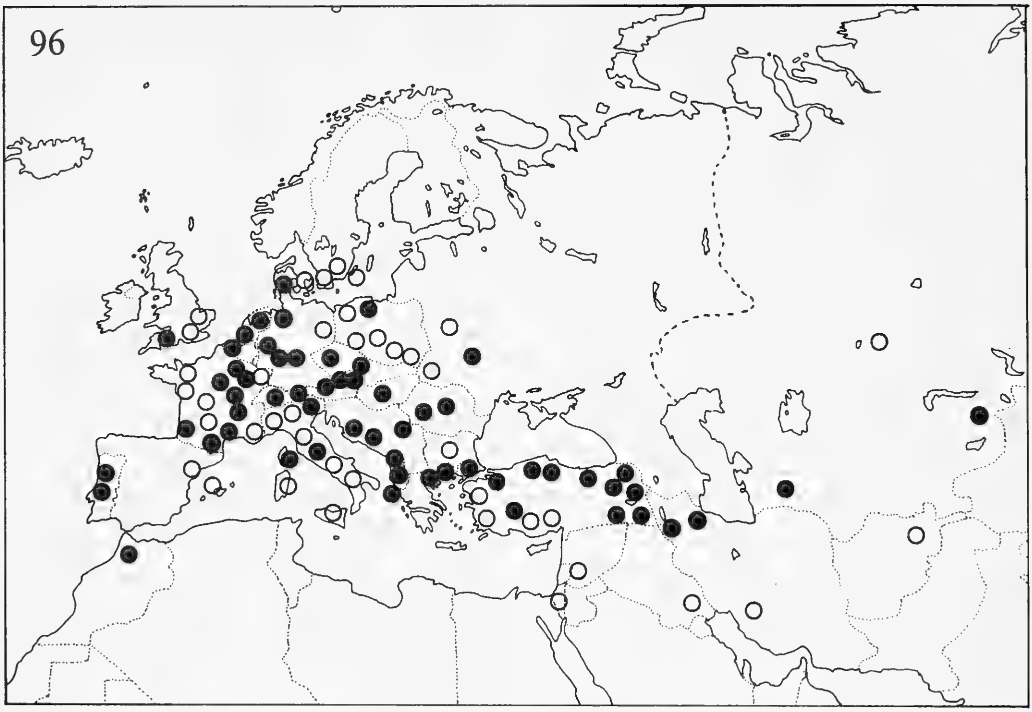

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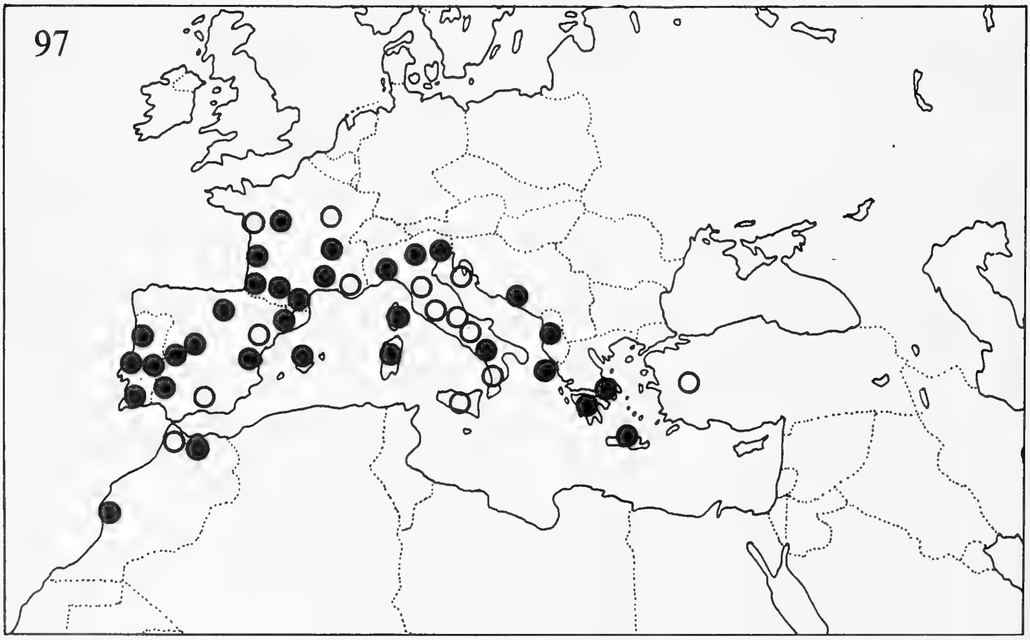

Fig. 96. Distribution of *Peltodytes caesus* (dots: examined; circles: literature records)
Fig. 97. Distribution of *Peltodytes rotundatus* (dots: examined; circles: literature records)

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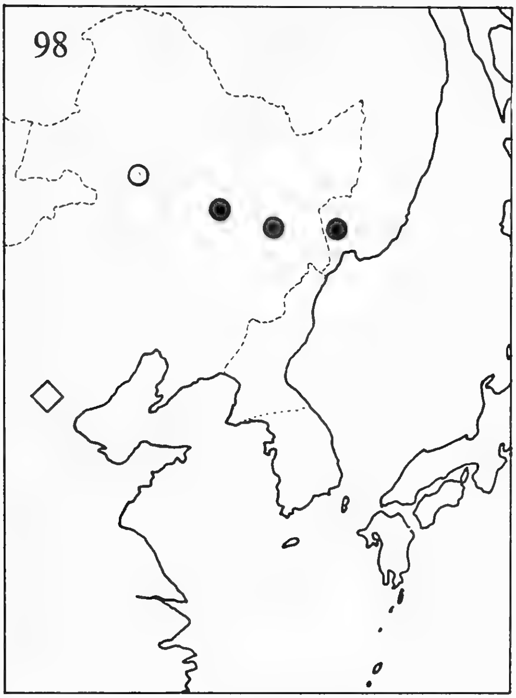

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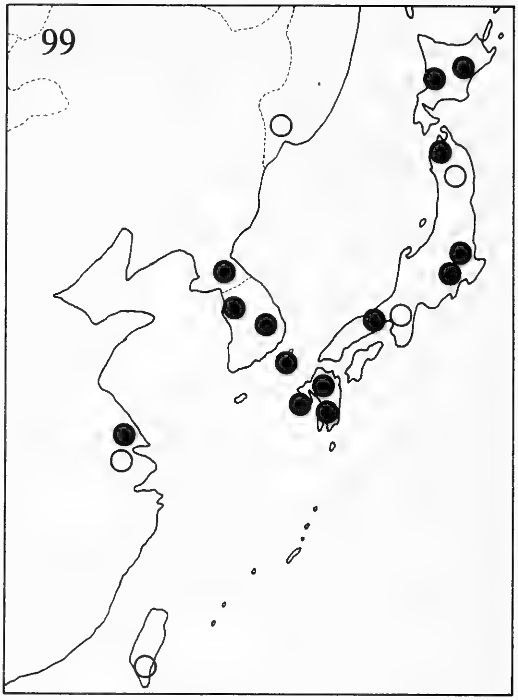

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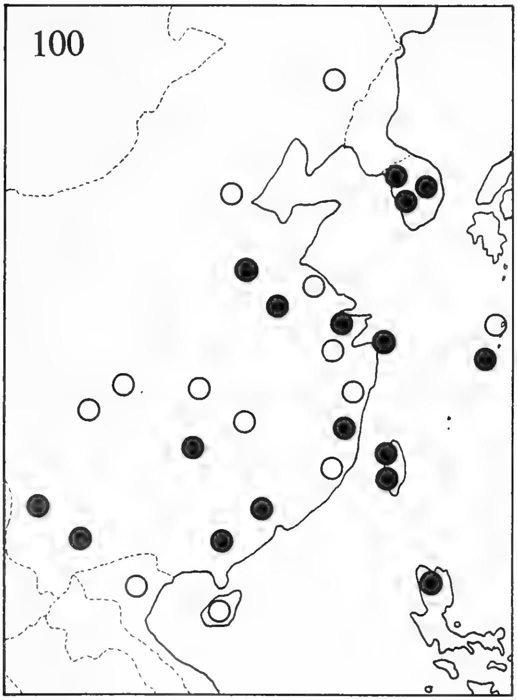

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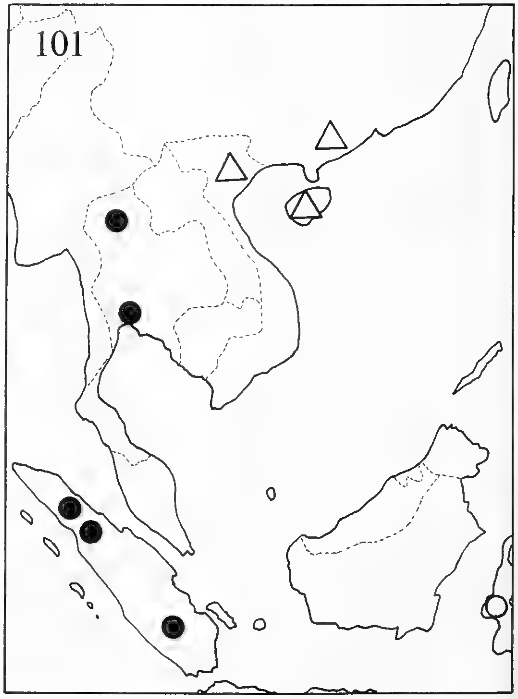

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Fig. 98. Distribution of *Peltodytes dauricus* (dots: examined; circle: literature record) and *Peltodytes pekinensis* (square)
Fig. 99. Distribution of *Peltodytes intermedius* (dots: examined; circles: literature records)
Fig. 100. Distribution of *Peltodytes sinensis* (dots: examined; circles: literature records)
Fig. 101. Distribution of *Peltodytes sumatrensis* (dots: examined; circle: literature record) and *Peltodytes coomani* (triangles)

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NOTES ON SYSTEMATICS OF GREEK SPECIES OF *POECILIMON* FISCHER, 1853 (ORTHOPTERA: PHANEROPTERINAE)

Willemse, F. & K.-G. Heller, 1992. Notes on systematics of Greek species of *Poecilimon* Fischer, 1853 (Orthoptera: Phaneropterinae). – Tijdschrift voor Entomologie 135: 299-315, figs. 1-43. [ISSN 0040-7496]. Published 1 December 1992.

New data on the systematics of Greek species of *Poecilimon* Fischer, 1853 are presented. Three new species are described: *P. gracilioides* (from Ipiros), *P. mariannae* (from Thessalia) and *P. erimanthos* (from the Peloponnisos). *P. artedentatus* Heller, *P. veluchianus* Ramme and *P. zimmeri* Ramme are given species rank. *P. mytilenensis* Werner is redescribed and additional descriptive notes are provided for *P. soulion* L. Willemse, *P. aegaeus* Werner and *P. athos* Tilmans et al. New data on bioacoustics, ecology and faunistics for some species are recorded as well. An updated check list of Greek species is included.

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Key words. – Orthoptera, Phaneropterinae, *Poecilimon*, taxonomy, bioacoustics, Greece.

The genus of *Poecilimon* Fischer, 1853 includes over one hundred species, spread over southeast Europe and adjacent Asia. All are short winged, usually green coloured, living in forests, shrubby vegetation or open habitats from sea-level to above the timberline. Some species are widespread, but most have restricted and some even remarkably small ranges. Systematics of *Poecilimon* are difficult due to the large number of closely similar species. Up to 1984 systematic studies were based entirely on morphology (Ramme 1933, Bey-Bienko 1954, Harz 1969, Willemse 1982, 1984).

As in most bush-crickets, males of *Poecilimon* produce calling songs which, in presenting an excellent means of recognizing, provide the basis for a mate selection system. Heller (1984) was the first to present results of an elaborate study on song and morphology of stridulatory file in *Poecilimon.*

Both constitute helpful distinctive characters (e. g. file in *P. ornatus/affinis*, song in *chopardi/veluchianus*). Using these two characters Heller (1984) concluded that a number of previously recognized species or groups of species are allied either markedly more or less than formerly presumed. As a result a number of taxonomic adjustments, mainly synonymic, were proposed. Renewed studies (Willemse 1985a, Heller 1988, 1990) of some of the species-groups, including morphological characters and based on more material, proved that some of these taxonomic readjustments were premature. The present paper is a further contribution towards the systematics of *Poecilimon,* partly based on bioacoustics, with the description of three new species. As far as the systematics of Greek species of *Poecilimon* concern the three main problems remaining are the taxonomic ranking of the species groups of *elegans - brunneri - macedonicus, jonicus - tessellatus - superbus, ampliatus - ebneri - klisuriensis* and the heterogeneous *affinis* complex. Besides new species can still be expected especially in the comparatively less well explored Aegean islands.

A side effect of recent research is a considerable amount of new faunistic data since its account in Willemse (1984, 1985a). Some new information may be found in Ingrisch & Pavicevic (1985) (e. g. *P. schmidti*), Ponel & Hebrard (1988), Heller (1988) and in this paper. But there is considerably more and the senior author is preparing a communication on important new faunistic data of Greek Orthoptera including also *Poecilimon.* For convenience an updated checklist of Greek *Poecilimon* taxa is included.

Material and methods

Depositories and abbreviations. – British Museum (Natural History), London (BMNH); Collection Heller, Universität Erlangen (CH); Collection A. Nadig, Chur (CN); Collection J. Szijj, Universität Essen (CS); Collection J. Tilmans, Warmond (CT); Collection Willemse, Eygelshoven (CW); Instituut voor Taxonomische Zoölogie, Amsterdam (ITZA);

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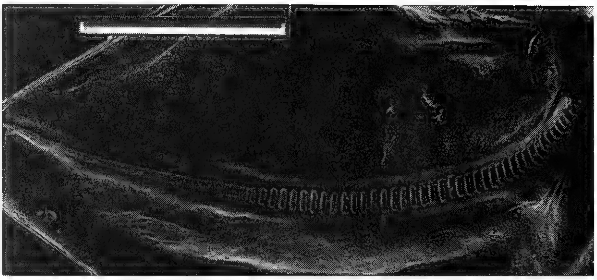

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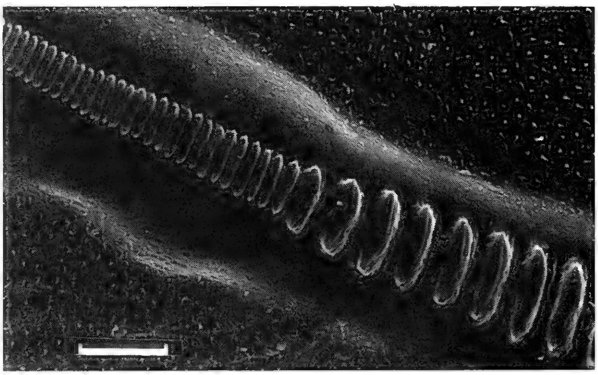

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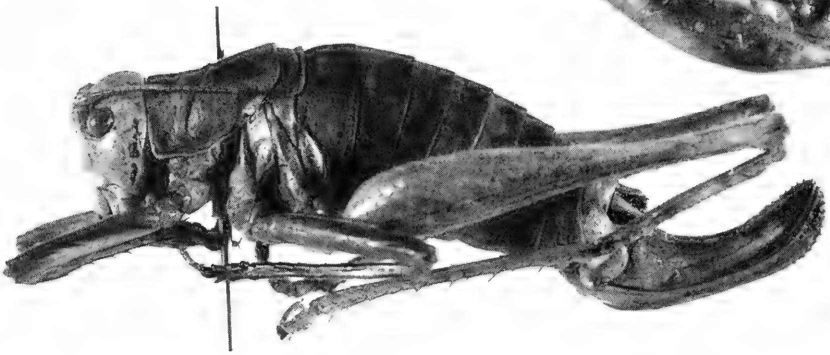

Figs. 1-5. *Poecilimon gracilioides*. - 1, ♂, dorsal view (holotype); 2, ♀, lateral view (allotype); 3, stridulatory file of left elytron ♂ (paratype), ventral view, distal end to the left (scale 1 mm); 4, idem, detail of mid to distal third (scale 100 μm); 5, base of ovipositor, lateral view (paratype).

Naturhistorisches Museum, Vienna (NHMV).

Song recording and analysis. – For recordings of the song the following equipment has been used: Uher 4200 Report Monitor with AKG D 202 E microphone with low frequencies off (after modification) (*P. gracilioides*); Uher 4200 IC with Uher M 645 microphone (recordings of other species). To improve quality recordings were made indoors. Oscillograms were made by using a personal computer and the program TURBOLAB (Stemmer AG). Wing movements were registrated by an opto-electronic device (Heller 1988). Full data of the recordings can be obtained from the authors. Stridulatory files were studied with a light microscope and a Scanning Electron Microscope (SEM) (Institut für Zoologie I, Universität Erlangen). A batdetector (QMC-mini) was used in the field to locate males as indicated in the text.

Song terminology. – Calling song: the song produced by an isolated male. Impulse: the sound produced by the contact of one file tooth with the scraper (= plectrum). Syllable: the sound produced by one complete up (opening) and down (closing)stroke of the fore wing. Hemisyllable: the sound produced by one unidirectional movement (opening or closing) of the fore wings. Echeme: a first-order assemblage of syllables. Echeme-sequence: a first order assemblage of echemes.

Presentation. – In the checklist species are presented in alphabetical order but the sequence of the species in the present study follows a preliminary arrangement of relationships based on the song pattern (Heller 1990). References listed under the species are not always complete, full bibliography up to 1985 may be found in Willemse (1982, 1984, 1985a). Material listed is new and does not include previously recorded specimens except for the type material of *P. aegaeus*. Measurements are given in mm and concern the length. Transliteration of Greek orthography in Roman characters agrees with the system proposed by the Permanent Committee on Geographical Names for British Official Use, London.

TAXONOMIC PART

Updated checklist of Greek *Poecilimon*

Those headed in this paper are provided with an asterisk in the list; names between brackets indicate places in the present paper where comparative notes are made.

**aegaeus* Werner, 1932
affinis (Frivaldsky, 1867)
anatolicus Ramme, 1933
artedentatus* Heller, 1984 **stat. n.
**athos* Tilmans e.a., 1989
brunneri (Frivaldsky, 1867)
chopardi Ramme, 1933 (in *mariannae* & *veluchianus*)
cretensis Werner, 1903
ebneri Ramme, 1933
erimanthos* **sp. n.
deplanatus Brunner von Wattenwyl, 1891
gracilioides* **sp. n. (also in *veluchianus*)
gracilis (Fieber, 1853) (in *gracilioides*)
hamatus Brunner von Wattenwyl, 1878
hoelzeli Harz, 1966 (in *veluchianus*)
ikariensis F. Willemse, 1982
jonicus jonicus (Fieber, 1853) (in *erimanthos*)
jonicus lobulatus F. Willemse, 1982 (in *erimanthos*, *gracilioides*, *veluchianus* & *werneri*)
jonicus tessellatus (Fischer, 1853) (in *erimanthos*)
klisuriensis F. Willemse, 1982
laevissimus (Fischer, 1853) (in *erimanthos*)
macedonicus Ramme, 1926
mariannae* **sp.n. (also in *propinquus* & *veluchianus*)
miramae Ramme, 1933
**mytilenensis* Werner, 1932
nobilis Brunner von Wattenwyl, 1878 (in *erimanthos*)
obesus Brunner von Wattenwyl, 1878 (in *artedentatus*)
orbelicus Pancic, 1883
ornatus (Schmidt, 1849) (in *gracilioides* & *veluchianus*)
paros Heller & Reinhold, 1992
pergamicus Brunner von Wattenwyl, 1891
pindos F. Willemse, 1982
**propinquus* Brunner von Wattenwyl, 1878 (also in *mariannae* & *veluchianus*)
sanctipauli Brunner von Wattenwyl, 1878
  schmidti (Fieber, 1853)
**soulion* L. Willemse, 1987 (also in *gracilioides*)
syriacus Brunner von Wattenwyl, 1891
thessalicus Brunner von Wattenwyl, 1891 (in *veluchianus*)
thoracicus (Fieber, 1853)
**veluchianus* Ramme, 1933 (also in *gracilioides*, *mariannae* & *propinquus*)
**werneri* Ramme, 1933 (also in *erimanthos*)
zimmeri Ramme, 1933 (in *erimanthos*, *gracilioides*, *mariannae* & *veluchianus*)
zwicki Ramme, 1939

Poecilimon artedentatus Heller stat. n.

Poecilimon obesus artedentatus Heller, 1984: 78; Willemse 1985a: 16; 1985b: 39; Heller 1988: 47; 1990: 140.
Poecilimon obesus; Werner 1929: 481; Ramme 1933: 513; Werner 1934: 324; 1938: 167; Beî-Bienko 1954: 271; Harz 1969: 118; Willemse 1982: 161; 1984: 34 (all partim).

Material studied. – Akhaia: Boubouka-Krioneri, W of Kalavrita; Kernitsai, N of Kalavrita 600 m (CW); Kalavrita and surr. 700-800 m; Flamboura-Vlasia 700-800 m; Drosato, NW of Kalavrita 900 m (CH); Arkadhia: surround. Dhavia, E of Khrisovitsi (CH); 4 km S of Tripolis 700 m (CW); Ilia: 4 km NW of Andritsena 650 m (CN).

Discussion

Originally *artedentatus* was erected at subspecific rank for the *P. obesus*-like populations from the Peloponnisos (Heller 1984; Willemse 1985a: map 3).

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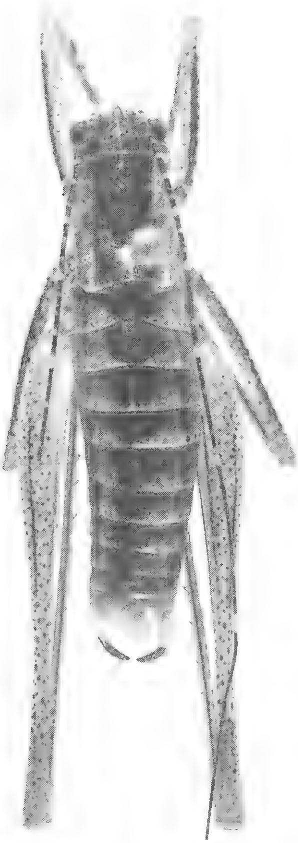

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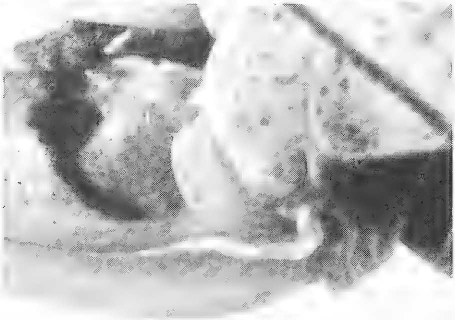

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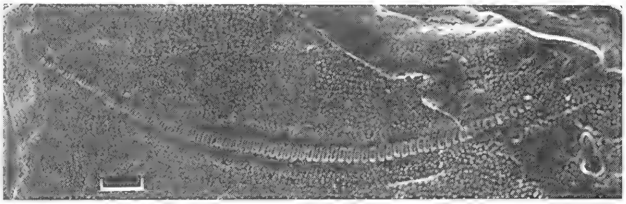

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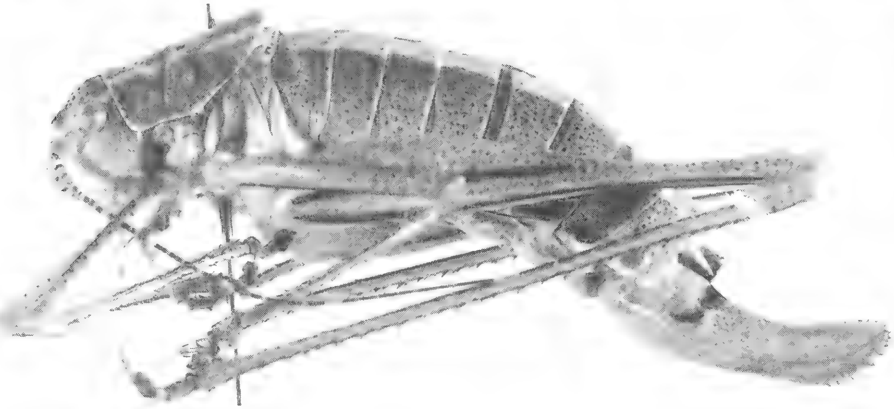


Figs. 6-10. *Poecilimon erimanthos*. - 6, ♂, dorsal view (holotype); 7, ♀, lateral view (allotype); 8, ♂, protrusion of second tergite, lateral view (paratype, Kalentzi, C. W.); 9, base of ovipositor, lateral view (paratype, A. Pandon-Alepokhori); 10, stridulatory file of left elytron ♂ (paratype, Kalentzi), ventral view, distal end to the left (scale 100 μm).

Distinction between *P. obesus* and *artedentatus* is largely based on the song and the stridulatory file. Considering the consistency and degree of difference and in order to balance the taxonomic interpretation assigned to them with the taxonomic interpretation given to similar differences observed in *Poecilimon* it has been decided to raise *artedentatus* to species level.

It is noted here that a confusing mistake has slipped into the key in Willemse (1985b: 38-39). The characters of the stridulatory file were exchanged erroneously and should read:

118(117) Stridulatory file with relative distance between the teeth larger, the total number of teeth less (some 120); etc. ....*Poecilimon obesus* Brunner 1878
Stridulatory file with relative distance between the teeth smaller, the total number of teeth larger (some 280); etc.................... ....*Poecilimon artedentatus* Heller, 1984

Poecilimon soulion **L. Willemse**
(fig. 11)

Poecilimon soulion L. Willemse, 1987: 173; Heller 1988: 51.

Material studied. – Type material.

Additional descriptive notes

Auditory spiracle large, aperture narrowly elliptical, dorsally reaching middle of pronotal lateral lobe. Female stridulatory apparatus: Ventral side of left elytron with well developed plectrum; right elytron with stridulatory pegs on dorsal side of veinlets which form a network bordering the widely rounded postero-apical edge of elytron.

Poecilimon gracilioides **sp. n.**
(figs. 1-5, 12, 24, 30)

Type material. – Holotype ♂: Hellas, Arta, Mt. Tzoumerka, S of Theodhoriana, 1400-1800 m, 24. vii. 1987, Fer Willemse (CW). – Paratypes 13♂ 4♀: same data (2♂ CH; 1♂ 1♀ BMNH; 1♀ allotype, 10♂ 2♀ CW).

Description

Male (fig. 1). – Medium-sized, remarkably slender, integument moderately shiny.

Head: fastigium of vertex produced anteriorly, lateral margins parallel, length and width about equal to those of second antennal segment, longitudinally impressed above.

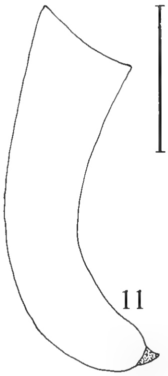
Thorax: pronotum (fig. 24) with metazona dome-shaped and raised above elytra, posterior margin emarginate. Auditory spiracle large, aperture narrow elliptical, reaching dorsally upper third of pronotal lateral lobe. Elytra in dorsal view with basal fourth covered by pronotum, apical margin extending beyond posterior margin of first tergite. Stridulatory file of left elytron (figs. 3-4) with about 120 teeth, reaching posterior margin of elytron; in ventral view arcuate, in profile concave proximally and almost straight in distal third; shortest distance between proximal and distal most tooth 2.7-2.9 mm, greatest width in mid part 0.19 mm; proximal two thirds with 38-45 well developed large teeth, distal third with about 80 much smaller teeth; spacing ranging from 22-24 proximally to 20-22 in mid part to about 80 teeth per mm in distal part; change from larger, wider and less closely set teeth to smaller, narrower and more densely arranged teeth at transition of mid to distal third of file rather abrupt. Hind femora unarmed or with a single ventral spine.

Abdomen: margins of tergites straight except slightly emarginate posterior margin of first tergite. Cercus (fig. 12) moderately long, stout, incurved and slightly tapering in apical third, apex strongly tapering into a short, strong, conical tooth near anterior margin. Subgenital plate reaching tip of cerci, lateral margins converging posteriorly, postero-lateral edges slightly protruding, posterior margin straight, weak median carina.

Coloration: yellowish-green. Vertex, pronotum, tergites and legs finely speckled rusty brown. Antennae yellowish brown. Fastigium of vertex rusty red. Pronotal dorsum with a pale yellow lateral stripe, in metazona bordered medially dark rusty brown, sometimes a similarly coloured median streak. Elytra yellowish with stridulatory area dark brown. Abdomen unicolorous or with two yellowish dorsal bands bordered laterally with black markings, sometimes a narrow black median stripe. Cercus yellowish, tip black. Legs of general colour.

Female (fig. 2). – Pronotum almost cylindrical, metazona very slightly inflated, scarcely raised posteriorly, posterior margin slightly concave. Elytra just visible, overlapping each other medio-dorsally, apical margin transverse, reaching anterior margin of first tergite or shorter. Stridulatory apparatus present: ventral side of left elytron with plectrum; dorsal side of right elytron with stridulatory pegs on top of veinlets which form a network bordering posterior margin and postero-apical angle of elytron, strongest pegs along posterior margin. Basal fold of dorsal margin of lower ovipositor valve lamelliform, strongly bent ventrally, forming with gonangulum a rather shallow laterally-facing groove (fig. 5). Coloration unicolorous green.

Measurements. – Body ♂ 18.0-21.0, ♀ 18.5-20.0; pronotum ♂ 4.2-4.6, ♀ 4.5-4.8; elytron ♂ 2.5-2.9, ♀ 0.1-0.3; hind femur ♂ 14.3-15.1, ♀ 15.2-15.6;



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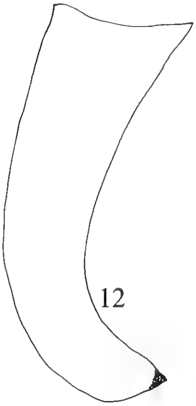

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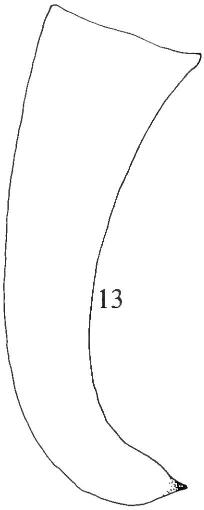

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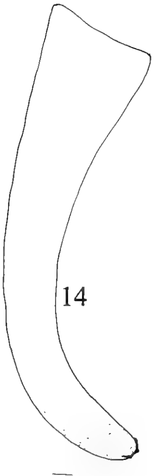

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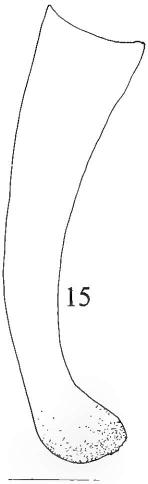

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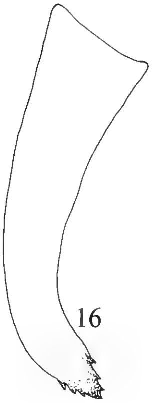

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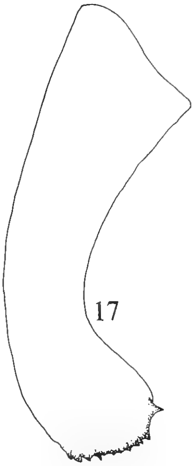

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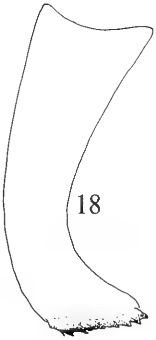

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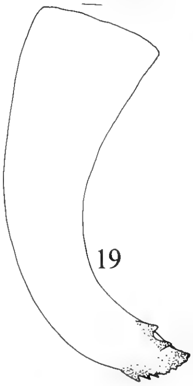

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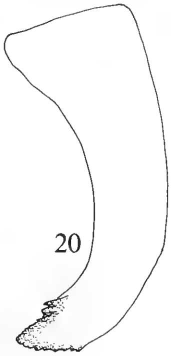

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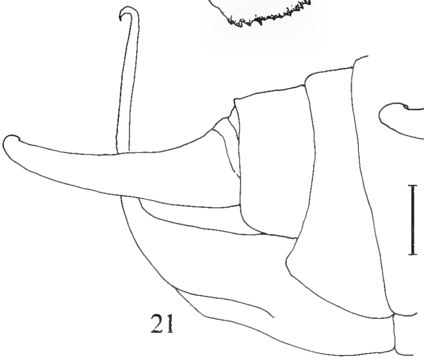

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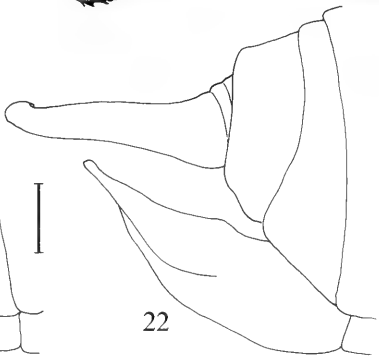

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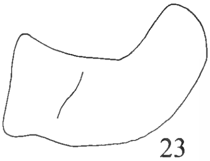

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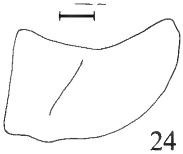

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Figs. 11-19. *Poecilimon,* left cercus ♂, dorsal view. - 11, *P. soulion* (paratype); 12, *P. gracilioides* (paratype); 13, *P. gracilis* (Mt. Pelister, Yugoslav Makedonia); 14, *P. erimanthos* (paratype, Alepokhori-Greveno); 15, *P. mytilenensis* (Ayiassos); 16, *P. mariannae* (paratype, Vrisia); 17, *P. propinquus* (Mt. Dhirfis, Evvoia); 18, *P. propinquus* (Mt. Othris, Magnisia); 19, *P. aegaeus* (paratype, Sira). - Fig. 20. *Poecilimon aegaeus,* right cercus (holotype, Mikonos). - Figs. 21-22. *Poecilimon,* tip of ♂ abdomen, lateral view. - 21, *P. mytilenensis* (Megalokhorion); 22, species (= ? *P. mytilenensis)* (Kaloni). – Figs. 23-24. *Poecilimon,* Pronotum ♂, lateral view. 23, *P. gracilis* (Florina, NW Greek Makedhonia); 24, *P. gracilioides* (paratype). Scales 1 mm.

ovipositor 8.4-8.7.

Bioacoustics. – Male calling song an isolated syllable (fig. 30), produced with intervals of several seconds. Two syllables produced immediately one after another occur only sporadically. Syllable composed of three impulse groups: a series of up to 50 faint impulses, slightly increasing in amplitude, followed by a second group of about 7 loud impulses separated from each other by intervals of 10 to 20 ms and the final group consisting of about 20 loud impulses with intervals less than 3 ms (30°C). Fore wing movements not yet registrated.

Distribution and ecology

Known only from Mt. Tzoumerka (1400-1800 m altitude), NE of the town of Arta, Ipiros, western continental Greece. Tzoumerka is the archaic name for Mt. Athamanon or Athamanika. This large mountain complex, highest summit 2393 m, is zoogeographically somewhat isolated being quite narrowly connected eastward with the Pindhos range and separated westward by the Arakhthos river from some lower mountains in western Ipiros. The new species was found at 1400-1800 m altitude on the northeastern slopes of one of the southern summits, named Spilia (1932 m), S of the village of Theodhoriana. The habitat, close to a spring, are rocky slopes covered by rich vegetation of low shrubs, herbs and grasses. The species occurs quite locally, was not numerous and found mainly on *Helleborus* leaves, together with *P. ornatus, jonicus lobulatus, zimmeri* and *veluchianus.*

Differential diagnosis

The species is defined by pronotum, fore wing and cercus in the male, basal fold of the lower ovipositor valve in the female and size, slender habitus, coloration and almost unarmed hind femora in both sexes. A key character is presented by the stridulatory file.

P. gracilioides resembles *P. gracilis* in size, coloration and general habitus but differs from it by less raised male pronotum (figs. 23-24), shorter male cercus (figs. 12-13) and especially in the male stridulatory file: in *gracilis* (L. Willemse 1987, Heller 1988) the teeth are gradually narrowing and closer set near the transition of mid to distal third of file length, in *gracilioides* size and spacing of teeth changes abruptly at that part of the file (figs. 3-4). The calling song resembles that of *P. gracilis* (Heller 1984, 1988) but the distinction is not yet pointed out because variability and influence of temperature are known insufficiently.

Readily recognizable differences with *P. soulion* (L. Willemse 1987, Heller 1988) refer to a more robust habitus, broader and less raised male pronotum, larger size, more spined hind femora, slightly deeper basal groove of the lower ovipositor valve and the coloration in this species. The male cercus of both species differs only slightly (figs. 11-12). The sudden change in spacing of the teeth of the stridulatory file is shared by both species. In *P. soulion* the file is longer (3.0-3.2 mm against 2.7-2.9 mm), the number of teeth in its proximal two thirds slightly larger (58-62 against 38-45) and the difference in spacing of the teeth in the mid part of the file compared with those at its proximal (= basal) end apparently larger: about 36 and 18 per mm against about 23 and 21 teeth per mm in *gracilioides.* Bioacoustics can not be compared as those of *P. soulion* are unknown.

Etymology

Named after its resemblance to *P. gracilis.*

Poecilimon werneri Ramme

(figs. 31, 42)

Poecilimon werneri Ramme, 1933: 530; Harz 1969: 135; Willemse 1985a: 17; 1985b: 41; Heller 1988: 58.
Poecilimon jonicus; Heller 1984: 95 (as synonym).

Material studied. – Aitolia-Akarnania: Menidhion 50 m; Anoixiatikon 50 m; Loutrakion 70 m; Mitikas 10 m; 10 km SE of Astakos 50 m (all CW); Akheloos delta, Kardhos (CS); Akhaia/Ilia: 2 km S of Porte (N of Pinios lake) 650 m (CH).

Additional descriptive notes

Auditory spiracle large, aperture elliptical, extending dorsally to upper third of pronotal lateral lobe. Female stridulatory apparatus: ventral side of left elytron provided with plectrum; stridulatory pegs on dorsal surface of small veinlets (most of them almost parallel to each other) of postero-apical part of right elytron.

Bioacoustics. – Male calling song (fig. 31) an isolated syllable, produced with intervals of about 1 s (ca. 29°C); syllable composed of two hemisyllables, closing one distinctly louder than opening one; opening hemisyllable (45 ms at ca. 29°C) about 25 impulses; closing hemisyllable (70 ms at ca. 29°C) commonly two groups of impulses separated by interval of about 25 ms (ca. 29°C), first group of 20-40 impulses, second group of 1-8 or sometimes missing; maximum of frequency spectrum 29-44 kHz.

Distribution

The range, previously poorly known (Willemse 1984: map 19), is remarkably small, restricted to coastal areas of extreme southwestern continental Greece and opposite part of the north-western Peloponnisos (fig. 42).

Discussion

Induced by the proposed synonymy of *P. werneri* with *jonicus* (Heller 1984) its specific status was ar-

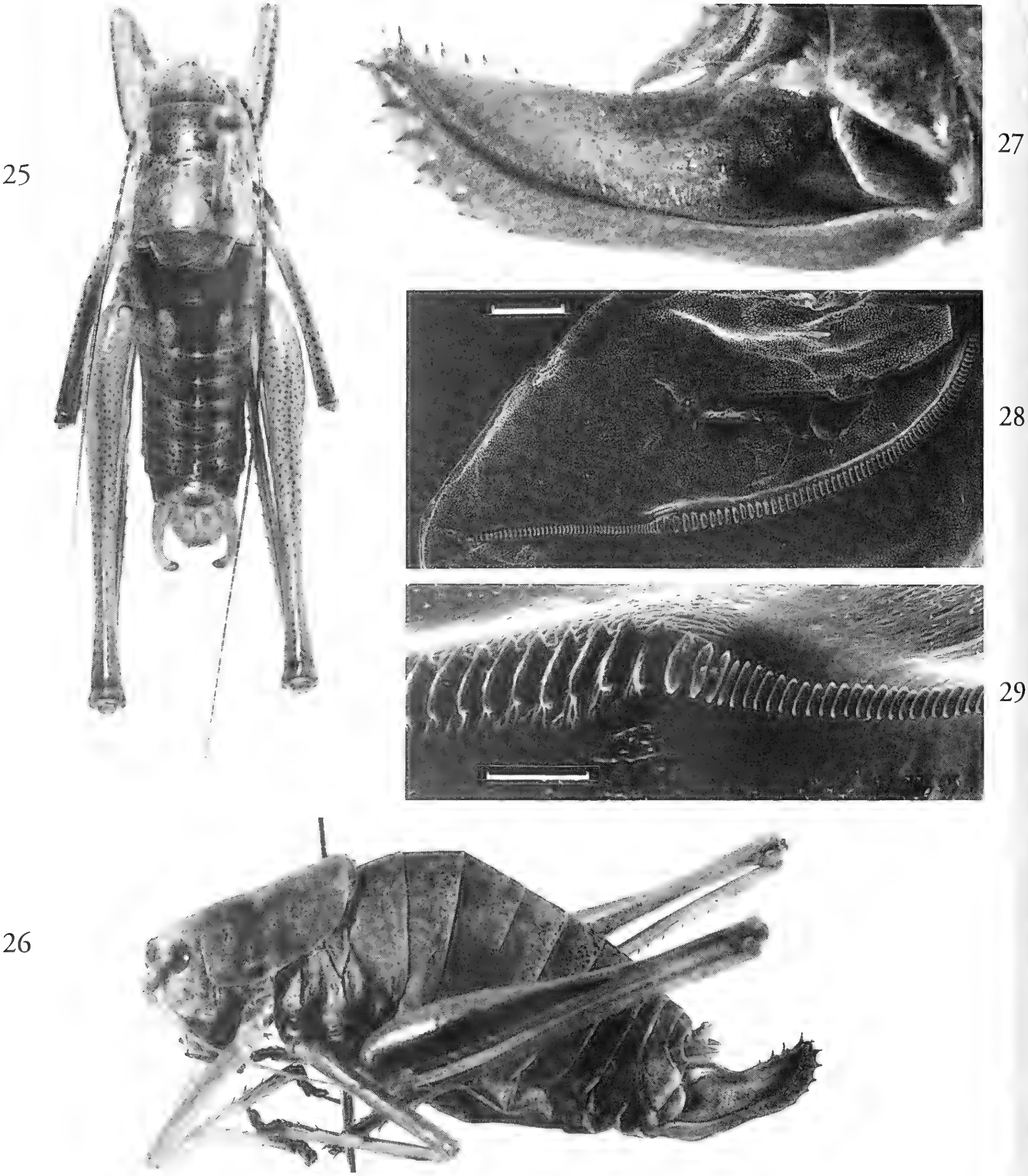

Fig. 25-29. *Poecilimon mytilenensis.* – 25, ♂, dorsal view (Ayiassos); 26, ♀, lateral view (Playia); 27, ovipositor and its base, lateral view (Megalokhorion); 28, stridulatory file of left elytron ♂ (Ayiassos), ventral view, distal end to the left (scale 300 μm); 29, idem, detail of mid to distal third, distal end to the right (scale 100 μm).

gued on morphological basis (Willemse 1985a). Evidence for its specific status is now presented both by their distinctive song and the syntopic occurrence with *P. jonicus lobulatus*, even on a single shrub (*Cistus* sp., *Rubus* sp.) (Menidhion and Anoixiatikon, both Aitolia-Akarnania).

Poecilimon erimanthos sp. n.

(figs. 6-10, 14, 32-33, 42)

[*P. erimanthos* F. Willemse & Heller 1988]: Heller 1988: 57; 1990: 142 (bioacoustics only).

Type material. – Holotype ♂: Hellas, Akhaia, Mt. Erimanthos , A. Pandhon-Alepkhori, 700 m, Fer Willemse, 17. vii. 1987 (cw). – Paratypes 7♂ 9♀: same data (1♂ 1♀ itza; 1♀ cn; 1♀ allotype, 6♂ 7♀ cw); Akhaia: Mt. Erimanthos, Alepokhori-Greveno, 800 m, 17. vii. 1987 (10♂ 3♀ cw; 1♂ 1♀ bmnh); Greveno-Kalentzi, 900 m, 17. vii. 1987 (1♂ 1♀ cw); Kalentzi-Drosia, 600 m, 17. vii. 1987 (2♂ 1♀ cw); Kalentzi, 900 m, 17. vii. 1987 (1♂ 1♀ cw), all Fer Willemse; Kalenzti, 4. vii. 1986, K.-G. Heller (1♂ 1♀ ch); Kalenzti and surr., 900-1100 m, 10. vii. 1985, A. Nadig (1♂ cn); Mt. Erimanthos ab. Kalentzi, 1700-2000 m [but probably 1100 m near Kalentzi], 4. viii. 1970, Willemse & Scherpbier (1♂ cw); Akhaia/Ilia: 2 km S of Porte (N of Pinios lake), 650 m, 14. vi. 1989, K.-G. Heller (5♂ ch); Ilia: 5 km E of Koumanis (Erimanthos valley), 600 m, 16. vi. 1989, K.-G. Heller (3♂ 1♀ ch); 3 km NW of Karia, 500 m, 15. vi. 1989 , K.-G. Heller (5♂ 11♀ ch); Keramidhia, 150 m, vi. 1988, K. Reinhold (4♂ 1♀ ch); Mt. Erimanthos, S of Kriavrisi, 800 m, 15. vii. 1987, Fer Willemse (9♂ 7♀ cw); Mt. Lambia ab. Lambia village, 1000-1150 m, 16. vii. 1991, Luc Willemse (3♂ 2♀ cw).

Description

Male (fig. 6). – Small, remarkably slender, integument moderately shiny.

Head: fastigium of vertex produced anteriorly, lateral margins parallel or slightly converging anteriorly, twice as long as wide, as narrow as width of third antennal segment or a little wider, longitudinally impressed above.

Thorax: pronotum with metazona not widening but slightly inflated posteriorly, posterior margin weakly emarginate. Auditory spiracle large, aperture widely elliptical, reaching dorsally upper fourth of pronotal lateral lobe. Elytra with basal three quarters covered by pronotum, apical margins reaching or just surpassing anterior margin of first tergite. Stridulatory file of left elytron (fig. 10) with 70-90 teeth, not quite reaching posterior margin of elytron; in ventral view slightly fusiform and arcuate, in profile distinctly bulging just beyond middle of length; shortest distance from proximal to distal most tooth 1.0-1.2 mm, greatest width in mid third 0.05 mm; in proximal two thirds 35-45 teeth, in distal third about same number of distally increasingly narrowing teeth; spacing in proximal two thirds almost regular, in distal third increasingly closer. Hind femur unarmed.

Abdomen: posterior margin of first tergite angularly excised. Second tergite with a quite remarkable median protrusion (fig. 8) at least as large as antennal scape and slightly wider than long; anterior and lateral sides slightly flattened and arising vertically, posterior side more sloping anteriorly (and thus longer than anterior side), depressed medially and merging with the inflated, weakly bilobate dorsal side; anterior and dorsal surface of this protrusion bristly. Cercus (fig. 14) slender, proximal half slightly tapering towards cylindrical apical half, from base to apex increasingly incurved, apex from below shortly and from other sides gradually tapering into a sharp and sometimes slightly irregularly shaped pointed crest. Subgenital plate reaching mid to distal third of cercus, slightly narrowing apically with obtuse median carina ventrally; lateral margins carinate, terminating into not or slightly protruding postero-lateral edges, posterior margin straight to slightly emarginate.

Coloration: yellowish green. Vertex, most of dorsum of pronotum, tergites and legs finely speckled rusty brown or blackish. Antennae yellowish, finely annulated dark brown. Occiput with spots sometimes more closely set medially, always unspotted along median line. Pronotal dorsum with yellowish median line, prozona and posterior part of metazona reddish brown and on either side a yellowish streak; lateral lobes often greenish. Elytra with stridulatory area usually brownish contrasting with yellowish to greenish white anterior part, apical margin sometimes dark brown. Abdomen dorsally yellowish, laterally of similar colour or brownish or mixed with green; tergites with yellow median line, on either side bordered by a black block, posterior margin yellowish; protrusion of second tergite and its surroundings on dorsum dark reddish brown; sternites yellowish or pale green. Cercus yellowish, apical third dorsally blackish, tip black. Subgenital plate pale yellowish. Femora with black dorsal incomplete stripe, lower keels blackish, especially distally and hind femur with black lateral incomplete stripe as well; tibiae yellowish brown, between spined upper edges often black.

Female (fig. 7). – Pronotum almost cylindrical, metazona not or scarcely inflated posteriorly. Elytra not or usually just visible, overlapping each other medio-dorsally, apical margin transverse, reaching anterior margin of first tergite. Stridulatory apparatus present: ventral side of left elytron with plectrum; dorsal side of right elytron with irregular rows of stridulatory pegs on top of a number of veinlets that reach posterior margin and postero-apical angle of elytron, those reaching posterior margin roughly parallel to each other. Basal fold of dorsal margin of lower ovipositor valve lamelliform, moderately protruding horizontally, not or very slightly impressed

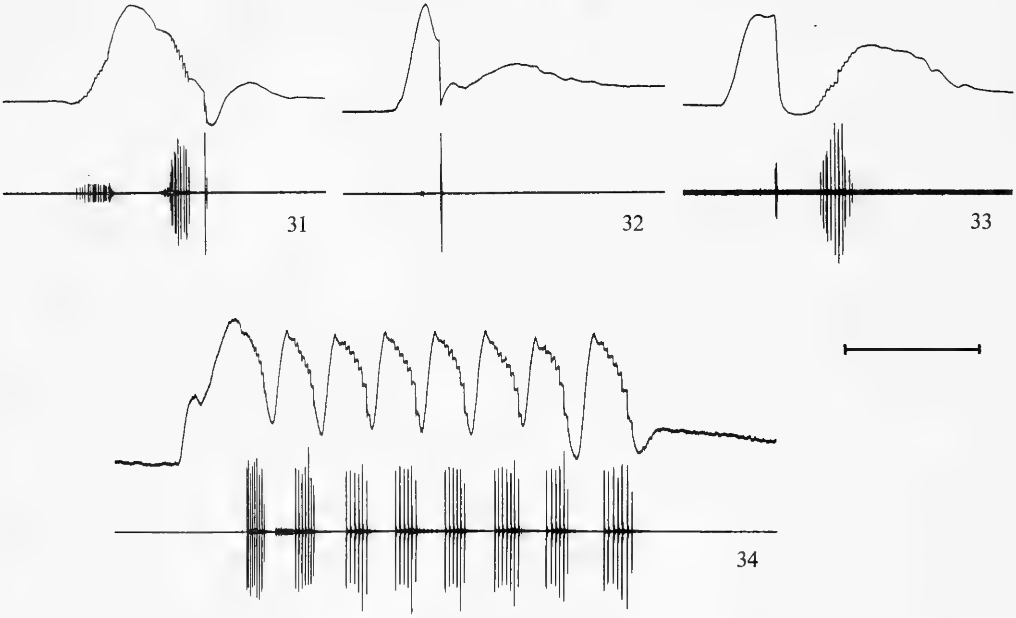

Fig. 30. *Poecilimon gracilioides,* oscillogram of ♂ calling song (paratype). – Fig. 31-34. *Poecilimon,* ♂, synchronous registration of left elytron movement (above; upward is opening, downward is closing of wing) and calling song (below). - 31, *P. werneri* (Porte); 32, *P. erimanthos,* isolated syllable (paratype, Kalentzi, C. H.); 33, *P. erimanthos,* echeme (paratype, Kalentzi, C. H.); 34, *P. mariannae* (holotype). Scale 200 ms.

dorsally, forming with gonangulum a longitudinal, deep and laterally-facing groove (fig. 9). Coloration as male, sometimes unicolorous greenish.

Measurements. – Body ♂ 17.0-20.0, ♀ 19.0-22.0; pronotum ♂ 4.1-4.7, ♀ 5.3-5.8; elytron ♂ 0.5-1.0, ♀ 0.0.-0.3; hind femur ♂ 14.0-17.1, ♀ 17.3-19.5; ovipositor 9.1-9.9.

Bioacoustics. – Male calling song (figs. 32-33) an isolated syllable (fig. 32) or a short echeme (fig. 33) repeated at variable intervals (often about 1 s; 23-24°C); isolated syllable consisting of very soft opening hemisyllable (sometimes even undetectable) and loud and very short (up to 5 ms; 23-24°C) closing hemisyllable. An echeme begins with a syllable similar to isolated one followed by a group of 10-15 impulses (about 50 ms; 23-24°C), produced during second opening of elytra while final closing movement produces no sound at all. Echemes possibly produced mainly by males which do receive response of a female.

Distribution and ecology

The range of the species covers a remarkably small area of the northwestern Peloponnisos: from the western and southern slopes of Mt. Erimanthos (up to 1100 m altitude) down to the adjacent lowlands of northern Ilia (fig. 42). The species was found on thistles, blackberry bushes and *Astragalus,* sometimes in a marshy spot. *P. erimanthos* occurred syntopically with *werneri* (Akhaia/Ilia: Porte), *laevissimus* (Akhaia: Kalentzi; Ilia: Koumanis), *zimmeri* (Ilia: Mt.Lambia) and *nobilis* (Ilia: Koumanis). Attempts to find the species together with *P. jonicus tessellatus* at the northeastern part of its range failed up to now.

Differential diagnosis

P. erimanthos is defined by pronotum, elytron and cercus in the male, basal fold of the lower ovipositor valve in the female and size, slender habitus, coloration and unarmed hind femora in both sexes. Most obvious feature is the median prominence of the male second tergite by which *P. erimanthos* is recognizable at a glance. So far known to us such a structure in *Poecilimon* exists only in *glandifer* Karabag, 1950 (Karabag 1950: fig. 7) and *ampliatus* Brunner von Wattenwyl, 1878 (Krauss 1878: pl. 3 fig. 3a, Harz 1969: fig. 373). The prominence in these species, however, is located on the first tergite, partly covered by the elytra and differently shaped. Also other features of these species differ clearly from *P. erimanthos.*

Except for the prominence of the second male tergite, *P. erimanthos* comes near the closely related species *laevissimus, werneri* and *jonicus* (s.l.).

The male second tergite of *P. laevissimus* presents no prominence but is slightly inflated, also bristly and of similar colour medially. Other distinctive features (Willemse 1982, Heller 1984) are summarized: male cercus quite larger; stridulatory file less bulged; pronotal metazona only a little more inflated; same coloration of body but black dots of tergites more solid; antennae more widely annulated; basal fold of lower ovipositor valve more and roundly impressed from above, groove larger and more rounded; size of body and legs usually larger but occasionally similar.

P. werneri differs in: slightly longer elytra, straight profile of stridulatory file; male cercus more incurved in apical third, tip more pointed; basal fold of lower ovipositor valve slightly arched upward anteriorly and groove with gonangulum more shallow and facing more anteriorly instead laterally; tergites with similar colour pattern but, on either side, an additional black lateral streak (Willemse 1982, 1985a).

P. jonicus (s. l.) can be distinguished by more inflated pronotal metazona; more visible and slightly longer elytra, file of similar shape but shorter, bulging stronger and more distally, teeth less closely set; male cercus pre-apically more angularly incurved and slightly flattened; basal groove of lower ovipositor valve smaller and round instead elongate and besides in *jonicus lobulatus* provided with an anterior inflated processus (Willemse 1982, 1985a).

The calling song resembles also these last three species. In *P. erimanthos* the duration of the closing hemisyllable of the isolated syllable or of the first syllable of an echeme respectively, is shorter than in *P. jonicus jonicus, jonicus lobulatus* and *werneri* (fig. 31, Heller 1984, 1988). Isolated syllables of *P. jonicus tessellatus, laevissimus* and *erimanthos* may be indistinguishable from each other. The echeme structure in *P. erimanthos,* however, is unique. Echemes in *P. laevissimus* and *werneri* were, so far known, not produced at all, while in *jonicus* (s. l.) the second syllable of an echeme is not restricted to an opening hemisyllable as in *erimanthos* but to a closing one or both to an opening and closing hemisyllable (Heller 1984).

Discussion

We observed that during mating the female nibbled eagerly at the peculiar prominence of the second male tergite. Further anatomy or function of the peculiar prominence of the male second tergite are unknown.

Etymology

A noun in apposition, named after its distribution that centres on Mt. Erimanthos.

Poecilimon mytilenensis Werner
(figs. 15, 21, 25-29)

Poecilimon mytilenensis Werner, 1932: 3; 1933: 404; Ramme 1933: 537; Werner 1934: 324; Harz 1969: 144; Willemse 1982: 188; 1984: 41; 1985b: 43; Heller 1988: 69 (in Willemse 1982, 1984, 1985b & Heller 1988 as *mytilensis*).

Material studied. – Lesvos: S of Ayiassos 500 m, Castanea forest; Megalokhorion 550 m; Playia, E of Plomari; Thermi, N of Mytilini (all ITZA); Andhissa (CW).

Redescription

Male (fig. 25). – Medium-sized, integument slightly glossy.

Head: fastigium of vertex with lateral margins parallel or slightly converging anteriorly, twice as long as wide, as wide as second antennal segment, smooth above.

Thorax: pronotum slightly compressed laterally and thus a little saddle-shaped; metazona slightly widening and raised posteriorly. Auditory spiracle large, aperture narrow elliptical, reaching dorsally upper third of pronotal lateral lobe. Elytra in dorsal view with basal two thirds covered by pronotum, apical margins reaching half length of first tergite. Stridulatory file of left elytron (figs. 28-29) with 100-120 teeth, reaching posterior margin of elytron; in ventral view arcuate, proximally more; in profile slightly concave in proximal two thirds, then sharply giving way like one step downstairs and farther distally again slightly concave; shortest distance between proximal and distal most tooth about 2.2 mm, greatest width near the step 0.06-0.07 mm; proximal two thirds with 50-60 distally gradually wider and less closely arranged teeth reaching the step and from there, in distal third, about similar number of teeth but now about half as wide and twice as closely set. Hind femur unarmed.

Abdomen: margins of tergites straight; medio-anterior part of second tergite slightly inflated, black. Cercus (fig. 15) slender, in proximal two thirds slightly, in distal third stronger in- and a little upcurved;

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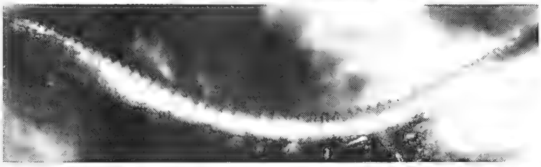

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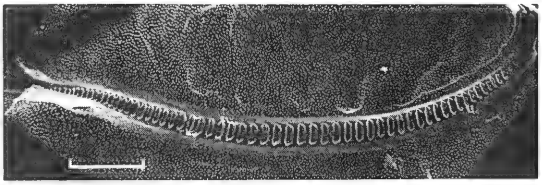

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Fig. 35-39. *Poecilimon aegaeus*. – 35, ♂, dorsal view (holotype); 36, ♂, lateral view (holotype); 37, base of ovipositor, lateral view (paratype, Sira); 38, stridulatory file of left elytron ♂ (holotype), ventral view, distal end to the left; 39, idem, in profile. - Fig. 40-41. *Poecilimon mariannae*. – 40, ♂, dorsal view (holotype); 41, stridulatory file of left elytron ♂ (paratype, Metallion), ventral view, distal end to the left (scale 300 μm).

proximal half slightly conical, distal half a little compressed dorso-ventrally, apical part flattened and widened (spatulate), apical edge slightest rounded and provided with minutely serrate and slightly downcurved crest at medio-posterior part of edge. Male subgenital plate (fig. 21) remarkably slender and long; in ventral view at least twice as long as greatest width, in distal half tapering to half greatest width or even less; posterior margin straight, postero-lateral edges slightly protruding; in profile distal half strongly upcurved, extending far between cerci and reaching level of last tergites, very edge of posterior margin commonly turned down. Coloration: straw yellow, sometimes mixed with green. Vertex, most of pronotum, tergites and legs finely speckled rusty brown or reddish. Antennae yellowish, finely annulated blackish. Median line of vertex and pronotum and a postocular stripe yellow. Pronotal dorsum usually with black dots in prozona and along sulci, metazona often with reddish flush. Elytra unicolorous yellowish, sometimes a pre-apical dark brown streak. Tergites medio-dorsally each with pair of black blocks, widening anteriorly especially in proximal tergites, not reaching very posterior margin and bordered laterally yellowish; lateral sides of tergites and all of sternites of general colour. Cerci yellowish, tip dorsally black. Subgenital plate of general colour, very hind margin sometimes blackish. Legs with more or less distinct black stripes.

Female (fig. 26). – Pronotal dorsum in profile straight to commonly slightly concave. Elytra completely covered by pronotum or just visible, shortly overlapping each other medio-dorsally. Stridulatory apparatus present: ventral side of left elytron with plectrum; dorsal side of posterior part of right elytron with stridulatory pegs on top of some 5-7 almost parallel to each other running veinlets and on top of several other non-directional veinlets towards postero-apical angle. Basal fold of dorsal margin of lower ovipositor valve lamelliform, moderately extending laterally but strongly impressed dorsally forming with gonangulum a round, deep and dorsolaterally-facing pit (fig. 27). Ovipositor comparatively short. Coloration as male but commonly unicolorous yellowish.

Measurements. – Body ♂ 18-20, ♀ 22-24; pronotum ♂ 5.7-6.0, ♀ 5.4-6.0; elytron ♂ 0.6-1.1, ♀ 0.1-0.5; hind femur ♂ 16.5-17.1, ♀ 16.3-17.2; ovipositor 6.3-7.0.

Bioacoustics. – Unknown.

Distribution

Only known from the eastern Aegean island of Lesvos, at least from its southern part (see remarks below).

Discussion

P. mytilenensis was known only from two males (type series) and one female (Werner 1934). The material listed above agrees fully with the descriptions and figures of the male holo- and paratype. Previous descriptions (Werner 1932, 1933, Ramme 1933, Harz 1969) are insufficient.

Additional material before us from the island of Lesvos: 3 km NW of Kaloni (ITZA); N of Kaloni (ITZA); Sikaminea (CW) is strongly reminiscent of *P. mytilenensis*, particularly the virtually identical male stridulatory file. However, the male subgenital plate (fig. 22) is remarkably different: much shorter, much less tapering posteriorly and the apical part not at all pointing dorsally between the cerci. Some other characters differ as well but not so conspicuously. It is also remarkable that these specimens are from the northern part while typical *P. mytilenensis* occur in the southern part of the island. Lack of bioacoustical particulars prevents further identification.

Poecilimon mariannae sp. n.

(figs. 16, 34, 40-41, 43)

Poecilimon cf. *aegaeus* Werner; Heller 1984: 104.
[*Poecilimon mariannae* F. Willemse & Heller, 1988]: Heller 1988: 68; 1990: 142 (bioacoustics only).

Type material. – Holotype ♂: Hellas, Fthiotis: Dhomokos, Metallion, 1 km South East, 450 m, K.-G. Heller, 21. vi. 80 (CW). – Paratypes 2♂ 1♀: same data (2♂ 1♀ allotype CH); Fthiotis: Metallion, 4 km S , 500 m, 10. vii. 1987, F. Willemse (3♂ 9♀ CW); 19. vii. 1991, F. & L. Willemse (1♂ 2♀ CW); 1 km SE of Metallion, 450 m, 29. v. 1989, K. -G. Heller (1♂ CH); 3 km SE of Metallion, 450 m, 29. v. 1989, K. -G. Heller (4♂ 6♀ CH); Perivoli, SW of Dhomokos, 500 m, 5. vi. 1989, K. -G. Heller (1♂ CH); Larissa: 1 km NW of Nea Monastirion, 150 m, 27. v. 1990, K. -G. Heller (4♂ 4♀ CH); 2 km SW of Vrisia, 150 m, 29. v. 1989, K. -G. Heller (5♂ 1♀ CH); Vrisia near Farsala, 200 m, 10. vii. 1987, F. Willemse (2♂ 3♀ CW); Kardhitsa: Mouzaki, 15. vi. 1991, K.-G. Heller (10♂ 5♀ CH).

Description

Male (fig. 40). – Small, robust, integument scarcely glossy.

Head: fastigium of vertex with lateral margins about parallel, slightly sloping antero-ventrally, short, as long as wide, narrower than scape, not or weakly impressed dorsally.

Thorax: pronotum slightly saddle-shaped, a little widening and metazona somewhat raised posteriorly; posterior margin emarginate. Auditory spiracle tiny, aperture split-like, greatest diameter as length of scape. Elytra well visible, apical margin reaching or just surpassing posterior margin of first tergite. Stridulatory file of left elytron (fig. 41) with 62-70 teeth, almost reaching posterior margin of elytron; in

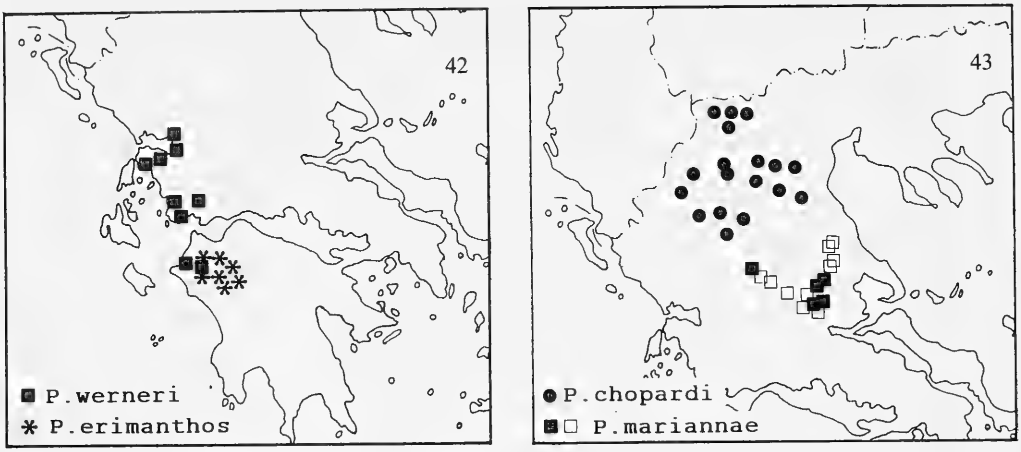

Fig. 42-43. *Poecilimon,* distribution in Greece. – 42, *P. werneri* and *P. erimanthos;* 43, *P. mariannae* and *P. chopardi.*

ventral view slightly fusiform and arcuate, in profile evenly arcuate except very distal part; shortest distance between proximal and distal most tooth 2.0-2.3 mm, greatest width in mid part 0.08-0.09 mm; spacing widest in mid third, distance between two successive teeth about 0.0416-0.0454 mm, i.e. 11 to 12 teeth per 0.5 mm, increasingly closer set both proximally and to a larger degree distally. Hind femur unarmed.

Abdomen: tergites without particulars. Cercus (fig. 16) slender, proximal half slightly conical, distal half almost cylindrical and gradually incurved; apex dorsally somewhat flattened, inner and outer margins provided with a series of 2-6 small teeth and terminating into a strong apical tooth. Subgenital plate short, wide, lateral margins converging posteriorly, postero-lateral edges not or barely produced and posterior margin short, straight or slightly emarginate.

Coloration: straw-yellow to yellowish green. Vertex, anterior half of pronotum, tergites and legs finely speckled rusty-brown. Antennae finely annulated. Occiput sometimes with spots closer set medially, median line always unspotted. Pronotum, on either side, with an ill defined yellowish streak, in metazona bordered medially reddish brown. Elytra pale brown, stridulatory vein and pre-apical spot dark brown. Abdomen of general colour, either provided or not with a median blackish band and an ill defined yellow lateral streak; median band composed of a pair of spots along anterior margin of tergites, extending and narrowing posteriorly without reaching posterior margin of tergites; median line of general colour, unspotted. Cercus with apex black. Legs sometimes with lower keels and a lateral incomplete stripe of hind femur blackish.

Female. – Pronotal dorsum almost cylindrical, metazona not or scarcely raised. Elytra completely covered by pronotum, lateral, widely separated from each other dorsally, no stridulatory apparatus. Basal fold of lower ovipositor valve strong, inflated, protruding ventrally and arched upward anteriorly, longitudinally impressed, forming with gonangulum an elongate shallow anteroventrally-facing groove. Coloration as in male, sometimes more unicolorous.

Measurements. – Body ♂ 17.0-20.0, ♀ 16.0-21.0; pronotum ♂ 4.3-5.2, ♀ 5.5-6.0; elytron ♂ 2.0- 2.4, ♀ 0.0-0.0; hind femur ♂ 17.0-17.5, ♀ 18.8-20.0; ovipositor 8.1-9.7.

Bioacoustics. – Male calling song consists of an echeme (Heller 1984; 1988; fig. 34), repeated at intervals of mostly 2-4 s (range 1-7 s; 22-24°C). Each echeme composed of 6-8 (range 4-11) syllables produced in a frequency of about 12-18 Hz (22-26°C). Impulse number per syllable from 6-15, first syllable(s) often containing more impulses than following ones. Impulses produced during closing movement of fore wings only, opening being silent. Maximum of frequency spectrum 20-30 kHz.

Distribution and ecology

The song of this species has been observed at the localities of the material listed above but also at many other localities: Dhomokos (near Metallion; A. Stefanos; Perivoli; Makrirakhi; between Dhomokos and Neo Monastiri); Farsala (very abundant near Vrisia; Khalkiadhes); Larissa (Khara; Zappion; Nees Karies; Larissa town); Kardhitsa (Sofadhes; Kombelos; eastern side Kardhitsa town). So far the range of the species extends from northeastern Central Greece (Fthiotis: Dhomokos) north- and northwestwards into Thessalia, reaching the town of Larissa and Mouzaki, beyond the town of Kardhitsa.

Localities referring to preserved material are mapped as solid squares, those based on acoustic observation as open ones (fig. 43).

We found the species on thistles and other plants mainly on the wayside and adjacent fields. It was common in the plains S of Dhomokos, around Neo Monastiri and N of Farsala and locally very abundant.

The range of *P. mariannae* is overlapped by those of *veluchianus* and *propinquus*. At most sites only one of these species occurs, at some more than one. Near Dhomokos, NW of Vrisia and some other localities the new species was found syntopically with *P. propinquus*. Along the southern border of the plain S of Dhomokos a narrow zone of syntopical occurrence of *P. mariannae* and *veluchianus* was detected, the latter inhabiting the still more southern located slopes that border this plain. At one spot, Makrirakhi (W of Dhomokos) we heard simultaneously the calling songs of even all the three species. Whether *P. mariannae* occurs syntopically with *chopardi* and *thessalicus* is still unknown. The areas where this might occur, N and W of Larissa, have not yet been explored (fig. 43).

Differential diagnosis

The species is virtually identical with *P. chopardi* except for its different song. We found only one morphological character that might be helpful to discriminate both taxa: spacing of the teeth of the stridulatory file of the left male elytron is greatest in the mid part of the file with 11-12 in the new species against 8-10 teeth per 0.5 mm in *P. chopardi*. Similar features to differentiate *P. chopardi* from the *thessalicus - veluchianus - zimmeri* group of species fit *mariannae* (Willemse 1985a). Bioacoustically, however, the new species is clearly defined by its song, differing in several characters from *P. chopardi* (Heller 1984; 1988). Most reliable and recognizable feature is the syllable number per echeme, 6-8 in *P. mariannae* against 3-4 in *chopardi*. Echemes with a different number of syllables are produced sometimes, viz. down to 4 in *P. mariannae* and up to 5 in *chopardi*. However, this happens quite exceptionally and besides irregularly by few specimens only. Also the syllable repetition rate within an echeme is different: *P. mariannae* about 13 Hz and *chopardi* 9 Hz (both at 25°C). Different ambient temperature, however, impedes the use of this character in the field. Finally, the syllable structure is different: all intervals are equally spaced in *P. mariannae* whereas each syllable consists of two groups of impulses separated by a longer interval in *chopardi*. Besides the number of impulses per syllable in *P. mariannae* appears to be smaller than in *chopardi*. Bioacoustical distinction with the *P. thessalicus - veluchianus - zimmeri* group of species is obvious.

Discussion

It is noted here that most previous records of *P. chopardi* (Willemse 1985a: 20) are based on morphological characters only. Confirmation by the song is certainly needed.

Etymology

Named in honour of Marianne Volleth, who found the first specimens.

Poecilimon veluchianus Ramme

Poecilimon veluchianus Ramme, 1933: 549; Werner 1933: 190 (as *veluchiensis* [sic]); Harz 1969: 150; Willemse 1985a: 20; 1985b: 42. *Poecilimon thessalicus veluchianus*; Heller 1984: 103; 1988: 66.

Poecilimon chopardi; Willemse 1982: 178 (partim); 1984: 39 (partim).

Material studied. – Magnisia: Mt. Othris ab. Kokkotoi 1000-1500 m (cw); Fthiotis: 4 km E of Oiti; 1 km N of Mesokhori (SE of Sperkhiadha) 550 m; 5 km W of Makrakomi 350 m; N of Vitoli (Makrakomi) 330 m; 4 km SW of Ag. Stefanos 500 m; Trilofo, NW of Lamia 800 m; Ag. Ekaterini, 2 km N of Fourka-Pass, N of Lamia 700 m; Brallos, S of Thermopilai pass; Fokis: 2 km E of Lilaia 350 m (all ch); Polidrosos, 3 km N of the village, wayside, near bridge crossing Kifisos river (cw); Arta: Mt. Tzoumerka, Athamani-Theodhoriana 1300 m; S of Theodhoriana 1400-1800 m (both cw); Kardhitsa: Fanari (ch); Aitolia-Akarnania: Mt. Valtou near summit Piramidha, N of Perdhikaki 1300-1600 m (cw).

Distribution and ecology

The range is much larger than previously known (Willemse 1985a: map 6), extending into eastern Arta, northeastern Aitolia-Akarnania, extreme northern Fthiotis as far as eastern Magnisia. The occurrence in Mt. Tzoumerka (Arta) was doubtful (Willemse 1985a) but has now been established. Previous records of syntopic occurrence of *P. veluchianus* with other congenerics are confused (Willemse 1982, 1985a). So far known the species may occur together with *P. ornatus*, *hoelzeli*, *gracilioides*, *chopardi*, *mariannae*, *jonicus lobulatus*, *propinquus* and most important *zimmeri* (see below). Previously we knew *P. veluchianus* only from montane habitats but the species may occur in the lowlands as well: e.g. Fthiotis: Vitoli 330 m (Heller 1988); surroundings of Lamia 100 m and many localities in the Sperkhios valley from Sperkhiadha to Lamia.

Discussion

P. thessalicus, *veluchianus* and *zimmeri* are very similar in their morphology and bioacoustics. While their distribution areas do meet, no clear overlaps exist. Stressing the similarities and allopatric distribution, these taxa have been considered subspecies by Heller (1984, 1988), while Willemse (1985a) argued that their differences were comparatively large and sufficiently stable to consider them species.

Recently, syntopic occurrences of *P. veluchianus* and *zimmeri* have been established: based on the male calling song, a 300 m wide zone was discovered, on the transition between the plain (*P. veluchianus*) and mountain slopes (*P. zimmeri*) near Lilaia (Fthiotis), in which both taxa occurred; likewise, in the same area an isolated population of *P. zimmeri* was discovered within the range of *veluchianus*, while the songs of both taxa was heard on the boundary of both populations; syntopic occurrence of both taxa was also found near the summit Piramidha of Mt. Valtou (N of Perdikhaki, NE Aetolia-Akarnania) and the type locality of *P. gracilioides* on Mt. Tzoumerka (S of Theodhorania, E of Arta). In all these localities no hybrids were found. We believe that the syntopic occurrence of *veluchianus* and *zimmeri* and the apparent absence of hybrids provides a strong enough argument to consider these taxa species and not subspecies.

Recent experimental studies on interbreeding between *P. thessalicus* and *veluchianus* reveal that they mate readily but do not have offspring (K. Reinhold, Erlangen, pers. comm.). Though syntopic occurrence of these taxa has as yet not been established both authors now agree that both taxa are best reflected by a species rather than subspecies level. Specimens from Fthiotis and Magnisia are remarkably slender, small in size and the armature of the male cercus is restricted to the inner apical margin. Their song is not distinctive from the remainder of the range. So far, these populations are considered conspecific with *P. veluchianus*, but further studies are currently in progress.

Poecilimon propinquus Brunner von Wattenwyl
(figs. 17-18)

Poecilimon propinquus Brunner von Wattenwyl, 1878: 44 (partim); Ramme 1933: 553; Willemse 1982: 185; 1984: 40; Heller 1984: 104; Willemse 1985a: 19; 1985b: 43; Heller 1988: 68; 1990: 144.

Material studied. – Magnisia: Mt. Othris above Kokkotoi 1100-1500 m (cw); Larissa: 2 km N of Vrisia 450 m; 4 km N of Zappion; Fthiotis: Dhomokos 500 m (all CH); Attiki, Skinios ; Mt. Parnis 1200 m; Avlon (all cw).

Distribution and ecology

Previously known only from the eastern Peloponnisos, Attiki and Evvoia (Willemse 1984: map 27), the range of this species extends remarkably more northward reaching the districts of Larissa and Magnisia. In Fthiotis and Larissa we found the species on thistles and other plants on the wayside and adjacent fields, on Mt. Othris mainly on ferns.

Syntopic occurrence of *P. propinquus* with *mariannae* has regularly been observed (see *mariannae*). *P. propinquus* and *veluchianus* were found together in the northern hills of the Sperkhios valley and in Mt. Othris. In most of these places one species was extremely predominant or occurring without competitors at one spot and with true syntopic occurrences at the borderlines only.

Discussion

The apical margin of the male cercus was known to be convex (fig. 17, Ramme 1933, Willemse 1982) but in the northern specimens from Magnisia, Larissa and Fthiotis it is scarcely convex or even straight (fig. 18). Bioacoustics are somewhat variable and for the time being we consider these populations conspecific as the song seems identical.

Poecilimon aegaeus Werner
(figs. 19-20, 35-39)

Poecilimon aegaeus Werner 1932: 2; 1933: 403; Ramme 1933: 552; Willemse 1982: 188; 1984: 41; 1985b: 42; Heller 1988: 69.

Material studied. – Holotype ♂: Graecia Mykonos iv 27, coll. Werner, Holo-Typus, *Poecilimon aegaeus* Werner ♂ det. Werner. – Allotype ♀ (juvenile): similar labels with the date 13 iv 27 and Allo-Typus; paratypes 1♂ 1♀: Coll. Br. v. W. Syra Erber, det. Br.v.W. *Poecilimon propinquus*, 5867, *Poecilimon aegaeus* Werner Ramme det (all NHMW).

Additional descriptive notes

Male (figs. 35-36). – Integument glossy, general habitus and shape of pronotum much as *P. propinquus*. Cercus incurved over all its length, apical part about evenly tapering, inner margin with a few coarse teeth, outer margin with more numerous finer teeth (figs. 19-20). Stridulatory file of left elytron of holotype (figs. 38-39) with about 55 teeth, spacing largest in mid part of file, 8 per mm, shortest distance between proximal and distal most tooth 3.16 mm, greatest width 0.097 mm. Coloration much as in *P. propinquus*.

Female. – Basal fold of lower ovipositor valve (Sira ♀, fig. 37) robust, protruding vertically downward and impressed in the middle forming with gonangulum an elongate groove resembling *P. propinquus*. Coloration also much as in that species.

Measurements (juvenile allotype omitted). – Body ♂ 21.1-21.2, ♀ 21.2; pronotum ♂ 6.8-7.0, ♀ 7.0; hind femur ♂ 15.2-15.9, ♀ 17.0; ovipositor 8.7.

Bioacoustics. – Unknown.

Poecilimon athos Tilmans et al.

Poecilimon athos Tilmans, F. Willemse & L. Willemse, 1989: 27.

Material studied. – Type series.

Additional descriptive notes

Auditory spiracle tiny, round, diameter as that of proximal segments of antennal flagellum. Female stridulatory apparatus: elytra small, widely separated from each other, lacking stridulatory pegs or plectrum.

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