Acta Zoologica Academiae Scientiarum Hungaricae

VOLUME 42 - NUMBER 1 - 1996

HUNGARIAN NATURAL HISTORY MUSEUM, BUDAPEST

ACTA ZOOLOGICA
ACADEMIAE SCIENTIARUM HUNGARICAE

AN INTERNATIONAL JOURNAL OF
ANIMAL TAXONOMY AND ECOLOGY

Acta Zoologica Academiae Scientiarum Hungaricae is published quarterly from February 1994 (other issues in May, August and November) by the Hungarian Natural History Museum and the Biological Section of the Hungarian Academy of Sciences with the financial support of the Hungarian Academy of Sciences.

EDITORIAL

Change of editors

The past two years have been spent by revitalizing our journal, *Acta Zoologica Academiae Scientiarum Hungaricae*. The responsibility of publishing the journal on behalf of the Hungarian Academy of Sciences was taken over by the Hungarian Natural History Museum from the publishing house of the academy, Akadémiai Kiadó. The editorial board was considerably expanded by an international panel of editorial advisors, whose advice and work as a referee are much appreciated.

A number of changes in editorial policy, content and format have taken place over the past these two years. The international character of the journal has always been our main concern. In Volume 40 and 41 one-third of the authorship comes from outside Hungary, which does not seem bad for the first phase of the way to becoming a truly international journal.

The former Editor-in-Chief, *László Papp*, resigned from his appointment in December, 1995, because the burden of a massive international project (editorial work on the Manual of Palaearctic Diptera) and other commitments made it difficult for him to maintain the level of editorial activity on the journal indispensable for the quality required. The Biology Section of the Hungarian Academy of Sciences accepted his resignation and delegated me the task of the Editor-in-Chief. The Hungarian members of the editorial board suggested that one more editor would help to spread the workload, and they nominated *Dr András Demeter* as assistant editor. The Biology Section approved this appointment as well.

I reassure the subscribers and readers of *Acta zoologica hungarica* that the aims and the scope of the journal have not changed because of the change in editorship. However, I have to confess that we are struggling with a major problem. In order to maintain a quality of papers, we must rely on reviewers' opinion. *Acta Zoologica Academiae Scientiarum Hungaricae* publishes papers in the fields of animal taxonomy and systematics, zoogeography, animal ecology, community ecology, population genetics, population biology, biodiversity studies and nature conservation problems. In the past two years have been able to provide a fairly rapid publication forum for the accepted papers. The journal is indexed in Current Contents.

We would welcome your comments, including your criticism, on the scientific quality of the papers, the format and appearance of the journal etc.

Dr. István Matskási
Editor-in-Chief

Acta Zoologica Academiae Scientiarum Hungaricae 42 (1), pp. 3–10, 1996

AN INTERESTING REPRODUCTION TYPE IN ENCHYTRAEIDS (OLIGOCHAETA)

K. DÓZSA-FARKAS

Department of Systematic Zoology and Ecology, Eötvös Loránd University
H–1088 Budapest, Puskin u. 3, Hungary

The reproduction biology of a recently described enchytraeid species, *Enchytraeus dudichi* was investigated. This species is able to reproduce both sexually and asexually by fragmentation. Data about the cocoon deposition, the incubation period, the growth of juveniles, the maturation, the occurrence of fragmentation, and the number, size, and growth of fragments were determined. When populations of *E. dudichi* occur in low densities fragmentation results. Fragmentation enhances the chance of the species to successfully colonize new habitats, whereas sexual reproduction maintains genetic diversity within the population.

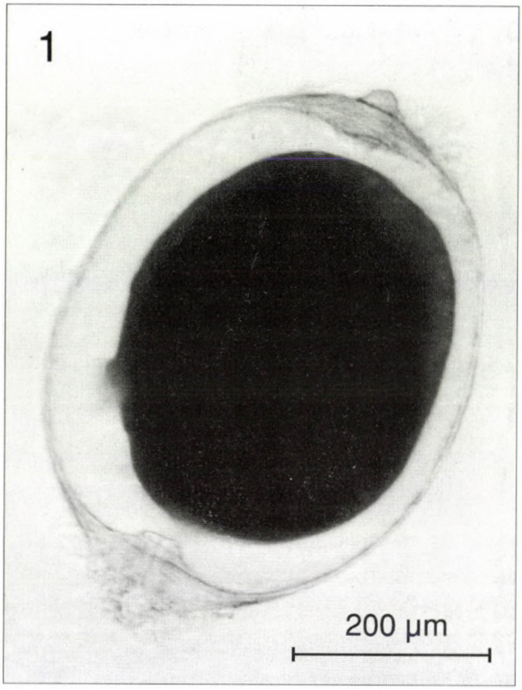
Key words: Enchytraeidae, sexual and asexual reproduction, fragmentation

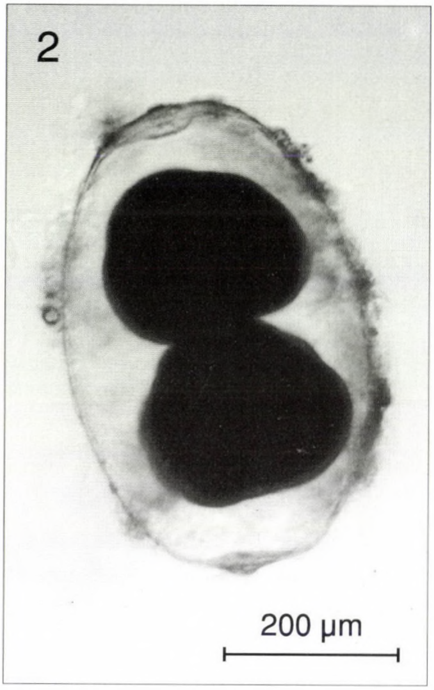
Reproduction by fragmentation in enchytraeids is a rare phenomenon. The species of the genera *Cognettia* and *Buchholzia* are well known for their fragmentation capabilities (CHRISTENSEN 1959, NIELSEN and CHRISTENSEN 1959). Until now only five species of the genus *Enchytraeus*, including *E. dudichi*, have been found to reproduce this way. Among these species, *E. japonensis* NAKAMURA, 1993, the adult form of which is unknown, reproduces only by fragmentation (NAKAMURA 1993), and *E. fragmentosus* BELL, 1959 reaches sexual maturity only under particular breeding conditions (VENA *et al.* 1969). The species *E. bigeminus* NIELSEN and CHRISTENSEN, 1963 and *E. variatus* BOUGUENEC and GIANI, 1987 are capable of both sexual and asexual reproduction. *Enchytraeus dudichi* DÓZSA-FARKAS, 1995 a recently described species, was found in garden soil originating from Iran. We observed that this species is also capable of fragmentation in laboratory cultures.

The objective of study was to obtain more detailed information on the reproductive biology of *E. dudichi*.

MATERIAL AND METHODS

The worms were kept in Petri-dishes on 1% agar-agar medium and fed with oatmeal and dried nettle (*Urtica dioica*) leaves. The juveniles and fragments of different ages were preserved in 70% ethanol and measured afterwards.





Figs 1, 2. Cocoon with one egg (1), with two eggs (2)

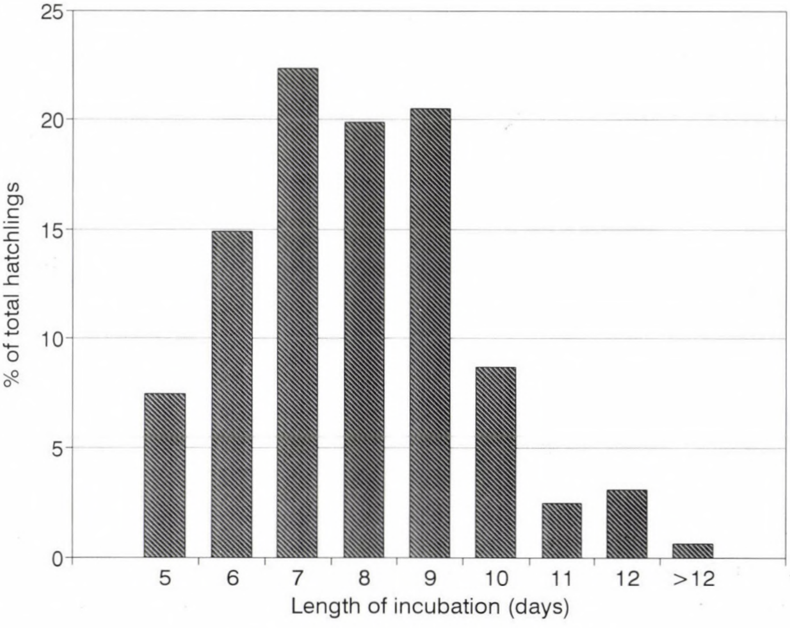


Fig. 3. Incubation period of cocoons

In the study of sexual reproduction, the number of deposited cocoons, the dimensions of the cocoons, the number of eggs per cocoon, the incubation period, and the growth rate of the juveniles were determined. In the case of fragmentation the number of fragments per animal, the number of segments per fragment, the size of fragments, and the growth rate of fragments were studied.

RESULTS

Sexual reproduction

Both *E. dudichi* juveniles and specimens grown from fragments broke up into 3–10 fragments after 16–25 days. They became sexually mature only at high densities and under favourable conditions. At this point both cocoon deposition and fragmentation occurred simultaneously.

The number of deposited cocoons was 0.5±0.2 per animal per day. Consequently, one cocoon was produced every second day. The average length of the cocoons was 596.8±68.5 µm, their width 289.1±34.1 µm. One or two eggs were deposited in one cocoon (Figs 1 and 2). The percentage of cocoons with one egg was 95%. The dimensions of eggs were 248.1±46.9×217.1±24.5 µm. The cocoons with two eggs were significantly ($P < 0.001$) larger: 620.0±75.8 × 303.4±24.2 µm. The percentile distribution of the length of the hatchlings' incubation period can be seen in Fig. 3. Incubation period was mostly 7–9 days (at 22–24 °C).

Figures 4 and 5 demonstrate the increase in segment number and length of juveniles. The segment number within hatching animals was 14–16 (mean

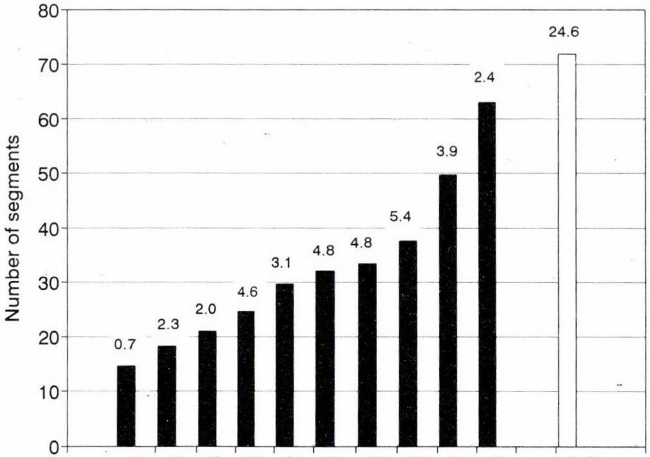


Fig. 4. Increase of the number of segments in juveniles at 22–24 °C

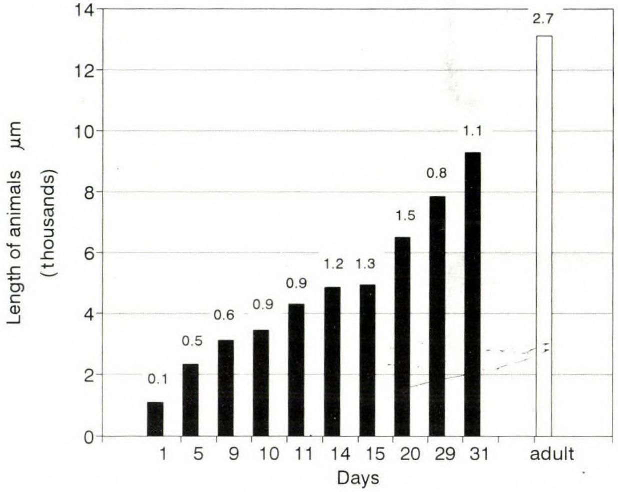


Fig. 5. Growth of the length of juveniles at 22–24 °C

14.7±0.7), with a mean length of 1.11±0.09 mm and width of 121.0±16.4 µm (measured in the VIth segment). After a month their segment number reached 63.0±2.4, with a length of 9.29±1.1 mm and width of 259.3±8.9 µm. The worms, if they did not fragmentize, became adults after 1–1.5 months at 22–24 °C.

The maximum segment number of adult specimens was 128 with a length of 22 mm, they had a mean segment number of 71.9±24.6, with a length of 13.1±2.7 mm and a width of 277.1±30.5 µm.

Reproduction by fragmentation

Mature animals with 50–70 segments break up into 7–18 fragments (Fig. 6). The percentage of the number of segments (3–6) of intermediary fragments can be seen in Fig. 7. The majority (56.2%) of the fragments have 3 (3.5±0.7) segments with a length of 672.6±140.3 µm. The anterior and posterior parts of the animal are longer, 9.7±2.0 segments (length: 1501.8±517.6 µm) and 12.0±2.8 segments (length: 1822.3±671.4 µm), respectively.

Comparing the data concerning *E. bigeminus* (CHRISTENSEN 1964, 1973) and *E. dudichi*, it can be established that the latter species has a greater capability of fragmentation since *E. bigeminus* breaks up into only 4–7 segments, the number of its segments are greater, in intermediary fragments 6–13, and in anterior and posterior ones, 11–18. The species *E. fragmentosus* breaks up into 3–11 fragments with about 5 segments each (BELL 1959). Immature specimens of *E. variatus* divide into only 3–6 fragments (BOUGUENEC and GIANI 1989).

Figures 8, 9 and 10 demonstrate the growth of the intermediary fragments. After 11 days the growth of the fragments, as regards both the number and length of segments, is less than those of juveniles of the same age (grown at 22–24 °C).

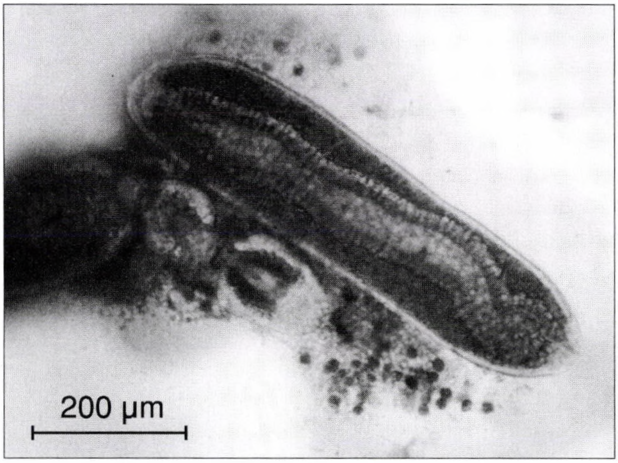


Fig. 6. One-day old segment

Higher temperatures accelerate regeneration. The growth rate of fragments kept at 29–30 °C was more than twice that of fragments kept at 22–24 °C: they reached the same size at three and seven days, respectively. By this time the head is completely regenerated, and the animals are capable of feeding. After this time only the posterior part develops. The regeneration of the head in *E. bigeminus* takes 6 days at 22–24 °C (CHRISTENSEN 1973), whereas in *E. fragmentosus* it takes 10 days (BELL 1959).

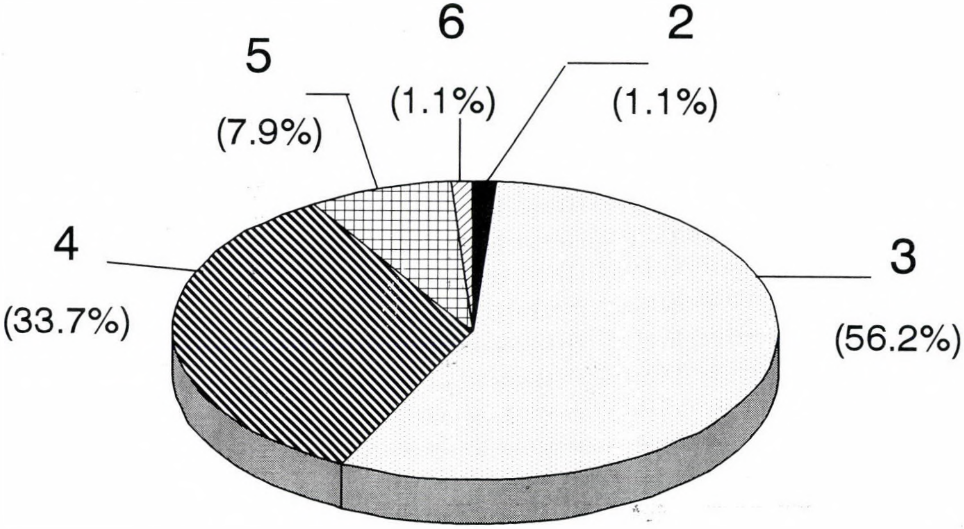


Fig. 7. Distribution of the number of segments in intermediary fragments

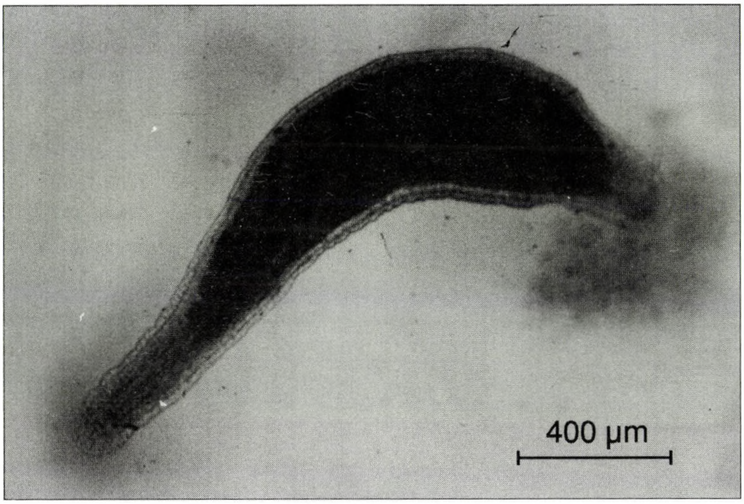


Fig. 8. Developing fragment

DISCUSSION

Fragmentation enhances the chances of the species to successfully colonize new habitats, whereas sexual reproduction maintains genetic diversity within the population.

The factors eliciting maturation and cocoon deposition can be very different. During most of the year species of the genera *Cognettia* and *Buchholzia* re-

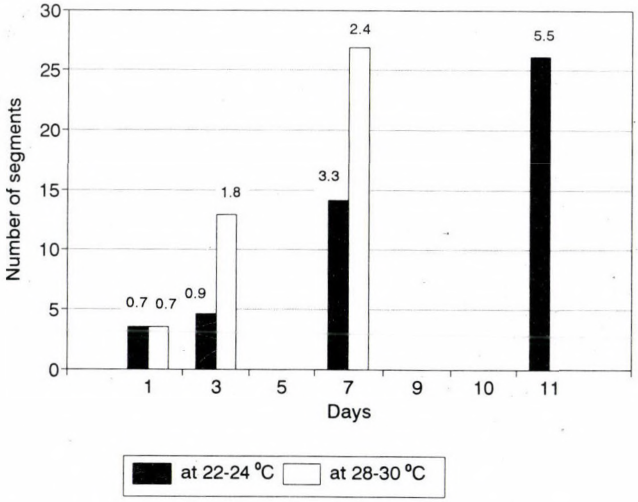


Fig. 9. Increase of the number of segments in intermediary fragments

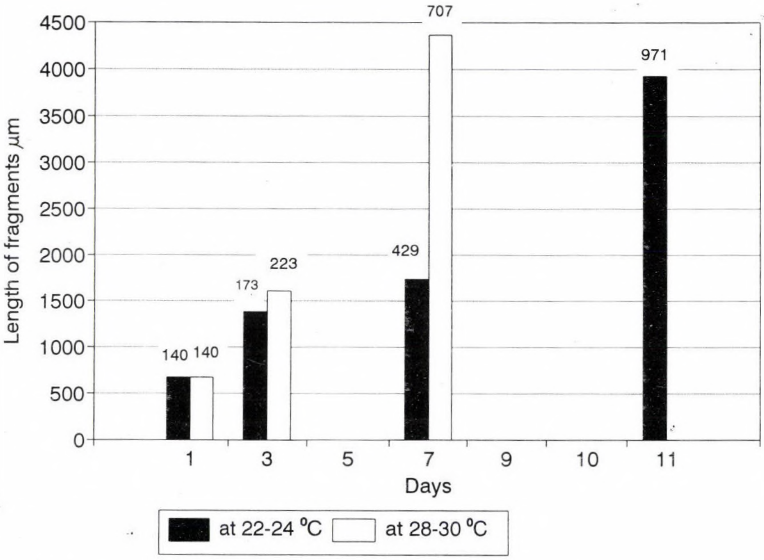


Fig. 10. Growth of the length of the intermediary fragments

produce asexually. Seasonal climatic factors influence the appearance of mature specimens, mostly in cold periods, such as late autumn and early spring in Europe (CHRISTENSEN 1959, NIELSEN and CHRISTENSEN 1959). As mentioned above, *E. bigeminus* held in cultures of low density results in sexual reproduction (CHRISTENSEN 1973). *Enchytraeus fragmentosus* became mature only on an adequate substrate (glass wool) in the laboratory (VENA *et al.* 1969, HAMILTON and HESS 1971).

Unlike *E. bigeminus*, which becomes sexually mature only at low densities, low densities of *E. dudichi* result in fragmentation. In most populations, after appearance of mature specimens the cocoon deposition and fragmentation take place simultaneously. The density dependence of the sexual type of reproduction needs further investigation.

* * *

Acknowledgement. – My thanks are due to Dr. F. BASKA for collecting the enchytraeid material in Iran.

REFERENCES

BELL, A. W. (1959) Enchytraeus fragmentosus, a new species of naturally fragmenting Oligochaete worm. *Science* **129**: 1278.

BOUGUENEC, V. and GIANI, N. (1987) Deux nouvelles espèces d'Enchytraeus (Oligochaeta, Enchytraeidae) et redescription d'E. bigeminus Niel. & Chr. Remarques sur le genre Enchytraeus. *Annls Limnol.* **23**(1): 9–22

BOUGUENEC, V. and GIANI, N. (1989) Biological studies upon Enchytraeus variatus Bouguenec and Giani 1987 in breeding cultures. *Hydrobiol.* **180**: 151–165.

CHRISTENSEN, B. (1959) Asexual reproduction in the Enchytraeidae (Olig.). *Nature* **184**: 1159–1160.

CHRISTENSEN, B. (1964) Regeneration of a new anterior end in Enchytraeus bigeminus (Enchytraeidae, Oligochaeta). *Vidensk. Medd. Dansk naturh. Foren* **127**: 259–273.

CHRISTENSEN, B. (1973) Density dependence of sexual reproduction in Enchytraeus bigeminus (Enchytraeidae). *Oikos* **24**: 287–294.

DÓZSA-FARKAS, K. (1995) Enchytraeus dudichi n. sp. a new fragmenting Enchytraeus species. *Opusc. Zool., Budapest* **27–28**: 41–44.

HAMILTON, M. and HESS, R. T. (1971) Axenic production of ova by Enchytraeus fragmentosus (Bell). *Can. J. Zool.* **49**: 1199–1200.

NAKAMURA, Y. (1993) A new fragmenting enchytraeid species, Enchytraeus japonensis from a cropped korobuku soil in Fukushima, Northern Japan (Enchytraeids in Japan 5). *Edaphologia* **50**: 37–39.

NIELSEN, C. O. and CHRISTENSEN, B. (1959) The Enchytraeidae, critical revision and taxonomy of European species. *Natura Jutl.* **8–9**: 1–160.

NIELSEN, C. O. and CHRISTENSEN, B. (1963) The Enchytraeidae, critical revision and taxonomy of European species. *Natura Jutl.* **10**(Suppl. 2): 1–19.

VENA, J. A., HESS, R. T. and GOTTHOLD, L. M. (1969) Attainment of sexuality in Enchytraeus fragmentosus Bell under laboratory conditions. *Experientia* **25**: 761.

Received November 8, 1995, accepted February 22, 1996

Acta Zoologica Academiae Scientiarum Hungaricae 42(1), pp. 11–15, 1996

DESCRIPTION OF TWO NEW SPECIES (ACARI: ORIBATIDA), WITH NOTES ON THE GENUS BALAZSELLA MAHUNKA, 1983

BALOGH, J.[1] and J. G. PALACIOS-VARGAS[2]

[1] *Zoosystematical and Ecological Institute, Eötvös Loránd University*
H–1088 Budapest, Puskin u. 3, Hungary
[2] *Laboratorio de Ecología y Sistemática de Microartrópodos, Depto. Biología, Fac. Ciencias,*
UNAM. 04510 México, D. F., Mexico

Two new species are described in the oribatid genus, *Balazsella* MAHUNKA, 1983. One of them: *Balazsella ilhabellae* sp. n. was collected in Brazil, *Balazsella mexicana* sp. n. with a special collecting method from Mexico. Some notes elucidate the position of the genus. With 8 original figures.

Key words: Acari, oribatid mites, new species, Brazil and Mexico

INTRODUCTION

In this report, two species of oribatid mites new to science are described from the Neotropics.

The collecting method was described in detail by MAHUNKA and PALACIOS-VARGAS (1995). The Biological Station of Chamela in Jalisco Cost is located 120 km north of the Manzanillo-Puerto Vallarta Highway. It is a very seasonal region, with concentrated rainfall from July to September. The dominating vegetation is a tropical deciduous forest and a tropical sub-deciduous forest (RZEDOWSKY 1978). We describe a new species: *Balazsella mexicana* sp. n. Further on we give the description of another species, *Balazsella ilhabellae* sp. n. from a material collected by the senior author in Brazil. Finally, by giving the differential diagnosis of the three species, we re-evaluate the taxonomic status of the genus *Balazsella* MAHUNKA, 1983.

The holotypes are deposited in the Department of Zoology of the Hungarian Natural History Museum, Budapest, the paratypes are deposited in the collection of both authors and the collection of the Museum d'Histoire naturelle, Genèva, Switzerland.

Balazsella ilhabellae sp. n.
(Figs 1–4)

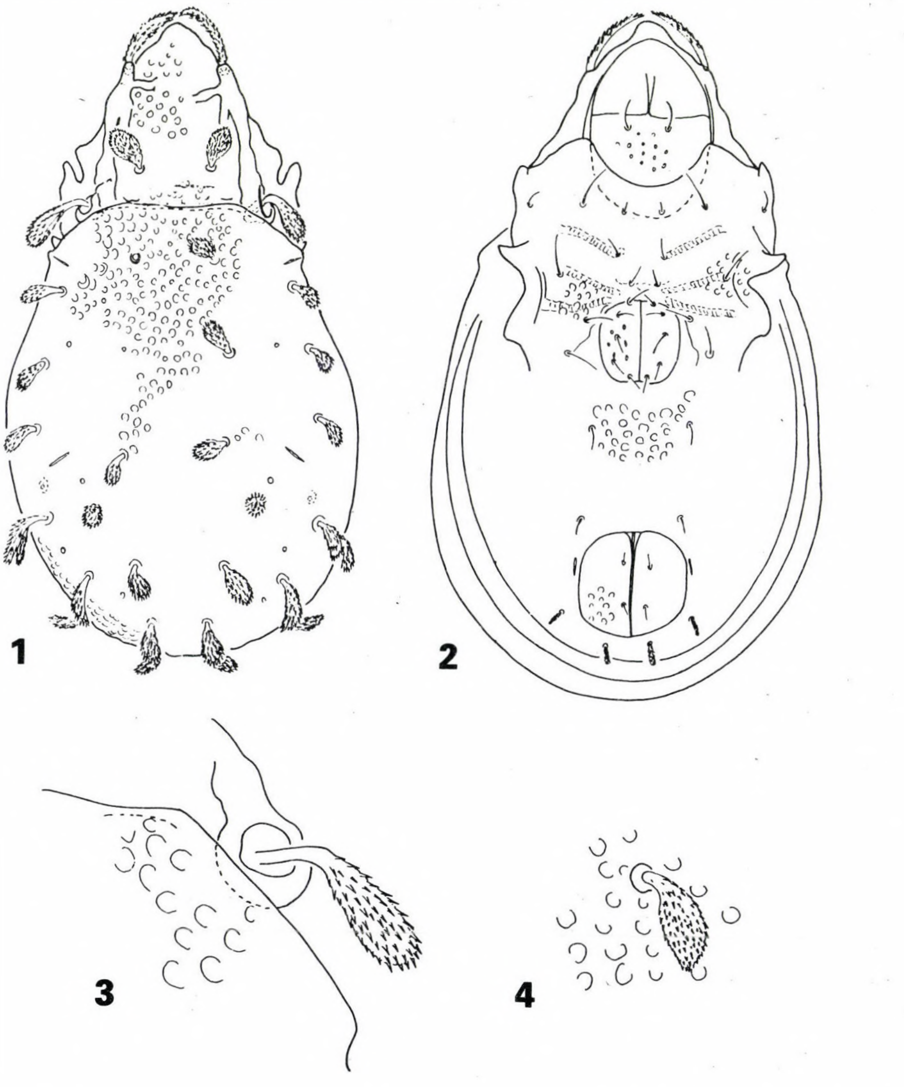
Measurements. Length of body: 275–320 µm, width of body: 120–166 µm.

Prodorsum: Rostrum conical. Lamellae with well-developed cusps, and a reduced translamella (Fig. 1). Whole surface distinctly and uniformly foveolate. Rostral setae setiform, sparsely ciliate, lamellar setae thickened, interlamellar setae phylliform. Sensillus (Fig. 3) elongated, clavate, its surface also spiculate.

Notogaster: Whole surface foveolate, alveoli of the fourteen pairs of notogastral setae similar to the foveolae in size. All setae phylliform, their surface distinctly spiculate (Fig. 4).

Lateral side: Prelamellae very short, directed laterally, not touching insertion of rostral setae. Exobothridial setae very short, hardly discernible.

Ventral side (Fig. 2): Mentum ornamented by smaller, the epimeral region, ventral plate and anal plates by larger, foveolae. Larger foveolae nearly equal in size, distance among them nearly



Figs 1–4. *Balazsella ilhabellae* sp. n.: 1 = body in dorsal aspect, 2 = body in ventral aspect, 3 = trichobothrium, 4 = setaJm

equal to diameter of foveolae. Genital plates with some very weak spots only. Apodemes weakly developed, only *ap. 2* and *ap. sej.* conspicuous, connected with each other in front of the genital aperture. Epimeral setal formula 3–3–2–2. Setae *1b* much longer and stronger than setae *1a* and *1c*. Anogenital setal formula: 5–1–2–3. Genital, aggenital, anal setae simple setiform, adanal ones more or less dilated, well pilose. The setae ad_1 the largest, setae ad_3 the smallest of all.

Legs: Shape and other characteristics similar to those of the next species, although, surface of femur and trochanter, specifically on side facing body, strongly wrinkled.

Material examined: Holotype: Brazil, Ilha de São Sebastiao, Parque Estadual de Ilhabela. 8 May, 1990. Collected from sparse moss on the tree trunks. Six paratypes from the same locality, collected from hanging soil and roots of Bromeliaceae.

Balazsella mexicana sp. n.

(Figs 5–8)

Measurements. Length of body: 254–294 µm, width of body: 112–124 µm.

Prodorsum: Rostrum widely rounded. Rostral and lamellar setae thick but setiform, distinctly pilose. Interlamellar setae phylliform. Rostral part of prodorsum irregularly foveolate. Lamellae well-developed, without translamellar ridges. In interlamellar region some longitudinal crests observable (Fig. 5). Sensillus very short, with dilated, rounded and sparsely spiculate head (Fig. 7).

Notogaster: End of body somewhat elevated, more pointed than that of previous species, covered with a layer of cerotegument composed of granules and filaments. Setae sharply pointed (Fig. 8), in dorsal view only 11 pairs discernible. Three pairs of *p* setae smaller than the other notogastral ones and only observable in ventral view.

Lateral side: Prelamellae very short, directed laterally, not touching insertion of rostral setae. Exobothridial setae very short, hardly discernible.

Ventral side (Fig. 6): Mentum with small and irregular foveolae. Epimeral region and ventral plate ornamented by very large and strong foveolate, no essential difference among them. Epimeral and ventral region similar to same regions of preceding species.

Legs: All legs tridactylous, homodactylous. Surface of leg segments variable, all femora and trochanter III and IV foveolate, all others smooth or only with some wrinkles. A conspicuous porose area present on inner surface of all femora. Solenidium φ2* of leg I well developed, long, solenidium φ1 very long, slightly dilated at its distal end.

Material examined: Holotype: Mexico: Jalisco State: Chamela Biological Station. Eight paratypes from the same sample.

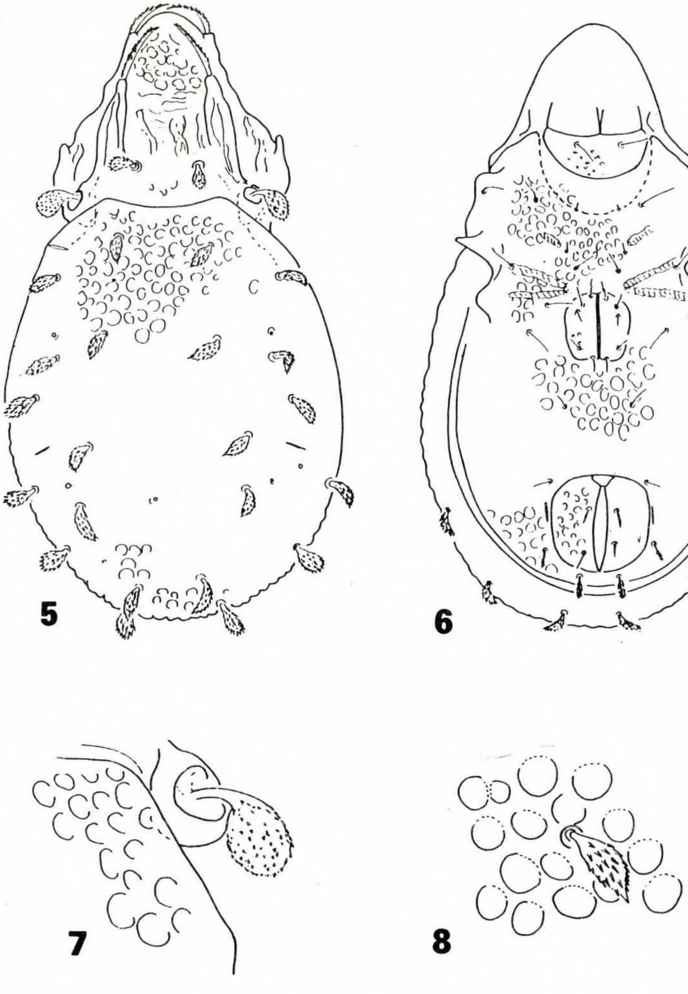
Remarks: This genus was established by MAHUNKA based on specimens from Brazil, with the original description of the type species (*Balazsella pilososetosa* MAHUNKA, 1983). He included it in the family Oribatulidae THOR, 1929. When subdividing Oribatuloidea, BALOGH and BALOGH (1984) transferred *Balazsella* to the family of Fenicheliidae since they recognized its relationships with *Hemileius*, in which the sacculi are present, while the pteromorphae are absent. It was also treated as such in their 1992 work on the "Oribatid Genera of the World". However, it seems probable that the family Fenicheliidae is an artificial unit, and the genus *Balazsella* has to be removed. The question cannot yet be

---

* MAHUNKA mistakenly referred to lack of φ_2 in describing the genus. This feature may clearly be seen on the type species of the genus, although it is very small and inclinate, and is almost wholly obscured by the surface of the tarsus.

fully answered, so for the time being this step has to be postponed. The two new species fit well within the original generic diagnosis, repeated below. The combination of features by which the taxa may be accommodated in the genus is given below:

1. notogaster with four pairs of sacculi (sometimes inconspicuous),
2. five pairs of genital setae (GAC formula: 5–1–2–3),
3. 14 pairs of dilated notogastral setae,
4. fissure *iad* in paraanal position,
5. arboricolous species, in the canopy, inhabiting the thin layers of moss on the trunk, and in the debris accumulated at the base of leaf-rosettes of epiphytic bromelias.



Figs 5–8. *Balazsella mexicana* sp. n. 5 = body in dorsal aspect, 6 = body in ventral aspect, 7 = trichobothrium, 8 = seta lm

The description of the two species are given above. The general characteristics may be found in the figures.

The three described species may be diagnosed with the subsequent key:

1 (2) Lamellar setae phylliform. Setae *ps1* phylliform, much longer than setae *ps2* and *ps3*. Length: 266 µm – Brazil: Assancao
Balazsella pilososetosa MAHUNKA, 1983

2 (1) Lamellar setae setiform, thick, densely pilose.
3 (4) Interlamellar region foveolate. Notogastral setae with rounded tip. Sensillus with an elongated head. Length: 275–320 µm. – Brazil: Ilha de São Sebastiao: Ilhabela **Balazsella ilhabellae** sp. n.

4 (3) Interlamellar region with longitudinal ribs. Notogastral setae with acuminate tips. Sensillus with a short capitate head. Length: 254–294 µm. – México: Chamela, Biological Station **Balazsella mexicana** sp. n.

Acknowledgements – This contribution officially belongs to the project "Biodiversity of Mexican Mites (E130.1976)" of the collaborative agreement between CONACYT (Mexico) and OMFB (Hungary). Specimens were obtained through the project "Efectos del uso de la selva baja caducifolia" (IN-2078/91) DGAPA-UNAM, Mexico in charge of the junior author.

REFERENCES

BALOGH, J. and BALOGH, P. (1984) A review of the Oribatuloidea Thor, 1929 (Acari: Oribatei). *Acta zool. hung.* **30**: 257–313.

BALOGH, J. and BALOGH, P. (1992) *The oribatid mites genera of the world, I–II.* Hungarian Natural History Museum, Budapest, pp. 263+375.

MAHUNKA, S. (1983) Data to the knowledge of Oribatid fauna of Surinam and Brasil (Acari). *Folia ent. hung.* **44**: 205–227.

MAHUNKA, S. and PALACIOS-VARGAS, G. J. (1995) Two new oribatid (Acari: Oribatida) species from the canopy of tropical dry forest in Mexico. *Acta zool. hung.* **41**(4): 295–300.

RZEDOWSKI, J. (1978) *Vegetación de México.* Ed. Limusa, México, 432 pp.

Received September 28, 1995, accepted May 21, 1996

The oribatid species described by Berlese (Acari)

MAHUNKA, S. and L. MAHUNKA-PAPP

The authors had the opportunity for years to study the Oribatid species described by Berlese currently deposited in the Istituto Sperimentale per la Zoologia Agraria at Florence. The results of this series of studies are summarized in this volume.

The volume begins with an essay-like Introduction heavily relying on subjective opinions discussing the general questions of Oribatology. The following section lists Berlese's species placed in the modern system helping the specialists with morphological notes and many drawings; here also the condition of the specimens is discussed and lectotypes are designated.

The third, large section is the catalogue proper, wherein all the species are listed in the systematic order together with their combination and synonymic names. Here one may find all the literature data, usually missing from ordinary works, with reference to Description and Taxonomy, Distribution, with special emphasis on Catalogues whose references are partly unreliable. Where it was deemed necessary further information are added under the heading of Remarks. The volume closes with a very detailed list of literature.

ISBN 963 7093 27 3
325 pages with several figures. Soft bound.

Price: 40 US dollars excl. p. & p.

Order should be sent
to the Hungarian Natural History Museum, Library
Baross u. 13., Budapest, H–1088 Hungary
Fax: (36)–(1)–1138820

Acta Zoologica Academiae Scientiarum Hungaricae 42 (1), pp. 17–22, 1996

ORIBATID MITES (ACARI: ORIBATIDA) FROM MADAGASCAR. I. ARCHIPHTHIRACARELLA GEN. N.

S. MAHUNKA

Department of Zoology, Hungarian Natural History Museum
H–1088 Budapest, Baross u. 13, Hungary

Two species of the oribatid mite family Phthiracaridae are discussed, one of them (*Phthiracarus insularis* BALOGH 1962) is redescribed and designated as the type of a new genus: *Archiphthiracarella* gen. n., the other is new to science and also belongs to this genus. With 11 original figures.

Key words: Acari, Oribatida, Phthiracaridae, new genus and species, Madagascar

INTRODUCTION

The oribatid fauna of Madagascar, East and South Africa and the islands adjacent to these regions has been studied by the author (e.g. MAHUNKA 1994) over a number of years. It is especially essential to know the highly diverse fauna of Madagascar in order to more readily comprehend those important faunal and floral relations between the Ethiopian and the Oriental regions which point to Gondwanan origin.

The renowned bryologist, Prof. T. PÓCS, recently collected many soil samples in these regions, including Madagascar. The recovered oribatid mites will be discussed in a number of succeeding papers.

In this paper I present to introduce two species belonging to the family Phthiracaridae PERTY, 1841, of which one undoubtedly represents the species of *Phthiracarus insularis* BALOGH, 1962. The other species is a close ally, but new to science. The subsequently discussed features, however, clearly demonstrate that both differ fundamentally from all the heretofore known *Phthiracarus* PERTY, 1841 species. Consequently, a new genus has to be erected.

The family Phthiracaridae and even the subfamily and/or genus have so far been considered monotypic taxa (e.g. NIEDBALA 1986, 1992), in spite of the fact that the taxa (family, genus) have always been diagnosed with several exceptions. On the other hand, characteristics such as the number of anal setae, the notogastral lyrifissures, leg chaetotaxy (seta *v'* of femur I, seta *l'* of genu IV) were wholly excluded as evolved characters, which in other related families readily separate genera and are accepted as plesiomorphic features. Consequently, the taxon named as *Phthiracarus*, either referring to a subfamily or family, is not monotypic (see MAHUNKA 1990*b*). Subsequent studies will most certainly bring about further divisions within the genus, as is demanded both by taxonomy and systematics. This fact is clearly demonstrated by this newly discovered taxon whose most significant feature (the position of the genital setae) differs from that of all other *Phthiracarus* species.

In describing the species I am using my own terminology (MAHUNKA 1990*a*).

DISCUSSION AND DESCRIPTIONS OF THE TAXA

Phthiracaridae PERTY, 1841

Archiphthiracarella gen. n.

Diagnosis: Family Phthiracaridae, subfamily Phthiracarinae. Low crista present, prodorsal surface partly sculptured. Lateral carina absent, sinus line present. All setae of prodorsum and notogaster smooth, 15 pairs arising on the notogaster. Eight pairs of genital setae present (g_1 absent?), forming one row. Setae g_5–g_9 located further from inner margin than g_2–g_4, which arise on anterior part of genital plate, near margin. Five pairs of normal ano-adanal setae, two pairs of anal ones nearer inner margin of ano-adanal plate than others. Setae *v'* of femur I absent, no seta on genu IV, setae *d* of tibia IV minute, coupled with the solenidium.

Type species: *Phthiracarus insularis* BALOGH, 1962.

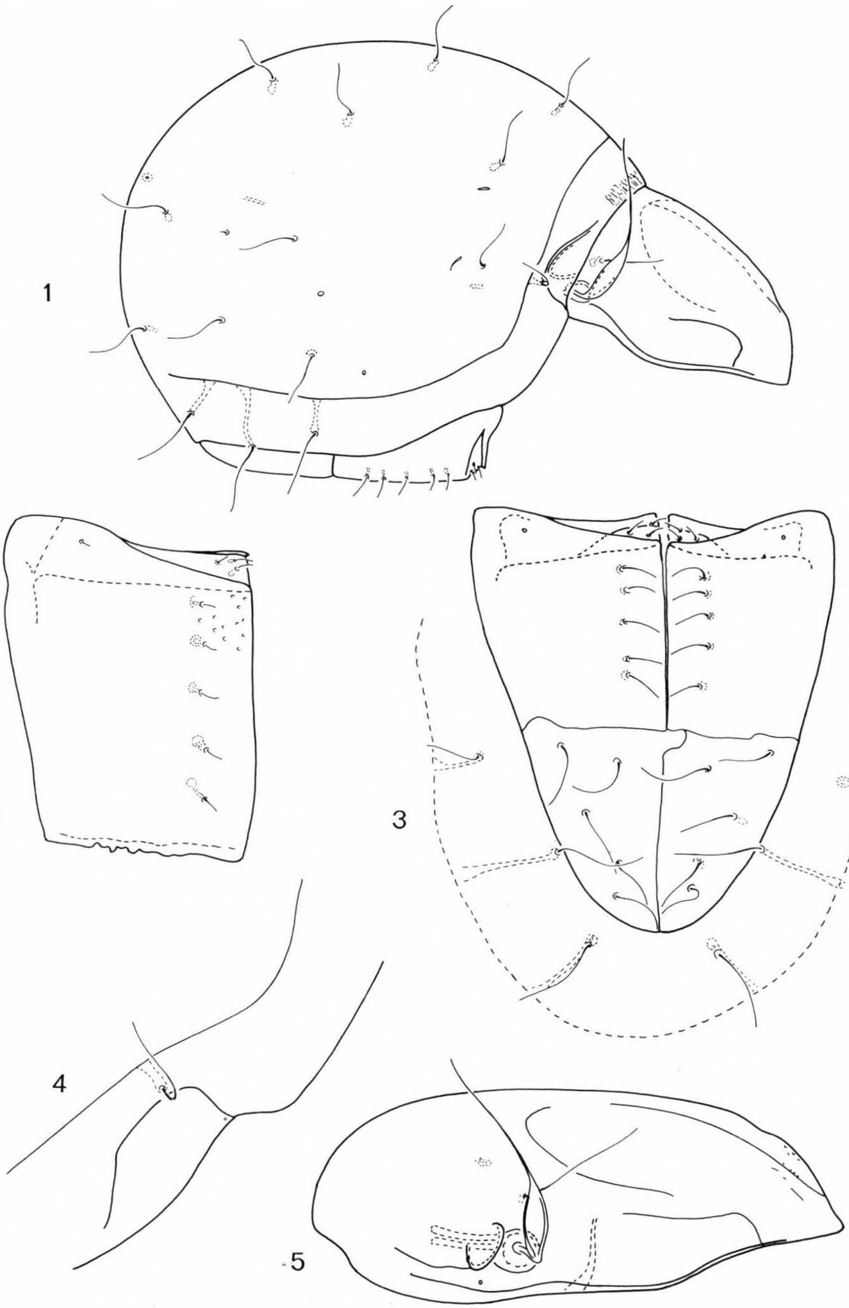
Remarks: This and the related species described below are unique in the subfamily Phthiracarinae by virtue of the position of their genital setae. In all other taxa the genital setae are arranged in two longitudinal rows and one of the rows (setae g_6–g_9) is located far from the inner margin, much farther than setae g_4–g_5.

Archiphthiracarella bulbifera sp. n.

Measurements. – Length of aspis: 185 µm, length of notogaster: 278 µm, height of notogaster: 218 µm.

Integument: Mostly finely punctate, on prodorsum (near lateral margin) some cerotegumental remnants also visible. Anterior part of crista, and a narrow field along it, foveolate. Basal margin of aspis with short, longitudinal crests.

Aspis: Rostral part conical in dorsal aspect. Dorsal margin in lateral view (Fig. 5) – except for a small hollow anteriorly – gradually convex. Lateral margin conspicuous, lateral crests not visible. Bothridial squama large, characteristically auriculate. Digitiform tracheoles conspicuous. Rostral setae setiform, lamellar setae filiform, interlamellar and exobothridial setae reduced (both



Figs 1–5. *Archiphthiracarella bulbifera* gen. et sp. n. 1 = body in lateral aspect, 2 = genital plate, 3 = anogenital region, 4 = collar line with seta c_3, 5 = aspis in lateral aspect

pairs represented only by their insertions). Sensillus well dilated basally, bulbiform, with a long, distal setiform end.

Gnathosoma: Chelicerae and palps typically phthiracaroid both in form and in chaetotaxy.

Notogaster: Globular. Collar line run far from anterior margin of notogaster. Lyrifissures inconspicuous, only three pairs (*ia, im, ips*) readily perceptible. Fifteen pairs of short, filiform, partly undulate notogastral setae present. All nearly equal in length and size. Origin of vestigial setae (f_1, f_2) also visible, f_1 arising before h_1 (Fig. 1). Setae c_1 far removed from collar line, setae c_3 arising between collar margin and anterior margin of notogaster (Fig. 4). Setae p_3 very near lateral margin, much nearer than setae p_2 or p_4.

Ventral regions: Genital plates well divided by a transverse minitectum. Three pairs of genital setae arising in the anterior part, two of them nearer to the inner margin than the other (Fig. 2). The five pairs of genital setae (g_5–g_9) longer than the preceding ones and much farther removed from the margin than the anterior 3 pairs. The position of the anal and adanal setae as shown in Fig. 3. They are equal in size.

Legs: The leg setal formulae is:

I: 1 – 3 – 2+2 – 4+1 – 17+3 – 1,
IV: 2 – 1 – 0 – 9 – 1.

Seta *d* of femur I setiform, located near to the anterior margin of the joint, seta *v*' absent. The small seta coupled with ω_2 (see PARRY 1979) comparatively short, fine. Seta *pv*' absent.

Material examined: Holotype (HO–1532–96): Malgasy Republic. "Central E Madagascar, degraded montane rainforest on Mt. Ambatokirijy at the S edge of Andasibe (Perinet) forest reserve, at 950–1000 m. alt. 3. Oct. 1994". Leg. Dr. T. PÓCS. Holotype deposited in the Hungarian Natural History Museum, Budapest, with identification number of the specimens in the Collection of Arachnida.

Etymology: This species is named after the roundly dilated "bulbiform" basal part of the sensillus.

Remarks: The new species is very similar to the type species of the genus (discussed below). However, it is distinguished from it by the form of the sensillus (much narrower in *insularis*), the position of setae c_3 and p_3, and by the reduced interlamellar setae (normal in *insularis*).

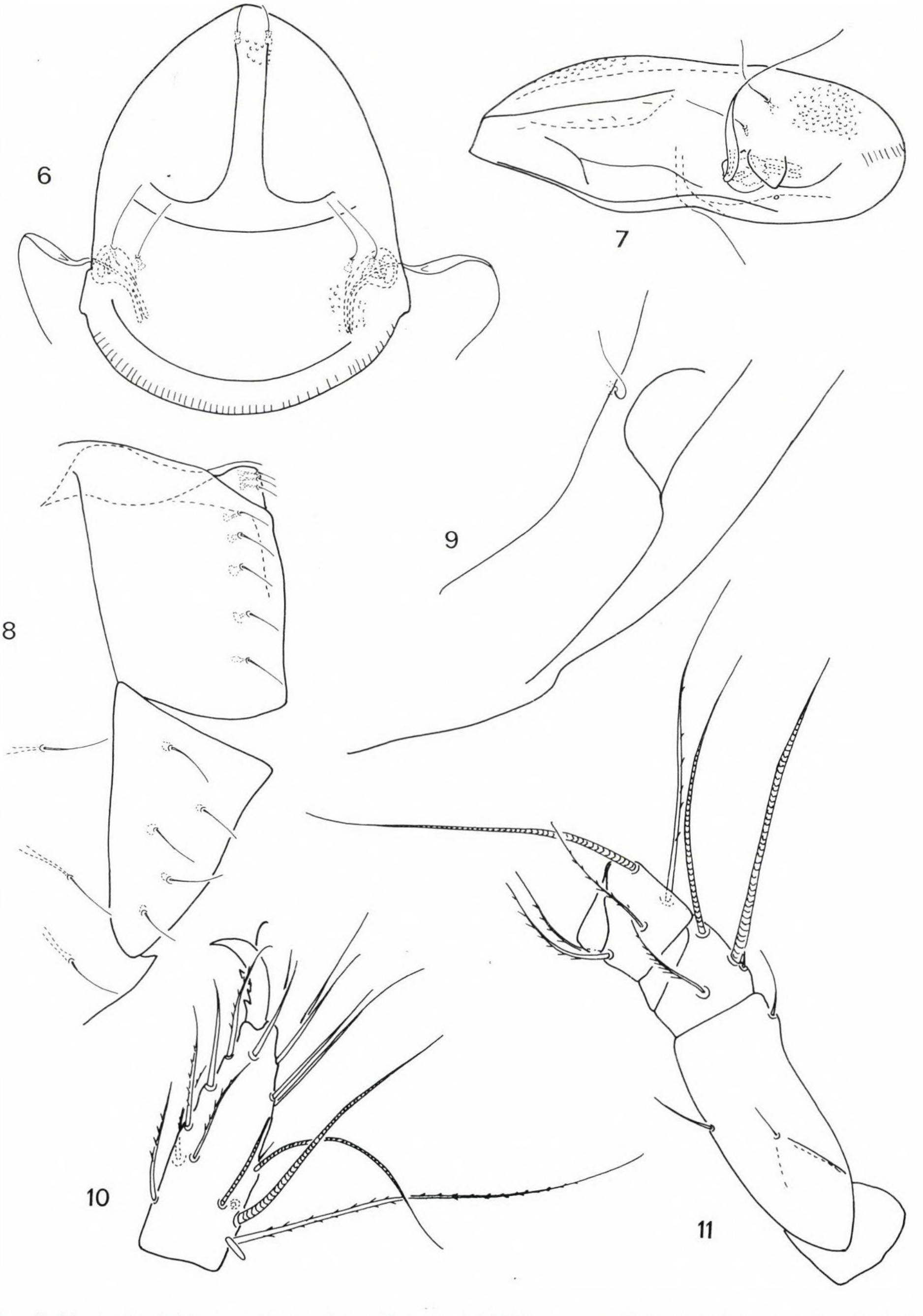
Archiphthiracarella insularis (BALOGH, 1962) comb. n.

The species was described on the basis of a single specimen (holotype) by BALOGH (1962) from Madagascar. Since the holotype specimen has been destroyed, I designate one specimen from this series to be a neotype.

Complementary description

Measurements. – Length of aspis: 201–246 µm, length of notogaster: 310–420 µm, height of notogaster: 261–338 µm.

Aspis: Dorsal margin clearly concave medially. The surface with sculpture consisting of small foveolae anteriorly and basally. Lamellar and interlamellar setae nearly equal in size (Fig. 6); both pairs filiform. Sensillus dilated basally, but much finer (Fig. 7) than in the preceding species.



Figs 6–11. *Archiphthiracarella insularis* (BALOGH, 1962) – 6 = aspis in dorsal aspect, 7 = aspis in lateral aspect, 8 = anogenital region, 9 = collar line with seta c_3, 10 = tarsus of leg I, 11 = femur genu and tibia of leg I

Notogaster: Similar to the preceding species, as are the notogastral setae. The position of the setae is different, setae c_3 arising clearly on the collar line (Fig. 9), seta p_3 far from the lateral margin.

Ventral regions: As shown in Fig. 8.

Legs: Leg I shown in Figs 10–11; similar to those of the preceding species. Leg chaetotaxy of mixed type, with same setal formulae as those of previous species. Sizes of setae are similar, only small setae coupled with solenidium ω_2 being longer than in other species.

Material examined: Neotype (NO–1533–96) and two other specimens: Malagasy Republic. "Central E Madagascar, degraded montane rainforest on Mt. Ambatokirijy at the S edge of Andasibe (Perinet) forest reserve, at 950–1000 m. alt. 3. Oct. 1994" Leg. Dr. T. PÓCS. Neotype (NO–1933–1996) and one more specimen are deposited in the HNHM, Budapest, while one specimen is in the Muséum d'Histoire naturelle, Genève, Switzerland. One specimen is in the collection of Dr. W. NIEDBALA.

Remarks: See after the preceding species.

Acknowledgement – This work was sponsored by the Hungarian National Scientific Research Fund (OTKA: T 016729).

REFERENCES

BALOGH, J. (1962) Reserches sur la faune endogée de Madagascar. VII. Oribates (Acariens) nouveaux. II. *Naturaliste malgache* **13**: 121–151.

MAHUNKA, S. (1990*a*) A survey of the superfamily Euphthiracaroidea Jacot, 1930 (Acari: Oribatida). *Folia ent. hung.* **51**: 37–80.

MAHUNKA, S. (1990*b*) Notes and remarks on Oribatid taxa (Acari), I. *Annls hist.-nat. Mus. natn. hung.* **82**: 191–215.

MAHUNKA, S. (1994) Oribatids from Madagascar (Acari: Oribatida) II. *Revue suisse zool.* **101**: 47–88.

NIEDBALA, W. (1986) Systeme des Phthiracaroidea (Oribatida, Euptyctima). *Acarologia* **27**: 61–84.

NIEDBALA, W. (1992) *Phthiracaroidea (Acari, Oribatida) Systematic Studies.* PWN Warsawa – Elsevir, Amsterdam, 612 pp.

PARRY, B. W. (1979) A revision of the British species of the genus Phthiracarus Perty, 1841 (Cryptostigmata: Euptyctima). *Bull. Br. Mus. nat. Hist. (Zool.)* **35**: 323–363.

Received January 22, 1996, accepted May 22, 1996

Acta Zoologica Academiae Scientiarum Hungaricae 42(1), pp. 23–40, 1996

NEW CLIVININI FROM THE ORIENTAL REGION (COLEOPTERA: CARABIDAE, SCARITINAE)

M. BALKENOHL

Kirchstrasse 5/2, 79211 Denzlingen, Germany

Five new species of the tribe Clivinini (Scaritinae) from Indochina are described and illustrated, and two new genera are erected for these species: *Sinesetosa* gen. n. is monotypical with the type species *S. acugena* sp. n. and *Rugiluclivina* gen. n. is based on four new species: *R. reticulata* sp. n., *R. puncticollis* sp. n., *R. wrasei* sp. n., and *R. rugicollis* sp. n.. A key to the known Oriental genera of the tribe Clivinini and to the species of the genus *Rugiluclivina* is given.

Key words: taxonomy, Coleoptera, Carabidae, Clivinini, Oriental region

INTRODUCTION

Around 130 species of the tribe Clivinini (sensu BASILEWSKY 1973) are known to occur in the Oriental region including New Guinea (ANDREWES 1929, 1930, 1931, 1936*a, b*, KULT 1951, DARLINGTON 1962). Especially in this group of Scaritinae there are many closely related species, sibling species, and many of them are not easy to discriminate. Most of the genera and species groups need to be revised. This may be a reason why only very few new Oriental Clivinini species have recently been described, although this region is still poorly investigated. The species described very recently exhibit extraordinary characters, so that they can be easily recognized with certainty even without new revisions of the groups (e.g. BAEHR 1989, DOSTAL 1993).

Checking Oriental material I became aware of five new interesting species showing such striking characters that they cannot be placed in any of the known species groups. Comparison with the other known Oriental genera revealed that the new species obviously belong to two new genera.

For the proposed "Key to Oriental genera of Clivinini", type and/or comparative material was examined for each genus. This material, as well as the type material of the new species described, is deposited in the following collections: BMNH – The Natural History Museum, London, United Kingdom, CBA – collection of author, Denzlingen, Germany, CBM – collection of Dr. Martin Baehr, München, Germany, CDW – collection of Dr. Alexander Dostal, Wien, Austria, CHP – collection of Prof. Dr. Karel Hurka, Praha, Czech Republic, CWB – collection of David W. Wrase, Berlin, Germany, HNHM – Department of Zoology, Hungarian Natural History Museum, Budapest, Hungary, IRSNB – Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium, NHMB – Naturhistorisches Museum Basel, Switzerland, NHMW – Naturhistorisches Museum, Wien, Austria, SMNS – Staatliches Museum für Naturkunde, Stuttgart, Germany.

Information given on the labels of the type material described are quoted as they appear on the labels.

Terms and descriptions of characters were based on ANDREWES (1929), JEANNEL (1957) and KULT (1959) with the following specifications: total length was measured including closed mandibles and the length of elytra does not include the pedunculus.

KEY TO ORIENTAL GENERA OF CLIVININI

1 Head without supraorbital and clypeal setigerous punctures; facial carina and facial sulcus on frons not developed; genae conspicuously projecting laterally **Sinesetosa** gen. n.

– Head with two pairs of supraorbital and one pair of clypeal setigerous punctures; facial carina and facial sulcus on each side of frons distinctly visible 2

2 Median line of pronotum conspicuously broad and deep; left mandible with distinctly sharp tooth at middle, gena as long as eye but not projecting laterally 3

– Median line of pronotum normally developed or indistinct; tooth at middle of left mandible absent or inconspicuous, gena shorter than eye 4

3 All intervals of elytron carinate in total; punctures of striae foveolate; antennal groove prolonged posteriorly above level of hind-eye *Androzelma* DOSTAL, 1993

– Intervals of elytron convex, only interval 8 carinate in total or at humerus and apex; punctures of striae not foveolate; antennal groove as long as 0.4 of eye diameter *Orictites* ANDREWES, 1931

4 Basal tarsomere of front leg large, with rows of numerous bristles on dorsal surface 5

– Basal tarsomere of front leg of moderate size or small, with few apical bristles only 7

5 Segments 4–10 of antenna flattened, with shiny areas on both flattened sides; labrum straight or with moderate excisions anteriorly; 2nd segment of labial palpus with the regular 2 setae 6

– Segments 4–10 of antenna cylindriform, completely pubescent; labrum with deep excision at middle, lateral parts forming projecting rounded lobes; 2nd segment of labial palpus with 1 seta *Rugiluclivina* gen. n.

6 Lateral teeth of clypeus conspicuously projecting anteriorly, oval, as big as frontal plates; labrum with 2 moderate excisions at middle; length 14–22 mm *Sparostes* PUTZEYS, 1867

– Lateral teeth of clypeus hardly projecting bejond middle of clypeus, much smaller than frontal plates; labrum straight anteriorly; length 7–11.5 mm *Pseudoclivina* KULT, 1947

7 Maxillary palp securiform; segment 2 of antenna attached excentrically to scapus 8

– Maxillary palp fusiform or ensiform; segment 2 of antenna attached normally to scapus 10

8 Proepisternum tumid, projecting laterally, distinctly visible from above; no interval of elytron with traces of carinae; frons of head with triangle-like tubercle *Trilophus* ANDREWES, 1927; *Trilophidius* JEANNEL, 1957

– Proepisternum not tumid laterally, reflexed margin forming the lateral border in dorsal view; interval 7 and/or 8 with carina(e) at humerus and/or apex; no triangle-like tubercle on frons of head 9

9 Pronotum with 3 punctured sulci in form of an "Y" on each side; frons of head hollowed out concavely *Ancus* PUTZEYS, 1867

– Pronotum without sulci; frons of head flattened to moderately convex; frons and clypeus distinctly elongated anteriorly *Syleter* ANDREWES, 1941

10 Frons of head with 3 anteriorly joining carinae, forming an arrow-head; clypeus 4-dentate; interval 7 with blunt rudimentary carina at humerus *Coryza* PUTZEYS, 1867

– Frons of head without carinate sculpture of an arrow-head; margin of clypeus without 4 acute teeth; intervals 7 and 8 carinate at humerus, 8 carinate at apex *Clivina* LATREILLE, 1802

Sinesetosa gen. n.

Type species: *Sinesetosa acugena* sp. n.

Description: Size and shape: small (4.8 mm), form elongate, parallel, dorsally depressed.

Head: Prognathous. Large. Surface slightly convex. Eye obtuse-angular, small and flat dorsally, four fifths located ventrally, divided from paragena by antennal groove. Clypeus fused to frons, asetose. Supraorbital setae missing. Labrum wide, anterior margin widely rounded off, 7-setose. Mandibles short, wide. Antennal groove half as long as eye, limited by transversal carina. Antenna short; scapus of moderate size, flattened dorsobasally, single seta situated dorsofrontally; pedicellus a quarter longer than 3rd segment; segments 4–11 moniliform, pubescent from apical third of 3rd segment.

Pronotum: Square, reflexed margin and marginal channel reaching from anterior angles to pedunculus, not interrupted. Anterior seta situated at end of anterior quarter, posterior seta at hind angle.

Elytron: Series umbilicata uninterrupted from humerus to apex. Seven-striate, striae 8 and 9 situated in marginal channel, base of first stria with small setigerous tubercle. Intervals 6 and 7 finely carinate mesially to striae, 5 finely carinate at humerus.

Lower surface: Intercoxal part of pronotum flattened, with fine carina anteriorly, prolonged anteriorly as short flattened keel. Abdominal sterna transversally sulcate (ventral strigae), 3rd–6th sternum with 2 setae each.

Legs: Protibia with one strong apical and 3 lateral denticles. Intermediate tibia with 2 rows of setigerous tubercles posteriorly in apical half, flattened between tubercle rows, not hirsute mesially. Tarsal segments asetose dorsally, those of males with no adhesive pads ventrally. First tarsomere of protarsus as long as tarsomeres 2–4.

For more details see description of type species.

Derivatio nominis: The name refers to the missing clypeal and supraorbital setae on the head.

Sinesetosa acugena sp. n.

(Figs 1, 2)

Type material: holotype (HT): male, Thailand, Amphoe Chiang Dao, Doi Chiang Dao, 1400 m, 7.I.1989, leg. J. TRAUTNER & K. GEIGENMÜLLER (SMNS).

Paratype (PT): 1 ♀, N Vietnam, Tam Dao, 900 m, 13–24.V.1989, leg. A. OLEXA (NHMB).

Description – Measurements: Length 4.7 mm (PT 4.8 mm); width 1.3 mm (PT 1.3 mm); ratio length/width of pronotum 0.93 (PT 0.94); ratio length/width of elytra 2.06 (PT 2.08).

Colour: Shiny. Dorsal and ventral surface fuscus in total. (PT dark fuscus.)

Head: Nearly as wide as pronotum. Outline campanulate. Clypeus and wings fused, finely margined, slightly bisinuate anteriorly, separated from supraantennal plate by slight notch. Supraantennal plate margined carina-like, with broad vault mesially and concavity laterally, covering scapus of antenna. Supraorbital furrow developed as deep wide channel. Clypeus and frons not divided by transverse impression, slightly convex. Longitudinal flat furrow between frons and supraantennal plates, diverging and indistinct posteriorly, running up to neck constriction (more distinct in PT). Frons moderately convex. Neck constriction interrupted at middle. Neck with distinct isodiametric reticulation laterally. Surface with finely scattered sticked punctures. Eye flattened dorsally, one fifth visible from above, ventral part convex, reaching antennal groove. Gena enclosing eye posteriorly by one third, with conspicuous projecting knob laterally. Mandibles with dorsal carina, two small teeth basally, scrobe short, basal half chagreened ventrally. Mentum large, divided from submentum by suture, basal seta at each side, distinct acute and unidentate tooth with carina at middle, each side of tooth with seta. Lateral lobes of mentum projecting beyond tooth, acute-oval, indistinctly margined laterally, mesial border of lobes and tooth carinate. Submentum with 4 setae situated in foveae. Gula with transverse reticulation, sutures distinct. Ligula short, moderately wide, obtuse-angled, two setae situated close together apically. Maxilla free at base, mesial lobe adunce, with fringe of setae at mesial border. Maxillary palp asetose, slender, terminal segment elongate-securiform, basal segment tumid. Apical segment of labial palp fusiform, 2nd segment with two setae mesially. Paragena angustate-carinate in whole length, divided from mentum and submentum by buccal fissure. Antenna short, reaching middle of pronotum, segments 4–10 moniliform, wider than long.

Fig. 1. *Sinesetosa acugena* gen. n. et sp. n. holotype, male, habitus

Fig. 3. *Rugiluclivina reticulata* gen. n. et sp. n. holotype, male, habitus

Pronotum: Quadrate, explanate on disc (lateral view), convex laterally (frontal view). Anterior angles projecting, rounded off. Posterior angles marked by slight knob. Lateral border straight. Reflexed margin and marginal channel smaller at anterior and posterior angles, wider at middle of base. Posterior seta removed from lateral channel by diameter of pore. Base slightly produced at middle. Anterior transverse line fine, interrupted at middle. Median line conspicuous, not joining anterior transverse line, reaching base. Basal impressions absent. Dorsal surface with scattered punctures of moderate size, laterally without punctures but with few fine transverse wrinkles.

Elytron: Elongate, side nearly parallel to suture. Disc flattened, distinctly convex laterally. Humerus rounded, with fine humeral tooth pointing medially. Base margined from humerus to peduncle, with isodiametric reticulation, 2 flat tubercles in form of triangles at declivity of 3rd and 4th interval each. Tubercle-like carina at indistinct scutellar stria. Striae punctate-striate, 1 and 7 reaching tip of apex, other ending on apical declivity, 1–4 free at base. Intervals flat, 6th and 7th finely carinate in total mesially, 5th carinate at humerus only, carina of 7th interval more distinct at apex. Intervals flattened, 6th and 7th narrowed, 3rd with 6/7 (PT 13/12), 5th with 4/6 (PT 11/14), 7th with 3/2 (PT 6/5) setigerous punctures, situated irregularly at intervals, punctures of 7th interval situated in apical half. Setae fine, short, erect.

Ala: Macropterous.

Lower surface: Proepisternum laterally covered with distinct transverse wrinkles and isodiametric reticulation, mesially with distinct punctures. Submarginal furrow more distinct anteriorly, reaching from anterior angle to pedunculus. Basal half of epipleura indistinctly sulcate, smooth. Abdominal sterna with conspicuous scattered punctures of moderate size; punctures of terminal segment with decreasing diameter apically to very finely ones. Ventral strigae smooth. Two apical setigerous punctures of 6th sternum very widely separated.

Legs: Protibia slightly sulcate dorsally, with lateral upper spine turned distinctly ventrally and laterally; movable spur ensiform, shorter than spine, turned slightly ventrally. First and 2nd preapical lateral denticles sharp, 3rd indistinct. Intermediate tibia with distinct spur apically.

Aedoeagus (Fig. 2): Median lobe squat, apex straight. Both parameres apically with one long seta and few short fine setae.

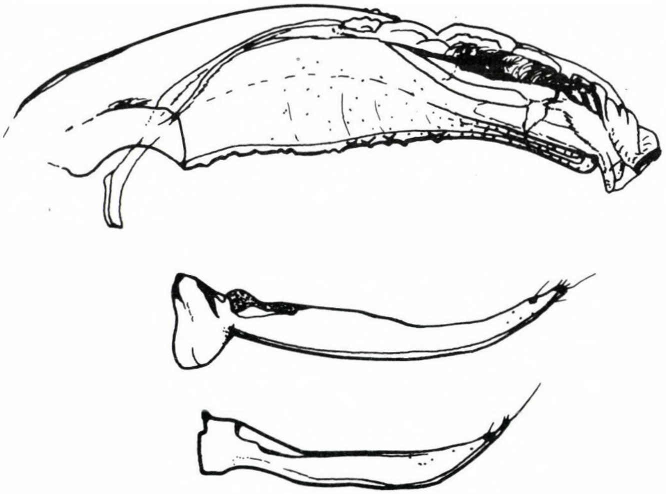


Fig. 2. *Sinesetosa acugena* gen. n. et sp. n. holotype, aedoeagus with parameres, left lateral view

Distribution and habitat: Known from the type localities in Thailand and North Vietnam. From Thailand a more precise description of the habitat is available: northwest side of Doi Chiang Dao, 1400 m, moist primary forest, steep slope, shady, in/under rotten wood.

Derivatio nominis: In reference to the noteworthy projecting genae.

Rugiluclivina gen. n.

Type species: *Rugiluclivina reticulata* sp. n.

Description – Size and shape: small (5.0–10.3 mm), cylindriform.

Head: Prognathous, smaller than pronotum. Surface globose, frons and clypeus covered with longitudinal carinae. Eye hemispherical, divided from paragena by antennal groove. Clypeus divided from frons by distinct transverse sulcus, one seta at each side. Two supraorbital setae at each side over posterior half of eye. Labrum wide, with conspicuous excision anteriorly, 6-setose. Segment 2 of labial palpus with one seta. Mandibles moderately long, sharp, wide at base. Antennal groove two-thirds shorter than eye. Antenna short, single seta of scapus situated dorsofrontally; pedicellus attached excentrically to scapus; segments 4–11 elongate, pubescent from apical two-thirds of 3rd segment.

Pronotum: Subquadrate, reflexed margin and marginal channel reaching from anterior angles to base, not interrupted. Anterior seta situated at end of anterior fifth, posterior seta at hind angle.

Elytron: Series umbilicata uninterrupted from humerus to apex. Seven-striate, striae 8 and 9 situated in marginal channel, base of intervals with tubercles, first with setigerous tubercle. Interval 7 carinate at humerus and apex, 8 carinate at humerus and apex or in total. Basal declivity perpendicularly falling.

Lower surface: Intercoxal part of pronotum flattened, with carina at each side. Abdominal sterna transversally sulcate (ventral strigae), 3rd–6th sternum with 2 setae each.

Legs: Protibia with one strong apical and three wide lateral denticles. Profemora ventrally with wing-like tooth at apex. Intermediate tibia with distinct apical spur, not hirsute mesially. First segment of protarsus long, dorsally with rows of setae. Tarsal segments of males with no adhesive pads ventrally.

For more details see description of type species.

Derivatio nominis: The name refers to the dense carinae on the frons and clypeus which gives the surface of the head a rugose appearance.

KEY TO SPECIES OF GENUS RUGILUCLIVINA

1 Third interval of elytron with 4 setigerous punctures, 8th carinate in whole length; labrum finely margined laterally 2

– Third interval of elytron with 3 setigerous punctures, 8th carinate at humerus and apex only; labrum not margined laterally 3

2 Black; whole surface of elytron covered with isodiametric reticulation, dull; intervals flattened; pronotum coreaceate; length 7.35–8.30 mm
R. reticulata sp. n.

– Brown; surface of elytron smooth, shiny; intervals convex; pronotum smooth on disc; 5.0–5.25 mm **R. wrasei** sp. n.

3 Elytra slightly dilated in apical half; 2 setae of ligula separated; dorsal surface of pronotum with punctures forming an "Y" at each side; base of pronotum moderately produced, reflexed margin running from posterior angle to base as concave line; length 5.70–6.80 mm **R. puncticollis** sp. n.

– Elytra not dilated in apical half; 2 setae of ligula close together or fused; dorsal surface of pronotum with transverse rugae; base of pronotum distinctly produced, reflexed margin running from posterior angle to base as straight line; length 8.0–10.3 mm. **R. rugicollis** sp. n.

Rugiluclivina reticulata sp. n.

(Figs 3, 9)

Type material: holotype: male, Asia, Laos, Vientiane env., VIII. 1989 (CBA).

Paratypes: 1 ♀, same data as holotype (CBA); 1 ♂, 1 ♀, Laos, Vientiane nábr. Mekongu, svétlo, VI. 1989, leg. T. SCHOLZ (CHP); 1 ♀, Laos, Thaduca env. 24.VI.1989 (CBA).

Description – Measurements: Length 7.35–8.30 mm ($\bar{x}$ = 7.85 mm; including closed mandibles), width 2.05–2.18 mm ($\bar{x}$ = 2.12 mm), ratio length/width of pronotum 0.94–0.99 ($\bar{x}$ = 0.97), ratio length/width of elytra 1.95–2.08 ($\bar{x}$ = 2.03); (n = 5).

Colour: Dorsal and ventral surface dull; melaenus; mouthparts, antennae, supraantennal plates, intermediate, and hind legs paler.

Head: One-fourth smaller than pronotum. Outline nearly square. Clypeus square, straight truncated anteriorly, with two projecting acute teeth laterally, margined, separated from frons by deep transversal furrow, distinctly separated from wings by notches. Wing a bit wider than a tooth of clypeus, projecting anteriorly as far as teeth of clypeus. Supraantennal plate vaulted, lateral border finely margined, projecting broadly laterally but not beyond eye, with obtuse rounded angle anteriorly, projecting anteriorly less than wing, separated from wing by notch. Furrows between clypeus, wing and supraantennal plate joining posteriorly, 2 clypeal setae situated at joining point of furrows, joined furrows meeting with transverse furrow at level of front-eye. Supraorbital furrow deep, wide, conspicuously diverging and running to level of hind gena. Supraorbital carina intimated and two distinct supraorbital setae at each side. Frons globose. Neck constriction absent. Dorsal surface covered completely with small longitudinal carinae and rugae, intricate at neck and posterior genae. Wing smooth. Slight median impression on frons in holotype and some paratypes. Eye of moderate size, hemispherical. Gena short, not projecting. Antenna not reaching posterior seta of pronotum, segments 4–10 elongate (ratio length/width 1.62), seta on scapus situated dorsofrontally at apical tip, segment 2 attached excentrically, segment 3 pubescent in apical two-thirds, fully pubescent from segment 4. Labrum as wide as clypeus, bilobed, conspicuously excised at middle, lobes finely margined laterally, 6-setose, ciliate laterally, surface with indistinct transverse reticulation. Mandibles nearly as long as head (open position), slender apically, sharp, apical half and lateral margin bent dorsally, with 3–4 fine longitudinal carinae in basal half. Maxillary palp slender, two apical segments slightly bent laterally; apical segment of labial palp fusiform, 2nd segment tumid, with 1 seta. Ligula long, wide, spatulate, two apical setae close together.

Pronotum: Subquadrate, explanate on disc (lateral view), equally globose in frontal view. Anterior angles pointed, slightly rounded and projecting. Posterior angles marked by knob. Lateral border rounded in anterior and posterior third, straight and parallel at middle. Reflexed margin and marginal channel of same size in whole length. Posterior seta removed from lateral channel by diameter of pore. Base slightly produced at middle. Reflexed margin running from posterior angles to base as concave line. Anterior transverse line deep, reaching anterior margin, not joining lateral margin. Median line distinct, complete. Dorsal surface conspicuously coreaceate in total, isodiametric reticulation at base.

Elytron: Cylindriform, slightly dilated in apical half, slightly contracted to humerus. Humerus rounded, rectangular. Base distinctly concave at declivity, margined from humerus to peduncle, declivity perpendicularly falling to pedunculus, setigerous tubercle at base of first stria, one fine tubercle at base of each other interval. Short tubercle-like carina at indistinct scutellar stria. Striae punctate-striate, 2–5 not reaching tip of apex, ending on apical declivity at carina of interval 7, 1–4 free at base. Punctures of stria 9 visible in marginal channel parallel to umbilical setigerous tubercles, more distinct apically. Intervals flat, convex at apical declivity, 7th distinctly carinate at humerus and apex, 8th carinate in total. Nineth interval with uninterrupted series of umbilical setae. Third interval with 4 setigerous punctures, situated at 3rd stria. Whole surface covered with distinct isodiametric reticulation.

Ala: Macropterous.

Lower surface: Proepisternum covered distinctly with isodiametric reticulation, some transverse wrinkles laterally, submarginal furrow visible in anterior half. Abdomen covered with distinct isodiametric reticulation, terminal segment with irregular transverse carinae in apical half, two apical setigerous punctures widely separated.

Legs: Protibia with distinct and complete carina and sulcus dorsally, lateral upper spine ensiform, turned distinctly ventrally and slightly laterally; movable spur explanate at apex, shorter than spine, turned slightly ventrally. Three preapical lateral denticles distinct, obliquely truncated. First segment of protarsus with rows of setae dorsally, nearly as long as other four segments together. Intermediate tibia with distinct spur apically, not densely hirsute at inner side.

Aedoeagus (Fig. 9): Median lobe moderately arcuate at middle, wide parts of endophallus covered with distinct spines. Both parameres apically with 4 long setae.

Distribution: Known from the type localities in Laos (Vientiane and Thaduea).

Derivatio nominis: The name is derived from the distinct reticulation on the elytra.

Rugiluclivina wrasei sp. n.

(Figs 6, 10)

Type material: holotype: male, North Laos, Mekong river, 10 km N Luang Prabang, 240 km N Vientiane, IX.1992, hilly country, sparse setteled, primary vegetation, leg. INSOMSAY SOMSY (CWB).

Paratypes: 4 ♂, 3 ♀, same data as holotype (CWB/CBA).

Description: Only characters different from the other species are given.

Measurements: Length 5.0–5.25 mm ($\bar{x}$ = 5.1 mm; including closed mandibles), width 1.25–1.34 mm ($\bar{x}$ = 1.3 mm), ratio length/width of pronotum 1.06–1.09 ($\bar{x}$ = 1.08), ratio length/width of elytra 2.15–2.24 ($\bar{x}$ = 2.20); (n = 8).

Colour: Shiny; fuscuous; labial palpus, maxillary palp, antennae and clypeus fulvus.

Head: One-fifth smaller than pronotum. Clypeus rectangular, wide, projecting lateral teeth small; transversal furrow deep; wing as wide as lateral tooth of clypeus, not projecting anteriorly as far as teeth of clypeus; supra-antennal plates vaulted, lateral border distinctly margined. Supraorbital furrow wide, conspicuously diverging posteriorly and ending at posterior supraorbital setigerous puncture. Supraorbital carina distinct at level of hind eye. Frons globose. Longitudinal carinae on dorsal surface running from neck to clypeus, converging anteriorly, partly joining at middle of clypeus. Wing with rugae. Slight median impression on frons (holotye and most of the paratypes). Segments of antenna elongate (ratio length/width 1.3), segment 3 pubescent from apical three-fourths. Labrum wider than clypeus, amargined, with indistinct transverse reticulation basally. Open mandibles one-fourth smaller than head. Two apical segments of maxillary palp securiform, bent distinctly laterally. Two apical setae of ligula fused.

Pronotum (Fig. 6): Outline subrectanglar. Nearly straight on disc (lateral view), explanate on disc and convex laterally in frontal view. Anterior angles small, acute, not as far advanced anteriorly as front border. Posterior angles very small, obtuse. Lateral border rounded at anterior angles and in posterior third, straight at middle. Reflexed margin and marginal channel finer at base. Base indistinctly produced at middle. Reflexed margin running from posterior angles to base as straight line. Dorsal surface smooth at middle, laterally with some punctures at base and a few rugae anteriorly. Lateral punctures and rugae variable, forming an "Y" in holotype and two paratypes, other paratypes with more rugae instead of punctures. Small longitudinal short rugae on both sides of anterior transverse line, indistinct isodiametric reticulation at basal declivity.

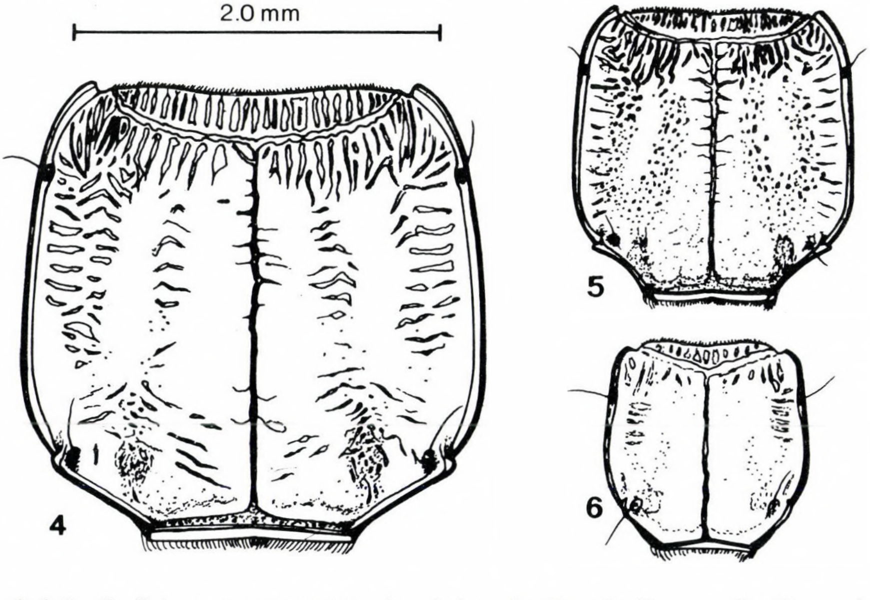
Elytron: Base distinctly concave at declivity. Fine carina at indistinct short scutellar stria. Tubercles at base of stria 2–4 indistinct, distinct at stria 5. Stria punctate-striate, punctures indistinct. Punctures of stria 9 visible in apical third. Intervals convex, 8th carinate in total, carina indistinct at middle. Seventh carinate at humerus and apex. Third interval with 4 setigerous punctures, situated at 3rd stria. Surface smooth, shiny. Intervals 7 and 8 with isodiametric reticulation.

Ala: Macropterous.

Lower surface: Submarginal furrow reaching from anterior angles to base. Abdomen nearly smooth at middle, sterna with distinct isodiametric reticulation, terminal segment with irregular rugae in apical three-fourths.

Legs: Protibia with complete sulcus dorsally, lateral upper spine turned ventrally and laterally; movable spur slightly explanate at apex, as long as spine. Segment 1 of protarsus as long as segment 2 and 3 together.

Aedoeagus (Fig. 10): Median lobe slightly arcuate at middle, distinctly arcuate apically. Endophallus strongly folded, some stronger spines visible laterally. Both parameres arcuate apically, with 4 setae at apex.



Figs 4–6. *Rugiluclivina* gen. n.: pronotum, dorsal view; 4 = *R. rugicollis* sp. n.; 5 = *R. puncticollis* sp. n.; 6 = *R. wrasei* sp. n.

Distribution: Known from the type locality in the North of Laos (Luang Prabang).

Derivatio nominis: The new species is dedicated to the specialist of Carabidae, David W. Wrase, Berlin.

Rugiluclivina puncticollis sp. n.

(Figs 5, 8)

Type material: holotype: male, Vietnam, Hanoi City, Ho Tay, 08.X.1986, at light, leg. MÉSZÁROS, OLÁH, VÁSÁRHELYI (HNHM).

Paratypes: 1 ♂, 6 ♀, same data as holotype and Vietnam, prov. Bac. Thai, Nguyen, 40 m, 21°24'N, 105°50'E, 23.V.1987, at light, leg. MATSKÁSI, OLÁH, TOPÁL (HNHM/CBA); 1 ♂, 1 ♀, Indo Chine, Hanoi, 1923/25, Coll. DUSSAULT (NHMB/CBA); 1 ♀ , Vietnam, Hanoi, 21.V.–11.VI.1986, leg. J. RYBNICÉK (NHMB); 1 ♀, Vietnam, Hoa binh, Ha son binh prov., 4.–7.VI.1986, leg. J RYBNICÉK (CBA); 1 ♂, Tonkin, Hanoi (CDW); 1 ♀, Tonkin, KOLLE 1917 (CBA); 1 ♀ , Vietnam, Hanoi, 21.V.–11.VI.1986, leg. J. HORÁK (CDW).

Description: Only characters different from the other species are given.

Measurements: Length 5.70–6.80 mm ($\bar{x}$ = 6.48 mm; including closed mandibles), width 1.55–1.85 mm ($\bar{x}$ = 1.76 mm), ratio length/width of pronotum 1.01–1.05 ($\bar{x}$ = 1.03), ratio length/width of elytra 2.01–2.07 ($\bar{x}$ = 2.05); (n = 15).

Colour: Shiny; dark fuscous; mouthparts, antennae, supra-antennal plates intermediate, and hind legs fulvus.

Head: Projecting lateral teeth of clypeus smaller. No median impression on frons. Segments of antenna elongate (ratio length/width 1.61). Labrum amargined laterally. Two apical setae of ligula separated.

Pronotum (Fig. 5): Slightly convex on disc (lateral view), equally convex in frontal view. Anterior angles acute, slightly projecting. Posterior angles marked by acute knob. Lateral border rounded in anterior quarter and posterior third, straight and slightly converging at middle. Reflexed margin and marginal channel finer in anterior quarter, wider at base. Base moderately produced at middle. Reflexed margin running from posterior angles to base as concave line. Dorsal surface with distinct punctures and some scattered finely sticked punctures, both forming a more or less distinct "Y" at each side, base of "Y" developed as slight basal impression, smooth and shiny areas at middle on both sides of median line and laterally at marginal channel, some distinct longitudinal short carinae on both sides of anterior transverse line, transverse wrinkles at sides, indistinct isodiametric reticulation at base.

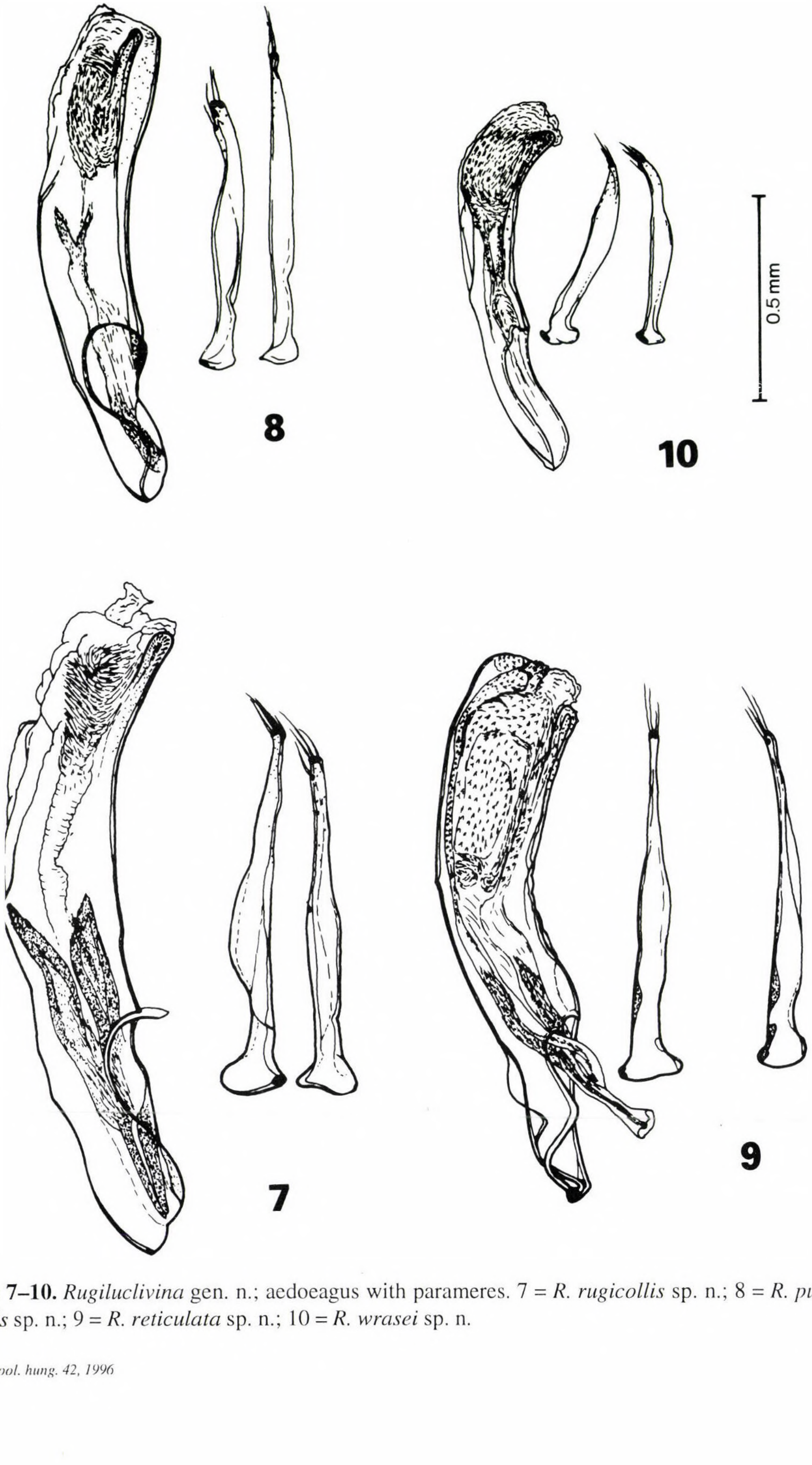
Elytron: Base moderately concave at declivity. Fine carina at indistinct short scutellar stria. Punctures of stria 9 visible in apical half. Intervals convex in total, 7th and 8th moderately carinate at humerus, 7th apically short and fine, 8th distinct at apex and 4 times longer than carina of 7th. Third interval with 3 setigerous punctures, situated at 3rd stria. Surface smooth, shiny. Interval 7 partly and 8 completely with isodiametric reticulation.

Ala: Macropterous.

Lower surface: Submarginal furrow reaching from anterior to posterior angles. Abdomen smooth at middle, sterna with isodiametric reticulation, terminal segment with irregular rugae in apical half.

Legs: Protibia with fine sulcus dorsally (interrupted in some of the paratypes), carina indistinct, lateral upper spine turned ventrally and laterally; movable spur slightly explanate at apex, as long as spine. Segments 2 to 5 of protarsus one-fifth longer than first segment.

Aedoeagus (Fig. 8): Median lobe slightly arcuate at middle. Endophallus strongly folded, few spines visible centraly. Both parameres with four long setae at apex.



Figs 7–10. *Rugiluclivina* gen. n.; aedoeagus with parameres. 7 = *R. rugicollis* sp. n.; 8 = *R. puncticollis* sp. n.; 9 = *R. reticulata* sp. n.; 10 = *R. wrasei* sp. n.

Distribution: Known from the type localities in Vietnam (Hanoi and Hoa binh).
Derivatio nominis: The name refers to the characteristic punctures on the pronotum.

Rugiluclivina rugicollis sp. n.
(Figs 4, 7)

Type material: holotype: male, Indo China, Ban Som Di., X. 1914, leg. R.V. de SALVAZA (BMNH).

Paratypes: 3 ♂, 3 ♀, same data as holotype (BMNH, CBA).

Description: Only characters different from the other species are given.

Measurements: Length 8.0–10.3 mm ($\bar{x}$ = 9.2 mm; including closed mandibles), width 2.13–2.75 mm ($\bar{x}$ = 2.46 mm), ratio length/width of pronotum 0.95–0.98 ($\bar{x}$ = 0.97), ratio length/width of elytra 2.03–2.11 ($\bar{x}$ = 2.08); (n = 7).

Colour: Shiny; dark fuscuous; mouthparts, antennae, supra-antennal plates, intermediate and hind legs paler.

Head: Clypeus rectangular, wide, projecting lateral teeth smaller. Transversal furrow moderately deep, wing twice as wide as a lateral tooth of clypeus, not projecting anteriorly as far as teeth of clypeus, supra-antennal plates slightly vaulted, lateral border distinctly margined. Supraorbital furrow wide, conspicuously diverging posteriorly and ending at posterior supraorbital setigerous puncture. Supraorbital carina distinct. Frons convex. Longitudinal carinae on dorsal surface running from neck to clypeus, converging anteriorly, partly joining at middle anteriorly. Wing with rugae. No median impression on frons. Segments of antenna elongate (ratio length/width 2.20), segment 3 pubescent from apical three-fourths. Labrum wider than clypeus, amargined, with fine and indistinct transverse reticulation. Two apical segments of maxillary palp securiform, bent distinctly laterally. Two apical setae of ligula fused (holotype) or close together (paratypes).

Pronotum (Fig. 4): Explanate on disc (lateral view), equally globose in frontal view. Anterior angles acute, slightly projecting. Lateral border rounded in anterior fifth and posterior third, straight and slightly converging at middle. Lateral border and marginal channel of same size from anterior angles to posterior setigerous punctures. Base distinctly produced. Reflexed margin running from posterior angles to base as straight line. Dorsal surface with transverse rugae laterally and short ones at median line, longitudinal short rugae on both sides of anterior transverse line, nearly smooth on disc, slight basal impression at each side, fine isodiametric reticulation at base.

Elytron: Not dilated in apical half, distinctly contracted to humerus. Base conspicuously concave at declivity. Short tubercle-like carina basally at suture. Stria 2–6 ending on apical declivity at carina of 7th interval. Intervals moderately convex in total, 7th and 8th moderately carinate at humerus, carina of 7th short apically, 8th distinctly and 3 times longer carinate at apex than 7th. Third interval with 3 setigerous punctures, situated at 3rd stria. Surface smooth, shiny, intervals with some transverse strioles, 8th completely with isodiametric reticulation.

Ala: Macropterous.

Lower surface: As in *R. puncticollis* sp. n.

Legs: Protibia as in *R. reticulata* n. sp.. Protarsus as in *R. puncticollis* sp. n.

Aedoeagus (Fig. 7): Median lobe moderately arcuate at middle. Endophallus with long and fine bristles. Both parameres with four long and strong setae at apex.

Distribution: Known from Ban Som district in Indo China.
Derivatio nominis: The name is derived from the rugae on the pronotum.

Table 1. Known Oriental genera of the tribe Clivinini: selection of diagnostic characters

	Characters	*Trilophus* ANDREWES *Trilophidius* JEANNEL[1]	*Syleter* ANDREWES	*Ancus* PUTZEYS	*Coryza* PUTZEYS	*Clivina* LATREILLE	*Sinesetosa* n.gen.	*Androzelma* DOSTAL	*Rugiluclivina* n.gen.	*Pseudoclivina* KULT	*Sparostes* PUTZEYS	*Orictites* ANDREWES
Head	facial carina on frons;	+	+	+	+	+	–	+	(–)	+	+	+
	facial sulcus on frons	+	+	+	+	+	–	+	+	+	+	+
	clypeus: front margin;	straight/ conc.	straight	2-dentate	4-dentate	variable	straight	concave	straight	±concave	2-dentate	4-dentate
	clypeal setigerous punctures	+	+	+	+	+	–	+	+	+	+	+
	supraorbital setig. punctures	2	2	2	2	2	–	2	2	2	2	2
	labial palpus: setae 2nd segm.	2	2	2	2	2	2	2	1	2	2	2
	mentum: length median tooth	<< lobes	equal	< lobes	equal	> lobes, variable	> lobes	> lobes	> lobes	equal	<< lobes	< lobes
	antennal grooves: length[3]	0.2-0.8	–	0.4	0.3	–/0.3	0.5	1.2	0.3	0.3	0.5	0.4
	antennae – segment 2 attached excentrically	+	+	+	–	–	–	+	+	–	+	+
	– scapus, setig. punct.	1	1 or 2	1	1	1	1	1	1	1	1	1
	– segm. 4-10: flat glittering areas[4]	–	–	–	–	–	–	+	–	+	+	+

Table 1 (continued)

Elytron	intervals – carinate	–	8: apex	7, 8: humerus	7: humerus, short, blunt	7, 8: humerus 8: apex	6–8: in total	all: in total	7, 8: humerus + apex/8: total	7, 8: humerus 8: apex[5]	7, 8: humerus 8: apex	8: humerus + apex
	– setig. punctures	ser. on/or 3, 5, 7	3:0/3	3:4	3:6	3:0/3–5	series on 3+5+7	3:1[2]	3:3/4	3:0/3	3:8	3:5/6
	9th stria: punctures visible	+	+	+	–	–	–	–	+	+	+	–
Legs	intermediate tibia: inner side densely hirsute (rows)	–	–	–	–	–	–	–	–	+	+	–
	tarsom. 1 of front leg big, hirsute dorsally	–	–	–	–	–	–	–	+	+	+	–
Length (mm)		2.3–3.3	2.3–4.5	4.0–5.2	3.4–4.8	3.5–18	4.8	8.9	5–10.3	7–11.5	14–22	10.3
Special characters		proepistern. tumid laterally	tarsom. 1 long; frons, clypeus elongated	pronotum: Y on each side; frons concave	head: arrowhead on frons	variable	genae	elytron: foveoate-striate	labrum excised conspic.	variable	clypeus, wings	pronotum median line

[1] *Trilophus/Trilophidius* complex under revision by the author, actually; [2] Not mentioned in the description; [3] Diameter of eye in ventral view [=1] serving as relative measurement; [4] "Glittering flat areas" on both sides of segment 4–10 with sparse or no pubescence, fully pubescent at margin, segments flattened; [5] See exception, *Pseudoclivina costata* ANDREWES, 1929

RELATIONSHIPS

The two genera erected exhibit numerous typical characters which makes the assumption evident that they obviously belong to the tribe Clivinini sensu BASILEWSKY (1973). Typical examples of those characters are: possession of the uninterrupted lateral series of umbilical punctures on the elytron, single preapical seta on the antennal scapus, the pubescence of antenna from segment 3 onwards, setae on the 2nd segment of labial palpus, two setae at each dorsal side of pronotum, base of elytron with a seta at each side near the sutura, presence of 2 pairs of setae on the abdominal sterna, the deep maxillary excision, missing antennal grooves on the ventral surface of pronotum, the clypeus and frontal plates which are not completely fused, the aedeagus which is not flattened at apex, the unequal setigerous parameres, and the habitus. However, other Oriental Clivinini have in addition 2 setae on the 2nd segment of the labial palp (Table 1, *Rugiluclivina* gen. n.: 1), 2 clypeal and 2 pairs of supraorbital setae (Table 1, *Sinesetosa* gen. n.: 0), and a different structure of head.

Among the Oriental genera, *Sinesetosa* gen. n. seems to be intermediate between *Ancus* PUTZEYS, 1867 and *Androzelma* DOSTAL, 1993, but is more related to *Ancus*. *Sinesetosa* and *Ancus* are of the same size, exhibit the same habitus and colour, the same square outline of the pronotum, and show the flattened disc of the elytra and frons of the head. The high degree of specialisation makes it difficult to assess the phylogenetic relationship. Similar strikingly developed genae as in *Sinesetosa acugena* sp. n. I have seen only in *Clivina urophthalmoides* KULT, 1947 from Brazil. This character may be considered apomorphic. However, the reduced chaetotaxy of the frons and clypeus combined with the campanulate outline of the head exhibit a weak similarity to the Salcediini. Another striking character, the numerous setae on intervals 3, 5, and 7 may be plesiomorphic as in *Trilophus* ANDREWES, 1927.

At first glance the four species of *Rugiluclivina* gen. n. look like small Scapterini or stout *Scolyptus* PUTZEYS, 1865 but they are not more closely related to either of these groups. However, the genus shares the following characters with *Pseudoclivina* KULT, 1947: big first tarsomere of front leg which is hirsute dorsally [beside these two genera this character is known in the Oriental genus *Sparostes* PUTZEYS, 1867, in the Ethiopian genus *Bohemania* PUTZEYS, 1865, and in species from the Neotropical Realm], size, compact habitus, colour, and position of elytral setigerous punctures. Other sharing characters are present but not so distinctly developed in *Pseudoclivina*. These are the cylindriform habitus, the perpendicular declivity at the base of the elytra, visibility of the 9th stria in marginal channel of elytra, and the well-developed and in some species complete submarginal furrow of the proepisternum. Therefore I believe that *Pseudoclivina* is the next related genus. Autapomorphic characters of *Rugiluclivina* are the conspicuously deep-excised labrum, the single seta on the 2nd segment of the labial palp which is, to my knowledge, not known in any other genera of Clivinini, the wing-like tooth at the profemora, and the numerous closely packed carinae on the clypeus and frons. The longitudinal carinae on the dorsal surface of the head are also developed in other groups of Clivinidae worldwide (e.g. *Coryza*: Oriental region, Ethiopian region, Arabian peninsula; *Halocoryza*: Ethiopian region, Arabian peninsula, Central America; *Lophocoryza*: Madagascar, Seychelles; *Schizogenius*: North and Central America), and in other species (eg, *Clivina coryzoides* BAEHR, 1989, Australian region; *C. rugiceps* KLUG, 1832, *C. stefania* MÜLLER, 1942, *Afroclivina mülleriana* KULT, 1959, last three Ethiopian region). This character is obviously a convergent development. In all these groups the carinae are clearly differentiated and restricted to a specific number (from 3 in *Coryza* up to 10 in *Halocoryza*). In *Rugiluclivina*, however, the carinae are numerous (> 18), densely packed, and somewhat irregular.

* * *

Acknowledgements – The following persons are thanked for the loan of the type material described: Dr. N. STORK, BMNH; Dr. O. MERKL, HNHM; Dr. W. SCHAWALLER, SMNS; Dr. M. BRANCUCCI, NHMB; Prof. Dr. K. HURKA, Praha; Dr. A. DOSTAL, Wien, and Mr. D. W. WRASE, Berlin. I would also like to thank Dr. M. BAEHR, München, Dr. P. HAMMOND, London, Dr. H. SCHÖNMANN, Wien, and Dr. K. DESENDER, Brussels, for the loan of type and other material of *Androzelma, Ancus, Orictites, Sparostes*, and *Salcedia*. Mr. P. BULIRSCH, Lovosice, and Dr. M. BAEHR, München, drew my attention to additional material of the species described. Mr. J. TRAUTNER kindly communicated the habitat description of *Sinesetosa acugena*. My heartful thanks are due to Dr. M. BAEHR, Zoologische Staatssammlung München, for critical hints during the preparation of the manuscript.

REFERENCES

ANDREWES, H. E. (1929) *The fauna of British India, including Ceylon and Burma. Coleoptera, Carabidae, Vol. I., Carabinae.* Taylor & Francis, London, 431 pp.

ANDREWES, H. E. (1930) *Catalogue of Indian Insects. Part 18, Carabidae.* Government of India Centr. Publ. Branch Calcutta, 388 pp.

ANDREWES, H. E. (1931) On the Carabidae of Mount Kinabalu. *J. SMS Mus., Kualalumpur* **16**: 431–485.

ANDREWES, H. E. (1936*a*) Papers on Oriental Carabidae. XXIX. *Ann. Mag. nat. Hist. London* (10) **17**: 307–318.

ANDREWES, H. E. (1936*b*) On some new species of Carabidae, chiefly from Java (II). *Treubia, Bogor* **15**: 211–224.

BAEHR, M. (1989) A new Clivina of the tranquebaria-group from Thailand (Coleoptera, Carabidae, Scaritinae). *Entomofauna, München* **10**: 17–24.

BASILEWSKY, P. (1973) Insectes Coléoptères Carabidae Scaritinae. *Faune de Madagascar, Paris* **37**: 1–322.

DARLINGTON, P. J. (1962) The Carabid beetles of New Guinea. Part I. Cicindelinae, Carabinae, Harpalinae through Pterostichini. *Bull. Mus. Comp. Zool., Cambridge, Mass.* **126**: 321–564.

DOSTAL, A. (1993) Beschreibung einer neuen Gattung aus Vietnam: Androzelma gen. nov. (Coleoptera, Carabidae, Scaritinae: Salcediini). *Z. Arbeitsgem. Österr. Ent., Wien* **45**: 117–121.

JEANNEL, R. (1957) Révision des petits Scaritides endogés voisons de Reicheia SAULCY. *Rev. Fr. Ent., Paris* **24**: 129–212.

KULT, K. (1951) Revision of the genus Clivina, Latr., from Oriental region. *Acta Soc. ent. Cechosl. Praha* **48**(1): 16–32.

KULT, K. (1959) Revision of the African species of the old genus Clivia Latr. (Col., Carabidae). *Rev. Zool. Bot. Afr.* **60**(1–2, 3–4): 172–192, 193–225.

Received February 16, 1996, accepted May 22, 1996

Acta Zoologica Academiae Scientiarum Hungaricae 42(1), pp. 41–57, 1996

ON THE GENUS PAMBOLUS (HYMENOPTERA, BRACONIDAE: PAMBOLINAE), WITH DESCRIPTION OF FOUR NEW TROPICAL SPECIES

J. PAPP

Department of Zoology, Hungarian Natural History Museum
H–1088 Budapest, Baross u. 13, Hungary

Four new *Pambolus* HALIDAY species, one from the Neotropical and three from the Oriental Region are described: *Pambolus hebes* sp. n. (Argentina), *P. ignarus* sp. n. (India), *P. nepalensis* sp. n. (Nepal) and *P. topali* sp. n. (India). Redescriptions of *Pambolus flavicornis* SZÉPLIGETI, 1913 (Tanzania) and *P. pulchricronis* SZÉPLIGETI, 1913 (Tanzania) are presented. Keys to the Ethiopian and Neotropical species of the genus *Pambolus* have been constructed. A checklist was compiled to the Pambolinae species of the world. With 41 original figures.

Key words: Hymenoptera, Braconidae, new species, tropics

INTRODUCTION

In his catalogue of Braconidae, R. D. SHENEFELT (1975: 1155–1163) listed twenty-five pamboline species assigned to four genera (+ two species and one genus as nomini nudi). Of these, one genus (*Ecphylopsis* ASHMEAD) with its two species was transferred to the tribe Hecabolini (BELOKOBYLSKIJ 1992*a*: 164) and, furthermore, seven *Pambolus* species names proved to be junior synonyms (BELOKOBYLSKIJ 1986*a*). VAN ACHTERBERG & QUICKE (1990) and BELOKOBYLSKIJ (1986*a*, 1986*b*, 1988, 1990, 1992*a*, 1992*b*) added three new genera and twenty-five new species to the subfamily Pambolinae. Taking into consideration the four new species herewith described, the subfamily Pambolinae comprises seven genera and forty-six species (see also the chapter Checklist of Pambolinae, p. 54).

Abbreviations used in the text: OD = diameter of an ocellus; OOL = shortest distance between hind ocellus and eye; POL = shortest distance between hind two ocelli; cu1 = first section of the cubital vein; cuqu1, cuqu2 = first and second transverse cubital vein; n. bas.1, n. bas.2 = first and second section of basal vein; n. rec. = recurrent vein; r1, r2 and r3 = first, second and third section of radial vein; B = first brachial cell; CU2 = second cubital cell; D1 = first discal cell; R = radial cell.

ETHIOPIAN REGION

Pambolus (Pambolus) flavicornis SZÉPLIGETI (Figs 1–4)

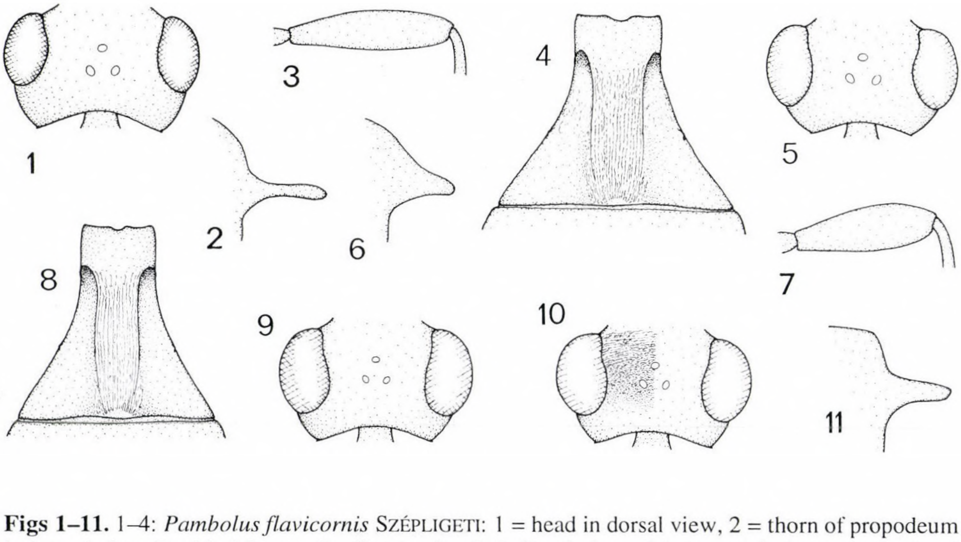
Pambolus flavicornis SZÉPLIGETI, 1913: Annls Mus. Nat. Hung. 11: 600 ♀, type locality: "Deutsch-Ostafrika: Kilimandjaro", lectotype (present designation) in Hungarian Natural History Museum, Budapest. – SHENEFELT 1975: 1161 (literature up to 1963).

Material examined. – Lectotype ♀: Tanzania (former Deutsch Ostafrika), Kilimandjaro, 1904, leg. KATONA (= KITTENBERGER) (Hym. Typ. No. 1592).

Additional features and corrections to the original description. – Body 2.4 mm long. Head in dorsal view (Fig. 1) subcubic, 1.66 times as broad as long, eye twice as long as temple (or temple half as long as eye), latter rounded. Ocelli small, POL:OD:OOL as 4:3:10. Eye in lateral view 1.3 times as high as wide. Head above finely uneven, shiny. – Antenna somewhat longer than body and with 26 antennomeres. First flagellomere five and penultimate flagellomere 2.5 times as long as broad apically.

Mesosoma in lateral view 1.77 times as long as high. Notaulix distinct, uncrenulated. Prescutellar furrow with five crenulae. Pair of lateral thorns of propodeum long and thin, as long as second tarsomere of hind tarsus (Fig. 2). Precoxal furrow short, uncrenulated. Mesonotum and mesopleuron weakly uneven, shiny; scutellum polished. – Hind femur (Fig. 3) long, 4.3 times as long as broad medially. Hind basitarsus as long as hind tarsomeres 2–4.

Metasoma as long as head and mesosoma combined. First tergite (Fig. 4) strongly broadening posteriorly, i.e. 1.25 times as wide behind as long medially, its anterior third parallel-sided, pair



Figs 1–11. 1–4: *Pambolus flavicornis* SZÉPLIGETI: 1 = head in dorsal view, 2 = thorn of propodeum in lateral view, 3 = hind femur, 4 = first tergite; 5–8: *Pambolus pulchricornis* SZÉPLIGETI: 5 = head in dorsal view, 6 = thorn of propodeum in lateral view, 7 = hind femur, 8 = first tergite; 9–11: *Pambolus hebes* sp. n.: 9 = head of female holotype in dorsal view, 10 = head of female paratype in dorsal view, 11 = thorn of propodeum in lateral view

of spiracles less beyond middle of tergite. Tergites 2–3 fused, second suture indistinct. Ovipositor sheath long, as long as hind tibia or two-thirds of metasoma.

Ground colour of body rusty brown, mesonotum and scutellum reddish brownish. Antenna faintly darkening yellowish. Palpi, tegulae and coxae pale yellow, legs yellow.

Male unknown.

Distribution: Tanzania.

Pambolus flavicornis SZÉPLIGETI is the closest relative of *P. pulchricornis* SZÉPLIGETI, their distinction is given in the subsequent key on the next page.

Pambolus pulchricornis SZÉPLIGETI
(Figs 5–8)

Pambolus pulchricornis SZÉPLIGETI, 1913: Annls Mus. Natn. Hung. 11: 600 ♀, type locality: "Deutsch-Ostafrika: Arusha-Ju", lectotype (present designation) in Hungarian Natural History Museum, Budapest. – SHENEFELT 1975: 1162 (literature up to 1963).

Material examined. – Lectotype ♀: Tanzania (former Deutsch Ostafrika), Arusha-Ju, December 1905, leg. KATONA (= KITTENBERGER), Hym. Typ. No. 1596.

Additional features and corrections to the original description. – Body 2.6 mm long. Head in dorsal view (Fig. 5) less transverse, 1.7 times as broad as long, eye three times as long as temple (or temple 0.28 times as long as eye), temple receded. Ocelli small, POL:OD:OOL as 4:3:8. Eye in lateral view 1.3 times as high as wide. Head polished; face medially with fine transverse striations, frons and vertex faintly uneven, shiny. – Antenna somewhat longer than body and with 23 antennomeres. First flagellomere 2.75 times and penultimate flagellomere 1.5 times as long as broad apically.

Mesosoma in lateral view 1.75 times as long as high. Notaulix restricted to declivous part of mesonotum, disc of mesonotum medio-longitudinally with a furrow-like impression. Prescutellar furrow with five crenulae. Pair of lateral thorns of propodeum short and less thin, as long as third tarsomere of hind tarsus (Fig. 6). Precoxal suture short, finely crenulated. Mesonotum weakly uneven, scutellum and mesopleuron polished. – Hind femur (Fig. 7) less long, 3.3 times as long as broad medially. Hind basitarsus as long as hind tarsomeres 2–4.

Metasoma about as long as head + mesosoma combined. First tergite (Fig. 8) less strongly broadening posteriorly, i.e. as long as broad behind, its anterior half parallel-sided, pair of spiracles beyond middle of tergite. Tergites 2–3 fused, second suture indistinct. Ovipositor sheath short, as long as hind basitarsus.

Ground colour of body rusty brown. Antenna darkening yellow to brownish yellow, flagellomeres 13–18 (or antennomeres 15–20) white, last three flagellomeres yellow. Palpi and tegulae pale yellow. Legs yellow.

Male unknown.

Distribution: Tanzania.

Pambolus pulchricornis SZÉPLIGETI is the closest relative of *P. flavicornis* SZÉPLIGETI, their distinction is disclosed in the subsequent key on the next page.

KEY TO THE ETHIOPIAN SPECIES OF THE GENUS PAMBOLUS

1 (6) Wings reduced to entirely absent; head in dorsal view cubic to subcubic (subgenus *Pambolus* HALIDAY, 1836)

2 (3) Antenna with 15 antennomeres, first flagellomere distinctly longer than second flagellomere. Second tergite aciculate becoming finer to nearly obsolete posteriorly. Second suture distinct. Ground colour fulvous, antenna distally darkening and apically piceous. ♀: 2 mm. – Republic of South Africa *P. (P.) aciculatus* BRUES

3 (2) Antenna with more than 20 antennomeres, first flagellomere at most slightly longer than second flagellomere. Second tergite polished, second suture indistinct.

4 (5) Temple in dorsal view rounded and half as long as eye (Fig. 1). Hind femur long, 4.3 times as long as broad (Fig. 3). First flagellomere five times as long as broad apically, antenna with 26 antennomeres. Pair of lateral thorns of propodeum thin (Fig. 2). Ovipositor sheath long, as long as hind tibia. Flagellum faintly darkening yellowish. ♀: 2.4 mm. – Tanzania *P. (P.) flavicornis* SZÉPLIGETI

5 (4) Temple in dorsal view receded and 0.28 times as long as eye (Fig. 5). Hind femur less long, 3.3 times as long as broad (Fig. 7). First flagellomere 2.75 times as long as broad apically, antenna with 23 antennomeres. Pair of lateral thorns of propodeum thinner (Fig. 6). Ovipositor sheath short, as long as hind basitarsus. Flagellomeres 13–18 white, otherwise flagellum darkening yellow to brownish yellow. ♀: 2.6 mm. – Tanzania *P. (P.) pulchricornis* SZÉPLIGETI

6 (1) Wings fully developed. Head in dorsal view transverse (subgenus *Phaenodus* FOERSTER, 1862).

7 (8) Head polished, mesonotum alutaceous. Mesonotum not convex, in lateral view its anterior and posterior parts forming at most an obtuse angle. Pronotum not long, usual in its form and sculpture. Antenna broken and with 19 antennomeres. Body black, legs pale yellow. ♀: 2.5 mm. – Malgasy *P. (Ph.) seyrigi* GRANGER

8 (7) Head shagreened, mesonotum smooth and shining. Mesonotum highly convex, in lateral view its anterior and posterior parts forming right angles. Pronotum unusually long, carinate in front and with a coarsely crenate fur-

row behind. Antenna with 35–37 antennomeres. Head and mesosoma dark rusty brown, metasoma brownish black. Legs reddish yellow. ♀: 3.5–4.5 mm. – Zimbabwe *P. (Ph.) africanus* BRUES

Remark. – The species *P. aciculatus*, *P. africanus* and *P. seyrigi* are known to me on the basis of their original description only.

NEOTROPICAL REGION

Pambolus (Pambolus) hebes sp. n. ♀♂

(Figs 9–12)

Material examined. – Holotype ♀ and 2 ♀ paratypes: South Argentina, prov. Chubut, Epuyen, selected material from sifted *Festuca* clumps, 17 May, 1961, leg. TOPÁL, loc. Nos 456–457. – 2 ♂ paratypes: South Argentina, prov. Rio Negro, Repollos, selected material from sifted soil from under stones on pasture near main road, 7 May, 1961, leg. TOPÁL, loc. No. 440.

The holotype and the four paratypes are deposited in the Department of Zoology of the Hungarian Natural History Museum, Budapest, Hym. Typ. Nos 7713 (holotype) and 7714–7717 (paratypes).

Etymology. – The species name "hebes" refers to the short and rather thick pair of thorns on propodeum (hebes = blunt).

Description of the holotype ♀. – Body 2 mm long. Head in dorsal view (Fig. 9) subcubic, 1.66 times as broad as long, eye 4.4 times as long as temple, latter receded, occiput moderately excavated. Ocelli small, POL:OD:OOL as 3:2:9. Eye in lateral view 1.5 times as high as wide, temple a bit less wide at its broadest part behind eye (cf. Fig. 18, see arrows). Malar space twice as long as basal width of mandible. Face transversely uneven and shiny, subshiny, head above (on frons transversely) coriaceous rugulose, temple (Fig. 10) and cheek polished. – Antenna somewhat longer than body and with 20 antennomeres. First flagellomere 2.75 times and penultimate flagellomere 1.75 times as long as broad apically.

Mesosoma in lateral view 1.57 times as long as high. Mesonotum and scutellum reduced in size. Notaulix distinct, uncrenulated. Pair of thorns of propodeum as long as third tarsomere of hind tarsus, basally thickening (Fig. 11). Propodeum areolated, medio-basal areola long and narrow, areolae with transverse rugae-rugulae (cf. Fig. 30). Precoxal furrow distinct, uncrenulated. Mesosoma coriaceous and dull, scutellum uneven and subshiny. – Hind femur 3.5 times as long as broad medially. Hind basitarsus slightly longer than tarsomeres 2–3 combined.

Wings strongly reduced, fore wing scale-like and its venation indistinct.

Metasoma almost as long as head + mesosoma combined. First tergite (Fig. 12) 1.4 times broader behind than long medially, strongly and evenly broadening posteriorly, more than twice as broad behind as basally, pair of basal keels merging into median longitudinal striation of tergite, pair of spiracles beyond middle of tergite. Further tergites polished. Suture between tergites 2–3 indistinct, i.e. tergites 2–3 fully fused. Ovipositor sheath as long as basitarsus of hind tarsus.

Ground colour of body reddish yellow, head above brownish, metasoma from second tergite darkening brown to blackish. Palpi pale yellow. Antenna reddish yellow, flagellomeres 13–18 lighter, flagellomeres 19–20 brownish. Legs reddish yellow.

Description of the female paratypes (2 ♀♀). – Similar to the holotype ♀. Body 2–2.1 mm. Head in dorsal view 1.7–1.75 times as broad as long, temple somewhat less receded (1 ♀ Fig. 10). Antenna with 22 antennomeres.

Description of the male paratypes (2 ♂♂). – Similar to the female. Body 2 mm long. Head in dorsal view 1.68–1.7 times as broad as long. Antenna with 20–21 antennomeres. First tergite 1.4–1.6 times as broad behind as long medially.

Host unknown.
Distribution: Argentina.

The new species, *P. (P.) hebes* sp. n., is the closest relative of *P. (Ph.) longicornis* ENDERLEIN, 1920 (Brazil), see the subsequent key for their distinction.

KEY TO THE NEOTROPICAL SPECIES OF THE GENUS PAMBOLUS

1 (2) Wings fully developed and with distinct venation (subgenus *Phaenodus* FOERSTER). Head smooth and shiny. Antenna long, twice as long as body and at least with 30 antennomeres. Propodeum reticulate rugose, pair of thorns long and thin. Second tergite medio-basally with fine longitudinal rugosity, otherwise smooth and shiny. Flagellum brown, flagellomeres 28–30 white. Body blackish brown with rusty brown pattern. Legs pale reddish yellow. ♀: 2.6 mm *P. (Ph.) longicornis* ENDERLEIN

2 (1) Wings hardly developed, i.e. scale-like, venation indistinct (subgenus *Pambolus* HALIDAY). Head coriaceous rugulose, dull (Fig. 10). Antenna short, somewhat longer than body and with 20–22 antennomeres. Propodeum with transverse rugae-rugulae, medio-basal areola long and narrow, pair of thorns short and thickening basally (Fig. 11). Second tergite polished. Flagellum reddish yellow, last one or two flagellomere(s) brownish to brown. Body reddish yellow or rusty yellow, metasoma posteriorly darkening brown to blackish. Legs reddish yellow. ♀♂: 2–2.1 mm **P. (P.) hebes** sp. n.

ORIENTAL REGION

Pambolus (Phaenodus) ignarus sp. n. ♀
(Figs 13–16)

Material examined. – Holotype ♀: India, Karnataka, Belgaum district, Talewadi, 780 m, 26 February, 1980, leg. TOPÁL, loc. No. 135 (in manuscript). – The holotype is deposited in the Department of Zoology of the Hungarian Natural History Museum, Budapest, Hym. Typ. No. 7718.

Etymology. – The species name, *Pambolus (P.) ignarus* sp. n., indicates its fairly isolated systematic position among the *Pambolus* species (ignarus = hardly known).

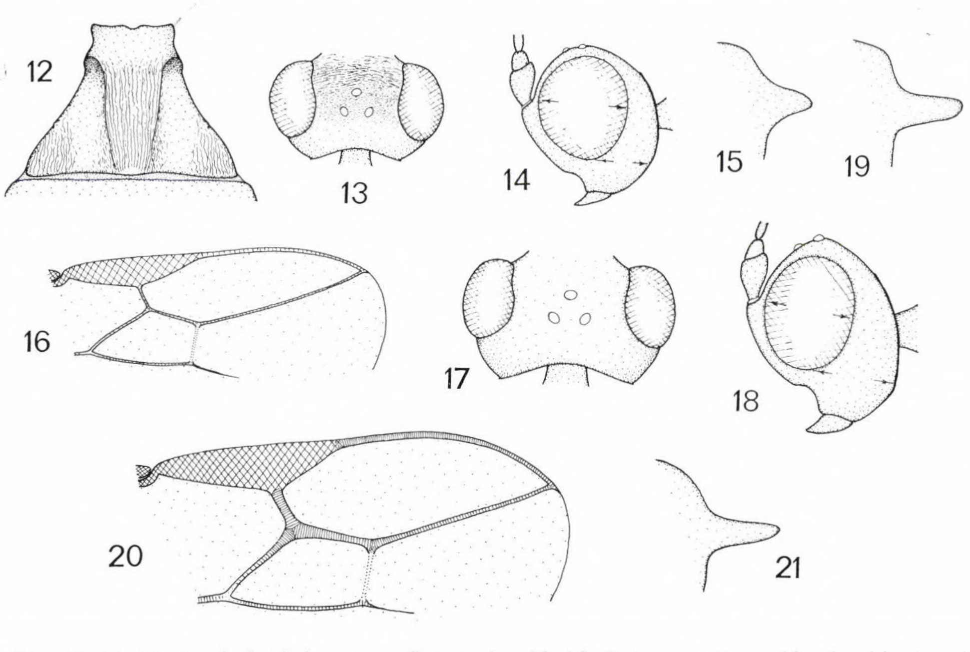
Description of the holotype ♀. – Body 1.8 mm long. Head in dorsal view (Fig. 13) less transverse, 1.7 times as broad as long, eye four times as long as temple, latter receded, occiput moderately excavated. POL:OD:OOL as 4:3:6. Eye in lateral view large, 1.17 times as high as wide and 1.8 times as wide as broadest part of temple behind eye (Fig. 14, see arrows). Malar space about twice as long as basal width of mandible. Face polished, frons transversely and finely striated, vertex and occiput faintly coriaceous (Fig. 13). – Antenna nearly twice as long as body and with 25 antennomeres. First flagellomere five times and penultimate flagellomere 2.6 times as long as broad apically.

Mesosoma in lateral view 1.2 times as long as high. Notaulix hardly distinct on disc of mesonotum. Prescutellar furrow with five crenulae. Precoxal suture distinct and crenulated, otherwise mesopleuron polished (below tegula rugose). Mesonotum finely granulose, scutellum polished. Propodeum areolated and sculptured (cf. Fig. 23); thorn of propodeum short, as long as half of third tarsomere of hind tarsus (Fig. 15). – Hind femur 3.75 times as long as broad. Hind basitarsus as long as tarsomeres 2–4 combined.

Fore wing somewhat longer than body. Pterostigma (Fig. 16) five times as long as wide, issuing radial vein somewhat distally from its middle; *r1* just shorter than width of pterostigma, *r2* twice as long as *r1*, *r3* almost four times as long as *r2* and reaching tip of wing, *cuqu1* one-third longer than *r2*, *cuqu2* effaced.

Metasoma as long as mesosoma. First tergite (cf. Fig. 27) evenly and strongly broadening posteriorly, 1.4 times as broad behind as long medially, a bit more than twice as broad behind as basally, pair of spiracles beyond middle of tergite; pair of basal keels becoming weaker posteriorly and between keels tergite longitudinally finely striate, laterally from keel uneven to smooth. Further tergites polished. Ovipositor sheath as long as hind basitarsus.

Ground colour of head brownish yellow, meso- and metasoma rusty brown. Face, clypeus and mandible yellow, palpi straw yellow. Ocellar field black. Pronotum, mesopleuron and propo-



Figs 12–21. 12: *Pambolus hebes* sp. n.: first tergite; 13–16: *P. ignarus* sp. n.: 13 = head in dorsal view, 14 = head in lateral view, 15 = thorn of propodeum in lateral view, 16 = distal part of right fore wing; 17–20: *Pambolus pallipes* FOERSTER: 17 = head in dorsal view, 18 = head in lateral view, 19 = thorn of propodeum in lateral view, 20 = distal part of right fore wing; 21: *Pambolus ruficeps* BELOKOBYLSKIJ: thorn of propodeum in lateral view

deum with blackish suffusion. Legs yellow, last tarsomeres brownish. Wings hyaline, pterostigma and veins opaque yellow, *n. bas.* faintly brownish.

Male and host unknown.
Distribution: India.

Of the *Pambolus* species of the Old World (BELOKOBYLSKIJ 1986*a*, 1992*a*, 1992*b*), the new species, *Pambolus* (*Phaenodus*) *ignarus* sp. n., seems to be similar to *P.* (*Ph.*) *pallipes* FOERSTER, 1862, the females of the two species are clearly different from each other in the features keyed below:

1 (2) Temple in dorsal view receded, eye four times as long as temple (Fig. 13). Eye in lateral view large, 1.8 times as wide as broadest part of temple behind eye (Fig. 14, see arrows). First flagellomere five times as long as broad apically. Pterostigma issuing radial vein less distally from its middle, meeting of veins r1, r2 and cuqu1 not thickened (Fig. 16). Thorn of propodeum short, as long as half of third tarsomere of hind tarsus (Fig. 15). Head brownish yellow. ♀: 1.8 mm **P. (Ph.) ignarus** sp. n.

2 (1) Temple in dorsal view less receded, eye almost four times as long as temple (Fig. 17). Eye in lateral view usual in size, about as wide as broadest part of temple behind eye (Fig. 18, see arrows). First flagellomere three times as long as broad apically. Pterostigma issuing radial vein more distally from its middle, veins metacarp, *r1*, *r2* and *cuqu1* somewhat thickened (Fig. 20). Thorn of propodeum long, as long as third tarsomere (Fig. 19). Head rusty brown with variable blackish pattern. ♀: 1.9–3 mm *P. (Ph.) pallipes* FOERSTER

The new species, *P. ignarus* sp. n., is closest to *P. ruficeps* BELOKOBYLSKIJ, 1988 from among the three Oriental species of the genus *Pambolus*. The two species may be separated from each other by the following features:

1 (2) Notaulix hardly distinct, uncrenulated. Antenna with 25 antennomeres, nearly twice as long as body. Thorn of propodeum short, half as long as third tarsomere of hind tarsus (Fig. 15). Face polished. ♀: 1.8 mm **P. (Ph.) ignarus** sp. n.

2 (1) Notaulix distinct and crenulated. Antenna with 33–40 antennomeres, 1.5–1.7 times as long as body. Thorn of propodeum as long as second or third tarsomere of hind tarsus (Fig. 21). Face reticulate rugulose. ♀: 3–4.2 mm, ♂: 1.6–3.2 mm *P. (Ph.) ruficeps* BELOKOBYLSKIJ

Pambolus (Phaenodus) nepalensis sp. n. ♀
(Figs 22–27)

Material examined. – Holotype ♀: Nepal, Birethanti, 7 August, 1981, leg. BERON. – Holotype is deposited in the Department of Zoology of the Hungarian Natural History Museum, Budapest, Hym. Typ. No. 7719.

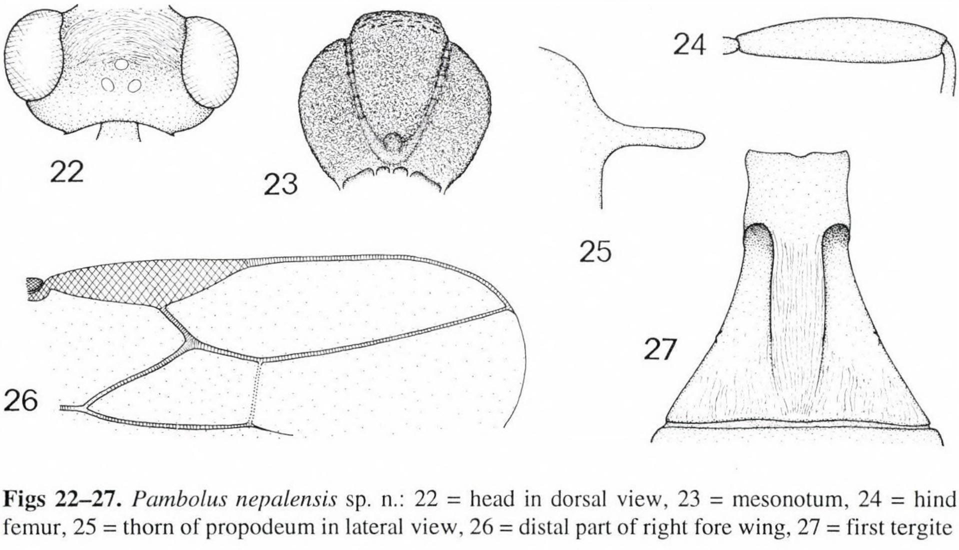
Etymology. – The species name "nepalensis" refers to the country (Nepal) where the type locality is.

Description of the holotype ♀. – Body 3.2 mm long. Head in dorsal view (Fig. 22) transverse, 1.9 times as broad as long, eye clearly three times as long as temple, latter constricted, occiput moderately excavated and here entirely carinated. Ocelli middle-sized, near to each other, POL:OD:OOL as 4:4:10. Eye in lateral view 1.27 times as high as wide and 1.22 times as wide as broadest part of temple behind eye. Malar space a bit less than four times as long as basal width of mandible. Shortest distance between tentorial pit and eye 1.4 times as long as distance between pair of tentorial pits. Occipital carina ventrally effaced. Head polished, face medially very finely and transversely striate, frons with transverse and arched striations, vertex coriaceous uneven (Fig. 22). – Antenna about twice as long as body and with 37 antennomeres. First flagellomere four times and penultimate flagellomere 2.2 times as long as broad apically.

Mesosoma in lateral view 1.5 times as long as high. Notaulix distinct and subcrenulated. Prescutellar furrow with five crenulae. Propodeum areolated and sculptured as usual (cf. Fig. 30), pair of lateral thorns long, as long as second tarsomere of hind tarsus (Fig. 25). Precoxal suture present and subcrenulated. Mesonotum densely coriaceous (Fig. 23); scutellum and mesopleuron smooth and shiny. – Hind femur 4.7 times as long as broad distally (Fig. 24). Hind basitarsus as long as hind tarsomeres 2–4.

Fore wing as long as body. Pterostigma (Fig. 26) 4.2 times as long as wide and issuing radial vein distally from its middle, *r1* as long as width of pterostigma, *r2* one-third longer than *r1*, *r3* reaching tip of wing and 3.6 times as long as *r2*, *cuqu1* 1.66 times as long as *r2*, *cuqu2* depigmented.

Metasoma as long as head + mesosoma combined. First tergite (Fig. 27) unevenly broadening posteriorly, i.e. its anterior third parallel-sided, rest strongly broadening, as long as broad be-



Figs 22–27. *Pambolus nepalensis* sp. n.: 22 = head in dorsal view, 23 = mesonotum, 24 = hind femur, 25 = thorn of propodeum in lateral view, 26 = distal part of right fore wing, 27 = first tergite

hind, more than twice as broad behind as basally; pair of basal keels almost parallel and posteriorly becoming weaker and merging into fine medio-longitudinal striation; pair of spiracles beyond middle of tergite. Second and third tergites entirely fused, i.e. suture between them indistinct, polished. Second tergite medio-basally with few very short and fine striae. Ovipositor sheath long, as long as hind tibia.

Ground colour of head and mesosoma reddish yellow with brownish suffusion on mesosoma. Face and cheek yellow, palpi pale yellow. Scape and pedicel yellow, flagellum darkening yellowish to brownish, last 13(–14) flagellomeres white. Metasoma yellow with brownish to brown suffusion on tergites 1–2. Legs yellow. Wings hyaline, pterostigma opaque yellow, veins brownish yellowish.

Male and host unknown.
Distribution: Nepal.

The new species, *Pambolus (Phaenodus) nepalensis* sp. n., resembles most closely *P. (Ph.) unicolor* BELOKOBYLSKIJ, 1992 (Vietnam) considering their transverse head, venation of wings and reddish yellow ground colour of body. The two species are distinguished by the following features:

1 (2) First tergite unevenly broadening posteriorly, i.e. its anterior third parallel-sided (Fig. 27). Antenna about twice as long as body, with 37 antennomeres. Thorn of propodeum long, as long as second tarsomere of hind tarsus (Fig. 25). Mesopleuron smooth and shiny, second tergite polished. Hind femur 4.1 times as long as broad (Fig. 24). Ovipositor sheath as long as hind tibia. Antenna distally, i.e. last 13(–14) flagellomeres white. ♀: 3.2 mm **P. (Ph.) nepalensis** sp. n.

2 (1) First tergite evenly broadening posteriorly (Fig. 112 in BELOKOBYLSKIJ 1992: 166). Antenna 1.3 times as long as body, with 24 antennomeres. Thorn of propodeum short. Mesopleuron densely reticulate rugulose, second tergite almost entirely rugo-striate (Fig. 112 l.c.). Hind femur 3.4 times as long as broad. Ovipositor sheath short, as long as first tergite. Antenna distally darkening yellowish brownish. ♀: 2.1 mm *P. (Ph.) unicolor* BELOKOBYLSKIJ

Pambolus (Phaenodus) ruficeps BELOKOBYLSKIJ, 1988

Described from Taiwan, reported from Malaysia and Vietnam (BELOKOBYLSKIJ 1990: 128, 1992*a*: 167). There are specimens (3 ♀♀ + 4 ♂♂) from India and Taiwan in the Hungarian Natural History Museum, Budapest.

India – 1 ♂: Prov. Jamu and Kashmir, Srinagar, 1500 m, 28 May, 1967, leg TOPÁL. 1 ♂: Prov. Orissa, Jajpur-Keonjahr district, Daitari, 25 November, 1967, leg. TOPÁL. – New to the fauna of India.

Taiwan (= Formosa) – 1 ♀: Chip-Chip, February 1909, leg. Sauter. 2 ♀♀ + 2 ♂♂: Mt. Hoozan, January (2 ♀♀) and March (2 ♂♂) 1910, leg. SAUTER.

Pambolus (Phaenodus) topali sp. n. ♀
(Figs 28–35)

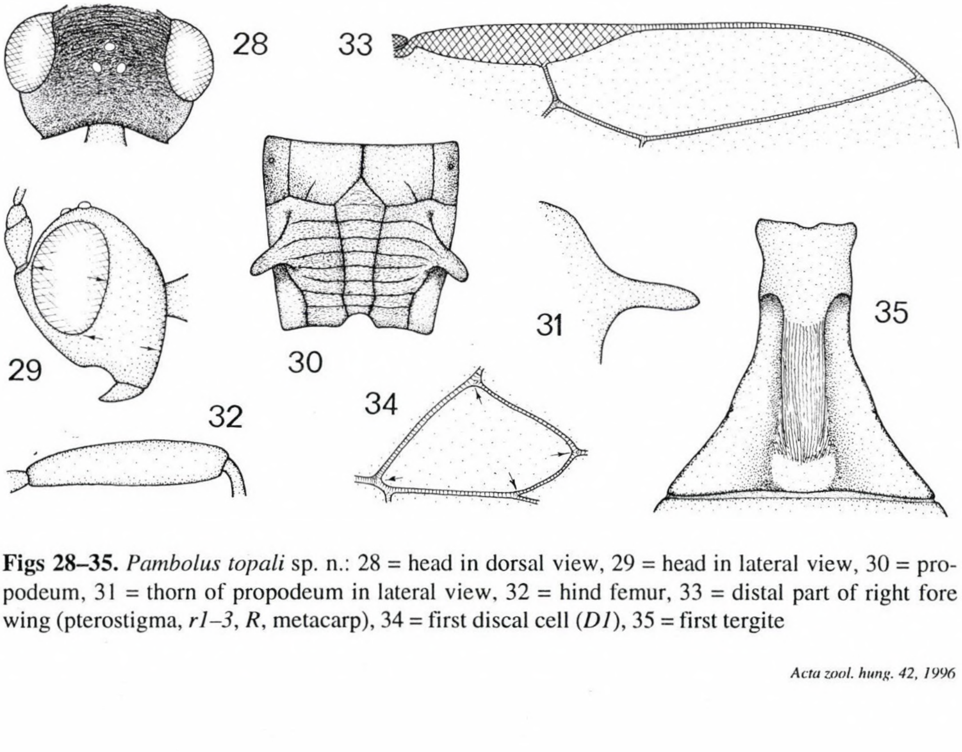
Material examined. – Holotype ♀ + 1 ♀ paratype: India, West Bengal, Darjeeling district, Ghum, Senchal reserved Forest, 2200 m, 8 October, 1967, leg. TOPÁL, loc. no. 779 (in manuscript). – 2 ♀ paratypes: same locality and collector, 1 ♀: 11 October, 1967 and 1 ♀: 12 October, 1967.

The holotype and three paratypes are deposited in the Department of Zology of the Hungarian Natural History Museum, Budapest, Hym. Typ. Nos 7720 (holotype) and 7721–7723 (paratypes).

Etymology. – The new species is dedicated to the mammalogist Dr. GYÖRGY TOPÁL, who considerably enriched the collections of the Hungarian Natural History Museum, Budapest with hundreds of wasps during his first zoological collecting trip to India in 1967.

Description of the holotype ♀. – Body 3.1 mm long. Head in dorsal view (Fig. 28) less transverse, 1.65 times as broad as long, eye just less than twice as long as temple, latter rounded, occiput moderately excavated. POL:OD:POL as 4:4:12. Eye in lateral view 1.5 times as high as wide and as wide as broadest part of temple behind eye (Fig. 29, see arrows). Malar space twice as long as basal width of mandible. Head rather transversely rugulo-rugose, frons transversely striate (Fig. 28). – Antenna about one-third longer than body and with 30 antennomeres. First flagellomere 3.4 times and penultimate flagellomere twice as long as broad apically.

Mesosoma in lateral view 1.55 times as long as high. Notaulix distinct and uncrenulated. Prescutellar furrow crenulated. Precoxal suture distinct and crenulated, otherwise mesopleuron



Figs 28–35. *Pambolus topali* sp. n.: 28 = head in dorsal view, 29 = head in lateral view, 30 = propodeum, 31 = thorn of propodeum in lateral view, 32 = hind femur, 33 = distal part of right fore wing (pterostigma, *r1–3*, *R*, metacarp), 34 = first discal cell (*D1*), 35 = first tergite

smooth and shiny (below tegula rugose). Mesonotum densely granulo-rugulose, scutellum less densely granulo-rugulose. Propodeum areolated, median areola narrow and long, i.e. about as wide as lunule (Fig. 30), thorn of propodeum long, as long as second tarsomere of hind tarsus (Fig. 31). – Hind femur (Fig. 32) 4.7 times as long as broad medially. Hind basitarsus a bit longer than tarsomeres 2–4 combined.

Fore wing about as long as body. Pterostigma (Fig. 33) 5.8 times as long as wide, issuing radial vein clearly distally from its middle; *r1* as long as width of pterostigma, *r2* 2.3 times as long as *r1*, *r3* 3.2 times as long as *r2* and approaching tip of wing, *cuqu1* one-fourth longer than *r1*. First discal cell (*D1*) unusually wide, 1.7 times as wide as high (Fig. 34, see arrows).

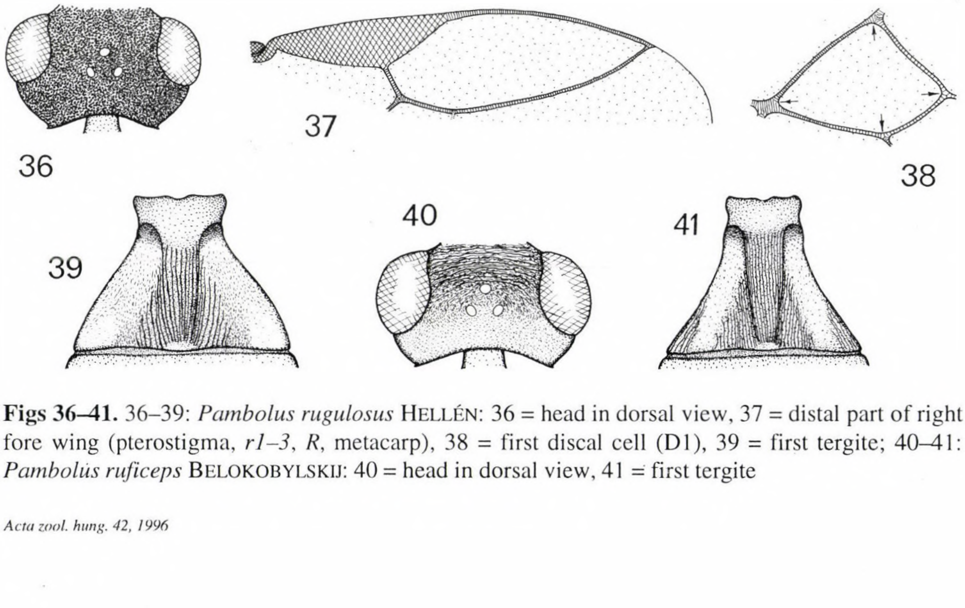
Metasoma as long as mesosoma + half head. First tergite (Fig. 35) as long as broad behind, 2.4 times broader behind than basally, its anterior half almost parallel-sided and its posterior half strongly broadening, pair of spiracles hardly distinct and behind middle of tergite; pair of keels reaching beyond middle of tergite and between keels tergite longitudinally striate, laterally from keel smooth and shiny (Fig. 35). Further tergites polished. Ovipositor sheath straight and as long as hind basitarsus.

Ground colour of body rusty brown. Antenna darkening brownish yellow to brownish. Palpi white. Pronotum and propodeum black, prosternum and mesopleuron blackish. First tergite black to blackish. Legs yellow. Wings hyaline, pterostigma and veins yellow.

Description of the female paratypes (3 ♀♀). – Similar to holotype. Body 3–3.1 mm (3: 1 ♀, 3.1: 2 ♀♀). Head in dorsal view 1.57–1.64 times as broad as long (1.57: 1 ♀, 1.6: 1 ♀, 1.64: 1 ♀). Antenna with 27–28 antennomeres (27: 2 ♀♀, 28: 1 ♀). Hind femur 4.6–5 times as long as broad medially (4.6: 1 ♀, 5: 2 ♀). *r2* twice as long as *r1* and *cuqu1* somewhat longer than *r2* (1 ♀). Ground colour of body yellowish brown to rusty brown without black(ish) pattern (1 ♀).

Male and host unknown.

With the help of BELOKOBYLSKIJ's key (1986: 22–23) to the Palaearctic species of the genus *Pambolus*, the new species *Pambolus (Phaenodus) topali* sp. n., runs to *P. rugulosus* HELLÉN, 1927 (Finland, Sweden, European part of Russia, Mongolia). The distinctive features of the two species are keyed as follows:



Figs 36–41. 36–39: *Pambolus rugulosus* HELLÉN: 36 = head in dorsal view, 37 = distal part of right fore wing (pterostigma, *r1–3*, *R*, metacarp), 38 = first discal cell (D1), 39 = first tergite; 40–41: *Pambolus ruficeps* BELOKOBYLSKIJ: 40 = head in dorsal view, 41 = first tergite

1 (2) Temple in dorsal view relatively less rounded, head above (vertex, occiput) rugose (Fig. 28). Antenna longer than body and with 27–30 antennomeres; first flagellomere 3–3.6 times as long as broad apically. Radial vein approaching tip of wing (Fig. 33) and first discal cell wide, 1.6–1.69 times as wide as high (Fig. 34, see arrows). First tergite 2.3–2.4 times broader behind than basally, its fore half almost parallel-sided and its hind half strongly broadening (Fig. 35), second tergite polished. Third femur 4.4–4.7 times as long as broad. Head above and mesonotum rusty brown. ♀: 3–3.1 mm **P. (Ph.) topali** sp. n.

2 (1) Temple in dorsal view relatively more rounded, head above (vertex, occiput) granulose (Fig. 36), finely granulose to almost smooth. Antenna about as long as body and with 21–22(–26) antennomeres; first flagellomere 2.4–2.7 times as long as broad apically. Radial vein less approaching tip of wing (Fig. 37) and first discal cell less wide, 1.3–1.4 times as wide as high (Fig. 38, see arrows). First tergite twice as broad behind than basally and evenly broadening posteriorly (Fig. 39), second tergite at least medio-basally strio-rugose. Third femur 3–3.5 times as long as broad. Head above and mesonotum black. ♀♂: 1.3–2.5 mm *P. (Ph.) rugulosus* HELLÉN

Of the three Oriental species of the genus *Pambolus* (BELOKOBYLSKIJ 1992: 164), the new species *Pambolus (Phaenodus) topali* sp. n., resembles most closely *P. (Ph.) ruficeps* BELOKOBYLSKIJ, 1988 (India, Malaysia, Taiwan, Vietnam) considering their subcubic head, venation of wings and length of ovipositor sheath. The two species are distinguished by the following keyed features:

1 (2) In dorsal view eye twice as long as temple, latter rounded (Fig. 28). Hind femur 4.6–5 times as long as broad medially. Antenna with 27–30 antennomeres. First tergite as long as broad behind (Fig. 35). Head above (vertex, occiput) rather transversely rugulo-rugose (Fig. 28). ♀: 3–3.1 mm **P. (Ph.) topali** sp. n.

2 (1) In dorsal view eye 2.7–3 times as long as temple, latter receded (Fig. 40). Hind femur 3.5–3.8 times as long as broad medially. Antenna with 33–40 antennomeres. First tergite 1.1–1.3 times as broad behind as long medially (Fig. 41). Head above (vertex, occiput) coriaceous to rugulose. ♀: 3–4.2 mm, ♂: 1.6–3.2 mm *P. (Ph.) ruficeps* BELOKOBYLSKIJ

CHECKLIST OF THE PAMBOLINAE (BRACONIDAE) SPECIES OF THE WORLD

Cedria WILKINSON, 1934

Oriental Region

anomala WILKINSON, 1935 – Burma, Vietnam
galinae BELOKOBYLSKIJ, 1990 – Vietnam
paradoxa WILKINSON, 1934 – Burma, India, People's Republic of China, Sri Lanka, Vietnam

Australian Region

australiensis BELOKOBYLSKIJ, 1988*b* – Australia (Queensland)

Chremyloides VAN ACHTERBERG, 1995

abnormis (BELOKOBYLSKIJ, 1988) (*Cedria*) – Australia (Australian Capital Territory
cardeleae VAN ACHTERBERG, 1995 – Australia (New South Wales)
naumanni VAN ACHTERBERG, 1995 – Australia (Victoria)

Chremylomorpha BELOKOBYLSKIJ, 1986*b*

mirabilis BELOKOBYLSKIJ, 1986*b* – Australia (New South Wales)

Chremylus HALIDAY, 1833

concinnus ENDERLEIN, 1912 – Taiwan
elaphus HALIDAY, 1833 – Cosmopolitan
[*striatus* SZÉPLIGETI, 1908, *Pentatermus* HEDQVIST, 1963]

Dimeris RUTHE, 1854

mira RUTHE, 1854 – Palaearctic Region

Eupambolus TOBIAS, 1964

amankutani BELOKOBYLSKIJ, 1985 – Uzbekhistan
apterus TOBIAS, 1964 – Kazakhstan

Notiopambolus VAN ACHTERBERG et QUICKE, 1990

- *areolaris* BELOKOBYLSKIJ, 1992*b* – Australia (New South Wales, Queensland)
- *depressicauda* VAN ACHTERBERG et QUICKE, 1990 – Australia (Australian Capital Territory, New South Wales, Queensland)
- *longitergum* BELOKOBYLSKIJ, 1992*b* – Australia (Queensland)
- *nigricornis* BELOKOBYLSKIJ, 1992*b* – Australia (New South Wales)
- *propodealis* BELOKOBYLSKIJ, 1992 – Australia (Australian Capital Territory, New South Wales, Queensland)

Pambolus HALIDAY, 1836 (*P.* = *Pambolus*, *Ph.* = *Phaenodus* FOERSTER)

Australian Region

- *(P.) alboannulatus* BELOKOBYLSKIJ, 1992*b* – Australia (New South Wales)
- *(P.) collessi* BELOKOBYLSKIJ, 1992*b* – Australia (Australian Capital Territory)
- *(P.) coracinus* BELOKOBYLSKIJ, 1992*b* – Australia (New South Wales)
- *(P.) gracilis* BELOKOBYLSKIJ, 1992*b* – Australia (New South Wales)
- *(Ph.) microspinosus* BELOKOBYLSKIJ, 1992*b* – Australia (Victoria)
- *(Ph.) similis* BELOKOBYLSKIJ, 1992*b* – Australia (Australian Capital Territory, New South Wales, Queensland, Tasmania)
- *(Ph.) spinator* BELOKOBYLSKIJ, 1992*b* – Australia (Queensland)
- *(Ph.) vernicosus* BELOKOBYLSKIJ, 1992*b* – Australia (Queensland)

Ethiopian (or Afrotropical) Region

- *(P.) aciculatus* BRUES, 1924 – Republic of South Africa
- *(Ph.) africanus* BRUES, 1924 – Zimbabwe
- *(P.) flavicornis* SZÉPLIGETI, 1913 – Tanzania
- *(P.) pulchricornis* SZÉPLIGETI, 1913 – Tanzania
- *(Ph.) seyrigi* GRANGER, 1949 – Malgasy

Nearctic Region

- *(Ph.) americanus* (ASHMEAD, 1892) – U.S.A.

Neotropical Region

- *(P.) hebes* sp. n. – Argentina
- *(Ph.) longicornis* (ENDERLEIN, 1920) – Brazil

Oriental Region

(Ph.) caudalis BELOKOBYLSKIJ, 1988*a* – Malaysia, Taiwan, Vietnam
(Ph.) ignarus sp. n. – India
(Ph.) nepalensis sp. n. – Nepal
(Ph.) ruficeps BELOKOBYLSKIJ, 1988*a* – Malaysia, Taiwan, Vietnam
(Ph.) topali sp. n. – India
(Ph.) unicolor BELOKOBYLSKIJ, 1992*a* – Vietnam

Palaearctic Region

(Ph.) achterbergi BELOKOBYLSKIJ, 1986*a* – Portugal: Canary Islands
(P.) biglumis HALIDAY, 1836 – Europe, Palaearctic Asia
(P.) brevipennis (KIEFFER, 1906) – Italy
(Ph.) curvicaudis BELOKOBYLSKIJ, 1986*a* – Russia: Far East Maritime Territory
(P.) halteratus (KIEFFER, 1906) – Italy: Sardegna
(Ph.) pallipes (FOERSTER, 1862) – Europe, Palaearctic Asia
(Ph.) rugulosus (HELLÉN, 1927) – Sweden, Finland, European part of Russia, Mongolia
(P.) tricolor (RUTHE, 1854) – Germany

Pilichremylus BELOKOBYLSKIJ, 1992

annulicornis BELOKOBYLSKIJ, 1992*b* – Australia (New South Wales)
antennatus BELOKOBYLSKIJ, 1992*b* – Australia (New South Wales)
articulatus BELOKOBYLSKIJ, 1992*b* – Australia (New South Wales, Queensland)
brachialis BELOKOBYLSKIJ, 1992*b* – Australia (Australian Capital Territory
rieki BELOKOBYLSKIJ, 1992*b* – Australia (Queensland)

Pseudochremylus VAN ACHTERBERG, 1995

angulifer VAN ACHTERBERG, 1995 – Australia (West Australia)

REFERENCES

ACHTERBERG, C. VAN (1995): Subfamily Pambolinae Marshall, 1885 (p. 102–109). In: Generic revision of the subfamily Betylobraconinae (Hymenoptera: Braconidae) and other groups with modified fore tarsus. *Zool. Verh. Leiden* **298**: 1–242.

ACHTERBERG, C. VAN & QUICKE, D. L. J. (1990) A new genus of the tribe Pambolini from Australia (Hymenoptera: Braconidae). *Zool. Med. Leiden* **64**(14): 177–181.

BELOKOBYLSKIJ, S. A. (1985) New species of Braconidae (Hymenoptera) from the Asiatic part of the USSR and Mongolia. *Rev. d'Ent. l'URSS* **64**(2): 388–394. (In Russian with English title and summary)

BELOKOBYLSKIJ, S. A. (1986*a*) A review of the Palaearctic species of the genera Pambolus Hal. and Dimeris Ruthe (Hymenoptera, Braconidae). *Proc. Zool. Inst. Leningrad* **159**: 18–37. (In Russian with English title)

BELOKOBYLSKIJ, S. A. (1986*b*) A new genus of the tribe Pambolini from Australia (Hymenoptera: Braconidae, Rogadinae). *Ent. Ber.* **46**: 86–88.

BELOKOBYLSKIJ, S. A. (1988) Braconids of the supertribe Exothecidii (Hymenoptera, Braconidae, Doryctinae) of Taiwan. *Proc. Zool. Inst. Leningrad* **175**: 3–37.

BELOKOBYLSKIJ, S. A. (1990) Material of the braconid subtribe Exothecidii (Hymenoptera, Braconidae, Doryctinae) in Vietnam. *Proc. Zool. Inst. Leningrad* **209**: 115–140. (In Russian)

BELOKOBYLSKIJ, S. A. (1992*a*) On the Indo–Malayan braconid fauna of the tribe Exothecini, Pambolini and Pentatermini (Hymenoptera, Braconidae). *Proc. Zool. Inst. Leningrad* **245**: 125–173. (In Russian)

BELOKOBYLSKIJ, S. A. (1992*b*) Braconid wasps of the tribe Pambolini (Hymenoptera, Braconidae) of Australia. *Rev. d'Ent. l'URSS* **71**: 179–198. (In Russian with English title and summary)

BRUES, C. T. (1924) Some South African parasitic Hymenoptera of the families Evaniidae, Braconidae, Alysiidae and Plumariidae in the South African Museum with a catalogue of the known species. *Ann. South Afr. Mus.* **19**: 1–150. (Pambolinae: p. 17.)

BRUES, C. T. (1926) Studies on the Ethiopian Braconidae, with a catalogue of the African species. *Proc. Amer. Acad. Arts Sci.* **61**: 205–436. (*Phaenodus*: p. 248–250.)

ENDERLEIN, G. (1920) Zur Kenntnis ausereuropäischer Braconiden. *Arch. Naturgesch.* **84**(A, 11) (1918): 51–224. (*Phaenodus*: p. 145–146.)

GRANGER, C. (1949) Braconides de Madagascar. *Mém. Inst. sci. Madagascar* (A)**2**: 1–428. (*Phaenodus*: p. 155–157.)

HEDQVIST, K-J. (1963) Notes on Hormiinae with description of new genera and species (Hym., Ichneumonoidea, Braconidae). *Ent. Tidsk.* **84**(1–2): 30–61.

SHENEFELT, R. D. 1975) Braconidae 8 Exothecinae Rogadinae. *Hym. Cat.* (n. ed.) pars **12**: 1115–1262. (Tribe Pambolini: p. 1155–1163.)

SHENEFELT, R. D. (1965): A contribution towards knowledge of the world literature regarding Braconidae (Hymenoptera: Braconidae). *Beitr. Ent.* **15**(3–4): 243–500.

SZÉPLIGETI, V. (1913) Neue afrikanische Braconiden aus der Sammlung des Ungarischen National Museums. *Annls Mus. Natn. Hung.* **11**: 592–608. (Pambolus: p. 600.)

WHARTON, R. A. (1993): Review of the Hormiini (Hymenoptera: Braconidae) with a description of new taxa. *J. Nat. Hist.* **27**: 107–171.

Received March 12, 1996, accepted May 22, 1996

Catalogue of Palaearctic Diptera

edited by Á. SOÓS, L. PAPP and P. OOSTERBROEK

Volume 1

Trichoceridae – Nymphomyiidae

The Catalogue contains the basic taxonomic, nomenclatorial and distribution data of all species occurring in the Palaearctic Region with the fundamental morphological features for the majority of the fly groups.

Contents: Introduction to Volumes 1–13 (Á. SOÓS and L. PAPP). History of the Catalogue of Palaearctic Diptera. Structure. Genera and their type-species. Species names, type-localities. Distribution. Literature data, references. Dates of publication. Readers. Acknowledgements and closing remarks. List of contributors (Vols 1–13). Type-species designations in Volume 1. New names proposed in Volume 1. Families: Trichoceridae (C. DAHL). Tanyderidae (R. WAGNER). Blephariceridae (P. ZWICK). Deuterophlebiidae (L. JEDLICKA). Tipulidae (P. OOSTERBROEK and BR. THEOWALD). Cylindrotomidae (Á. SOÓS and P. OOSTERBROEK). Limoniidae (E. N. SAVCHENKO, P. OOSTERBROEK and J. STARY). Ptychopteridae (R. ROZKOSNY). Nymphomyiidae (L. JEDLICKA). Bibliography. Index.

April 30, 1992. 520 pages
US$ 80.00 plus US$ 5.00 for package and postage
(and an extra US$ 5.00 if you want it air mail)
ISBN 963 7093 10 9
© Hungarian Natural History Museum, Budapest

Order should be sent
to the Hungarian Natural History Museum, Library
Baross u. 13., Budapest, H–1088 Hungary
Fax: (36)–(1)–1138820

Acta Zoologica Academiae Scientiarum Hungaricae 42(1), pp. 59–63, 1996

TWO NEW DOLERUS SPECIES FROM KOREA (HYMENOPTERA, SYMPHYTA, TENTHREDINIDAE)

HARIS, A.[1] and S. BLANK[2]

[1]*Göncöl Foundation, Vác, Ilona u. 3, H–2600, Hungary*
[2] *Deutsches Entomologisches Institut, Eberswalde, Schicklerstr. 5, D–16225, Germany*

Two new *Dolerus* species are described from Korea, *D. albolineolatus* sp. n. and *D. pseudojaponicus* sp. n. They are compared to *D. lewisii* CAMERON, 1886 and *D. japonicus* KIRBY, 1882.

Key words: Hymenoptera, Symphyta, *Dolerus albolineolatus*, *D. pseudojaponicus*, new species

The following descriptions are part of an investigation of Palaearctic *Dolerus*, which is intended to clarify the taxonomy, distribution, and biology of species of the genus. The only comprehensive treatment of the species of *Dolerus* of Korea is that by (LEE & RYU 1989). They give a key and illustrate 12 species and one subspecies. Most of them also occur in Japan. Six of the species are widely distributed of which four are Palaearctic and two are eastern Palaearctic, and the other six species occur only in Japan and Korea. TAKEUCHI (1952) listed the Japanese species. The following two new species are known only from Korea. Although each is based on a single female, they differ significantly from other species of *Dolerus*.

Dolerus albolineolatus sp. n.

Female: Body black with metallic reflection, only lateral lobes of mesonotum and tegulae red; posterior margins of abdominal tergites 2–9 white. Legs entirely black. Head roughly and deeply punctured with shining interspaces on vertex. Antenna about as long as length of abdomen. Occipital furrows slightly developed. Head in dorsal view parallel behind eyes. Clypeus deeply excised for depth of half its total length. Pronotum and mesonotum deeply and sporadically punctured. Inner half of lateral mesonotal lobes smooth and highly polished. Outer half of these lobes covered by relatively large rectangular or triangular pits. Mesoscutellum coarsely and roughly punctured with smooth area in middle above. Mesopleuron coarsely and densely punctured without shining interspaces. Wings slightly infuscated; venation black, forewing stigma with brown margin. Thorax moderately covered with white pubescence. Hairs as long as diameter of front ocellus. Abdomen shining. Abdominal segments 2–9 covered with dense transverse microsculpture. Sawsheath rounded apically. The distance of the tips of hairs of the opposite sides of sawsheath larger than the breadth of the sawsheath. Apical setae of sawsheath black and strong. Apices of these setae always straight, never inwardly curved. Dorsal view of sawsheath as in Fig. 1. Length: 9.5 mm.

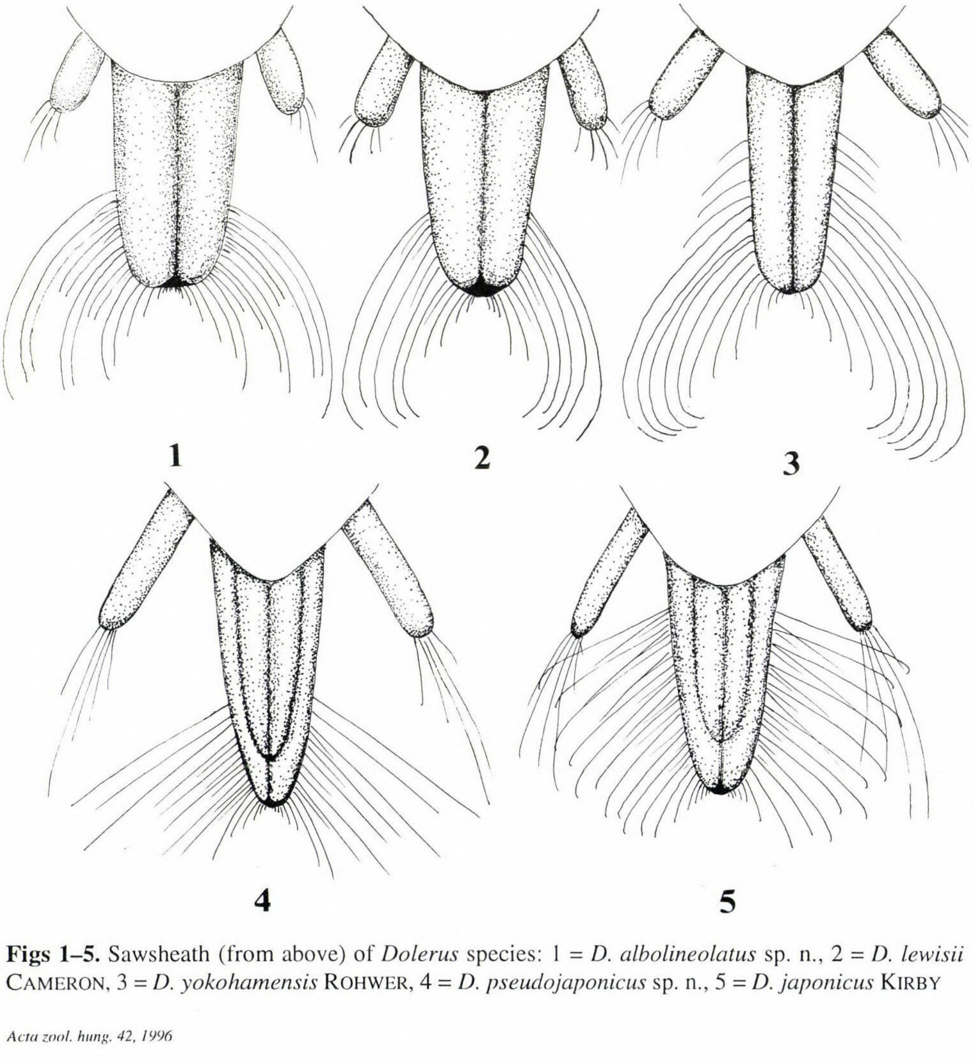
Male: unknown.

Holotype: female, Korea, 04. 04. 1987, leg.: S. M. RYU. Deposited in STEPHAN BLANK's collection, Deutsches Entomologisches Institut, Eberswalde.

Etymology: The specific name refers to the white margins of the abdominal segment.

This species closely resembles *Dolerus lewisii* CAMERON, 1886. *Dolerus lewisii* has a very strong greenish-blue metallic reflection which entirely covers the black base colour, the pronotum and propleuron are red, and it is much smaller species, 6.5–7.5 mm long. *Dolerus albolineolatus* sp. n. is black with a metallic shine but lacks a greenish-blue reflection the pronotum and propleuron are black, and it is a larger species, 9.5 mm long. The setae of the sawsheath are also different, as compared in Figs 1 and 2.

CAMERON (1886) is not precise in his original description: "Bluish-black; the middle lobes of mesonotum coppery, edges of abdominal segments white".

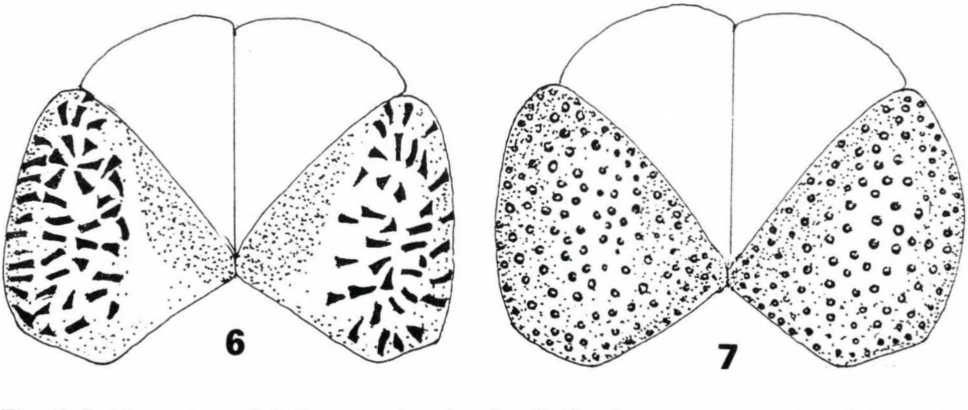


Figs 1–5. Sawsheath (from above) of *Dolerus* species: 1 = *D. albolineolatus* sp. n., 2 = *D. lewisii* CAMERON, 3 = *D. yokohamensis* ROHWER, 4 = *D. pseudojaponicus* sp. n., 5 = *D. japonicus* KIRBY

This suggests that *Dolerus lewisii* has a black pronotum, which is not true, and his description is not entirely in accordance with his holotype. We examined numerous specimens of *D. lewisii* in the Deutches Entomologisches Institut, Eberswalde and in The Natural History Museum, London, including the holotype. The holotype has the pronotum, propleuron, and the lateral lobes of the mesonotum entirely, and front lobes of mesonotum mainly red. The base colour is very shiny greenish-blue and the sawsheath is as in Fig. 2. *Dolerus manticatus* KONOW, 1907 is also closely related to D. albolineolatus, but it is easily distinguished by its very clearly apically dilated sawsheath, red pronotum and front lobes of the mesonotum.

Dolerus hordei ROHWER, 1925 is also closely related to *D. lewisii* CAMERON (but not to *albolineolatus*). One significant difference is the expressive violet luster on the mesoscutellum of *D. hordei*.

The fourth related species, *Dolerus yokohamensis* ROHWER, 1925 also differs from *albolineolatus*. The former species the lateral lobes of the mesonotum are deeply and uniformly punctured as in Fig. 7. The cenchri are light brown. The temple has shining interspaces about as large as the single or double punctures. The apices of the hairs of the sawsheath are inwardly curved as in Fig. 3. In *Dolerus albolineolatus* n. sp. the lateral lobes of the mesonotum are smooth and shining on their inner half and with large rectangular or triangular pits on their outer half as in Fig. 6. The cenchri are yellowish white. The temple is deeply and densely punctured, moderately shining without interspaces. The apices of the hairs of the sawsheath are straight. The new species belongs to the *nitens* group according to GOULET's system (GOULET 1986). *Dolerus albolineolatus* runs to *D. lewisii* in LEE and RYU's key. The most closely related European species is *Dolerus sanguinicollis* (ZOMBORI 1982, BENSON 1952).



Figs 6, 7. Mesonotum of *Dolerus* species: 6 = *D. albolineolatus* sp. n., 7 = *D. yokohamensis* ROHWER

Holotypes examined: *Dolerus lewisii* CAMERON, 1886; female, Nagasaki, Japan, deposited in The Natural History Museum, London.

Dolerus hordei ROHWER, 1925; female, Yamanshi, Japan, 15–27. 04. leg. S. I. KUWANA, on barley, type no. 27303, in the Smithsonian Institution, Washington, D. C.

Dolerus pseudojaponicus sp. n.

Female: Head and antenna entirely black. Pronotum, front and lateral lobes of mesonotum, and tegulae red; prosternum red with two lateral black spots; upper third of mesopleuron also red; other parts of thorax black. Basal part of fore coxa, fore knee, and upper half of fore tibia red; middle and hind legs entirely black. Abdomen red except for black first segment. Sawsheath and cercus black; sawsheath with dorsal and apical margins red. Wings darkly infuscate. Head and thorax moderately covered by whitish pubescence about as long as diameter of front ocellus. Two large, smooth and moderately shining areas alongside occipital furrows each about as large as half of vertex between occipital furrows. Head in dorsal view with sides slightly converging behind eyes. Antenna as long as length of abdomen. Clypeus roundly emarginated for depth of half its total length. Occipital furrows well developed. Pronotum and mesonotum sporadically punctured with interspaces about same size as punctures. Mesoscutellum deeply and roughly punctured. Mesopleuron with crater-like punctures, most expressively seen on upper half of mesopleuron. Abdominal segments smooth and shining. Dorsal view of sawsheath as in Fig. 4. Length: 9.5 mm.

Male: unknown.

Holotype: female, Korea, 04. 04. 1987 (no further data available). Deposited in STEPHAN BLANK's collection, Deutsches Entomologisches Institut, Eberswalde.

Etymology: The specific name refers to its remote similarity to *Dolerus japonicus* KIRBY, 1882.

Dolerus pseudojaponicus is closely related to *D. japonicus* KIRBY, 1882, but the latter is shorter and a much more slender species, 8.0–9.0 mm long, its wings are hyaline, and the apical setae of the sawsheath are pale and curved at their apices (Fig. 5). In contrast, *D. pseudojaponicus* is larger and stouter, its wings are clearly infuscate, and the apical setae of the sawsheath are dark and straight (Fig. 4). According to GOULET's system *Dolerus pseudojaponicus* belongs to the subgenus *Dolerus*. It runs to *Dolerus japonicus* in LEE and RYU's key. The most closely related European species is *Dolerus aericeps* THOMSON, 1871 (ZOMBORI 1982, BENSON 1952).

Holotype examined: *Dolerus japonicus* KIRBY, female, Japan, in The Natural History Museum, London.

REFERENCES

BENSON, R. B. (1952) Hymenoptera 2. Symphyta. Section (B). *Handbook for the identification of British Insects* 6 **26**: 51–137.

CAMERON, P. (1886) Hymenoptera from Japan and the Pacific. *Trans. Nat. Hist. Soc. Glasgow* **1**: 268.

GOULET, H. (1986) The genera and species of the Nearctic Dolerini (Symphyta: Tenthredinidae: Selandrinae): classification and phylogeny. *Mem. Ent. Soc. Canada* **135**: 481–483.

LEE, J.-W. & RYU, S.-M. (1989) A systematic study of the Symphyta (Hymenoptera) in Korea I. scanning electron microscopic study of the Dolerinae (Tenthredinidae). *Ent. Res. Bull. Korean Ent. Inst., Korean Univ.* **15**: 1–10.

KIRBY, W. (1882) *List of Hymenoptera, with descriptions and figures of the typical specimens in the British Museum. 1. Tenthredinidae and Siricidae.* Trustees of the British Museum. London, 450 pp.

KONOW, F. W. (1907) Neue Chalastogastra aus Museum Hamburg und Madrid. *Zeits. Hym. Dipt.* **7**: 163–164.

ROHWER, S. A. (1925*a*) Sawflies from the Maritime Province of Siberia. *Proc. U.S. Nat. Mus.* **68**: 1–12.

ROHWER, S. A. (1925*b*) Three sawflies from Japan. *Washington Acad. Sci.* 15 **21**: 481–483.

TAKEUCHI, K. (1952) *A generic classification of the Japanese Tenthredinidae (Hymenoptera, Symphyta).* Kyoto, 90 pp.

ZOMBORI L. (1982) Tenthredinoidea 2. In: *Fauna Hungariae 153.* Akadémiai Kiadó, Budapest, 144 pp.

Received December 13, 1995, accepted May 22, 1996

Publications of the Hungarian Natural History Museum are available

Korsós, Z. and I. Kiss (eds) (1992): Proceedings of the 6th Ordinary General Meeting of the Societas Europaea Herpetologica, 19–23 August 1991, Budapest, Hungary. 531 pp. – ISBN 963 7093 12 5 (50 DM).

Mahunka, S. (ed.) (1991): The Bátorliget Nature Reserves – after forty years. Vols 1–2, 848 pp. – ISBN 963 7093 08 7, 963 7093 09 5 (USD 45).

Papp, L. and A. Szappanos (1992): Bagócslegyek – Gasterophilidae, Oestridae, Hypodermatidae. (in Hungarian), 56 pp. – ISBN 963 7093 11 7 (USD 15).

Soós, Á. and L. Papp (eds) (1992): Catalogue of Palaearctic Diptera. Vol. 1: Trichoceridae – Nymphomyiidae. 520 pp. – ISBN 963 7093 10 9 (USD 80).

Soós, Á. and L. Papp (eds) (1992): Catalogue of Palaearctic Diptera. Vol. 13: Anthomyiidae – Tachinidae. 624 pp. – ISBN 963 7093 21 4 (USD 85).

Zombori, L. and L. Peregovits (1992): Proceedings of the Fourth European Congress of Entomology and the XIII. Internationale Symposium für die Entomofaunistik Mitteleuropas, Gödöllő, Hungary, 1991. Vols 1–2, pp. 884. – ISBN 963 7093 14 1, 963 7093 15 X (USD 15).

Mahunka, S. and L. Zombori (eds) (1993): The fauna of the Bükk National Park. Vol. 1, 456 pp. – ISBN 963 7093 20 6 (USD 30).

Szujkó-Lacza, J. and D. Kováts (eds) (1993): The Flora of the Kiskunság National Park. Vol. 1. The Flowering Plants. 469 pp. – ISBN 963 7093 19 2 (USD 30).

Báldi, A., G. Csorba and Z. Korsós (1995): Magyarország szárazföldi gerinceseinek természetvédelmi szempontú értékelési rendszere. [Setting priorities for the conservation of terrestrial vertebrates in Hungary.] (in Hungarian with an extensive English summary), 59 pp. – ISBN 963 7093 26 5 (USD 10).

Mahunka, S. and L. Mahunka-Papp (1995): The Oribatid species described by Berlese (Acari). 325 pp. – ISBN 963 7093 27 3 (USD 40).

Verseghy, K. (1995): Magyarország zuzmóflórájának kézikönyve. [The lichen flora of Hungary.] (in Hungarian), 415 pp. – ISBN 963 7093 22 2 (USD 40).

Mahunka, S. (ed.) (1995): The fauna of the Bükk National Park, Vol. 2, 655 pp. –ISBN 963 7093 20 x

Orders should be sent to:

The Library, Hungarian Natural History Museum
H–1088 Budapest, Baross u. 13, Hungary
Fax: +36-1-113-8820

Acta Zoologica Academiae Scientiarum Hungaricae 42(1), pp. 65–72, 1996

ON THE TAXONOMY OF THE HADERONIA CULTA (MOORE, 1881) SPECIES GROUP (LEPIDOPTERA, NOCTUIDAE)

M. HREBLAY

H–2030, Érd, Somfa u. 15, Hungary

The taxa of the *Haderonia culta* group are revised, *H. violacea* (LEECH, 1900) stat. n. is considered a valid species, and a new species, *H. ignorata* sp. n. from China is described. With 25 figures.

Key words: new species, *Haderonia*, Hadeninae, Noctuidae, Himalayan region

INTRODUCTION

In recent years, large material of moths of the family Noctuidae has been collected by Hungarian lepidopterologists in the Himalayan region. This material contains several specimens belonging to the *Haderonia culta* MOORE species group, which externally can be divided into a few groups. A detailed study of the genitalia revealed that more than two species of this species group occur in the southern Himalayas. In his comprehensive paper, VARGA (1992) distinguished only two species of the *H. culta* group and treated the *culta–subviolacea* complex as a single species.

An examination of the holotypes of *Haderonia culta* (MOORE, 1881) and *H. culta* var. *subviolacea* (LEECH, 1900), both preserved in The Natural History Museum, London (BMNH), revealed that *H. subviolacea* represents a distinct species (stat. n.), and is not conspecific with *H. culta* MOORE, as published by HAMPSON (1905) and followed by BOURSIN (1964). The incorrect synonymization was probably based on unsufficient material. The holotype of *H. culta* is a female while that of *H. subviolacea* is a male, therefore the correct association of the sexes requires larger material of both taxa.

In addition, as an unexpected result of the studies of the genital slides of *Haderonia* in The Natural History Museum (BMNH), a fourth, undescribed species from China was also found, the description of which is given below.

SYSTEMATIC PART

The genus *Haderonia* was described by STAUDINGER (1896), together with *subarschanica* STAUDINGER as its type species. This genus belongs to the *Haderonia* STAUDINGER – *Ctenoceratoda* VARGA, 1992 – *Tricheurois* HAMPSON, 1905 – *Polia* OCHSENHEIMER, 1816 complex. These genera form a group in which the different genera and their species groups are easily separable from each other by their external features, but the basic structure of the genitalia is very similar. On the other hand, the species within same species group are also regularly very closely related to each other as regards their external features. As a consequence of the similarity of the genitalia of within a genus, the comparison of larger series is necessary for the recognition of the specific features. This problem was discussed in details by VARGA (1992) in connection with the description of the genus *Ctenoceratoda* (type species: *sukharevae* VARGA, 1974) for the *khorgossi–zetina* species group.

The *Haderonia culta* group consists of four species. Members of the species group can be easily separated from the species of the other groups of the genus by their large size and broad, dark violet-brown forewings, and by the characteristic, well-developed saccular extension of the male genitalia.

CHECKLIST OF THE SPECIES OF THE HADERONIA CULTA GROUP

culta (MOORE, 1881)
subviolacea (LEECH, 1900) stat. n.
kalikotei VARGA, 1992
ignorata sp. n.

KEY TO THE SPECIES OF THE HADERONIA CULTA GROUP BASED ON THE MALE GENITALIA

1 Cucullus large, bilobate, saccular extensions short, not reaching ventral extremity of cucullus *kalikotei*

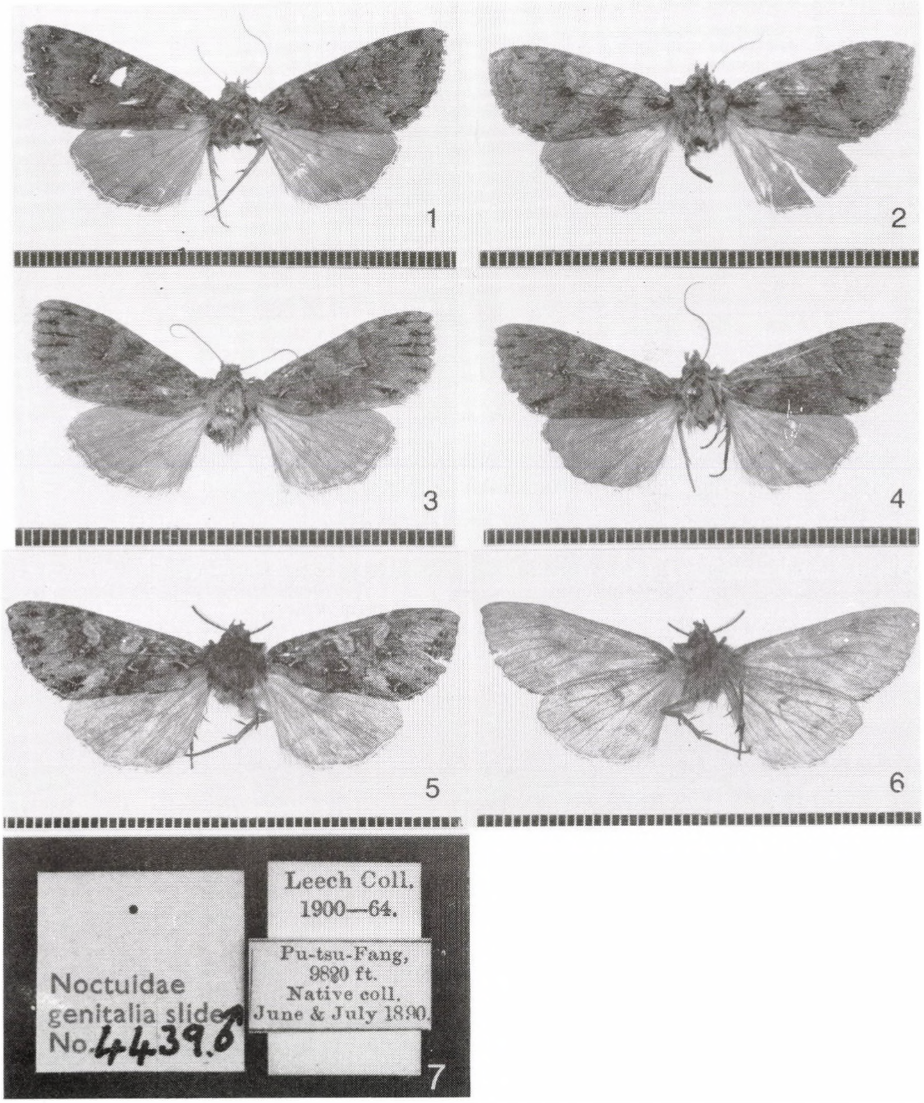
– Cucullus significantly smaller, simple, saccular extensions much longer, regularly reaching ventral extremity of cucullus

2 Saccular extensions strongly dilated apically, forming large, more or less triangular plates *ignorata*

– Saccular extensions apically tapering or only very slightly widened

3 Neck of cucullus stronger, broader, fields of hair-brushes of saccular extensions shorter, first bend of vesica expanded, more or less conical *subviolacea*

– Neck of cucullus narrower, fields of hair-brushes of saccular extensions longer, first bend of vesica tubular, rounded *culta*



Noctuidae
genitalia slide
No. 4439♂

Leech Coll.
1900—64.

Pu-tsu-Fang,
9820 ft.
Native coll.
June & July 1890.

Figs 1–7. 1 = *Haderonia culta* (MOORE, 1881), holotype; 2–4 = *H. subviolacea* (LEECH, 1900); 2 = holotype; 3 = female, Tibet; 4 = male, Tibet; 5–7 = *H. ignorata* sp. n., holotype

Haderonia culta (MOORE, 1881)

Mamestra culta MOORE, 1881: 347. Type locality: N India, Dalhousie

Examined material: holotype, female, "N-India, Dalhousia" gen. slide BMNH Noct. No. 4442, 1 ♂, Tibet, gen. slide BMNH Noct. No. 4443 male (coll. BMNH, London), – Nepal, Ganesh Himal: 1 ♂, 1 ♀, Yure Karka, 3,370 m, 14. VI. 1993, 1 ♂, 2 ♀, Jaisuli Kunda, 4,150 m, 16–17. VI. 1993, leg. MÁRTON HREBLAY & GÁBOR CSORBA, 2 ♂, 1 km E of Somdang, 3,850 m, 23. VII. 1995, 85°13'E, 28°10'N, 5 ♂, 1 ♀, 3 km SE of Somdang, 3,450 m, 25. VII. 1995, 85°13'E, 28°10'N, 9 ♂, Khurpudanda Pass, 3,600 m, 22. VII. 1995, 85°13'E, 28°12'N, leg. MÁRTON HREBLAY & TIBOR CSŐVÁRI, – Nepal, 6 km SW of Kalinchok peak: 1 ♂, 3,160 m, 6. VIII. 1995, 86°E, 27°23'N, Nepal, 4 km SW of Kalinchok peak: 1 ♂, 3,000 m, 7. VIII. 1995, 86°01'E, 27°23'N, leg. MÁRTON HREBLAY & TIBOR CSŐVÁRI, – Nepal, Solu Khumbu Himal: 9 ♂, 3 ♀, 7 km E of Lukla, 3,450 m, 1. VII. 1993, 7 ♂, 12 km E of Lukla, Yak Karka, 4,000 m, 30. VI. 1993, leg. M. HREBLAY & G. CSORBA. Gen. slide Nos HREBLAY: 4524, 4594, 5574, 5575, 5886, 5887, 5889, 8093, 8094, 8211, 8245, 8246, 8247, 8249, 8250 males, 4525, 4595, 6626, 6627 females (coll. HREBLAY, Érd).

Diagnosis: See *H. subviolacea*.

Male genitalia (Figs 8–11, 16, 17): Uncus short, tegumen narrow, vinculum rounded. Sacculus short with strong, narrow saccular extension. Hairbush on saccular extension well-developed, asymmetric, larger on left side. Neck of cucullus moderately narrow, corona present. Aedeagus slightly curved, vesica tubular with two bends forming an S distally with a longitudinal bend of spines.

Female genitalia (Figs 21, 22): Ostium well sclerotized, ductus bursae long, simple, well sclerotized. Cervix bursae recurved, ribbed, corpus bursae without signa.

Distribution: A Himalayan–Sino-Tibetan species, occurring from the Hindukush Mts towards the southern Himalayan region and southern China (Prov. Yuennan).

Remarks: The taxon considered here as *H. culta* is rather heterogeneous, it may contain more than one subspecies (or species?). Specimens of the western populations are smaller and their genitalia are relatively smaller, with more scarce and smaller hairbush on saccular extension. The specimens of the eastern populations are regularly larger and darker.

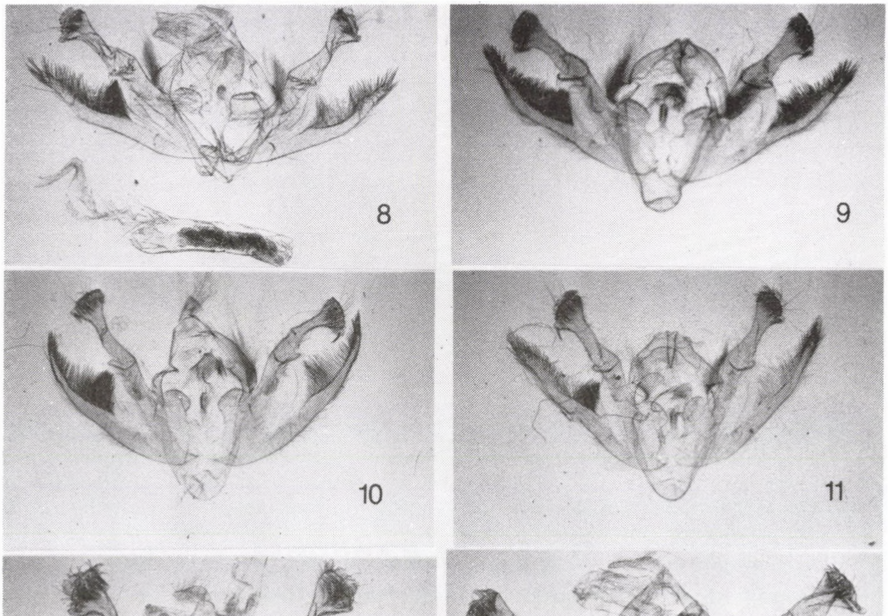
The genital slide published by BOURSIN (1964, plate XII: 48), and the specimen published by YOSHIMOTO (1994, plate 83: 31) indeed represent *H. culta* MOORE, as here considered.

Haderonia subviolacea (LEECH, 1900) **stat. n.**

Hadena culta var. *subviolacea* LEECH, 1900: 55, Type locality: China, Omei-shan

Examined material: holotype, male, "W-China" gen. slide BMNH Noct. No. 4438, 1 ♂, 1 ♀, Tibet, Yatung gen. slide BMNH Noct. Nos 4440 male, 4441 female (coll. BMNH, London), 6 ♂, Nepal, Solu Khumbu Himal, 5 km E of Lukla, 3,200 m, 27. VI. 1993, leg. MÁRTON HREBLAY & GÁBOR CSORBA, 2 ♀, Nepal, Solu Khumbu Himal, 7 km E of Lukla, 3,450 m, 1. VII. 1993, leg.

MÁRTON HREBLAY & GÁBOR CSORBA, 2 ♂, 1 ♀, Nepal, Solu Khumbu Himal, Lukla, 2,800 m, 2. VII. 1993, leg. MÁRTON HREBLAY & GÁBOR CSORBA, 1 ♂, Nepal, Ganesh Himal 1 km E of Somdang, 3,850 m, 23. VII. 1995, 85°13'E, 28°10'N, leg. MÁRTON HREBLAY & TIBOR CSŐVÁRI, 1 ♀ Nepal, Ganesh Himal 3 km E of Somdang, 3,450 m, 25. VII. 1995, 85°13'E, 28°11'N, leg. MÁRTON HREBLAY & TIBOR CSŐVÁRI. Gen slide Nos HREBLAY: 6623, 6624, 6625 males, 5888, 5890 females (coll. HREBLAY, Érd).



Figs 8–15. 8–11 = *Haderonia culta* (MOORE, 1881); 8 = Tibet; 9, 10 = Nepal; 11 = Pakistan; 12 = *H. ignorata* sp. n., holotype; 13–15 = *H. subviolacea* (LEECH, 1900); 13 = holotype; 14, 15 = Nepal

Diagnosis: Externally this species differs from *H. culta* in its somewhat smaller size, and the lighter, less intensive violet-brown ground colour of the forewing.

The male genitalia of *H. subviolacea* (Figs 13–15, 18, 19) have stronger and wider neck of cucullus, the tube of vesica is expanded at the first bend. The female genitalia of *H. subviolacea* differ from those of *H. culta* by its somewhat narrower ostium and more complex proximal part of the cervix bursae. This is the place of the expanded bend of the vesica during copulation, as indicated by an arrow in Figs 18–19 and 24, 25.

Distribution: This species occurs in the central Himalayas and in Tibet.

Haderonia kalikotei VARGA, 1992

Haderonia kalikotei VARGA, 1992: 97, type locality: Nepal

Examined material: holotype and 34 paratypes, Nepal, Prov. 3, East Jumbesi, 2750 m, 25–31. VII. 1964, leg W. Dierl (coll. ZSM, Munich), 1 ♂, Nepal, Solu Khumbu Himal, Lukla, 2800 m, 2. VII. 1993, leg. MÁRTON HREBLAY & GÁBOR CSORBA, 1 ♂, Nepal, 6 km SW of Kalinchok peak, 3160 m, 6. VIII. 1995, 86°E, 27°23'N, leg. MÁRTON HREBLAY & TIBOR CSŐVÁRI. Slide Nos 5910, 8013 HREBLAY (males) (coll. HREBLAY, Érd).

The diagnosis of the species given by VARGA (1992) is correct, except that one important feature is missing, namely that the pectination of the antenna of the male is about half of that of *H. culta* and *H. subviolacea*.

Distribution: Central- and Eastern Nepal.

Haderonia ignorata sp. n.

Holotype: China, "Pu-tsu-fang, 9820 ft., Native coll., June & July 1890; Leech Coll. 1900–64; Noctuidae genital slide No. 4439, male" (coll. The Natural History Museum, London).

Diagnosis. The new species is easily separable from its closest relatives, *H. culta, H. subviolacea* and *H. kalikotei* by its large, wide saccular extensions.

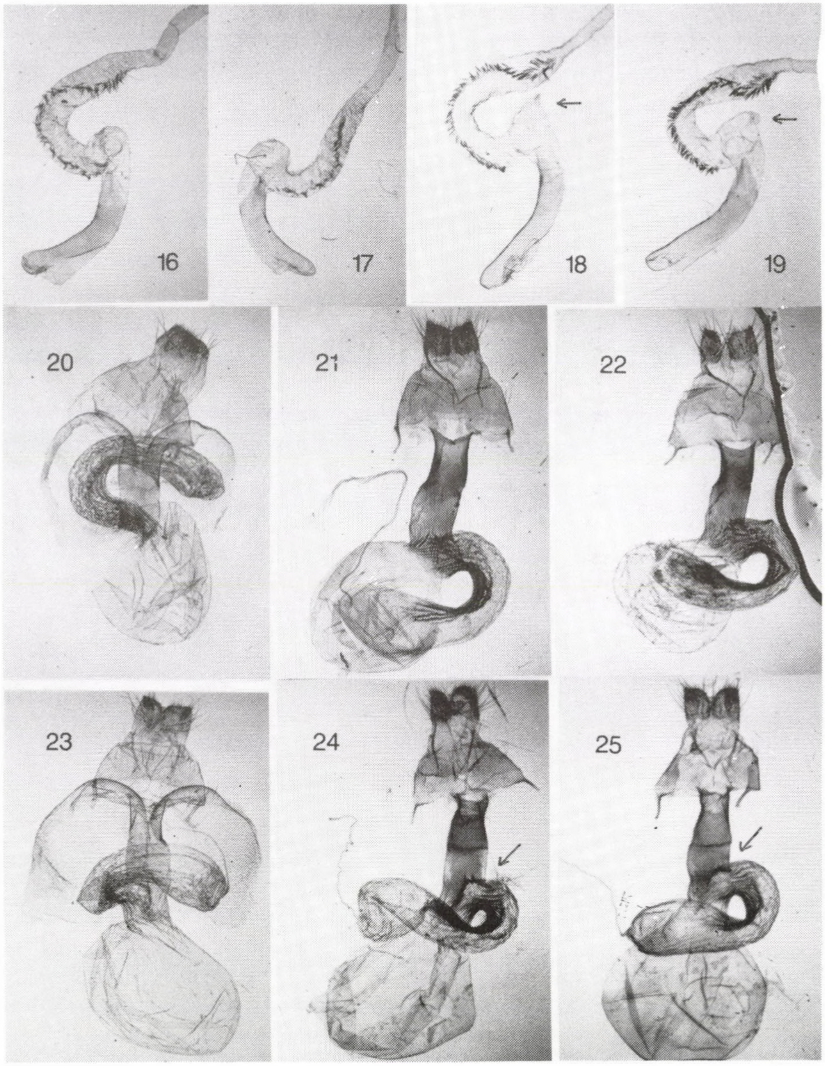
Description: Colouration, shape and pattern of forewing is similar to those of Haderonia culta MOORE. Head and thorax dark reddish-brown mixed with violaceous and a few whitish hairs, antennae shortly bipectinate. Ground colour of forewing dark red-brownish suffused with violaceous grey and irrorated with whitish. Subbasal, ante- and postmedial crosslines rather diffuse, double, waved. Subterminal an interrupted, fine, whitish line, defined by a row of indistinct, dark brown arrowheads; terminal line consisting of a series of small, dark triangles. Dark streak of submedian fold strong but short, black, defined by a white line, orbicular and reniform stigmata large, finely encircled with dark brown and filled with pale whitish grey; reniform with a white spot at lower extremity. Claviform relatively short, apical part sharply defined with black and white lines.

Marginal field with a large, blackish brown patch at tornus divided into two parts by subterminal and defined by a whitish-grey patch at inner side. Hind wing pale cupreous brown, marginal area somewhat darker, discal spot and transverse line rather diffuse.

Male genitalia (Fig. 12): Uncus short, tegumen narrow, vinculum rounded. Valva with saccular extension large, wide. Neck of cucullus narrow, short, corona present. Aedeagus slightly curved, vesica tubular, distally with a longitudinal belt of spines.

Female unknown.

Distribution: Only a single male is known from China, Pu-tsu-fang.



Figs 16–25. 16, 17 = *Haderonia culta* (Moore, 1881); 16 = Nepal; 17 = Pakistan; 18, 19 = *H. subviolacea* (Leech, 1900), Nepal; 20–22 = *H. culta* (Moore); 20 = holotype; 21, 22 = Nepal; 23–25 = *H. subviolacea* (Leech); 23 = Tibet; 24, 25 = Nepal

Acknowledgements – I wish to express my sincere thanks to Dr. W. DIERL and Dr. A. HAUSMANN (ZS, Munich), Mr. M. HONEY (The Natural History Museum, London), Dr. L. RONKAY (HNHM, Budapest), Dr. D. STÜNING (MAK, Bonn) for the possibility of studying collections in their care, and Mr. P. HURST (The Natural History Museum, London) for his kind assistance with the photographs.

The research was supported by the Hungarian National Scientific Research Fund, OTKA grant number 16465.

REFERENCES

BOURSIN, C. (1964) Noctuidae Trifinae. Zweiter Beiträg zur Kenntnis der Fauna der Noctuidae von Nepal. (Beiträge zur Kenntnis der "Noctuidae Trifinae" 146). *Veröff. zool. Stsslg. München* **8**: 1–140.

HAMPSON, G. F. (1905) *Catalogue of the Lepidoptera Phalaenae in the British Museum. Vol. 5.* London. Taylor and Francis, p. 634, plates 78: 95.

VARGA, Z. (1992) Taxonomic notes on the genus Haderonia Staudinger, 1896 with description of one new genus and four new species (Lepidoptera Noctuidae). *Acta zool. hung.* **38**(1–2): 95–112.

YOSHIMOTO, H. (1994) Noctuidae. In Moths of Nepal. Part III. *Tinea* **14**(Suppl.): 95–139.

Received March 20, 1996, accepted May 31, 1996

Acta Zoologica Academiae Scientiarum Hungaricae 42 (1), pp. 73–79, 1996

THE GENUS ANARSIA ZELLER (LEPIDOPTERA, GELECHIIDAE) FROM SIBERIA AND FAR EAST

PARK, K. T.[1] and M. G. PONOMARENKO[2]

[1] *Department of Agrobiology, Kangwon National University, Chuncheon, 200–701, Korea*
[2] *Institute of Biology and Pedology, Far East Branch of Russian Academy of Sciences*
690022, Vladivostok, Russia

Six species of the genus *Anarsia* ZELLER were recognized from Siberia and Far East. Two of the species are described as new to science (*Anarsia gajiensis* sp. n. and *A. sibirica* sp. n.), and *A. bipinnata* MEYRICK is reported from the Primorye Territory (Russian Far East) for the first time. Key to the species is given.

Key words: Lepidoptera, Gelechiidae, *Anarsia*, new species, Siberia, Far East

INTRODUCTION

Moths of the *Anarsia* group occupy a particular position in the family Gelechiidae: because of specific characters such as sexual dimorphism in male and female labial palpi, modified scales and long sclerotized processes on the valva, and asymmetry in the genitalia of both sexes in many species. Based on these characters AMSEL (1977) raised the taxonomic rank of this group to the family Anarsiidae. However, the opinion that this group must be assigned to the Gelechiidae – relating to the *Hypatima* group with similar functional morphological characters – is more widely accepted (MEYRICK 1925, JANSE 1949, PARK 1991, PONOMARENKO 1992). According to literature data, at present the *Anarsia* group includes nearly 100 species (GAEDE 1937, JANSE 1949, 1963, CLARKE 1955, 1969, KUZNETZOV 1957, AMSEL 1967, PONOMARENKO 1989, PARK 1991, 1995), yet the real number of species of the group can be estimated to be less than that, because some of them should be transferred to other genera.

The present paper includes descriptions of two new species. The type specimens of *Anarsia gajiensis* are deposited in the collection of the Center of Insect Systematics (Korea, Chuncheon); the holotype of *Anarsia sibirica* is in the Institute of Biology and Pedology (Vladivostok), paratypes are in the collection of the Zoological Institute (St.-Petersburg) and in the Zoological Museum of the Institute of Animal Systematics and Ecology (Russia, Novosibirsk).

LIST OF ANARSIA ZELLER, 1939 SPECIES FROM SIBERIA AND FAR EAST

Type species: *Tinea spartiella* SCHRANK, 1802

1. *Anarsia bimaculata* PONOMARENKO, 1989
   Distribution: Primorye Territory, Korea (Central).
2. *Anarsia bipinnata* MEYRICK, 1932
   Material examined: 4 males, Primorye Territory, Gornotaezhnoe, 20 km SE Ussuriysk, 19.07, 15, 30.08.1994; 23.08.1995 (PONOMARENKO).
   Distribution: Primorye Territory (new record), Korea, Japan.
3. *Anarsia nigricana* PARK, 1991
   Distribution: Korea (Central).
4. *Anarsia gajiensis* sp. n.
   Distribution: Korea (South).
5. *Anarsia spartiella* (SCHRANK, 1802)
   Distribution: Europe, Asia Minor, Eastern Siberia, Mongolia.
6. *Anarsia sibirica* sp. n.
   Distribution: Siberia (South).

KEY TO THE SPECIES BASED ON THE MALE GENITALIA

1	Valva strongly asymmetrical	2
–	Valva almost symmetrical	5
2	Right valva on the lower margin of its distal part with a tongue-shaped protrusion	*A. bimaculata* PONOMARENKO
–	Right valva on the lower margin of its distal part without a tongue-shaped protrusion	3
3	Right valva with oval cucullus, its process almost straight (Fig. 4)	*A. sibirica* sp. n.
–	Right valva with quadrangular cucullus, its process curved	4
4	Base of process on the left valva near its lower margin, right valva with the dentes behind its process (Fig. 8)	*A. spartiella* SCHRANK

– Base of process on the left valva on the middle of its outer side, right valva without dentes behind its process *A. nigricana* PARK

5 Membranous lobe on the middle of the left valva larger than that of the right valva *A. bipinnata* MEYRICK

– Membranous lobe on the middle of the left valva same size as that of the right valva (Fig. 2) *A. gajiensis* sp. n.

Anarsia gajiensis sp. n.
(Figs 1–3)

Diagnosis. Both sexes of this species very closely resemble to *Anarsia euphorodes* MEYRICK and to *A. aspera* PARK in the pattern of the forewings and the genitalia (PARK 1995, Figs 2–6, 7–12, 41, 42). It differs from the latter species by the membranous lobes on both valvae in the male genitalia and by the oval plate on the 8th tergite in the female genitalia.

Holotype: male, Mt. Gaji-san, Gyungnam Prov., 19.08.1993 (K. T. PARK & B. K. BYUN). Paratypes: 1 male, Oradong, Jeju Prov., 10.06.1993 (K. T. PARK), 1 female, Mt. Juwang-san, Gyungbug Prov., 18.08.1993 (K. T. PARK & B. K. BYUN).

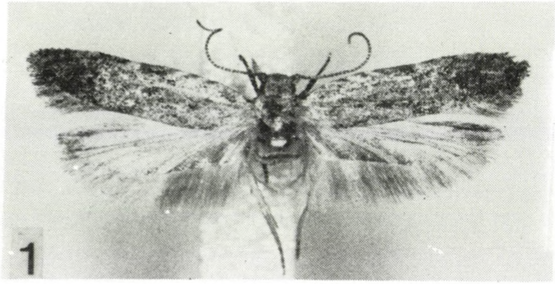
Description. Wingspan 12–13 mm (Fig. 1). Head and thorax grey. Second segment of labial palpus with triangular scale tuft, dark greyish-brown on outer surface and light grey on anterior margin. Basal part and (near) apex of third segment of female light grey; with two greyish-brown rings at middle part. Groundcolour of forewing grey; with a small, almost triangular greyish-brown spot on costal margin near middle; two similarly coloured streaks before and two beyond this spot. Hindwing grey.

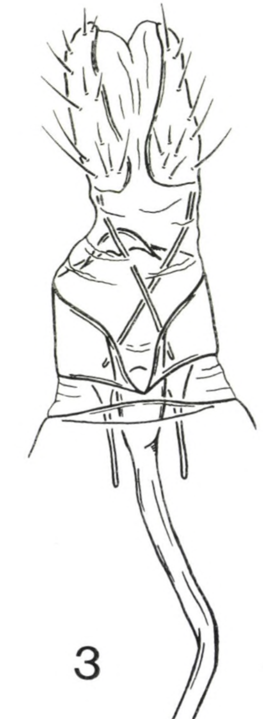
Male genitalia (Fig. 2). Uncus slightly broader than distal part of tegumen, with a process curved dorsally. Tegumen typical for the *Anarsia* group: long, slightly dilated in the middle and more dilated in the basal part. Valva almost symmetrical, with sclerotized distal part and a curved sharp apex inwardly with a long membranous lobe at middle of both valvae. Vinculum narrow. Juxta a quadrangular sclerotized plate. Aedeagus canal-shaped, shortly dilated basally, slightly narrowed towards apex beyond 1/4.

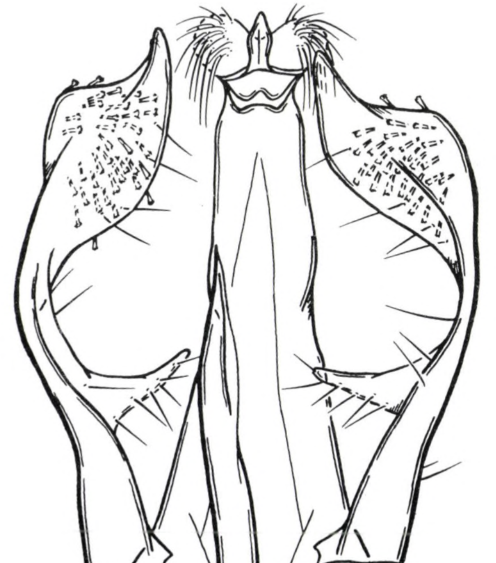
Female genitalia (Fig. 3). Ovipositor short, membrane between 8th and 9th segments almost half length of papillae anales. Apophyses anteriores about quarter length of apophyses posteriores. Eighth tergite with an oval sclerotized plate. Ostium at same level as anterior margin of sternite 8. Antrum goblet-shaped. Ductus bursae narrow, as long as corpus bursae. Corpus bursae membranous, oval, with a small crescent-shaped signum.

Distribution: Korea (South).

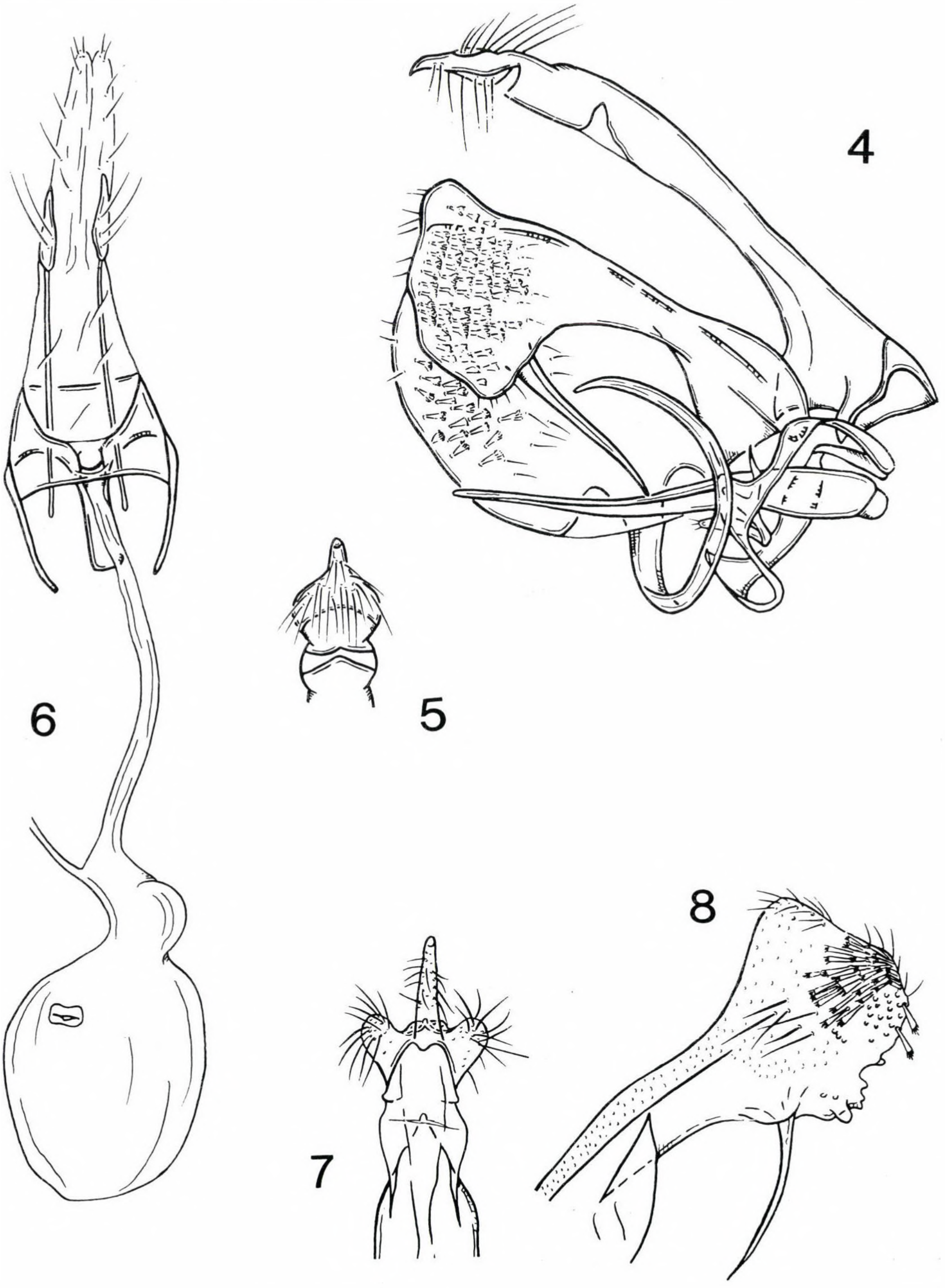
Figs 1–3. *Anarsia gajiensis* sp. n.: 1 = adult, 2 = male genitalia, 3 = female genitalia







Figs 4–6. *A. sibirica* sp. n.: 4 = male genitalia, 5 = uncus, 6 = female genitalia; *A. spartiella* SCHRANK 7 = uncus, 8 = right cucullus



Anarsia sibirica sp. n.
(Figs 4–6)

Diagnosis. The new species is very similar to *Anarsia spartiella* SCHRANK in the pattern of the forewings and the male genitalia. It can be distinguished from it by the shape of the uncus, left cucullus, and the female genitalia.

Holotype: male, Novosibirsk, Academgorodok, 23.07.1988 (DUBATOLOV). Paratypes: 1 female, same locality, 23.07.1988 (DUBATOLOV); 1 female, Minusinsk, 10.07.1924 (KOZHANCHIKOV); 3 female, Altai, Berezovka, 25.07.1986 (USTYUZHANIN); 2 MALE, Altai, Ongudayskiy distr., 23.06.1989 (USTYUZHANIN), 25.06.1989 (ARTEMIEVA).

Description. Wingspan 16–17 mm. Head and thorax light grey. Second segment of labial palpus with a quadrangular scale tuft, dark grey on the outer surface. Third segment of female light grey with two dark-grey rings at base and middle. Groundcolour of forewing light grey, of a faint brown hue; six light brown streaks on costal margin, third one larger than others; several small dark brown spots along middle part of wings. Hindwing grey.

Male genitalia (Figs 4, 5). Uncus slightly wider than tegumen, with a finger-shaped process at apex; without lateral lobes, whereas with rounded lateral lobes in *A. spartiella* (Fig. 7). Gnathos absent. Tegumen dilated in basal part. Valva asymmetrical. Left valva rounded with long switch-shaped process on lower margin, bilaterally membranous. Right valva with oval cucullus and almost straight process on lower margin. Valva of *spartiella* with quadrangular cucullus and dentes on its lower margin beyond the curved process (Fig. 8). Vinculum narrow, its sternal plates triangular. Juxta with two lobes. Aedeagus almost straight, narrower towards apex, inflated at basal third, with the basal rounded plate.

Female genitalia (Fig. 6). Ovipositor short, membrane between 8th and 9th segments half length of papillae anales. Eighth tergite with a long rectangular plate, with oval opening on base, its length almost as long as apophyses anteriores. Ostium oval, at middle of 8th sternite. Antrum sclerotized near ostium. Ductus bursae narrow, almost as long as length of corpus bursae, membranous. Ductus seminalis arising from near base of ductus bursae. Corpus bursae membranous, oval, narrowed at junction of ductus bursae, with a small crescent-shaped signum.

Distribution: Siberia (South).

REFERENCES

AMSEL, H. G. (1967) Die afghanischen Arten des Anarsia complexes. *Beitr. Naturk. Forsch. SW., Deutchl.* **24**(30): 17–31.

AMSEL, H. G. (1977) Vier neue Kleinschmetterlingsarten aus Iran (Lepidoptera). *Beitr. Naturk. Forsch. SW., Karlsruhe* **36**: 227–236.

CLARKE, J. F. G. (1955) *Catalogue of the Type Specimens of Microlepidoptera in the British Museum (Natural History) described by Edward Meyrick.* V. London. British Museum (Nat. Hist.). 332 pp.

CLARKE, J. F. G. (1969) *Catalogue of the Type Specimens of Microlepidoptera in the British Museum (Natural History) described by Edward Meyrick.* VI. London. British Museum (Nat. Hist.). 537 pp.

GAEDE, M. (1937) Gelechiidae. *In* BRYK, F. (ed.) *Lepidopterum Catalogues*, 630 pp.

JANSE, A. J. T. (1949) Gelechiidae. *Moths of South Africa* **5**(1): 16–37.

JANSE, A. J. T. (1963) Gelechiidae. *Moths of South Africa.* **6**(2): 214–215, **6**(3): 253–254.

KUZNETZOV, V. I. (1957) Anarsia eleagnella Kuzn., sp. n. (Lepidoptera, Gelechiidae), a new pest of Elaeagnus in the USSR. *Zool. Zhurn., Moscow* **36**: 1097–1098.

MEYRICK, E. (1925) Lepidoptera Heterocera, Family Gelechiidae. *Genera Insectorum*, Fasc. 184. 290 pp.

PARK, K. T. (1991) Korean species of the genus Anarsia (Lepidoptera, Gelechiidae). *Japan. J. Ent.* **59**: 490–498.

PARK, K. T. (1995) Review of Anarsia with descriptions of four new species (Lepidoptera: Gelechiidae). *Tropical Lepidoptera* **6**(1): 55–66.

PONOMARENKO, M. G. (1989) A review of moths of the genus Anarsia Z. (Lepidoptera, Gelechiidae) of the fauna of the USSR. *Ent. Obozr.* **68**(3): 628–641.

PONOMARENKO, M. G. (1992) Functional morphological analysis of male genitalia of the gelechiid moths of the subfamily Dichomeridinae sensu novo (Lepidoptera, Gelechiidae). *Ent. Obozr.* **71**(1): 160–178.

Received February 2, 1996, accepted March 14, 1996

Catalogue of Palaearctic Diptera

edited by Á. Soós and L. Papp

Volume 13
Anthomyiidae–Tachinidae

The Catalogue contains the basic taxonomic, nomenclatorial and distribution data of all species occurring in the Palaearctic Region with the fundamental morphological features for the majority of the fly groups.

Volume 13 lists the names of 460 genera, 38 subgenera and 2389 species assigned to three families. Furthermore, 672 synonymous generic and 2477 specific names, 1807 emendations, errors, nomina dubia and doubtful genera and species are listed. The period of the Catalogue extends from 1758 to 31 December, 1982.

Contents: Explication to distribution. Type-species designations in Volume 13. New name proposed in Volume 13. Families: Anthomyiidae (Á. Dely–Draskovits). Rhinophoridae (B. Herting). Tachinidae (B. Herting and Á. Dely–Draskovits). Bibliography. Index.

December 15, 1993. 624 pages
US$ 85.00 plus US$ 5.00 for package and postage
(and an extra US$ 5.00 if you want it air mail)
ISBN 963 70 9321 4
© Hungarian Natural History Museum, Budapest

Order should be sent
to the Hungarian Natural History Museum, Library
Baross u. 13., Budapest, H–1088 Hungary
Fax: (36)–(1)–1138820

Acta Zoologica Academiae Scientiarum Hungaricae 42(1), pp. 81–88, 1996

SOME CONIOPTERYGIDAE (NEUROPTERA) FROM A MOUNTAIN RAINFOREST OF TANZANIA

SZIRÁKI, GY.[1] and L. GREVE[2]

[1]*Zoological Department, Hungarian Natural History Museum*
H–1088 Budapest, Baross utca 13, Hungary
[2]*Zoological Museum, University of Bergen, Muséplass 3, N–5007 Bergen, Norway*

Four coniopterygid species were represented by seven male specimens collected in Tanzania by the scientific expedition of the Zoological Museum of the University of Bergen. Three of them – *Nimboa pallida* sp. n., *Coniopteryx (Xeroconiopteryx) unguicaudata* sp. n. and *Semidalis obscura* sp. n. – are described as new. The presence of scale-like hairs on the antennae of the *Nimboa* species, and occurence of clasping first legs in the genus *Semidalis* is reported first time.

Key words: Coniopterygidae, new species, Tanzania, scale like hairs, clasping fore leg

In the insect material collected by the scientific expedition of the Zoological Museum of Bergen University (ZMB) to Tanzania – among many other insects – there were some coniopterygid specimens as well.

The collecting sites were situated in the valley of the Kaputu Stream, in the Mazumbai Forest Reserve in the West Usambara Mountains, between 1535–1650 m above the sea level, in a mountain rainforest. The insects were captured by Malaise traps (ANDERSEN & JOHANSON 1992).

All the ten collected coniopterygids belong to the subfamily Coniopteryginae. Seven of them are males and these represent one known and three hitherto undescribed species.

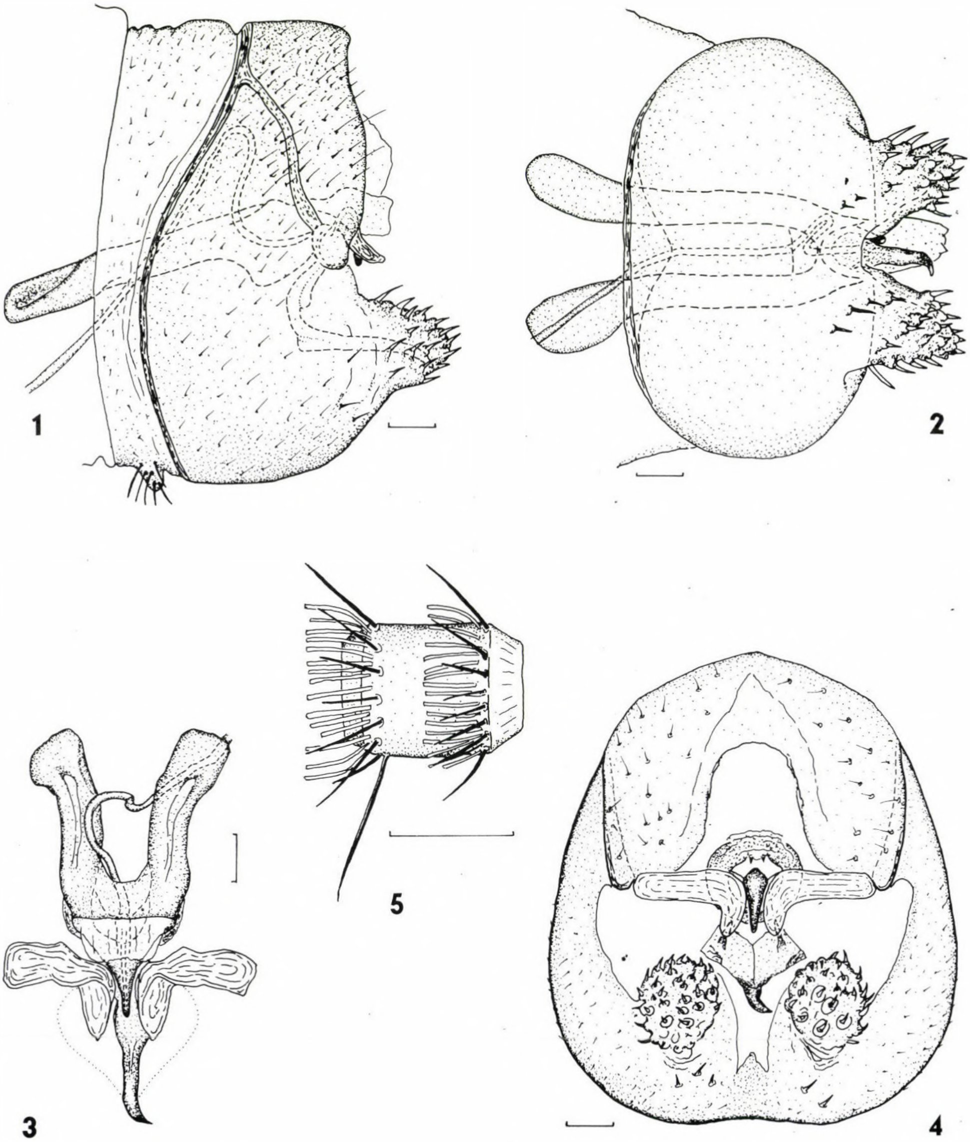
Nimboa pallida sp. n.
(Figs 1–5)

Holotype: male, Tanzania, Tanga region, W Usambara Mts, Mazumbai, stream-side, 1650 m a.s.l., Malaise trap, November 2–6, 1990, leg. ZMB's Tanzania Exp. Deposited in the Zoological Museum of the University of Bergen; (ZMBN Type No.240).

Description: Structure of frons and palpi normal. Colour of head light brown. Eyes black, moderately large. Antennae 1.6 mm long, 28-segmented, pale yellowish brown. Scapus three times as long as broad, pedicel and median flagellar segments about 1.5 times as long as broad, while basal flagellar segments as broad as long. Setae present on flagellar segments, ordinary hairs in two regular whorls. Scale-like hairs arranged apically of each whorl of ordinary hairs (Fig. 5), as in case of *Neosemidalis* s. str. species (MEINANDER, 1972).

Thorax light brown, legs pale ochreous. Length of forewing 2.8 mm, of hindwing 2.5 mm. Wing membrane hyaline, apparently unspotted, however, crossveins R$_1$-Rs and Rs-M$_{1+2}$ light brown.

Male terminalia (Figs 1–4) strongly sclerotized. Ectoproct with proximo-ventral apodeme. Stylus broad, unforked, falcate. Ring-like caudal paramere structure narrow. Penis sclerite consisting of a dorsal and a ventral part. Both parts pointed apically and curved downwards. Distinctly



Figs 1–5. *Nimboa pallida* sp. n.: 1 = male terminalia, lateral view, 2 = male terminalia, ventral view, 3 = male internal genitalia, caudo dorsal view, 4 = male terminalia, caudal view, 5 = median antennal segment of male. Scale: 0.03 mm.

sclerotized ductus ejaculatorius connected to the dorsal part of the penal sclerite. Large processus terminalis of hypandrium covered by short, but thick spines with strong basal knobs. Median incision deep.

Remarks: Because of the broad, unforked and falcate stylus the new species resembles *Nimboa capensis* TJEDER, 1957, especially those specimens, which had earlier been identified as *N. natalensis* TJEDER, 1957, a species placed in recently synonymy (MEINANDER 1995).

The main distinctive characteristics of *Nimboa pallida* sp. n. are:

- large, spiny processus terminalis of hypandrium;
- narrow ringlike caudal paramere structure;
- presence of scale-like hairs on the antennal segments.

This third feature had not been reported earlier in the genus *Nimboa*, but it was known in other two genera (namely: *Coniopteryx*, and *Neosemidalis*) of the tribe Coniopterygini.

Coniopteryx (Xeroconiopteryx) unguicaudata sp. n.
(Figs 6–10)

Holotype: male, Tanzania, Tanga region, W Usambara Mts, Mazumbai, stream-side, 1535 m a.s.l., Malaise trap, February 4–12, 1991, leg. ZMB's Tanzania Exp. Deposited in the Zoological Museum of the University of Bergen (ZMBN Type No. 241). Paratype: 1 male, same locality and collector as holotype, August 1–8, 1991 – deposited in the Zoological Department of the Hungarian Natural History Museum, Budapest.

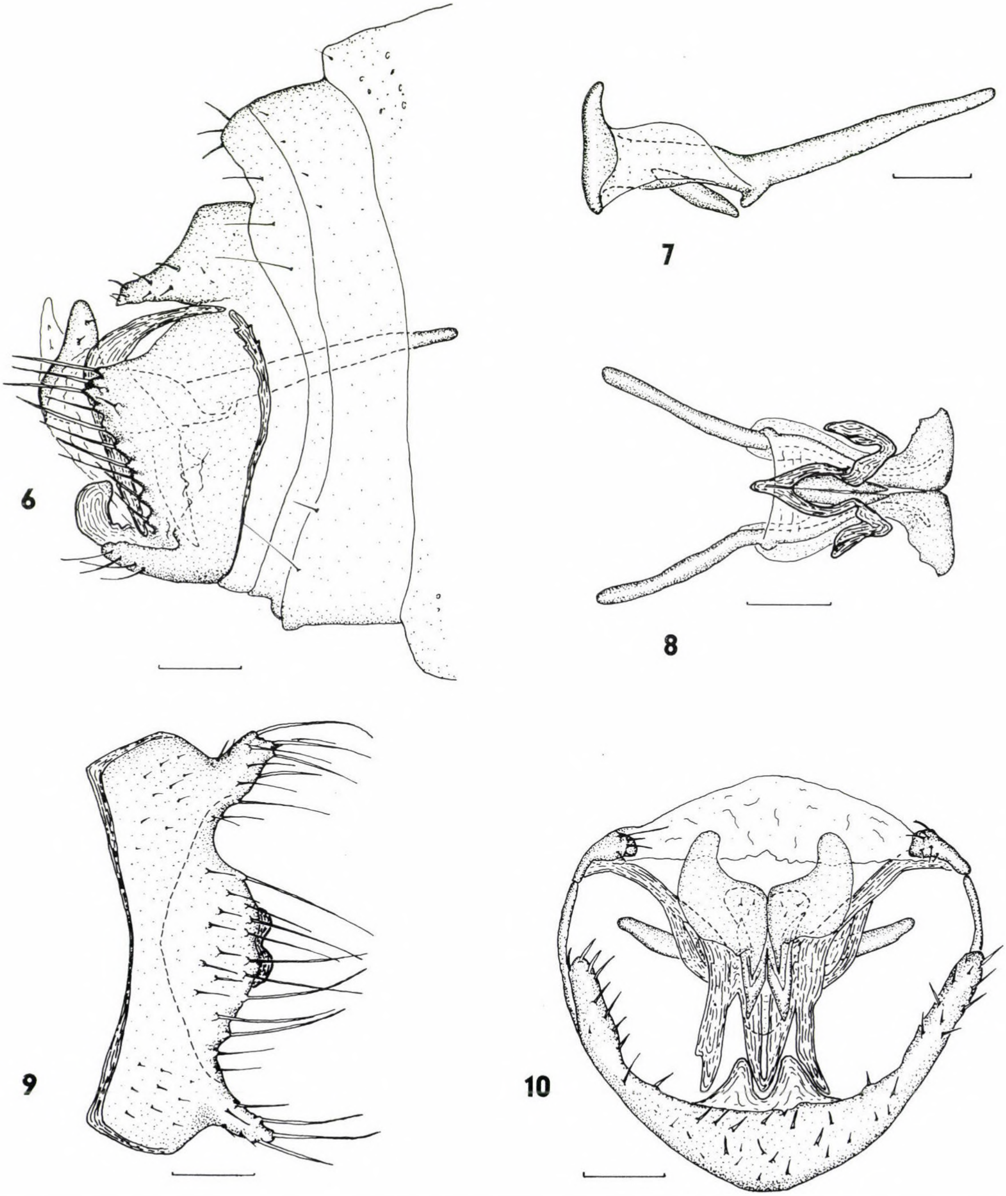
Description: Frons and palpi normal. Head light brown. Eyes black, moderately large (height half of total height of head). Antennae 1.2–1.3 mm, 29–31-segmented, light brown. Scape about as broad as long, pedicel 1.5 times as long as broad, while basal flagellar segments about 1.5 times as broad as long. Setae present, ordinary hairs in two, rather irregular, whorls. Scale-like hairs on proximal half of flagellar segments, and on large part of pedicel.

Thorax and legs light brown. Length of fore wing 2.0 mm, of hind wing 1.5 mm. Wing membrane also light brown with darker brown longitudinal veins.

Male terminalia as Figs 6–10. Hypandrium in lateral view somewhat higher than broad. Apodeme along the anterior margin ventrally thinned. Processus terminalis short, with a dorsally directed, hairless caudal projection. This projection in lateral view curved, claw-like. Its median incision deep. Processus lateralis strongly sclerotized, large, with rather acute dorso-caudal corner. Gonarcus small, weakly chitinized. Styli forked. Its outer branches very long and pointed, inner branches forming an acute median projection. Parameres rather long and slender with well-developed processus ventralis. Processus apicalis with a dorsal and a ventral projection; in lateral view both are pointed, while in caudal view the dorsal one rounded. Penis sclerites short and moderately pointed.

Because of the forked styli, the caudal structure of the paramere, and the setting of the scale-like hairs on the flagellar segments and pedicel, this new *Co-*

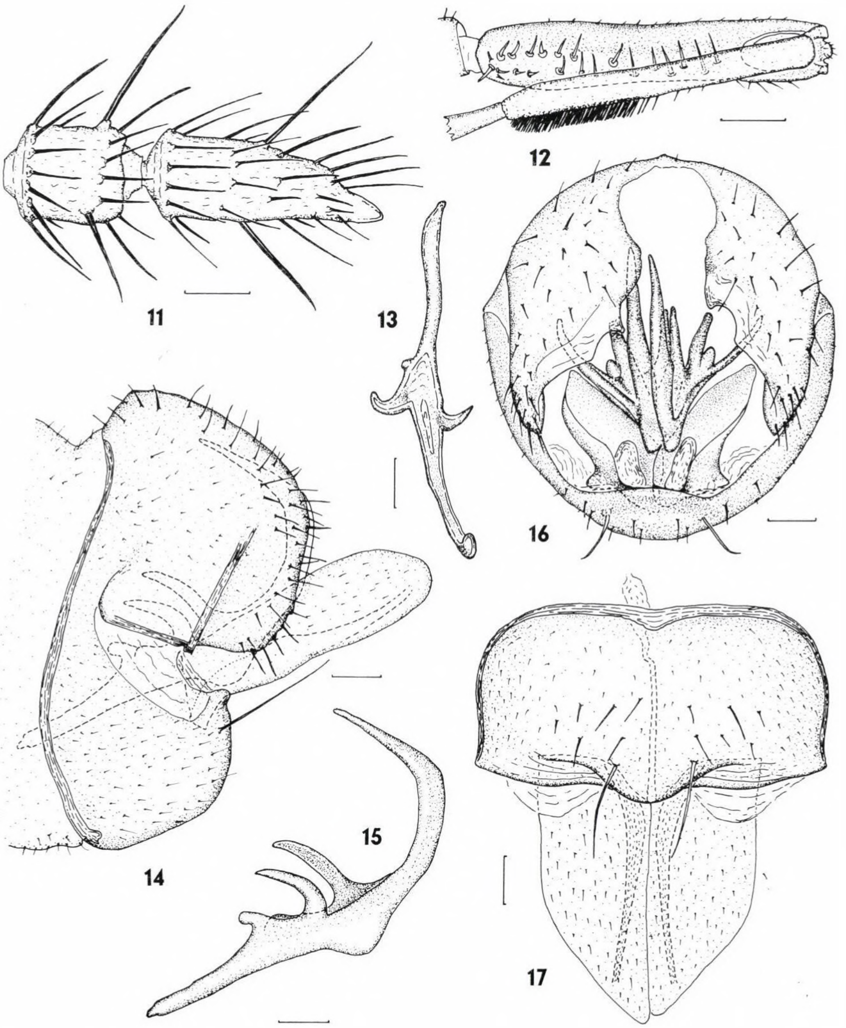
niopteryx species resembles in some respect *C. (X.) laticaudata* SZIRÁKI, 1994 in the *C. crassicornis* species group (MEINANDER 1972).



Figs 6–10. *Coniopteryx unguicaudata* sp. n.: 6 = male terminalia, lateral view, 7 = paramere, lateral view, 8 = male internal genitalia, ventral view, 9 = hypandrium, ventral view, 10 = male internal genitalia, caudal view. Scale: 0.03 mm.

Remarks: The main distinctive characteristics of *Coniopteryx unguicaudata* sp. n. are:

- acute median projection of the inner branches of the deeply forked styli;
- hairless, dorsally directed, in lateral view curved claw-like caudal projection of hypandrium;
- small penis sclerites.



Figs 11–17. *Semidalis obscura* sp. n.: 11 = apical segments of male antenna, 12 = first femur and tibia of male, 13 = paramere, dorsal view, 14 = male terminalia, lateral view, 15 = paramere, lateral view, 16 = male terminalia, caudal view, 17 = hypandrium, ventral accessorial sclerites and ductus ejaculatorius, ventral view. Scale in Figs 11, 13–17: 0.06 mm, in Fig. 12 = 0.13 mm

Semidalis obscura sp. n.
(Figs 11–17)

Holotype: male, Tanzania, Tanga region, W Usambara Mts, Mazumbai, stream-side, 1540 m a.s.l., Malaise trap, November 2, 1990, leg. ZMB's Tanzania Exp. Deposited in the Zoological Museum of the University of Bergen (ZMBN Type No. 242).

Paratypes: 1 male, same data as in the case of holotype, but 1535 m a.s.l., January 4–13, 1991. Deposited in the Zoological Museum of the University of Bergen; 1 male, same data as in holotype, but about 30 m from the stream-side, 1550 m a.s.l., November 1, 1990. Deposited in the Zoological Department of the Hungarian Natural History Museum, Budapest.

Description: Structure of frons and palpi normal. Colour of head dark brown. Eyes black. Antennae 2.5–2.6 mm, 33–37-segmented, mostly dark brown, but last 6–8 segments light brown. Scape, pedicel and median flagellar segments as long as broad. Terminal segment about 2.5 times as long as broad and pointed apically (Fig. 11). In addition to ordinary hairs, setae also present on flagellar segments.

Sclerites on dorsal part of thorax, thoracal sutures, coxae, tarsi and joints of legs dark brown. Other parts of thorax and legs, together with abdomen, pale ochreous. First femur (Fig. 12) distinctly thickened, and provided with two longitudinal rows of stout spines.

Length of fore wing 3.5 mm, of hind wing 2.8–3.0 mm. Wing membrane light, longitudinal veins dark brown. Cu_1 somewhat stronger and darker than the other veins. Crossvein R_1-Rs strongly oblique.

Male terminalia: as in Figs 13–17. Ectoproct short and broadly rounded with a short thorn medially, but without ventral inner process. First part of ninth segment synscleritous and with a well-developed anterior apodeme. Ninth tergite partly separated from ectoproct by a vertical apodeme ending ventrally in a minute knob. Before this apodeme a wide lobe ventrally bordered by a strong longitudinal apodeme. Hypandrium short with two setae. Its caudal edge rounded in ventral view. Paramere slender, terminal part forming a very large, pointed hook curving upwards. Middle part of paramere with three other dorsal projections: one large on inner, another large and a little one on outer side (Figs 13, 15). Definite uncini absent, but a pair of large ventral plates with strongly sclerotized inner ridge below parameres.* Ductus ejaculatorius distinctly sclerotized.

Remarks: The new species is close to *Semidalis maculipennis* because of the similarity in the structure of the parameres, because of the absence of definite uncini and the presence of similar plate-like sclerites below the parameres.

The main distinctive characteristics of *Semidalis obscura* sp. n. are:

- "clasping" first leg in the males;
- short and broadly rounded ectoproct. (The ectoproct of *S. maculipennis* has a fairly acute, subtriangular outer process.);
- presence of the lateral lobe of ninth tergite with special structure;

---

* The origin of these plates is uncertain, but they are obviously the same structures as the bilobed ventral plate of *Semidalis maculipennis* MEINANDER, 1975, which was interpreted as hypandrium (MEINENDER 1983) or the similar plate of *S. kolbei* ENDERLEIN, 1906, which was regarded as uncini (MEINANDER 1972). It is possible that the "pair of accessory long sclerites" of *S. faulkneri* MEINANDER, 1990 is also homologous with the above-mentioned structures.

- presence of a large, acute outer and a same inner dorsal projection at the middle part of the paramere. (In the case of *S. maculipennis* there is not at all dorsal projection on the inner side of the paramere.)

Further differences between the two related species are: the fore wings of *S. maculipennis* are spotted, while those of *S. obscura* sp. n. unspotted; the head of *S. maculipennis* is ochreous brown, while that of *S. obscura* is dark brown. A transverse knob is present on the ninth sternite of *S. maculipennis*, which is absent in the case of *S. obscura*.

The structure of the first leg of *S. obscura* sp. n. clearly suggests a clasping function. The same structure is well-known in the case of males of the genus *Coniopteryx* (tribe Coniopterygini) (e.g. MEINANDER 1972), but hitherto it was unknown in *Semidalis* species (tribe Conwentziini). Now this feature may be regarded as a synapomorphic character of both tribes of subfamily Coniopteryginae.

Semidalis africana ENDERLEIN, 1906

Material: One male specimen, Tanzania, Tanga region, W Usambara Mts, Mazumbai, stream-side, 1540 m a.s.l., Malaise trap, January 4–13, 1991, leg. ZMB's Tanzania Exp.

The genitalia of the examined specimen completely agree with those of *S. terminalis* KIMMINS, 1951, figured by MEINANDER (1972), which species later was synonymized (MEINANDER 1990) with *S. africana*. The three other localities where this species had hitherto been collected, are situated also in Tanzania and in Kenya.

* * *

Two of the three female specimens occurring in the examined material belong to the genus *Coniopterx*. As they were captured at the same locality as the holotype and the paratype of *Coniopteryx unguicaudata* sp. n., possibly they are conspecific. However, the uncertainty of this possibility is too large to handle these females as paratypes of *C. unguicaudata*. In the case of the single *Semidalis* female, which was collected at the same site as the holotype of *S. obscura* and the captured male specimen of *S. africana*, the uncertainty even is greater.

Acknowledgements – We are indebted to all members of the expedition. We are grateful to the Norwegian Research Council for Science and the Humanities (NZVF/NFR), the University of Bergen and the Norwegian Agency for International Developement (NORAD) for financial support. The Hungarian National Research Fund (OTKA) support is acknowledged from grant number T016729.

REFERENCES

ANDERSEN, T. & JOHANSON, K. A. (1992) Caddisflies (Trichoptera) from a mountain rain forest in NE Tanzania. *Proc. 7th Intern. Symp. Trichoptera* pp. 59–64.

MEINANDER, M. (1972) A revision of the family Coniopterygidae (Planipennia). *Acta Zool. Fennica* **136**: 1–357.

MEINANDER, M. (1983) The Coniopterygidae (Neuroptera) of southern Africa and adjacent Indian Ocean Islands. *Ann. Natal Mus.* **25**: 475–499.

MEINANDER, M. (1990) The Coniopterygidae (Neuroptera, Planipennia). A check-list of the species of the world, descriptions of new species and other new data. *Acta Zool. Fennica* **189**: 1–95.

MEINANDER, M. (1995) Coniopterygidae from southern and East Africa. *African Entomol.* **3**: (in print).

Received March 6, 1996, accepted May 21, 1996

ACTA ZOOLOGICA ACADEMIAE SCIENTIARUM HUNGARICAE

An international journal of animal taxonomy and ecology

Instruction to authors

Submission of a paper implies that it has not been published previously, that is not under consideration for publication elsewhere, and that if accepted for the Acta Zoologica Hungarica, the authors will transfer copyright to the Hungarian Academy of Sciences/the Hungarian Natural History Museum as is customary. Articles and illustrations become the property of the HAS/HNHM.

Papers must be in English with British spelling, and be original contributions in the field of animal taxonomy, systematics, zoogeography and ecology. All manuscripts must be submitted to one of the editors (editor, assistant editor).

Entire manuscripts must be submitted on IBM compatible floppy disk and in duplicate printed copies and the author should retain a copy. In the case of multiple authors, the corresponding author should be indicated. Series of numbered papers will not be considered.

Manuscripts must be printed with double spacing (including the reference list), and with wide margins (30–35 mm) on the left side of the paper only. Authors are requested to keep their communications as concise as possible. Footnotes should be avoided or minimized, and italics should not be used for emphasis. A running head of not more than 30 letters should be supplied.

The manuscript should contain the following information:

Title should be followed by the name and full address of the author(s). Where possible, the fax and/or e-mail number of the corresponding author should be supplied with the manuscript, for use by the publisher.

Abstract should be a brief summary of the contents and conclusions of the paper, and should not be longer than 200 words and should not contain references.

Key words should not be more than five (exceptionally 6) key word entries.

Introduction should contain a brief survey of the relevant literature and the reasons for doing the work.

Materials and Methods supply sufficient information to permit repetition of the experimental or field work. The technical description of methods should be given only when such methods are new.

Results should be presented concisely. Only in exceptional cases will it be permissible to present the same set of results in both table and a figure. The results section should not be used for discussion.

Discussion should be separate from the results section and should deal with the significance of the results and their relationship to the object of the work (and, this is the place of the identification key in taxonomic revisions).

Acknowledgements (at most in 10 lines).

References. In principle the Harvard system is to be followed. References should be detailed in the following order: authors' names and initials, date of publication (in parentheses), the title of the article, the name of the journal as abbreviated in the World List of Scientific Periodicals (4th edn 1963), the volume, and the first and last pages of the article, e.g.

NORRBOM, A. L. and KIM, K. C. (1985) Taxonomy and phylogenetic relationships of Copromyza Fallén (s.s.) (Diptera: Sphaeroceridae). *Ann. Entomol. Soc. Am.* **78**: 331–347.

For books the author's names, date of publication, title, edition, page reference, publisher's name and the place of publication should be given, e.g.

HINTON, H. E. (1981) *Biology of insect eggs*, vol. 2. Pergamon Press, New York.

or

MCALPINE, J. F. (1981) Morphology and terminology, adults, pp. 9–63. *In* MCALPINE *et al.* (eds) *Manual of Nearctic Diptera*, vol. 1. Agriculture Canada, Ottawa.

In the text references should be given as MARSHALL (1992) or (MARSHALL 1992). When a citation includes more than two authors, e.g. GREY, BLACK and WHITE, the paper should be referred to in the text as GREY *et al.*, provided that this not ambiguous. If papers by the same author(s) in the same year are cited, they should be distinguished by the letters, *a, b, c,* etc., e.g. MARSHALL (1992*a*).

References to papers "in press" must mean that the article has been accepted for publication. References to "personal communications" and unpublished work are permitted in the text only: references to papers in preparation or submitted are not permissible.

All necessary **illustrations** should accompany the manuscript, but should not be inserted in the text. All photographs, graphs and diagrams should be numbered consecutively in Arabic numerals in the order in which they are referred to in the text. Glossy photographs or positive prints should be sent unmounted wherever possible and should be kept to a minimum. Figures should be of good quality. Explanation of lettering and symbols should be given in the figure caption and only exceptionally in the figures. Lettering and symbols to appear on the illustration should be of sufficient size to allow for considerable reduction where necessary (usually proper for a 50% reduction in size). Scales must be indicated on micrographs, not by magnifications in the legends. Figure size must not exceed 24×30 cm. On the back of each illustration should be indicated the author's name, the figure number (in Arabic numerals), and the top of the illustration, where this is not clear. Halftones should be included only when they are essential. Details and quotation of publication of colour plates should be made to the editors. The following symbols should be used on line drawing: ● ■ ○ ❑ ▲ ◆ ♦ etc.

Legends to figures should be typed on a separate sheet. They should give sufficient data to make the illustration comprehensible without reference to the text.

Tables and appendices should be constructed so as to be intelligible without reference to the text, numbered in Arabic numerals and typed on separate sheets. Every table should be provided with an explanatory caption and each column should carry an appropriate heading. Units of measure should always be indicated clearly (metric units are preferred). All tables and figures must be referred to in the text.

Only standard **abbreviations** should be used. Arbitrary abbreviations and jargon will not be accepted.

The Latin names should be given for all species used in the investigation, although taxonomic affiliation and authority need not be provided in the title.

Page proofs will be sent to the author (or the first-mentioned author in a paper of multiple authorship) for checking. Corrections to the proofs must be restricted to printers' errors. Any substantial alterations other than these may be charged to the author. Authors are particularly requested to return their corrected proofs as quickly as possible in order to facilitate rapid publication. Please note that authors are urged to check their proofs carefully before return, since late corrections cannot be guaranteed for inclusion in the printed journal.

Fifty reprints free of charge will be sent to the first author; extra copies of the issue (at a specially reduced rate) can be ordered on the form which will accompany the proofs. These should be returned to: The Editorial Office of the Acta Zoologica, Hungarian Natural History Museum, Budapest, Baross u. 13, H–1088, Hungary

The **page charge** required from authors outside Hungary is USD 15 per printed page. In exceptional cases, the page charge may be waived. Please contact the editor in before submitting a paper if you ask for a waiver. Authors of papers exceeding 16 printed pages are asked to pay USD 40 (or HUF equivalent) for each such page, i.e. all costs of publication (irrespective of their nationality).

FOR FURTHER INFORMATION PLEASE CONTACT US
The Editorial Office of the Acta Zoologica
H–1088 Budapest, Baross u. 13, Hungary
Fax: (36–1) 1138820
E-mail: h7962per@ella.hu

SUBSCRIPTION INFORMATION

Orders should be addressed to

Editorial Office of the Acta Zoologica
Hungarian Natural History Museum
H-1088 Budapest, Baross u. 13, Hungary

Typeset: Pars Ltd., Budapest.
Printed by Dabas Jegyzet Ltd., Hungary

CONTENTS

HU ISSN 1217–8837

Acta Zoologica

Academiae Scientiarum Hungaricae

VOLUME 42 - NUMBER 2 - 1996

HUNGARIAN NATURAL HISTORY MUSEUM, BUDAPEST

ACTA ZOOLOGICA
ACADEMIAE SCIENTIARUM HUNGARICAE

AN INTERNATIONAL JOURNAL OF ANIMAL TAXONOMY AND ECOLOGY

Acta Zoologica Academiae Scientiarum Hungaricae is published quarterly from February 1994 (other issues in May, August and November) by the Hungarian Natural History Museum and the Biological Section of the Hungarian Academy of Sciences with the financial support of the Hungarian Academy of Sciences.

Acta Zoologica Academiae Scientiarum Hungaricae 42 (2), pp. 89–109, 1996

OLD WORLD RHIPIDANDRUS LECONTE: SYNONYMIES, FAUNISTICS, IDENTIFICATION KEY AND DESCRIPTION OF TWO NEW SPECIES FROM AUSTRALIA (COLEOPTERA: TENEBRIONIDAE)

MERKL, O.[1] and T. V. KOMPANTZEVA[2]*

[1]*Department of Zoology, Hungarian Natural History Museum*
H–1088 Budapest, Baross u. 13, Hungary
[2]*A. N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences*
117071 Moscow, Leninsky pr. 33, Russia

The Old World species of *Rhipidandrus* are reviewed. *R. caesus* sp. n. and *R. crowsoni* sp. n. are described from Australia. New synonymies (junior synonym first): *R. cioides clypeatus* KASZAB, 1955 = *R. cioides* KASZAB, 1955; *R. similis* KASZAB, 1955 = *R. crenipennis* (MOTSCHULSKY, 1858); *R. zaitzevi* KOMPANTZEVA et MERKL, 1992 = *R. crenipennis* MOTSCHULSKY, 1858; *R. dybasi* KULZER, 1957 = *R. speculifrons* (GEBIEN, 1922); *R. sodalis* KULZER, 1957 = *R. speculifrons* (GEBIEN, 1922); *R. scolytoides* CHUJO, 1985 = *R. speculifrons* (GEBIEN, 1922); *Bolitopertha novemcostata* GEBIEN, 1910 = *R. borbonicus* (FAIRMARE, 1880). A key for the identification of the Old World species is given.

Key words: taxonomy, Coleoptera, Tenebrionidae, *Rhipidandrus*, Old World.

The genus *Rhipidandrus* LECONTE, 1862 is a member of the tenebrionine tribe Bolitophagini. Its systematic position is discussed in detail by KOMPANTSEVA (1995). Based on characters of the recently described larva of *R. crenipennis* (MOTSCHULSKY, 1858) as well as on adult features, this genus is closely related to the Palearctic *Eledona* LATREILLE, 1796, the Palearctic *Eledonoprius* REITTER, 1911 and the African *Bolitolaemus* GEBIEN, 1920. The separation of *Rhipidandrus* in a distinct subtribe Rhipidandrina by WATT (1974) and DOYEN *et al.* (1989) seems unjustifiable (KOMPANTSEVA 1995).

The first Old World species belonging here, *Xyloborus crenipennis*, was described from "Birma" by MOTSCHULSKY (1858) who placed it in the "Bostrichi" (= Scolytidae). Later, FAIRMARE (1880) described *Bolitophagus borbonicus* (Tenebrionidae) from Réunion. WATERHOUSE (1894) described *Cherostus* in the "Cioidae" (= Ciidae) with two species, *simpsoni* from Australia and *walkeri* from Damma Island of the Moluccas. GEBIEN (1910) erected the tenebrionid genus

---

* The different spellings "KOMPANTSEVA" and "KOMPANTZEVA" have been alternatively used in the literature (*e.g.* KOMPANTSEVA 1995, KOMPANTZEVA & MERKL 1992). The junior author prefers "ts" but in the present paper "tz" is retained because it is so written in all type labels (O. MERKL).

Bolitopertha for *B. novemcostata* from Tanganyika. GEBIEN (1939) synonymized *Bolitopertha* and *Cherostus* with the New World tenebrionid genus of *Rhipidandrus*.

Further species have been added by CHUJO (1985), GEBIEN (1914, 1922), KASZAB (1955*a, b*), KOMPANTZEVA & MERKL (1992), KULZER (1957) and VINSON (1950). KASZAB (1955*a*) and KULZER (1957) provided keys to the non-African Old World species.

The present paper is devoted to the re-examination of the Old World species of *Rhipidandrus* and contains distributional data and a key to the species. *R. simpsoni* (WATERHOUSE, 1894) and *R. walkeri* (WATERHOUSE, 1894) are frequently collected and well-defined species with clear-cut features so no effort was made to obtain their types for study. The other species are, however, quite uniform in most respects, although the sexes differ in some external features (see below). In some cases females and males were described as different species. Examination of the types resulted in the synonymization of several names. The type of *R. madagascariensis* (LACORDAIRE, 1866) has not been seen by the authors. A specimen determined as *R. madagascariensis* by Z. KASZAB and deposited in the HNHM belongs to a species of Ciidae.

Because of the great deal of uniformity in the adult features, and in order to avoid redundance, the old species are not re-described in detail. The authors believe the identification key is detailed enough and includes all diagnostic characters.

MATERIAL AND PRESENTATION OF DATA

The following acronyms are used in the text for indicating depositories of the investigated specimens. The names of individuals responsible for loans of material follow the names of institution: ANIC – Australian National Insect Collection, Canberra, Australia. Dr. J. F. LAWRENCE; BMNH – The Natural History Museum, formerly British Museum (Natural History), London, United Kingdom. Miss JANE BEARD; BREM – Private collection of Dr. H. J. BREMER, Heidelberg, Germany; ELKU – Entomological Laboratory, Kyushu University, Fukuoka, Japan. Mr. T. UENO; FREY – Frey Collection, Tutzing bei München, Germany. Dr. G. SCHERER; HNHM – Hungarian Natural History Museum, Budapest, Hungary. Dr. O. MERKL; MASU – Private collection of Dr. K. MASUMOTO, Yokohama, Japan; MHNP – Muséum National d'Histoire Naturelle, Paris, France. Dr. C. GIRARD; SIEE – A. N. Severtsov Institute of Ecology and Evolution, Moscow, Russia. Dr. T. KOMPANTZEVA; SHIB – Private collection of Mr. T. SHIBATA, Osaka, Japan; SMNS – Staatliches Museum für Naturkunde Stuttgart. Dr. W. SCHAWALLER; ZETT – Private collection of Dr. H. ZETTEL, Wien, Austria; ZMUM – Zoological Museum of the Moscow State University, Moscow, Russia. Dr. N. NIKITSKY; ZSM – Zoologische Staatssammlung, München, Germany. Dr. G. SCHERER; UENO – Private collection of Mr. TERUHISA UENO, Fukuoka, Japan.

The text of the consecutive labels of the available type specimens are cited verbatim, every label being numbered from the uppermost to the lowest. Data of non-type specimens are given as follows: locality (as written on the labels), method of collecting (if presented on the label), date of collecting, name of collector(s), number of specimens and depository (in parentheses).

Body length was measured from the anterior margin of pronotum to the apex of the elytra.

Scanning electron micrographs were made by S–2360N Hitachi SEM in natural scanning mode with Robinson backscatter detector.

Rhipidandrus LECONTE, 1862

Xyloborus MOTSCHULSKY, 1858: 64 (nomen nudum).

Rhipidandrus LECONTE, 1862: 236. Type species: *Xyletinus flabellicornis* STURM, 1826, by original monotypy.

Bolitopertha GEBIEN, 1910: 379. Type species: *Bolitopertha novemcostata* GEBIEN, 1910, by original monotypy.

Cherostus WATERHOUSE, 1894: 68. Type species: *Cherostus walkeri* WATERHOUSE, 1894, herewith designated.

Description – Body subcylindrical, parallel-sided, strongly convex above. Colour dark reddish-brown to blackish-brown. Surface with rough sculpturing, often covered with greyish exudate. Punctures of head and pronotum in fact polygonal (tetragonal to hexagonal) impressions separated by narrow, ridged interspaces. Apical part of antennae and legs finely pubescent.

Head subglobular, coarsely and densely punctate; ocular ridge feebly convex and short; eyes relatively large, oblique-oval in dorsal view, rounded oval in lateral view; labrum relatively small, trapezoidal, inclined anteriorly, anterior margin slightly concave, with distinct transverse ridge mediobasally. Antennae 11-segmented, with 5 to 7-segmented club; segments 5 to 10 gradually dilated internally; segment 11 elliptic; mandibles assymmetrical, wedge-shaped, with broad base, with two apical teeth, well-developed ridged mola and membranous prostheca; apical teeth of left mandible with distinctly serrulated cutting edges; terminal segment of maxillary palpi longitudinal, weakly compressed at sides; labium with ligula; apical segment of labial palpi oblong-oval; mentum subtrapezoidal, with mid-longitudinal carina; ventral surface of head scarcely and deeply punctate; antennal grooves well-developed; gula triangular, strongly narrowed anteriorly, slightly convex, shining.

Pronotum transverse, widest at base, strongly arched above; sides weakly rounded, with narrow margins visible for entire length from above; anterior angles obtuse, posterior angles almost rectangular; prosternum narrow, short, coarsely punctate, carinate mid-longitudinally; prosternal process strongly arched between coxae, flattened and abrupt at apex; propleura convex, finely punctate.

Scutellum triangular, moderately convex, coarsely punctate.

Elytra strongly convex, subparallel, lateral margins very narrow, invisible from above except anterior end; disc moderately convex, steeply sloping laterally and posteriorly; humerus rounded, feebly produced; surface with 10 striae; interstriae strongly carinate; 10th carina usually present; epipleura moderately wide, gradually tapering toward elytral apex, finely rugulose.

Ventral surface glabrous, sparsely punctate; mesosternum with deep, broadly rounded excavation mediobasally; intercoxal process very narrow; mesocoxal cavities large, oblique oval; mesotrochantins exposed; metasternum moderately convex, with distinct mid-longitudinal groove and deep excavation mediobasally; metacoxal cavities large, transverse; ventrites slightly convex; last visible ventrite with denser punctation and with shallow groove along apical margin.

Fore femora thick, vested with pale, short setae, with shallow, bluntly bordered groove on upper surface; middle and hind femora longer; fore tibiae dilated apically, apical margin serrate and moderately bent outwards, produced in a short tooth at external angle; inner angle with a longer and thicker lower spur and a very short and thinner upper one; lateral margin carinate and serrate; middle and hind tibiae more slender and longer; tarsal formula seemingly 4–4–4, but in reality 5–5–4, since basal segment of fore and middle tarsi weakly sclerotized and withdrawn into special tibial excavation, so indistinctly visible in dorsal view; segments 2–4 (visible 1–3) equal in length, last segment as long as 2–4 combined.

Sexual dimorphism – External apical angle of middle and hind tibiae with spine-like process in females (Fig. 13), while with only small denticles in males (Fig. 14). Except for *R. walkeri* (Fig. 1), sculpture of frons and clypeus more or less different between female and male of all species where both sexes are known. Females usually with impunctate or sparsely punctate areas (Figs 8, 11, 18), while the frons of males is uniformly punctate in most cases (Figs 9, 12, 19). In *R. crenipennis* and *R. caesus*, both females and males have a similar impunctate frontal spot, which more expanded in females (Figs 5–6, 16). *R. crowsoni* with a different type of dimorphism in sculpture of clypeus (see Figs 22–23 for description and key).

The aedeagus minute and lightly sclerotized (Figs 28–29), therefore of no use in separation of species. Ovipositor unsclerotized (TSCHINKEL & DOYEN 1980).

KEY TO THE OLD WORLD SPECIES OF *RHIPIDANDRUS*
(except *R. nudus*)

1 Frons deeply impressed; clypeus impunctate; frontal impression and anterior third of clypeus with dense, erect, golden pubescence (Fig. 1). Cranial surface similar in both sexes. Pronotum in lateral portions with punctures tending to be longitudinal. Elytral striae with short transverse, oblique or irregular ridges, often reduced to tubercles; 10th carina well-developed and long, reaching posterior two-third of elytral length (Fig. 2). Length 3.2–4.1 mm. Australia, New Guinea, Moluccas
R. walkeri (WATERHOUSE, 1894)

– Frons not impressed; frons and clypeus glabrous 2

2 Larger (above 4.5 mm). 10th elytral carina long, reaching posterior 1/3 of elytral length; elytral striae with a network of longitudinal and transverse ridges. Pronotum in lateral portions with punctures tending to be longitudinal (Fig. 4). Male: frons coarsely and densely punctate; clypeus finely granulate-punctate; frontoclypeal suture distinct (Fig. 3). Female unknown. Length 4.6–4.8 mm. Melanesia (Fiji and Samoa)
R. cioides KASZAB, 1955

– Smaller (under 4.5 mm). 10th elytral carina shorter or completely obsolete 3

3 Elytral striae divided into more or less regular quadrangles by transverse ridges connecting adjacent carinae (Figs 7, 10, 15). Pronotum in lateral portions with punctures not differing from those of middle 4

– Elytral striae with reticulated sculpture (Figs 17, 20, 25) 6

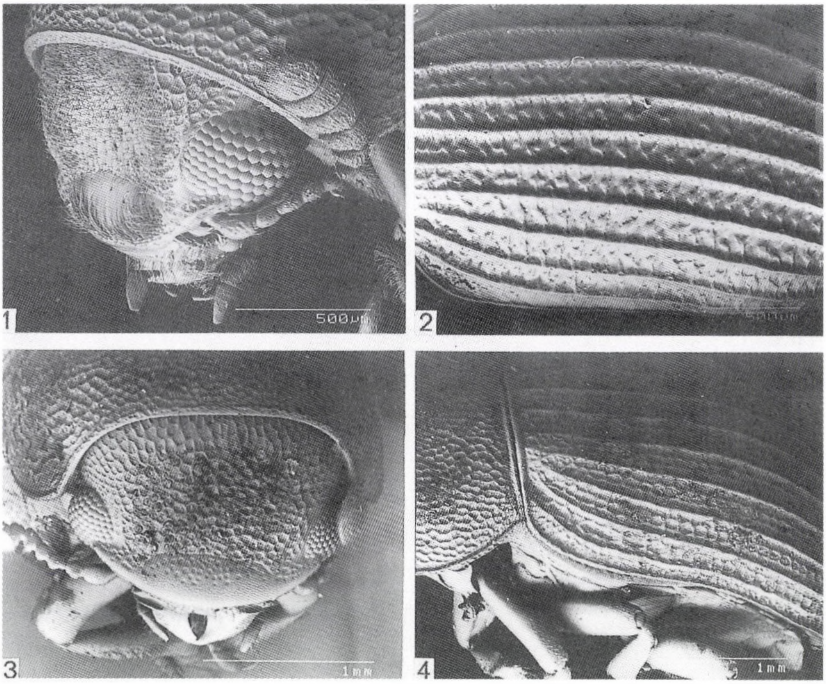
4 Female and male with more or less similar cranial surface (Figs 5–6). Frons with ovoid, longitudinal, shiny, impunctate spot (more expanded in females); clypeus shining but sparsely punctate; frontoclypeal suture vague

but distinct. 10th elytral carina absent (Fig. 7). Length 2.7–3.2 mm. Indo-Malayan Region (Vietnam, Indonesia, Philippines)
R. crenipennis (MOTSCHULSKY, 1858)

– Female and male with different cranial surface. Male with cranial surface always dull, coarsely and uniformly punctate (Figs 9, 12). 10th elytral carina almost always present (Figs 10, 15) 5

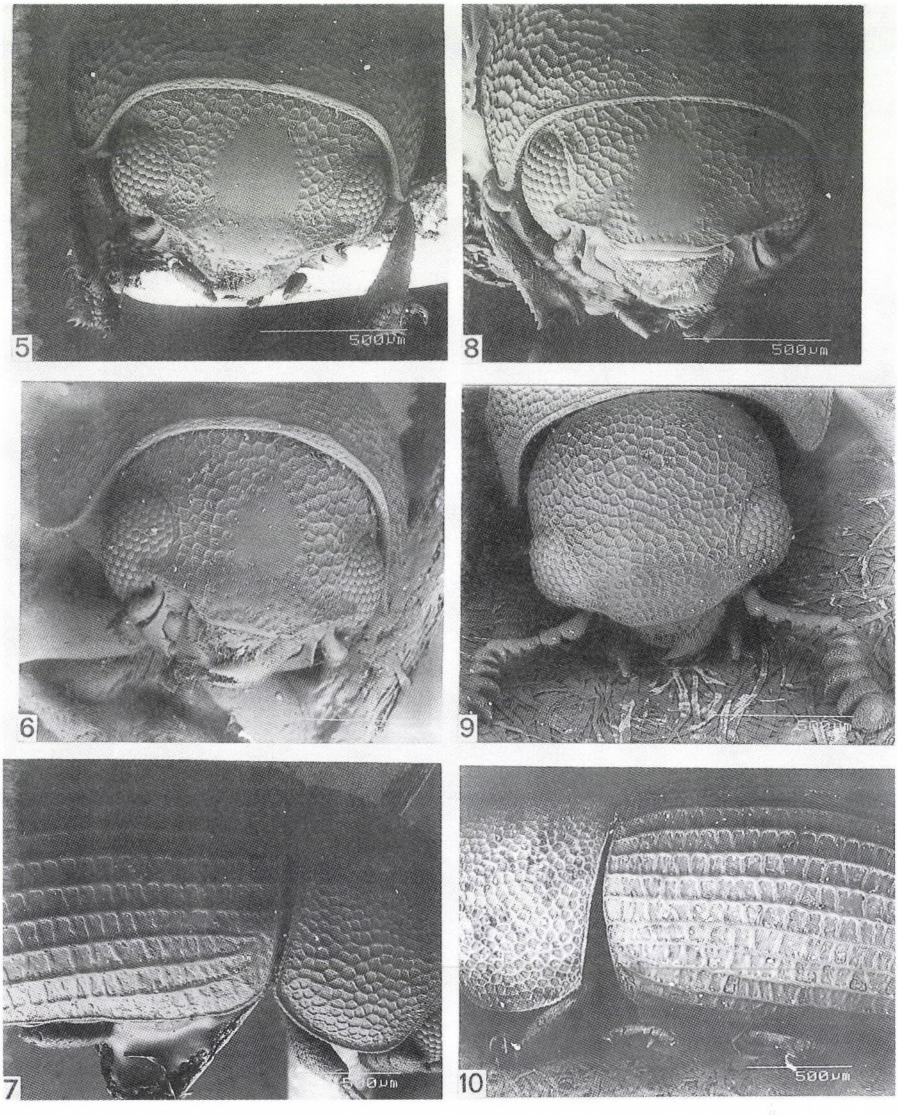
5 Smaller (under 3 mm). Female: cranium with glistening, impunctate frontoclypeal area; frontoclypeal suture completely obsolete (Fig. 8). Male: frontoclypeal suture vaguely indicated (Fig. 9). Length 2.3–2.9 mm. Seychelles, Indo-Malayan Region to Ryukyus, Micronesia and Australia
R. speculifrons (GEBIEN, 1922)

Larger (above 3 mm). Female: frons with poorly limited, shining area with small, sparse punctures; clypeus shining, with sparse punctures; frontoclypeal suture distinct (Fig 11). Male: frontoclypeal suture distinct (Fig. 12). Length 3.4–4.0 mm. East and South Africa, Madagascar, Mascarenhas
R. borbonicus (FAIRMARE, 1880)



Figs 1–4. 1–2 = *Rhipidandrus walkeri* (WATERHOUSE): 1 = head, 2 = left elytron, lateral view; 3–4 = *R. cioides* KASZAB: 3 = head of male, 4 = pronotum and left elytron, lateral view

6 Pronotum in lateral portions with punctures not differing from those of middle. Elytral striae with oblique and transverse wrinkles (Fig. 17). Female and male with more or less similar cranial surface; frons with ovoid, transverse, shiny, impunctate spot (more expanded in females); clypeus shining, impunctate; frontoclypeal suture deeply impressed (Fig 16). Length 3.1–3.4 mm. Australia **R. caesus** sp. n.



Figs 5–10. 5–7 = *Rhipidandrus crenipennis* (MOTSCHULSKY): 5 = head of female, 6 = head of male, 7 = right elytron and pronotum, lateral view; 8–10 = *R. speculifrons* (GEBIEN): 8 = head of female, 9 = head of male, 10 = pronotum and left elytron, lateral view

– Pronotum in lateral portions with punctures tending to be longitudinal. Elytral striae with wrinkles forming a row of polygonal cells (Figs 20, 25). Female and male with different cranial surface 7

7 Female: frons with an ill-defined impunctate area; clypeus without crenulate ridge (Fig. 18). Male: frons coarsely and uniformly punctate; clypeus without tubercles (Fig. 19). Length 3.0–4.0 mm. Australia, Solomon Islands *R. simpsoni* (WATERHOUSE, 1894)

– Female: clypeus with finely crenulate transverse ridge (Fig. 22). Male: clypeus with a pair of sharp tubercles (Fig. 23). Punctation of frons similar in both sexes. Length 2.9–3.8 mm. Australia **R. crowsoni** sp. n.

Rhipidandrus borbonicus (FAIRMARE, 1880)
(Figs 11–15)

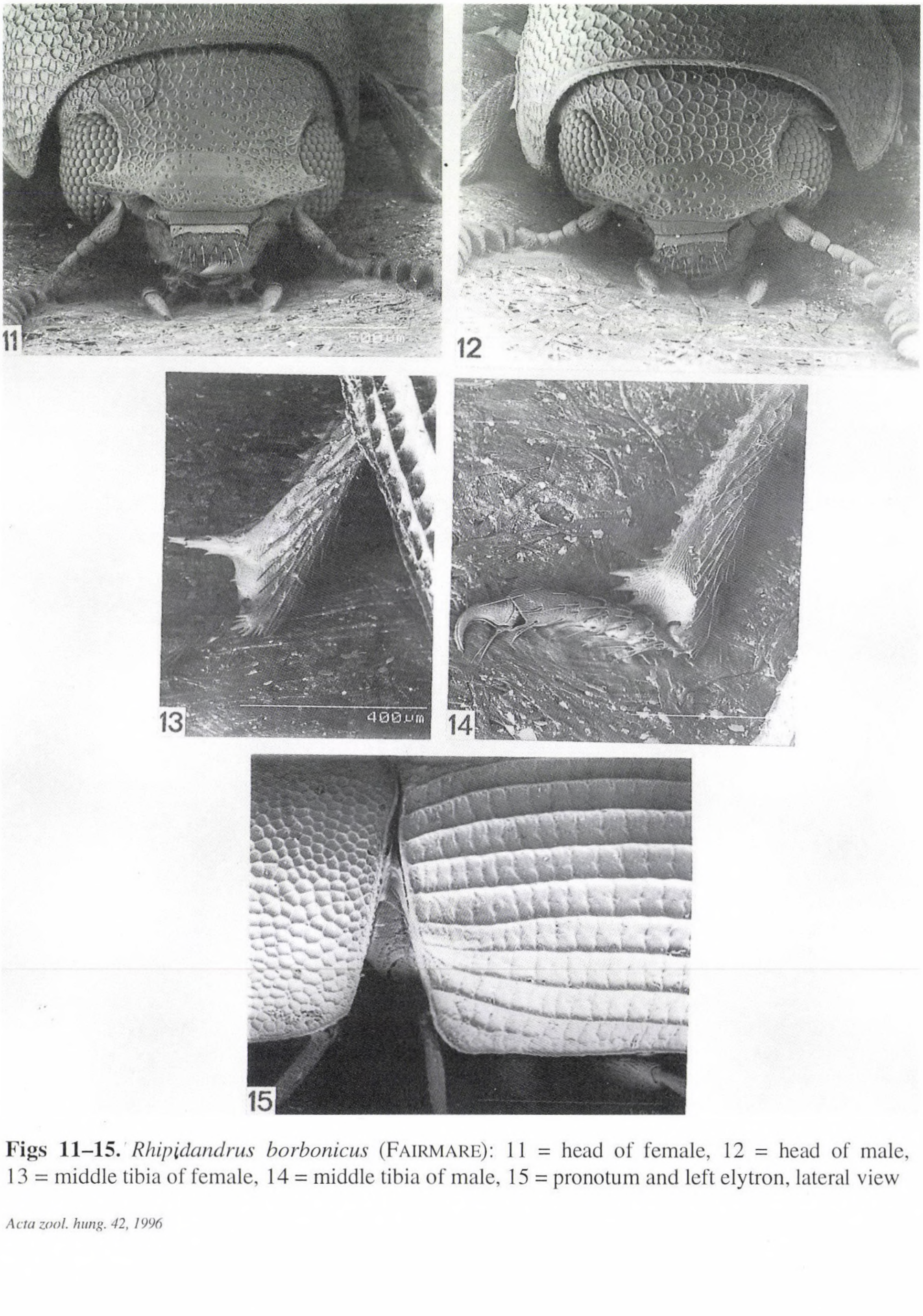
Bolitophagus borbonicus FAIRMARE, 1880: 293.
Bolitopertha novemcostata GEBIEN, 1910: 380, **syn. n.**
Cherostus fungivorus VINSON, 1950: 144. Synonymized by VINSON (1953: 145).
Rhipidandrus borbonicus: VINSON 1953: 145.
Rhipidandrus novemcostatus: GEBIEN 1939: 522.
Rhipidandrus novemcostatus: KASZAB 1971: 227.

Type material examined – *Bolitophagus borbonicus* – A female specimen which is mounted on a card along with a male is herewith designated as lectotype (MHNP). The specimen glued distal to the pin is the female lectotype, while the proximal specimen is a male paralectotype. Their labels are the following: 1. "MUSEUM PARIS La Réunion (Coll. Ch. Coquerel) COLL. L. FAIRMAIRE 1906" [printed and handwritten on light blue paper]; 2. "TYPE" [printed with red on white paper]; 3. "Bolitophag. borbonicus Fairm. I. Bourbon" [handwritten on white paper]; 4. "Lectotypus ♀ Bolitophagus borbonicus Fairmare, 1880 des. Merkl & Kompantzeva, 1995 (distal to pin)" [printed and handwritten on red paper]; 5. "Paralectotypus ♂ Bolitophagus borbonicus Fairmare, 1880 des. Merkl & Kompantzeva, 1995 (proximal to pin)" [printed and handwritten on yellow paper]; 6 "Rhipidandrus borbonicus (FRM.) det. O. Merkl, 1995 [handwritten and printed on white paper].

Bolitopertha novemcostata – One female syntype (HNHM) was available for study. Its labels are as follows: 1. ♂ [printed on white paper with black frame; the specimen is, in fact, a female!]; 2. "Dar es Sal. 20.II.1903. (Eichelbaum)." [handwritten on pink paper]; 3. "Bolitopertha 9–costata x. Geb." [handwritten on white paper]; 4. "Sammlung H. Gebien" [printed on white paper]; 5. "Syntypus 1909 Bolitopertha 9–costata Gebien" [handwritten and printed on white paper with red frame]; 6. "Rhipidandrus borbonicus (FRM.) ♀ det. O. Merkl, 1995 [handwritten and printed on white paper].

Cherostus fungivorus – Seven specimens considered to be syntypes (BMNH) were examined. One card-mounted female specimen tagged with type labels is herewith designated as lectotype. Its labels are the following: 1. "♂ " [printed; the specimen is, in fact, a female!]; 2. "SYN-TYPE" [printed on circular, white paper with blue border]; 3. "Type" [printed on circular, white paper with red border]; 4. "MAURITIUS Moka 6.i.1948 J. Vinson" [printed on white paper;

6., i. and 48 are handwritten]; 5. "TYPE" [handwritten on red paper]; 6. "ex fungus" [handwritten on white paper]; 7. "Brit. Mus. 1951 231" [printed and handwritten on white paper]; 8. "Cherostus fungivorus Vinson det. J. VINSON 1950" [handwritten and printed on white paper]; 9. "Lectotypus ♀ Cherostus fungivorus Vinson, 1950 des. Merkl & Kompantzeva, 1995" [printed and handwritten on red paper]; 10. "Rhipidandrus borbonicus (FRM.) det. O. Merkl, 1995" [handwritten and printed on white paper].



Figs 11–15. *Rhipidandrus borbonicus* (FAIRMARE): 11 = head of female, 12 = head of male, 13 = middle tibia of female, 14 = middle tibia of male, 15 = pronotum and left elytron, lateral view

The six paralectotypes are also card-mounted. Three cards each have a common pin. Their labels are as follows: 1. "MAURITIUS Moka 19 J. Vinson" [printed on white paper; this is the same label as the fourth label of the lectotype but the handwritten 6., i. and 48 are missing]; 2. "Brit. Mus. 1972–220" [printed and handwritten on white paper]; 3. "PARALECTOTYPUS ♂ [or] ♀ *Cherostus fungivorus* Vinson, 1950 des. Merkl & Kompantzeva, 1995" [printed on yellow paper with the sex-mark handwritten]; 4. "Rhipidandrus borbonicus (FRM.) det. O. Merkl, 1995" [handwritten and printed on white paper].

Both pins are tagged with three paralectotype labels indicating the sex; their sequence is equivalent to that of the specimens on the pins.

While the specimen designated as lectotype was received by the BMNH in 1951, the other six specimens came to the BMNH in 1972 from Mauritius (JANE BEAR, pers. comm.). However, the quality of the cards, the pins and the locality labels are the same. Therefore it seems undoubted that all specimens are from VINSON's original series: "Moka, 6.i.1948, several examples found breeding in fungi; other examples were previously collected in the same material" (VINSON 1950).

Non-type material examined – Madagascar: no closer locality, 1906, FERRIER DE LA BATHIE (1, MHNP). – Mascarenhas: La Réunion, 1906, CH. COQUEREL (1, MHNP); I. Bourbon, no other data (2, MHNP). – South Africa: Natal, no closer locality, Dr. MARTIN (4, HNHM). – Tanzania: Usa River, 3900 feet, light trap, 15.XI.–31.XII.1965, Dr. J. SZUNYOGHY (4, HNHM); same, 1.XII.1965–31.I.1966 (1, HNHM); same, at light, 1965 (1, HNHM); Morogoro, Uluguru Mts., IV.1991, E. RAUTENSTRAUCH (1, BREM); Ngare Sero, prope Usa River, 1200 m, in trocknem Baumschwamm, 24–31.III.1981, H. J. BREMER (38, BREM; 2, HNHM; 1, UENO); Zanzibar, no other data (1, HNHM).

Distribution – Madagascar, Mascarenhas (Mauritius and Réunion), Tanzania, South Africa.

Remarks – The synonymy of *Bolitopertha novemcostata* is obvious. In all probability, VINSON had not seen GEBIEN's type or any other specimen identified as *Bolitopertha novemcostata* but apparently presumed that his species described from the Mascarene Islands had a much wider distribution (VINSON 1953): "Il est de plus probable que cette espèce n'est pas propre aux îles Mascareignes: dans la collection du British Museum se trouvent cinq exemplaires non déterminés provenant de l'Afrique du Sud qui sont apparemment identiques."

Dissection of the genitalia of several specimens made it clear that both GEBIEN (1910) and VINSON (1950) had inverted the sexes. The long apical spine of the middle and hind tibiae is a feature characteristic for the female and not for the male as the above authors stated.

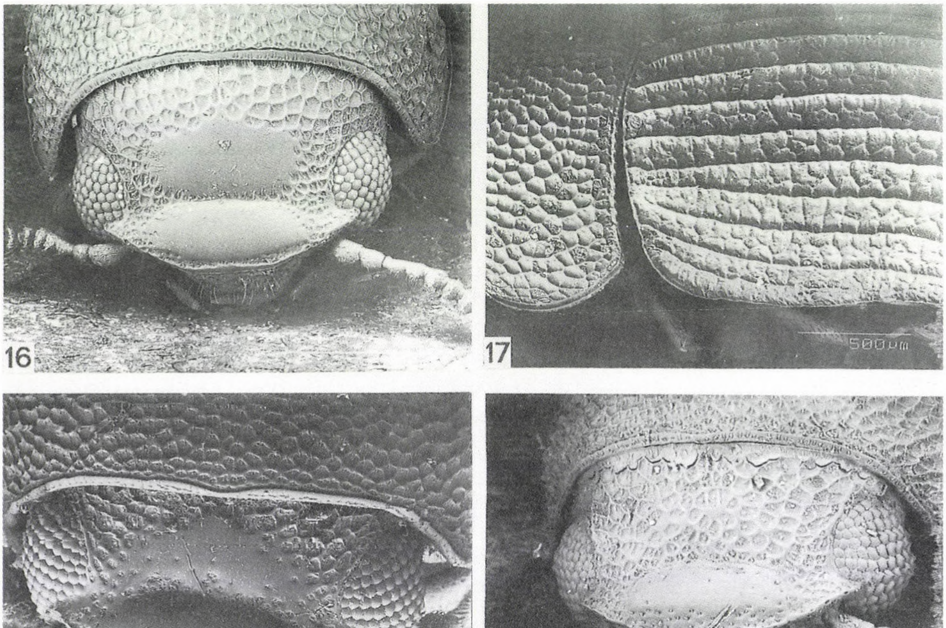
Rhipidandrus caesus sp. n.
(Figs 16–17)

Description – Colour reddish-brown; legs, antennae and maxillary palpi somewhat paler. Length 3.1–3.4 mm.

Female. Frons more than three times wider than eye diameter, with a transverse, shiny, impunctate spot; clypeus convex, shining, impunctate; frontoclypeal suture deeply impressed; vertex coarsely punctate (Fig. 16). Antennae with 5-segmented club; segments 1 to 4 subconical, 5 to 6 slightly, 7 to 10 strongly dilated internally, depressed, densely setulose apically; segment 11 rounded; segment length ratios as follows: 3:1.25:1.2:1.05:1.0:1.1:1.0:1.05:1.1:1.4:2.7.

Pronotum about 1.4 times wider than long, disc moderately convex, coarsely punctate; punctation uniform mesally and laterally (Fig. 17).

Elytra about 1.3 times as long as wide and 2.1 times as long as pronotum; striae deeply impressed, with a zigzagged sculpturing formed by oblique wrinkles and blunt tubercles (Fig. 17); 1st carina reaching elytral apex and connected with lateral margin; carinae 3, 5, 7 and 9 ending just be-



Figs 16–21. 16–17 = *Rhipidandrus caesus* sp. n.: 16 = head of female, 17 = pronotum and left elytron, lateral view; 18–20 = *R. simpsoni* (WATERHOUSE): 18 = head of female, 19 = head of male, 20 = left elytron, lateral view; 21 = *R. nudus* (GEBIEN): head of male

fore apex, carinae 2, 4, 6 and 8 ending before apical 1/6; 10th carina weak but present, reaching 1/3 of elytral length.

Male. Clypeus and frons similar to those of male but impunctate frontal spot somewhat smaller. Aedeagus with apicale of tegmen shorter than basale, apical part of apicale distinctly divided.

Type material – Holotype, female (ANIC), labelled as follows: 1. "12.23S 132.56E 7 km NW. by N. of Cahills Crossing, East Alligator River, N.T. 27.v.73, E. G. Matthews" [printed on white paper]; 2. "in bracket fungus" [printed on white paper]; 3. "Larva in spirit collection" 4. "Holotypus ♀ Rhipidandrus caesus Merkl & Kompantzeva, 1996" [printed and handwritten on red paper].

Paratypes: Australia (Northern Territory): labelled as the holotype (1 ♂, 3 ♀♀, ANIC; 1 ♀, HNHM). – All paratypes are tagged with the following label: "PARATYPUS ♂ [or] ♀ *Rhipidandrus caesus* Merkl & Kompantseva, 1996" [printed on yellow paper with the sex-mark handwritten].

Remarks. – *R. caesus* vaguely resembles *R. simpsoni*. The lateral punctures of the pronotum (Fig. 17) do not tend to be longitudinal as in *R. simpsoni* and the sculpture of the elytral interstriae is also different. The frontal spot of female *R. caesus* is completely impunctate (Fig. 16) while that of *R. simpsoni* has a few scattered punctures (Fig. 18).

The specific epithet comes from the Latin adjective *caesus* (= cut), in reference to the deeply impressed frontoclypeal suture, which sharply divides the glossy, impunctate area of the head.

Rhipidandrus cioides KASZAB, 1955
(Figs 3–4)

Rhipidandrus cioides KASZAB, 1955*a*: 460.
Rhipidandrus cioides clypeatus KASZAB, 1955*b*: 655, **syn. n.**

Type material examined – *Rhipidandrus cioides* – Three male paratypes (HNHM), one card-mounted and two paper-pointed, were examined. They are labelled as follows: 1. "Thawathi, Ovalau, Fiji VII–16–38" [printed and handwritten on white paper]; 2. "Dead shelf fungi 800" [printed and handwritten on white paper]; 3. "EC Zimmermann Collector" [printed on white paper]; 4. "Paratypus 1952 Rhipidandrus cioides Kaszab" [handwritten and printed on white paper with red frame].

Rhipidandrus cioides clypeatus – Three male paratypes (HNHM), one card-mounted and two paper-pointed, were examined. The card-mounted specimen is labelled as follows: 1. "Afiamalu Upolu, Samoa VII–2–40" [printed and handwritten on white paper]; 2. "2200 feet" [printed on white paper]; 3. "Dead shelf fungi" [printed on white paper]; 4. "EC Zimmermann Collector" [printed on white paper]; 5. "Paratypus 1953 Rhipidandrus cioides clypeatus Kaszab" [handwritten and printed on white paper with red frame].

The paper-pointed specimens are labelled as above except the first label which has "VI–30–40" instead of "VII–2–40".

Non-type material examined – None.

Distribution – Melanesia (Fiji and Samoa).

Remarks – *R. cioides* is the largest among all described congeners. Although the female is unknown, the sheer size and the elytral sculpture make this species unmistakable. *R. cioides clypeatus*, described from Samoa, does not appear to be distinct from the Fiji specimens. The features thought to be distinguishing by KASZAB (1955*b*) are a matter of degree.

Rhipidandrus crenipennis (MOTSCHULSKY, 1858)
(Figs 5–7)

Xyloborus crenipennis MOTSCHULSKY, 1858: 64.
Rhipidandrus crenipennis: GEBIEN 1939: 522.
Rhipidandrus similis KASZAB, 1955*a*: 462, **syn. n.**
Rhipidandrus zaitzevi KOMPANTZEVA et MERKL, 1992: 89, **syn. n.**
Rhipidandrus crenipennis: KOMPANTSEVA 1995: 55. [Description of larva.]

Type material examined – *Xyloborus crenipennis* – The type series (ZMUM) consists of five specimens (syntypes) glued to one common card with the following labels: 1. "Xyloborus crenipennis Motsch Ind. or." [handwritten on yellow paper]; 2. "Rhipidandrus crenipennis (Mots.) Dr. Z. Kaszab det., 1979" [handwritten and printed on white paper].

Rhipidandrus similis – The holotype (HNHM) is a card-mounted female specimen labelled as follows: 1. "Philippinen Limay, Luzon" [handwritten on white paper]; 2. "Holotypus 1955 Rhipidandrus similis Kaszab" [handwritten and printed on white paper with red frame]; 3. "*Rhipidandrus crenipennis* (Motschulsky, 1858) ♀ det. O. Merkl, 1994" [printed on white paper].

The three examined paratypes of *R. similis* belong to *R. speculifrons*. See their data under that species.

Rhipidandrus zaitzevi – The holotype (HNHM) is a male specimen mounted on a paper point and labelled as follows: 1. "VIETNAM, Gia Lai-Con tum province, Buon Loi, 20.VII.1983, leg. J. Zaitzev" [printed on white paper]; 2. "Holotypus ♂ Rhipidandrus zaitzevi Kompantzeva & Merkl, 1992" [printed and handwritten on red paper]; 3. "*Rhipidandrus crenipennis* (Motschulsky, 1858) det. O. Merkl, 1994" [printed on white paper].

A total of 23 paratypes (3 ♂♂, 3 ♀♀, HNHM; 9 ♂♂, 8 ♀♀, SIEE) of *R. zaitzevi* are labelled as the holotype except the second label which is as follows: "PARATYPUS ♂ [or] ♀ *Rhipidandrus zaitzevi* Kompantzeva & Merkl, 1992" [printed on yellow paper with the sex-mark handwritten].

Non-type material examined – Indonesia: Lombok, Sembalun Lawang, Mt. Rinjani, 1700 m, 6–8. II. 1994, BOLM (17, SMNS; 5, HNHM); South Sumatra, Benakat, 2–13.IX.1994, H. MAKIHARA (17, MASU; 6, HNHM). – Philippines: Luzon, Limay, X.1914, G. BOETTCHER (1, FREY, identified as *R. similis* by H. KULZER in 1954).

Distribution – Vietnam, Indonesia, Philippines.

Remarks – *R. crenipennis* is distinguished from *R. speculifrons* by the absence of the 10th elytral carina (Fig. 7) and the shining but sparsely punctate clypeus (Figs 5–6). Both males and females have a shining impunctate area on the frons which is finely separated from the clypeus by the frontoclypeal suture. This area is more expanded in the females.

The average size of *R. crenipennis* is larger than that of *R. speculifrons*. This is especially apparent in a series of *Rhipidandrus* specimens collected at Benakat, South Sumatra, which consisted of both species.

The synonymy of *R. similis* is obvious and the same holds for the recently described *zaitzevi*. It needs to be said in the present authors' excuse, that they had no possibility to examine the type of *R. crenipennis* while describing *zaitzevi*. The type material of *R. crenipennis* is now available and it is clear that all specimens of *R. zaitzevi* are conspecific with *R. crenipennis*.

Rhipidandrus crowsoni sp. n.

(Figs 22–29)

Rhipidandrus sp.: Kompantseva 1995: 57.

Description – Colour reddish-brown to blackish-brown; legs, antennae and maxillary palpi slightly lighter; pronotal disc sometimes red (teneral specimens?). Length 2.9–3.8 mm.

Female. Frons flattened anteriorly, more than three times wider than diameter of eye; clypeus moderately convex and reflexed, weakly punctate, with a crenulate transverse carina mesally (Fig. 22); frontoclypeal suture distinct; vertex strongly convex, coarsely punctate; antennae with 5-segmented club; segments 1 to 4 subcylindrical, 5 and 6 slightly, 7 to 10 strongly dilated internally, depressed, densely setulose apically; segment 11 elliptic; segment length ratios as follows: 1.9:1.3:1.1:1.0:1.0:1.0:1.4:1.5:1.6:1.65:2.6.

Pronotum about 1.45 times wider than long, disc moderately convex, coarsely punctate at middle, lateral punctures tending to be longitudinal, punctural interspaces forming longitudinal and oblique wrinkles laterally (Fig. 25).

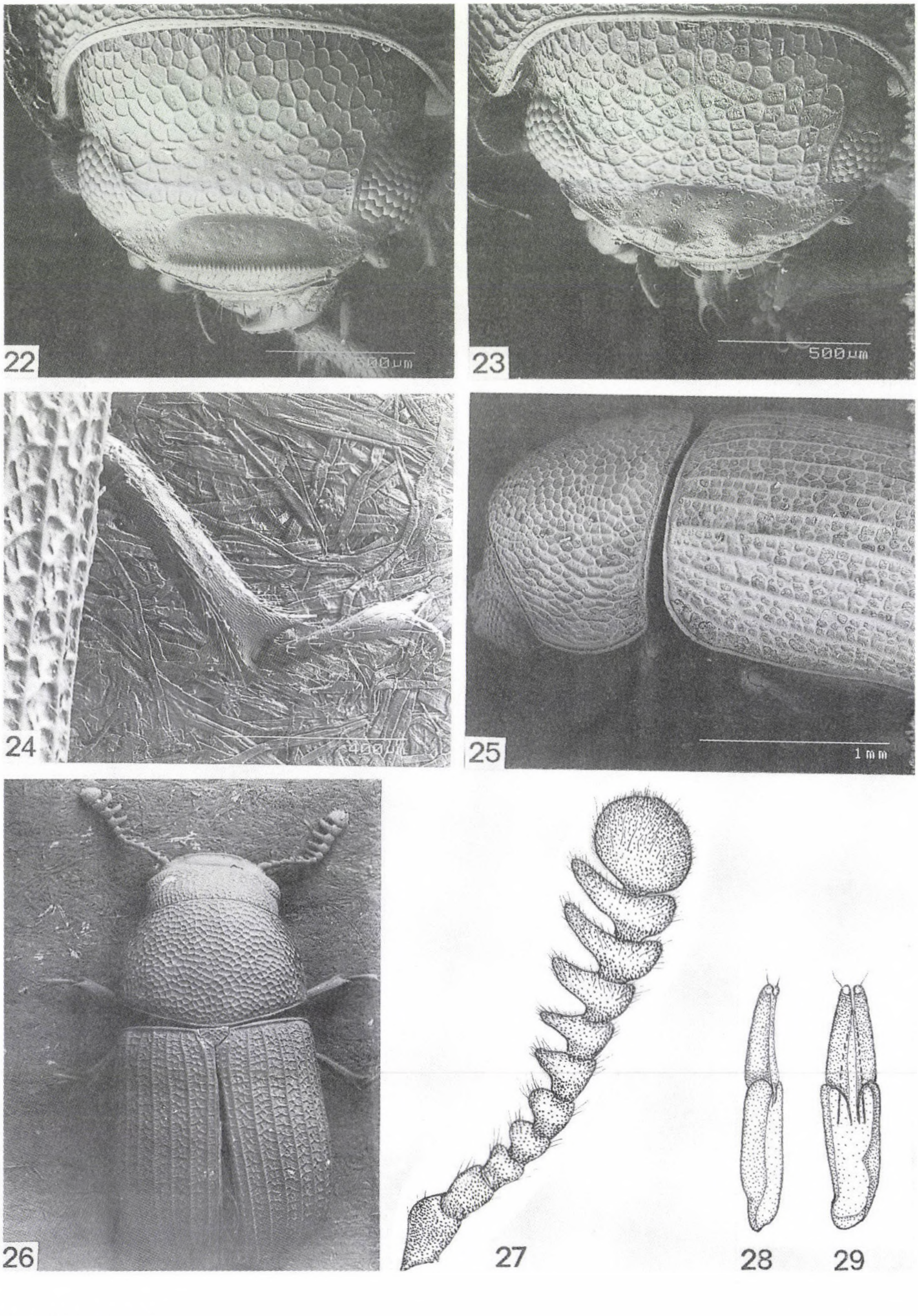
Elytra about 1.2 times as long as wide and 1.9 times as long as pronotum; striae deeply impressed, with transverse and oblique by raised wrinkles forming a mesh-like sculpture which includes a row of polygonal cells in every stria (Fig. 25); 1st carina reaching elytral apex and connected with lateral margin; carinae 3, 5, 7 and 9 ending just before apex, carinae 2, 4, 6 and 8 ending before apical 1/6; 10th carina present, reaching half of elytral length. Middle tibia: Fig. 24.

Male. Clypeus with a pair of short, blunt tubercles mesally (Fig. 23). Antenna: Fig. 27. Aedeagus (Figs 28–29) with apicale of tegmen shorter than basale, apical part of apicale distinctly divided.

Type material – Holotype, female (ANIC), labelled as follows: 1. "Mossman Gorge, N. Q. 200', rainforest, In bracket fungi, 28.x.1966, E. Britton" [printed on white paper]; 2. "Holotypus ♀ Rhipidandrus crowsoni Merkl & Kompantzeva, 1996" [printed and handwritten on red paper].

Paratypes: Australia (Queensland): labelled as the holotype (1 ♂, 4 ♀♀, ANIC; 1 ♂, 1 ♀, BMNH; 1 ♂, 1 ♀, HNHM); same, in fungi (2 ♂♂, 2 ♀♀, ANIC; 1 ♂, 1 ♀, HNHM; 1 ♂, 1 ♀, SIEE; 1 ♀, SMNS); Cape Tribulation, 200 m, 14.VII.1982, S. & J. Peck SBP7, J.F. Lawrence Lot 82–35, *Nigroporus* (2 ♂♂, 2 ♀♀, ANIC; 1 ♂, SMNS); Cooloola N.P., Camp Milo, 16.X.1978, D. Rentz, J. F. Lawrence Lot 78–19, *Ganoderma* (2 ♂♂, ANIC); Julatten, 18–22.VIII.1982, J.F. Lawrence, J. F. Lawrence Lot 82–11, *Ganoderma lucidum* gp. (1 ♀, ANIC); Lake Barrine, 750 m, 29.VII.1982, S. & J. Peck, J. F. Lawrence Lot 82–50, unidentified fungus (3 ♂♂, 3 ♀♀, ANIC; 1 ♂, 1 ♀, BREM); 15.47S 145.17E, Moses Ck., 4 km NbyE Mt. Finnigan, 14–16.X.1980, ex ethanol, J. C. Cardale (1 ♂, ANIC); Mossman Gorge N.P., 6 km SW of Mossman, 50 m, 11.VII.1982, S. & J. Peck SBP6, J.F. Lawrence Lot 82–28, *Nigroporus* (2 ♂♂, 3 ♀♀, ANIC; 1 ♂, 1 ♀, HNHM); 17.14S 145.46E, Mulgrave R. Rd., 9 km WNW Bellenden Ker, 140 m, 2.IV.1984, A. Calder & T. Weir (1 ♂, ANIC); New England N.P., 1500 m, 26.VIII.1982, S. & J. Peck, J.F. Lawrence Lot

Figs 22–29. *Rhipidandrus crowsoni* sp. n.: 22 = head of female, 23 = head of male, 24 = middle tibia of female, 25 = pronotum and left elytron, lateral view, 26 = habitus of female, 27 = right antenna of male, 28 = aedeagus, lateral view, 29 = aedeagus, ventral view



82–77, unidentified Polyporales (2 ♂♂, ANIC); 1 mi. E of Palmerston, under bark, 6.XI.1966, E. BRITTON (1 ♂, 6 ♀♀, ANIC; 1 ♀, HNHM); Paluma, 6–7.X.1978, D.W. Frith, J. F. LAWRENCE Lot 78–193, *Fomitopsis dochmia* (2 ♂♂, 1 ♀, ANIC); same, 6–7.XI.1978 (3 ♂♂, 1 ♀, ANIC); same, 11–12.XII.1978, J. F. LAWRENCE Lot 78–201 (1 ♀, ANIC); 25.57S 153.06E, nr Poona Lake, Cooloola N.P., 18.IV.1982, A. CALDER, J. F. LAWRENCE Lot 82–2, *Nigroporus vinosus* (1 ♂, 2 ♀♀, ANIC; 1 ♂, 1 ♀, HNHM); Tamborine Mts., 16.VIII.1986, R. A. CROWSON (1 ♂, 1 ♀, ANIC; 1 ♂, 1 ♀, HNHM; 2 ♂♂, 2 ♀♀, SIEE); Topaz N.P., SE of Malanda, 720 m, rainforest, log and leaf litter, 28.VII.1982, S. & J. PECK SBP93 (1 ♀, ANIC). – Australia (New South Wales): Barrington Tops, Mt. Allyn–Burraga Tr., 1000 m, 16–17.VI.1978, log litter and fungi, S. & J. PECK (1 ♂, ANIC); Brindle Ck., 800 m N of Kyogle, 21.VI.1978, S. & J. PECK, J. F. LAWRENCE Lot 78–141, *Ganoderma* (2 ♂♂, 1 ♀, ANIC); same, 8 m N of Kyogle, 20–21.VI.1978, *Ganoderma applanatum* (1 ♂, 1 ♀, ANIC); Brindle Ck., 800 m nr Kyogle, Wiangarie S.F., 20.VI.1978, S. & J. PECK, J. F. LAWRENCE Lot 78–141, *Ganoderma applanatum* (3 ♂♂, 1 ♀, ANIC); Bruxner Park, 200 m, Coffs Harbour, 9.VII.1978, ex leaf log litter, S. & J. PECK (2 ♂♂, ANIC). – All paratypes are tagged with the following label: "PARATYPUS ♂ [or] ♀ *Rhipidandrus crowsoni* Merkl & Kompantzeva, 1996" [printed on yellow paper with the sex-mark handwritten].

Non-paratype specimens – Australia (Queensland): Boar Pkt. Rd. 4 m N Gillies Highway, fungus, 28.XI.1969, J. G. BROOKS (6 and 8 specimens glued on two common cards, respectively, ANIC); Little Mulgrave Valley, 9.X.1969, J. G. BROOKS (6 specimens glued on a common card, ANIC); Little Mulgrave Valley, 5 m NW Gillies Highway, from fungus, 9.X.1969, J. G. BROOKS (7 specimens glued on a common card, ANIC); East Palmerston, 600', in fungus, 6.XI.1966, J. G. BROOKS (6 specimens glued on a common card, ANIC); Ravenshoe, IV.1948, J. G. BROOKS (5 specimens glued on a common card, ANIC). – Australia (New South Wales): Brindle Ck., 8 m N of Kyogle, 20–21.VI.1978, S. & J. PECK, J. F. LAWRENCE Lot 78–141, *Ganoderma applanatum* (7 specimens in a plastic vial, ANIC).

Remarks – *R. crowsoni* is close to *R. simpsoni* in the reticulated elytral striate and the longitudinally wrinkled lateral portion of pronotum. However, it differs from all described congeners in the unique sculptural elements of the clypeus (Figs 22–23).

The species is dedicated to Dr. ROY A. CROWSON, one of the most outstanding figures of present-day coleopterology, who called the attention of one of the authors (T. K.) to this species.

Rhipidandrus nudus (GEBIEN, 1914)

(Fig. 21)

Cherostus nudus GEBIEN, 1914: 14.
Rhipidandrus nudus: GEBIEN 1939: 522.

Type material examined – *Cherostus nudus* – The "type" and five "cotypes" were available for study. All are males, with the following labels:

The "type" (FREY), mounted on a translucent plastic point: 1. "Banguey b. Borneo" [handwritten on white paper]; 2. "Type! No. 273" [printed and handwritten on red paper]; 3. "Cherostus nudus x Geb" [handwritten on white paper]; 4. "Sammlung H. Gebien" [printed on white paper].

Of four "cotypes", three are mounted on translucent plastic points (FREY), one card-mounted (HNHM): 1. "Banguey b. Borneo" [handwritten on white paper]; 2. "Cotype! No. 273" [printed and handwritten on red paper]; 3. "Cherostus nudus x Geb" [handwritten on white paper]; 4. "Sammlung H. Gebien" [printed on white paper].

The fifth "cotype" belongs to *R. speculifrons*. See its data under that species.

Remarks – The status of *R. nudus* is problematic. Apart from one of the secondary types ("cotypes"), which clearly belongs to *R. speculifrons*, the remaining specimens have elytral striae divided into quadrangles by transverse ridges (as in *R. speculifrons* and *R. crenipennis*); no 10th elytral carina (as in *R. crenipennis*); no glossy area on frons, clypeus is shining and impunctate, and the frontoclypeal suture is distinct (Fig. 21). This surface type of frontoclypeal area is unlike *R. crenipennis* (Figs 5–6) and *R. speculifrons* (Figs 8–9). Unfortunately, all the types are males and, because the females are usually crucial for separation of the species of this genus, *R. nudus* cannot be identified and keyed correctly. An adequate resolution should be postponed until females associated to males similar to the primary type of *R. nudus* become available.

Rhipidandrus simpsoni (WATERHOUSE, 1894)
(Figs 18–20)

Cherostus Simpsoni WATERHOUSE, 1894: 69.
Rhipidandrus Simpsoni: GEBIEN 1939: 522.
Rhipidandrus simpsoni: KASZAB 1955*a*: 461.

Type material examined – None.

Non-type material examined – Australia (Queensland): 13.44S 143.20E, 11 km WbyN of Bald Hill, McIlwraith Range, search party campsite, 520 m, 27.VI.–12.VII.1989, T. A. WEIR, J. F. LAWRENCE Lot –, *Ganoderma lucidum* (1, ANIC); Cairns, IX.1950, G. BROOKS (1, ANIC); 16.55S 145.46E, Cairns, 19 km up Whitfield Ra. Rd., 390 m, 16.II.1971, J. G. & J. A. G. BROOKS (1, ANIC); Cooloola N.P., Camp Milo, 16.X.1978, D. RENTZ, J. F. LAWRENCE Lot 78–191, *Ganoderma* (2, ANIC; 1, HNHM); Edge Hill, Cairns, 8.X.1966, J. G. BROOKS (12, ANIC; 1, HNHM); Ewan Rd., c. 8 km W of Paluma, at light, 8–18.I.1974, J. G. BROOKS (7, ANIC; 1, HNHM); Ewan Rd., 3 km W. of Paluma, 2980', fungus, 11.I.1974 (8, ANIC); same, surface at night (1, ANIC); same, 13.45S 143.22E, 500 m, mango tree site, J. F. LAWRENCE Lot –, *Ganoderma lucidum* (1, ANIC); Kuranda, XI.1946, J. G. BROOKS Bequest, 1976 (2, ANIC); same, VII.1949, J. G. BROOKS Bequest, 1976 (3, ANIC); same, HACKER, no other data (3, BREM); 17.17S 145.38E, nr. Lake Eacham, Atherton Tableland, 7.XII.1985, J. BALDERSON (1, ANIC); 28.24S 153.08E, Lamington N.P., O'Reillys, 2–4.III.1980, J. F. LAWRENCE, J. F. LAWRENCE Lot 80–30 *Ganoderma* (3, ANIC; 3, HNHM); Mareeba, 19–25.XII.1961, H. DEMARZ (1, HNHM); Mt. Spec, XI.1973, G. BROOKS (1, ANIC); Paluma, 6–7.XI.1978, D. FRITH, J. F. LAWRENCE Lot 78–192, *Ganoderma applanatum* (3, ANIC); same, 31.XII.1979, J. F. LAWRENCE Lot 79–47, *Ganoderma lucidum* gp. (4, ANIC; 1, HNHM); same, 11.VII.1980, J. F. LAWRENCE Lot 80–52 *Stereum fasciatum* (1, ANIC); W. slope of Seymour Ra., Dinner Ck. Rd., nr. Innisfail, rainforest, under bark, 3.XI.1966, E. BRITTON (2, ANIC); Wallaman Falls, 1.X.1967, G. BROOKS (3, ANIC); Whitfield Rg. Rd., c. 486 m, 3.II.1970, at light, J.G. & J.A.G. Brooks (1, ANIC); Wiangaree S. F., NSW Isaksson Ridge, 1050 m, window trap 592, 29.II.–3.III.1980, A. NEWTON & M. THAYER (1, ANIC). – Australia (New South Wales): Eungai, in fungus on log, XI.1933, J. ARMSTRONG (2, ANIC); Mackswille, XII.1992, WACHTEL (3, BREM; 1, HNHM). – Solomon Is.: Shortland I., IV.1966, F. PARKER (1, ANIC).

Distribution – Australia (Queensland, New South Wales), Solomon Islands.

Remarks. – The extent of the impunctate frontal area of the female is variable. In some specimens this area is vague and quite similar to that in the male.

Rhipidandrus speculifrons (GEBIEN, 1922)
(Figs 8–10)

Cherostus speculifrons GEBIEN, 1922: 288.
Rhipidandrus speculifrons: GEBIEN 1939: 522.
Rhipidandrus dybasi KULZER, 1957: 204, **syn. n.**
Rhipidandrus sodalis KULZER, 1957: 206, **syn. n.**
Rhipidandrus similis: KASZAB 1979: 76. [Misidentification of *R. speculifrons* GEBIEN.]
Rhipidandrus crenipennis: KASZAB 1979: 77. [Misidentification of *R. speculifrons* GEBIEN.]
Rhipidandrus scolytoides CHUJO, 1985: 62, **syn. n.**

Type material examined – *Cherostus speculifrons* – Six syntype specimens (5, FREY; 1, HNHM), all females and card-mounted, were examined. Their labels are as follows: 1. "Long Isl. 12–22.7.08" [printed on bluish paper]; 2. "Mahe 1908–09 Seychell. Exp" [printed on bluish paper]; 3. "Cotype! No, 1100" [printed and handwritten on red paper]; 4. "Cherostus speculifrons x Geb." [handwritten on white paper]; 5. "*Rhipidandrus speculifrons* (Gebien, 1922) ♀ det. O. Merkl, 1995" [printed on white paper].

Rhipidandrus scolytoides – The holotype (ELKU) is a male specimen mounted on a paper point with the following labels: 1. "Urauchi Iriomote Loo-Choo 23.VII.1963 Y. HAMA" [handwritten and printed on white paper]"; 2. "SHIBATA Collection" [printed on green paper]; 3. "Collection of Ent. Lab. Ehime Univ." [printed on light blue paper]; 4. "Holotype ♂ Rhipidandrus scolytoides M. T. Chûjô, 1985" [printed and handwritten on red paper]; 5. "Type No. 2531 Kyushu Univ." [printed and handwritten on red paper]; 6. "*Rhipidandrus speculifrons* (Gebien, 1922) ♂ det. O. Merkl, 1995" [printed on white paper].

A female paratype (SHIB) mounted on a paper point was also available, which is labelled as follows: 1. "Urauchi Iriomote Loo-Choo 23.VII.1963 Y. HAMA" [handwritten and printed on white paper]"; 2. "SHIBATA Collection" [printed on green paper]; 3. "Paratype ♀ Rhipidandrus scolytoides M. T. Chûjô, 1985" [printed and handwritten on blue paper]; 4. "*Rhipidandrus speculifrons* (Gebien, 1922) ♀ det. O. Merkl, 1995" [printed on white paper].

Rhipidandrus sodalis – Three paratypes (FREY), all males and mounted on paper points, were examined. The labels of two specimens are the following: 1. "Guam I., Marianas Fadang 31 May 1945" [printed on white paper]; 2. "Col. & pres. by Henry S. Dybas Lot 2129a" [printed and handwritten on white paper]; 3. "ex Polypore fungus" [printed on white paper]; 4. "PARATYPUS Rhipidandrus sodalis nov. det. H. Kulzer 1955" [printed with red and handwritten with black on white paper]; 5. "*Rhipidandrus speculifrons* (Gebien, 1922) ♂ det. O. Merkl, 1995" [printed on white paper].

The labels of the third specimen are the same with the exception of "Lot 2130a" instead of "Lot 2129a" on the second label.

Rhipidandrus dybasi – Six paratypes, all females and mounted on paper points, were available for study. Their labels are as follows:

First specimen (FREY): 1. "Colonia, PONAPE I. 23 Feb. 1948 nr. sea level" [printed on white paper]; 2. "in polypore fungus" [printed on white paper]; 3. "Pacific Sci. Board Ent. Surv. of Micronesia, H. S. Dybas leg." [printed on white paper]; 4. "PARATYPUS Rhipidandrus dybasi nov. det. H. Kulzer 1955" [printed with red and handwritten with black on white paper]; 5. "*Rhipidandrus speculifrons* (Gebien, 1922) ♀ det. O. Merkl, 1995" [printed on white paper].

Second specimen (FREY): 1. "Guam I., Marianas Fadang 31 May 1945" [printed on white paper]; 2. "Col. & pres. by Henry S. Dybas Lot 2129a" [printed and handwritten on white paper];

3. "ex Polypore fungus" [printed on white paper]; 4. "PARATYPUS Rhipidandrus dybasi nov. det. H. Kulzer 1955" [printed with red and handwritten with black on white paper]. 5. "*Rhipidandrus speculifrons* (Gebien, 1922) ♀ det. O. Merkl, 1995" [printed on white paper].

Third, fourth and fifth specimens, with paper points on a common pin (FREY): 1. "Saipan I., Marianas Mt. Tagpochau, 1 mi. NNE of summit 22:XII:44" [printed on white paper]; 2. "Col. & pres. by Henry S. Dybas Lot 291" [printed and handwritten on white paper]; 3. "*Rhipidandrus speculifrons* (Gebien, 1922) ♀ det. O. Merkl, 1995" [printed on white paper].

Sixth specimen (HNHM): 1. "Ulimang, BABELTHUAP I. Palau Islands 13 Dec. 1947" [printed on white paper]; 2. "in polypore fungus" [printed on white paper]; 3. "Pacific Sci. Board Ent. Surv. of Micronesia, H. S. Dybas leg." [printed on white paper]; 4. "Paratypus 1957 Rhipidandrus Dybasi Kulzer" [handwritten and printed on white paper with red frame]; 5. "*Rhipidandrus speculifrons* (Gebien, 1922) ♀ det. O. Merkl, 1995" [printed on white paper].

Rhipidandrus similis – Three paratypes, all card-mounted females, belong to *R. speculifrons* (the holotype belongs to *R. crenipennis*, see above). Their labels are as follows:

First specimen (HNHM): 1. "Philippinen Binaluan" [handwritten on white paper]; 2. "Paratypus 1955 Rhipidandrus similis Kaszab" [handwritten and printed on white paper with red frame]; 3. "crenipennis Mots. det. Kaszab" [handwritten and printed on white paper]; 4. "*Rhipidandrus speculifrons* (Gebien, 1922) ♀ det. O. Merkl, 1995" [printed on white paper].

Second specimen (HNHM): 1. "Ceylon" [handwritten on white paper]; 2. "Paratypus 1955 Rhipidandrus similis Kaszab" [handwritten and printed on white paper with red frame]; 3. "crenipennis Mots. det. Kaszab [handwritten and printed on white paper]; 4. "*Rhipidandrus speculifrons* (Gebien, 1922) ♀ det. O. Merkl, 1995" [printed on white paper].

Third specimen (FREY): 1. "Banguey b. Borneo" [handwritten on white paper]; 2. "Paratypus 1955 Rhipidandrus similis Kaszab" [handwritten and printed on white paper with red frame]; 3. "*Rhipidandrus speculifrons* (Gebien, 1922) ♀ det. O. Merkl, 1995" [printed on white paper].

Cherostus nudus – One of the five "cotypes" studied, mounted on a translucent plastic point (FREY) belongs to *R. speculifrons*. It is labelled as follows: 1. "Kuching Jan. 1906 TM" [printed and handwritten on white paper]; 2. "6" [handwritten on white paper]; 3. "Cotype! No. 273" [printed and handwritten on red paper]; 4. "Cherostus nudus x Geb" [handwritten on white paper]; 5. "Rhipidandrus crenipennis Motsch. ? det. H. Kulzer 1954" [handwritten and printed on white paper]; 6. "*Rhipidandrus speculifrons* (Gebien, 1922) ♂ det. O. Merkl, 1995" [printed on white paper].

Non-type material examined – Australia (Queensland): 15.41S 145.12E Annan R., 3 km WbyS of Black Mt., 27.IX.1980, T. Weir (1, ANIC; 2, HNHM); same, J. F. Lawrence Lot 80–67 *Ganoderma* sp. (4, ANIC); 16.03S to 16.05S 145.28E, Cape Tribulation Area, ex *Ganoderma lucidum*, 1–11.V.1992, J. F. Lawrence (7, ANIC, identified by *R. similis* by J. F. Lawrence); Claudie R., nr. Iron Rg., 19–25.VI.1978, J. F. Lawrence, J. F. Lawrence Lot 78–87, *Ganoderma lucidum* gp. (1, ANIC); Kuranda, Hacker, no other data (1, BREM). – Papua New Guinea: Boze, Binaturi R., 15.V.1969, Fred Parker, J. F. Lawrence Lot 2735, *Ganoderma* sp. (2, ANIC). – Indonesia: South Sumatra, Benakat, 2–13.IX.1994, H. Makihara (50, MASU; 14, HNHM); Sulawesi S. O., ins. Buton, Wakarumba, 3–7.II.1994, M. Strba & I. Jenis (1, BREM). – Sri Lanka: 'Ceylon', no other data (1, HNHM, identified as *R. crenipennis* by Z. Kaszab); 'Ceylan', Nietner (1, BREM; 1, ZSM, identified as *R. similis* by H. J. Bremer, 1989); 'Ceylan', Peradenia, no other data (1, HNHM, identified as *R. similis* by Z. Kaszab in 1979 and as *R. crenipennis* by Z. Kaszab in a later date); Western Province, Gampaha B. Gard., 19.VI.1985, Ole Mehl (1, HNHM, identified as *R. crenipennis* by Z. Kaszab). – Malaysia: Johor, Endau riv., Selendang env., 29.IV–6.V.1993, I. Jenis & M. Strba (4, BREM; 1, HNHM); Pahang, Pulau Tioman, 2 km S Kampung Juara, secondary growth, from logs & bracket fungi, 15.III.1995, No. 29, O. Merkl (4, HNHM); Selangor, Kuala Selangor, 19.III.1975, J. Fleagle, J. F. Lawrence Lot 3944, *Coriolopsis badia* (2, ANIC). – Vietnam: mountains SW Kui-chau, 200 m, 11.IV.1963, Kabakov (1, HNHM). – Micronesia: Guam I., Fadang, beating vegetation, 31.V.1945, H. S. Dybas (1, Frey, identified as *R. crenipennis* by H. Kulzer in 1954); Guam I., Talofofo, headwaters plateau, on *Areca* palm, 17.VI.1936, R. L. Usinger (1, FREY); Palau Is., Babelthuap I., Ulimang, in dead stem of large leaf vine, 16.XII.1947, H. S. Dybas (1, HNHM, identified as *R. dybasi* by Z. Kaszab); Palau Is., Koror, 15–

25.V.1948, K. L. MAEHLER (1, FREY, identified as *R. crenipennis* by H. KULZER in 1954). – Philippines: Bataan, Olongapo, Subic Base, Riding Stable, 2.XII.1993, H. ZETTEL (1, ZETT); S. Theodoro, n. Mindoro I., VON PILZEN, no other data (2, FREY, identified as *R. similis* by H. KULZER in 1954). – Seychelles: Long I., Mahe, 12–22.VII.1908, Seychelles Expedition (1, HNHM, 3, ZSM, identified as *R. speculifrons* by H. GEBIEN in 1922; these specimens are obviously from the same series as the types and have the same labels except the third, red type label).

Distribution – Seychelles, Srí Lanka, Thailand, Malaysia (Peninsular Malaysia and Sarawak in Borneo), Vietnam, Japan (Ryukyu Is), Indonesia (Sumatra, Sulawesi), Micronesia (Guam I., Mariana I., Palau I., Ponape I.), Philippines, Papua New Guinea, Australia (Queensland).

Remarks – *R. speculifrons* differs from *R. crenipennis* in the cranial surface. The cranium (including frons and clypeus) of males is coarsely and uniformly punctate (Fig. 9) while females have a common fronto-clypeal area which is glistening and completely impunctate (Fig. 8). The frontoclypeal suture is completely obsolete on females. A distinct (albeit short) 10th carina is almost always present on the elytra (Fig. 10). However, the difference between *R. speculifrons* and *R. crenipennis* in the presence or absence of the 10th carina is not clear-cut. Although all studied specimens of *R. crenipennis* have no 10th carina, the only *R. speculifrons* specimen from Vietnam also lacks this carina. Therefore, in separation of *R. speculifrons* and *R. crenipennis* the cranial surface is considered to be the most decisive feature.

The synonymy of *R. dybasi* and *R. scolytoides* is obvious. However, the three paratypes of *R. sodalis* differ from all other examined specimens in the surface of the head. Based on the absence of long apical spine on the tibiae and the presence of the 10th carina of the elytra, they are males of *R. speculifrons*, but their clypeus is weakly shining and the coarse punctures typical for male *R. speculifrons* are obsolete. Cranial surface of *Rhipidandrus* must be subject to wear, because these beetles are internal feeders of hard fungal sporocarps. According to the labels, the second paratype of *R. dybasi* is from the same series as the three dubious males and this specimen is a female *R. speculifrons* without any doubt. We believe, therefore, that paratypes of *R. dybasi* are specimens of *R. speculifrons* with abraded clypeus.

Although CHUJO's *R. scolytoides* was proved to be synonymous with *R. speculifrons*, he was the first to recognize that the specimens with uniformly punctate head and those with the glossy area are conspecific and represent different sexes of the same species (CHUJO 1985).

R. speculifrons was described from the Seychelles but its known range extends from the Ryukyus and Micronesia to the north and across the Indo-Australian Realm as far south as Queensland. The occurrence on the Seychelles seems to be isolated but beetles of Oriental origin have long been known in the islands of the western Indian Ocean, including Madagascar. In CROWSON's (1981: 623) categories of distributional pattern, *Rhipidandrus* may fall into the fourth category, i.e. larvae and adults are associated with dead wood and able to survive for a long time in sea-drifted logs, so they can spread across wide habitat gaps. This may explain the occurrence of *R. speculifrons* in such remote islands as Seychelles, Ryukyus or various parts of Micronesia.

Rhipidandrus walkeri (WATERHOUSE, 1894)
(Figs 1–2)

Cherostus Walkeri WATERHOUSE, 1894: 69.
Rhipidandrus Walkeri: GEBIEN 1939: 522.
Rhipidandrus walkeri: KASZAB 1955*a*: 461.

Type material examined – None.

Non-type material examined – Australia (Queensland): 13.44S 143.20E, 11 km WbyN of Bald Hill, McIlwraith Range, search party campsite, 520 m, 27.VI.–12.VII.1989, T. A. WEIR, J. F. LAWRENCE Lot –, *Ganoderma lucidum* (18, ANIC; 4, HNHM); same, surface at night (2, ANIC); same, 13.45S 143.22E, 500 m, mango tree site, J. F. LAWRENCE Lot –, *Ganoderma lucidum* (3, ANIC); Caen district, Cape York, HACKER, no other data (2, BREM); 16.03S to 16.05S 145.28E, Cape Tribulation area, ex *Ganoderma lucidum*, 1–11.V.1992, J. F. LAWRENCE (5, ANIC; 1, HNHM); Cairns, 9150 [?], G. BROOKS (3, ANIC); Cairns, VI.1946, J. G. BROOKS Bequest, 1976 (2, ANIC); Claudie R., nr. Iron Rg., 19–25.VI.1978, J. F. LAWRENCE, J. F. LAWRENCE Lot 78–69, *Ganoderma applanatum* (7, ANIC; 1, HNHM); same, J. F. LAWRENCE Lot 78–99, *Ganoderma applanatum* (5, ANIC; 1, HNHM); same, J. F. LAWRENCE Lot 78–71, *Ganoderma* sp. (1, ANIC); Edge Hill, Cairns, 8.X.1966, J. G. BROOKS (1, ANIC); 12.44S 143.14E, 3 km ENE of Mt. Tozer, 28.VI.–4.VII.1986, T. WEIR & A. CALDER, J. F. LAWRENCE Lot 86–4, *Ganoderma lucidum* gp. (2, ANIC); same, J. F. LAWRENCE Lot 86–5, *Ganoderma applanatum* (1, ANIC); W. slope of Seymour Ra., Dinner Ck. Rd., nr. Innisfail, rainforest, under bark, 3.XI.1966, E. BRITTON (2, ANIC; 1, HNHM). – Papua New Guinea: Prov. Morobe, Umg. Lae, 11.III.1979, W. G. ULLRICH (11, BREM; 2, HNHM). – Indonesia: Ins. Kei, no other data (3, HNHM).

Distribution – Australia (Queensland), Papua New Guinea, Indonesia (Moluccas: Dammar Island and Kei Island).

Remarks – The frontal concavity vested with golden pubescence is distinctive for this species and makes it unmistakable.

* * *

Acknowledgements – We thank the curators and private collectors mentioned in the "Material and presentation of data" as well as Dr. R. A. CROWSON (Glasgow) for the loan of material. The SEM photographs were produced by Dr. Z. KRISTÓF (Department of Plant Anatomy, Eötvös Loránd University, Budapest). Miss ORSOLYA FEGYVERES collected the measurements (except on *R. crowsoni*). The research was supported by the Hungarian Scientific Research Fund (OTKA No. T–017699).

REFERENCES

CHUJO, M. (1985) Notes on the Japanese Tenebrionidae (Coleoptera). *Esakia* **23**: 61–66.

CROWSON, R. A. (1981) *The Biology of the Coleoptera*. Academic Press, New York, 802 pp.

DOYEN, J. T., MATTHEWS, E. G. & LAWRENCE, J. F. (1990) Classification and Annotated Checklist of the Australian Genera of Tenebrionidae (Coleoptera). *Invertebr. Taxon.* **3**[1989]: 229–260.

FAIRMARE, L. (1880) Diagnoses de Coléoptères de l'île de La Réunion. *Le Naturaliste* **2**(37): 293.

GEBIEN, H. (1910) 7. Coleoptera. 19. Tenebrionidae, pp. 363–396. *In* SJÖSTEDT, Y. (ed.) *Wissenschaftliche Ergebnisse der Schwedischen Zoologischen Expedition nach dem Kilimandjaro, dem Meru und den umgebenden Massaisteppen Deutsch-Ostafrikas 1905–1906. 1. Band.* Königl. Schwedischen Akademie der Wissenschaften, Stockholm.

GEBIEN, H. (1914) Die Tenebrionidenfauna Borneos. Erster Teil. *Sarawak Mus. J.* **2**(5): 1–58.

GEBIEN, H. (1922) Coleoptera, Heteromera: Tenebrionidae, *In* The Percy Sladen Trust Expedition to the Indian Ocean in 1905, under the leadership of Mr. J. Stanley Gardiner, M. A. Volume VII. – *Tr. Linn. Soc. London* **18**(1): 261–324.

GEBIEN, H. (1938–42) Katalog der Tenebrioniden. Teil II. *Mitt. münch. ent. Ges.* **28–32**: 370–744. [Repaged. Special part: 1939, *Mitt. münch. ent. Ges.* **29**: 498–529.]

KASZAB, Z. (1955*a*) Tenebrioniden der Fiji-Inseln. *Proc. Hawaiian Ent. Soc.* **15**(3): 423–563.

KASZAB, Z. (1955*b*) Die Tenebrioniden der Samoa-Inseln (Coleoptera). *Proc. Hawaiian Ent. Soc.* **15**(3): 639–671.

KASZAB, Z. (1971) The Scientific Results of Hungarian Zoological Expedition to Tanganyika 15. Coleoptera: Tenebrionidae. *Annls hist.-nat. Mus. natn. hung.* **63**: 225–238.

KASZAB, Z. (1979) Faunistik der Tenebrioniden von Sri Lanka. *Folia ent. hung.* **32**(2): 43–128.

KOMPANTSEVA, T. V. (1995): Larva of Rhipidandrus crenipennis (Motschulsky, 1858), and the position of the genus in Bolitophagini (Coleoptera, Tenebrionidae). – *Russian Ent. J.* **4**(1–4): 55–59.

KOMPANTZEVA, T. & MERKL, O. (1992) A new Rhipidandrus species from Vietnam (Coleoptera: Tenebrionidae). *Folia ent. hung.* **53**: 89–92.

KULZER, H. (1957) Coleoptera: Tenebrionidae. *Insects of Micronesia* **17**(3): 185–256.

LECONTE, J. L. (1862) Classification of the Coleoptera of North America. Prepared for the Smithsonian Institution. Part 1 (cont.). *Smithsonian Misc. Coll.* **3**: 209–286.

MOTSCHULSKY, V. (1858) Insectes des Indes orientales. *Études ent.* **7**: 20–122.

TSCHINKEL, W. R. & DOYEN, J. T (1980) Comparative anatomy of the defensive glands, ovipositors and female genital tubes of tenebrionid beetles (Coleoptera). *Int. J. Insect Morphol. Embryol.* **9**: 321–368.

VINSON, J. (1950) New species of Coleoptera from the Mascarene Islands. *Proc. R. Ent. Soc. London (B)* **19**: 142–147.

VINSON, J. (1953) Coléoptères nouveaux ou peu connus de l'île de La Réunion. *Bull. Soc. ent. France* **58**: 143–146.

WATERHOUSE, C. O. (1894) Coleoptera (partim). *In* WALKER, J.: A Visit to Damma Island, East Indian Archipelago. *Ann. Mag. Nat. Hist.* (Ser. 6) **14**: 64–71.

WATT, J. C. (1974) A revised subfamily classification of Tenebrionidae (Coleoptera). *N. Zealand J. Zool.* **1**(4): 381–452.

Received May 9, 1996, accepted December 20, 1996

Publications of the Hungarian Natural History Museum are available

Korsós, Z. and I. Kiss (eds) (1992): Proceedings of the 6th Ordinary General Meeting of the Societas Europaea Herpetologica, 19–23 August 1991, Budapest, Hungary. 531 pp. – ISBN 963 7093 12 5 (50 DM).

Mahunka, S. (ed.) (1991): The Bátorliget Nature Reserves – after forty years. Vols 1–2, 848 pp. – ISBN 963 7093 08 7, 963 7093 09 5 (USD 45).

Papp, L. and A. Szappanos (1992): Bagócslegyek – Gasterophilidae, Oestridae, Hypodermatidae. (in Hungarian), 56 pp. – ISBN 963 7093 11 7 (USD 15).

Soós, Á. and L. Papp (eds) (1992): Catalogue of Palaearctic Diptera. Vol. 1: Trichoceridae – Nymphomyiidae. 520 pp. – ISBN 963 7093 10 9 (USD 80).

Soós, Á. and L. Papp (eds) (1992): Catalogue of Palaearctic Diptera. Vol. 13: Anthomyiidae – Tachinidae. 624 pp. – ISBN 963 7093 21 4 (USD 85).

Zombori, L. and L. Peregovits (1992): Proceedings of the Fourth European Congress of Entomology and the XIII. Internationale Symposium für die Entomofaunistik Mitteleuropas, Gödöllő, Hungary, 1991. Vols 1–2, pp. 884. – ISBN 963 7093 14 1, 963 7093 15 X (USD 15).

Mahunka, S. and L. Zombori (eds) (1993): The fauna of the Bükk National Park. Vol. 1, 456 pp. – ISBN 963 7093 20 6 (USD 30).

Szujkó-Lacza, J. and D. Kováts (eds) (1993): The Flora of the Kiskunság National Park. Vol. 1. The Flowering Plants. 469 pp. – ISBN 963 7093 19 2 (USD 30).

Báldi, A., G. Csorba and Z. Korsós (1995): Magyarország szárazföldi gerinceseinek természetvédelmi szempontú értékelési rendszere. [Setting priorities for the conservation of terrestrial vertebrates in Hungary.] (in Hungarian with an extensive English summary), 59 pp. – ISBN 963 7093 26 5 (USD 10).

Mahunka, S. and L. Mahunka-Papp (1995): The Oribatid species described by Berlese (Acari). 325 pp. – ISBN 963 7093 27 3 (USD 40).

Verseghy, K. (1995): Magyarország zuzmóflórájának kézikönyve. [The lichen flora of Hungary.] (in Hungarian), 415 pp. – ISBN 963 7093 22 2 (USD 40).

Mahunka, S. (ed.) (1996): The fauna of the Bükk National Park, Vol. 2, 655 pp. – ISBN 963 70 93 32 x (USD 60)

Hably, L. (ed.) (1996): Emlékkötet Andreánszky Gábor (1895–1967) születésének 100. évfordulója alkalmából rendezett emlékülés előadásainak anyagából (Noszvaj, 1995. június 19–21). 183 pp. – ISBN 963 7093 33 8

Orders should be sent to:

The Library, Hungarian Natural History Museum
H–1088 Budapest, Baross u. 13, Hungary
Fax: +36-1-1171669

Acta Zoologica Academiae Scientiarum Hungaricae 42 (2), pp. 111–125, 1996

THE GENUS ULOMA DEJEAN (COLEOPTERA: TENEBRIONIDAE) IN THE HIMALAYAS*

W. SCHAWALLER**

Staatliches Museum für Naturkunde, Rosenstein 1, D–70191 Stuttgart, Germany

The species of the genus *Uloma* DEJEAN, 1821 (Coleoptera: Tenebrionidae) from the Himalayas are revised and an identification key for males is provided. The species characters are discussed. *Uloma sherpa* sp.n. from the eastern Himalayas is described, *Uloma prehimalayana* KASZAB, 1975 is considered a junior synonym of *Uloma rubripes* (HOPE, 1831), *Uloma kulzeri* ARDOIN, 1960 is considered a junior synonym of *Uloma ruficornis* ALLARD, 1896. Remarks on distribution and biology are added.

Key words: Coleoptera, Tenebrionidae, *Uloma*, new species, key, Himalayas

INTRODUCTION

The genus *Uloma* DEJEAN, 1821 is a tenebrionid genus distributed in nearly all zoogeographical regions. More than 200 species have been described, but very often based on only typological aspects, thus the taxonomic status of many species is still doubtful. Recent revisions exist only for a few regions, as for Australia (KASZAB 1982), and for Japan, Korea and Taiwan (MASUMOTO & NISHIKAWA 1986). Up to now Himalayan species have been treated only in a few papers (ALLARD 1896; ARDOIN 1960; KASZAB 1975, 1977). With new material at hand from the Himalayas, I attempt to summarize in this paper all known species from that region.

Much taxonomic confusion exists because of the relatively uniform external appearance of the species. KASZAB (1982) was the first to use several distinct species characters (see the following chapter), mainly secondary sexual characters, which allow one to recognize at least the males with certainty. For phylogenetical discussions all Oriental species should be revised and "out-groups" must be studied for judging the morphological species characters.

The species of *Uloma* occur in rotten wood or under the bark of trees and are distributed both in temperate and tropical forests. They are absent in arid biotopes. Pine trees as well as broad-leaved trees are inhabited by the different species. In general, the congeners can be considered as indicators of mature

---

* Results of the Himalaya Expeditions of. J. MARTENS, no. 205. – For no. 204 see: *Kol. Rdsch.*, suppl. 1996. – J. M. sponsored by Deutscher Akademischer Austauschdienst and Deutsche Forschungsgemeinschaft.

** Contribution to Tenebrionidae, no. 16. – For no. 15 see: *Rev. suisse Zool.* **103**, 1996.

forests, which are highly endangered in nearly all parts of the world, in particular in the Himalayas.

SPECIES CHARACTERS

Ligula: The ligula (=praementum sensu KASZAB) of males bears either a few sparse setae sometimes completely lacking or a dense brush of short yellow setae. The lack or presence and also the extension of this brush is specific. The shape of the ligula itself is without taxonomic value.

Mentum: The shape of the male mentum seems to be of less value, but the structure of the surface (flat, with a single excavation, with several impressions) is specific. A further distinct species character – at least in males – is the lack or presence and extension of a dense yellow setation (as on the ligula).

Antenna: The shape of the antennal segments is identical in both sexes of some species, some other species possess a sexually dimorphic antenna. The shape of the sexual dimorphic male antenna is specific. The length relations of the single antennal segments are of less value.

Head: Some species possess a sexually dimorphic head with deeper excavations or ridges/horns. This dimorphism is specific.

Pronotum: Some species have a sexually dimorphic pronotum with specific impressions and/or excavations in the males. Also specific is a bordered or unbordered posterior margin. The shape of the pronotum itself and the surface punctation seem more variable.

Elytra: The shape of the elytra, the form of the elytral lateral margin, the size of the punctures in the elytral stripes, the form and the punctation of the intervals are variable to a certain extend and not very helpful for species separation.

Sternites: Punctation and wrinkled structure are variable and without specific peculiarities.

Protibia: In many species the male anterior tibia possesses specific peculiarities, such as the general shape, excavations on the medial side, rows of granules or keels.

Aedeagus: The shape of the parameres is characteristic at least for species groups, the shape of the bended basal tube is similar in all congeners. The length in relation to the size of the abdomen is variable to a certain extent.

Body: The shape of the body in general and size is of less taxonomic value but may help when a comparison with more numerous material is possible. The colouration varies from light brown to nearly black and reflects more the age of sclerotization than a specific character.

Uloma bhutanensis KASZAB, 1975
(Figs 29–33)

Material: Bhutan, Phuntsholing, 200–400 m, 25.IV.1972 leg. W. WITTMER, holotype and 2 paratypes in NHMB, 1 paratype in HNHM.

Description: Body brown, for shape see Fig. 29, length 9.5–9.8 mm. Head without sexual dimorphism. Antenna (Fig. 31) without sexual dimorphism. Mentum in males (Fig. 32) excavated, dense setation in a narrow garland only at the lateral sides. Ligula in males (Fig. 32) with a few sparse setae. Pronotum in males (Fig. 29) anteriorly with a distinct impression, basal margin unbordered, punctation coarser in impression, surface between punctation without micropunctation (25× magnification). Punctures of elytral rows only somewhat broader than stripes, elytral intervals flat. Last visible sternite unbordered. Protibia in males see Fig. 30. Aedeagus shown in Fig. 33.

Distribution: Restricted to the eastern Himalayas, known only from the type locality in Bhutan.

Uloma nepalica KASZAB, 1977
(Figs 24–28)

Material: Nepal, Myagdi Distr., Muri, 2100–2300 m, III.–IV.1970 leg. J. MARTENS, 1 paratype in HNHM. Nepal, Myagdi Distr., Bobang S Dhorpatan, E.IV.1970 leg. J. MARTENS, 3 paratypes in HNHM.

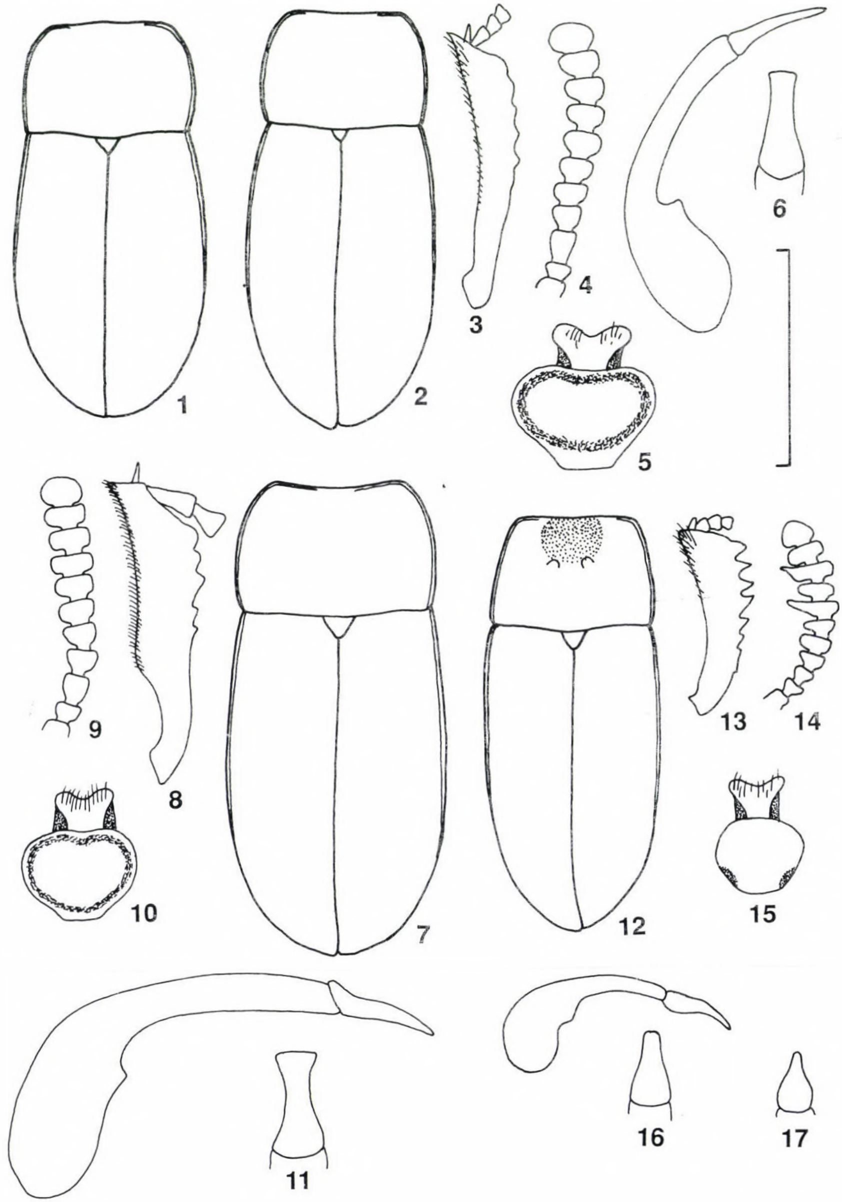
Description: Body brown, for shape see Fig. 24, length 11.8–13.5 mm. Head without distinct sexual dimorphism. Antenna in males (Fig. 26) with the segments 5, 7 and 9 distinctly pointed at inner side (numeration of these segments incorrect in the original description). Mentum in males (Fig. 27) distinctly excavated, dense setation in a narrow garland interrupted anteriorly and posteriorly. Ligula in males (Fig. 27) with a few sparse setae. Pronotum in males (Fig. 24) anteriorly with a feeble impression, basal margin unbordered, punctation coarser in impression, surface between punctation with micropunctation (25× magnification). Punctures of elytral rows small and not broader than stripes, elytral intervals flat. Last visible sternite unbordered. Protibia in males shown in Fig. 25, ventral side with dilatation. Aedeagus as in Fig. 28.

Distribution: Restricted to the central Himalayas, known only from the type series from Nepal southwest of Dhaulagiri.

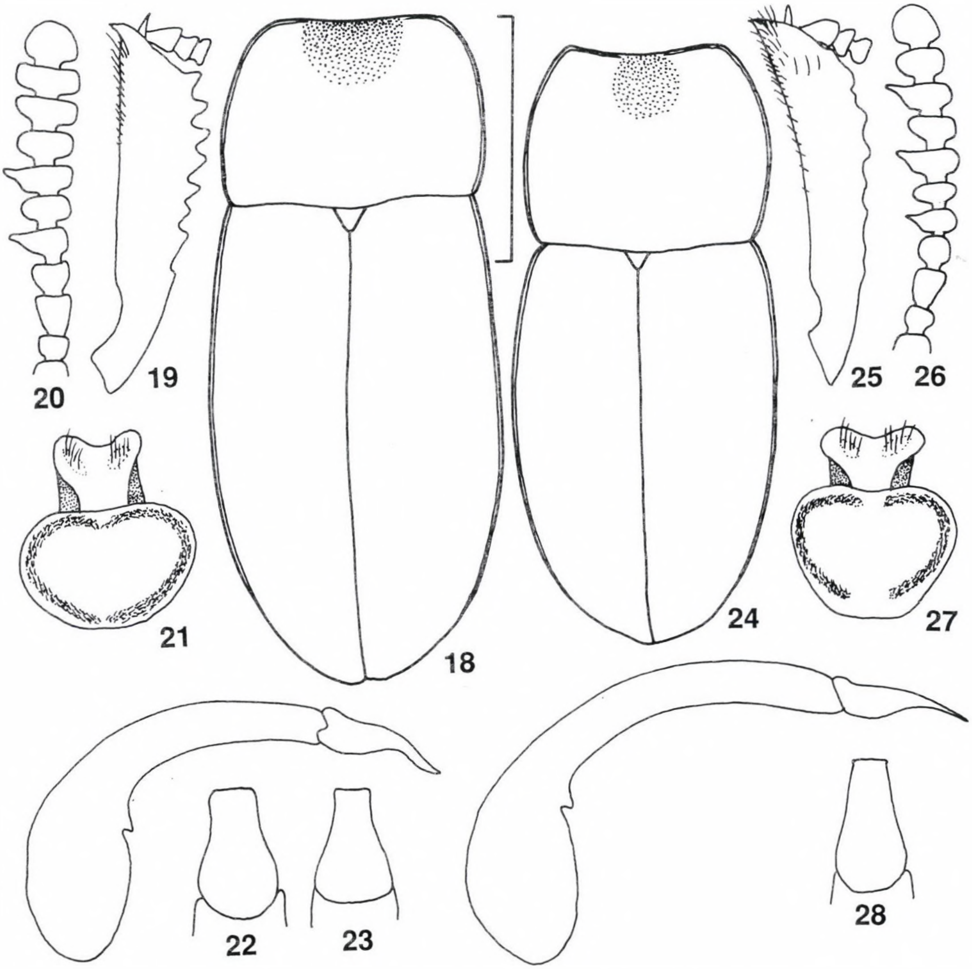
Uloma polita (WIEDEMANN, 1821)
(Figs 7–11)

Material: Bhutan, Samchi, 300 m, 7.–11.V.1972 leg. W. WITTMER et al., 2 ex. HNHM. India, Sikkim, Rishi Khola, 700 m, 3.XII.1981 leg. B. BHAKTA, 1 ex. NHMB. India, Sikkim, Tadung, 1700 m, 26.VI.1984 leg. C. RAI, 1 ex. NHMB. India, Darjeeling, Algarah, 1500 m, 10.X.1981 leg. B. BHAKTA, 1 ex. NHMB. India, Darjeeling, Kalimpong, Nashay, 850 m, 16.IV.1984 leg. C. RAI, 1 ex. NHMB. India, Darjeeling, Kalimpong, Purbong, 950 m, VI.1982 leg. C. RAI, 1 ex. SMNS. India, Assam, Kaziranga, 75 m, 7.–9.V.1976 leg. W. WITTMER & C. BARONI URBANI, 1 ex. HNHM. Nepal, Terai, Sauraha-Chitwan, 20.–25.V.1992 leg. J. MORAVEC, 1 ex. NHMB. Nepal, between Hetaura and Pipley, 9.VI.1968 leg. E. WOYNAROVICH, 1 ex. HNHM. Nepal, Bhimpedi valley, 400 m, 4.–7.IV.1982 leg. G. EBERT, 1 ex. HNHM. Nepal, Pokhara, Pame,

Figs 1–17. 1–6 = *Uloma ruficornis*. 1 = dorsal view of female holotype of *ruficornis*, 2 = dorsal view of male paratype of *kulzeri* syn. n., 3 = male protibia, 4 = male antenna, 5 = male mentum and ligula, 6 = aedeagus. 7–11 = *Uloma polita*. 7 = dorsal view of male, 8 = male protibia, 9 = male antenna, 10 = male mentum and ligula, 11 = aedeagus. 12–16 = *Uloma sherpa* sp. n. 12 = dorsal view of male paratype, 13 = male protibia, 14 = male antenna, 15 = male mentum and ligula, 16 = aedeagus. 17 = *Uloma recurva*, aedeagus of male from Sumatra. Scales: dorsal view 5 mm; antenna, protibia, aedeagus 2 mm; mentum 1 mm



900 m, 5.–8.V.1993 leg. D. AHRENS, 2 ex. SMNS. Nepal, Pokhara, lake, 850 m, 10.V.1993 leg. J. SCHMIDT, 1 ex. SMNS. Nepal, Pokhara, 900 m, 2.–3.V.1984 leg. C. HOLZSCHUH, 1 ex. NHMB. Nepal, Pokhara, Chhoti Patan, 2.VI.1992 leg. J. MORAVEC, 1 ex. NHMB. Nepal, Kali Gandaki, Tatopani, 1100–1200 m, 22.–24.V.1984 leg. B. BHAKTA, 1 ex. NHMB. Nepal, Myagdi Distr., Bim to Darbang, 1150–1000 m, 30.V.1995 leg. J. MARTENS & W. SCHAWALLER, 1 ex. SMNS. India, Uttar Pradesh, Uttarkashi, 1300–1400 m, 18.V.1978 leg. W. WITTMER, 3 ex. NHMB. India, Uttar Pradesh, Barkot, 5.–12.VI.1981 leg. M. BRANCUCCI, 2 ex. NHMB. India, Uttar Pradesh, Gangani, 1250 m, 13.–20.VI.1981 leg. M. BRANCUCCI, 9 ex. NHMB, 2 ex. SMNS.



Figs 18–28. 18–23 = *Uloma rubripes*. 18 = dorsal view of male paratype of *prehimalayana* syn. n., 19 = male protibia, 20 = male antenna, 21 = male mentum and ligula, 22 = aedeagus of paratype of *prehimalayana* syn. n., 23 = aedeagus of male from Nepal: Hedagna. 24–28 = *Uloma nepalica*. 24 = dorsal view of male paratype, 25 = male protibia, 26 = male antenna, 27 = male mentum and ligula, 28 = aedeagus. Scales as in Figs 1–17

Description: Body black, for shape see Fig. 7, length 10.0–12.0 mm. Head without distinct sexual dimorphism. Antenna (Fig. 9) without sexual dimorphism. Mentum in males (Fig. 10) distinctly excavated, dense setation in a narrow garland at all sides. Ligula in males (Fig. 10) with a few sparse setae. Pronotum without sexual dimorphism and without impression, basal margin unbordered, punctation distinctly coarser at sides, medial part nearly unpunctured, surface between punctation without micropunctation (25× magnification). Punctures of elytral rows small and not broader than stripes, medial elytral intervals flat and lateral ones convex. Last visible sternite unbordered. Protibia in males see Fig. 8. Aedeagus as in Fig. 11.

Remarks: GEBIEN (1912) published a redescription of the type and noted concerning the parameres "das meisselförmig abgestutzte Ende etwas verbreitert". This corresponds with the shape of the Himalayan (and other available) material (Fig. 11) but does not correspond with the drawing of a Japanese record in MASUMOTO & NISHIKAWA (1986: Fig. 47). It cannot be decided now whether this is an error in identification or these differences reflect infraspecific variation.

Distribution: Known from India, Burma, Thailand, Vietnam, also from some southern Japanese islands, Taiwan, Sri Lanka and even from Madagascar, Mauritius and Rodriguez Islands (SMNS, unpublished material). In the Himalayas, from Uttar Pradesh in the west to Bhutan in the east.

Uloma rubripes (HOPE, 1831)
(Figs 18–23)
Uloma prehimalayana KASZAB, 1975, **syn. n.**

Material: Bhutan, 87 km from Phuntsholing, 22.V.1972 leg. W. WITTMER et al., 1 male paratype of *prehimalayana* in HNHM. Bhutan, Chasilakha, VI.1979 leg. D. KHANDU, 1 ex. NHMB. India, Meghalaya, Khasi Hills, Mawphlang, 1800 m, 28.X.1978 leg. C. BESUCHET & I. LÖBL, 1 ex. MHNG. India, Sikkim, Lagyap, 1800 m, 28.X.1985 leg. C. RAI, 1 ex. NHMB. India, Sikkim, Natok, 1500 m, 26.IV.1985 leg. C. RAI, 1 ex. NHMB. India, Sikkim, Rongay, 1800 m, 23.IV.1985 leg. C. RAI, 1 ex. NHMB. India, Darjeeling, upper Bombusty, 1200 m, 5.VIII.1985 leg. C. RAI, 1 ex. NHMB. India, Darjeeling, lower Bombusty, Kalimpong, 900 m, 5.VIII.1985 leg. C. RAI, 1 ex. SMNS. India, Darjeeling, Alghera, 1720 m, 18.IV.1984 leg. C. RAI, 1 ex. NHMB. India, Darjeeling, Algarah, 1800 m, 9.X.1978 leg. C. BESUCHET & I. LÖBL, 2 ex. MHNG. Nepal, Sankhua Sabha Distr., Arun Valley bottom between Hedangna and Num, 950–1000 m, 6.–8.VI.1988 leg. J. MARTENS & W. SCHAWALLER, 3 ex. SMNS. Nepal, Arun Valley, Hedangna-Num, 800 m, 16.VI.1983 leg. M. BRANCUCCI, 11 ex. NHMB, 2 ex. SMNS. Nepal, Arun Valley, Num, 1550 m, 5.–6.VI.1983 leg. M. BRANCUCCI, 1 ex. NHMB. Nepal, Arun Valley, Chichila-Mure, 1950–2000 m, 1.VI.1983 leg. M. BRANCUCCI, 1 ex. NHMB. Nepal, Arun Valley, Lamobagar Gola, 1400 m, 8.–14.VI.1983 leg. M. BRANCUCCI, 5 ex. NHMB. Eastern Nepal, Biratnagar, 140 m, 21.V.1980 leg. W. WITTMER, 2 ex. NHMB. Nepal, Khandbari Distr., NE Kuwapani, 2500 m, 11.–15.IV.1982 leg. A. & Z. SMETANA, 5 ex. MHNG. Nepal, Langtang, Ramche-Dunche, 27.IV.1978, 1 ex. HNHM. Nepal, Janakpur, Dolakha, Tama Koshi, 850 m, 24.–29.V.1989 leg. M. BRANCUCCI, 1 ex. NHMB. Nepal, Pokhara, 9.–12.X.1980 leg. JALZIC, 2 ex. HNHM. Nepal, Pokhara, 15.–17.VI.1990 leg. S. BILY, 1 ex. NHMB. Nepal, S Annapurna Mts., 4 km NE Siklis, below Taunja Danda, 2200–2400 m, 6.VIII.1995 leg. O. JÄGER, 4 ex. SMTD. Nepal, Modi Khola, Banthanti-Landrung, 2500–1600 m, 2.VI.1984 leg. C. RAI, 1 ex. NHMB. Nepal, Modi Khola, Landrung, 1100–1800 m, 3.–6.VI.1984 leg. C. RAI, 2 ex. NHMB. Nepal, Modi Khola, Pothana, 1900 m, 5.–7.V.1984 leg. B. BHAKTA, 1 ex. NHMB. Nepal, Kali Gandaki, Kalopani, 2500–2800 m, 21.–25.VI.1986 leg. C. HOLZSCHUH, 1 ex. NHMB. Nepal, Kali Gandaki, Khopchepani-Ghasa, 1600–2000 m, 19.VI.1986 leg. C. HOLZ-

SCHUH, 1 ex. NHMB. Nepal, Myagdi Distr., Myagdi Khola S Boghara, 1400 m, 27.–28.V.1995, leg. J. MARTENS & W. SCHAWALLER, 1 ex. SMNS. India, Uttar Pradesh, Bhowali, 1500–1600 m, 12.V.1978 leg. W. WITTMER, 2 ex. NHMB.

Description: Body brown, for shape see Fig. 18, length 10.0–16.5 mm. Head in males with a bihorned elevated anterior ridge, less developed in females. Antenna in males (Fig. 20) with segments 5 and 7 distinctly pointed at inner side. Mentum in males (Fig. 21) slightly excavated, dense setation in a narrow garland at all sides. Ligula in males (Fig. 21) with a few sparse setae. Pronotum in males (Fig. 18) anteriorly with a distinct impression, basal margin unbordered, punctation coarser in impression, surface between punctation without micropunctation (25× magnification). Punctures of elytral rows only somewhat broader than stripes, elytral intervals slightly convex. Last visible sternite unbordered. Protibia in males as in Fig. 19, ventral side with dilatation. Aedeagus depicted in Figs 22–23.

Synonymy: When describing *prehimalayana*, KASZAB (1975) pointed to the similarity with *rubripes* and he noted differences mainly in the structure of the male mentum, the shape of the protibia in males and the shape of the aedeagus (Figs 22–23). These differences fully fall within the range of infraspecific morphological variation of the widespread *rubripes* and are not considered herein as specific.

Remarks: The Nepalese series from the Arun valley between Hedangna and Num includes a few specimens which are somewhat smaller (10.0–11.0 mm) than records from other localities (13.0–16.5 mm), a single such small male has only the antennal segment 7 dilated. This difference is considered as not specific. GEBIEN (1927) also reported some smaller specimens from Sumatra with a different male antenna.

Distribution: Widespread in the Oriental region: Nepal, Thailand, Borneo, Sumatra, Bali and other Sunda Islands (GEBIEN 1927), records from New Guinea and the Philippines should be revised. *Uloma prehimalayana* was described from Bhutan and Assam. In the Himalayas distributed from Uttar Pradesh in the west to Bhutan and Indian Meghalaya in the east.

Uloma ruficornis ALLARD, 1896
(Figs 1–6)
Uloma kulzeri ARDOIN, 1960, **syn. n.**

Material: India, Sikkim, 1886 leg. HARMAND, 1 female holotype of *ruficornis* in MHNP. India, Darjeeling, Pedong, 1934, 1 male paratype of *kulzeri* in HNHM. India, Darjeeling, North point, 1000–2000 m, 15.X.1967 leg. G. TOPÁL, 1 ex. in HNHM. India, West Bengal, Nalbani, N Salt Lake, 26.IV.1967 leg. G. TOPÁL, 1 ex. in HNHM.

Description: Body brown, for shape see Figs 1–2, length 10.3–11.0 mm. Head without distinct sexual dimorphism. Antenna (Fig. 4) without sexual dimorphism. Mentum in males (Fig. 5) distinctly excavated, dense setation in a narrow garland at all sides. Ligula in males (Fig. 5) with a few sparse setae. Pronotum without sexual dimorphism and without impression, basal margin unbordered, punctation only slightly coarser at sides, surface between punctation without micropunctation (25× magnification). Punctures of elytral rows small and not broader than stripes, elytral intervals slightly convex. Last visible sternite unbordered. Protibia in males depicted in Fig. 3. Aedeagus as in Fig. 6.

Remarks: *Uloma kulzeri* ARDOIN, 1960 is considered a junior synonym of *Uloma ruficornis* ALLARD, 1896 although the holotype of *ruficornis* is a female. Body size, shape and punctation of the pronotum, the pattern of elytral rows and the structure of legs show no specific differences. Furthermore, the type localities are situated close to each other.

Distribution: Restricted to the eastern Himalayas, known from the Indian Sikkim, Darjeeling and West Bengal.

Uloma rufilabris FAIRMAIRE, 1882
(Figs 34–38)

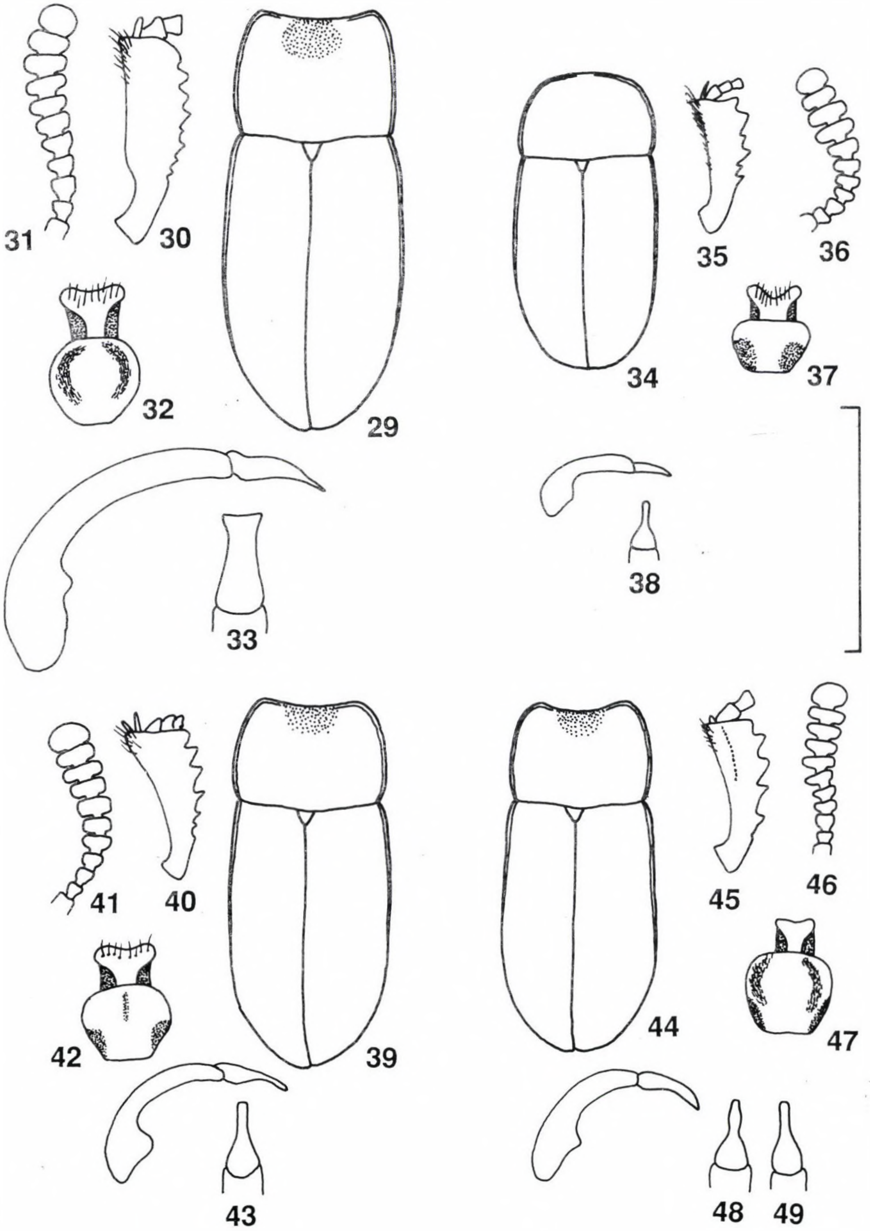
Material: India, Assam, Manas, 200 m, 23.X.1978 leg. C. BESUCHET & I. LÖBL, 6 ex. MHNG, 1 ex. SMNS. India, Darjeeling, Sakyong, 1140 m, 25.IX.1981 leg. B. BHAKTA, 1 ex. NHMB. East Nepal, Lamobagar Gao, 1400 m, 28.–31.V.1980 leg. W. WITTMER, 1 ex. NHMB. Nepal, Hetara, Pipley, 26.V.–5.VI.1969 leg. WOYNAROVICH, 1 ex. HNHM. Nepal, Bheri zone, Nepalgunj, 200 m, 17.–20.VI.1995 leg. D. AHRENS, 1 ex. SMNS. India, Uttar Pradesh, Gangani, 1250 m, 13.–20.VI.1981 leg. M. BRANCUCCI, 12 ex. NHMB, 3 ex. SMNS. India, Uttar Pradesh, Barkot, 1100–1200 m, 5.–12.VI.1981 leg. M. BRANCUCCI, 6 ex. NHMB.

Description: Body brown, for shape see Fig. 34, length 5.5–7.0 mm. Head without sexual dimorphism. Antenna (Fig. 36) without sexual dimorphism. Mentum in males (Fig. 37) nearly flat, without setation, with distinct basolateral impressions. Ligula in males (Fig. 37) with a few sparse setae. Pronotum without sexual dimorphism and without impression, basal margin unbordered, punctation equal, surface between punctation without micropunctation (25× magnification). Punctures of elytral rows broader than stripes, elytral intervals slightly convex. Last visible sternite unbordered. Protibia in males as in Fig. 35. Aedeagus shown in Fig. 38.

Remarks: The above-listed material coincides with material from Sumatra (locus typicus) and other Oriental regions identified by the late Dr. KASZAB, and also fits with the description. However, the original description is quite cursory (FAIRMAIRE, 1882) and gives no information about the male mentum and the aedeagus. Furthermore, the differences to *contracta* FAIRMAIRE, 1882, described also from Sumatra, seem quite doubtful.

Distribution: The species was described from Sumatra and is obviously widely distributed in the Oriental region: Other Sunda Islands, Indian subcontinent, Thailand (according to material in HNHM and SMNS). In the Himalayas, distributed from Uttar Pradesh in the west to Assam in the east.

Figs 29–49. 29–33 = *Uloma bhutanensis*. 29 = dorsal view of male paratype, 30 = male protibia, 31 = male antenna, 32 = male mentum and ligula, 33 = aedeagus. 34–38 = *Uloma rufilabris*. 34 = dorsal view of male, 35 = male protibia, 36 = male antenna, 37 = male mentum and ligula, 38 = aedeagus. 39–43 = *Uloma scita*. 39 = dorsal view of male, 40 = male protibia, 41 = male antenna, 42 = male mentum and ligula, 43 = aedeagus. 44–49 = *Uloma spinipes*. 44 = dorsal view of male paratype, 45 = male protibia, 46 = male antenna, 47 = male mentum and ligula, 48 = aedeagus of paratype, 49 = aedeagus of male from Nepal: Hedagna. Scales as in Figs 1–17



Uloma scita WALKER, 1858
(Figs 39–43)

Material: India, Meghalaya, Garo Hills, Dainadubi, 250 m, 4.XI.1978 leg. C. BESUCHET & I. LÖBL, 1 ex. MHNG. Nepal, Jumla distr., 2 km N of Jumla, 2300–2800 m, 30.IV.1995 leg. A. WEIGEL, 2 ex. NKME. India, Himachal Pradesh, Manali, Solang valley, 2500 m, 20.VII.1989 leg. A. RIEDEL, 1 ex. SMNS. India, Uttar Pradesh, Gangani, 1250 m, 13.–20.VI.1981 leg. M. BRANCUCCI, 4 ex. NHMB, 1 ex. SMNS. India, Kashmir, Gulmarg, 2750 m, V.1974 leg. R. KENYERY, 1 ex. HNHM. Pakistan, Swat, Utrot, 2200–2800 m, 12.–14.VII.1982 leg. D. ERBER & W. HEINZ, 2 ex. SMNS. Pakistan, Swat, S Utrot, 2500–2600 m, 13.–14.V.1983 leg. C. BESUCHET & I. LÖBL, 5 ex. MHNG, 1 ex. SMNS. Pakistan, Swat, Madyan, 1400 m, 16.V.1983 leg. C. BESUCHET & I. LÖBL, 1 ex. MHNG. Pakistan, Hazara, Shogran, 2400 m, 3.VI.1983 leg. C. BESUCHET & I. LÖBL, 2 ex. MHNG. Pakistan, Chitral, Lawarai Pass, 2600 m, 23.V.1983 leg. C. BESUCHET & I. LÖBL, 1 ex. MHNG.

Description: Body brown, for shape see Fig. 39, length 6.8–7.5 mm. Head without sexual dimorphism. Antenna (Fig. 41) without sexual dimorphism. Mentum in males (Fig. 42) with distinct basolateral impressions and a medial impression, without any setation. Ligula in males (Fig. 42) with a few sparse setae. Pronotum in males (Fig. 39) anteriorly with a distinct impression, basal margin unbordered, punctation only laterally somewhat coarser, surface without micropunctation (25× magnification). Punctures of elytral rows somewhat broader than stripes, elytral intervals slightly convex. Last visible sternite unbordered. Protibia in males shown in Fig. 40. Aedeagus as in Fig. 43.

Remarks: When describing the species *spinipes*, KASZAB (1975) noted its close similarity to *scita* concerning the external appearance, and pointed to significant differences (shape of aedeagus, pattern of setation on mentum and structure of protibia in males). The above-listed specimens correspond to material in HNHM identified by the late Dr. KASZAB. A quite similar species occurs in Bali (unpublished material in SMNS), having the protibia with a row of granules and a male mentum like *spinipes*, but the parameres have a tip even longer than in *scita*. See also remarks under *spinipes*.

The taxonomic status of *Uloma picicornis* FAIRMAIRE, 1882 from Sumatra seems doubtful and probably this species is a synonym of *scita* WALKER, 1858. KASZAB (1939) figured the aedeagus of *picicornis* but gave no information whether this was based on the type(s). Judging from this figure, *picicornis* is distinctly different from *scita*, but the specimens which I have available from Sumatra have the parameres like *scita*. However, the specimens in HNHM and SMNS from Borneo identified by Dr. KASZAB as *picicornis* have the parameres like the above-cited illustration. So it cannot be excluded that *picicornis* (*locus typicus* Sumatra) is a synonym of *scita* (*locus typicus* Sri Lanka) and the population in Borneo represents a different described or undescribed species. To clarify this confusion, a revision of all Indo-Malayan *Uloma* is needed.

Distribution: Described from Sri Lanka and obviously at least also on the Indian subcontinent. Records from other regions (Seychelles: KASZAB 1979) should be revised. In the Himalayas, known from the western parts of Pakistan, from Uttar Pradesh and Himachal Pradesh, Western Nepal and (disjunctly) from the Indian Meghalaya in the east.

Uloma sherpa sp. n.
(Figs 12–16)

Holotype (male): Nepal, Arun valley, Hedangna-Num, 800 m, 16.VI.1983 leg. M. BRANCUCCI, NHMB.

Paratypes: Same data as holotype, 3 ex. NHMB, 1 ex. SMNS. Nepal, Arun valley, Chichila, 1950 m, 31.V.1983 leg. M. BRANCUCCI, 1 ex. NHMB. India, Darjeeling, Dhuga, 1200 m, 12.IV.1983 leg. B. BHAKTA, 1 ex. NHMB, 1 ex. SMNS. Bhutan, 87 km from Phuntsholing, 22.V.1972 leg. W. WITTMER et al., 1 ex. NHMB.

Description: Body brown, for shape see Fig. 12, length 9.2–10.5 mm. Head in males with a bihorned elevated anterior ridge, less developed in females. Antenna in males (Fig. 14) with the segments 7 and 9 distinctly pointed at inner side. Mentum in males (Fig. 15) slightly excavated, without setation. Ligula in males (Fig. 15) with a few sparse setae. Pronotum in males (Fig. 12) anteriorly with a distinct impression having two small medial swellings at its posterior margin, pronotum in females with a weak impression without swellings, basal margin unbordered, punctation coarser in and sparser behind impression, surface between punctation without micropunctation (25× magnification). Punctures of elytral rows somewhat broader than stripes, elytral intervals slightly convex. Last visible sternite unbordered. Protibia in males as in Fig. 13. For aedeagus, see Fig. 16.

Remarks: *Uloma sherpa* n.sp. is quite similar to *recurva* GEBIEN, 1927 from Sumatra (material: N Sumatra, Partungkoan, Samosir, 28.VIII.1991 leg. D. ERBER, 3 ex. SMNS). Both species share the striking shape of the male antennal segments with the dilated segments 7 and 9 and the shape of the male protibia. The main differences lie in the shape of the aedeagus (Figs 16–17), the male mentum (*sherpa* sp. n. without, *recurva* with setation), the structure of the male pronotum (*sherpa* sp. n. with small and medially situated swellings behind the anterior impression and basal margin without impressions, *recurva* with bigger and more lateral situated swellings behind the anterior impression and basal margin with three impressions) and the body shape (*sherpa* sp. n. elongate, *recurva* somewhat broader). The single specimen from Bhutan was already recognized and labelled by Dr. KASZAB in 1974 as a new species close to *recurva*.

Distribution: Restricted to the eastern Himalayas, known only from the type localities in eastern Nepal, Darjeeling and Bhutan.

Uloma spinipes KASZAB, 1975
(Figs 44–49)

Material: Bhutan, Phuntsholing, 200–400 m, 25.IV.1972 leg. W. WITTMER et al., holotype and 3 paratypes in NHMB, 2 paratypes in HNHM. Nepal, Arun Valley, Hedangna-Num, 800 m, 16.VI.1983 leg. M. BRANCUCCI, 3 ex. NHMB, 1 ex SMNS. Nepal, Janakpur, Dolakha, Tama Koshi, 850–1100 m, 24.–29.V.1989 leg. M. BRANCUCCI, 1 ex. NHMB, 1 ex. SMNS.

Description: Body brown, for shape see Fig. 44, length 6.8–8.0 mm. Head without sexual dimorphism. Antenna (Fig. 46) without sexual dimorphism. Mentum in males (Fig. 47) with distinct basolateral impressions, slightly excavated, dense setation in a narrow garland only on the lateral sides. Ligula in males (Fig. 47) without or with a few sparse setae. Pronotum in males (Fig. 44) anteriorly with a distinct impression, basal margin unbordered, punctation only laterally somewhat coarser, surface without micropunctation (25× magnification). Punctures of elytral rows somewhat broader than stripes, elytral intervals slightly convex. Last visible sternite unbordered. Protibia in males as in Fig. 45, dorsal side in anterior part with a longitudinal row of granules. Aedeagus shown in Figs 48–49.

Remarks: The available males from Nepal have the parameres slightly different from those of the type series (Figs 48–49) and somewhat similar to those in *scita* (Fig. 43), but all other characters (in particular setation on mentum and row of granules on the protibia in males) correspond to the types from Bhutan. If further studies show, that absence or presence of the setation on the male mentum and absence or presence of the row of granules on the male protibia are only infraspecific variations, then *spinipes* must be considered a synonym of *scita*.

Distribution: Restricted to the Himalayas, described from Bhutan and known from at least eastern Nepal.

Uloma sp.

Material: India, E Sikkim, Rongay, 1800 m, 23.IV.1985 leg. C. RAI, 3 females NHMB.

Remarks: This series probably represents a new species but I desist from describing it without also having males at hand. Body length around 12.5 m, body shape stumpy and somewhat similar to the shape of *heynei* GEBIEN, 1912 from southern India. A similar, yet unnamed species occurs in Malaysia (unpublished material in HNHM, SMNS).

KEY OF THE HIMALAYAN SPECIES
(only males)

1 Pronotum without impression or other sexual dimorphism 2

– Pronotum of males with a medial impression in the anterior half 4

2 Protibia with a narrow basal third and with a broad, more or less parallel distal part, body black (Figs 7–11) *polita*

– Protibia broadened from basal to distal more or less equally, body brown 3

3 Body length 10.3–11.0 mm, mentum with dense setation in a narrow garland at all sides (Figs 1–6) *ruficornis*

– Body length 5.5–7.0 mm, mentum without setation (Figs 34–38) *rufilabris*

4 Antenna with sexual dimorphism, in males some segments medially distinctly prolonged 5

– Antenna without sexual dimorphism, all segments broadened equally in both sexes 7

5 Pronotum with 2 small medial swellings at the posterior margin of the impression, mentum without setation (Figs 12–16) *sherpa* sp. n.

– Pronotum with simple round impression, mentum with dense setation in a narrow garland 6

6 Antennal segments 5, 7 and 9 with medial prolongation, head unarmed, parameres longer (Figs 24–28) *nepalica*

– Antennal segments 5 and 7 with medial prolongation, head in males with a bihorned elevated anterior ridge, which is less developed in females, parameres shorter (Figs 18–23) *rubripes*

7 Mentum without setation (Figs 39–43) *scita*

– Mentum with dense setation in a narrow garland at the lateral sides 8

8 Parameres with a narrow tip, protibia with a longitudinal row of granules (Figs 44–49) *spinipes*

– Parameres with a broad tip, protibia without granules (Figs 29–33) *bhutanensis*

BIOLOGY AND ZOOGEOGRAPHY

Uloma species are characteristic elements of wooded habitats. They usually live together with their larvae under the bark or in rotten wood of different de-composition. They seem to have a wide ecological plasticity, because at least in Nepal the same species often occurs in different forest types. Humidity and the condition of the rotten wood might be important limiting factors, rather than the tree species. It is striking that in Nepal, *Uloma* has been actually found only in subtropical forest and agricultural land below 1000 m, just as in mountainous mixed forests up to 2800 m, but is obviously lacking in subalpine *Abies/Rhododendron* forests above 3000 m.

Uloma scita is described from Sri Lanka, i.e. from tropical forests which might be similar also in the northeastern Indian Meghalaya. But the same species (at least with the present taxonomic knowledge) is recorded herein also from drier mountainous forests of the western Himalayas with a quite different composition of trees. *Uloma rubripes* shows a wider ecological spectrum too, in Nepal it is recorded from subtropical forests of altitudes below 1000 m but also from quite different mountainous forests up to 2800 m. I found *rubripes* in the Myagdi Khola valley in a forest at about 1400 m altitude in a rotten *Pinus* log. *Uloma polita* with its wide distribution in the Oriental region in Nepal is an element only of the lowland zones up to about 1000 m, here occuring in native forests just as in cultivated land with single trees.

The number of *Uloma* species in the Himalayas increases from west to east. This general statement is valid for many groups of plants and animals, based mainly on different ecological conditions (in particular higher humidity in the east) and different zoogeographical origin. Concerning *Uloma*, it cannot yet be decided whether all species have penetrated into the young uprising Himalayas and from which zoogeographical region, or if they or at least some of them have evolved locally by new isolations from an ancient penetrating ancestor. Their phylogenetical relations are still unknown.

* * *

Abbreviations: HNHM – Hungarian Natural History Museum Budapest; MHNG – Muséum d'Histoire Naturelle Genève; MHNP – Muséum National d'Histoire Naturelle Paris; NHMB – Naturhistorisches Museum Basel; NKME – Naturkundemuseum Erfurt; SMNS – Staatliches Museum für Naturkunde Stuttgart; SMTD – Staatliches Museum für Tierkunde Dresden.

Acknowledgements – I thank Dr. M. BRANCUCCI (Basel), Dr. C. GIRARD (Paris), Mr. M. HARTMANN (Erfurt), Mr. O. JÄGER (Dresden), Dr. I. LÖBL (Genève) and Dr. O. MERKL (Budapest) for the loan of material .

REFERENCES

ALLARD, M. (1896) Hétéromères recueillis au Sikkim par le Dr. Harmand (Col.). *Bull. Soc. ent. France* **1896**: 318–321.

ARDOIN, P. (1960) Une nouvelle espèce d'Uloma (Tenebrionidae) de l'Inde. *Ent. Arb. Mus. Frey* **11**: 273–275.

GEBIEN, H. (1912) Neue Käfer aus der Familie Tenebrionidae des Museums Wiebaden. *Jahrb. nass. Ver. Naturk.* **65**: 232–248.

GEBIEN, H. (1927) Fauna sumatrensis (Beitrag Nr. 31). Tenebrionidae (Col.). *Suppl. Ent.* **15**: 22–58.

KASZAB, Z. (1939) Tenebrioniden aus Neu-Guinea. *Nova Guinea (NS)* **3**: 185–267.

KASZAB, Z. (1975) Ergebnisse der Bhutan-Expedition 1972 des Naturhistorischen Museums in Basel. Coleptera: Fam. Tenebrionidae. *Ent. Basiliensia* **1**: 313–333.

KASZAB, Z. (1977) Tenebrionidae der Nepal-Expeditionen von Dr. J. Martens (1969–1974) (Insecta: Coleoptera). *Senckenbergiana Biol.* **57**(1976): 241–283.

KASZAB, Z. (1979) Faunistik der Tenebrioniden von Sri Lanka (Coleoptera). *Folia ent. hung.* **32**: 43–128.

KASZAB, Z. (1982) Revision der australischen Uloma-Arten (Coleoptera: Tenebrionidae). *Acta zool. hung.* **28**: 233–291.

MASUMOTO, K. & NISHIKAWA, N. (1986) A revisional study of the species of the genus Uloma from Japan, Korea and Taiwan (Tenebrionidae, Coleoptera). *Insecta Matsumurana* **35**: 17–43.

Received March 30, 1996, accepted December 20, 1996

Catalogue of Palaearctic Diptera

edited by Á. SOÓS, L. PAPP and P. OOSTERBROEK

Volume 1

Trichoceridae – Nymphomyiidae

The Catalogue contains the basic taxonomic, nomenclatorial and distribution data of all species occurring in the Palaearctic Region with the fundamental morphological features for the majority of the fly groups.

Contents: Introduction to Volumes 1–13 (Á. SOÓS and L. PAPP). History of the Catalogue of Palaearctic Diptera. Structure. Genera and their type-species. Species names, type-localities. Distribution. Literature data, references. Dates of publication. Readers. Acknowledgements and closing remarks. List of contributors (Vols 1–13). Type-species designations in Volume 1. New names proposed in Volume 1. Families: Trichoceridae (C. DAHL). Tanyderidae (R. WAGNER). Blephariceridae (P. ZWICK). Deuterophlebiidae (L. JEDLICKA). Tipulidae (P. OOSTERBROEK and BR. THEOWALD). Cylindrotomidae (Á. SOÓS and P. OOSTERBROEK). Limoniidae (E. N. SAVCHENKO, P. OOSTERBROEK and J. STARY). Ptychopteridae (R. ROZKOSNY). Nymphomyiidae (L. JEDLICKA). Bibliography. Index.

April 30, 1992. 520 pages
US$ 80.00 plus US$ 8.00 for package and postage
(and an extra US$ 5.00 if you want it air mail)
ISBN 963 7093 10 9

Order should be sent
to the Hungarian Natural History Museum, Library
Baross u. 13., Budapest, H–1088 Hungary
Fax: (36–1) 1171669

Acta Zoologica Academiae Scientiarum Hungaricae 42 (2), pp. 127–132, 1996

NEW SPECIES OF DIPLOSMITTIA SÆTHER, 1981 FROM COSTA RICA (CHIRONOMIDAE, ORTHOCLADIINAE)

T. ANDERSEN

Museum of Zoology, Bergen Museum, Muséplass 3, N–5007 Bergen, Norway

Diplosmittia beluina sp. n. and *D. forficata* sp. n. are described as male imago based on specimens collected at La Selva Biological Station in Costa Rica. The genus *Diplosmittia* SÆTHER, 1981, described from the British West Indies, now includes five species from North, Central and South America. A key to the species is given.

Key words: Chironomidae, Orthocladiinae, *Diplosmittia*, new species, Costa Rica

The genus *Diplosmittia* was described by SÆTHER (1981) based on a species from the British West Indies. SÆTHER (1985, 1988) described two additional species belonging to the genus. The genus thus comprises *D. harrisoni* SÆTHER, 1981 from St. Lucia and St. Vincent, *D. carinata* SÆTHER, 1985 from Michigan, U.S.A. and *D. recisus* SÆTHER, 1988 from Peru. During a course in tropical entomology in Costa Rica, males of two new *Diplosmittia* species were collected, and are described and figured below. The immatures of *Diplosmittia* are unknown, but are presumed to be riparian (HUDSON 1987).

METHODS AND MORPHOLOGY

The material examined was mounted on slides following the procedure outlined by SÆTHER (1969). The general terminology follows SÆTHER (1980). The types of *Diplosmittia beluina* sp. n. and *D. forficata* sp. n. are deposited in the Museum of Zoology, Bergen (ZMBN).

SYSTEMATIC PART

Diplosmittia SÆTHER, 1981

Gonocoxite with weak or without inferior volsella. Gonostylus divided to base or occasionally fused in basal half, lobe with megaseta with small to large rounded crista dorsalis or without crista dorsalis. Otherwise as in SÆTHER (1981: 29, 1988: 45).

Diplosmittia beluina sp. n.

(Figs 1–4)

Holotype: male, Costa Rica: Heredia Province, La Selva Biological Station, 10°26'N, 83°59'W, Malaise trap, 2. IV. 1993, leg. OLE A. SÆTHER (ZMBN No.: 245).

Diagnostic characters: see key.

Etymology: From the Latin *beluinus*, brutal, bestial, referring to the fist-shaped gonostylus.

Description. Male imago (holotype). – Total length 1.35 mm. Wing length 0.82 mm. Total length/wing length 1.64. Wing length/length of profemur 1.56. Coloration brownish; thorax with scutum, median anepisternum, and preepisternum darker brown. Tarsi of all legs light brown.

Head. Antennae with 10 flagellomeres, ultimate flagellomere 216 µm long. AR 0.62. Postorbitals absent, outer verticals 2, inner verticals 3. Clypeus with 6 setae. Cibarial pump, tentorium and stipes as in Fig. 1; tentorium 62 µm long, 11 µm wide; stipes 44 µm long. Palp segments 1–4 lengths in µm: 18, 17, 25, 34; segment 5 not measurable. Third palpal segment with 3 sensilla clavata subapically, 13 µm long.

Thorax (Fig. 2). Antepronotum with 1 lateral seta. Dorsocentrals 5; acrostichals 2 very weak in lighter, median field; prealars 3. Scutellum with 2 setae.

Wing (Fig. 3). VR 1.45. R_{2+3} ending 3/4 of distance between R_1 and R_{4+5}. Costal extension 104 µm long; weak, false vein reaching wing tip. Brachiolum with 1 setae.

Legs. Spur of front tibia 22 µm long, spurs of middle tibia 12 µm and 10 µm of hind tibia 29 µm and 12 µm long. Width at apex of front tibia 21 µm, of middle tibia 19 µm, of hind tibia 22 µm. Hind tibial comb with 8 setae; shortest setae 12 µm long, longest setae 19 µm long. Lengths (in µm) and proportion of legs:

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
p_1	256	344	123	74	51	27	25	0.35	4.08	4.87	2.5
p_2	336	356	133	72	47	27	23	0.37	4.88	5.20	3.8
p_3	280	316	144	80	82	25	23	0.45	3.52	4.13	3.7

Hypopygium (Fig. 4). Anal point with 5 lateral and basal setae on crested point, laterosternite IX with 2 setae. Phallapodeme 55 µm long, transverse sternapodeme 44 µm long. Virga 44 µm long. Gonocoxite 87 µm long, with weak inferior volsella. Gonostylus 46 µm long, with basal lobe 48 µm long; megaseta 9 µm long. HR 1.90, HV 2.93.

Diplosmittia forficata sp. n.

(Figs 5–9)

Holotype: male, Costa Rica: Heredia Province, La Selva Biological Station, 10°26'N, 83°59'W, Malaise trap, 16. IV. 1993, leg. OLE A. SÆTHER (ZMBN No.: 246).

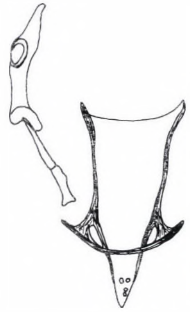
Diagnostic characters: see key.

Etymology: From the Latin *forficatus*, scissors-shaped, forked, referring to the shape of the gonostylus.

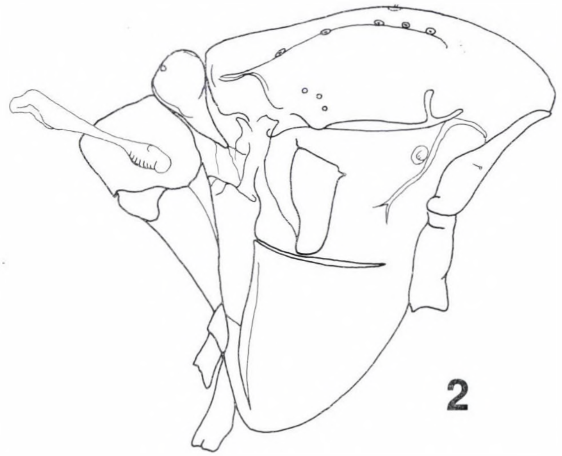
Description: Male imago (holotype). – Total length 1.36 mm. Wing length 0.81 mm. Total length/wing length 1.67. Wing length/length of profemur 1.52. Coloration light brown.

Head (Fig. 5). Antennae with 10 flagellomeres, ultimate flagellomere 244 µm long. AR 0.77. Postorbitals absent, outer verticals 2, inner verticals 3. Clypeus with 8 setae. Tentorium and stipes

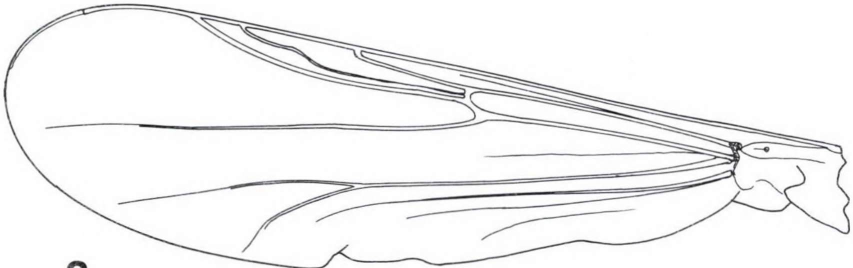
Figs 1–4. *Diplosmittia beluina* sp. n., holotype, male, imago: 1 = cibarial pump, tentorium and stipes; 2 = thorax; 3 = wing; 4 = hypopygium, dorsal view left, ventral view right



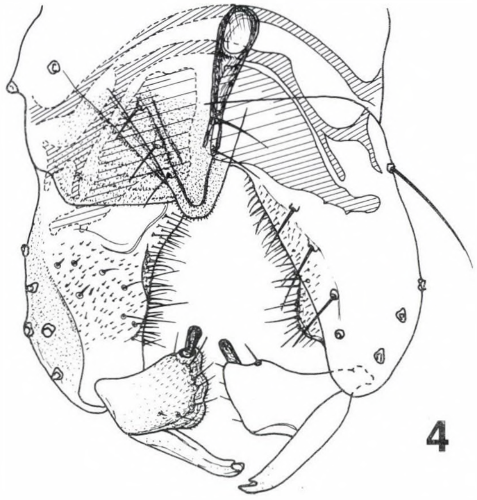
1



2

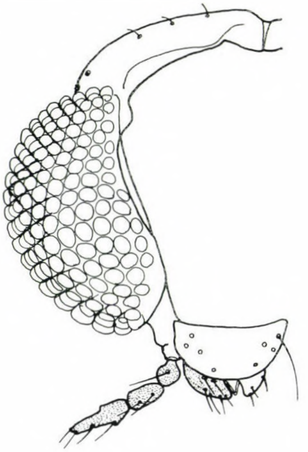


3

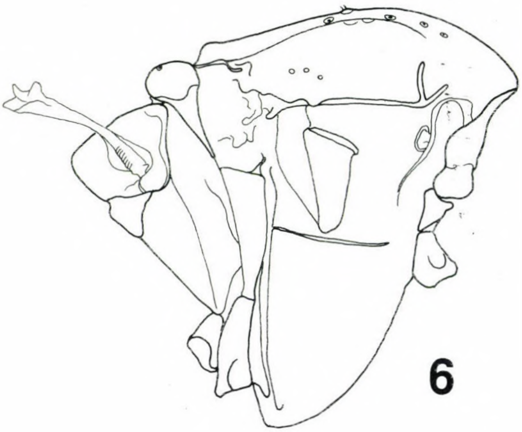


4

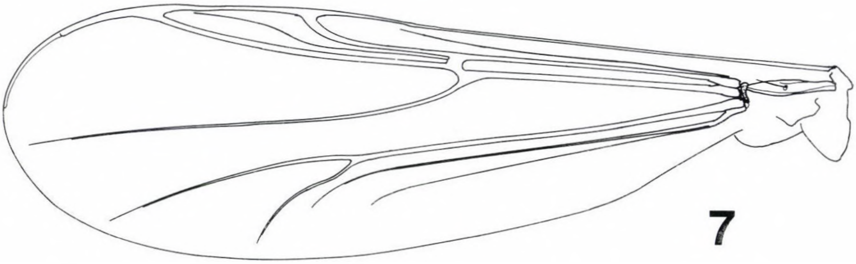
Figs 5–9. *Diplosmittia forficata* sp. n., holotype, male, imago: 5 = head; 6 = thorax; 7 = wing; 8 = tentorium and stipes; 9 = hypopygium, dorsal view left, ventral view right



5

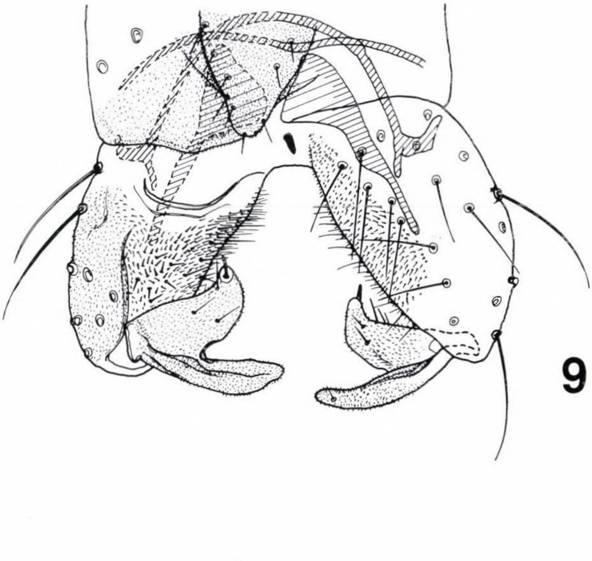


6



7

8



9

as in Fig. 8; tentorium 86 µm long, 12 µm wide; stipes 62 µm long. Palp apparently 4-segmented; segment lengths in µm: 10, 17, 26, 43. Third palpal segment with 2 sensilla clavata centrally on ventral side, 11 µm long.

Thorax (Fig. 6). Antepronotum without seta. Dorsocentrals 4; acrostichals 2 in lighter, median field; prealars 3. Scutellum with 2 setae.

Wing (Fig. 7). VR 1.40. R_{2+3} ends 3/4 of distance between R_1 and R_{4+5}. Costal extension 98 µm long, false vein reaching wing tip. Brachiolum with 1 setae.

Legs. Spur of front tibia 29 µm long, spurs of middle tibia 14 µm and 8 µm long, of hind tibia 35 µm and 22 µm. Width at apex of front tibia 18 µm, of middle tibia 18 µm, of hind tibia 28 µm. Hind tibial comb of 9 setae; shortest setae 14 µm long, longest setae 19 µm long. Lengths (in µm) and proportion of legs:

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
p_1	260	336	148	109	90	41	29	0.44	2.76	4.02	3.8
p_2	328	348	129	74	49	29	25	0.37	4.54	5.24	4.0
p_3	284	320	150	80	88	33	25	0.46	3.33	4.02	4.9

Hypopygium (Fig. 9). Anal point with 10 setae, laterosternite IX with 2 setae. Phallapodeme 70 µm long, transverse sternapodeme 47 µm long. Virga 6 µm long. Gonocoxite 88 µm long. Gonostylus with lobes split 29 µm from base; lobe with megaseta 40 µm long, basal lobe 54 µm long, megaseta 10 µm long. HR 2.20, HV 3.40.

DISCUSSION

According to SÆTHER (1981), *Diplosmittia* is closely related to *Pseudosmittia* GOETGHEBUER, 1932, but is characterized by having the gonostylus deeply divided. In the related genus *Lobosmittia* SÆTHER & ANDERSEN, 1993 the gonostylus has a basal or subapical lobe, but is never deeply split.

One of the new species, *D. forficata* sp. n., is tentatively placed in *Diplosmittia*. It appears to have a four-segmented palp, resulting from segment four and five being fused, but more material is needed to ensure that a fifth palp segment is not broken off. Among related genera a short, four-segmented palp is elsewhere only found in *Colosmittia* ANDERSEN & SÆTHER, 1994. Furthermore, *D. forficata* sp. n. is the only *Diplosmittia* species which has the two lobes of the gonostylus partly fused and it has a comparatively short virga. The tarsomeres of the front leg are also longer than in the other species; the ratio "Beinverhältnisse" (BV) is 2.76 in *D. forficata* sp. n. compared to a BV between 3.75 and 4.75 in the other species.

Key to male imagines of *Diplosmittia* SÆTHER

1 Antennae with 13 segments, costa not or barely extended 2

– Antennae with 9 or 10 segments, costal extension present 3

2 Anal point crested, AR 0.80; Michigan *D. carinata* SÆTHER

– Anal point without crest, AR 0.56; St. Lucia and St. Vincent *D. harrisoni* SÆTHER

3 Antennae with 9 segments; gonostylus with large, rounded crista dorsalis; Peru *D. recisus* SÆTHER

– Antennae with 10 segments; gonostylus without or with small, rounded crista dorsalis 4

4 Gonostylus lacking crista dorsalis (Fig. 4), AR 0.62; Costa Rica *D. beluina* sp. n.

– Gonostylus with small, rounded crista dorsalis (Fig. 9); AR 0.77; Costa Rica *D. forficata* sp. n.

Acknowledgements. – The expedition to Costa Rica was funded by The Research Council of Norway (NFR), and the University of Bergen. I am indebted to Professor OLE A. SÆTHER, University of Bergen, for valuable advise and discussions. Thanks are also due to Dr. DAN JANZEN, University of Pennsylvania, Philadelphia, U.S.A. and the staff at INBIO, Heredia, Costa Rica, for their cooperation and support. GLADYS RAMIREZ made the slide preparation.

REFERENCES

HUDSON, P. L. (1987) Unusual larval habitats and life history of Chironomid (Diptera) genera. *In* SÆTHER, O. A. (ed.) A conspectus of contemporary studies in Chironomidae (Diptera). *Ent. scand., Suppl.* **29**: 369–373.

SÆTHER, O. A. (1969) Some Nearctic Podonominae, Diamesinae, and Orthocladiinae (Diptera: Chironomidae). *Bull. Fish. Res. Bd Can.* **107:** 1–154.

SÆTHER, O. A. (1980) Glossary of chironomid morphology terminology (Diptera: Chironomidae). *Ent. scand., Suppl.* **14:** 1–51.

SÆTHER, O. A. (1981) Orthocladiinae (Diptera: Chironomidae) from the British West Indies, with descriptions of Antillocladius n. gen., Lipurometriocnemus n. gen., Compterosmittia n. gen. and Diplosmittia n. gen. *Ent. scand., Suppl.* **16:** 1–46.

SÆTHER, O. A. (1985) Diplosmittia carinata spec. nov. from Michigan (Diptera, Chironomidae). *Spixiana, Suppl.* **11:** 55–57.

SÆTHER, O. A. (1988) Diplosmittia recisus spec. nov. from Peru (Diptera, Chironomidae). *Spixiana, Suppl.* **14:** 45–47.

Received June 28, 1996, accepted December 20, 1996

Acta Zoologica Academiae Scientiarum Hungaricae 42 (2), pp. 133–144, 1996

NEW DATA ON THE SUBFAMILY CLEPTINAE (HYMENOPTERA: CHRYSIDIDAE)

L. MÓCZÁR

H–1114 Budapest, Szabolcska M. u. 1, Hungary

Two species are described from Mexico: *Cleptidea flavisterna* ♀ and *C. mexicana* ♂. *Lustrina* KURIAN is revalidated from synonymy as a valid genus. New synonyms of *Mesitius neotropicus* BRUES and *Cleptidea propodealis* KIMSEY are established. Lectotype is designated in *C. fasciata.* The key for the 19 *Cleptidea* species is amended. New taxonomic and distributional data, and information concerning the variability are presented. New data of the type materials are given and some data are corrected in the preceding literature.

Key words: taxonomy, distribution of genera *Lustrina* and *Cleptidea*, Hymenoptera, Chrysididae

INTRODUCTION

The specimens of this subfamily are generally rare and represented very infrequently in museums in the Nearctic Region. The first species was described by DALMAN (1823). DUCKE (1902*a*, 1902*b*, 1904, 1905 and 1906) published three new species and for the first time a key. The revision of *Cleptidea* was published by KIMSEY (1981, 1986*a*) with 8 new species and a key. KIMSEY divided the genus into six species groups. KIMSEY and BOHART (1991) listed the publication date and the locations of the type material, the synonyms and the distribution of the 18 known species of *Cleptidea* of the World in their fundamental work. An updated key of KIMSEY was given by MÓCZÁR (1996) with a new species. It is completed presently with two new species: *Cleptidea flavisterna* ♀ and *C. mexicana* ♂ both from Mexico. *Lustrina* KURIAN with genotype *L. assamensis* KURIAN is revalidated as a good genus. New synonyms are established: *Mesitius neotropicus* BRUES = identical with *C. dubuyssoni* (DUCKE), *C. propodealis* KIMSEY = identical with *C. fasciata* (DALMAN). A lectotype is designated for *C. fasciata.* New taxonomic, distributional data, and information are presented concerning the variability of *C. fasciata* (DALMAN), *C. mutilloides* (DUCKE), *C. nigrocincta* (KIEFFER), *C. panamensis* KIMSEY and *C. xanthomelas* (MOCSÁRY). New detailed data of the type materials are given, to clarify the status of the holotypes and lectotypes, and some data of the earlier literature are corrected.

Acronyms of museums, universities, institutions: AEI – The American Entomological Institute, Gainesville, USA; BMNH – The Natural History Museum (formerly British Museum Natural History), London, Great Britain; CNC – Agriculture and Agri-Food (formerly Canadian

National Collection), Research Branch, Ottawa, Canada; FRI – Forest Research Institute, Dehra Dun, India; HNHM – Department of Zoology, Hungarian National History Museum, Budapest, Hungary; MCZ – Museum of Comparative Zoology, Harvard University, Cambridge, USA; MNHN – Museum National d'Histoire Naturelle, Paris, France; NMW – Naturhistorisches Museum, Zoologische Abteilung, Wien, Austria; NRS – Naturhistoriska Riksmuseet, Stockholm, Sweden; UCD – Bohart Museum of Entomology, University of California, Davis, USA; USNM – National Museum of Natural History (formerly United States National Museum), Smithsonian Institution, Washington, D. C., USA; ZMB – Museum für Naturkunde der Humboldt Universität (formerly Zoologisches Museum), Berlin, Deutschland.

Symbols: F-I (-II-III) = flagellomere I (and II, III); MS = malar space; MOD = middle ocellus diameter; POL = postocellar line; OOL = ocular-ocellar line; Ped = pedicellus, PD = puncture diameter; T-I etc. tergum or tergite (T-I the first segment etc.).

Subfamily Cleptinae

Cleptinae: KIMSEY and BOHART 1991: 52 ♀ ♂

The main differences of the related genera:

1 Claws with one perpendicular submedial tooth. Head as wide as long or longer. Pronotum with or without groove along mid-line *Cleptes* LATREILLE

– Claws bifid, with single, large, subparallel subsidiary tooth 2

2 Head length somewhat more than half the width. Pronotum without a median longitudinal line *Lustrina* KURIAN

– Head wider than long. Pronotum with deep groove along mid-line *Cleptidea* MOCSÁRY

Lustrina KURIAN

Lustrina KURIAN, 1955: 86; KIMSEY and BOHART 1991: 53 (syn. of *Cleptes*)

Lustrina assamensis KURIAN, 1955

Lustrina assamensis KURIAN, 1955: 87 ♀ Figs 76–80. Holotype ♀; India: Murphulani T. E. Assam, 1–12–1920 (Dehra Dun) (FRI) ?
Lustrina assamensis: NAGY 1968: 168 ♀ Fig. 1 (Examin. of holotype)
Cleptes assamensis (KURIAN): KIMSEY and BOHART 1991: 53, 59 (Coll. Dehra Dun ?)

NAGY (1968) furnished a drawing of the holotype, studied KURIAN's two slides, and after his thorough examination considered it to be a well-defined independent genus. It is necessary to consider also its geographical position.

Albeit Dr. S. SINGH kindly sent KURIAN's large publication to me, he could not find the type species. The search for the other KURIAN types by KROMBEIN (1996:2) was also unsuccessful.

On the other hand I recommend that this strange species be separated from the related *Cleptidea* species by using the 1–11 couplets of the *Cleptidea* key (p.141) and the main characteristics as follows: "Head brown with a violet lustre...; clypeus, mandible..., antennae dark reddish brown. Thorax brown, with reddish metallic blue in some places and green elsewhere; ...tergites with a variety of lustre; first is mostly green; second violet, third blue, green and violet, with a golden-yellow band anteriorly, fourth basally yellowish brown, apically black; ...Eyes bare; pronotum without a median longitudinal impression; ...propodeum laterally ends in two teeth... directed posteriorly..." (According to KURIAN).

Distribution. India, Assam (KURIAN 1955).

Cleptidea MOCSÁRY

Cleptidea MOCSÁRY, 1904: 567. Type: *Cleptes aurora* F. SMITH, 1874: 452

Cleptidea aurora (F. SMITH, 1874)

Cleptes aurora F. SMITH, 1874: 452 ♀. Lectotype ♀ desig. KIMSEY 1986*b*: 106; Brazil: Teffe (Ega) (BMNH).

Cleptidea aurora: MOCSÁRY, 1904: 567 ♀ ♂; DUCKE 1906: 8, ♀ ♂; KIMSEY 1981: 803, ♀ ♂, Figs 1, 3, 5, 7, 9.

Material examined: 2 ♂. Brazil: Estado do Pará: Faro II, 1♂ and Obidos XII (DUCKE), 1 ♂ (HNHM).

Addition to SMITH's diagnosis: T-II-IV with gradually denser and deeper punctures.

Distribution. Northern part of South America (KIMSEY and BOHART 1991).

Cleptidea dubuyssoni (DUCKE)

Cleptes aurora var. *buyssoni* DUCKE, 1904: 29 ♂. Holotype ♂; Brazil: Oyapok (MNHN).

Cleptes buyssoni DUCKE, 1905: 100 ♀ ♂

Cleptes dubuyssoni DUCKE, 1913: 12
Cleptidea dubuyssoni: KIMSEY 1986*a*: 317
Mesitius neotropicus BRUES, 1914: 119 ♂. Holotype ♂. Guyana: Bartica (MCZ). New synonymy.
Cleptidea neotropica (BRUES): KIMSEY and BOHART 1991: 69 ♂

Material examined: 2 ♀, 2 ♂. Brazil: Brasilia (no more data), 1 ♂ (HNHM). Venezuela: Aragua Maracay, El Limón Pozo del Diablo, I 1996 (M. SHARKEY), 1 ♀ (HNHM); Carabobo Canoabo VIII 1992, coffee plant 1000 m (L. MASNER), 1 ♀ (CNC). Guyana: "Br. Guiana Feb. 3. Am", "M. C. Z. holotype 28775", "Mesitius neotropica Brues Type", 1 ♂ (MCZ).

The original diagnosis of *neotropicus* corresponds to the holotype and it is identical with *dubuyssoni* both in color and in sculpture. Consequently I consider *neotropicus* to be a synonym.

Distribution. Brazil, Surinam (KIMSEY 1986*a*), Guyana and Venezuela.

Cleptidea fasciata (DALMAN)

Cleptes fasciata DALMAN, 1823: 90, 2 ♀. Lectotype ♀ (designated herein); Brasilia (NRS).
Cleptes fasciata: DAHLBOM 1854: 11–12 ♀ Tab. I. 1.
Cleptidea fasciata: KIMSEY 1981: 802, 805 ♀ ♂; 1986*a*: 316; KIMSEY and BOHART 1991: 67–69 Fig. 13 ♀; MÓCZÁR 1996: 154.
Cleptidea propodealis KIMSEY, 1986*a*: 316, 322 1 ♀ Fig. 5 (not 10). Holotype ♀; Brazil: Santa Catarina, Nova Teutonia (UCD). New synonymy.
Cleptidea propodealis: MÓCZÁR 1996: 154, 156, 157 ♀♂ Figs 10–12, 21–22.

Material examined: 8 ♀ 4 ♂. Brasil: Lectotype: "Brasilá Freyreiss" (handwriting), "Schh" (according to DAHLBOM, SCHÖNHERR), 1 ♀ (NRS). Paralectotype: "Brasil", "Schh", 1 ♀ (HNHM, Budapest Hym. Typ. No. 3852); Nova Teutonia 300–500 m XII (Fr. PLAUMANN), *Cleptidea fasciata* (DALMAN) det. L. S. KIMSEY, 1 ♀ (CNC); same locality XI, 2 ♂ (NMW); same locality and collector 3 ♀, 2 ♂ (HNHM) and 2 ♀ (USNM) (MÓCZÁR 1996).

According to DALMAN's diagnosis: "Logit. lin. 3 vel 4", I designate the first female as lectotype. The second female also with "Schh" label is designated the paralectotype, which is preserved in Budapest. Both of them correspond to the original description. DAHLBOM examined also two specimens from Stockholm and from Berlin. The latter female (Brasil: Virmond) proved to belong to *C. xanthomelas* (MOCSÁRY). Both DAHLBOM's detailed description and KIMSEY (1981) agree with the type material, except KIMSEY's data: 1981: 805, 1986*a*: 316 and Fig. 13, as well as KIMSEY and BOHART (1991: 65), which is only in part equivalent to the lectotype.

Comparing the listed specimens the colours are variable. Thorax entirely yellowish or orange, paler in old specimens, except metanotum, propodeum and legs with brown last tarsomeres. Metanotum dark reddish brown with blackish deepening on both sides (in lecto- and paralectotypes), metanotum nearly entirely red (in 1 ♀ det. KIMSEY), only in front partly red (in 3 ♀, 1 ♂) or entirely black (in 2 ♀, 3 ♂). Propoedum largely yellowish and vertically whitish, except black central area; inner sides of hollows bilaterally black; a small spot brown on propodeum laterally above midcoxae (in lectotype). With same colour, but a spot before base of propodeal spine and a large brownish black spot above midcoxae (in paralectotype). Propodeum entirely black in remaining females and males, except the spines always white, and also black with more or less yellowish spot round base of spine. Antennomeres also orange or partly brownish or blackish to a different degree. The comparison of the proportions shows no essential differences. (The numbers were obtained by dividing the length of the morphological part by its width.)

	Ped	F-I	F-II	MS : MOD
fasciata ♀ lectotype	2.3	3	1.1	1.5
fasciata ♀ det. KIMSEY	2.0	3.1	1.1	1.2
fasciata ♀ (KIMSEY 1981)	–	3	longer than wide	about 1
propodealis ♀ (KIMSEY 1986*a*)	2.3	2.7	as long as wide	1.0
fasciata ♂ (KIMSEY 1981)	2.0	slightly more than 3	about 1.5	-
propodealis ♂ (MÓCZÁR 1996)	1.9	2.7	1.3	1.5 (not 0.7)

These small differences concerning the colour and proportions establish only the variability of one species, and they are not sufficient to distinguish two species. I believe *C. propodealis* KIMSEY, 1986*a* should be regarded as a synonym.

Further additions to the description of the lectotype:

Length 9.3 mm. Mandible black only basally. Body with long white hairs especially on ventral side; pronotum and mesonotum also with brownish hairs. Mandibles with two normal and a minute third teeth. Posterior margins of hind ocelli connected with a distinct sulcus. Lateral margins of head very strongly convergent behind eyes. Metanotal projection low, its top faintly impressed medially, much wider than high also in lateral view, posterior fovea deep, slightly elliptic horizontally. T-III sparsely and double punctured. Male (MÓCZÁR 1996): same as female, but metanotum and propodeum black; spines shorter. Metanotal projection rounded on top. Male genitalia, Figs 21, 22, etc. as in *propodealis* (MÓCZÁR 1996: 157–158).

Distribution. Brazil (DALMAN 1823). Panama, Peru, Argentina (KIMSEY 1981).

Cleptidea flavisterna sp. n.

Holotype ♀ : "Mex. Sin. 15 mi. W El Palmito, 5000' 25 July 1964. W. R. M. Mason" (CNC).

Length ♀ 7 mm. Head, pronotal disc medially, mesonotum, scutellum and postscutellum largely with bright green highlights, gena partly, rest of pronotum, especially mesonotum and scutellum with violet reflection. Propleuron, collar, both sides of metanotum, disc, posterior face of propodeum, petiolar insertion and a narrow line before hind coxae, brownish black. Mandibles largely, lateral margin of pronotum, 2 large hollows in front laterally of metanotum yellowish white. Tegula, mesopleuron, side of propodeum and thorax ventrally orange. Last 3 tarsomeres above yellowish brown. Pterostigma, veins brown, nervulus interstitial. Body with long white hairs.

Facial punctation deep, dense and separated by 0–0.5 PD apart. Frontal sulcus distinct, reaching fore ocellus, narrow sulcus connecting small pits outside of hind ocelli. Ocelli in an acute angle, POL : OOL = 7:14. Ped 2.2 times as long as wide, F-I length 2.0 times width, F-II 0.9 times width. MS 0.6 MOD long. Sides of clypeus convergent to apex. Pronotum with deep, coarse punctures 0.5–1.0 PD apart, surface uneven, with large, deep row of pits anteriorly and posteriorly. Mesonotum, postscutellum moderately convex, smooth, shining with only a few smaller punctures laterally. Posterior fovea 8.5 times as wide medially as long. Lateral margin of propodeum hardly convex medially, propodeal teeth 2.8 times as long as wide medially. T-I smooth, shining and nearly impunctate, T-II with dense small punctures, T-III-IV with small double punctures. Hindcoxa with very small tooth basally.

♂. Unknown.

Cleptidea magnifica (DUCKE)

Cleptes magnificus DUCKE, 1905: 99, 102 ♂. Holotype ♂; Brazil: Oyapok (MNHN).
Cleptidea magnifica (DUCKE): KIMSEY 1981: 805 ♂♀ Fig. 11.

Material examined: 1♂. Guyana: Bas Maroni, Charvein IX (Moult), 1♂ (HNHM).

Distribution. Brazil (DUCKE 1905). First record for Guyana.

Cleptidea mexicana sp. n.

Holotype ♂: Mexico: "Mex. Sin. 15 mi. W. El Palmito, 5000' 4 Aug. 1964. W. R. M. Mason" (CNC).

Length of ♂ 6.5 mm. Head, prothorax, mesothorax, scutellum, postscutellum and central area of propodeum purple with greenish blue reflection. Clypeus, base of mandible, antenna, propodeal teeth and last four tarsomeres brown; rest of propodeum, lower part of mesopleuron bluish black. Tegula, fore and middle legs light yellowish brown, hind legs more brownish. Abdominal segment I, except dark brownish-black posterior streak and blackish petiolar insertion and large lateral spots of segment II yellowish brown; rest of segment II, and segments III-V black. Pterostigma pale brown, veins largely brown, nervulus interstitial. Body with long white, partly with pale brownish hairs.

Facial punctation deep and separated by about 0.5 PD. Frontal sulcus very short, developed only below fore ocellus. A narrow and deep sulcus connecting small pits of hind ocelli. Ocelli in an acute angle, POL : OOL = 6 : 14. Lateral margin of clypeus conspicuously convergent to slightly emarginate apex. Ped 1.3 times as long as wide, F-I length 2.8 times width, F-II 1.9 times width. MS 0.4 MOD long. Pronotal punctures coarse and uneven with small and narrow row of pits along posterior margin. Mesonotum and scutellum with large, deep punctures, separated by 13 PD apart. Postscutellum (metanotum) convex, shining, with only some smaller punctures, posterior fossa about 6 times as wide as long medially. Lateral margin of propodeum conspicuously convex medially, teeth slender, 3.3 times as long as wide medially. T-I with very fine punctures, T-II with very dense and fine punctures, T-III-IV with double punctures. Hindcoxa with distinct tooth basally.

♀. Unknown. Additional specimens of both sexes may indicate that *flavisterna* and *mexicana* belong the same species.

Cleptidea mutilloides (DUCKE)

Cleptes mutilloides DUCKE, 1902a: 91, 2♂. Lectotype ♂ (desig. KIMSEY 1981: 806 not 1986 by KIMSEY and BOHART 1991: 69); Brazil: Pará (MNHN).
Cleptes mutilloides: DUCKE 1902b: 204 ♀.
Cleptidea mutilloides: MOCSÁRY 1904: 569; KIMSEY 1981: 806 ♀♂ Fig. 12; MÓCZÁR 1996: 153–154 ♀♂ Figs 4–6.

Material examined: 1♀ 8♂. Brazil: "Brasil Pará 20.3.1900 Ducke", "Cleptes mutilloides Ducke ♂ typ. det. A. Ducke", "Cleptes mutilloides Ducke det. Mocsáry", "Paralectotypus Cleptidea mutilloides Ducke ♀ (sic!) desig. LSK" (in fact ♂, not ♀), "Cleptidea mutilloides Ducke ♂ det. Móczár 1994", "Hym. Typ. No. 3836 Mus. Budapest", 1 ♂ (HNHM); Brasil Pará 8.3.1902 (Ducke), "Cleptes mutilloides Ducke ♀ type det. A. Ducke" albeit this specimen was labelled as type by DUCKE, it is not "Paralectotypus Cleptes mutilloides Ducke desig. LS Kimsey", because it was published later (1902*b*) not in the original diagnosis, 1 ♀ (HNHM); "Brasil Pará" or "Pará Ducke" labels with III, 3 ♂ with det DUCKE and 2 ♂ without date, partly with det. MOCSÁRY labels, 2 ♂ (HNHM) and (NMW).

Additions to the original description (♀): Length 6.2 mm. Frons with coarse punctures, punctures larger than PD (MÓCZÁR 1996, Fig. 4). Frontal sulcus deep before midocellus. Scutellum with scattered and larger punctures, interspaces polished medially. Metanotal projection short with two fovea posteriorly (1. c. Fig. 5). Posterolateral spine of propodeum white. Postocellar groove connected with a sulcus. Pronotum with deep groove along mid-line and with coarse punctures similar to mesonotum (l. c. Fig. 6).

Distribution. Brazil, North Argentina (KIMSEY and BOHART 1991).

Cleptidea napoana KIMSEY, 1986

Cleptidea napoana KIMSEY, 1986*a*: 318 ♂ ♀. Holotype ♂. Ecuador: Napo, Limoncocha (CNC).

Material examined: 1♀. "Ecuador, Napo, Limoncocha, 250 m 18–28. VI. 1976 S. and J. Peck", 1 ♀ paratype (CNC).

Addition to the description (of paratype): Pronotal disc largely black, only frontal corners with blue reflection behind the hyaline margin; lateral sides yellowish red. Anterior margin of pronotum medially, tip of pronotal lobe and tegula anteriorly, yellowish; pit row red along posterior margin. Central area of propodeal disc yellowish red, propodeal tooth white.

Distribution. Ecuador (KIMSEY 1986*a*).

Cleptidea nigrocincta (KIEFFER, 1911)

Godfrinia nigrocincta KIEFFER, 1911: 207 Fig. 6. Holotype ♂; Mexico: Tabasco, Teapa (BMNH).
Cleptidea nigrocincta: KIMSEY 1986*a*: 319 ♂♀.

Material examined: 1 ♂ 1 ♀. Mexico: Chiapas Muste n(ear) Huixtla IX, XI Mal. trap (WELLING), 1 ♂ 1 ♀ (CNC).

Additions to KIMSEY's description: Vertex with purple reflection behind ocelli and apex of abdomen partly whitish (♂). Simultaneously KIMSEY published *C. janzeni* new species (♂) with the same colour, which reminds one of nigrocincta (B). The following table compares the proportions.

	Ped	F-I	F-II	MS : MOD
nigrocincta ♂ (KIMSEY 1986*a*)	2.4	2.3	1.7	0.7
nigrocincta ♂ det. KIMSEY	1.4	2.7	1.4	0.7
nigrocincta ♀ (KIMSEY 1986*a*)	1.7	2.4	1.3	–
nigrocincta ♀ det. KIMSEY	2.2	2.3	1.1	0.8
janzeni ♂ (KIMSEY 1986*a*)	1.6	2.1	1.2	1.0

It is worth mentioning that substantial inequality is present only between the proportions of the pedicellus. Further difference: "Métapleures et haut des mésopleures ridés longitudinalement" (KIEFFER 1911), and not wrinkled but smooth, shining (♂ det. KIMSEY). One may presume that these differences establish only the variability of the species. The examination of more specimens (♀ ♂), found in the future may solve these problems.

Distribution. Mexico (KIEFFER 1911, KIMSEY 1986*a*).

Cleptidea panamensis KIMSEY, 1986

Cleptidea buyssoni: KIMSEY 1981: 807 Fig. 10, not DUCKE 1904.

Cleptidea panamensis KIMSEY, 1986*a*: 319 ♀♂ Figs 2, 7, 10 (not 4, 9). Holotype ♂; Panama: Canal Zone (UCD).

Cleptidea panamensis: MÓCZÁR 1996: 154.

Material examined: 3 ♀ 3 ♂. Panama: "Canal Zone, Pan Barro Colorado I V 25 1981 RB and LS Kimsey", "Paratypus Cleptidea panamensis ♂ Kimsey", 1 ♂ and with the same data, except the date VII 1 1977 and ♀, 1 ♀ (UCD); Barro Colorado Id. VI 14 1939 (ZETEK), 1 ♂ (HNHM). Venezuela: San Esteban, swept XI 1939 (P. ANDUZE), 1 ♂ and Trinidad: Rio Pan 16 III 1912 (A. BUSCK), 1♀ (USNM). Costa Rica: Puntarenas Manuel Antonio N. P. VIII 1986 (L. MASNER), 1 ♀ (CNC).

The specimens correspond to the original diagnosis and paratypes listed here, except small differences as follows. In all ♀: F-I are 2.4–2.5 times (in specimen Puntarenas 2.6 times) (not 3) as long as wide; vertex nearly black (not dark metallic blue) behind ocelli; mesopleuron entirely reddish exceptionally in Puntarenas ♀; scape, Ped, F-I partly white partly green and/or dark brown (Puntarenas). T-II of all ♂ and ♀ with large whitish spots laterally (not whitish anteriorly), T-III double punctured. The metanotal projection reddish brown, also on paratype in female (not red), brownish black in paratype male, or yellowish red in all above listed male (not purple). Further data to the original description: white marking along inner ocular margins remarkably narrower in ♀ than in ♂. Frons with coarse punctures (Trinidad ♀) length of body (♀ ♂): 6–6.7 mm.

Distribution. Panama, Costa Rica (KIMSEY, 1986*a*). First record for Venezuela and Tridinad.

Cleptidea xanthomelas (MOCSÁRY)

Cleptes xanthomelas MOCSÁRY, 1889: 36, 2 ♀ T.1 Fig. 10. Lectotype (desig. KIMSEY 1981: 806 not 1986*a*) (KIMSEY and BOHART 1991: 707); Brasil: Blumenau (HNHM).
Cleptidea xanthomelas: MOCSÁRY 1904: 569 ♀; KIMSEY 1981: 806 ♀♂ Fig. 13; KIMSEY 1986*a*: 324 (revised distribution); MÓCZÁR 1996: 154, figs 13–15.

Material examined: 4♀. Brazil: "Brasilia" "738/67 = Blumenau", "xanthomelas Mocs. typ. det. Mocsáry", "Holotypus ♀ Cleptes xanthomelas Mocsáry LSK", "Lectotypus Cleptes xanthomelas Mocsáry ♀ det. Móczár 1995", 1 ♀ (Hym. Typ. No. 3837 Mus. Budapest) (HNHM); "Blumenau Brasil, 1855 I. Hetschko", "Cleptes xanthomelas det. Mocsáry", "Type Paratype" (red label), "Paralectotypus Cleptes xanthomelas Mocsáry ♀ det. Móczár 995", (NMW); Nova Teutonia Sta. Catarina 10 1967 (F. PLAUMANN), 1 ♀ (HNHM); Virmond, Cleptes fasciata DALM. sec. DHLB. 1854 det. BISCHOFF, 1 ♀ (ZMB).

According to Fig. 10 of (MOCSÁRY 1889), the colour of mesonotum is "testaceous" (= yellowish orange) in the lectotype. KIMSEY stated in her key (1986*a*: 316): "scutum black", probably on the basis of such a specimen which is similar to the one from Nova Teutonia listed above (MÓCZÁR 1996, Fig. 14). This (♀) is identical with the lectotype in sculpture and in colour, except for the black scutum and the small differences given in the key. I regard these specimens with black scutum as a variety of *xanthomelas.*

Distribution. Brazil (MOCSÁRY, 1889).

THE REVISED KEY OF CLEPTIDEA

Summarizing the preceding data establishes that the following corrections are needed in the previous key of world species (MÓCZÁR 1996). The original couplets 1–12 remain unchanged except that the number 16 should be changed to 15 in the key.

13 Fore wings with two brown bands subbasally and sublaterally. Propodeum partly or nearly entirely black, except lateral spines white and digitate. T-II-III black with basolateral whitish spots. Both sides of T-III with scattered and remarkably deeper and larger punctures than basally or punctures on T-II. Metanotal projection low, reddish or entirely black

fasciata (DALMAN)

– Fore wings with one subapical brown band. Propoedum orange. T-III black, without lateral spot 14

14 (the preceding key couplet 14 should be omitted and the preceding couplet 15 remains unchanged with *xanthomelas* (MOCSÁRY) and *xantha* KIMSEY

15 (in the preceding key couplets 16–18 should be changed to 15–19 as follows): Wings unbanded, evenly slightly brown tinted. Abdomen entirely orange or only segment I except a dark brown streak before posterior margin and segment II laterally light brown. Scape, Ped brown. Thorax with metallic highlights at least dorsally 16

– Wings partly unstained or with yellow or brown band(s). Abdomen partly white, yellow, orange, black, brown and in some species with light spots. Scape, Ped red. Thorax largely reddish orange also dorsally 17

16 F-I-III white. Head, thorax dorsally metallic green, partly with violet reflection. Thorax laterally and ventrally nearly entirely and legs orange. Abdomen entirely orange. Propodeal disc largely and posterior face dark brownish black, lateral teeth white. 7 mm *flavisterna* sp. n. ♀

– All flagellomeres brown. Head, thorax nearly entirely with purple highlights with greenish blue reflections. Abdominal segment II medially, III-V entirely brown to black. Propodeum entirely black-dark brownish black including lateral teeth. 6.5 mm *mexicana* sp. n. ♂

17 Abdominal segment I and basal half of II white, legs dark brownish black. Metanotal projection wider than high in lateral view. MS 0.7–1.0 MOD long 18

– Abdomen without white, at most yellow, red or black, legs red. Metanotal projection longer than high. MS 1.2–1.1 MOD long 19

18 Pronotum, mesonotum, scutellum, metanotum, thorax laterally and ventrally red (♂); propodeum black, except white lateral teeth, or red to brownish black posteriorly (♀). Mandible, F-I-II (-III) red and venter of first several flagellomeres red, rest of flagellum black. Legs largely dark brown (♂) or reddish brown (♀). Head with metallic blue (♂) or golden green (♀) highlights. Wings with basal und subapical brown bands. Metanotal posterior fovea 6 (♂) or 8 (♀) times as wide as long. Posterior part of segment II and rest of abdomen brownish black, except for large whitish spot laterally

on segment III (♂) or segment III medially and IV entirely brownish orange (♀). 58 mm *nigrocincta* (KIEFFER)

– Thorax yellow, except propleuron, sternum, mesopleuron ventrally and propodeum black, only lateral teeth pale. F-I-III blackish. Flagellomeres, legs dark brown. Head dark metallic blue. Wings brown stained except for unstained medial band. Posterior fovea about 8 times as wide as long. Apical half of segment II brown, segment III brown with small whitish lateral spot, IV-V brown becoming yellower on the V. 4 mm *janzeni* KIMSEY ♂

19 Segment I and anterior half of II red, rest black. Thorax with propodeum red; tegula, prosternum black. F-I-III red. Forewing with faint yellow medial band. Head black with metallic green highlights. Metanotal fovea 4 (♀) or 2.5–3 (♂) times as wide as long. ♀ 7.5, ♂ 5.5 mm *viridiceps* (KIEFFER)

– Segment I and II anteriorly yellow, posteriorly blackish brown, III-IV orange, only III brown laterally. Thorax, propodeum red, except posterior face of propodeum dark brown. F-I and F-II reddish. Wings with 2 brown bands. Head black with green and brassy highlights. Metanotal fovea 6 times as wide as long. 5 mm *balboana* KIMSEY ♀

* * *

Acknowledgements. – My sincere thanks are extended for the loan of types, type material and unidentified material to curators and technical staff of the museums and institutes listed follows: Dr. K. V. KROMBEIN (USNM), Dr. J. PAPP (HNHM), Dr. L. MASNER and Mr. J. HUBER (CNC), Dr. L. S. KIMSEY and Mr. L. A. BAPTISTE (UCD), Dr. M. FISCHER and Mr. St. SCHÖDL (NMW), Dr. B. GUSTAFSSON (NRS), Dr. F. KOCH and Miss KLEINE-MÖLLHOF (ZMB) and Mr. M. S. KELLEY (MCZ).

REFERENCES

BRUES, Ch. T. (1914) The bethylid genus Mesitius in South America. *Ent. News* **25**: 119–120.

DAHLBOM, A. G. (1854) Hymenoptera Europea praecipue borealia etc. *Berolini Lund* **2**: XXIII+412 pp. Tab I-XII.

DALMAN, J. W. (1823) *Analecta entomologica*. Holmiae, Lindhianis 104 pp.

DUCKE, A. (1902*a*) Eine neue südamerikanische Cleptes-Art. *Z. syst. Hymenopt. Dipterol.* **2**: 91–93.

DUCKE, A. (1902*b*) Neue Goldwespen von Pará. *Z. syst. Hymenopt. Dipterol.* **2**: 204–207.

DUCKE, A. (1904) Revisione dei Crisididi dello stato Brasiliano del Pará. *Bull. Soc. ent. ital.* **36**: 13–48.

DUCKE, A. (1905) Supplemento alla revisione dei Crisididi dello stato brasiliano del Pará. *Bull. Soc. ent. ital.* **36**: 99–102.

DUCKE, A. (1906) Secondo supplemento alla revisione dei Crisididi dello stato brasiliano del Pará. *Bull. Soc. ent. ital.* **38**: 3–19.

DUCKE, A. (1913) As Chrysididas do Brazil. *In Cat. faun. brasil.* **4**: 1–31.

KIEFFER, J. J. (1910–1911) Nouveaux Bethylides et Dryinides exotiques du British Museum de Londres. *Annls Soc. scient. Brux.* **35**: 200–233.

KIMSEY, L. S. (1981) The Cleptinae of the Western Hemisphere. *Proc. biol. Soc. Wash.* **94**: 808–818.

KIMSEY, L. S. (1986*a*) Cleptidea revisited. *J. Kansas Ent. Soc.* **59**: 314–324.

KIMSEY, L. S. (1986*b*) Designation of Chrysidid Lectotypes. *Pan-Pac. Ent.* **62**: 105–110.

KIMSEY, L. S. and BOHART, R. M. (1990–1991) *The Chrysidid Wasps of the World.* Subfamily Cleptinae. Oxford Univ. Press. pp. 52–70.

KROMBEIN, K. V. (1996) Biosystematic Studies of Ceylonese Wasps, XXI: A Revision of the Bethylinae and Epyrinae. *Smithson. Contr. Zool.* **579**: 1–29.

KURIAN, CH. (1955) Bethyloidea from India. *Agra Univ. J. Res.* **4**(1): 67–155.

MOCSÁRY, A. (1989) Cleptinae. *In Monographia Chrysididarum orbis terrarum universi.* Budapest, Acad. Sci., pp. 35–60, Plate 1.

MOCSÁRY, A. (1904) Observatio de Clepte aurora Smith. *Annls Mus. Nat. Hung.* **2**: 567–569.

MÓCZÁR, L. (1996) Additions to American Cleptinae. *Ent. Soc. Wash. Memoir* **17**: 143–150.

NAGY, C. G. (1968) A New Record of Mesitinae. *Mem. Soc. ent. ital.* **47**: 168–176.

SMITH, F. (1874) A revision of the hymenopterous genera Cleptes, Parnopes, Anthracias, Pyria and Stilbum etc. *Trans. ent. Soc., London* **1874**: 451–471.

Received June 13, 1996, accepted December 20, 1996

Acta Zoologica Academiae Scientiarium Hungaricae 42(2), pp. 145–155, 1996

REDESCRIPTION OF NITOKRA DIVARICATA CHAPPUIS, 1923 (COPEPODA, HARPACTICOIDA) WITH FIRST RECORDS FROM AUSTROPOTAMOBIUS TORRENTIUM SCHRANK

DANIELLE DEFAYE

Muséum National d'Histoire Naturelle, Laboratoire de Zoologie-Arthropodes (Crustacés)
61, rue de Buffon, 75005 Paris, France

Nitokra divaricata CHAPPUIS, 1923 (Copepoda, Harpacticoida, Ameiridae) is redescribed. This is the first record for Austria, as well as for a commensal copepod of the crayfish *Austropotamobius torrentium* SCHRANK.

Keywords: Copepoda, Harpacticoida, gills, crayfish, commensal

INTRODUCTION

Nitokra divaricata CHAPPUIS, 1923 was first described from a cave in Rumania (Paros) for a female found in a vial containing *Potamobius* sp. The male was then described by CHAPPUIS (1926) from Germany (DIEKSEE, SCHÖHSEE), the specimens coming from gills of the crayfish *Astacus.* GURNEY (1930) confirmed the status of this species as a "true" *Nitokra.* KIEFER (1937) reported it "aus Wasser, in dem *Potamobius astacus* von Kos Mitrovica" from the former Jugoslavia. JAKUBISIAK (1939) pointed out its presence in Poland as a commensal of *Astacus leptodactylus* (Lake Zawiszczowskie) and *A. fluviatilis* (Poznan region) naming it *Nitocrella divaricata,* as did STRASKRABA (1956), who reported it as a commensal of *Astacus astacus* from Silesia. It was then cited, also as *Nitocrella,* by GEORGESCU *et al.* (1962) from Rumania, by STERBA (1964) from *Astacus astacus,* and by STERBA (1969) from the former Czechoslovakia. BORUTZKY (1952) mentioned its presence in Russia (south of the Volga river) and reported the presence of the variety *caspica* (described by BEHNING, 1936) for this harpacticoid from Caspian Sea.

Harpacticoid samples collected from gills of *Austropotamobius torrentium* SCHRANK by M. H. NESEMANN from Austria and Germany proved to be *Nitokra divaricata.* This is the first mention of this species for Austria. This is also the first time that it is recorded as a commensal of *Austropotamobius torrentium.* A redescription with figures is given to complement the earlier ones, since those were often only partial, particularly concerning the male.

MATERIAL AND METHODS

Material examined: females and males from different localities: Austria – All material from *Austropotamobius torrentium,* NESEMANN coll: In the Vienna forest: Vienna, small stream near Neuwaldegg, near Schwarzenbergallee, 17.5.1994; Vienna, left tributary of Neuwaldegg stream, hypocrenal, *Walldbach,* 15.5.1994; Halter stream, on road out of village of Hütteldorf, 02.05.1995; Wienerwald stream, southeast of Henberg, 2.4.1995; Dornbach stream, upstream, 19.02.1995; permanent stream at right of upper Domb, 9.4.1995; Copepoda, right tributary of lower Eckbach, 15.02.1995, H. NESEMANN coll. & det..; Germany – Hessen, Odenwald forest, Weschnitz region, stream & north of Steinbach, near Fürth, from *A. torrentium,* 22.04.1995. D. BRANDIS & H. NESEMANN coll.

Methods: Specimens were dissected in lactic acid or glycerol and the dissected parts mounted in glycerol. All drawings were made using a camera lucida attached to a Wild M20 or Leitz Diaplan microscopes. Abbreviations used: P1–P4 = first–fourth natatory legs, P5–P6 = fifth–sixth modified legs, Enp = endopodite, Exp = exopodite.

The specimens are deposited in the Hungarian Natural History Museum, Budapest (Hungary).

SYSTEMATICS AND REDESCRIPTION

Family Ameiridae MONARD, 1927; LANG, 1948
Subfamily Ameirinae LANG, 1948
Genus *Nitokra* BOECK, 1864

Nitokra divaricata CHAPPUIS, 1923
(Figs 1–3)

Nitocra divaricata CHAPPUIS, 1923: 23 Figs 1–2, 1926: 516 Figs 1–4, 1927*: 49, 1933*: 20, 27, 47, GURNEY, 1927*: 546, 1930: 110 Figs 17–20, 1932: 53; KIEFER, 1937: 80; LANG, 1948: 819 Figs 327,6; DUSSART, 1967: 214 Fig. 80, PLESA, 1969: 169; STERBA, 1969; DUSSART & DEFAYE, 1990: 51.

Nitocrella divaricata BORUTZKY, 1931: 130 Fig. 20, 1952/64: 114 Fig. 48; CHAPPUIS, 1937*: 524, 1938*: 164; JAKUBISIAK, 1939: 121; GEORGESCU, MARCUS & SERBAN, 1962*: 76; STERBA, 1964: 271 Figs 1–7; DAMIAN–GEORGESCU, 1970: 71 Fig. 25; STRASKRABA, 1956: 593, Fig. 2 (the references marked with an asterisk are simple citations, not referring to commensalism or distribution).

Female (Figs 1 and 2): Length without furcal setae: 0.580 mm (mean, n=10)

Habitus (Fig. 1*a*) cylindrical, body elongated, with length/width ratio about 5. Cephalosome without nuchal organ, with triangular, prominent rostrum. Posterior fringe of thoracic somites without any ornamentation except last one, with short lateral spines. Genital double somite (Fig. 1*a, b*) with remnant of division visible on dorsal part and marked laterally by row of about ten very small spines. Genital area (Fig. 1*d*) situated anteriorly, in proximal part of somite. Two urosomites posterior to genital somite each with lateral row of long spines, the more posterior somite with additional ventral row of same spines. Small circular integumental windows present on each side on urosomites; double genital somite having two pairs of these integumental windows (indicated by dotted lines, Fig. 1*a*). Anal somite with some spines inserted ventrally at medial bases of furcal rami; dorsally, a pair of long, strong spines near medial insertion of furcal rami, some lateral spines at base of furca. Anal operculum slightly convex with generally four denticles (sometimes 5 ot 6). Furcal rami (Fig. 1*a, b, c*) about 2 times longer than broad, divergent, with convex dorsal basal prominence in lateral view (Fig. 1*c*); ending in two long terminal median setae, inner seta 2.7 times the outer (and 0.8 times the total body length), short inner seta, dorsal seta, and two latero-external setae with two or three small spines inserted at base.

Antennule (Fig. 1*e*) short, of eight segments, fourth segment with strong aesthetasc, end of aesthetasc passing last segment of appendage. Antenna (Fig. 1*f*) bisegmented, with exopodite unisegmented, short and bearing three setae. Mandible (Fig. 1*g*) with exopodite bisegmented, second segment with four terminal setae. Maxillule (Fig. 1*h*) with arthrite of praecoxa bearing five short strong terminal claws, basipodite and coxopodite armed respectively with four and two setae. Maxilla (Fig. 1*i*): syncoxa with two endites, distal one bearing two setae, proximal endite elongated, without characterized setae; endopodite represented by two setae. Maxilliped (Fig. 1*j*) prehensile, with two rows of few spines on coxopodite.

P1 to P4 (Fig. 2*a–d*) with trisegmented rami. All endopodites and exopodites with inner seta on second segment.

P1 (Fig. 2*a*) with endopodite longer than exopodite. Enp1 almost as long as exopodite, bearing thin setae inserted at distal third on inner margin; at base of Enp, a strong spine on the basipodite; Enp2 with internal seta inserted distally, Enp3 ending in strong spine and two setae of inequal length. Exp with seta at inner side of Exp2; Exp3 bearing three lateral spines and two long terminal setae.

P2 to P4 with endopodite shorter than exopodite. P2 (Fig. 2*b*) with intercoxal plate ornamented with few spines on each distal corner – no such spines on intercoxal plates of P1, P3 and P4. Enp2 with two distal setae; exopodite with an internal seta on the second segment and three spines and two setae on the third. P3 (Fig. 2*c*) with Enp3 bearing two setae and a spine and Exp3 with three spines and two long setae with different ciliation. P4 (Fig. 2*d*) with Enp similar to EnpP3, Exp3 bearing seven setae and spines.

Fig. 1. *Nitokra divaricata* CHAPPUIS, 1923. Female: a = habitus, dorsal view, b = urosome, ventral, c = anal somite and furca, lateral, d = genital area, e = antennule, f = antenna, g = mandible, h = maxillule, i = maxilla, j = maxilliped

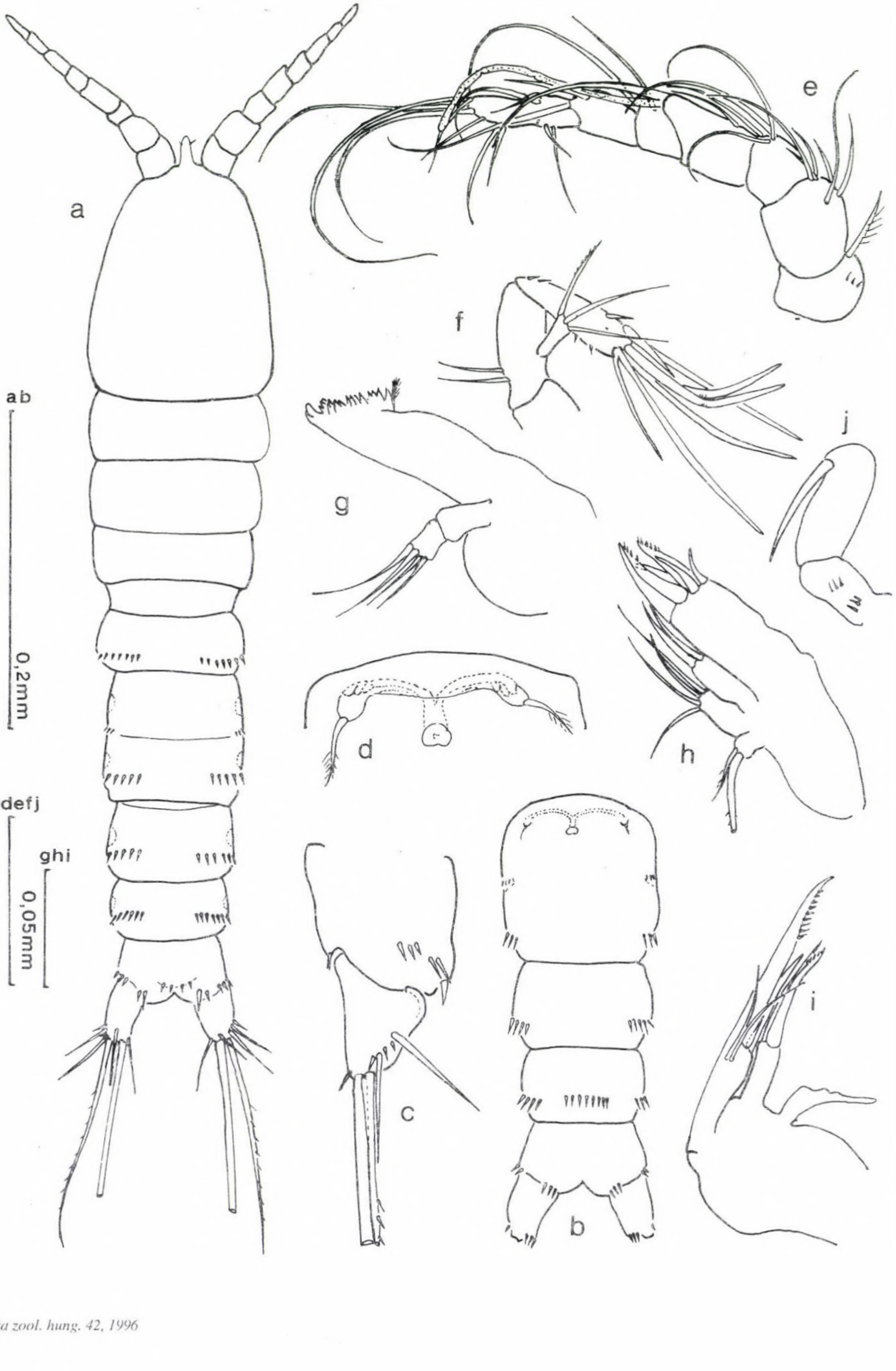


Fig. 2. *Nitokra divaricata* CHAPPUIS, 1923. Female: a = P1; b = P2, c = P3, d = P4, e = P5

P5 (Fig. 2*e*) with basoendopodite bearing five setae and spines, the three medialmost spines short. Exopodite 2.9 times longer than broad, with six setae, two terminal setae the longest, longest one of them 2.4 times as long as exopodite.

Egg-sac single, with about twelve eggs.

Setae and spine formula (using LANG's (1948) method):

	Enp	Exp
P1	1.1.021	0.1.023
P2	0.1.011	0.1.023
P3	0.1.111	0.1.023
P4	0.1.111	0.1.223
P5	5	6

Male (Figs 3, 4): Length without furcal setae: 0.570 mm (mean, n=3)

Habitus (Fig. 3*a*) of similar aspect and size as female, with similar prominent triangular rostrum, but without integumental windows. Posterior fringe of somites with ornamentation: on last thoracic somite and first urosomite, lateral rows of spines; on three next posterior somites, spines present all around somite except on dorsal central part. Anal somite and furca as in female. Anal operculum slightly convex, with five denticles (instead of usual four in female).

Antennule (Fig. 3*b*) prehensile, of eight segments with strong aesthetasc on segment 4 as in female. Antenna (Fig. 3*c*) bisegmented, with exopodite unisegmented, short, and bearing three setae. Mandible, maxillule and maxilla of same morphology as in female (not figured). Maxilliped (Fig. 3*d*) prehensile, with single lateral row of few spines on the coxopodite.

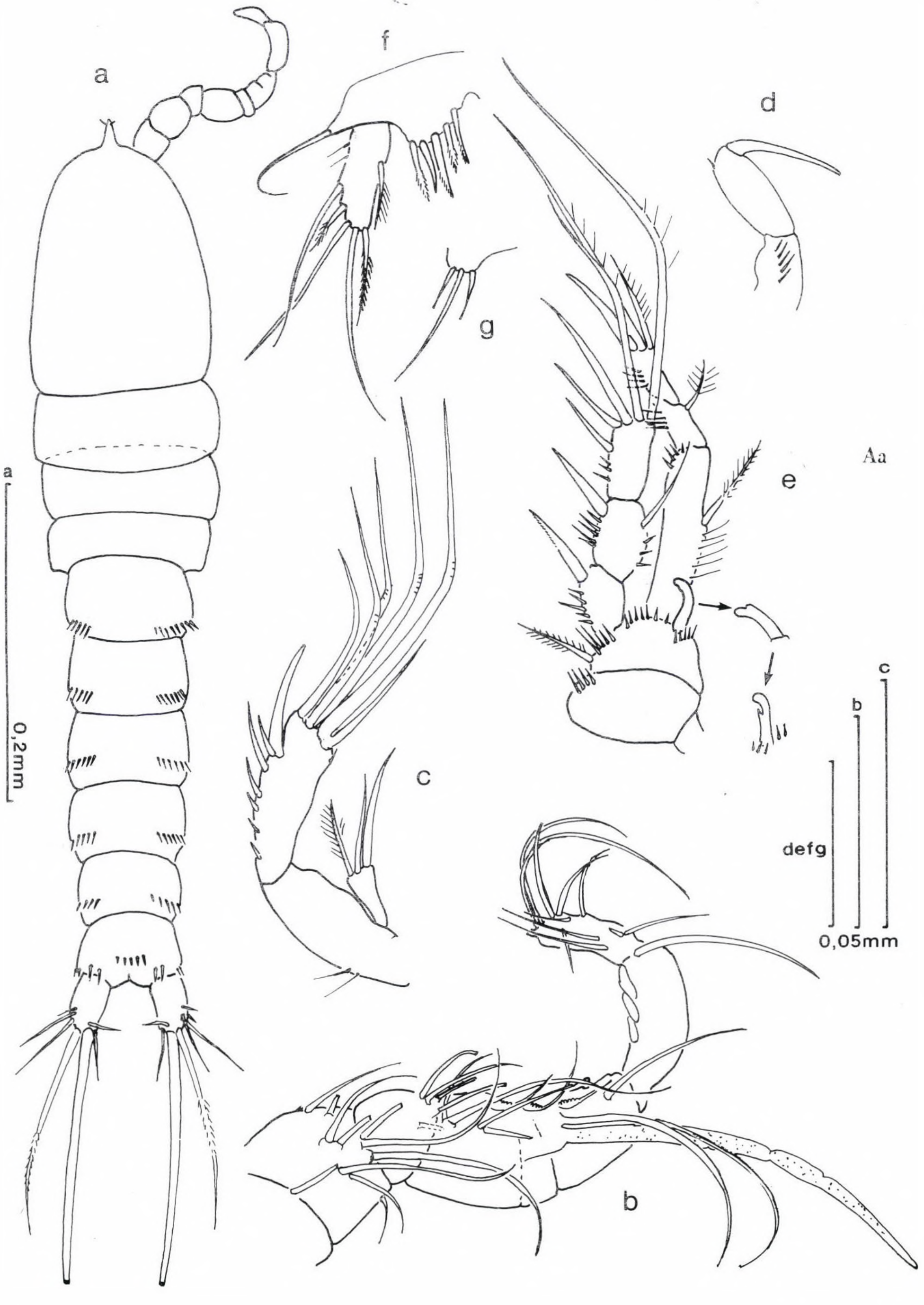
P1 to P4: Sexual dimorphism visible on P1 (Fig. 3*e*), P3 (Fig. 4*b*) and P5 (Fig. 3*f*). P2 (Fig. 4*b*) and P4 (Fig. 4*c*) similar to female.

P1 (Fig. 3*e*) with strong spine inserted on inner angle of basipodite modified: end bulging and curved to form a small strong claw (under different views on Fig. 3*e*). P3 with endopodite ornamented on inner margin of Enp2 and 3 with a compact row of very small denticles. Enp3 with two terminal spines, outer spine curved and of the same length as inner, both together forming pliers.

P5 (Fig. 3*f*) with basoendopodite bearing five short setae and spines of almost same length. Exopodite 2.4 times as long as broad, with six setae inserted at locations different than in female, one inserted on internal margin, two inserted distally, and three on external margin of segment.

P6 (Fig. 3*g*) consisting of three setae, median seta at least twice longer than others.

Fig. 3. *Nitokra divaricata* CHAPPUIS, 1923, male: a = habitus, dorsal view, b = antennule, c = antenna, d = maxilliped, e = P1 with details of spine of inner corner of basipodite, f = P5, g = P6



Setae and spine formula (following LANG's (1948) method):

	Enp	Exp
P1	1.1.021	0.1.023
P2	0.1.011	0.1.023
P3	0.1.111	0.1.023
P4	0.1.111	0.1.223
P5	5	6

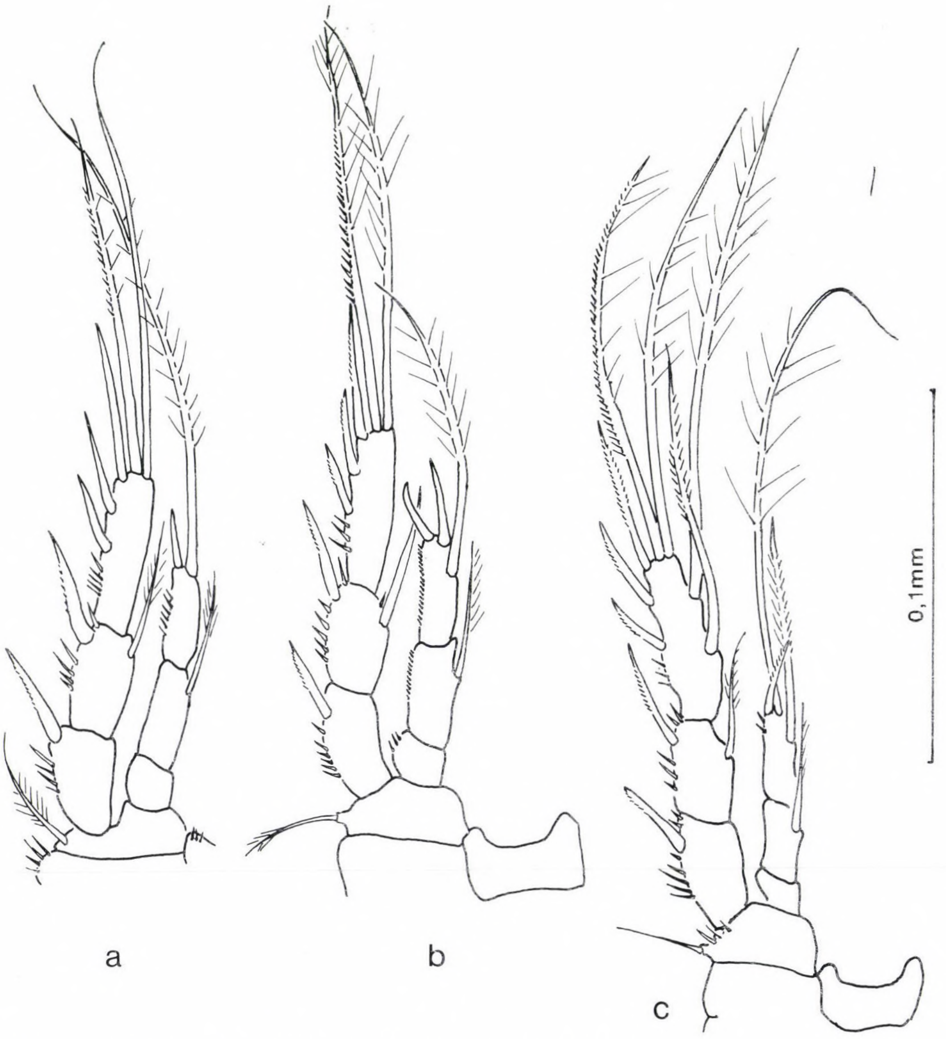


Fig. 4. *Nitokra divaricata* CHAPPUIS, 1923, male: a = P2, b = P3, c = P4

The specimens of *N. divaricata* from this study conform to the earlier partial descriptions (CHAPPUIS 1923, 1926, STRASKRABA 1956, STERBA 1964, DUSSART, 1967). The variability is very low, only a slight variation in the number of denticles of the anal operculum and in the relative length of furcal setae has been observed. The allocation to the genus *Nitokra* does not need to be demonstrated any more (particularly the trisegmented endopodites of P2 to P4 are typical).

DISCUSSION

In the first description of *Nitokra divaricata* by CHAPPUIS 1923, the author thought that, because of the unmodified morphology of the habitus it was doubtful that the specimen was a parasite of *Potamobius* sp., although the specimen was found in a vial containing the decapod. This opinion rapidly changed when this species was found in the gill cavity of crayfish (CHAPPUIS 1926). The present findings confirm once more that this harpacticoid usually lives in the gill cavity or in proximity to decapod crustacea.

Only a few cases of harpacticoids commensal of crayfishes have been reported. The canthocamptid *Attheyella pilosa* CHAPPUIS, 1929 and *A. carolinensis* CHAPPUIS, 1932 were identified as associates of both *Cambarus tenebrosus* and *Orconectes rusticus rusticus* from the southeastern United States (BOWMAN *et al.*, 1968).

As in these species, *Nitokra divaricata* does not seem to show a real specificity for its host: it has been found living with *Astacus astacus, A. fluviatilis, A. leptodactylus* and finally *Austropotamobius torrentium.*

GURNEY (1932) considered that the species was "much modified" "as a result of commensal life". In fact, the specimens appear very little modified when they are compared to other *Nitokra,* especially the closest species *Nitokra hibernica* (BRADY, 1880), as already noticed by CHAPPUIS (1923). The only character which could be noticed is the reduction of length of the segments of the legs and the slender shape of the body. PESCE (1983) identified a free-living female specimen from Italy as *N. cf. divaricata*; moreover, in STERBA (1969) there is no mention of the association of this harpacticoid with a crayfish in the former Czechoslovakia. These findings need to be confirmed because they would prove that the species can live "outside" a crayfish. This argument could support the hypothesis that *N. divaricata* is firstly a free-living species which uses the crayfish when it is present, as a shelter for reproduction and against predators and a source for food, and as a way to be carried (phoresis) to more favourable biotopes. Another argument supporting this hypothesis is the presence in two samples in this study of two free-living cyclopoid specimens: a copepodite (C4) of *Paracylops* sp. (right tributary of lower Eckbach, from *A. torrentium* 15.02.1995) and a female of *Acanthocyclops robustus* (G. O. SARS, 1863) (permanent stream at right of upper Domb, from *A. torrentium* 9.4.1995).

The geographical distribution of *N. divaricata* extends from the Caspian Sea (with the subspecies *caspica*) to Germany, so although the samples are scattered, we can say that it is present in Central Europe. Its habit as a free species needs to be demonstrated. It will be also informative to compare the distribution of this harpacticoid with that of its host, *Austropotamobius torrentium*. As this crayfish is present in Central Europe (BOTT 1950, HOLTHUIS, 1967), Switzerland and Luxembourg (ARRIGNON 1995), a study of the possible commensal copepods living in their gill cavity as well as other crayfishes should yield new information on the commensalism of harpacticoid copepods.

* * *

Acknowledgements. – I am very grateful to Dr. L. FORRÓ (Hungarian Natural History Museum, Budapest, Hungary) for sending the material of *Nitokra divaricata* CHAPPUIS, 1923, to Dr. B. DUSSART, and an anonymous referee who made helpful comments on the manuscript.

REFERENCES

ARRIGNON, J. (1995) L'écrevisse, indicateur biologique? *L'astaciculteur de France, Bull.* n° **42:** 4–10.

BEHNING, A. L. (1936) Nitocra divaricata CHAPPUIS im Kaspisee. In *Miscellanea aralocaspica. Int. Rev. ges. Hydrobiol. Hydrogr.* **33**: 247–249.

BORUTZKY, E. V. (1931) *Keys to determination of fresh-water organisms of the U.S.S.R.A. Freshwater Fauna*, Part 3, pp. 245 (Russian).

BORUTZKY, E. V. (1952) *Fauna of the USSR. Crustacea. Freshwater Harpacticoida.* III, 4. Izd. Akad. Nauk SSSR, Moskow-Leningrad, 424 p. [in Russian, English translation by IPST Jerusalem, 1964, pp. 396].

BOTT, R. (1950) Die Flusskrebse Europas (Decapoda, Astacidae). *Abh. senckenberg. naturf. Ges.* **483**: 1–36.

BOWMAN, T. E., PRINS, R. & MORRIS, B. (1968) Notes on the harpacticoid copepods Attheyella pilosa and A. carolinensis, associates of crayfishes in the eastern United States. *Proc. biol. Soc. Wash.* **81**: 571–586.

CHAPPUIS, P. A. (1923) Description de deux harpacticides nouveaux de Transylvanie (Note préliminaire). *Bul. soc. Stiinte., Cluj* **2**: 27–45.

CHAPPUIS, P. A. (1926) Harpacticiden aus der Kiemenhöhle des Flusskrebses. *Archiv. Hydrobiol.* **17** : 515–520.

CHAPPUIS, P. A. (1927) Die Tierwelt der unterirdischen Gewässer. *Die Binnengewasser* **3** pp. 176.

CHAPPUIS, P. A. (1933) Copépodes (1re série) avec l'énumération de tous les Copépodes cavernicoles connus en 1939. *Arch. Zool. exp. gén.* **76**: 1–57.

CHAPPUIS, P. A. (1937) Weitere Subterrane Harpacticoiden aus Jugoslavien. *Bull. Soc Stii., Cluj* **8**: 503–532.

CHAPPUIS, P. A. (1938) Subterrane Harpacticoiden aus Süd-Italien. *Bull. Soc Stii., Cluj* **9**: 153–181.

DAMIAN-GEORGESCU, A. (1970) Copepoda Harpacticoida (forma de apa dulce). *Fauna Republicii Socialiste Romania. Crustacea* 4(11) pp. 248.

DUSSART, B. H. (1967) *Les copépodes des eaux continentales. Tome I.* Calanodes et Harpacticodes. Ed. Boubée, Paris, pp. 500.

DUSSART, B. H. & DEFAYE, D. (1990) Répertoire mondial des crustacés copépodes des eaux intérieures. III. Harpacticodes. *Crustaceana*, Suppl. **16**: pp. 384.

GEORGESCU, A., MARCUS, A. & SERBAN, M. (1962) Les Harpacticodes de la R.P.R. *Trav. mus. hist. nat. "Gr. Antipa"* **8**: 75–92.

GURNEY, R. (1927) Report on the *Crustacea Copepoda* (Littoral and semi-parasitic). *Trans. zool. Soc., London* **33**: 536–577.

GURNEY, R. (1930) Notes on certain species of freshwater copepoda. 1. A new species of Moraria. 2. Two commensal species of Harpacticoida. *Zool. Anz.* **90**: 105–112.

GURNEY, R. (1932) *British Fresh-Water Copepoda. Vol. II.* The Ray Soc., London, pp. 336.

HOLTHUIS, L. B. (1967) Decapoda. *In Limnofauna Europaea*, Stuttgart, pp. 189–192.

JAKUBISIAK, S. (1939) Sur le copépode Nitocrella divaricata (CHAPPUIS), commensal de l'Ecrevisse. *Arch. Hydrobiol. Ryb.* **12**: 117–121.

KIEFER, F. (1937) Die freilebenden Ruderfusskrebse (*Crustacea Copepoda*) Jugoslawiens. *Wiss. Gesellsch. Skopje* **18**(6): 77–105.

LANG, K. (1948) *Monographie der Harpacticiden.* I, pp. 1–896, II, pp. 897–1682. Hakan Ohlsson, Lund.

PESCE, G. L. (1983) Contributo alla conoscenza degli Arpacticoida delle acque sotterranee della regione Pugliese (Crustacea: Copepoda). *Thalassia Salentina* **13**: 62–81.

PLESA, C. (1969) Fauna cavernicola acvatica din Pesterile calcaroase. *In* CALINESCU R. (ed.) *Biogeografia Romaniei.* Edit. Stiint., Bucuresti, pp. 354–358.

STERBA, O. (1964) Plazivky (Copepoda Harpacticoidea) Moravy a Slovenska. *Acta univ. palacki. olomuc., fac. rer. nat.* **16**: 203–213.

STERBA, O. (1969) Über die geographischer verbreitung der Harpacticiden (Copepoda: Harpacticoida) in der Tschechoslowakei. *Véstn. cesk. spol. zool.* **33**: 162–173.

STRASKRABA, M. (1956) Nitocrella divaricata in der Kiemenhöhle des Krebses Astacus astacus L. in Schlesien. *Prir. sborn. Ostrav. Lraje* **17**(4): 593–595.

Received March 13, 1996, accepted December 20, 1996

Catalogue of Palaearctic Diptera

edited by Á. SOÓS and L. PAPP

Volume 13
Anthomyiidae–Tachinidae

The Catalogue contains the basic taxonomic, nomenclatorial and distribution data of all species occurring in the Palaearctic Region with the fundamental morphological features for the majority of the fly groups.

Volume 13 lists the names of 460 genera, 38 subgenera and 2389 species assigned to three families. Furthermore, 672 synonymous generic and 2477 specific names, 1807 emendations, errors, nomina dubia and doubtful genera and species are listed. The period of the Catalogue extends from 1758 to 31 December, 1982.

Contents: Explication to distribution. Type-species designations in Volume 13. New name proposed in Volume 13. Families: Anthomyiidae (Á. DELY–DRASKOVITS). Rhinophoridae (B. HERTING). Tachinidae (B. HERTING and Á. DELY–DRASKOVITS). Bibliography. Index.

December 15, 1993. 624 pages
US$ 85.00 plus US$ 8.00 for package and postage
(and an extra US$ 5.00 if you want it air mail)
ISBN 963 70 9321 4

Order should be sent
to the Hungarian Natural History Museum, Library
Baross u. 13., Budapest, H–1088 Hungary
Fax: (36–1) 1171669

Acta Zoologica Academiae Scientiarum Hungaricae 42 (2), pp. 157–162, 1996

UNUSUAL NEW ORIBATID MITES (ACARI: ORIBATIDA) OF THE WORLD, I.

J. BALOGH[1] and S. MAHUNKA[2]

[1]*Ecological Research Group of the Hungarian Academy of Sciences*
Department of Zoology, Hungarian Natural History Museum
H–1088 Budapest, Baross u. 13, Hungary
[2]*Department of Zoology, Hungarian Natural History Museum*
H–1088 Budapest, Baross u. 13, Hungary

One new genus and species of Australian ceratozetoid oribatid mite is described and illustrated.

Key words: Acari, Oribatida, new genus and species, Australia

INTRODUCTION

During the last three decades the authors have carried out soil zoological research by sampling with Berlese extractors in various parts of the world, mainly in tropical and subtropical regions. These studies had a dual aim. On the one hand, by making thorough examinations we hoped to become acquainted with the oribatid fauna of these regions; on the other hand, by acquiring a rich and highly diverse material, we hoped to document and preserve the soil fauna for posterity in view of the general environmental degradation which is becoming more and more apparent.

These Berlese samples were so rich in material that we and our collaborators have described numerous mite species in several hundred articles. The Museum d'Histoire Naturelle of Geneva has also supported many of these researches, the material of which has been mostly elaborated by the junior author. Extensive explorations all over the world have yielded a huge quantity of collected material, of which only a fraction has yet been made public. It is unlikely that this work will be completed in the near future, especially that concerning the oribatid mites. Consequently, we have decided not to proceed with the regular step-by-step publication, but instead give priority to those taxa which seem to solve some taxonomic problems by bridging larger gaps, thereby helping those colleagues whose primary aim is to create an evolutionary system.

The present contribution presents the description of a new ceratozetoid species from the Southern hemisphere, apparently a characteristic representative of the region. This group is rather inadequately known in this hemisphere. The new taxon is all the more interesting since some of its features represent apparent links between other known taxa (see BALOGH & BALOGH 1992).

In the descriptions, we primarily follow the technical terminology of BEHAN-PELLETIER (1984).

DESCRIPTION OF THE NEW TAXON

Leebates gen. n.

Diagnosis: Superfamily Ceratozetoidea JACOT, 1925. Rostrum undivided. Large and unusual lamellae and translamella present, lamellar setae arising on their cusps, interlamellar setae from strong apophyses. Tutorium well-developed, with sharply pointed apex. Dorsosejugal suture present. Pedotecta 1 and 2–3 very large, custodium normal, discidium with wide and dilated ventrolateral part. Pteromorphae immovable. Ten pairs of notogastral setae, four pairs of porose areas and five pairs of large lyrifissures present on notogaster. Gnathosoma typical for the family. Anogenital setal formula: 5 – 1 – 2 – 2. Legs tridactyle, with strong heterodactyly. Tibia of leg I without long apophyses.

Type species: *Leebates bornemisszai* sp. n.

Remarks: The features given above in such a combination have hitherto been unknown in this superfamily.

Derivatio nominis: We dedicate the new genus to our late friend, Dr. D. C. LEE, the outstanding researcher of the oribatid fauna of Australia.

Leebates bornemisszai sp. n.

Measurements. – Length of body: 307 μm, width of body: 209 μm.

Integument: Whole surface covered by a cerotegument layer consisting of comparatively large, rounded parts, appearing to be pustules.

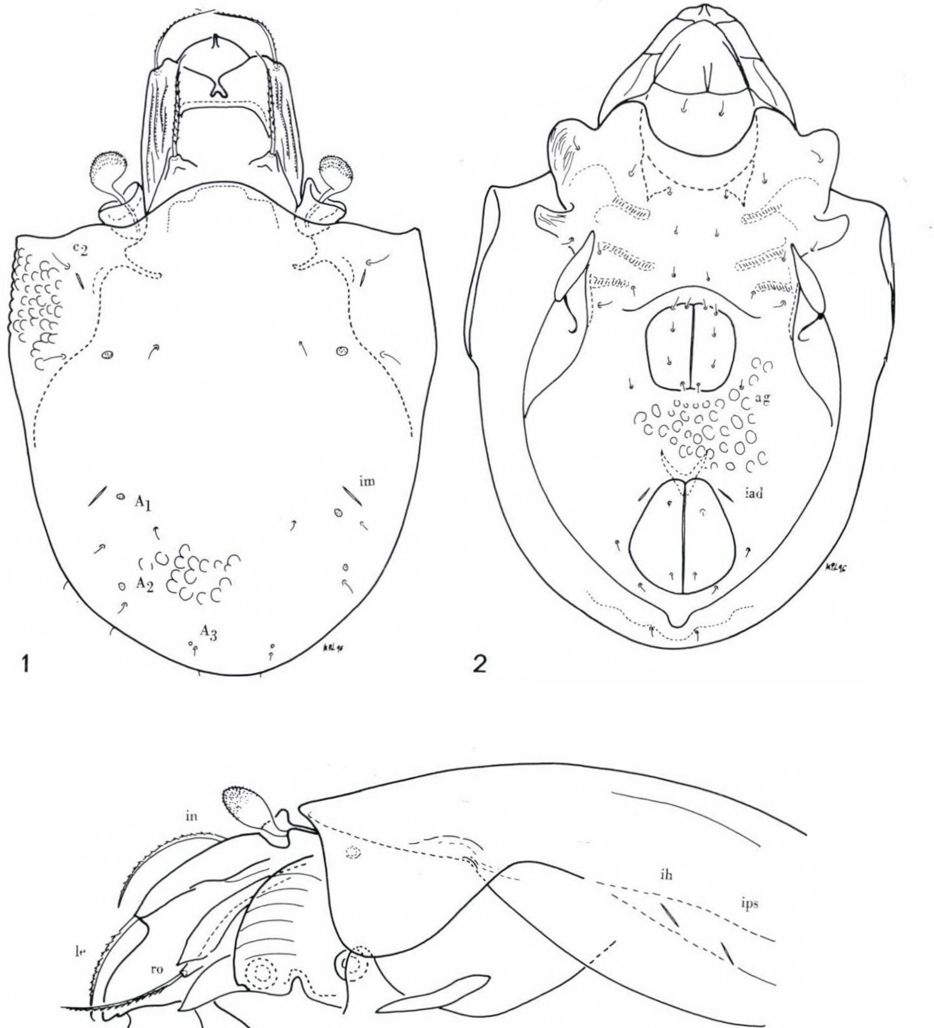
Prodorsum: Rostrum slightly angulate anteriorly, rostral apex with a characteristic, Y-shaped crest dorsally (Fig. 4). Lamellae very wide, their cusps approaching one another medially, connected by a translamella (Fig. 5). Between them a small triangular cusp present. Lamellar apices reduced or mostly rounded, lamellar surface with some longitudinal striae. Lamellar setae arising laterally on wide cusps. A pair of strong interlamellar apophyses present, on which interlamellar setae arise (Fig. 1). Rostral, lamellar and interlamellar setae setiform, distinctly barbed, rostral setae also arising from a small apophysis. Bothridium conspicuously raised from the body surface, of ceratozetoid type with a deep notch between *svm* and *svl*. Sensillus clavate, covered by small spicules.

Notogaster: Dorsosejugal suture convex medially, reaching forward between bothridia (Fig. 1). Ten pairs of short notogastral setae and 4 pairs of porose areas (?) present, but porosity of these areas very difficult to see, only clearly visible in *Aa*. Other three pairs apparently pori only. An unpaired round spot (?) visible between setae p_1 (Fig. 6). All 5 pairs of lyrifissures conspicuously long, *ih* and *ips* located laterally, sloping transversally (Fig. 6).

Lateral part of prodorsum: Tutorium lamelliform, well developed, with a sharply pointed apex. A conspicuous apophysis observable near it, bearing an unilaterally barbed rostral seta (Fig. 3). Porose areas *Ah* present, others not observable. Pedotectum I very large, ornamented by arched lineolae; distal end slightly excavate basally. Genal tooth short. Custodium well-developed, wide. Discidium very large, with dilated ventrolateral part.

Gnathosoma: Normal for family.

Coxisternal region: Without any characteristic sculpture, form of apodemes normal for family. In front of genital aperture an arched line observable. Epimeral setal formula: 3–1–3–2 (?) (we were not able to find setae *4c*), all setae minute.



Figs 1–3. *Leebates bornemisszai* gen. et sp. n.: 1 = body in dorsal aspect, 2 = ventral aspect, 3 = podosoma in lateral aspect

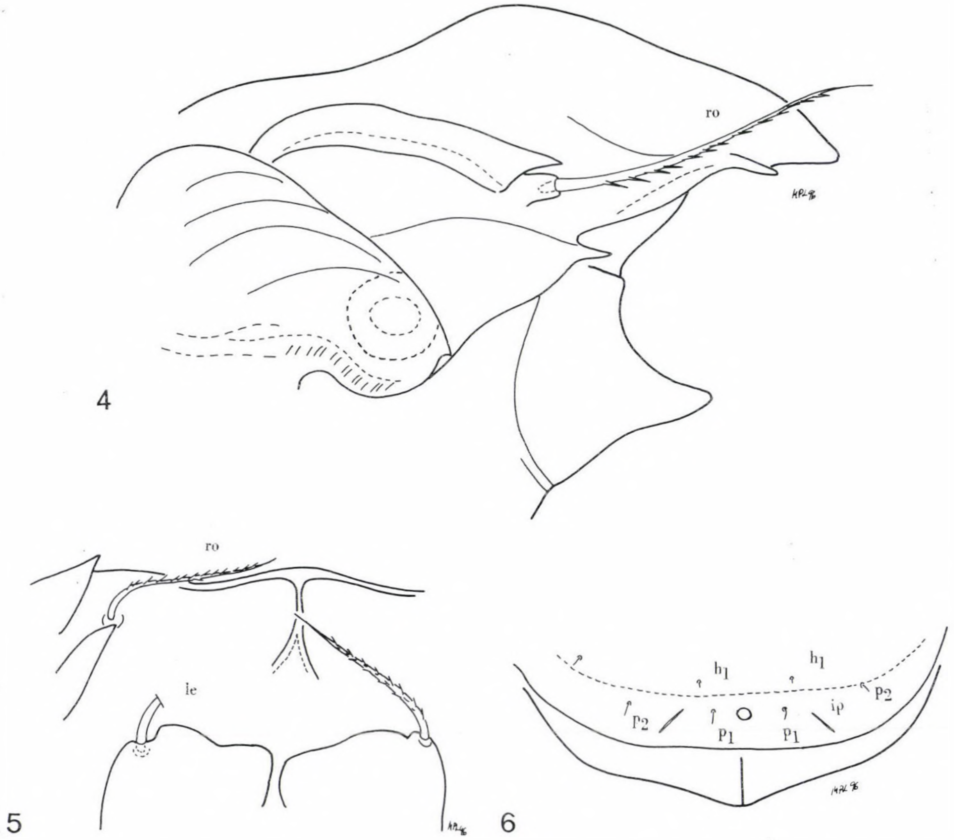
Anogentital region: Ventral plate ornamented by large but shallow foveolae (Fig. 2). All setae in this region short and simple. Anogenital setal formula: 5 – 1 – 2 – 2. Lyrifissures *iad* located near to anterior angle of anal aperture. Posterior margin of the notogaster with a deep notch medially (Fig. 2).

Legs: All legs tridactylous with strong heterodactyly. Solenidion *om1* strong and long, *om2* much thinner and shorter. Solenidion φ2 arising on dorsal surface of tibia, near φ1. Legs setal formula:

I: 1–5–3+1–4+2–18+2–3 (Fig. 7)
IV: 1–2–3+1–12–3 (Fig. 8).

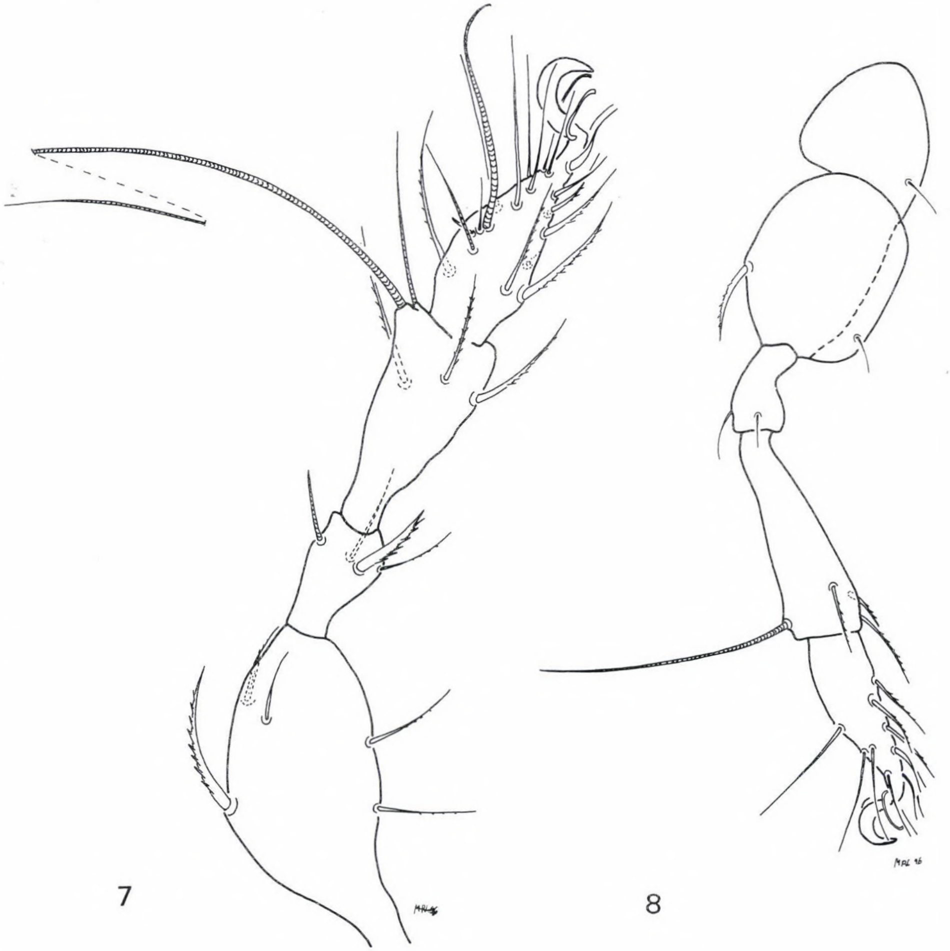
Material examined: holotype: (1553–HO–96) – Australia, Victoria, Boolarra, Laughing Waters, ca. 100 miles from Melbourne. 15 April, 1989. Leg. D. J. SZABÓ. Deposited in the Hungarian Natural History Museum, Budapest.

Remarks: See after the generic diagnosis.



Figs 4–6. *Leebates bornemisszai* gen. et sp. n.: 4 = rostral part of prodorsum in lateral aspect, 5 = rostral apex and the cusps of lamellae, 6 = posteromarginal part of the notogaster in posterior view

Figs 7–8. *Leebates bornemisszai* gen. et sp. n.: 7 = leg I, 8 = leg IV



Etymology: We dedicate the new species to Dr. G. Bornemissza, the renowned coleopterist of Hungarian descent, who has done a great deal in exploring the Coleoptera fauna of Australia and helped the senior author in many ways while he was in Australia.

* * *

Acknowledgement – This work was sponsored in part by the Hungarian Scientific Research Fund (OTKA grant number T 16729).

REFERENCES

BALOGH, J. and P. BALOGH (1992) *The Oribatid Mites Genera of the World I–II.* Hungarian Natural History Museum, Budapest, pp. 263+375.

BEHAN-PELLETIER, V. (1984) Ceratozetes (Acari: Ceratozetidae) of Canada and Alaska. *Can. Ent.* **116**: 1449–1517.

Received May 12, 1996, accepted December 20, 1996

Acta Zoologica Academiae Scientiarum Hungaricae 42 (2), pp. 163–181, 1996

GALUMNATOID TAXA (ACARI: ORIBATIDA) FROM MADAGASCAR (PART 1)

S. MAHUNKA

Department of Zoology, Hungarian Natural History Museum
H–1088 Budapest, Baross u. 13, Hungary

Thirteen species of galumnatoid mites from Madagascar are listed, 9 of which are new to science. *Ctenogalumna* BALOGH 1960 is synonymized with *Allogalumna* GRANDJEAN, 1936.

Key words: Acari, Oribatida: Galumnatidae, new species, Madagascar

INTRODUCTION

A programme of correlated research on the distribution of oribatid mites and mosses in the Ethiopian and Oriental regions was started by the bryologist Dr. T. PÓCS, and myself (MAHUNKA 1993). The work is hindered, however, by the large number of unknown taxa of Oribatida in these regions. Consequently, it has been necessary to describe many species before the main correlations can be identified. A notably diverse group in this area is the Galumnatoidea. The South African species have been dealt with in the works of ENGELBRECHT (1969, 1972*a*, 1972*b*, 1972*c*, 1973), while Central and East African species have been studied by BALOGH (e.g. 1960, 1962) and MAHUNKA (e.g. 1986).

The oribatid fauna of Madagascar is of primary importance. For many years research has been mainly based on the extensive collections of Dr. B. HAUSER, Museum d'Histoire Naturelle, Geneva and of Dr. T. PÓCS, Eger, Hungary (e.g. MAHUNKA 1993, 1994, 1996). The material belonging the superfamily Galumnatoidea, collected by Dr. T. PÓCS is species rich and I have found it necessary to publish the findings in two parts.

Few species of Madagascar Galumnatoidea have been described. BALOGH (1960) described only four species from Madagascar: *Ctenogalumna madagascarensis* BALOGH, 1960, *Galumnella pauliani* BALOGH, 1960, *Orthogalumna saeva* BALOGH, 1960, *Xenogalumna longula* BALOGH, 1960. In one of my recent papers (MAHUNKA 1996 in press) I describe three further species belonging in the genus Galumna collected by Dr. B. HAUSER.

DISCUSSION AND DESCRIPTIONS OF THE TAXA

Allogalumna costata sp. n.
(Figs 1–5)

Measurements. – Length of body: 542–598 μm, width of body: 403–445 μm.

Prodorsum: Rostrum strongly and abruptly narrowed anteriorly, beak-shaped in lateral aspect (Fig. 2). Sublamellar (*S*) lines strong, gradually arching to acetabulum of leg I (Fig. 2). Rostral setae short, glabrous and fine; lamellar setae longer and distinctly pilose. Interlamellar setae absent, represented only by their alveoli. Sensillus long, setiform, arched backwards bearing 5–7 conspicuous spines (Fig. 1).

Notogaster: Dorsosejugal suture interrupted between small, nearly round porose areas, guttiform sculpture also present in dorsosejugal region. Dorsophragmatic apophyses *hy* star-shaped with a round centre. Ten pairs of alveoli and four pairs of porose areas well visible. Among porose areas *Aa* slightly larger than others, but no essential difference among them. A_1 and A_2 located conspicuously near to each other. Porose area A_3 standing very far from each other. Median pore (*mp*) absent both in male and female specimens. Lyrifissures *im* located medially, near to porose area A_1.

Ventral region (Fig. 5): Epimeral setae deficient, epimeral surface ornamented by some weak spots. Epimeral setal formula: 1 – 0 – 2 – 1. Three pairs of conspicuous setae arising on anterior margin of genital plates, all others much shorter. Some very fine, mostly longitudinal striae visible on genital plates (Fig. 3). Anal plates with stronger sculpture (Fig. 4), comprising strong longitudinal but arched and connected costae. Postanal porose area absent. All setae in anoadanal region minute. Lyrifissures *iad* located in adanal position.

Legs: Chaetotaxy of legs typical for the genus.

Material examined: holotype (1546–HO–1996) – Malagasy Republic. Central East Madagascar. Degraded montane rainforest on Mt. Ambatokirijy at the southern edge of Andasibe (Perinet) Forest Reserve, at 950–1000 m alt. 18°57'15''S, 48°26'20''E, 3. Oct. 1994. Leg. Dr. T. Pócs. Nine paratypes collected from the same sample. Holotype and 8 paratypes deposited in the Department of Zoology, Hungarian Natural History Museum, Budapest (HNHM), with identification number of the specimens in the Collection of Arachnida, one paratype deposited in the Muséum d'Histoire Naturelle, Genève (MHNG).

Remarks: The new species is excellently characterised by the sculpture of the genital and anal plates, no similar sculpture is known in this genus.

Derivatio nominis: This species is named after the costate sculpture of the anal plates.

Allogalumna insolita sp. n.
(Figs 6–10)

Measurements. – Length of body: 394–428 μm, width of body: 312–340 μm.

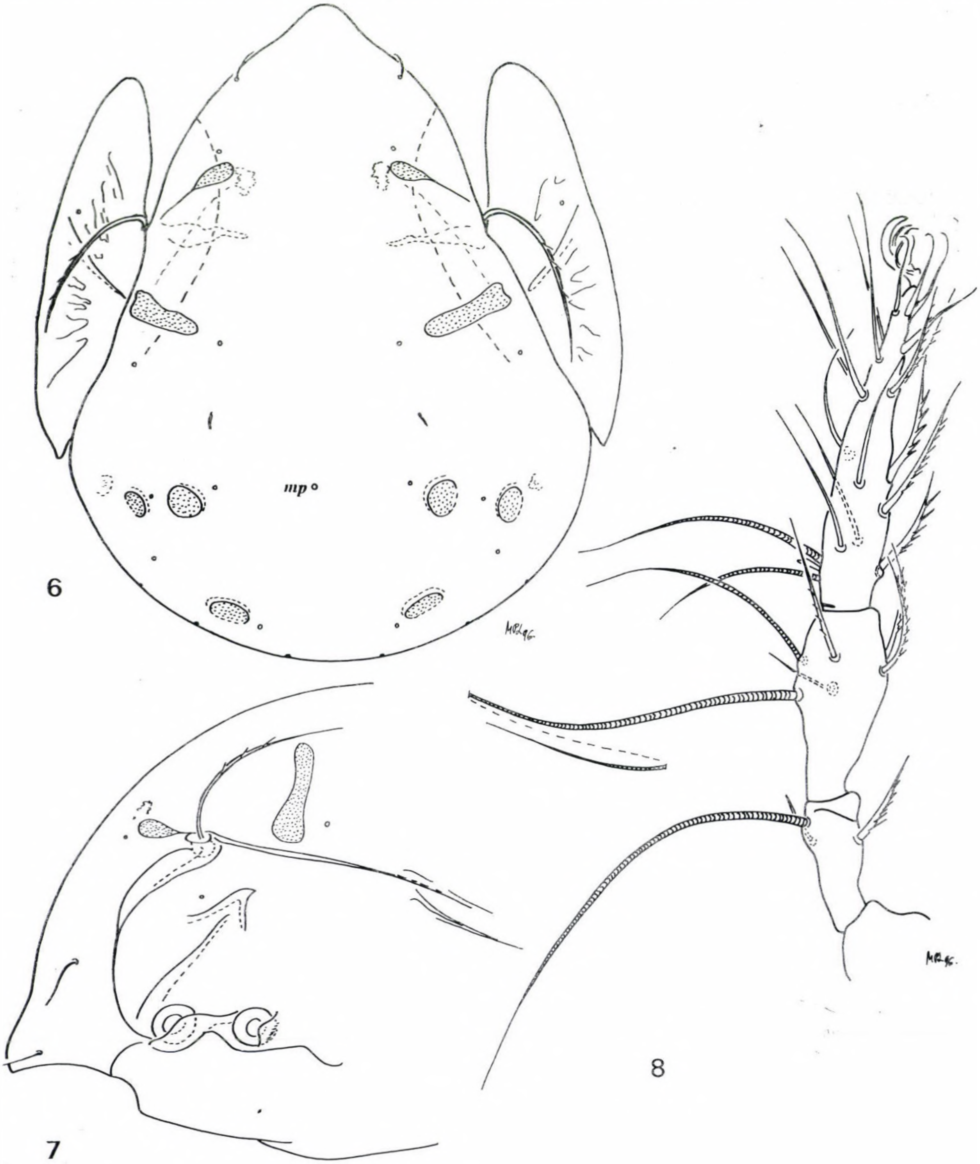
Prodorsum: Rostrum strongly and abruptly narrowed anteriorly. Sublamellar (*S*) lines distinct in dorsal aspect (Fig. 6). Lamellar and rostral setae short, glabrous and fine. Interlamellar setae absent, represented only by their alveoli. Sensillus long, setiform, arched backwards, hardly thickened medially, bearing 2–3 conspicuous spines (Fig. 7).

Notogaster: Dorsosejugal suture interrupted between large, guttiform areae porosae dorsosejugales and the dorsophragmatic apophyses (*hy*). Ten pairs of alveoli and four pairs of porose areas conspicuous. Among porose areas *Aa* largest, elongated transversally. A_1 and A_2 located conspicu-

Figs 1–5. *Allogalumna costata* sp. n.: 1 = dorsal aspect, 2 = lateral part of podosoma, 3 = genital plate, 4 = anal plate, 5 = ventral aspect

ously near to each other, transversally, *A1* slightly the larger. Median pore present both in male and female specimens. Lyrifissures *im* located medially, situated characteristically near to each other (Fig. 6).

Ventral regions: Epimeral setae deficient; epimeral surface ornamented by some weak spots. Epimeral setal formula: 1 – 1 – 2 – 1. Two pairs of setae arising on anterior margin of genital plates, setae g_1 comparatively long, all others represented by their alveoli; a pair of conspicuous



Figs 6-8. *Allogalumna insolita* sp. n.: 6 = dorsal aspect, 7 = lateral part of podosoma, 8 = leg I

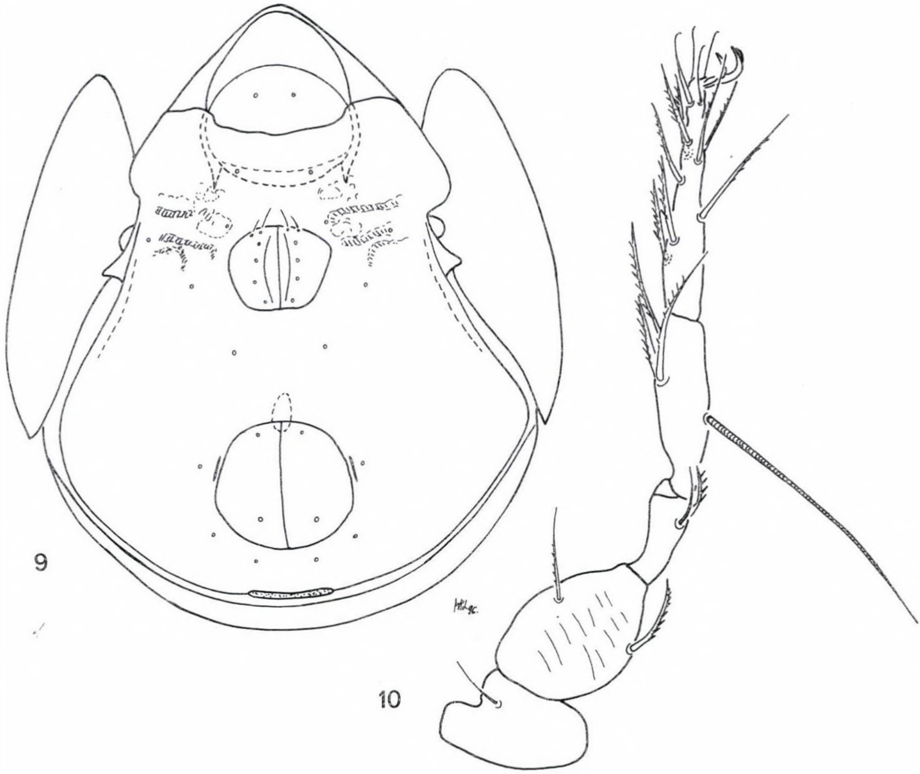
longitudinal lines also visible (Fig. 9) on plates. All other setae in anogenital region also absent, shown only by their alveoli. A distinct, narrow postanal porose area (*ap*) present. Lyrifissures *iad* located in adanal position.

Legs: Chaetotaxy of legs typical for the genus, position of basal setae and solenidium of tarsus and tibia I shown in Fig. 8, leg IV shown in Fig. 10.

Material examined: holotype (1547–HO–1996) – Malagasy Republic. Central East Madagascar. Degraded montane rainforest on Mt. Ambatokirijy at the South edge of Andasibe (Perinet) Forest Reserve, at 950–1000 m alt. 18°57'15''S, 48°26'20''E, 3, Oct. 1994. Leg. Dr. T. Pócs. Thirty-one paratypes collected from the same sample. Holotype and 29 paratypes deposited in HNHM, 2 paratypes in MHNG.

Remarks: The position of the notogastral porose areas of the new species is unique in the genus Allogalumna GRANDJEAN, 1936.

Derivatio nominis: After the peculiar position of the porose areas A_1 and A_2.



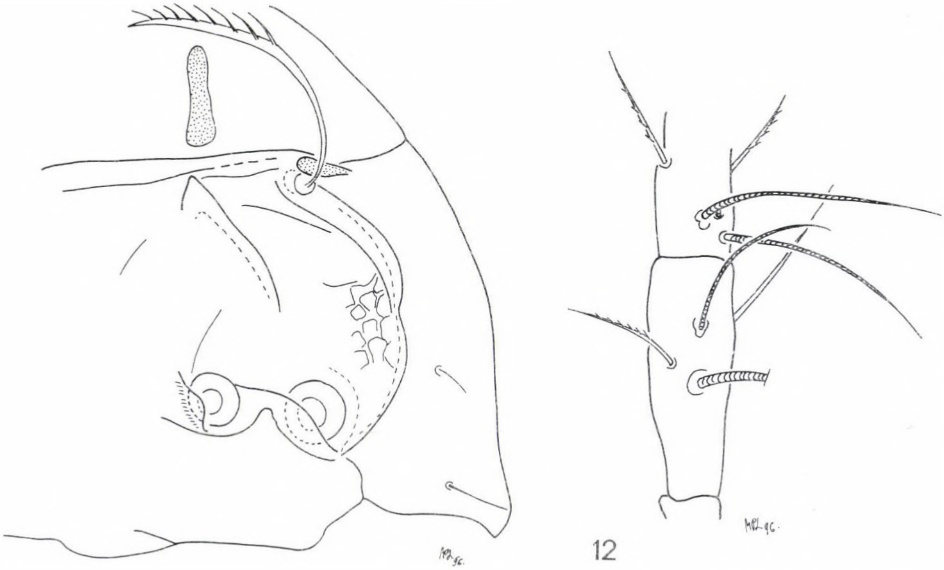
Figs 9-10. *Allogalumna insolita* sp. n.: 9 = ventral aspect, 10 = leg IV

Allogalumna madagascarensis (BALOGH, 1960) **comb. n.**
(Figs 11, 12)

A long series of specimens have been extracted from one of the samples. The specimens were compared with the description of BALOGH and the paratype specimens, and the species identity was confirmed.

This species was designated by BALOGH as the type of the genus *Ctenogalumna*. A detailed study proved that the lamellar line is indeed reduced completely, but the sublamellar line is present and clearly recognizable. Furthermore, the paratypes of both sexes display the median pore. On the notogaster no other feature for characterising the genus was discovered (the shape of the sensillus alone is not sufficient). Consequently, I consider *Ctenogalumna* BALOGH, 1960 to be a junior subjective synonym of *Allogalumna* GRANDJEAN, 1936.

The description of the species is fundamentally correct, although the study of a longer series of specimens revealed that the sensillus is in fact less thickened than originally described and the number of the lateral branches varies between 6 and 10 (Fig. 11), although even in a single specimen this number may vary. Solenidia φ_1 and φ_2 on leg I are far removed from the anterior margin of the tibia, and are far from each other. Solenidium om_2 on the tarsus is placed behind om_1 (Fig. 12).



11 12

Figs 11-12. *Allogalumna madagascarensis* (BALOGH, 1960): 11 = lateral part of podosoma, 12 = solenidial group of leg I

Material examined: 17 specimens: Malagasy Republic. Central East Madagascar. Degraded montane rainforest on Mt. Ambatokirijy at the southern edge of Andasibe (Perinet) Forest Reserve, at 950–1000 m alt. 18°57'15''S, 48°26'20''E, 3 Oct. 1994. Leg. Dr. T. PÓCS.

Allogalumna pocsi sp. n.
(Figs 13–15)

Measurements. – Length of body: 252–296 µm, width of body: 197–214 µm.

Prodorsum: Rostrum widely rounded in dorsal aspect. Lamellar line absent, sublamellar one well developed, reaching acetabulum of leg I (Fig. 12). Rostral and lamellar setae short, fine and smooth. Interlamellar setae represented only by their alveoli. Sensillus robust, its head rounded, nearly symmetric, bearing some small spines on its distal margin (Fig. 11). Areae porosae dorsosejugales very large, guttiform, gradually narrowing laterally.

Notogaster: Dorsosejugal suture absent, dorsophragmatic apophyses (*hy*) small, located very near to porose areas. Median pore present both in males and females. Ten pairs of alveoli of vestigial notogastral setae present. Lyrifissure *im* located medially, anteriorly, small (Fig. 11). Areae porosae adalares (*Aa*) round, large, the other three pairs smaller, A_3 elongated and larger than A_1 and A_2.

Ventral regions: Shape of apodeme 2 and sejugal apodeme typical for the genus. Epimeral region mostly smooth, but some weak spots observable. Epimeral setal formula: 1 – 1 – 1 – 1. Two pairs of genital setae inserted on anterior margin of genital plates. All setae in anogenital region very fine and short. Lyrifissures *iad* located near to anal aperture, a little inverse apoanal position. A distinct, ovally elongated, large area porosa postanalis present (Fig. 13).

Legs: The position of the solenidia of tibia and tarsus of leg I is similar to the preceding species.

Material examined: holotype (1540–HO–1996) – Malagasy Republic. Central East Madagascar. Degraded montane rainforest on Mt. Ambatokirijy at the southern edge of Andasibe (Perinet) Forest Reserve, at 950–1000 m alt. 18°57'15''S, 48°26'20''E, 3 Oct. 1994. Leg. Dr. T. PÓCS. Nineteen paratypes collected from the same sample. Holotype and 17 paratypes deposited in HNHM, 2 paratypes in MHNG.

Remarks: The new species is well characterised by the striking shape of its sensillus. On this basis it is most closely related to the next new species (*A. superporosa* sp. n.), however, the form and largeness of the porose areas and the position of the genital setae are quite different.

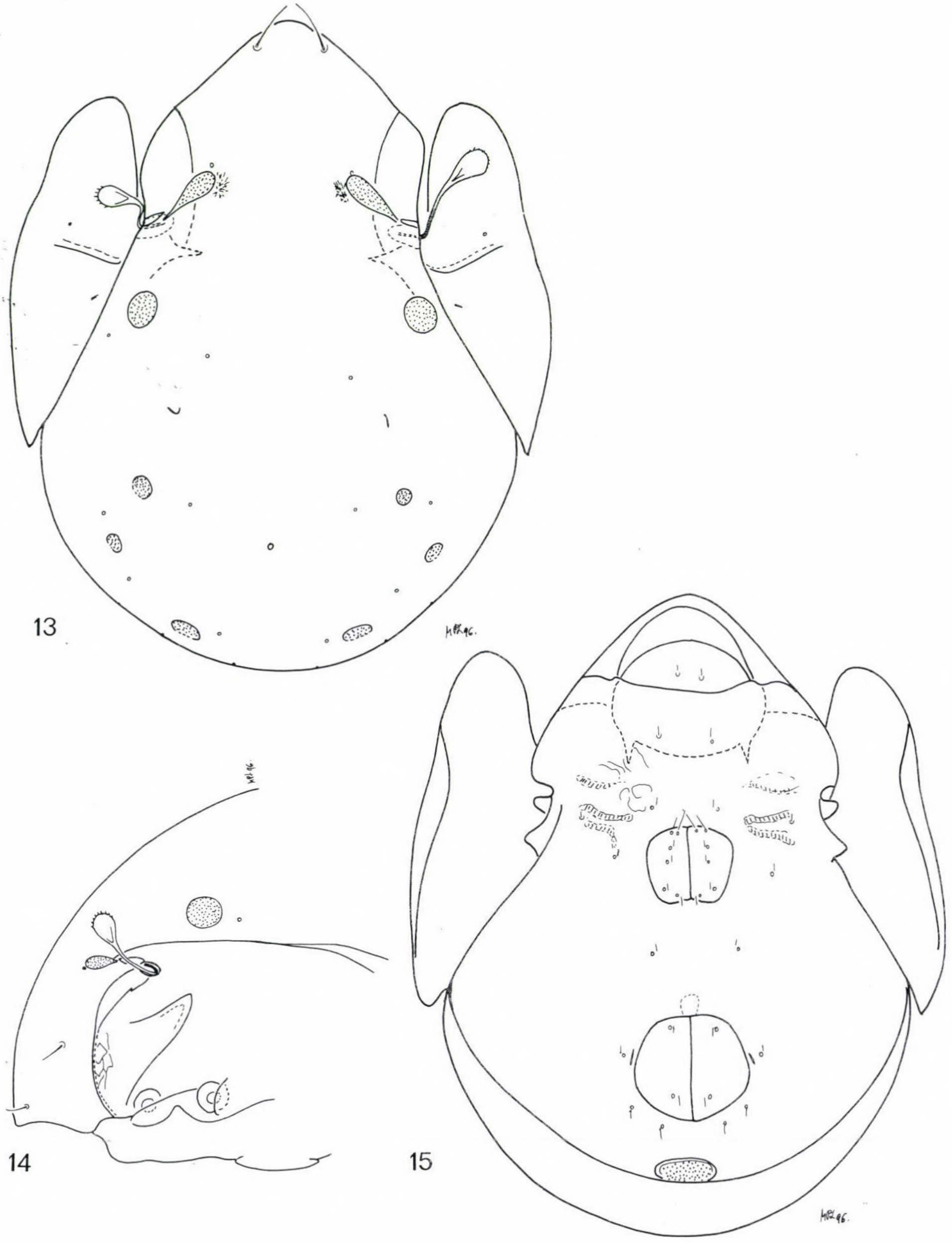
Derivatio nominis: I dedicate the new species to my friend Dr. TAMÁS PÓCS (Eger, Hungary) the collector of this very rich material.

Allogalumna superporosa sp. n.
(Figs 16–18)

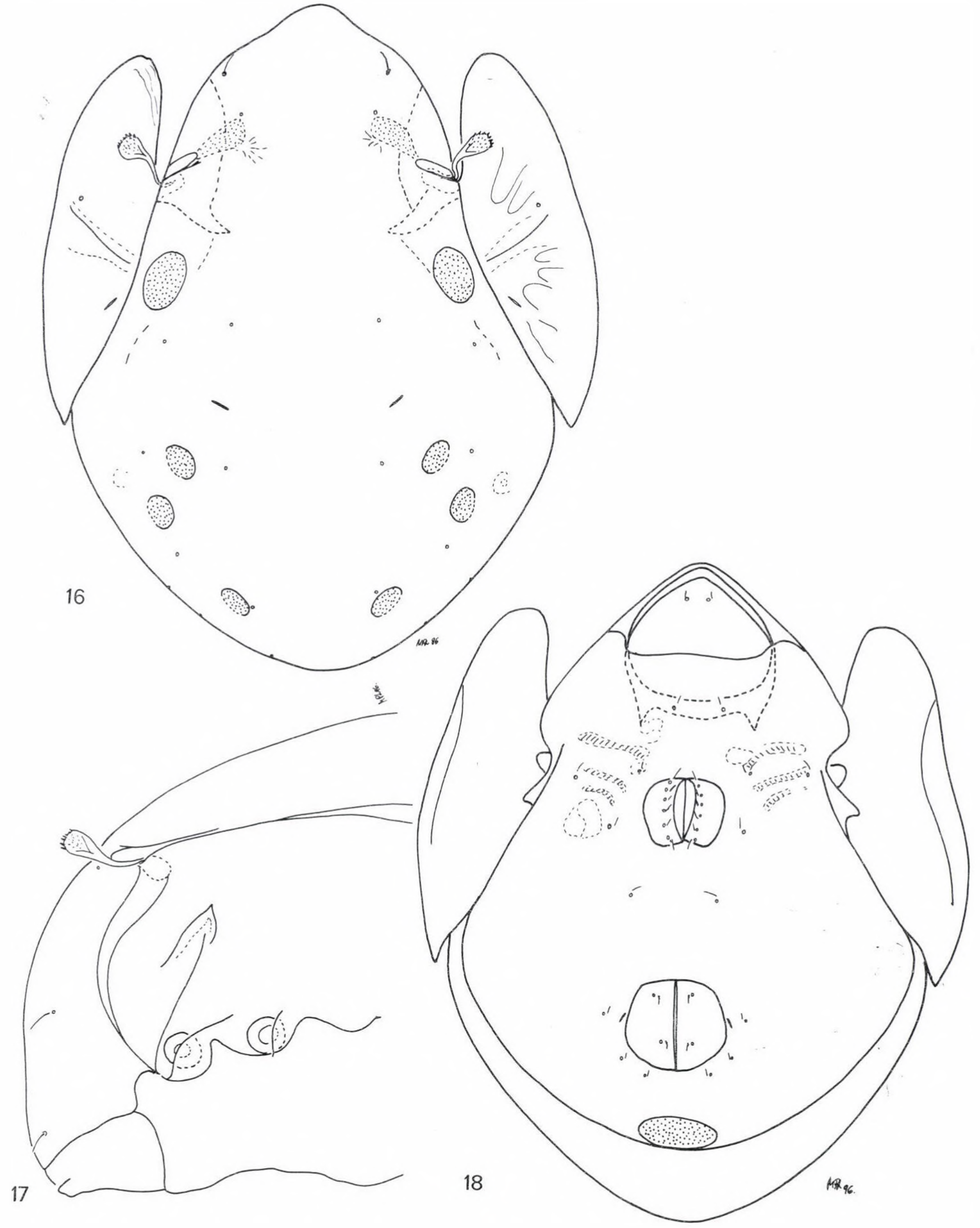
Measurements. – Length of body: 372–390 µm, width of body: 174–280 µm.

Prodorsum: Rostrum widely rounded. Lamellar and rostral setae simple, short, glabrous and fine, interlamellar setae absent, represented only by their alveoli. Sensillus short, with conspicuously dilated head, bearing short, distinct spines on its anterior margin (Fig. 15).

Figs 13-15. *Allogalumna pocsi* sp. n.: 13 = dorsal aspect, 14 = lateral part of podosoma, 15 = ventral aspect



Figs 16-18. *Allogalumna superporosa* sp. n.: 16 = dorsal aspect, 17 = lateral part of podosoma, 18 = ventral aspect



Notogaster: Strongly narrowed posteriorly, its shape characteristic. Dorsosejugal suture absent between very large, guttiform areae porosae dorsosejugales and dorsophragmatic apophyses *hy*. Ten pairs of alveoli and four pairs of porose areas well visible. Among porose areas *Aa* largest, A_1 and A_2 located conspicuously near to each other, *A3* slightly smaller and placed posteriorly. Median pore absent. Lyrifissures *im* located medially (Fig. 14).

Lateral part of prodorsum: Sublamellar line conspicuous, rest of sculpture shown in Fig. 15.

Ventral regions: Epimeral setae deficient, epimeral surface ornamented by some weak spots. Epimeral setal formula: 1 – 1 – 2 – 1. Only one pair of setae arising on anterior margin of genital plates, all arising in one arched longitudinal row (Fig. 16). All setae in anogenital region very short. A very large, oval porose area postanalis present. Lyrifissures *iad* located in adanal position.

Legs: Chaetotaxy of legs typical for the genus.

Material examined: holotype (1548–HO–1996) – Malagasy Republic. Central East Madagascar. Degraded montane rainforest on Mt. Ambatokirijy at the southern edge of Andasibe (Perinet) Forest Reserve, at 950–1000 m alt. 18°57'15''S, 48°26'20''E, 3 Oct. 1994. Leg. Dr. T. Pócs. One paratype collected from the same sample. Holotype in HNHM, 1 paratype in MHNG.

Remarks: The new species is well characterised by the unusual shape of the notogaster, the very large porose areas and the form of the sensillus. This combination of characters is otherwise unknown in this genus.

Derivatio nominis: The species is named after the conspicuously large porose areas of the body.

Galumna armatifera sp. n.
(Figs 19–22)

Measurements. – Length of body: 361–379 µm, width of body: 278–290 µm.

Prodorsum: Lamellar (*L*) line conspicuous even in dorsal view (Fig. 19). Lamellar and rostral setae short, glabrous and fine, interlamellar setae absent, represented only by their alveoli. Sensillus long, with gradually dilated head, blunt at tip; head directed anterolaterally, with some conspicuous spines or spicules. Areae porosae dorsosejugales large, guttiform.

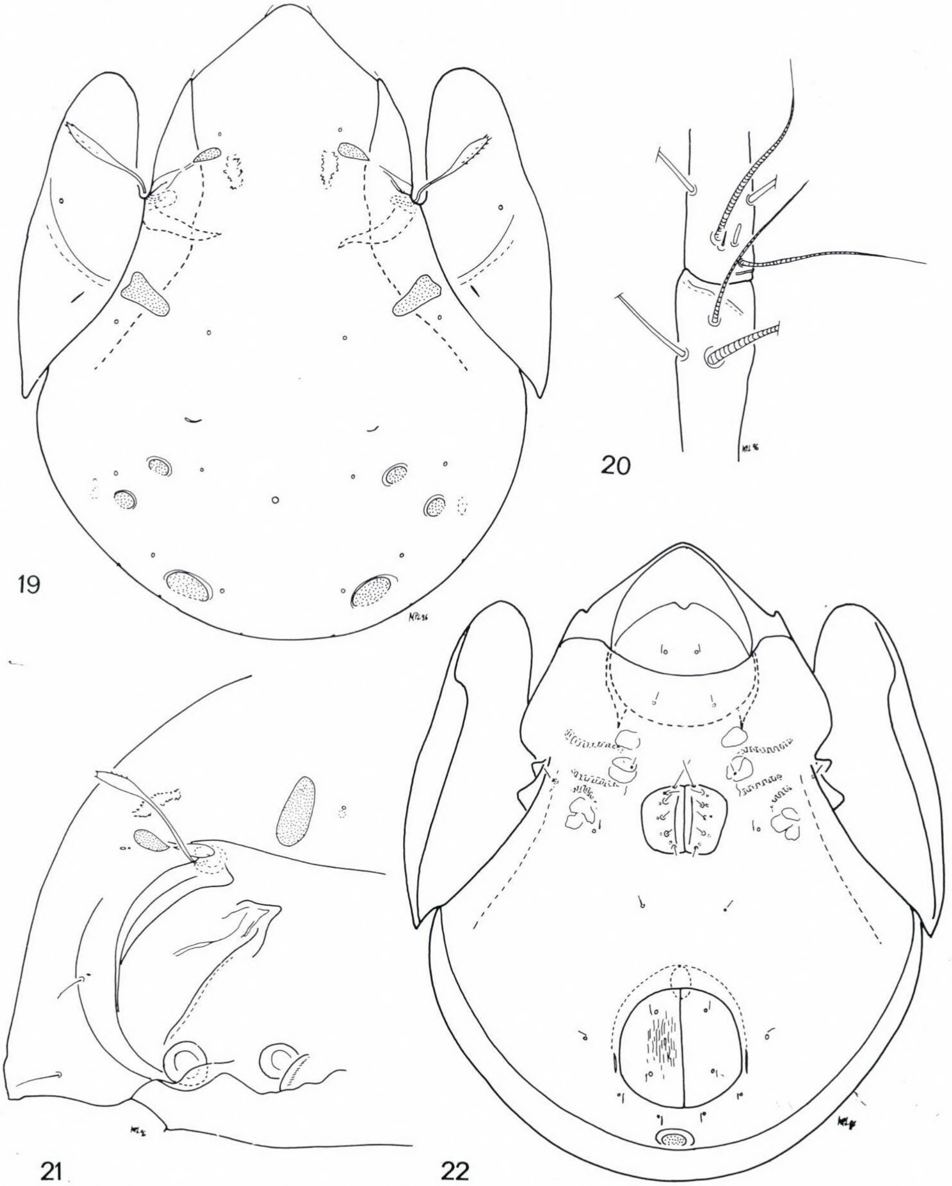
Lateral part of prodorsum: Lamellar (*L*) lines distinct, sublamellar (*S*) ones sometimes hardly observable, slightly converging anteriorly (Fig. 21). Circumpedal carina weak, but comparatively long.

Notogaster: Dorsosejugal suture absent between the areae porosae dorsosejugales. Surface of notogaster smooth. Of the porose areas *Aa* largest, elongated transversally; A_1 and A_2 located near each other, both nearly round and much smaller than the more distant A*3*. Median pore present. Lyrifissures *im* slightly more medial than their normal position (Fig. 19).

Ventral regions: Epimeral setae deficient, typical for the genus. Epimeral surface ornamented by some weak spots. Genital aperture broad, with a sharp line on surface. Size of anal plates normal. Only one pair of setae arising on anterior margin of genital plates, all others inserted behind it, along an almost longitudinal line. Seta g_1 comparatively long, its base simple, the other five very short, with conspicuously large alveoli (Fig. 22). All other setae in anogenital region very short and simple, apparently rigid. Anal plates normal, their surface distinctly lineolate (Fig. 22). A distinct, almost round area porosa postanalis (*ap*) present. Of the adanal setae ad_1 and ad_2 inserted behind anal aperture, setae ad_3 and lyrifissures *iad* in adanal position.

Legs: All legs tridactylous. Position of basal setae and solenidia of tarsus and tibia I as shown in Fig. 20. Many setae on ventral part of legs with conspicuously strong spines, e.g. all setae of tibia IV (*l', v', v''*) and setae *pv'* on tarsi IV.

Material examined: holotype (1555–HO–1996) – Malagasy Republic. Central East Madagascar. Degraded montane rainforest on Mt. Ambatokirijy at the southern edge of Andasibe (Perinet) Forest Reserve, at 950–1000 m alt. 18°57'15''S, 48°26'20''E, 3 Oct. 1994. Leg. Dr. T. PÓCS. Five paratypes collected from the same sample. Seven paratypes: Malagasy Republic, Masoala peninsula, tropical rainforest at the west coast on the sideridge E of Ambanizana village, at 100–450 m alt 15°37'S, 49°59'east 9–11. September 1994. Holotype and 11 paratypes deposited in HNHM, 1 paratype in MHNG.



Figs 19-22. *Galumna armatifera* sp. n.: 19 = dorsal aspect, 20 = solenidial group of leg I, 21 = lateral part of podosoma, 22 = ventral aspect

Remarks: The new species resembles *Galumna dimidiata* ENGELBRECHT, 1969 from South Africa in the form of the notogastral porose areas. However, it is distinguished from it by the presence of the dorsosejugal suture. The new species differs from all the hitherto known *Galumna* species in the peculiar form of the sensillus.

Derivatio nominis: This species is named after the club–like, spinose sensilli.

Leptogalumna reducta sp. n.
(Figs 23–26)

Measurements. – Length of body: 233 μm, width of body: 153 μm.

Prodorsum: Elongated, gradually narrowing anteriorly. Lamellar line absent (typical for this genus), sublamellar line short, weakly developed. Rostral, lamellar and interlamellar setae fine, short and smooth. Sensillus long, setiform, directed backwards, strongly arched at its distal end and bearing eleven, comparatively strong spines ordered unilaterally. Dorsosejugal porose area reduced, only one porus observable in it.

Notogaster: Dorsosejugal suture slightly concave medially, conspicuous. Surface of notogaster smooth, ten pairs of short setae and four pairs of areae porose observable on it (Fig. 23). Porose areas reduced, Aa, the largest, bearing many pori, A_1, A_2 and A_3 each with one or two pori.

Lateral part of prodorsum: Sublamellar line ending far from acetabulum of leg I (Fig. 25). Pedotecta 1 small, flatly arched.

Gnathosoma: Chelicera and palp typical for the genus.

Ventral regions: Epimeral surface mostly smooth, only some irregular spots observable. Apodemes and epimeral borders weakly developed, epimeral setal formula: 1 – 1 – 1 – 1. Circumpedal carina short, ending far from lateral margin of ventral plate (Fig. 25). Anogenital setal formula: 6 – 1 – 2 – 3 (only 5 pairs of setae arising on one of genital plates). Of the adanal setae ad_1 and ad_2 comparatively long, arising along an arched thickening behind anal aperture. Lyrifissures *iad* long, in clearly inverse apoanal position (Fig. 24).

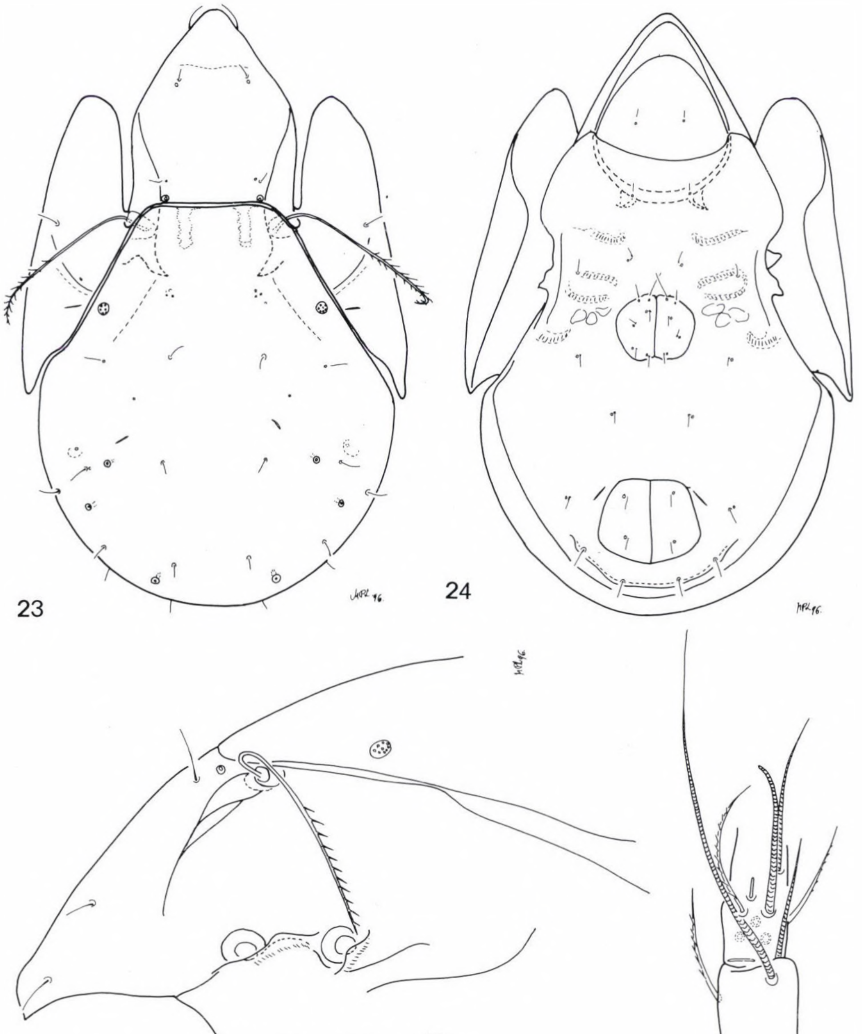
Legs: All legs monodactylous (typical for this genus). Solenidial group of leg I as shown in Fig. 26. E located between solenidia om_1 and om_2.

Material examined: holotype (1539–HO–1996) – Malagasy Republic. Central East Madagascar. Degraded montane rainforest on Mt. Ambatokirijy at the southern edge of Andasibe (Perinet) Forest Reserve, at 950–1000 m alt. 18°57'15''S, 48°26'20''E, 3 Oct. 1994. Leg. Dr. T. PÓCS.

Remarks: The genus *Leptogalumna* BALOGH, 1960 was described from Angola, and previously only the type species (*L. spinosa*) had been known. The new species is distinguished from it by the smooth interlamellar setae (clearly ciliate in the examined paratypes of *L. spinosa*). The much shorter sublamellar line (reaching to the acetabulum in *L. spinosa*), and by the shape of the porose areas of the notogaster (not reduced in *L. spinosa*), position of setae *4b*. Lyrifissures *iad* are inverse apoanal in both species (it may be a generic character), but in the new species located anteriorly.

Derivatio nominis: The new species is named after the peculiarly reduced porose areas of the notogaster.

Figs 23–26. *Leptogalumna reducta* sp. n.: 23 = dorsal aspect, 24 = ventral aspect, 25 = lateral part of podosoma, 26 = solenidial group of leg I

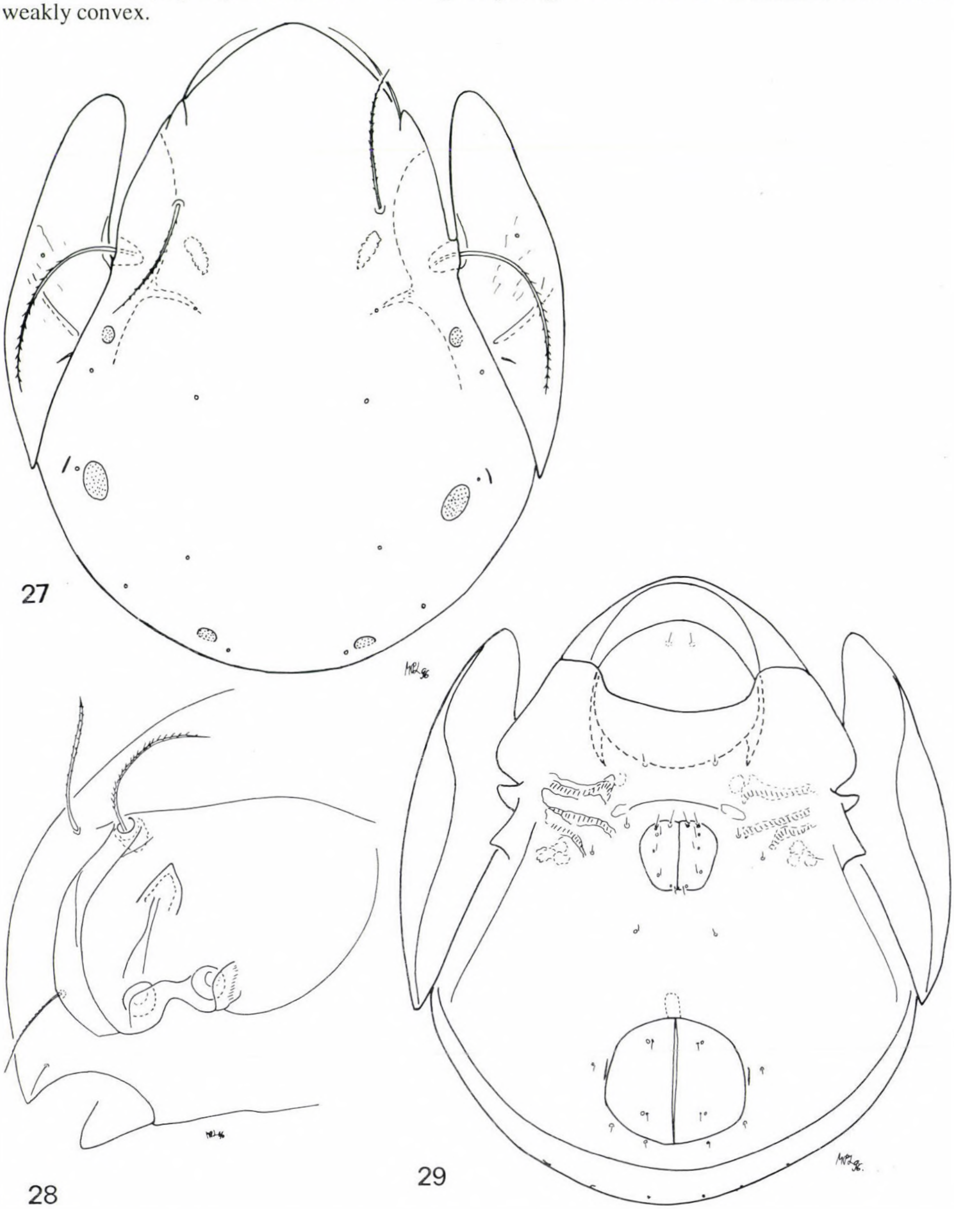


Pergalumna andasibe sp. n.
(Figs 27–29)

Measurements. – Length of body: 340–395 µm, width of body: 268–313 µm.

Prodorsum: Lamellar (*L*) and sublamellar line (*S*) conspicuous in dorsal aspect (Fig. 27), insertion of lamellar setae between lamellar lines also visible. Rostral setae short, lamellar ones longer, both pairs thin, simple. Interlamellar setae thickest and longest of all, well spiculate. Sensillus very long, setiform, directed backwards, with approximately 20 short, but distinct spines. Notogaster: Dorsosejugal suture and dorsosejugal areae porosae absent, dorsophragmatic apophyses comparatively large. Ten pairs of small alveoli and three pairs of porose areas present. Among the latter *Aa* is conspicuously small, round, A_1 much larger, elliptical. Porose area A_2 similar to *Aa*. Lyrifissures *im* located laterally, near to porose area A_1 (Fig. 27)

Lateral regions of podosoma: Lamellar and sublamellar lines slightly diverging from each other medially (Fig. 28). Lines T and E strong, very long, lines T directed towards E. Pedotecta 1 weakly convex.



Figs 27–29. *Pergalumna andasibe* sp. n.: 27 = dorsal aspect, 28 = lateral part of podosoma, 29 = ventral aspect

Ventral regions: Epimeral surface with a few spots, an arched line observable in sejugal region. All epimeral setae minute (Fig. 29). Genital and anal setae smooth, two pairs of setae arising on anterior margin of genital plates. All setae in anogenital region also minute, their position and the lyrifissures *iad* as shown in Fig. 29.

Legs: Chaetotaxy of legs having pergalumnoid characters. Tarsus I with solenidium om_2 posteriorly. Setal formulae of legs:

I: O – 4 – 3+1 – 4+2 – 19+2 – 3,
IV: 1 – 2 – 2 – 3+1 – 12 – 3.

Material examined: holotype (1549–HO–1996) – Malagasy Republic. Central East Madagascar. Degraded montane rainforest on Mt. Ambatokirijy at the southern edge of Andasibe (Perinet) Forest Reserve, at 950–1000 m alt. 18°57'15''S, 48°26'20''E, 3. Oct. 1994. Leg. Dr. T. PÓCS. Seventeen paratypes collected from the same sample. Holotype and 15 paratypes deposited in HNHM, 2 paratypes in MHNG.

Remarks: In spite of the fact that the lamellar setae arise between the lamellar lines, the generic affiliation of this new species is rather problematic, because the median pori is absent in both sexes. Nevertheless, in my opinion, it belongs to the genus *Pergalumna* GRANDJEAN, 1936. The new species differs from all hitherto known species of this genus by the very small porose area *Aa*, and the much larger porose area A_1. The direction of the lamellar and sublamellar lines and the form of pedotecta 1 are also characteristic.

Derivatio nominis: This species is named after the type locality.

Pergalumna fastigata sp. n.
(Figs 30–33)

Measurements: Length of body: 476–499 µm, width of body: 334–368 µm.

Prodorsum: Rostral part wide, rounded. Lamellar and sublamellar line also clearly observable in dorsal aspect (Fig. 30). Rostral and lamellar setae simple, fine, interlamellar setae minute and hardly observable. Sensillus narrow, directed backwards, finely roughened.

Notogaster: Dorsosejugal suture and dorsosejugal porose areas absent. Dorsophragmatic apophyses present, comparatively large, conspicuously long. Ten pairs of small alveoli and three pairs of round, comparatively small porose areas present. Lyrifissures *im* located laterally, near porose area A_1 (Fig. 30)

Lateral regions of podosoma: Lamellar and sublamellar lines running nearly parallel to each other (Fig. 32). Pedotecta 1 convex.

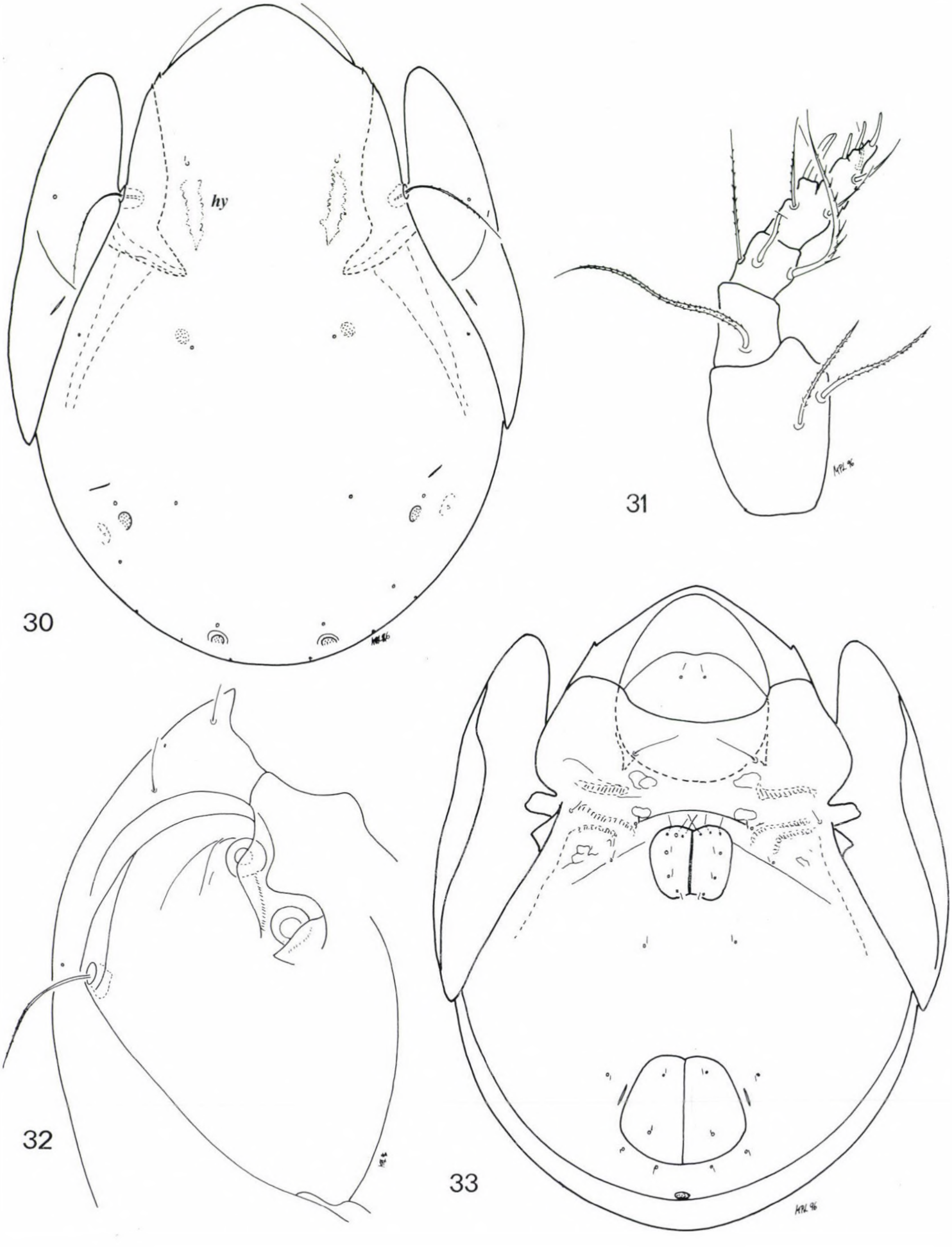
Ventral regions: Epimeral surface with few spots, an arched line observable in sejugal region. Among epimeral setae *1a* are conspicuously long, much longer than others (Fig. 33). Surface of genital and anal plates smooth, three pairs of setae arising on anterior margin of genital plates. All setae in anogenital region also minute, their position and lyrifissures *iad* as shown in Fig. 33.

Gnathosoma: Form and setation of palp as shown in Fig. 31.

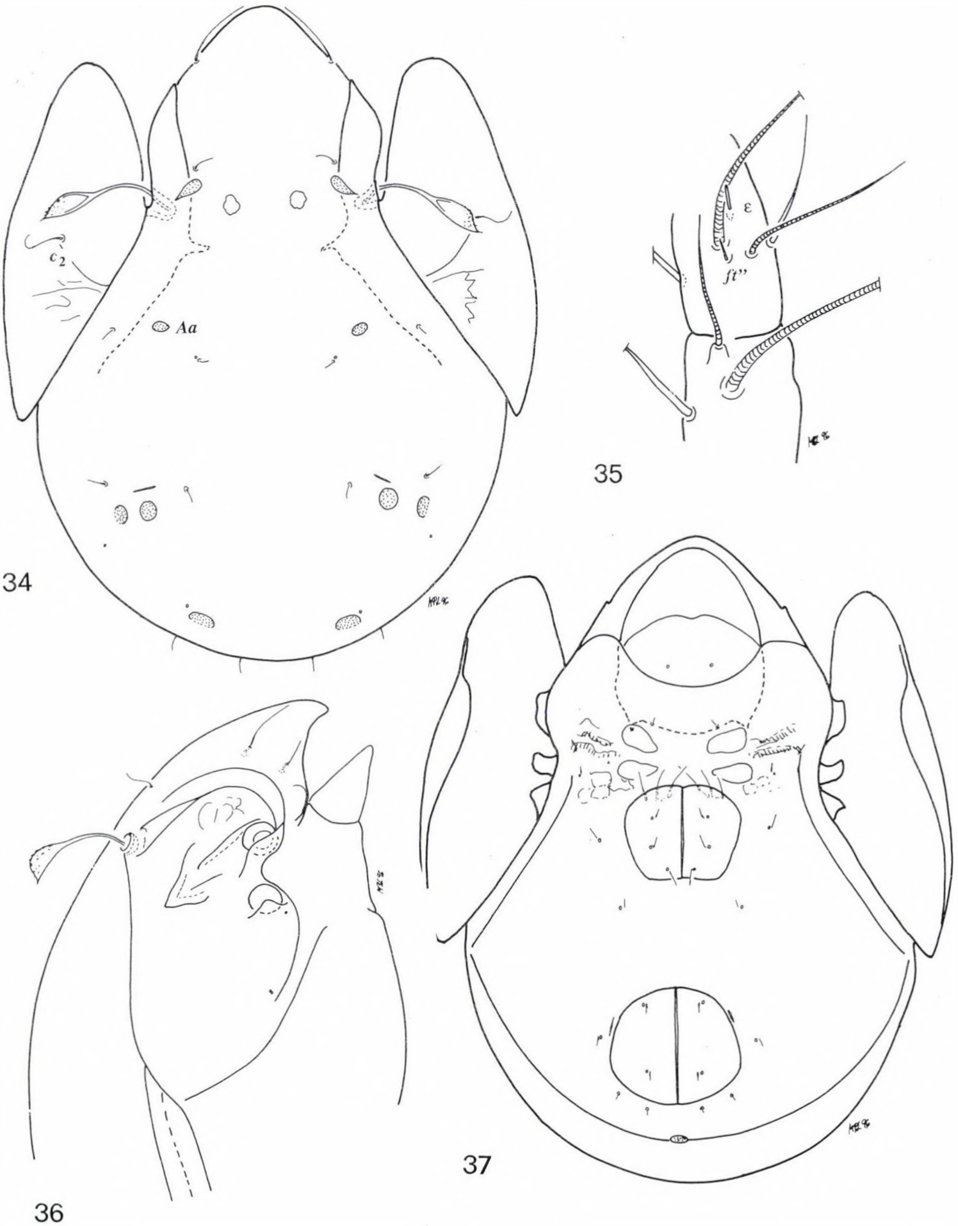
Legs: All legs tridactylous, strong heterodactyly present. Seta *ft''* of tarsus I arising far from solenidium om_1, *epsz* located between om_1 and om_2.

Material examined: (holotype 1551–HO–1996) – Malagasy Republic, Masoala peninsula, tropical rainforest at the west coast on the sideridge east of Ambanizana village, at 100–450 m alt

Figs 30–33. *Pergalumna fastigata* sp. n.: 30 = dorsal aspect, 31 = palp, 32 = lateral part of podosoma, 33 = ventral aspect



Figs 34–37. *Trichogalumna madagassica* sp. n.: 34 = dorsal aspect, 35 = solenidial group of leg I, 36 = lateral part of podosoma, 37 = ventral aspect



15°37'S, 49°59'E. 9–11th September, 1994. Ten paratypes from the same sample. Holotype and 9 paratypes deposited in HNHM, 1 paratype in MHNG.

Remarks: The new species is well characterised by the peculiarly long epimeral setae *1a*. This feature and the form of the dorsophragmatic apophyses was hitherto unknown in the genus *Pergalumna* GRANDJEAN, 1936.

Derivatio nominis: This species is named after the peculiar form of the dorsophragmatic apophyses: fastigatus (Latin) = sloping.

Trichogalumna madagassica sp. n.
(Figs 34–37)

Measurements. – Length of body: 356–368 µm, width of body: 252–260 µm.

Prodorsum: Rostrum conical. Lamellar (*L*) lines well observable, slightly protruding in dorsal view (Fig. 34). Lamellar setae conspicuously long, rostral setae shorter; interlamellar setae shortest of all and characteristically bending inwards. All setae glabrous and fine. Sensillus long, directed outwards and backwards, its head lanceolate, this part clearly asymmetric, its surface finely spiculate.

Lateral part of prodorsum: Lamellar (*L*) and sublamellar (*S*) lines conspicuous, running parallel, lamellar setae arising between lamellar lines. Other structures as shown in Fig. 36.

Notogaster: Dorsosejugal suture absent, area porosae dorsosejugales small. Ten pairs of short and fine notogastral setae clearly observable, setae c_2 longer then others. Four pairs of porose area present: *Aa* located far from pteromorphae, slightly elongated transversally; A_1 and A_2 located very near to each other; *A1* larger than *Aa*; A_3 standing far from A_1 and A_2. Median pore absent. Lyrifissures *im* located slightly more medially than normal, hence situated characteristically near to each other (Fig. 37).

Ventral regions: Epimeral setae deficient, epimeral setal formula 1 – 0 – 2 – 1. Epimeral surface ornamented by large spots, two wide transversal areas also well observable on surface. Three pairs of setae arising on anterior margin of genital plates, all others inserted along a longitudinal line (Fig. 37). All other setae in anogenital region very short and simple, all apparently rigid. A small, oval area porosa postanalis (*ap*) present. Lyrifissures *iad* located in adanal position.

Legs: Position of basal setae and solenidium of tarsus and tibia I as shown in Fig. 35.

Material examined: holotype (1552–HO–1996) – Malagasy Republic. Central East Madagascar. Degraded montane rainforest on Mt. Ambatokirijy at the southern edge of Andasibe (Perinet) Forest Reserve, at 950–1000 m alt. 18°57'15''S, 48°26'20''E, 3 Oct. 1994. Leg. Dr. T. PÓCS. One paratype collected from the same sample. Holotype deposited in HNHM, 1 paratype in MHNG.

Remarks: The shape of the notogastral porose areas (*Aa* A_1) and the great difference among the setae, c_2 setae more than two times longer than the others, are unique in the genus Trichogalumna.

Derivatio nominis: This species is named for its country of origin.

Acknowledgement – This work was supported by the Hungarian Scientific Research Fund (OTKA grant number T 16729). I am very grateful to two anonymous referees for their suggestions and very careful review of the manuscript.

REFERENCES

BALOGH, J. (1960) Oribates (Acari) nouveaux d'Angola et du Congo Belge (2^{eme} série). *Publcoes cult. Co. Diam. Angola* **51**: 13–40.

BALOGH, J. (1962) Reserches sur la faune endogee de Madagascar. VII. Oribates (Acariens) nouveaux. II. *Naturaliste malgache* **13**: 121–151.

BALOGH, J. and P. BALOGH (1992) The Oribatid Mites Genera of the World I-II. *Hungarian Natural History Museum*, Budapest, pp. 263–375.

ENGELBRECHT, C. M. (1969) Some South African species of the genus Galumna Von Heyden, 1826 (Acari: Galumnidae). *J. ent. South Afr.* **32**: 99–122.

ENGELBRECHT, C. M. (1972*a*) Galumnids from South Africa (Galumnidae, Oribatei). *Acarologia* **14**: 109–140.

ENGELBRECHT, C. M. (1972*b*) Dimidiogalumna villierensis (Galumnidae: Oribatei), a new South African galumnid genus and its type species. *Acarologia* **14**: 141–149.

ENGELBRECHT, C. M. (1972*c*) South African species of the genus Trichogalumna Balogh, 1961 (Galumnidae: Oribatei). *Acarologia* **14**: 268–280.

ENGELBRECHT, C. M. (1973) South African Galumnoidea (Oribatei: Acari): new taxa and records. *Navors. nas. Mus., Bloemfontein*, pp. 394–415.

MAHUNKA, S. (1986) Studies on the Oribatid fauna of Kenya (Acari: Oribatida) II. *Folia ent. hung.* **47**: 77–102.

MAHUNKA, S. (1990) Notes and remarks on Oribatid taxa (Acari), I. *Annls hist.-nat. Mus. natn. Hung.* **82**: 191–215.

MAHUNKA, S. (1993) New and interesting mites from the Geneva Museum LXXVI. Oribatids from Madagascar I. (Acari: Oribatida). *Revue suisse Zool.* **100**(2): 289–315.

MAHUNKA, S. (1994) New and interesting mites from the Geneva Museum LXXIX. Oribatids from Madagascar II. (Acari: Oribatida). *Revue suisse Zool.* **101**(1): 47–88.

MAHUNKA, S. (1995) Oribatids from Sabah, East Malaysia (Acari Oribatida, Parakalummoidea n. stat. and Galumnoidea). *Tropical Zoology* **8**: 269–308.

MAHUNKA, S. (1996) New and interesting mites from the Geneva Museum LXXXIII. Oribatids from Madagascar III. (Acari: Oribatida). *Revue suisse Zool.* (in print)

Received July 12, 1996, accepted December 20, 1996

The oribatid species described by Berlese (Acari)

MAHUNKA, S. and L. MAHUNKA-PAPP

The authors had the opportunity for years to study the Oribatid species described by Berlese currently deposited in the Istituto Sperimentale per la Zoologia Agraria at Florence. The results of this series of studies are summarized in this volume.

The volume begins with an essay-like Introduction heavily relying on subjective opinions discussing the general questions of Oribatology. The following section lists Berlese's species placed in the modern system helping the specialists with morphological notes and many drawings; here also the condition of the specimens is discussed and lectotypes are designated.

The third, large section is the catalogue proper, wherein all the species are listed in the systematic order together with their combination and synonymic names. Here one may find all the literature data, usually missing from ordinary works, with reference to Description and Taxonomy, Distribution, with special emphasis on Catalogues whose references are partly unreliable. Where it was deemed necessary further information are added under the heading of Remarks. The volume closes with a very detailed list of literature.

ISBN 963 7093 27 3
325 pages with several figures. Soft bound.
© Hungarian Natural History Museum, Budapest, 1995
Price: 40 US dollars excl. p. & p.

Order should be sent
to the Hungarian Natural History Museum, Library
Baross u. 13., Budapest, H–1088 Hungary
Fax: (36–1) 1171669

ACTA ZOOLOGICA
ACADEMIAE SCIENTIARUM HUNGARICAE

An international journal of animal taxonomy and ecology

Instruction to authors

Submission of a paper implies that it has not been published previously, that is not under consideration for publication elsewhere, and that if accepted for the Acta Zoologica Hungarica, the authors will transfer copyright to the Hungarian Academy of Sciences/the Hungarian Natural History Museum as is customary. Articles and illustrations become the property of the HAS/HNHM.

Papers must be in English with British spelling, and be original contributions in the field of animal taxonomy, systematics, zoogeography and ecology. All manuscripts must be submitted to one of the editors (editor, assistant editor).

Entire manuscripts must be submitted on IBM compatible floppy disk and in duplicate printed copies and the author should retain a copy. In the case of multiple authors, the corresponding author should be indicated. Series of numbered papers will not be considered.

Manuscripts must be printed with double spacing (including the reference list), and with wide margins (30–35 mm) on the left side of the paper only. Authors are requested to keep their communications as concise as possible. Footnotes should be avoided or minimized, and italics should not be used for emphasis. A running head of not more than 30 letters should be supplied.

The manuscript should contain the following information:

Title should be followed by the name and full address of the author(s). Where possible, the fax and/or e-mail number of the corresponding author should be supplied with the manuscript, for use by the publisher.

Abstract should be a brief summary of the contents and conclusions of the paper, and should not be longer than 200 words and should not contain references.

Key words should not be more than five (exceptionally 6) key word entries.

Introduction should contain a brief survey of the relevant literature and the reasons for doing the work.

Materials and Methods supply sufficient information to permit repetition of the experimental or field work. The technical description of methods should be given only when such methods are new.

Results should be presented concisely. Only in exceptional cases will it be permissible to present the same set of results in both table and a figure. The results section should not be used for discussion.

Discussion should be separate from the results section and should deal with the significance of the results and their relationship to the object of the work (and, this is the place of the identification key in taxonomic revisions).

Acknowledgements (at most in 10 lines).

References. In principle the Harvard system is to be followed. References should be detailed in the following order: authors' names and initials, date of publication (in parentheses), the title of the article, the name of the journal as abbreviated in the World List of Scientific Periodicals (4th edn 1963), the volume, and the first and last pages of the article, e.g.

NORRBOM, A. L. and KIM, K. C. (1985) Taxonomy and phylogenetic relationships of Copromyza Fallén (s.s.) (Diptera: Sphaeroceridae). *Ann. Entomol. Soc. Am.* **78**: 331–347.

For books the author's names, date of publication, title, edition, page reference, publisher's name and the place of publication should be given, e.g.

HINTON, H. E. (1981) *Biology of insect eggs*, vol. 2. Pergamon Press, New York.

or

MCALPINE, J. F. (1981) Morphology and terminology, adults, pp. 9–63. *In* MCALPINE *et al.* (eds) *Manual of Nearctic Diptera*, vol. 1. Agriculture Canada, Ottawa.

In the text references should be given as MARSHALL (1992) or (MARSHALL 1992). When a citation includes more than two authors, e.g. GREY, BLACK and WHITE, the paper should be referred to in the text as GREY *et al.*, provided that this not ambiguous. If papers by the same author(s) in the same year are cited, they should be distinguished by the letters, *a, b, c,* etc., e.g. MARSHALL (1992*a*).

References to papers "in press" must mean that the article has been accepted for publication. References to "personal communications" and unpublished work are permitted in the text only: references to papers in preparation or submitted are not permissible.

All necessary **illustrations** should accompany the manuscript, but should not be inserted in the text. All photographs, graphs and diagrams should be numbered consecutively in Arabic numerals in the order in which they are referred to in the text. Glossy photographs or positive prints should be sent unmounted wherever possible and should be kept to a minimum. Figures should be of good quality. Explanation of lettering and symbols should be given in the figure caption and only exceptionally in the figures. Lettering and symbols to appear on the illustration should be of sufficient size to allow for considerable reduction where necessary (usually proper for a 50% reduction in size). Scales must be indicated on micrographs, not by magnifications in the legends. Figure size must not exceed 24×30 cm. On the back of each illustration should be indicated the author's name, the figure number (in Arabic numerals), and the top of the illustration, where this is not clear. Halftones should be included only when they are essential. Details and quotation of publication of colour plates should be made to the editors. The following symbols should be used on line drawing: ● ■ ❍ ❑ ▲ ◆ ♦ etc.

Legends to figures should be typed on a separate sheet. They should give sufficient data to make the illustration comprehensible without reference to the text.

Tables and appendices should be constructed so as to be intelligible without reference to the text, numbered in Arabic numerals and typed on separate sheets. Every table should be provided with an explanatory caption and each column should carry an appropriate heading. Units of measure should always be indicated clearly (metric units are preferred). All tables and figures must be referred to in the text.

Only standard **abbreviations** should be used. Arbitrary abbreviations and jargon will not be accepted.

The Latin names should be given for all species used in the investigation, although taxonomic affiliation and authority need not be provided in the title.

Page proofs will be sent to the author (or the first-mentioned author in a paper of multiple authorship) for checking. Corrections to the proofs must be restricted to printers' errors. Any substantial alterations other than these may be charged to the author. Authors are particularly requested to return their corrected proofs as quickly as possible in order to facilitate rapid publication. Please note that authors are urged to check their proofs carefully before return, since late corrections cannot be guaranteed for inclusion in the printed journal.

Fifty reprints free of charge will be sent to the first author; extra copies of the issue (at a specially reduced rate) can be ordered on the form which will accompany the proofs. These should be returned to: The Editorial Office of the Acta Zoologica, Hungarian Natural History Museum, Budapest, Baross u. 13, H–1088, Hungary

The **page charge** required from authors outside Hungary is USD 15 per printed page. In exceptional cases, the page charge may be waived. Please contact the editor in before submitting a paper if you ask for a waiver. Authors of papers exceeding 16 printed pages are asked to pay USD 40 (or HUF equivalent) for each such page, i.e. all costs of publication (irrespective of their nationality).

FOR FURTHER INFORMATION PLEASE CONTACT US
The Editorial Office of the Acta Zoologica
H–1088 Budapest, Baross u. 13, Hungary
Fax: (36–1) 1171669
E-mail: h7962per@ella.hu

SUBSCRIPTION INFORMATION

Orders should be addressed to

Editorial Office of the Acta Zoologica
Hungarian Natural History Museum
H-1088 Budapest, Baross u. 13, Hungary
Fax: (36–1) 1171669
E-mail: H7962PER@ELLA.HU

Typeset: Pars Ltd., Budapest.
Printed by Dabas Jegyzet Ltd., Hungary

CONTENTS

HU ISSN 1217–8837

Acta Zoologica

Academiae Scientiarum Hungaricae

VOLUME 42 - NUMBER 3 - 1996

HUNGARIAN NATURAL HISTORY MUSEUM, BUDAPEST

ACTA ZOOLOGICA ACADEMIAE SCIENTIARUM HUNGARICAE

AN INTERNATIONAL JOURNAL OF
ANIMAL TAXONOMY AND ECOLOGY

Acta Zoologica Academiae Scientiarum Hungaricae is published quarterly from February 1994 (other issues in May, August and November) by the Hungarian Natural History Museum and the Biological Section of the Hungarian Academy of Sciences with the financial support of the Hungarian Academy of Sciences.

Acta Zoologica Academiae Scientiarum Hungaricae 42 (3), pp. 163–172, 1996

EDGE EFFECTS IN TROPICAL VERSUS TEMPERATE FOREST BIRD COMMUNITIES: THREE ALTERNATIVE HYPOTHESES FOR THE EXPLANATION OF DIFFERENCES

A. BÁLDI

Animal Ecology Research Group of the Hungarian Academy of Sciences,
Hungarian Natural History Museum,
H–1088 Budapest, Baross u. 13, Hungary

The forest edge is the outermost belt of a relatively homogeneous wooded area. The presence and abundance of animals usually differ between edge and interior habitats. Both temperate and tropical zone forest bird communities have been shown to be affected by edges. However, the response of bird communities differs in the two zones: diversity and density usually increase in temperate forest edges, but decline in tropical edges. I propose three alternative hypotheses to explain the observed differences. Hypothesis 1 considers the spatial pattern of the vegetation in Europe and Amazonia, and proposes that pattern in Europe is naturally more patchy, and hence contains more edges. Hypothesis 2 states that changes in vegetation pattern during glaciation were more pronounced in Europe than in Amazonia, resulting in more heterogeneous and patchy vegetation. I discuss this hypothesis in the light of recent views that argue that Amazonia was much more dynamic than previously believed. Hypothesis 3 suggests that human disturbances during historical times may also account for edge creation. The three processes underlying the hypotheses together created a more fragmented landscape in Europe, and temperate zone forest bird communities are adapted to this habitat, whereas those in the tropics do not tolerate fragmentation and edge creation.

Key words: tropical versus temperate forest edges, bird communities, spatial and temporal variations, human activity

INTRODUCTION

The extreme bird species richness of tropical forests has puzzled naturalists for a long time (e.g. WALLACE 1876, HUTCHINSON 1959). The difference between the structure of tropical and temperate bird communities remains a key issue in avian ecology (e.g. THIOLLAY 1990), since not only the number of species but other characteristics of the communities are also different (e.g. number of guilds, body sizes within guild). However, there are no clear explanations for the differences, and several conventional ideas have recently been challenged. For example, it was widely accepted that survival rates of adult birds are higher in the humid tropics than in temperate areas, but in a detailed comparison KARR *et al.* (1990) did not find any evidence for it. TERBORGH (1985) showed that the widespread conviction that the structural qualities of the habitat alone may account for the large diversity of tropical rain forests cannot be supported. Other factors, like resources and competitors, should also be taken into account.

Regarding the large differences between tropical and temperate ecosystems, it is not surprising that bird community ecologists have found significantly different responses of forest bird communities to habitat edges in the two zones. Due to the difficulties in censusing birds in tropical rain forests (e.g. up to 500 species on several km^2, unknown vocalisation), the edge effect in this habitat has been described only in the last few years (TERBORGH *et al.* 1990, THIOLLAY 1994).

In the present paper I propose three hypotheses to explain the different effects of habitat edge on bird communities in the forests of the temperate and the tropical zones. These hypotheses consider differences in (1) the spatial pattern of vegetation, (2) the temporal dynamics of vegetation patterns during glaciation, and (3) human disturbances.

EDGE EFFECTS IN TEMPERATE AND TROPICAL FORESTS

The distribution of organisms usually differs between edge and interior habitats. This is the so-called edge effect. (Note that there are several different definitions in the literature.) The phenomenon was already known by the beginning of this century, and during the last few decades many papers have been published on this topic. However, these papers almost exclusively dealt with temperate zone forests (ROSENBERG & RAPHAEL 1986, MURCIA 1995). A forest edge is the outermost belt of the forest, where the microclimate and vegetation is markedly different from that in interior forest habitats. In this study, I will focus on sharp edges, where a forest joins to a clear-cut area or agricultural land.

The differences between edge and interior bird communities in the temperate zone have been shown in several habitats: deciduous forests (e.g. FROCHOT 1987, FULLER & WHITTINGTON 1987, MOSKÁT & FUISZ 1994, BÁLDI & KISBENEDEK 1994), coniferous forests (e.g. HANSSON 1983) and plantations (BÁLDI & MOSKÁT 1994, MØLLER 1989) (Table 1). However, views on how animal communities respond to forest edges remain unresolved (e.g. REESE & RATTI 1988, MURCIA 1995). Conventional wisdom suggests that edges are beneficial for wildlife, but more recent studies and ideas have not always confirmed this hypothesis (HARRIS 1988, YAHNER 1988). For example, HELLE & HELLE (1982) and HANSSON (1983) found much greater density in the edge, but MARTIN (1983) found lower density on small than on larger islands, perhaps as a consequence of impoverished edges. All three results originated from Scandinavia. The confusion about how community structure parameters change across edges is not surprising, for even the distribution of individual species may vary. For example, the Robin (*Erithacus rubecula*), a small, temperate zone passerine

Table 1. Some examples of the edge effect on bird communities in the temperate zone (Europe). Edge: edge preferring species; Int.: interior preferring species; No effect: species occurring irrespectively of edges. The cited studies applied different census methods, which resulted in different species numbers. The study by MOSKÁT & FUISZ (1994) was carried out in oak forests with and without bush layer

Habitat	Edge	Int.	No effect	Source
Oak forest – meadow	13	3	48	FROCHOT 1987
Ash-lime forest – open farmland	9	0	9	FULLER & WHITTINGTON 1987
Coniferous forest – clear-cut area	8	2	4	HANSSON 1983
Oak forest – agricultural land	14	1	23	BÁLDI & KISBENEDEK 1994
Oak forest (bush) – open orchard	4	5	17	MOSKÁT & FUISZ 1994
Oak forest (no bush) – open orchard	7	6	18	MOSKÁT & FUISZ 1994

bird, has been shown to avoid deciduous forest edges (MOSKÁT & FUISZ 1994), to prefer edges (BÁLDI & KISBENEDEK 1994), and to occur irrespective of the edges (FULLER & WHITTINGTON 1987). We may conclude that edge effects in temperate zone forest birds vary both at the community and at the population levels.

The abundance and diversity of tropical rain forest bird communities has attracted the interest of ornithologists for a long time. The effects of forest fragmentation on bird distribution have also been studied in recent decades. The significant decline of the number of bird species due to fragmentation has been documented in several neotropical (TERBORGH & WINTER 1980) and paleotropical areas (NEWMARK 1991). Due to the lack of acceptable census methods for tropical rain forests and the huge number of bird species to census, there are only a few detailed studies of avian community structure (TERBORGH 1985, THIOLLAY 1994). In one of the detailed studies of an Amazonian forest bird community,

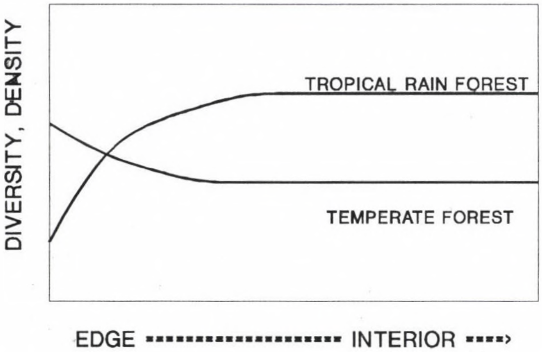


Fig. 1. Scheme of the different effects of forest edge on the structure of bird communities in the temperate and tropical zones

TERBORGH *et al.* (1990) found that the number of species remained unchanged or decreased in the edge, regardless of edge type. In another large study, Lovejoy *et al.* (1986) also found that the number of bird species declined in the edge of an Amazonian rain forest, as a consequence of high levels of habitat specificity. The similarity and consistency of these results of fragmentation and edge effects suggest remarkably different responses of temperate and tropical forest bird communities to forest edges (Fig. 1).

THREE ALTERNATIVE EXPLANATIONS FOR THE DIFFERENT EFFECTS OF EDGES ON BIRDS IN TROPICAL VERSUS TEMPERATE FORESTS

For the sake of simplicity, and because of the availability of data, I analysed historical and bird distributional data from the South-American tropical (the Amazon basin), and the European temperate zones. It is possible to include other regions, such as the Afrotropical or North-American temperate zones, but there might be difficulties, e.g.: i) the lack of quantitative data from other tropical rain forest edges; or ii) the different biogeographic situation of the European and the North American continents, due to the position of mountain barriers (UDVARDY 1983).

Below, I suggest three alternative hypotheses for the explanation of different edge effects. The first and second hypotheses consider space and time, respectively, the third evaluates human impacts. These hypothesis are not exclusive, the described processes can interact. However, my aim was to clearly show the possible mechanisms, thus I emphasised the differences between the processes rather than the similarities and interactions.

Hypothesis 1: *Different geomorphology in Europe and Amazonia*

The different geomorphology of Europe and Amazonia has resulted in different patchiness of vegetation on a continental scale. The area of the Amazon basin and Europe (including the East European Plain) is similar (7,180 000 km^2 and 10,508 000 km^2, respectively), but their geomorphology is quite different. While the former is only one drainage area, the latter consists of many river basins, high mountains, hills, plains and lakes, and is bordered by a rugged seashore for thousands of kilometres, resulting in many very different vegetation types. That is, on a continental scale Europe is naturally more patchy than Amazonia. The difference between the scale of patchiness in the two zones is apparent if we consider the drainage areas: Amazonia is one large basin, whereas in Europe the basins are smaller by nearly an order of magnitude (Table 2). Even the sum of the largest drainage areas in Europe is less than that of the Amazon basin.

Table 2. The area of Amazonia and the three largest European drainage basins, and Europe (in km^2)

Locality	Area (km^2)
River Amazonas	7.180 000
River Volga	1.360 000
River Danube	817 000
River Dneper	504 000
Europe	10.508 000

This patchiness of European geomorphology may led to the adaptation of bird species to these natural edges.

Hypothesis 2: *The vegetation in Amazonia was more stable during the glaciations than in Europe*

From a historical point of view, plant communities during the glaciations must be viewed as impermanent in Europe. Changes have occurred continuously, even on a fine time scale (ca. 1000 years) (ROY *et al.* 1996). Similar changes may have occurred at different times in different parts of Europe, or the changes may have differed between geographical areas (HUNTLEY 1988). During the last glaciation (about 20,000 to 18,000 yr BP), there were nine very different vegetation types in Europe, including arctic tundra, boreal vegetation, open woodlands, and semideserts (FRENZEL *et al.* 1992). Furthermore, vegetation zones have varied considerably over the last ca. 10,000 years. There was a periodical expansion of non-forested biomes during the glaciations and extension of forests during the interglaciations (VARGA 1995). Therefore, the predominance of edge bird species may be an adaptation to the discontinuously wooded habitat that was extensive in the non-glaciated parts of Europe (HUNTLEY 1988), and to the continuously changing pattern of vegetation cover.

The history of tropical rain forests during the glaciations was different. Conventional wisdom suggests (e.g. UDVARDY 1983), that there were no major changes in the vegetation, the changes in the climate were moderate, and the temperature in tropical lowlands remained high during the glacials. These areas were relatively stable in a paleontological sense (HAFFER 1981). However, there is controversy about how much disturbance there was. The recent view is that Amazonia was not as stable as previously believed (WEBB 1995). For example, STUTE *et al.* (1995) showed that the temperature in lowland Brazil was 5.4°C cooler during the last glacial than today. CAMPBELL (1991) argued that there was even a large lake in the Amazonian basin during the late Pleistocene. Nevertheless, ^{13}C variation in Amazonian soils suggests that the retreat of forests might occur only on a local scale and not on regional ones (MARTINELLI *et al.* 1996, but see DESJARDINS *et al.* 1996). Besides the large scale processes, there were changes on a finer scale as well: the rivers undulated across the landscape, left secondary forests in vast meanders, and carved primary forests. The changing vegetation patterns may explain the high species diversity of tropical forests on the basis of fragmentation due to climatic changes (when the Amazonian forests were reduced to several forest islands), and the creation of refugia (HENGEVELD 1990, UDVARDY 1983). Both bird and plant data seem to confirm this idea (PRANCE 1981, 1996). However, a very recent research on pollen records indicate that glacial age forests were comparable to modern forests (COLINVAUX *et al.* 1996).

The recent view that Amazonian vegetation was not stable during glaciations seems to be in contradiction with this hypothesis. However, historical data of the glaciations suggest that, although the tropical lowland rain forest habitats were not as stable as believed, the variation of habitats and the scale of changes are different from those in the temperate zone. For example, the total area of the supposed refuges in tropical South America (Fig. 9.9 in PRANCE 1981) is almost in the size of all of Europe, so they should be viewed as permanent on the spatial scale on which Europe must be viewed as impermanent. Indeed, the response of vegetation in the Southern Hemisphere to glaciations has been substantially different from that in the Northern Hemisphere (MARKGRAF *et al.* 1995). The relative stability of tropical rain forests on a 'European' scale might have allowed the adaptation of bird species to continuous forest habitats and the speciation of forest interior species. Humid forests are ornithologically fairly homogeneous on local and regional scales (OLROG 1969).

Hypothesis 3: *Human habitat alternation was more pronounced in Europe than in Amazonia*

The human impact on the biosphere has a long history. For example, HONG *et al.* (1994) showed that lead pollution occurred on a hemispheric scale as early as 2500 years ago by Greek and Roman civilisations. Other human disturbances during the Quaternary greatly diminished and fragmented European forests, whereas in North America temperate forests were far more extensive and continuous (MÖNKÖNNEN 1994). Obviously, the tropical forest of South America should be viewed as even more extensive and continuous than North American forests, because of the shorter history of human disturbance. Thus, Europe already had an artificially fragmented forest landscape several millennia ago, but in Amazonia there was no such strong disturbance (HANNAH *et al.* 1995). Human populations were established in the latter area ca. 10,000 years ago (BUSH & COLINVAUX 1994).

DISCUSSION

Temperate zone bird communities are adapted to an impermanent habitat, with relatively small patch size (on a continental scale), whereas tropical ones are adapted to a more stable habitat, where there are large patches. Therefore, species that tolerate edge habitats are more abundant in temperate zone bird communities than in the tropical communities, where the relative number of species adapted to interior habitats is much higher. (This may be one factor that accounts for the high tropical diversity, because interior communities are more dissimilar than edge communities (HARRIS & SILVA-LOPEZ 1992).) In a recent review TURNER (1996) argued that fragment edges may be inhospitable not only to birds but to the majority of forest species.

I argue that the different community structures of tropical and temperate forests may be explained by the above three hypotheses. The three processes (spatial variability, temporal changes and human disturbances) together created relatively more edges in Europe than in Amazonia during the last several thousand years. This led in turn to bird communities adapted to fragmented habitats, containing more edges than tropical forests.

The different history of the two zones during the Pleistocene resulted in different bird communities. Besides the different ratio of edge and interior bird species, the number and composition of guilds also differs. Tropical communities harbour many frugivores, usually large-bodied species, whereas in the temperate communities insectivores comprise the large majority of bird species (TERBORGH 1985). Large frugivores are especially sensitive to tropical forest fragmentation (TERBORGH & WINTER 1980, KATTAN *et al.* 1994), and they are usually absent from non-mature forests (WOINARSKI 1990). COHN-HAFT & SHERRY (1994) argued that foraging stereotypy in interior birds increases their sensitivity to disturbances.

A future research task is to follow the effects of tropical deforestation and habitat fragmentation in the Amazon (SKOLE & TUCKER 1993), including detailed analysis of edge effects in different successional phases of the rain forests. It is clear that more samples from the huge tropical rain forests will be required to test these three hypotheses and to determine their relative importance.

* * *

Acknowledgements – I am indebted to C. MOSKÁT, M. D. F. UDVARDY, Z. VARGA, J. A. WIENS and an anonymous reviewer for comments on earlier drafts of the manuscript. The study was supported by a grant from the National Scientific Research Fund (OTKA No. F/5249).

REFERENCES

BÁLDI, A. & KISBENEDEK, T. (1994) Comparative analysis of edge effect on bird and beetle communities. *Acta zool. hung*. **40**: 1–14.

BÁLDI, A. & MOSKÁT, C. (1994) Effect of the edge on the structure of bird communities in Hungarian riparian forests. pp. 7–10. *In* HAGEMEIJER, E. J. M. & VERSTRAEL, T. J. (eds) *Bird Numbers 1992. Distribution, monitoring and ecological aspects. Poster appendix of the Proc. 12th Int. Conf. IBCC and EOAC.* Statistics Netherlands, Voorburg/Heerlen and SOVON, Beek-Ubbergen.

BUSH, M. B. & COLINVAUX, P. A. (1994) Tropical forest disturbance: paleoecological records from Darien, Panama. *Ecology* **75**: 1761–1768.

CAMPBELL, K. E. (1991) Andean icefields to Amazonian jungles: a radical new view of the late Pleistocene of South America. *Bol. IG-USP, Publ. Esp.* **8**: 57–69.

COHN-HAFT, M. & SHERRY, T. W. (1994) Evolution of avian foraging stereotypes in tropical rainforest habitats. *J. Orn.* **135**(suppl.): 481.

COLINVAUX, P. A., DE OLIVIERA, P. E., MORENO, J. E., MILLER, M. C. & BUSH, M. B. (1996) A long pollen record from lowland Amazonia: Forest and cooling in glacial times. *Science* **273**: 85–88.

DESJARDINS, T., CARNERIO FILHO, A., MARIOTTI, A., CHAUVEL, A. & GIRARDIN, C. (1996) Changes of the forest-savanna boundary in Brazilian Amazonia during the Holocene revealed by stable isotope ratios of soil organic carbon. *Oecologia* **108**: 749–756.

FRENZEL, B., PÉCSI, M. & VELICHKO, A. A. (1992) *Atlas of paleoclimates and paleoenvironments of the Northern Hemisphere. Late Pleistocene-Holocene.* Geographical Research Institute, Hungarian Academy of Sciences, Budapest, Hungary.

FROCHOT, B. (1987) Synergism in bird communities: a method to measure edge effect. *Acta Oecol.* **8**: 253–258.

FULLER, R. J. & WHITTINGTON, P. A. (1987) Breeding bird distribution within Lincolnshire ash-lime woodlands: the influence of rides and the woodland edge. *Acta Oecol.* **8**: 259–268.

HAFFER, J. (1981) Aspects of neotropical bird speciation during the Cenozoic. pp. 371–394. *In* NELSON, G. & ROSEN, D. E. (eds) *Vicariance Biogeography. A critique*. Columbia University Press, New York.

HANNAH, L., CARR, J. L. & LANKERANI, A. (1995) Human disturbance and natural habitat: a biom level analysis of a global data set. *Biodivers & Conserv.* **4**: 128–155.

HANSSON, L. (1983) Bird numbers across edges between mature conifer forest and clearcuts in Central-Sweden. *Ornis Scand.* **14**: 97–103.

HARRIS, L. D. (1988) Edge effects and conservation of biotic diversity. *Conserv. Biol.* **2**: 330–332.

HARRIS, L. D. & SILVA-LOPEZ, G. (1992) Forest fragmentation and the conservation of biological diversity. pp. 197–237. *In* FIEDLER, P. L. & JAIN, S. K. (eds) *Conservation biology. The theory and practice of nature conservation, preservation and management.* Chapman & Hall, New York.

HELLE, E. & HELLE, P. (1982) Edge effect on forest bird densities on offshore islands in the northern Gulf of Bothnia. *Ann. Zool. Fennici* **19**: 165–169.

HENGEVELD, R. (1990) *Dynamic Biogeography*. Cambridge University Press, Cambridge. 249 pp.

HONG, S., CANDELONE, J.-P., PATTERSON, C. C. & BOUTRON, C. F. (1994) Greenland ice evidence of hemispheric lead pollution two millenia ago by Greek and Roman civilizations. *Science* **265**: 1841–1843.

HUNTLEY, B. (1988) European post-glacial vegetation history: a new perspective. pp. 1061–1077. *In* QUELLETT, H. (ed.) *Acta XIX Congr. Int. Ornithologici,* Vol. 1. University of Ottawa Press, Ottawa, Ontario.

HUTCHINSON, G. E. (1959) Homage to Santa Rosalia, or why are there so many kinds of animals? *Am. Nat.* **93**: 145–159.

KARR, J. R., NICHOLS, J. D., KLIMKIEWICZ, K. & BRAWN, J. D. (1990) Survival rates of birds of tropical and temperate forests: will the dogma survive? *Am. Nat.* **136**: 277–291.

KATTAN, G. H., ALVAREZ-LÓPEZ, H. & GIRALDO, M. (1994) Forest fragmentation and bird extinctions: San Antonio eighty years later. *Conserv. Biol.* **8**: 138–146.

LOVEJOY, T. E., BIERREGAARD Jr, R. O., RYLANDS, A. B., MALCOLM, J. R., QUINTELA, C. E., HARPER, L. H., BROWN Jr, K. S., POWELL, A. H., POWELL, G. V. N., SCHUBART, H. O. R. & HAYS, M. B. (1986) Edge and other effects of isolation on Amazon forest fragments. pp. 257–285. *In* SOULÉ, M. E. (ed.) *Conservation Biology. The Science of Scarcity and Diversity.* Sinauer Associates, Sunderland, Massachusetts.

MARKGRAF, V., MCGLONE, M. & HOPE, G. (1995) Neogene paleoenvironmental and paleoclimatic change in southern temperate ecosystems – a southern perspective. *TREE* **10**: 143–147.

MARTIN, J.–L. (1983) Impoverishment of island bird communities in a Finnish archipelago. *Ornis Scand.* **14:** 66–77.

MARTINELLI, L. A., PESSENDA, L. C. R., ESPINOZA, E., CAMARGO, P. B., TELLES, E. C., CERRI, C. C., VICTORIA, R. L., ARAVENA, R., RICHEY, J. & TRUMBORE, S. (1996) Carbon-13 variation with depth in soils of Brazil and climate change during the Quaternary. *Oecologia* **106**: 376–381.

MØLLER, A. P. (1989) Nest site selection across field-woodland ecotones: the effect of nest predation. *Oikos* **56**: 240–246.

MÖNKKÖNEN, M. (1994) Diversity patterns in Palearctic and Nearctic forest bird assemblages. *J. Biogeogr.* **21**: 183–195.

MOSKÁT, C. & FUISZ, T. (1994) Forest management and bird communities in the beech and oak forests of the Hungarian Mountains. pp. 29–38. *In* HAGEMEIJER, E. J. M. & VERSTRAEL, T. J. (eds) *Bird Numbers 1992. Distribution, monitoring and ecological aspects. Proc. 12th Int. Conf. IBCC and EOAC.* Statistics Netherlands, Voorburg/Heerlen and SOVON, Beek-Ubbergen.

MURCIA, C. (1995) Edge effects in fragmented forests: implications for conservation. *TREE* **10**: 58–62.

NEWMARK, W. D. (1991) Tropical forest fragmentation and the local extinction of understory birds in the Eastern Usambara Mountains, Tanzania. *Conserv. Biol.* **5**: 67–78.

OLROG, C. C. (1969) Birds of South America. pp. 849–878. *In* FITTKAU, E. J. ILLIES, J., KLINGE, H., SCHWABE, G. H. & SIOLI, H. (eds) *Biogeography and ecology in South America.* Dr. W. Junk N. V. Publishers, The Hague, Netherlands.

PRANCE, G. T. (1981) Discussion. pp. 395–405. *In* NELSON, G. & ROSEN, D. E. (eds) *Vicariance Biogeography. A critique.* Columbia University Press, New York.

PRANCE, G. T. (1996) Islands in Amazonia. *Phil. Trans. R. Soc. Lond. B* **351**: 823–833.

REESE, K. P. & RATTI, J. T. (1988) Edge effect: a concept under scrutiny. *Transactions of the North American Wildlife and Natural Resources Conference* **53**:127–136.

ROSENBERG, K. V. & RAPHAEL, M. G. (1986) Effect of forest fragmentation on vertebrates in douglas-fir forests. pp. 263–272. *In* VERNER, J., MORRISON, M. L. & RALPH, C. J. (eds) *Wildlife 2000. Modeling habitat relationships of terrestrial vertebrates.* The University of Wisconsin Press, Madison, Wisconsin,

ROY, K., VALENTINE, J. W. JABLONSKI, D. & KIDWELL, S. M. (1996) Scales of climatic variability and time averaging in Pleistocene biotas: implications for ecology and evolution. – *TREE* **11**: 458–463.

SKOLE, D. & TUCKER, C. (1993) Tropical deforestation and habitat fragmentation in the Amazon: satellite data from 1978 to 1988. *Science* **260**: 1905–1910.

STUTE, M., FORSTER, M., FRISCHKORN, H., SEREJO, A., CLARK, J. F., SCHLOSSER, P., BROECKER, W. S. & BONANI, G. (1995) Cooling of tropical Brasil (5°C) during the last glacial maximum. *Science* **269**: 379–383.

TERBORGH, J. (1985) Habitat selection in Amazonian birds. pp. 311–338. *In* CODY, M. L. (ed.) *Habitat selection in birds.* Academic Press, Orlando.

TERBORGH, J., ROBINSON, S. K., PARKER III, T. A., MUNN, C. A. & PIERPONT, N. (1990) Structure and organisation of an Amazonian forest bird community. *Ecol. Monogr.* **60**: 213–238.

TERBORGH, J. & WINTER, B. (1980) Some causes of extinction. pp. 119–133. *In* SOULÉ, M. E. & WILCOX, B. A. (eds) *Conservation Biology. An evolutionary-ecological perspective.* Sinauer Associates, Inc. Sunderland, Massachusetts.

THIOLLAY, J.-M. (1990) Comparative diversity of temperate and tropical forest bird communities: the influence of habitat heterogeneity. *Acta Oecol.* **11**: 887–911.

THIOLLAY, J.-M. (1994) Structure, density and rarity in an Amazonian rainforest bird community. *J. Trop. Ecol.* **10**: 449–481.

TURNER, I. M. (1996) Species loss in fragments of tropical rain forest: a review of the evidence. *J. Appl. Ecol.* **33**: 200–209.

UDVARDY, M. (1983) Dinamikus állatföldrajz [Dynamic Zoogeography]. Tankönyvkiadó, Budapest [in Hungarian].

VARGA, Z. (1995) Geographical patterns of biological diversity in the Palaearctic Region and the Carpathian Basin. *Acta zool. hung.* **41**: 71–92.

WALLACE, A. R. (1876) *The geographical distribution of animals.* Harper, New York.

WEBB, S. D. (1995) Biological implications of the middle Miocene Amazon seaway. *Science* **269**: 360–362.

WOINARSKI, J. C. Z. (1990) Effects of fire on the bird communities of tropical woodlands and open forests in northern Australia. *Aust. J. Ecol.* **15**: 1–22.

YAHNER, R. H. (1988) Changes in wildlife communities near edges. *Conserv. Biol.* **2**: 333–339.

Received 13th August 1996, accepted 19th December 1996

Acta Zoologica Academiae Scientiarum Hungaricae 42(3), pp. 173–185, 1996

THREE NEW GENERA OF LAUXANIIDAE (DIPTERA) FROM PAPUA NEW GUINEA

PAPP, L. and S. P. KIM

Department of Zoology, Hungarian Natural History Museum
H–1088 Budapest, Baross utca 13, Hungary
Division of Entomology, CSIRO, GPO Box 1700, Canberra, A.C.T. 2601, Australia

Three new genera of the family Lauxaniidae are described here from Papua New Guinea: *Kimiella* L. PAPP, gen. n. (type-species: *K. simplex* L. PAPP et KIM, sp. n., additional species: *K. grisea* KIM et L. PAPP, sp. n., *K. spatulifer* L. PAPP et KIM, sp. n.), *Lyciovibrissina* L. PAPP et KIM, gen. n. (type-species: *L. minor* L. PAPP et KIM, sp. n.) and *Celyphohomoneura* L. PAPP et KIM, gen. n. (type-species: *C. nitida* L. PAPP et KIM, sp. n., additional species: *C. nigrifacies* KIM et L. PAPP). With 22 original figures.

Key words: Lauxaniidae, new genera, new species, taxonomy, Papua New Guinea

INTRODUCTION

The pioneer of dipterology in Hungary, Dr K. KERTÉSZ published four papers on Papua New Guinean Lauxaniidae in 1899–1900 (but his second paper on Formosan Lauxaniidae (KERTÉSZ 1915) also contains several new Papua New Guinean lauxaniids), describing 44 new species and several new genera; for complete bibliographical data see EVENHUIS & OKADOME (1989) and KIM (1994). In their catalogue, EVENHUIS & OKADOME (1989) listed 56 lauxaniid species from Papua, i.e., no significant elaboration of the lauxaniid taxa was performed in the last 70 or so years and many species await description. Recently Dr S. P. KIM has turned his attention to the Lauxaniidae of the Australian (Indo-Australian) region, but materials other than Australian were not treated in his monograph (KIM 1994); he will publish on this country later.

Most of the unnamed lauxaniid materials in the Hungarian Natural History Museum from the tropics (but not all of them) was sent to Dr G. E. SHEWELL by Dr F. MIHÁLYI in the 1960s and they were returned in the 1970s and 1980s. Dr SHEWELL sent back several specimens with label notices “N. genus”, “new species” etc. (cf. PAPP & SILVA 1995). These labels are not removed and quoted below. We think it is most remarkable that all the materials below had been preserved in this collection in the years of Dr K. KERTÉSZ’s curatorship and we suppose, KERTÉSZ saw all of them but for unknown reasons, he did not describe them (the holotype of *Celyphohomoneura nitida* was sent him by M. BEZZI, we think). For comparisons HENDEL's (1925) and STUCKENBERG's (1971) keys were used but actually these three new genera are peculiar enough to be characterized easily.

In view of the richness of the New Guinean lauxaniid fauna, this paper cannot be more than only a minor contribution to their better knowledge.

In the descriptions we follow SHEWELL's (1987) terminology. All the type-specimens of the new species below are deposited in the Diptera Collection, Department of Zoology, Hungarian Natural History Museum, Budapest (HNHM) or in the Australian National Insect Collection, Canberra (ANIC).

LAUXANIINAE

Kimiella L. PAPP, gen. nov.

(Figs 1–2, 4–12)

Type-species: *K. simplex* L. PAPP et KIM.

Gender: feminine.

Other included species: *K. grisea* KIM et L. PAPP, *K. spatulifer* L. PAPP et KIM.

Face flat and narrow, frons not much broader, c. 1/3 width of head. Genae wide with 3 longer setae on lower margin, otherwise without conspicuous bristles. Only *vti* strong among head bristles. In STUCKENBERG's (1971) key it comes to couplet 44 but anterior fronto-orbitals not inclinate or reclinate but eclinate; broad fronto-orbital plates (brownish covered with silvery microtomentum) directed inwards joining ocellar triangle, consequently posterior fronto-orbitals situated not close to eyes but anterior pair emerging closer to sagittal line than to eyes, approximately in line with posterior ocellar setae; anterior fronto-orbitals shortened (c. 1/2 of posterior orbitals) and eclinate; several short setae also on extraorbital parts of fron (longer than usual in lauxaniids).

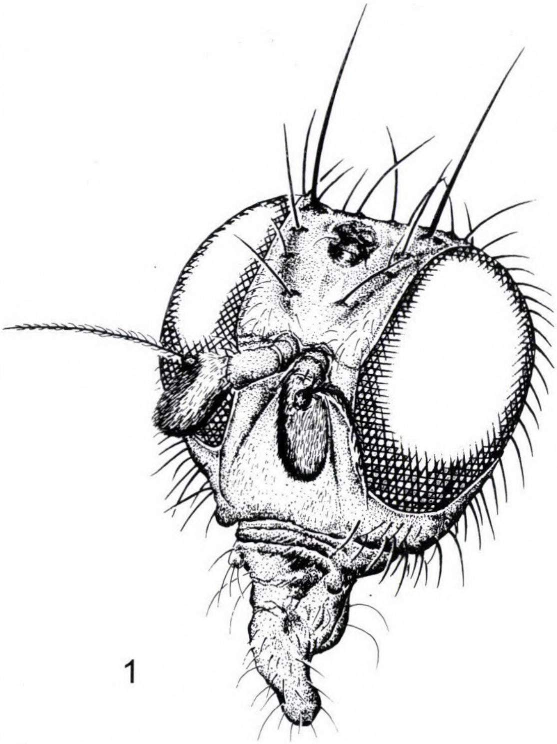
Thoracic chaetotaxy: 1 *pprn,* 2 *np,* 1 *posth,* 2 *sa,* 1 *pa,* 0+3 *dc,* 2 *sc,* 1 *proepst,* 1 *anepst,* 2 *kepst* pairs. Anepisternum with several setae, 3 longer ones on its ventral part pointing downwards. Acrostichal setulae in 4 rows, none of them bristled.

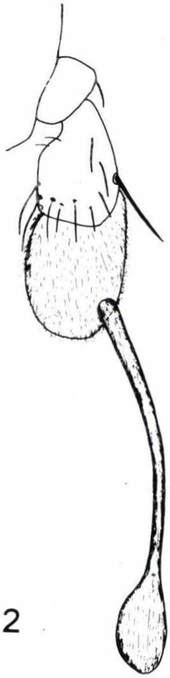
Wings with medial vein slightly upcurving, i.e., R_{4+5} and M veins converging, intracrossvein section less than half length of distal section of vein M, alula large.

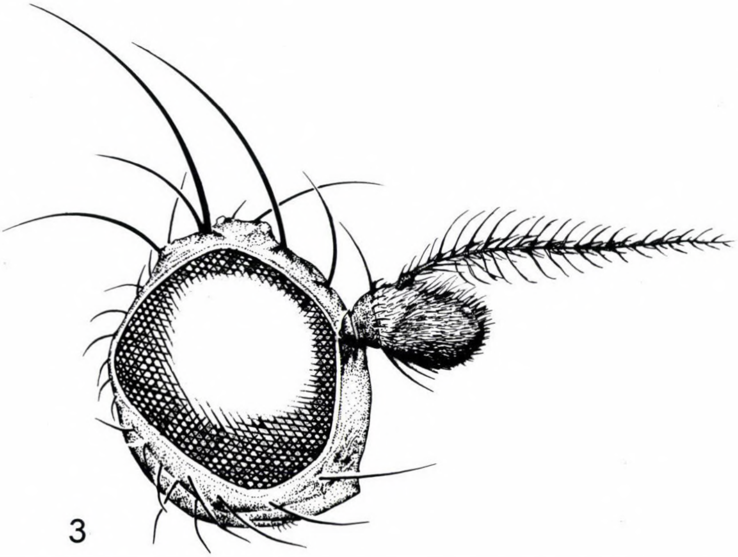
Male fore femora with very long setae on posterodorsal, posteroventral and ventral sides, preapicals extremely long. Female fore femora with long setae in *pd* and *pv* rows.

Male epandrium (Figs 4–6) large, mediolaterally with a pair of large extraordinary plates bearing medium long thick setae. Cerci rather small (Figs 4, 6) with short setae only. Surstyli small, narrow, medially directed (Fig. 5), not observable in profile or in caudal view (Figs 4, 6). Postgonites or gonopods (Fig. 5) long and thin with broad base, asymmetrical. Aedeagus very short, membraneous, not sclerotized.

Etymology. This new genus is named after Dr S. P. KIM (Canberra), for his great achievements in studies of the Australian Lauxaniidae.


1


2


3

Figs 1–3. 1 = *Kimiella simplex* sp. n., paratype male, head in sublateral-subfrontal view; 2 = *K. spatulifer* sp. n., holotype male, left antenna (arista somewhat shortened in this view); 3 = *Lyciovibrissina minor* sp. n., holotype male: head in sublateral view

Kimiella simplex L. PAPP et KIM, sp. n.
(Figs 1, 4–6)

Holotype male (HNHM): N. Guinea, Biró 1898xi – Sattelberg, Huon Golf.
Paratypes: 1 ♂, 2 ♀ (one of them damaged): same data as for the holotype (1 ♀ in ANIC).

Measurements in mm: body length holotype c. 3.3 (not precisely measurable by its downcurved abdomen), paratype male 3.54, paratype females 3.25–3.5, wing length 3.30 (holotype), 3.0–3.4 (paratypes), wing width 1.10 (holotype), 1.07–1.17 (paratypes), length of thorax 1.38 (holotype).

Body brownish, mesonotum, pleurae covered with greyish-silvery microtomentum. Abdominal tergites yellowish anteriorly but with dark brown, broad transverse bands on distal margin.

Head rather large, 0.74 mm high. Gena broad, 0.20 mm wide in holotype. Palpi with 3 long hairs apical one 0.21 mm.

Wings greyish with yellow veins but without fuliginous hue (cf. *spatulifer*). Stronger setulae on third costal section stopping just after vein R_{2+3}. Intracrossvein section of vein M 0.42 mm, distal section 1.18 mm, hind crossvein 0.25 mm (holotype).

Legs with extremely long, mostly thin hairlike bristles in rows on posterodorsal, posteroventral and all ventral sides of fore femur and on anterodorsal and anteroventral sides of hind femur. Preapical bristles on male fore femur 0.38 mm, on hind femur 0.34 mm long.

Male genitalia as given above; possibly armature of surstyli and shape of postgonites (Fig. 5) specific features.

Female cerci short with numerous short straight hairs.

Kimiella grisea KIM et L. PAPP, sp. n.
(Figs 7–12)

Holotype male (ANIC): NEW GUINEA, Eastern H'lands South, Okapa (at light), 23 Oct. 1964, R. Hornabrook.

Measurements (in mm): body length 2.47, length of thorax 1.17, length of wing 2.59, width of wing 0.95.

Similar to *K. simplex* but smaller and body blackish brown.

Head large, 0.71 mm high, general colour blackish brown; frons blackish brown, slightly broader than 1/3 width of head. Eyes with dense microcilia. Seta between anterior and posterior fronto-orbitals indistinct (Fig. 7), contrarily to *K. simplex*. Fronto-orbital plate same colour as rest of frons. Genae 0.10 mm wide. Peristomal setae longer than in *K. simplex* (Fig. 7, cf. Fig. 1).

Acrostichal (intradorsocentral) setulae in 2 rows only (4 in its congeners); anepisternum with extra setulae. Thicker setulae on c. 1/3 of third costal section (Fig. 8). Upper part of wing not darkened (Fig. 8), medial vein not upcurving. Alula smaller than in *K. simplex*.

Colour and armature of legs as given in Figs 9–11.

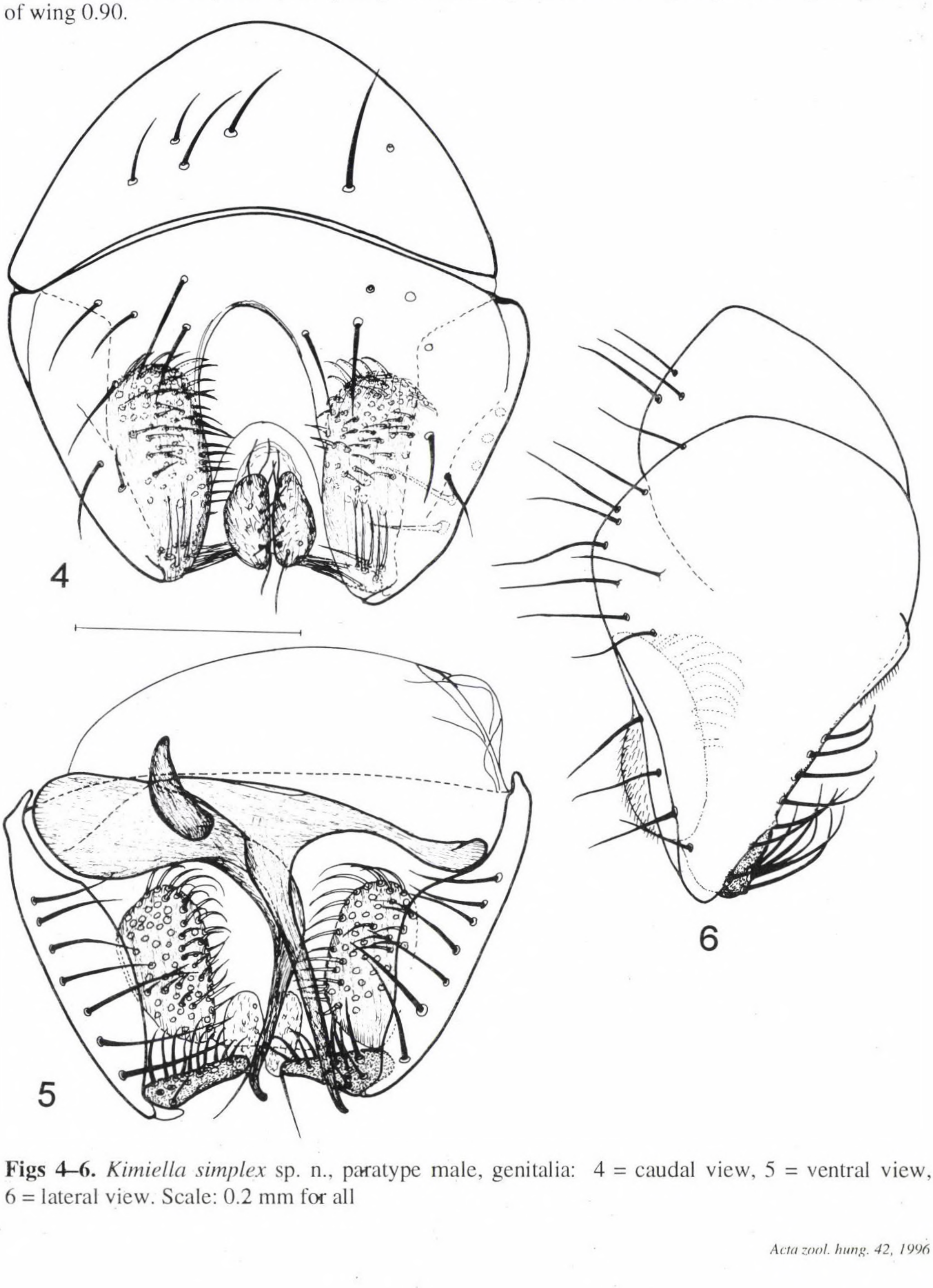
Almost all abdominal tergites blackish (Fig. 12), contrarily to *K. simplex* basic structure of male genitalia similar to those of *simplex* but right gonite thin and longer than epandrium, judged without preparation.

Kimiella grisea sp. n. has all the peculiar characteristics of the new genus, however, it is rather different from the type-species. Not only the colour of body and head, but e.g., its 2 rows of acrostichals (instead of 4) make it easily distinguishable from the other two species.

Kimiella spatulifer L. PAPP et KIM, sp. n.
(Fig. 2)

Holotype male (HNHM): N. Guinea, Biró 1898xi – Sattelberg, Huon Golf. – "N. genus" Det. SHEWELL, 1977.

Measurements (in mm): body length c. 2.7, length of thorax 1.14, length of wing 2.58, width of wing 0.90.



Figs 4–6. *Kimiella simplex* sp. n., paratype male, genitalia: 4 = caudal view, 5 = ventral view, 6 = lateral view. Scale: 0.2 mm for all

Similar to *K. simplex* but smaller and

a) antennae different, particularly so for the strongly modified arista (Fig. 2): thickened and apical part widened and enlarged into a broad flat apex (arista curved in three dimensions);

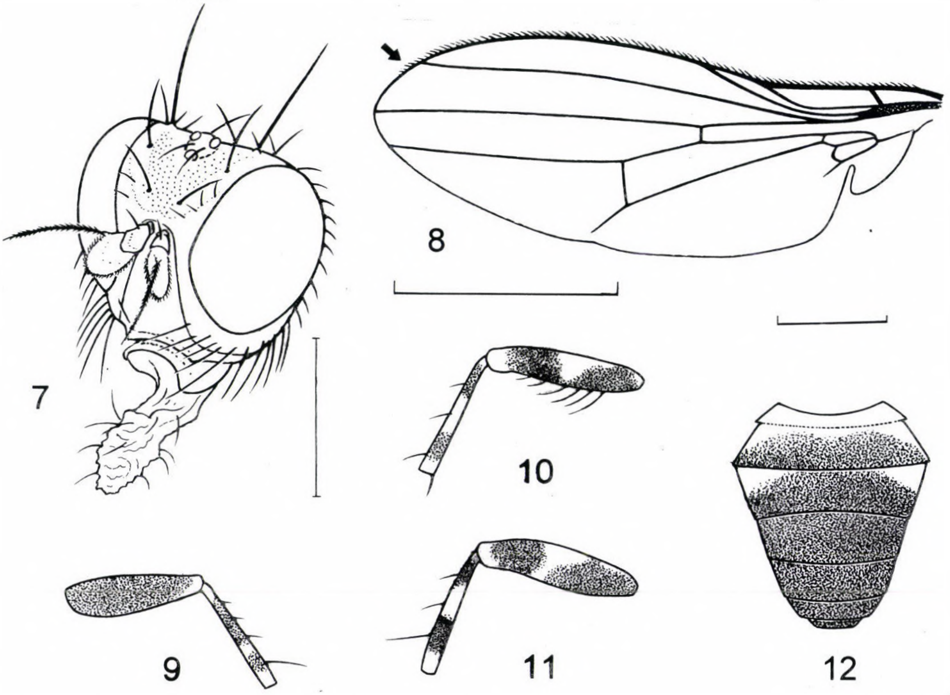
b) setae on legs weaker (long thin setae on anteral, *pd* and *pv* sides of fore femur less dense, some hairlike bristles of 0.155 mm on fore tibia, some thin but very long bristles also on hind tarsomeres, preapical on hind tibia 0.24 mm);

c) though wing venation similar, upper third in this species dark fuliginous;

d) anepisternum with extra setulae;

e) anterior fronto-orbitals, though lost in the holotype, must be strong as judged by width of their bases.

Head large, 0.76 mm high and 0.78 mm wide, eyes with microcilia. Genae 0.19 mm wide. Length of antenna 0.41 mm, length of arista (distance from base to tip) 0.55 mm, width of apical part 0.072 mm. Thicker setula on c. 2/9 of third costal section. Intracrossvein section of vein M 0.353 mm, distal section 0.948 mm. Distal transverse bands of abdominal tergites even broader than in *K. simplex*. Male genitalia must be similar as regards its basic structure to those of *K. simplex*, judged from externally.



Figs 7–12. *Kimiella grisea* sp. n., holotype male: 7 = head, sublateral-subfrontal view, 8 = wing, 9 = fore leg, 10 = middle leg, 11 = hind leg, 12 = abdomen dorsally. Scales: 0.5 mm for Figs 7, 12, 1.0 mm for Fig. 8

Lyciovibrissina L. PAPP et KIM, gen. nov.

(Fig. 3)

Type-species: *L. minor* L. PAPP et KIM.

Gender: feminine.

It keys to *Lyciella* in STUCKENBERG's (1971) key but it possesses a pair of true vibrissae (the lack of vibrissae is thought to be one of the synapomorphies of the family).

Anterior fronto-orbitals not far behind level of lunule and though anterior pair not weak (nearly as long as antennae, c. 2/5 length of posterior fronto-orbitals), posterior *ors* much longer (almost as long as height of eye). Both *oc* and *pvt* pairs strong, *vti* extremely long, longer than height of head, 1.5 times as long as posterior fronto-orbitals (Fig. 3).

Flagellomere normal with long cilia. Arista long, 2.6 times as long as 1st flagellomere with moderately long plume dorsally and ventrally.

Face only slightly convex, genal edge with true vibrissae (0.26–0.28 mm long), some of peristomials also long. Genae very narrow, 1/10 length of eye.

Prosternum bare. Thoracic chaetotaxy: 1 *pprn*, 2 *np*, 1 *posth*, 2 *sa*, 1 *pa*, 1+2 *dc*, rather weak *prsc*, 2 *sc* pairs. *Acmi* rather sparse, only 2 rows of minute setulae; only a few of such setulae on intra-alar area. Proepisternal thin but distinct, 1 strong anepisternal and 1 shorter + 1 longer *kepst* present, anepisternum with some additional setulae.

Wings with brown spots on distal end of veins Sc (R_1), R_{2+3}, R_{4+5}, M and CuA_1, plus on the r-m crossvein and on vein M at dm-cu crossvein, similarly to wing of *Shatalkinia.* Alula small, liguliform, contrarily to broad alula of *Shatalkinia.* Wing definitely sapromyziform but spinules on 3rd costal section are so small, that seen in high (100×) magnification only (this is why Dr SHEWELL thought it a homoneurine genus).

Legs short, particularly so for femora. Femora thickened with long and thick bristles. Dorsal preapicals and femoral bristles extremely long though thin (see below with description of species).

Its face pattern resembles to those of *Shatalkinia* L. PAPP, 1984 (described as a subgenus of *Lyciella* but it seems better to regard it as a distinct genus), but its body is much smaller and the presence of vibrissae makes this fly peculiar among the lauxaniids. Otherwise there are several cases of vibrissa-like setae in lauxaniids, e.g. in *Chaetolauxania sternopleuralis* KERTÉSZ, 1915 (p. 496–7, KERTÉSZ 1915: Fig. 4), a New Guinean species, which is not related to *Lyciovibrissina.* Dr I. YAROM (pers. comm.) suggested a possible relationship of the new genus to *Isoclusia* MALLOCH, 1929 (described and known only from Western Samoa), but that is a homoneurine genus (see MALLOCH 1929, cf. EVENHUIS & OKADOME (1989)).

Lyciovibrissina minor L. PAPP et KIM, sp. n.

(Fig. 3)

Holotype male (HNHM): N. Guinea, Biró 96 – Friedrich-Wilh.-hafen. – 991 (or 166). Paratype female (HNHM, rather mouldy): ibid., 1900 – [Dr SHEWELL's handwriting] "Gen.? (vibr.)" – "genus ? (Homoneurinae)" Det. SHEWELL, 1977.

Measurements in mm: body length 2.33 (holotype), ca 2.3 (paratype), wing length 2.38, 2.21, wing width 0.97, 0.93.

Body dull brownish grey, abdominal terga yellowish grey with intricate but symmetrical dark brown pattern.

Head (Fig. 3) broad, width 1.02 mm (holotype), height 0.67 mm, length 0.41 mm.

First flagellomere normal with 0.038 mm long cilia. Arista long (0.67 mm), 2.58 times as long as 1st flagellomere (0.26 mm measured dorsally) with moderately long (up to 0.12 mm) plume dorsally and ventrally.

Wings brownish with dark brown spots (see above), veins ochreous. Intracrossvein section of vein M shorter than distal section (0.54 mm vs 0.63 mm). Strong costal setulae to the middle of the 3rd costal section.

Legs short, fore and hind femora thickened, fore femora with anterodorsal and posterodorsal rows of very long setae, hind femur with similarly long 1 anterodorsal and 1 anteroventral setae on distal third (the latter one 0.28 mm). Fore femur with weak anteroventral comb of c. 4 setulae.

Abdominal terga 3–6 with very long and thick marginal bristles. Male genitalia minute (not studied).

HOMONEURINAE

Celyphohomoneura L. PAPP et KIM, gen. n.

(Figs 13–15, 16–22)

Type species: *C. nitida* L. PAPP et KIM.

Gender: feminine.

Other included species: *C. nigrifacies* KIM et L. PAPP.

Thorax extremely large bulbous (Figs 15 and 21), shining black, scutellum large (its *habitus* resembling that of celyphids).

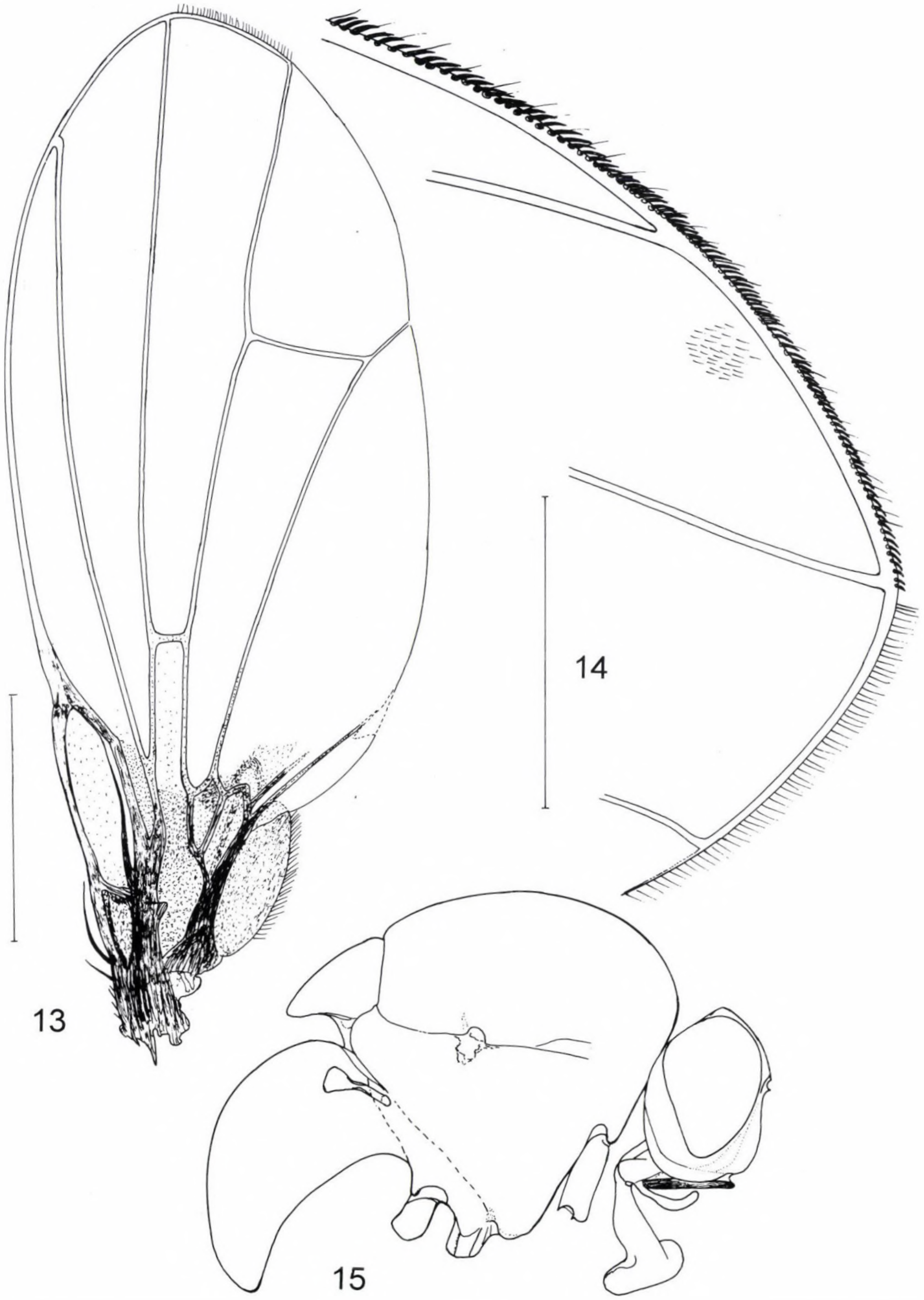
Arista plumose, anterior fronto-orbitals less than half as long as posteriors. Face bright yellow, rather strongly convex, genal width only 1/10 length of eye, no genal angle.

0+2 *dc* pairs, 1 strong *prsc,* 1 posthumeral pair present, 6 rows of very short *acmi* instead of 2+ or 4 rows as in *Xangelina.* Strong posterior pair of bristles anteriorly to prescutellars better interpreted as *postalars* (rather than dorsocentrals, though at level of posterior *dc* pair of other lauxaniids).

Wing (Figs 13–14, 20) somewhat rounded, homoneuriform (there are species also in *Xangelina* with homoneuriform wings, I. YAROM (pers. comm.), costal setulae all black and thick. Intracrossvein section of vein M much longer than its distal section. Wing base darkened by enlarged dense black hairs in a transverse band (Figs 13 and 20); costa with 2 extremely long (0.37 mm) setae basally (Fig. 13).

Mid-tibia with 2 evenly long and thick apicoventrals and a third additional shorter seta. Fore femora with anteroventral comb. Mid-femora anteriorly with a row of thick (though not very long) setae in distal half.

Tergite 6 short (half length of 5th), tergite 7 small and hidden under T_6. "Protandrium" without any ventral sclerotized parts. Sternites 3–6 normal, sternite 1 short and thin, sternite 2 reduced to a short bare sclerite with wide Y-shaped darker marking. Details of male genitalia as given in Figs 16–19.



Figs 13–15. *Celyphohomoneura nitida* sp. n., holotype male: 13 = right wing dorsally, 14 = tip of wing in higher magnification, 15 = silhouette of body. Scales: 1.0 mm for Fig. 13, 0.5 mm for Fig. 14

In KIM's (1994) key the species goes to *Tanyura* but it is generally different. Probably it is related to *Xangelina* WALKER (its face is similarly convex, proepisternal bristle present, etc.) but the scutellum in *Xangelina* is normal, the frons of the new genus is not flat and sloping, it has 0+2 and not 0+3 *dc* pairs, and there are no longer *acmi* as in *Xangelina*. Vein ratios are different: intracrossvein section of vein M in *Xangelina* as long as, or shorter than distal section, while distal section here is much shorter. Mid tibia is with 1 apicoventral in *Xangelina* but 2 in *Celyphohomoneura*. Otherwise as YAROM says (pers. comm.) having 2 apicoventrals is a synapomorphy for the subfamily Homoneurinae (shared with *Trypetisoma*).

Celyphohomoneura nitida L. PAPP et KIM, sp. n.

(Figs 13–15)

Holotype male (HNHM, right wing broken with minor losses; removed and prepared on a slide): N. GUINEA MER., BUJAKORI, Agosto 1890, L. LORIA – Museo Civ. Genova – "Homoneurinae new genus" Det. SHEWELL 1965.

Measurements (in mm): body length 3.96, length of thorax 2.46, length of wing 4.14, width of wing 1.72.

Head shining ochreous yellow, longest rays of arista 0.26 mm. Lower part of face somewhat less protruding than in *C. nigrifacies* (Fig. 15). Ocellar bristles rather weak, shorter and much thinner than postverticals, anterior fronto-orbital only 2/5 of length of posterior ones.

Thorax shining black with blue reflection. Wings (Figs 13–14) yellowish, somewhat rounded (length/width ratio 2.40 only), homoneuriform, veins ochreous yellow incl. costa, intracrossvein section 1.26 mm, dm-cu crossvein 0.507 mm, distal section of M 1.11 mm. Row of thick thornlets on 3rd costal section terminated exactly at end of R_{4+5} (Fig. 14). Costa with 2 extremely long (0.37 mm) setae basally (Fig. 13). Knob of halteres yellowish brown, stalk yellow. Femora with yellow apices.

Abdomen comparatively small (Fig. 15), greyish yellow (except for dark T_1 and anterior half of T_2) with 1 small medial and 1 pair of small lateral dark spots on terga T_3–T_5 each. Lateral spots larger than in *C. nigrifacies*. Epandrium small and short, cerci comparatively long, apex rounded, with short setae only; surstyli long and narrow, digitiform, longer than in *C. nigrifacies*, basal part less widening. Inner genital parts not studied on the unique holotype.

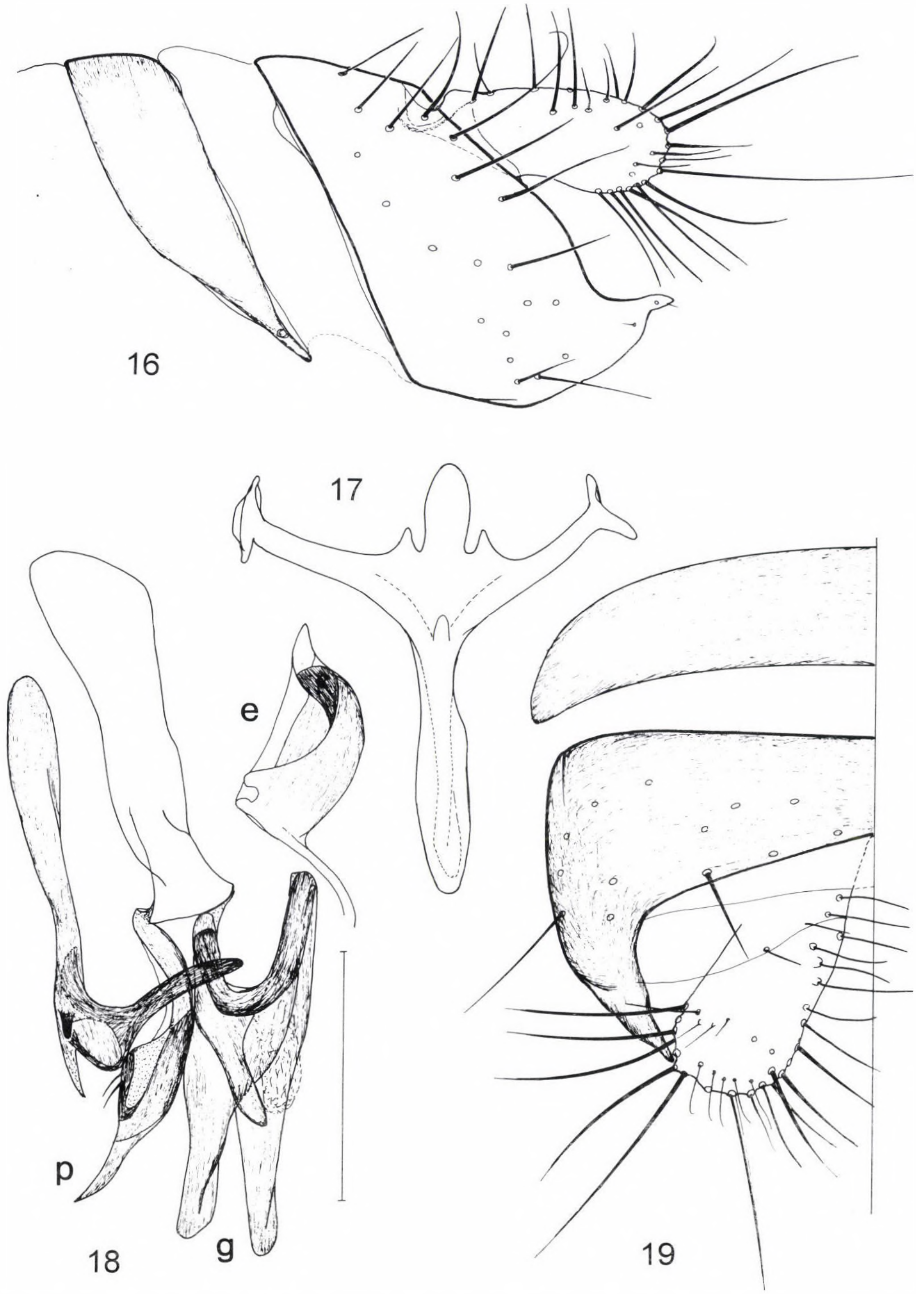
Female unknown.

Celyphohomoneura nigrifacies KIM et L. PAPP, sp. n.

(Figs 16–19, 20–22)

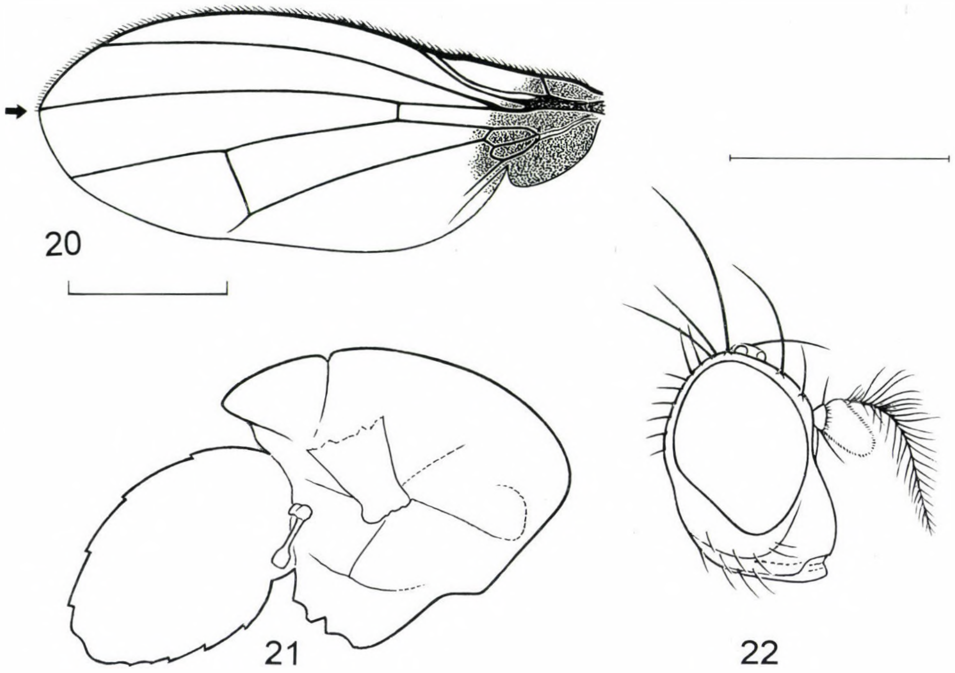
Holotype male (ANIC): Mt Lamington Dist., Northern Division, Papua, July 1927, C. T. McNamara; paratype male (HNHM, abdomen and genitalia in a plastic microvial with glycerine): Upper Manki logging area near Bulolo, New Guinea, 5000 ft., 23 March 1973, F. R. Wylie and P. Shanahan. Sticky Trap.

Paratype male damaged, parts of wings lost, left fore leg lost, also some bristles are broken out and lost.



Figs 16–19. *Celyphohomoneura nigrifacies* sp. n., paratype male, genitalia: 16 = protandrium, cercus and epandrium with surstylus laterally, 17 = hypandrium, 18 = inner genitalia laterally, 19 = left half of outer terminalia dorsally (e: ejaculatory apodeme, g: gonopods, p: paramere). Scale: 0.2 mm for all

Figs 20–22. *Celyphohomoneura nigrifacies* sp. n., paratype male: 20 = left wing dorsally, 21 = silhouette of body, 22 = head laterally. Scales: 1.0 mm for Figs 20–21 and 22, respectively



Measurements (in mm): body length 3.30, 3.62, length of thorax 2.23. 2.31, length of wing 3.58, 4.17, width of wing 1.49.

Shape of body (Fig. 21) similar to that of *C. nitida*, i.e., thorax and scutellum exteremely large, abdomen comparatively small.

Facial plate, clypeus and palpi all dark, i.e., whole head black. Lower part of face strongly protruding (Fig. 22). Tip an dorsal edge of flagellomere darkened (contrarily to *C. nitida*). Head bristles as in *C. nitida.*

Thorax shining black but without blue reflexion.

Wings similar to those of *C. nitida* but basal dark area larger than in *nitida* (Fig. 20, cf. Fig. 13). Knob of halteres brown.

All femora dark.

Abdominal spots faint on holotype, but otherwise lateral spots smaller than in *C. nitida.* Male protandrium and also epandrium short (Figs 16, 19), surstyli fused with epandrium, rather short in this species. Cerci large flat plates with long setae (Figs 16, 19). Hypandrium (Fig. 17) rather thin with a characteristic mediocaudal process, with a pair of short caudal processes, seen also in profile (Fig. 18), lateral pair of processes long (Fig. 18), hypandrial apodeme rather long. Aedeagal complex symmetrical, except for slightly asymmetrical gonopods, aedeagus short membraneous, phallophore with a pair of digitiform lateral processes (Fig. 18). Parameres long with sharp apex, gonopods robust, ejaculatory apodeme comparatively large (Fig. 18). Aedeagal apodeme long and thick but not strongly sclerotized.

Female unknown.

Acknowledgements – We are grateful to Dr ILAN YAROM (Tel Aviv University) for advice and for corrections of the first version of generic diagnoses, and to Dr A. SZAPPANOS for the two head figures (Figs 1, 3).

REFERENCES

EVENHUIS, N. L. and OKADOME, T. (1989) 90. Family Lauxaniidae, pp. 576–589. *In* EVENHUIS, N. L. (ed.): *Catalog of the Diptera of the Australasian and Oceanian Regions*, Bishop Museum Press and E. J. Brill, Honolulu, 1155 pp.

HENDEL, F. (1925) Neue Übersicht über die bisher bekannt gewordenen Gattungen der Lauxaniiden, nebst Beschreibung neuer Gattungen und Arten. *Encycl. ent. Ser. B. II, Dipt.* **2**: 103–142.

KERTÉSZ, K. (1915) Sauter's Formosa-Ausbeute. Lauxaniinae. II. *Annls Mus. natn hung.* **13**: 491–534.

KIM, S. P. (1994) Australian Lauxaniid Flies. Revision of the Australian species of Homoneura van der Wulp, Trypetisoma Malloch and allied genera (Diptera: Lauxaniidae). *Monographs on Invertebrate Taxonomy, Vol. 1.*, CSIRO Australia, 445 pp.

MALLOCH, J. R. (1929) Clusiidae (Heteroneuridae) and Sapromyzidae. *Insects Samoa* **6**: 199–213.

PAPP, L. and SILVA, V. C. (1995) Seven new genera of the Neotropical Lauxaniidae (Diptera). *Acta zool. hung.* **41**(3): 185–208.

SHEWELL, G. E. (1987) Chapter 87. Lauxaniidae. Vol. 2, pp. 951–964. *In* MCALPINE, J. F. *et al.* (eds): *Manual of Nearctic Diptera*, Research Branch, Agriculture Canada, Ottawa. Agric. Can. Monogr. 28.

STUCKENBERG, B. R. (1971) A review of the Old World genera of Lauxaniidae (Diptera). *Ann. Natal. Mus.* **20**(3): 499–610.

Received 31th October 1996, accepted 19th December 1996

Catalogue of Palaearctic Diptera

edited by Á. SOÓS and L. PAPP

Volume 13
Anthomyiidae–Tachinidae

The Catalogue contains the basic taxonomic, nomenclatorial and distribution data of all species occurring in the Palaearctic Region with the fundamental morphological features for the majority of the fly groups.

Volume 13 lists the names of 460 genera, 38 subgenera and 2389 species assigned to three families. Furthermore, 672 synonymous generic and 2477 specific names, 1807 emendations, errors, nomina dubia and doubtful genera and species are listed. The period of the Catalogue extends from 1758 to 31 December, 1982.

Contents: Explication to distribution. Type-species designations in Volume 13. New name proposed in Volume 13. Families: Anthomyiidae (Á. DELY–DRASKOVITS). Rhinophoridae (B. HERTING). Tachinidae (B. HERTING and Á. DELY–DRASKOVITS). Bibliography. Index.

December 15, 1993. 624 pages
US$ 85.00 plus US$ 8.00 for package and postage
(and an extra US$ 5.00 if you want it air mail)
ISBN 963 70 9321 4

Order should be sent
to the Hungarian Natural History Museum, Library
Baross u. 13., Budapest, H–1088 Hungary
Fax: (36–1) 1171669

Acta Zoologica Academiae Scientiarum Hungaricae 42 (3), pp. 187–194, 1996

NEW EAST-PALEARCTIC DOLERUS SPECIES (HYMENOPTERA, SYMPHYTA, TENTHREDINIDAE)

HARIS, A.

Budapest Plant Health and Soil Conservation Station
Budaörsi u. 141–145, H-1118 Budapest, Hungary

Three new *Dolerus* species are described: *Dolerus shanghaiensis* from China, *D. nipponicus* from Japan and *D. persicus* from Iran. A new colour variation of *Dolerus japonicus* KIRBY from Japan is noted. The hitherto unknown male of *Dolerus albolineolatus* HARIS & BLANK, 1996 is also described.

Key words: Hymenoptera, Symphyta, *Dolerus*, new species, East Palaearctic

INTRODUCTION

The East-Palaearctic *Dolerus* species, like many Hymenoptera from this region, are poorly known. Although many species have been described, there is no comprehensive study or identification key for these species, and it makes their study very difficult.

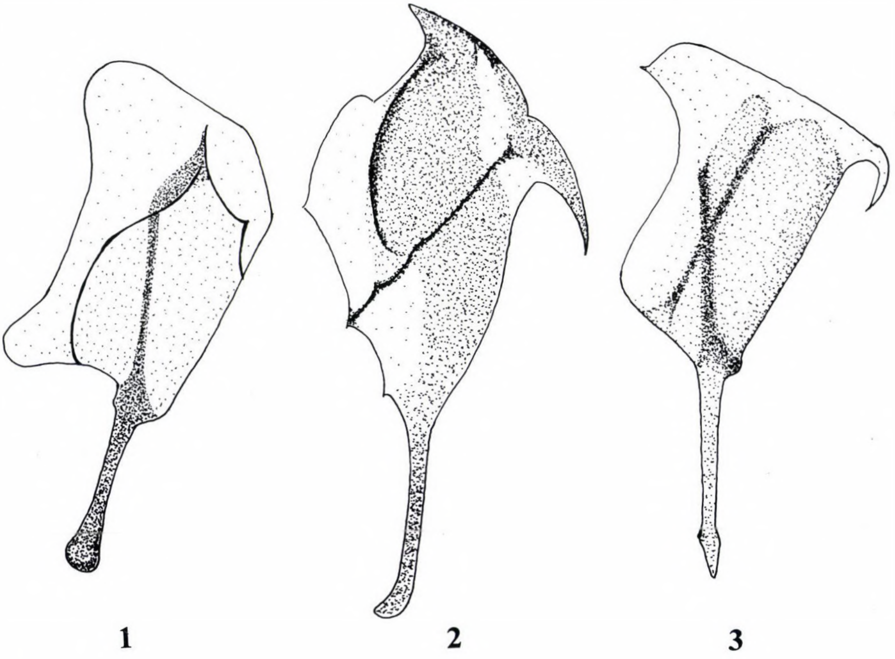
TAKEUCHI (1952) listed the Japanese species. LEE & RYU (1989) gave an identification key to the Korean species. MALAISE (1931) studied the sawfly fauna of Kamchatka and mentioned 10 *Dolerus* species. KIRBY (1882) published a list of Hymenoptera in the British Museum, and his book includes many species of *Dolerus* from the East-Palaearctic Region. MUCHE (1965) published the results of his expedition to Mongolia and later published on the Mongolian collection of the Hungarian Natural History Museum, Budapest (MUCHE 1968). ZHELOCHOVTSEV (1928, 1935) discussed the Palaearctic species of *Dolerus* in two papers.

In this paper one new species from Japan, one species from Korea, one from China, and one from Iran is described. The description of the hitherto unknown male of *Dolerus albolineolatus* HARIS et BLANK, 1996, and the colour variation in *D. japonicus* KIRBY is discussed.

Dolerus shanghaiensis sp. n.
(Figs 1, 4, 7)

Female: Body shining black without greenish or bluish metallic luster. Apical third of mandibles brownish red. Pronotum, propleuron, prosternum, tegula, upper half of mesopleuron, and outer margin of median lobe red. Cenchri brownish yellow. Wings hyaline. Venation black on inner half and brown on outer half of forewing. Stigma black with wide brown margin. Legs black. Head: Vertex densely and roughly, and temple sporadically but deeply punctured with shining interspaces about 3–4× as large as a puncture. OOL : POL : OCL = 1.3 : 1.0 : 1.2. Clypeal emargination 0.25 as deep as median length. Head in dorsal view slightly converging behind eyes. Antenna short, 2/3 as long as abdomen. Length of antennomere 3 little longer than 4 (1.0 : 1.1). Thorax (Mesosoma): Pronotum and propleuron with dense and fine puncture. Median lobe of mesonotum densely and deeply punctured with interspaces about as large as a puncture but anterior margin smooth and shining. Lateral lobes densely and finely punctured on posterior half and more sporadically punctured on posterior half. Punctures of mesoscutellum dense but not rough, without shining interspaces. Mesoscutellar appendage smooth and shining. Metascutellum deeply and sporadically punctured. Katepimeron shining with very fine sculpture. Metepimeron and metepisternum very finely and densely punctured. Mesosternum sporadically punctured, shining. Distance between cenchri about 1.4× as long as width of cenchrus. Claws with small inner tooth. Postocellar and mesonotal furrows not deep but well defined. Pubescence white, moderately dense on head and on thorax. Abdomen (Metasoma) nearly bold. Hairs as long as diameter of front ocellus. Abdomen with fine transverse surface sculpture from 2nd tergite. Sawsheath dilated apically. Apical setae brownish, curved as in Fig. 4. Serrulae in Fig. 7. Length: 8.5–10.0 mm.

Male: Very similar to female but red margin of mesonotal median lobes narrower, and upper third of mesopleuron red. Surface sculpture like female but temples roughly punctured. Head behind eyes in dorsal view, strongly converging. Antenna and abdomen subequal. Pubescence as in female. OOL : POL : OCL = 1.1 : 1.0 : 0.8. Length of antennomere 3 1.2× as long as that of 4. Antennomere 8 5.5× as long as its width. Clypeal emargination 0.3x as deep as median length. Distance between cenchri about 1.2× as long as width of cenchrus. Penis valve in Fig. 1. Length: 7.0–8.0 mm.



Figs 1–3. Valve of 1 = *Dolerus shanghaiensis* sp. n., 2 = *D. yokohamensis* ROHW., 3 = *D. albolineolatus* HARIS et BLANK

Holotype: male, "Shanghai, China, March 7. 1935 E. Suenson", Penis valvae on slide Acc. No. 36 H. F. CHU.

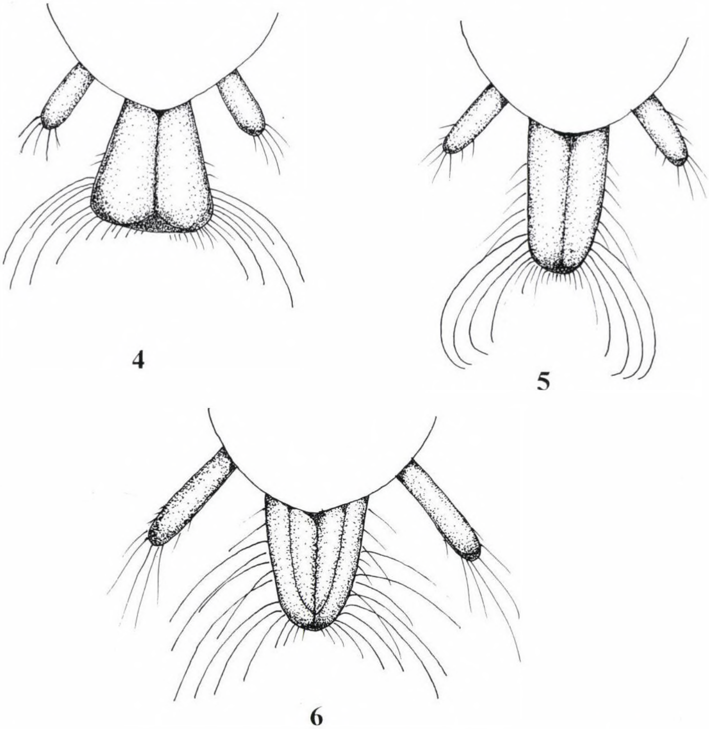
Paratypes: one male and one female, "Shanghai, China March 7. 1935 E. Suenson"; one female, "Sanghai, China March 6. 1935 E. Suenson".

The holotype is in good condition. The holotype and the paratypes are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D. C.

This species is quite unique and there is no similar species in the genus *Dolerus*. It is easy to distinguish it from the others by its coloration and genitalia. Its closest relative is *Dolerus rufotorquatus* O. COSTA (ZOMBORI 1982, BENSON 1952). The new species belongs to the *nitens* group according to GOULET's classification (GOULET 1986).

Dolerus nipponicus sp. n.
(Figs 5 and 8)

Female: Shining black with slight bluish luster. Apical third of mandibles brownish red. Prothorax, tegulae, front and lateral lobes of mesonotum, mesopleuron, and mesosternum red. Katepimeron, metepimeron, and mesepisternum with red spots. Abdominal segments from the second



Figs 4–6. Sawsheath (from above) of 6 = *D. shanghaiensis* sp. n., 5 = *D. nipponicus* sp. n., 6 = *D. persicus* sp. n.

with narrow whitish hind margins. Clypeus deeply excised for depth of half its total length. Head in dorsal view subparallel or slightly converging behind eyes. OOL : POL. OCL = 1.3–1.4 : 1.0 : 1.0–1.2. Length of antennomere 3 1.1× longer than that of 4. Antenna little longer than costa. Vertex and temples densely, uniformly, little roughly punctured, shining. Temples with shining interspaces about 3–4× diameter of a puncture. Pronotum and propleuron densely punctured without interspaces. Front and lateral lobes of mesonotum shining, densely and uniformly punctured with interspaces about as large as a puncture. Front lobe little more deeply punctured than lateral lobes. Mesoscutellum deeply, uniformly but not roughly punctured with interspaces as large as a puncture. Mesoscutellar appendage shining with very fine transverse surface sculpture. Metascutellum shining, sporadically punctured. Katepimeron, metepimeron and mesepisternum densely and finely punctured. Mesopleuron with dense and moderately rough punctures. Mesosternum shining, moderate densely punctured, interspaces about 3–4× larger than a puncture. Thorax moderately covered with white pubescence. Hairs as long as diameter of front ocellus. Distance between cenchri about 1.2–1.3× as long as width of cenchrus. First abdominal segment smooth and shining. Abdominal segments 2–9 covered with dense transverse microsculpture. Sawsheath rounded apically. Apical setae curved inwardly as in Fig. 5. Length: 10.0–11.0 mm.

Holotype: female, "Japan: Ishikawa Pref., Mt. Hakusan, 1100–1300 meters, May 18, 1979, Collectors: I. Togashi & D. R. Smith".

Paratype: female, "Japan: Hyogo Pref., Mt. Kasagata-yama, May 9, 1979, T. naito, N. Hirose, A. Shinohira, & D. R. Smith".

The holotype is in good condition. Both the holotype and the paratype are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D. C.

This species closely resembles *Dolerus yokohamensis* ROHWER, 1925 and *Dolerus affinis* CAMERON, 1876. The differencial diagnosis is as follows:

The new species belongs to the *nitens* group (GOULET 1986).

Dolerus persicus sp. n.

(Fig. 6)

Head black. Apical third of mandible brownish red. Prothorax, tegula, front and lateral lobes of mesonotum red. Upper half of mesopleuron red. Scutellum red with black hind margin. Other parts of thorax black. Cenchri white. Legs entirely black. Abdomen red, including first segment. Basal part of first segment infuscate. Cerci red, sawqsheath black with red spots. Wings infuscate, stigma, and venation black. Apical and basal part of stigma brown. Clypeal emargination 0.25–0.30× as deep as median length. Head in dorsal view, parallel behind eyes and slightly narrowed at edge of temples. OOL : POL : OCL = 1.4 : 1.0 : 1.4. Vertex and temples densely and roughly punctured with short shining interspaces about equal to half diameter of a puncture.

Pronotum and propleuron densely and finely punctured without interspaces. Front and lateral lobes of mesonotum and mesoscutellum densely, finely and uniformly punctured with small shining interspaces. Mesoscutellar appendage smooth and shining. Metascutellum smooth and shining with 4 or 5 punctures. Katepimeron with dense, fine sculpture. Mesopleuron with dense and coarse but not crater-like punctures. Metepimeron and mesepisternum shining, densely and moderately roughly punctured. Mesosternum shining, densely and finely punctured with sporadically occurring interspaces about 1–3× diameter of punctures. Pubescence rare on the mesonotum. Hairs 0.6–0.7× as long as front ocellus on mesonotum and equally long on propleuron. Distance between cenchri about 1.15× longer than width of one. Occipital and mesonotal furrows well developed. Abdominal segments smooth and shining. Sawsheath relatively wide and short in dorsal view. Apical setae curved and directed outwards in obtuse angle as in Fig. 6. Length: 11.5 mm.

Holotype: female, "Iran: Kordistan Prov, 66 km. NNW. of Sanandadj, May 23–24, 1965, J W Neal".

Both of the antennae of the holotype has only 2 joints. The holotype deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D. C.

Dolerus persicus is related to *D. madidus* (KLUG), *D. uliginosus* (KLUG) (ZOMBORI 1982, BENSON 1952) and *D. harukawai* WATERSTON (WATERSTON 1926). The most significant differences are listed below:

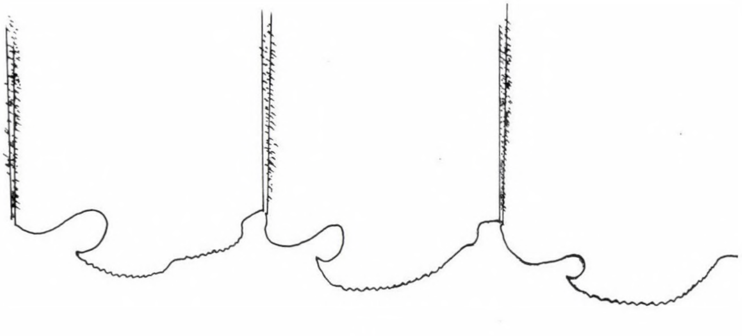
The new species differs from *D. coccinatus* ZHELOCHOVTSEV, 1928 and *D. kurahashii* TOGASHI, 1989 by the red marked legs and very short setae of sawsheath of the latter two species. The new species belongs to the subgenus *Archaetoprion* GOULET, 1986.

Dolerus japonicus KIRBY, 1882

New colour variation. Female: Head black. Clypeus, labrum red. Apical half of mandible brownish red. Thorax partly black. Propleuron, prosternum, pronotum, front and lateral lobes of mesonotum, tegulae, upper third of mesopleuron red. Cenchri yellowish white. Abdomen red. First tergite and ovipositor black. Legs black, only fore tibia and apical third of fore femora red. Wings dark infuscate, venation and stigma black.

Data of the collection: "Japan: Osaka Prefecture 800 m Izumi Katswiagi 24. IX. 1993 A. Freidberg & F. Kaplan". Deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D. C.

The new variation differs from *Dolerus japonicus* KIRBY by its dark infuscate wings and entirely red labrum and clypeus. This colour variation slightly resembles to *Dolerus pseudojaponicus* HARIS & BLANK (1996), but the surface sculpture and the structure of the sawsheath are completely different in these two species.

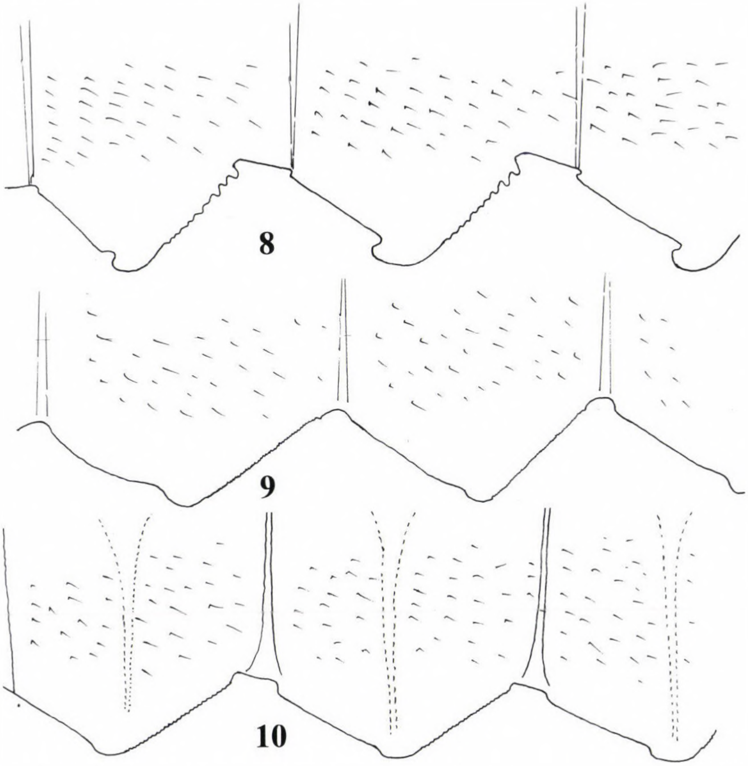


7

Fig. 7. Basal 4–6th serrulae of the lancet of *D. shanghaiensis* sp. n.

Dolerus albolineolatus Haris et Blank, 1996
(Fig. 3)

Male: Shining black. Apical third of mandible brownish red. Thorax black, lateral lobes of mesonotum red. Cenchri brown. Abdomen without white margins on segments. Wings slightly infuscate, venation and stigma black, stigma with brown margin. Clypeus deeply excised for depth of half its total length. Head in dorsal view parallel behind eyes. OOL : POL : OCL = 1.1 : 1.0 : 1.1. Antenna about 1.25× longer than abdomen and as long as costa and stigma. Length of antennomere 3 little longer than 4 (1.0 : 1.1). Eighth antennomere 4× longer than its maximal width. Vertex and temples densely and moderately roughly punctured without interspaces. Pronotum and propleuron densely and moderately roughly punctured. Front lobe of mesonotum densely and deeply but not roughly punctured, slightly shining with interspaces 0.5–2.0× diameter of a puncture. Lateral lobes of mesonotum nearly smooth with sporadic, with shallow punctures, andslightly shining. Mesoscutellum densely and uniformly punctured. Mesoscutellar appendage smooth and shining. Metascutellum sporadically punctured. Katepimeron, metepimeron, and mesepisternum densely punctured. Mesopleuron densely and coarsely punctured. Mesosternum densely, deeply but finely and uniformly punctured, shining with interspaces about equal to diameter of a puncture. Distance between cenchri about 1.7× as long as width of one. Pubescence white and about as long as diameter of front ocellus on propleuron. Mesonotal setae blunt. Occipital and mesonotal furrows well developed. First abdominal segment smooth and shining, 2–9 covered with dense transverse microsculpture. Penis valve as in Fig. 3. Length: 8.5 mm.



Figs 8–10. Basal 4–6th serrulae of the lancet of 8 = *D. nipponicus* sp. n., 9 = *D. affinis* CAM., *D. yokohamensis* ROHW.

Data of collection: "Munsun-Ni, Korea Apr. 13. 1954 Krauel". Deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D. C.

Although the female of *D. albolineatus* is very close to *D. yokohamensis* ROHWER, the male is not similar to the male of *yokohamensis* but rather resemble to its own female. This male undoubtfully belongs to *albolineolatus*. This is confirmed by the surface sculpture and the coloration of the whole body which correspond to those of the female. In the original description of *D. albolineolatus*, the pits of the lateral lobes are not a specific character but are the result of muscular contraction after death. Thus, the differential diagnosis for the female needs to be corrected: Lateral lobe of mesonotum densely punctured in *D. yokohamensis* and nearly impunctate, or very sporadically punctured in *albolineolatus*. Front lobe very rarely black in *yokohamensis* and completely black, at most with a very little spot in the inner edge, in *albolineolatus*, apices of apical setae of sawsheath curved inwardly in *yokohamensis* and never curved inwardly in *albolineolatus*, cenchri of *yokohamensis* yellowish white and cenchri of *albolineolatus* are brown. The male of *albolineolatus* is very similar to the female, the male of *yokohamensis* is very different from the female. The similar structure of the penis valves proves the close relationship of these two species, as compared in Figs 2 and 3.

* * *

Acknowledgement – The author thanks Dr DAVID R. SMITH for his valuable support during the preparation of this work.

REFERENCES

BENSON, R. B. (1952) Hymenoptera 2. Symphyta. Section (B). *Handbook for the identification of British Insects* 6 **26**: 51–137.

GOULET, H. (1986) The genera and species of the Nearctic Dolerini (Symphyta: Tenthredinidae: Selandrinae): classification and phylogeny. *Mem. Ent. Soc. Canada* **135**: 481–483.

HARIS A. & BLANK, S. (1996) Two new *Dolerus* species from Korea (Hymenoptera, Symphyta, Tenthredinidae). *Acta zool. hung*. **42**(1): 59–63.

LEE, J.-W. & RYU, S.-M. (1989) A systematic study of the Symphyta (Hymenoptera) in Korea I. scanning electron microscopic study of the Dolerinae (Tenthredinidae). *Ent. Res. Bull. Korean Ent. Inst., Korean Univ.* **15**: 1–10.

KIRBY, W. (1882) *List of Hymenoptera, with descriptions and figures of the Typical Specimens in the British Museum. 1. Tenthredinidae and Siricidae.* Trustees of the British Museum. London, 450 pp.

MALAISE, R. (1931) Entomologische Ergebnisse der schwedischen Kamtchatka-Expedition 1920–1922. 35. Tenthredinidae. *Arkiv för zoologi* 23 **8**: 1–68.

MUCHE, H. (1965) Mongolische Dolerini (Tenthredinidae, Dolerinae). *Reichenbachia, Mus. Tierk. Dresden.* 5. **20**: 181–190.

MUCHE, H. (1968) 155. Tenthredininae. Ergebnisse der zoologischen Forschungen von Dr. Z. Kaszab in der Mongolei (Hymenoptera) *Reichenbachia, Mus. Tierk. Dresden.* 11. **15**: 171–175.

TAKEUCHI, K. (1952) *A generic classification of the Japanese Tenthredinidae (Hymenoptera, Symphyta).* Kyoto, 90 pp.

TOGASHI, I. (1989) Some Sawflies (Hymenoptera, Tenthredinidae) from Pakistan Collected by Dr. H. Kurahashi in 1987. *Jpn. J. Ent.* **57**(3): 573–580.

WATERSTON, J. (1926) A new species of saw-fly from Japan. *The Entomologist* **59**: 206–209.

ZHELOCHOVTSEV, A. N. (1928) 7. Über palarktische Dolerinae. *Mitteil. Entom. Abteil. Zool. Mus. Univ. Moskau* **45**: 105–112.

ZHELOCHOVTSEV, A. N. (1935) Notes sur les Dolerinae (Hym.) paléarctiques. *Arch. Muz. Zool. Univ. Moscou* **2**: 79–83.

ZOMBORI L. (1982) Tenthredinoidea 2. In *Fauna Hungariae 153.* Akadémiai Kiadó, Budapest, 144 pp.

Received 17th September 1996, accepted 19th December 1996

Acta Zoologica Academiae Scientiarum Hungaricae 42 (3), pp. 195–230, 1996

NEW SPECIES AND SUBSPECIES OF DICHAGYRIS, CHERSOTIS AND RHYACIA (LEPIDOPTERA, NOCTUIDAE) FROM CENTRAL ASIA

Z. VARGA

Department of Zoology and Evolutionary Biology,
L. Kossuth University, H–4010 Debrecen, Egyetem-tér 1, Hungary

Ten new species: *Dichagyris (Dichagyris) korshunovi* (Turkmenistan, Kopet-Dagh Mts), *Dichagyris (D.) kautti* (India, Himachal Pradesh), *D. (D.) naumanni* (Turkmenistan, Kugitang-Tau Mts), *D. (D.) kongur* (Kazakhstan, Alma-Ata region), *D. (Yigoga) hissariensis* (Tadjikistan, Hissar Mts), *D. (Y.) thylacina* (Turkmenistan, Kopet-Dagh Mts), *Chersotis nekrasovi* (Tadjikistan W Pamir Mts), *Ch. herczigi* (Pakistan, Himalaya Mts), *Rhyacia gabori* (Turkmenistan, Kopet-Dagh Mts), *Rh. fabiani* (Turkmenistan, Kopet-Dagh Mts), as well as five new subspecies: *Dichagyris clara gobialtaica* (Mongolia, Adz Bogd Uul Mts), *D. celebrata pashtu* (Pakistan, Karakoram Mts), *D. argentea acroptera* (Turkmenistan, Kopet-Dagh Mts), *Chersotis anatolica transcaspiae* (Turkmenistan, Kopet-Dagh Mts) are described. With 130 figures.

Key word: *Dichagyris, Chersotis, Rhyacia,* Noctuidae, Central Asia, new taxa

INTRODUCTION

Before the forthcoming revision of the noctuid genera *Dichagyris* LEDERER, 1857 (incl. *Yigoga* NYE, 1975), *Chersotis* BOISDUVAL, 1840 and *Rhyacia* HÜBNER, [1821] 1816, several new species and subspecies belonging to those genera herewith described. Most of the new taxa were collected during recent zoological expeditions to the arid regions of Central Asia.

Abbreviation of the museums and collections in which most of the types are deposited: Hungarian Natural History Museum, Budapest (HNHM), Finnish Museum of Natural History, Helsinki (FMNH), Department of Zoology, Kossuth University, Debrecen, coll. VARGA (DZUD). The types of new taxa which are deposited in different Hungarian private collections (FÁBIÁN (Budapest), GYULAI (Miskolc), HERCZIG (Baj), HREBLAY (Érd) and G. RONKAY are accessible by contacting the Department of Zoology of the Hungarian Natural History Museum, Budapest.

Dichagyris (Dichagyris) korshunovi sp. n.
(Figs 1–2)

Holotype: male, "Turkmenistan, Kopet-Dagh Mts, 6 km S of Ipay-Kala, 1600 m, 57°07'E, 38°17'N, 16–23. 08. 1992, leg. M. Hreblay, Gy. M. László & G. Ronkay" (HNHM, Budapest, ex coll. G. RONKAY), Slide: 6929 (VARGA).

Paratypes: 38 males and 53 females, from the same locality and from the following localities: Turkmenistan, Kopet-Dagh Mts 800–1500 m, valley of the rivers Ipay-Kala and Point-Kala, 59°54–57' E, 38°13–15'N, 30. 06–04. 07.1992., leg. FÁBIÁN, HERCZIG, PODLUSSÁNY & VARGA; Turkmenistan, Kopet-Dagh Mts, Dushak, 1800 m, 57°56'E, 37°54'N, 06–08.07. 1992., leg. FÁBIÁN, HERCZIG, PODLUSSÁNY & VARGA; from the same locality, 1500 m, 07–08.08. 1992., leg. HREBLAY, LÁSZLÓ & G. RONKAY; (HNHM, Budapest), coll. FÁBIÁN (Budapest), GYULAI (Miskolc) HERCZIG (Baj), HREBLAY (Érd), G. RONKAY (Budapest) and VARGA (DZUD). Slides: 6785, 6795, 6806, 6923 (VARGA), 3505 (HREBLAY).

Etymology: The new species is dedicated to Dr. V. KORSHUNOV, zoologist in Ashkhabad, who in many ways assisted our expeditions to Turkmenistan.

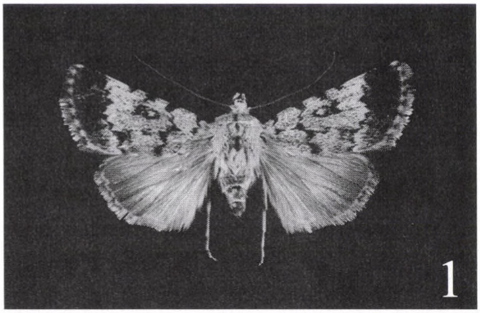
Diagnosis: Externally the new species is similar to *Dichagyris (D.) stellans* (CORTI & DRAUDT, 1933) (well-marked maculation and light stripe between postmedian line and subterminal dark shadow) and to lighter specimens of *Dichagyris (D.) melanuroides* KOZHANTSCHIKOV, 1930 (well-marked maculation, dark irroration of the ground-colour). Neither of those species have, however, bulbed cornuti and they have a different curving of vesica, longer and more angulate shape of valva etc. *Dichagyris (D.) melanura* (KOLLAR, 1846), dissimilar in external features, has similar male genitalia with a bulbed cornutus on the subbasal diverticulum, but the vesica of the new species is more curved and twisted, valvae broader with stronger harpe and ampulla, clavus longer and acute. *Dichagyris (D.) rhadamanthys* (REISSER, 1948), an island taxon from Crete which has been considered as a distinct species by HACKER & LÖDL (1989) and FIBIGER (1990), also has a bulbed cornutus but the ventral costa of its valvae is concave with an angular edge of the sacculus, while this part is convex and more rounded in the genitalia of the new species (Figs 33–49).

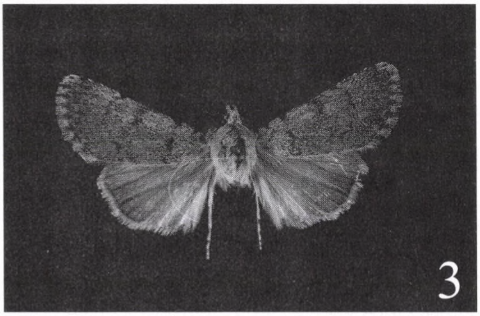
Description – Male: Wingspan: 35.5–37.0 mm, length of forewing: 16–17 mm. Antenna filiform, densely ciliate. Head and thorax light greyish ochreous, hairs often blackish tipped, mostly on collar and tegulae. Abdomen light brownish ochreous. Forewing light greyish ochreous, irrorated blackish brown, orbicular stigma and inner side of reniform stigma surrounded with dark brown scales, claviform spot obsolescent, marked with dark brown scales. Transversal lines simple, waved, medial shadow at costa and between orbicular and reniform stigmata well-marked, below the middle cell obsolescent. Subterminal shadow dark brown, broad; between subterminal and postmedian lines a light stripe, base of fringes with light ochreous spots, then dark brown, greyish-brown tipped. Hindwing light ochreous grey, shiny, terminal part darker, fringes basally yellowish, then dark brownish grey. Underside light silky ochreous, shiny with dark terminal band, dissected with light veins.

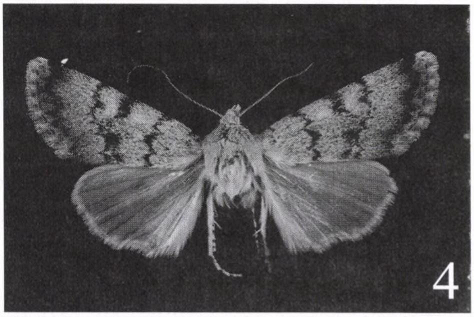
Female: Wingspan 35–37 mm, length of forewing: 15.5–16.5 mm; similar to male, but abdomen apically with dark reddish-brown hairs; all markings of forewing more expressed, hindwing dark brownish-grey, dark terminal band of the underside unicolorous.

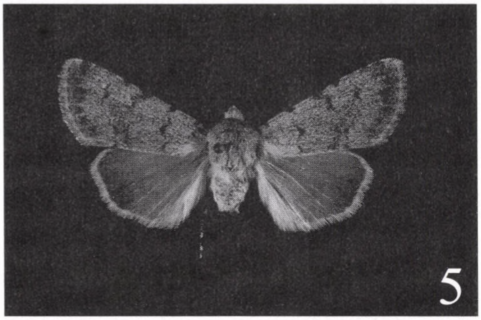
Male genitalia (Figs 33, 41): uncus long, straight, only apically slightly curved and pointed; valva broad, distal part short; cucullus rounded, corona with 6–8 setae; harpe strong, slightly curved, overreaching costa; ampulla clubbed, distally with setae; clavus long, acute; juxta weakly sclerotized; aedoeagus long, straight; carina with a sclerotized tubercle; vesica tubular, recurved with a strong, bulbed subbasal cornutus, obliquely backwards directed.

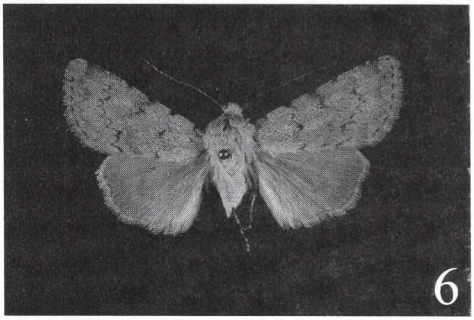
Figs 1–8. 1–2: 1 = *Dichagyris korshunovi* VARGA, sp. n., holotype male, 2 = paratype female, Turkmenistan, Kopet-Dagh Mts, Ipay-Kala valley; 3 = *D. kautti* VARGA, sp. n., holotype male, India, Himachal Pradesh, Spiti valley; 4 = *D. scotographa* VARGA 1990, Pakistan, Karakoram Mts; 5 = *D. clara gobialtaica* VARGA, ssp. n., holotype male, Mongolia, Gobi Altay Mts; 6 = *D. clara clara* (STAUDINGER), Kirghisia, Issyk-Kul; 7–8: *D. naumanni* VARGA, sp. n. 7 = holotype, male, 8 = paratype, male, Turkmenistan, Kugitang-Tau Mts

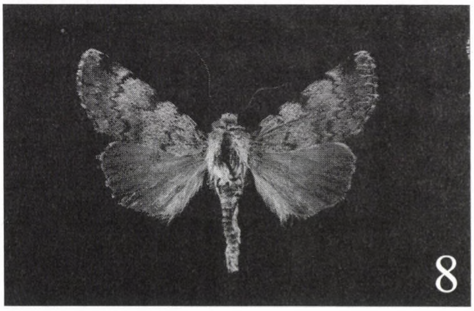












Taxonomic relationships of the new species – The new species belongs to the *melanura* species group of the genus *Dichagyris* LEDERER, 1857 (subgenus *Dichagyris*). The statement of FIBIGER & HACKER (1990) that *D. (D.) melanura* and related species belong to an "undescribed subgenus" within the genus *Dichagyris,* must be regarded as erroneous, because *D. (D.) melanura* is the type species of the genus. This species group can be subdivided into two subgroups of closely related species based on the subbasal cornutus of the vesica. *D. (D.) melanura*, *D. (D.) rhadamanthys*, *D. (D.) korshunovi* and a further species from Hakkari (SE Turkey, collected by A. MOBERG) have bulbed cornutus on a short, tubercle-like diverticulum, while *Dichagyris (D.) grisescens* STAUDINGER, 1878, *Dichagyris (D.) leucomelas* BRANDT, 1941, *D (D.) melanuroides*, *D. (D.) stellans* (= *D (D.) eremopsis* (BOURSIN, 1948)) and *Dichagyris (D.) duskei* MOBERG & FIBIGER, 1990 (bona sp., *stat. rev.*) have a simple, not bulbed cornutus in the same position. The taxonomic and phylogenetic relationships of this species group will be discussed in a forthcoming paper on the phylogenetic-taxonomic subdivision of the genus *Dichagyris* LEDERER and related genera.

Distribution and bionomics – The new species is known only from of the Kopet-Dagh Mts in Turkmenistan, where it was found mainly in two localities. It appears to be a late flying species, being abundant from the end of June to the middle of August, mostly at elevations between 1500–1800 m a. s. l. It does not occur, however, in the low-lying sites (e.g. Kara-Kala).

Dichagyris (Dichagyris) kautti sp. n.
(Fig.3)

Holotype: male, India, Himachal Pradesh, Spiti, Spiti Valley, 6 km SE Kaza, 4150 m, 17. 07. 1994, leg KAUTT & WEISZ (HNHM, Budapest, ex coll. G. RONKAY). Slide 5055 (L. RONKAY)

Paratypes: a large series of both sexes from the same locality and Spiti Valley, several localities near Kaza, 3600–4350 m, 28.06–07.08.1994 and village Kagha, 3850 m, 08–09.08.1994; leg. KAUTT & WEISZ (HNHM, Budapest), H. HACKER (Staffelstein, Germany), HREBLAY (Érd) G. RONKAY (Budapest) and Z. VARGA (DZUD). Slides: 6960, 6961, 6988 (males), 6975, 6981 (females, VARGA).

Etymology: The new species is dedicated to one of the collectors.

Diagnosis: Superficially the new species resembles the less marked, greyish specimens of sympatrically occurring *Dichagyris (D.) himalayensis* (TURATI, 1933). The irrorate fringe (both sexes) and the heavily sclerotized papillae anales (females) are diagnostic characters of the new species allowing an easy separation. In critical cases (worn males) the study of genitalia is necessary which shows that *D. (D.) kautti* sp. n. and *D. (D.) himalayensis* are not very closely related, indeed (see below). All truly closely related species, *Dichagyris (D.) clara*

(STAUDINGER, 1888), *D. (D.) scotographa* and *Dichagyris (D.) leucographa* VARGA, 1990 have more distinct markings and several distinctive features in the male genitalia (Figs 4, 50–53, 56–57 in this paper; VARGA 1990: Figs 76–132 and plates IV–V). In this group, the most important distinctive features can be found in the carina: form and dentation of the "baculum"-like crest and in the shape, size and orientation of the basal and subbasal diverticula. In addition, in this group females usually have strongly sclerotized, acute papillae anales, while the papillae of *D. (D.) himalayensis* are rounded and only weakly sclerotized. *D. (D.) kautti* sp. n. appears to be smaller on the average than the closely related species, especially *D. (D.) scotographa* which has mostly similar genitalia, but very dissimilar external features.

Description – Male: Wingspan: 39.5–41 mm, length of forewing: 19–20 mm. Antenna filiform, densely ciliate. Head and thorax ochreous, brownish irrorated. Abdomen slightly paler ochreous, shiny. Forewing relatively rounded, outer margin convex, apex only very moderately acute, coloration greyish ochreous, covered with darker brown scales. All markings on forewings obsolescent, only postmedian line and terminal shadow slightly more marked. Ante- and postmediane lines simple, only slightly waved and crenulate, antemedian nearly straight, dark brown, interrupted with ochreous scales. Fringes basally with blackish spots, then with yellowish-ochreous stripe, slightly irrorate. Hindwing pale ochreous grey, shiny, terminal part slightly darker. Underside of forewing pale, shiny ochreous grey, only postmedian slightly marked; cell and terminal part with greyish shadow, dissected by pale veins. Underside of hindwing concolorous, whitish ochreous, shiny, without markings.

Female: Wingspan: 40.0–41.5 mm, length of forewing: 19.0–20.5 mm; similar to male, antenna filiform, hindwing slightly more suffused.

Male genitalia (Figs: 54, 55, 58): With general features of *clara*-group of genus *Dichagyris (subg. Dichagyris).* Valva elongate with narrow cucullus and corona. Harpe strong, nearly straight, exceeding costa. Aedeagus long, straight, carina with a "baculum"-like dentate, heavily sclerotized crest. Vesica tubular, broad; with a short pyramide-like basal and with a tubercle-like subbasal diverticulum. (The basal diverticulum is broad, globular in *Dichagyris (D.) scotographa* VARGA, 1990.) Cornutus on the subbasal diverticulum long, straight, acute. Distally with tubercle-like terminal diverticulum.

Female genitalia: in general similar to those of other species of *clara*-group, papillae anales relatively shorter, sclerotized, with numerous strongly sclerotized setae.

Taxonomic and biogeographic relationships – The *clara*-group of the genus *Dichagyris (Dichagyris)* consists of four, mostly allopatric species. *D. (D.) clara*, described from the Issyk-Kul area (western Tien-Shan Mts), has the widest and northern most range (Kazakhstan, Kirghisia, Chinese Turkestan); taxonomically it has proved to be polytypic (see below). Its easternmost populations have been found in mountainous areas of SW Mongolia. *D. (D.) leucographa*, externally similar to *clara*, but clearly distinct in genitalia (see: VARGA 1990), seems to be confined to the southern part of the Pamir-plateau (Afghanistan, Prov. Badakhshan, Wakhan valley) and adjacent parts of the Karakoram Mts. In some parts of its range it appears to be the dominant species (e.g. parts of the Wakhan valley). *D. (D.) scotographa*, also described from the Wakhan valley of the Pamir Mts, seems to be widely distributed in the Pamir, Karakoram and Hindukush Mts. It also occurs in Pakistan, in the westernmost part of the Himalayas. All these specimens, being preserved in large series in several large collections (HACKER, HERCZIG, HREBLAY, G. RONKAY), taxonomically cannot be separated from specimens of the type series. *D. (D.) kautti*, being very closely related to *D. (D.) scotographa*, seems to be confined to a smaller area in the southwestern part of Himalaya Mts (Northern India, Himachal Pradesh; a detailed description of the habitat is given by HACKER *et al.* 1996) and it is also geographically well separated from the species mentioned above.

Dichagyris clara gobialtaica ssp. n.

(Fig. 5)

Holotype: male, "Mongolia, Gobi Altay Mts, Adz Bogd Uul, valley of Ih gol, 1800 m, 3–4.08.1988, leg. Peregovits & Varga", deposited in the collection of Z. VARGA (DZUD, Hungary). Slide 5117 (VARGA); VARGA 1990: Plate V, Fig. 8.

Paratypes: 8 males and 6 females from the same locality and data, in collections of HNHM (Budapest), P. GYULAI (Miskolc), M. HREBLAY (Érd), G. RONKAY (Budapest) and Z. VARGA (DZUD).

Etymology: named after the range of the new subspecies.

Diagnosis: The new subspecies differs from the nominate *Dichagyris clara clara* (STAUDINGER, 1888), by its shorter, less acute forewings; darker, more brownish forewing ground colour, somewhat wider, more diffuse crosslines and slightly darker hindwings. In their brownish suffusion and the relatively short forewing, the darkest specimens of the new subspecies resemble the sympatric *D. ignara* (STAUDINGER, 1896) which belongs, however, to a completely different species group and is very dissimilar in its genital characters. Other species of the *D. (D.) clara*-group are dissimilar in all external features (VARGA 1990, Fig. 5–6 and plates IV–V).

Description – Male: Wingspan: 37–40.5 mm, length of forewing: 16.5–19 mm. Antenna filiform, shortly and densely ciliate. Head and thorax ochreous grey with brownish irroration, abdomen greyish whitish ochreous with some blackish brown scales. Forewing greyish ochreous, irrorated with brown scales, shiny. All spots obliterate, transversal lines simple, indistinctly marked, only antemedian line a little more marked with blackish-brown scales. Postmedian line crenulate, dissected by veins into obsolescent lunules. Medial and subterminal shadows brown, darker at costa, then obsolescent. With fine blackish-brown lunules at base of cilia and with a light ochreous stripe. Cilia greyish ochreous, nearly concolorous. Hindwings light brownish-grey, terminal part darker, suffused, cellular lunule and postdiscal stripe obsolescent. Underside whitish ochreous with darker suffusion in cell of forewings and in terminal area, postmedian marked with darker scales.

Female: Wingspan 38–40 mm, length of forewing 17–18.5 mm; similar to male, antenna filiform, forewing with slightly darker suffusion.

Male genitalia (VARGA 1990: Figs 103–106, 131–132) similar to that of nominate subspecies; distal part of valva and cucullus slightly broader, dentated part of carina narrower, longer.

Distribution – The new subspecies was collected in a southern, canyon-like valley of the island-like high mountain massive (Adz Bogd Uul) of the Gobi Altay Mts, near to the Chinese border. From this locality the high chains of the eastern Tien-Shan Mts, exceeding 5000 m, are well visible. The nominate subspecies also occurs in Chinese Turkestan (environs of Urumchi; coll. ZSM, Munich). In both areas, *D. (D.) clara* occurs sympatrically with the externally superficially similar *D. (D.) himalayensis*.

Dichagyris (Dichagyris) naumanni sp. n.

(Figs 7–8)

Holotype: male, "Turkmenistan, Kugitang-Tau Mts, 4 km SW of Airi-Baba peak, 66°34'E, 37°50'N, 2000 m, 22.05. 1991, leg. M. Hreblay & G. Ronkay", coll. Z. VARGA (DZUD). Slide 6802 (VARGA).

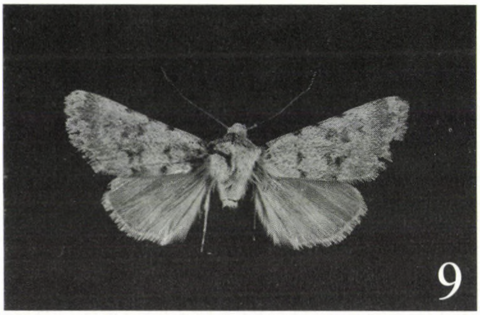
Paratypes: 2 males and 3 females from the same locality and data, 1 female from Turkmenistan, Kugitang-Tau Mts, 6 km SW from Bazar-Tepe, 500–600 m, 18–19.05.1991; coll. HNHM (Budapest), HREBLAY (Érd) and G. RONKAY (Budapest); 2 male and 1 female, Afghanistan, Prov. Samangan, Kotal-e-Rabatak, 1400 m, 10. 06. 1970, leg. C. M. NAUMANN, coll. Zool. Forschungsinst. & Museum A. Koenig, Bonn (ZFMK) and Z. VARGA (DZUD). Slides: 4061 (VARGA) male, 6810 (VARGA), female.

Etymology: The new species is dedicated to Prof. Dr. C. M. NAUMANN, who collected the first specimens of this species.

Diagnosis: The most important distinctive characters are as follows. The new species is on the average smaller than the other species of the *Dichagyris (D.) umbrifera* (ALPHERAKY, 1882) group (with the exception of the most remote *D. (D.) boursini* BRANDT, 1941). It shows a striking external similarity to *D. (D.) umbrifera* (ALPHERAKY, 1882) and *D. (D.) kaszabi* VARGA, 1973. It is similar in coloration to *D. (D.) umbrifera* but the terminal shadow of the forewing is lighter and less concolorous, the hindwing and the underside are less suffused. *D. (D.) kaszabi* appears to be closely related to *D. (D.) umbrifera*, but is more robust, reddish in coloration. *D. (D.) jacobsoni* KOZHANTSCHIKOV, 1930 shows a rather contrasting whitish ochreous to dark sepia-brown coloration which differs from the new species.

The male genitalia are also different. The valva is narrower than in *D. (D.) umbrifera* but also more rounded than in *D. (D.) jacobsoni*. The harpe is relatively straight and not acute, compared to that in the closely related species. The vesica is not as broad and ample as in related species, the subbasal cornutus is finer, thinner and more acute than in other species of this group. It differs also in the smaller clavus and by the protuberance of the subterminal diverticulum of the vesica. *D. (D.) kaszabi* can be distinguished by the very broad and angulate form of the valva and the very ample, huge vesica (Figs 59–64 and 68–69).

Figs 9–16. 9 = *D. argentea* cf. *argentea* KOZHANTSCHIKOV, Afghanistan, Dasht-i-Nawar; 10 = *D. argentea acroptera* VARGA, ssp. n., holotype, Turkmenistan, Kopet-Dagh Mts, Karayalchi valley; 11–12 = *D. argentea darius* BOURSIN, paratypes, Iran, Elburs Mts, less and stronger marked males; 13 = *D. kongur* VARGA, sp. n., holotype, Kazakhstan, Tash-Kara-su; 14 = *D. celebrata celebrata* (ALPHERAKY) Turkmenistan, Kopet-Dagh Mts, Ipay-Kala valley; 15–16: *D. celebrata pashtu* VARGA, ssp. n, paratypes, Pakistan, Karakoram Mts, 15 = male; 16 = female


9


10

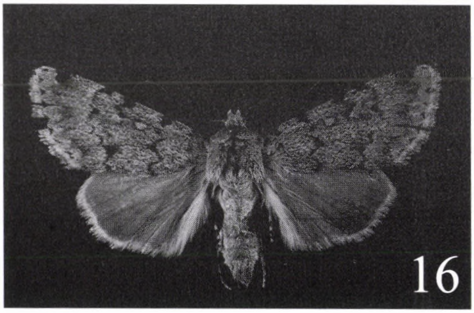

11


12


13


14


15


16

Description – Males: Wingspan 35.5–39 mm, length of forewing 16.5–19 mm. Antenna filiform, shortly ciliate. Head and thorax light ochreous with scarce reddish brown irroration. Forewing of same colour with dark greyish brown, waved and crenulate transversal lines, medial and terminal shadow. Costal part of medial shadow well-marked and broken at an acute angle. Outer part of terminal shadow lighter. Hindwing light ochreous brown with darker brown, obsolescent terminal shadow. Underside pale ochreous with dark brown terminal shadow.

Female: Wingspan 40–41 mm, length of forewing 19.5–20 mm. Sexes alike.

Male genitalia (Figs 62–63, 70): with general features of *D. (D.) umbrifera*-group (see below); uncus long, straight; valvae relatively narrow, costa only slightly convex; harpe straight; ampulla weakly sclerotized, short; clavus small, short; aedeagus short, nearly straight; vesica S-shaped, not very ample, subbasal cornutus very fine, pin-shaped; subterminal diverticulum with a little protuberance.

Taxonomical relationships – The new species belongs to the *umbrifera*-group of the genus (and subgenus) *Dichagyris* and appears to be the eastern sister species of *D. (D.) jacobsoni*. It shows also a striking external similarity to *D. (D.) umbrifera* and *D. (D.) kaszabi*. *Dichagyris (D.) achtalensis* (KOZHANTSCHIKOV, 1929), described as "*Rhyacia*", suggested by him to be related to *Rh. helvetina* (BOISDUVAL, 1840), is easily separable by its more homogeneous reddish brown suffusion of the forewings and by the dentate carina on the aedeagus. *Dichagyris (D.) herzi* (KOZHANTSCHIKOV, 1930), described only from two females, appears to be very closely related to *D. (D.) achtalensis* but is larger, and with more concolorous and darker reddish suffusion, in the male genitalia with small differences in the shape of the harpe and the dentation of carina only, and with a different orientation of the subbasal diverticulum having a stronger cornutus. A male paratype of *D. (D.) achtalensis*, a further male from eastern Turkey (Transcaucasia) and several specimens of *D. (D.) herzi* collected in Turkmenistan (near Kara-Kala) clearly display these external characters and also the characters of the male genitalia described above (Figs 65–67 and 71). *Dichagyris (D.) boursini* BRANDT, 1941 (*stat. rev.*) is a lowland species from southern Iran, being rather distant from the other members of this species group in its thick harpe and long, tubular vesica without terminal diverticula. Hence, the synonymisation of this species with *D. (D.) jacobsoni* KOZHANTSCHIKOV by HACKER (1990) is not justified.

Distribution and bionomics – This new species was taken in medium high altitudes in an island-like mountain massif in easternmost Turkmenistan and in northern Afghanistan, bordering Uzbekistan. It seems to be an early flying species (mid-May and early June), just as the other species of the *umbrifera*-group; with the exception of *D. kaszabi* which occurs at higher elevations of the Mongol Altay (1500–2300 m) and the main flying period is mid-July. It is very remarkable that all species of the *D. (D.) umbrifera*-group, with the exception of the partly sympatric but very dissimilar *D. (D.) jacobsoni* and *D. (D.) achtalensis*, are strictly allopatric which reflects a relatively recent (probably Quaternary) speciation in this group.

Dichagyris (Dichagyris) argentea acroptera ssp. n.
(Fig. 10)

Holotype: male, "Turkmenistan, Kopet-Dagh Mts, 1600 m, 25 km E of Nochur, Karayalchi valley, 05. 10. 1991, leg. Podlussány, Ronkay, L. & Varga" (deposited in HNHM, Budapest).

Paratypes: 8 males from the same locality, also from 900 m, 04.10.1991 (HNHM, coll. G. RONKAY and Z. VARGA, DZUD). Slides: 6394, 6395, 6934, 6955 (VARGA).

Etymology: acute-winged (gr.)

Diagnosis: The new subspecies is conspicuously acute-winged and darker than all the described subspecies of *Dichagyris (D.) argentea* (KOZHANTSCHIKOV, 1929). It appears to be well differentiated from *D. (D.) argentea darius* BOURSIN, 1940 of Iran (Figs 9–12), but closely related to an undescribed subspecies, known only by two males from Armenia and from E. Turkey, prov. Van, respectively (see: *taxonomic note*). It differs also from the easternmost subspecies of *D. (D.) argentea*, known to me only by a short series from E. Afghanistan, by the less broad and rounded shape of the valva, by the more curved and pointed harpe, by the more angular form of the juxta and the finer subbasal cornutus of the vesica. The differences of the new subspecies from *D. (D.) argentea darius* are nearly the same as the differences of the new subspecies from the *D. (D.) argentea* population of Afghanistan, but the valva of *D. (D.) argentea darius* is more elongate than in the latter subspecies. The valva of the undescribed subspecies from Armenia and E Turkey is narrower, nearly acute at the cucullus. It appears to be important that in all other subspecies the harpe nearly reaches the end of the valva, but in the new subspecies it keeps a distance of about one-third of the harpe (Figs 72–74 vs. 75–76). The differences in the male genitalia seem to be small but rather constant in this group, whose members are considered here only as allopatric subspecies of a widely distributed polytypic species, because the available material of this group is very limited.

Description – Male: Wingspan: 34.0–35.5 mm; length of forewings 16–17 mm. Antennae filiform, shortly, densely ciliate. Head and thorax greyish ochreous, irrorated with dark brown hairs, part of hairs whitish tipped. Abdomen slightly lighter greyish ochreous. Forewing greyish ochreous, irrorated with dark brown scales, maculation obsolescent, transversal lines simple, often obsolescent, waved (antemedian) or waved and crenulate (postmedian). Medial and terminal shadow obsolescent, at base of fringes with darker spots. Underside silky greyish ochreous with slightly darker terminal shadow (forewing) and shiny ochreous white (hindwing).

Female unknown.

Male genitalia (Figs 75–76, 79): uncus long, nearly straight, only distally curved; valva broad, cucullus rounded, corona with 8–10 setae; harpe strong, curved and pointed; juxta broad, pentagonal; aedeagus strong, straight, carina strongly sclerotized; vesica broad, tubular, with helicoid curving and with a very fine, thin and pointed subbasal cornutus.

Taxonomic relationships – The *D. argentea* specimens collected in Dasht-i-Nawar, E Afghanistan, were considered (and labelled) by BOURSIN (1940) to represent the nominate subspecies of *D. (D.) argentea*, described by KOZHANTSCHIKOV (1929) from "Pishpek" (= Bishkek, the former Frunze, Kirghisia), unfortunately based only on a single female. Thus the taxonomic identity of the nominate subspecies remains somewhat uncertain. However, populations from Iran (*D. argentea darius*) and from Turkmenistan (*D. argentea acroptera*) appear, sufficiently well-differentiated to have their own subspecific names. Despite its external differences, the polytypic species *D. (D.) argentea* belongs to a group of late summer or early autumnal species which display the similar basic structure of the male genitalia: *Dichagyris (D.) singularis* (STAUDINGER, 1877), *Dichagyris (D.) pfeifferi* CORTI & DRAUDT, 1933, *Dichagyris (D.) fredi* BRANDT, 1938 and *Dichagyris (D.) anastasia* (DRAUDT, 1936). It appears to be evident that *Dichagyris (Yigoga) flavina* (HERRICH-SCHÄFFER, 1852) – frequently confused with *D. (D.) anastasia* -, *D. (Y.) serraticornis* (STAUDINGER, 1897) and *D. (Y.) lutescens* (EVERSMANN, 1844) belong to a completely different group of species (and to a different subgenus!) than the former ones and they are not closely related with them.

Taxonomic note – The late CH. BOURSIN (1940) mentioned a specimen of *D. (D.) argentea*, identified as "*argentea*" by KOZHANTSCHIKOV, which was collected near Darasham (Armenia). He separated it by external characters from *D. argentea darius* without giving a subspecific name for this specimen. Judging from the figures, published by BOURSIN, this undescribed taxon was also collected in eastern Turkey, but unfortunately only by a single specimen. The data of this new specimen are as follows: Turkey, prov. Van, Catak, Kavussahap daglari, 8–9. 9. 1991, leg. & coll. GYULAI, slide: 6862 (VARGA), male. The male genitalia shows the same basic features as the former subspecies, but the valva is narrower, nearly pointed at the cucullus, the harpe nearly reaches the end of the valva; juxta less angular; vesica and cornutus appear to be identical with those of the Turkmenian subspecies (Figs 73, 80). In any case, it appears to be more closely related to them than to the nominate subspecies and to *D. (D.) argentea darius* from Iran. However, more material is needed for a correct taxonomical description.

Dichagyris (Dichagyris) kongur sp. n.
(Fig. 13)

Holotype: male, "Kazakhstan, Alma-Ata region, Tash-Kara-su, 500 m, 21.06.1993, leg. Lukhtanov", coll. GYULAI (Miskolc, Hungary).

Paratypes: 14 males and 15 females from the following localities: Kazakhstan, Alma-Ata region, pristan. Dubinskaja, 550 m, 13–18.06.1993, leg. LUKHTANOV; Kazakhstan, Alma-Ata region, Torai-Gir Mts, 20 km SE Kokpek, 1500 m, 22.06.1993, leg. LUKHTANOV; Kazakhstan, Alma-Ata region, Boguty Mts, 900–1400 m, 9–11.06.1993, leg. LUKHTANOV; Kazakhstan, Charin region, vic. Chundja, 29.06.1992 and 11.06.1986, leg. I. KOSTYUK; Kazakhstan, Tshimkent region, Karatau

Mts Kentau, 650 m; coll. HNHM, GYULAI (Miskolc), HREBLAY (Érd), G. RONKAY (Budapest), VARGA (DZUD). Slides: 6766, 6774, 6891 (VARGA) males, 6870 (VARGA) female.

Etymology: the word "*kongur*" is used in the Kazakh language for the characterisation of "earth-brown" horses. It was also preserved in the (almost extinct) language of the Kumanian people, living in Hungary, e.g. in the name of the famous Hungarian linguist, the late Professor I. MÁNDOKY-KONGUR who devoted his life for his Turkological surveys. This name should also be a hommage to Professor MÁNDOKY-KONGUR.

Diagnosis: The new species can be separated from *Dichagyris (D.) celebrata* (ALPHERAKY, 1897) by its smaller size, shorter forewings, concolorous dull brown coloration and particularly by its different genitalia. The harpe is shorter and less curved, the vesica is narrower and differently coiled, the cornutus is larger (male); the papillae anales are shorter, apophyses posteriores longer and straighter, ductus bursae relatively broader (female) than in *D. (D.) celebrata* and its subspecies (Figs 81–90).

Description – Male: Wingspan: 32.5 – 39.5 mm, length of forewing 16–19 mm. Antennae filiform, shortly ciliate. Head and thorax dull greyish ochreous brown, irrorated dark brown. Abdomen dull ochreous brown. Forewing concolorous, markings dark brown, maculation obsolescent. Costal and submedial part of transversal lines more marked, separated to blackish brown spots. Blackish spots at the basis of fringes. Hindwing light greyish-brown with obsolescent terminal shadow. Underside nearly concolorous light brownish-grey, with very obsolescent terminal shadow.

Female: Wingspan: 34 – 39 mm, length of forewings: 17.0–18.5 mm. Sexes alike.

Male genitalia (Figs 81–82 and 86–87): uncus long, slightly curved; valva broad, slightly concave on outer margin; harpe very short; clavus small, weakly sclerotized; juxta broad, weakly sclerotized; aedeagus straight, carina weakly sclerotized; vesica not very broad, coiled twice, with a short subbasal cornutus.

Female genitalia: papillae anales weakly sclerotized with long setae; distal apophyses straight, long; ostium bursae with U-shaped sclerotization; ductus bursae broad, only slightly folded and rugulose; bursa long, broad; cervix broad, subglobular.

Taxonomic relationships – *Dichagyris (D.) kongur* sp. n. is the closest relative of *D. (D.) celebrata*, which is a widely distributed polytypic species from NW Kazakhstan (Uralsk) and Central Turkey (prov. Ankara) to the Himalaya region. Its nominate subspecies occurs in Turkmenistan. It is a large, contrasting marked, broadwinged moth. Populations from Tadjikistan, Afghanistan, Pakistan have a duller coloration, more obsolescent markings and more acutely shaped forewings. This subspecies will be described subsequently. The new species is also externally similar to *D. (D.) kirghisa* (EVERSMANN, 1856) which is a species hitherto incompletely studied, not collected recently and also not represented in most large collections. I could study a male syntype from the CORTI collection (Natural History Museum, Basel); I compared it with a genital drawing of an other syntype of this species (coll. ZIN, St. Petersburg) made by A. MOBERG. Thus, I could clarify that this species is more closely related to *Dichagyris (D.) squalorum* (EVERSMANN, 1856) and *D. (D.) terminicincta* CORTI, 1933. This species is very strongly irrorated with blackish-brown scales and the transversal lines and shadows on the forewings are very strongly crenulate.

Distribution and bionomy – The new species is known only from a few, steppe localities in Kazakhstan. It seems to inhabit low or moderate altitudes and flies relatively early.

Dichagyris celebrata pashtu ssp. n.
(Figs 15–16)

Holotype: male, "Pakistan, Karakoram Mts, Hispar valley, Huru, 74°42'E, 36°15'N, 23.07.1994, leg. B. Herczig, GY. M. László & G. Ronkay" (coll. G. RONKAY, Budapest).

Paratypes: a series of 50 specimens of both sexes from the same locality and from Pakistan, Hindukush Mts, 5 km E Booni, 2200 m, 36°60' N, 72°03'E, 22.06.1992, colls HNHM (Budapest), HERCZIG (Baj), GYULAI (Miskolc), HREBLAY (Érd), G. RONKAY (Budapest) and Z. VARGA (DZUD); slide 6982 (VARGA), 3485 (HREBLAY).

Etymology: the name refers to the Pashtu people inhabiting the neighbouring parts of Afghanistan and Pakistan.

I consider the specimens occurring in E–NE Afghanistan also to belong to the new subspecies, but because of the enormous external variability of *D. (D.) celebrata*, I designate a homogeneous series of specimens as paratypes.Etymology: the name refers to the Pashtu people inhabiting the neighbouring parts of Afghanistan and Pakistan.

Diagnostic characters – Slightly larger and more acute-winged than the nominate subspecies (Figs 15–16 vs. 14). The coloration is darker throughout and less contrasting; the dark brownish suffusion on the thorax and forewings is much stronger, but the terminal shadow is less expressed, than transversal lines are more obsolescent. The series collected in the Karakoram Mts appears to be rather homogeneous and is clearly distinct from the nominate subspecies. The specimens collected in the eastern, mountaneous part of Afghanistan (Paghman Mts, Salang Pass, Hindukush Mts) also display the same phenotypical characters but I have not examined long any series from these localities. Thus, I decided not to include these in the series of paratypes. The subspecies occurring locally in the central parts of Asia Minor (mainly near lake Tuz Gölü) has a much shorter, more rounded shape of the forewings, a light ochreous grey coloration with scarce dark suffusion and a dark terminal shadow. Based on these external characters, it can be mostly referred to *D. (D.) celebrata assimilata* (KOZHANTSCHIKOV, 1929) described from Transcaucasia. Unfortunately, all subspecific taxa of *D. celebrata* described by KOZHANTSCHIKOV (1929) are based on single or a few specimens only and do not represent the range of variation of the populations concerned.

Description: In expanse (44–47 mm) and forewing length (22–24 mm) the largest subspecies of the very polytypic *D. (D.) celebrata.* All external structural characters as in the nominate subspecies. Forewings very pointed and elongate, apex acute. Head and thorax strongly irrorate with dark brown hairs. Light ochreous brown forewings densely covered by dark scales. Transversal lines blackish-brown, simple, disrupted into distinct spots or lunules. At inner margin of reniform stigma present, and at tip of claviform stigma with blackish-brown scales, maculation otherwise absent. Medial and terminal shadow obsolescent. Cilia light ochreous grey, darker brown irrorate. Hindwings light ochreous-grey with obsolescent terminal shadow, cilia whitish. Underside of wings light ochreous grey; on forewings postmedian and darker suffused parts of medial and terminal shadow obsolescent.

Sexes alike.

Male genitalia (Figs 85, 90): with basic characters of species; valva large, very broad, vesica huge with a short but strong, pyramide-shaped cornutus.

Distribution and bionomics – The nominate subspecies of *D. (D.) celebrata* appears to occur at moderate altitudes and inhabits semi-desert-like, rocky habitats. The subspecies occurring near the Lake Tuz Gölü also inhabits low-lying, semi-desert-like, but halophytic habitats. On the other hand, the new subspecies inhabits higher altitudes in a colder and more continental part of Central Asia. Thus, it represents a well-differentiated subspecies of *D. (D.) celebrata.*

Dichagyris (Yigoga) hissariensis sp. n.

(Fig. 17)

Holotype: female, "Tadjikistan, Hissar Mts, Romit, 1100 m, 39°N, 68°40'E, 13.06.1991, leg. Jürivete" (deposited in FNHM, Helsinki). Slide 7017 (VARGA).

Paratype, male, from the same locality and data as the holotype, (FNHM, Helsinki) slide 7003 (VARGA).

Etymology: from the type locality of the species.

Diagnosis – Phenotypically the new species does not display any significant similarity to the other species of the subgenus *Yigoga* Nye, 1975. The markings slightly resemble those in *Dichagyris (Yigoga) signifera* (DENIS & SCHIFFERMÜLLER, 1775) and *D. (Y.) orientis* (ALPHERAKY, 1882), but the new species is smaller with narrow, elongate forewings, while the species mentioned above are short-winged, with a more rounded shape of the forewings.

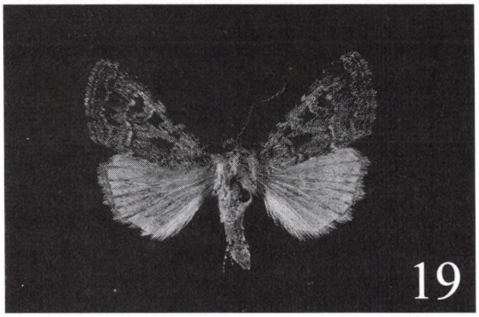
Description: The following description of external characters is based on the holotype female, because the male paratype is very worn.

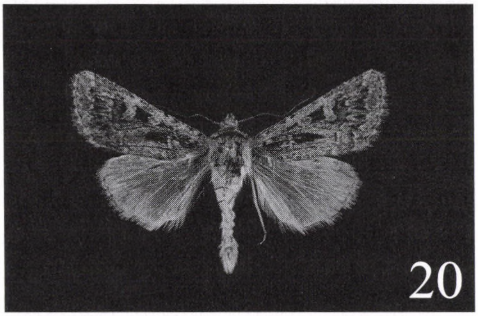
Wingspan: 32 mm, length of forewing: 15 mm. Antenna filiform. Head and thorax grey, densely irrorated by blackish hairs with whitish tips. Abdomen pale grey, irrorated with blackish brown hairs. Forewing elongate, light grey with slight reddish brown shine and irrorated by blackish brown scales. Transversal lines double, darker grey, filled with pale grey scales; antemedian slightly waved, postmedian finely crenulate. Reniform stigma large, upwards extended, bordered by blackish scales, especially between reniform and postmedian line. Orbicular stigma large, oblique, also bordered with blackish-brown scales. Claviform spot narrow, acute, marked with dark

Figs 17–24. 17 = *D. (Yigoga) hissariensis* VARGA, sp. n. holotype female, Tadjikistan, Hissar Mts; 18 = *D. (Y.) lupina* (BRANDT) Turkmenistan, Kopet-Dagh Mts, Firyuza; 19 = *D. (Y.) thylacina* ssp., Tadjikistan, Hissar Mts; 20 = *D. (Y.) thylacina* VARGA, sp. n., paratype male. Turkmenistan, Kopet-Dagh Mts, Ipay-Kala valley; 21–22: *Chersotis herczigi* VARGA, sp. n., Pakistan, Himalaya Mts, Kaghan valley, 21 = holotype, male, 22 = paratype, female; 23 = *Ch. firdussi* SCHWINGENSCHUSS, Afghanistan, Paghman Mts; 24 = *Ch. nekrasovi* VARGA, sp. n., holotype, male, Tadjikistan, Pamir Mts, Chorog


17

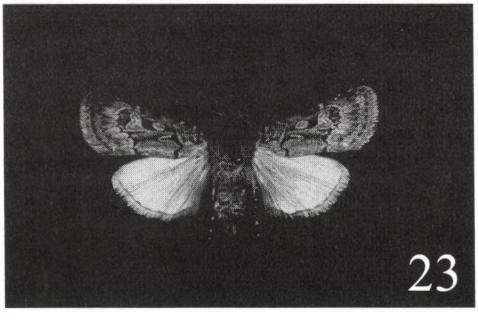

18


19


20


21


22


23


24

scales. Forewing with black basal dash; two strongly marked, black and 3–4 less marked, grey arrowheads at subterminal line. Fine black spots at base of cilia, then a very thin ochraceous stripe. Cilia pale ochreous grey, indistinctly irrorated with darker scales. Hindwings whitish grey with pale ochreous shine.

Male genitalia (Figs 91–92): In general characters similar to those of the species group *Dichagyris (Yigoga) orientis* (ALPHERAKY, 1882) – *D. (Y.) nachadira* BRANDT, 1941. Uncus long, falcate; valvae relatively narrow, elongate. Aedeagus long, straight, vesica very long, tubular, with a small cornutus on subbasal diverticulum; distally slightly widening.

Female genitalia: Papillae anales, ostium and ductus bursae weakly sclerotized, bursa bisaccate, corpus and cervix long, tubular. Structures of female genitalia very simplified.

Taxonomic relationships – The new species seems to occupy an intermediate position between the two species groups of the subgenus *Yigoga: D. (Y.) signifera – D. (Y.) orientis – D. (Y.) nachadira* and *Dichagyris (Y.) lupina* (BRANDT, 1941) – *Dichagyris (Y.) thylacina* sp. n. (see below), respectively. I have seen a single female (coll. V. NEKRASOV, Moscow) from the western Pamir Mts. (Chorog, Botanical garden, collected in September) which may also belong to an undescribed species, related to *D. (Y.) hissariensis* sp. n. Unfortunately, the male of that species is so far unknown; the female genitalia are rather simplified with few taxonomically relevant characters.

Distribution – The new species is known only by one male and one female from the type locality.

Dichagyris (Yigoga) thylacina sp. n. (Fig. 20)

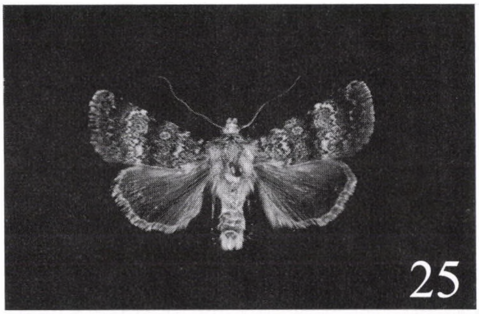
Holotype: male, "Turkmenistan, Kopet-Dagh Mts, 400–600 m, Firyuza, 58°05’E, 37°59’N, 28.09.1991, leg. A. Podlussány, L. Ronkay & Z. Varga", (HNHM, Budapest). Slide 7013 (VARGA).

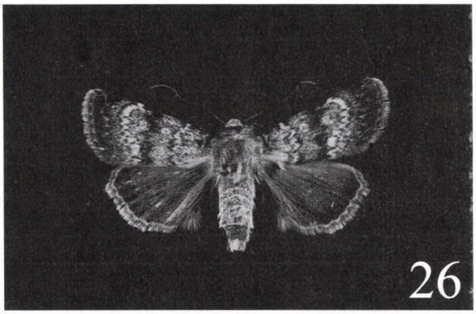
Paratypes: 1 male from the same locality and data as the holotype, 1 male from the same locality, but dated 12. 10. 1991; 5 males and 3 females from: Turkmenistan, Kopet-Dagh Mts, 1600 m, Ipay-Kala, 59° 54–57’E, 38°13–15’N, 16–23.08.1992, leg. HREBLAY, LÁSZLÓ & G. RONKAY; 1 male and 1 female, Turkmenistan, Kopet-Dagh Mts, 5 km S Chuli, 58°01’E, 37°56’N, 700–800 m, 30.09.1991, leg. PODLUSSÁNY, L. RONKAY & VARGA and 25.08.1992, leg. HREBLAY, LÁSZLÓ & G. RONKAY; 2 males and 1 female, Turkmenistan, Kopet-Dagh Mts, Karayalchi, 700–1600 m, 04–05.10. 1991, leg. PODLUSSÁNY, L. RONKAY & VARGA; 1 male, Turkmenistan, Kopet-Dagh Mts 500 m, Arap-Ata, 12 km E from Kara-Kala, 56°19’E, 38°04’N, 08.10.1991, leg. PODLUSSÁNY, L. RONKAY & VARGA; colls HNHM, GYULAI (Miskolc), HREBLAY (Érd), G. RONKAY (Budapest) and Z. VARGA (DZUD); slide 7016 (VARGA)

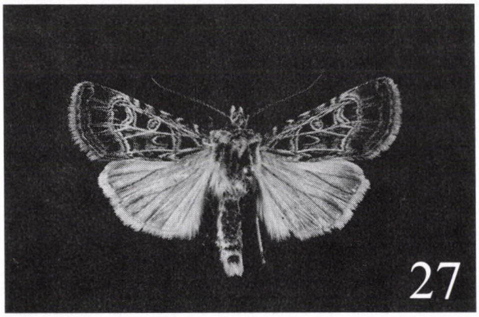
Etymology: *thylakos* = wolf (greek), refers to the related species *Dichagyris (Yigoga) lupina* (BRANDT, 1941, *Agrotis*)

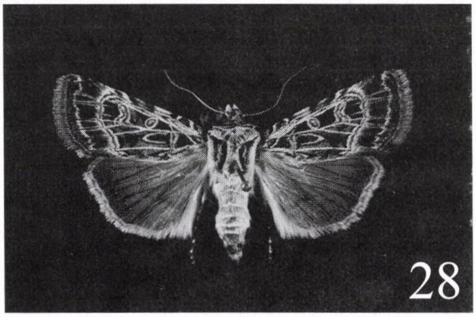
Diagnosis – The new species is most similar to *Dichagyris (Yigoga) lupina* (BRANDT, 1941) to which appears to be also closely related. *D. (Y.) lupina* has, however, longer brushes of cilia on the antennae (males) and shorter wings; orbicular spot more regular, rounded; claviform spot shorter and not acute; basal dark spot on forewings and arrowheads obsolescent; hindwings usually pure

Figs 25–32. 25–26: *Ch. laeta macini* RÁKOSY, Romania, Dobrogea, Macin Mts; 27–28: *Ch. anatolica transcaspiae* VARGA, ssp. n., paratypes, Turkmenistan, Kopet-Dagh Mts, Dushak, 27 = male, 28 = female; 29–30: *Rhyacia gabori* VARGA, sp. n., Turkmenistan, Kopet-Dagh Mts, Ipay-Kala valley and Dushak, 29 = holotype male, 30 = paratype female; 31–32 *Rh. fabiani* VARGA, sp. n., Turkmenistan, Kopet-Dagh Mts, Dushak, 31 = holotype, female, 32 = paratype, females


25


26


27


28


29


30


31


32

white, also in females (Fig. 18). The wing markings of the new species also slightly resemble those in *D. (Y.) truculenta* (LEDERER, 1853) which is, however, much larger, more brownish-ochraceous and is not closely related to this species group.

The new species shows also several distinctive characters in the male genitalia (compared to *D. (Y.) lupina*): the cucullus is less tapering, the corona is broader, the harpe is more pointed and curved forming a different angle with the valve; the aedeagus and vesica are slightly shorter and also the subbasal diverticulum with the fine cornutus shows a different orientation (Figs 93, 96 vs 94–95, 97–99).

It could be noted that the specimens collected in Hissar Mts. (Tadjikistan) have nearly identical characters both externally and in the male genitalia. More material is needed to decide whether these specimens represent only a subspecies of *D. (Y.) thylacina* or belong to a different species (Fig. 19).

Description – Male: Wingspan 31.5–34 mm, length of forewing 14.5–16 mm. Antenna filiform, shortly ciliate. Head and thorax light grey, darker brownish grey irrorated and with some ochreous shine. Abdomen ochreous grey, covered with darker, greyish-brown hairs. Forewings pale ochreous grey, more or less densely covered by darker brownish grey scales. Transversal lines double, marked with blackish brown scales, filled with whitish grey, obsolescent. Reniform stigma regular, large, bordered with dark, blackish scales and filled with brownish grey. Orbicular stigma variable, marginally marked with blackish brown scales and with a dark spot centrally. Claviform spot long, acute, nearly concolorous blackish brown. Blackish basal dash on forewing; three to four sharp, blackish arrowheads at the subterminal line. Hindwing whitish.

Female: Generally similar to male; wingspan 33–34 mm, length of forewing 15–16 mm, antenna filiform, hindwing with fuscous suffusion.

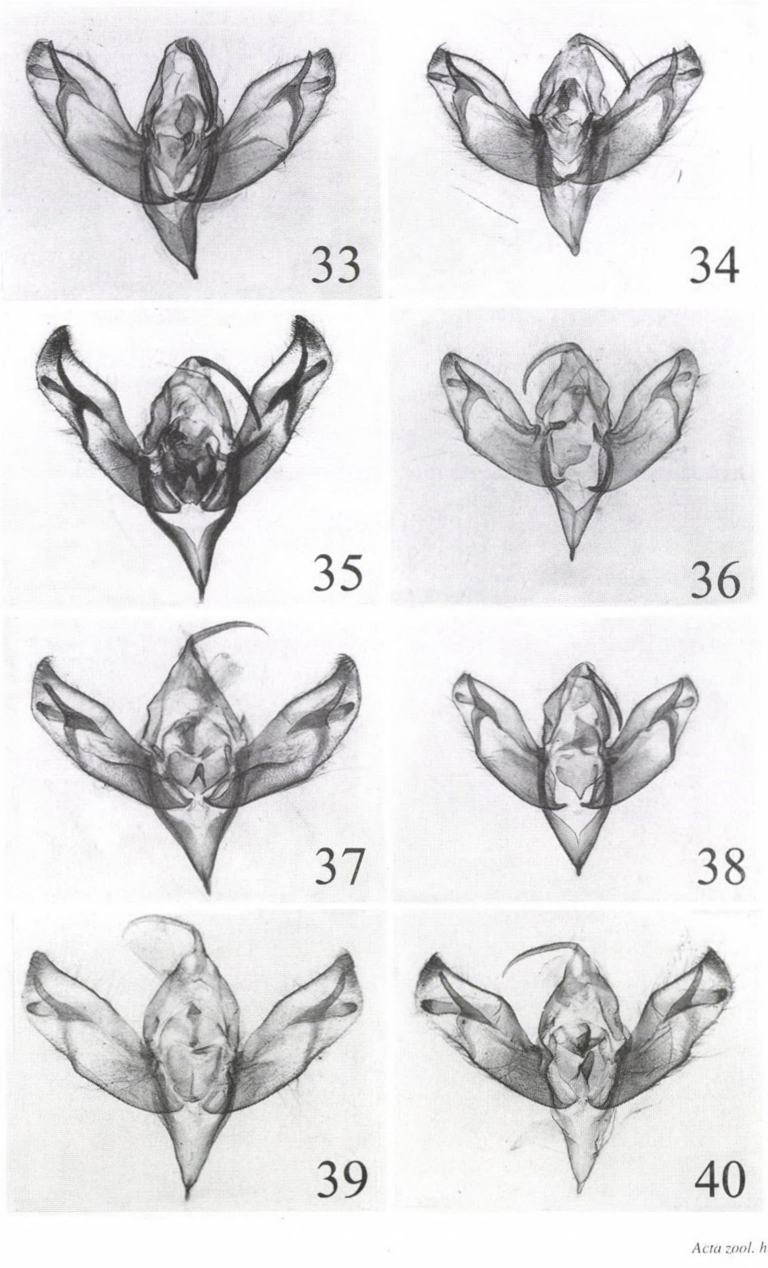
Male genitalia (94–95 and 97–99): Generally agreeing to those of other species of the subgenus *Yigoga*. Uncus falcate, long; valva elongate, margins nearly parallel, cucullus and corona well developed; harpe pointed, slightly curved, base forming an acute angle with outer margin of valva. Vesica long, tubular; with a fine cornutus on the subbasal diverticulum.

Female genitalia: Papillae anales and ductus bursae weakly sclerotized, bursa bifide, corpus and cervix nearly of same length, tubular.

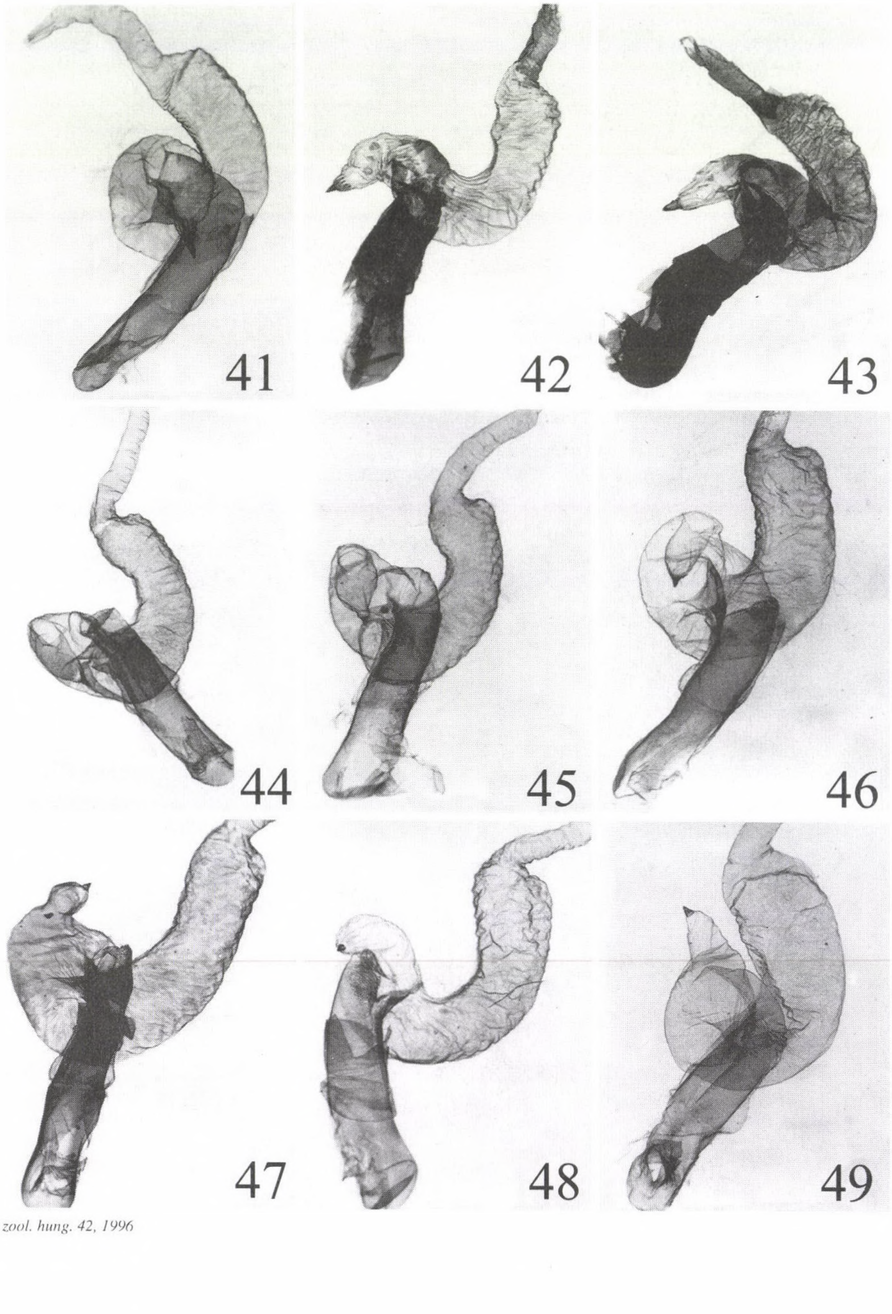
Taxonomic relationships – Based on the morphology of the genitalia of both sexes, this species and also *D. (Y.) lupina* are placed into the subgenus *Yigoga*. These sister species seem to be closest related to *D. (Y.) orientis, D. (Y.) nachadira* and to the species of the species-group *D. (Y.) disturbans* (PÜNGELER, 1914) – *D. (Y.) perturbans* (BOURSIN, 1948) – *D. (Y.) subturbans* (BOURSIN, 1948) – *D. (Y.) exornata* VARGA, 1990 on the one hand, and to *D. (Y.) improba* (STAUDINGER, 1888) – *D. (Y.) glaucescens* (CHRISTOPH, 1887) – *D. (Y.) stigmatula* (KOZHANTSCHIKOV, 1937) on the other hand. Hence, I cannot agree with the placement of *D. (Y.) lupina* in "*Agrotis*" as given by POOLE (1989).

Because I could not find any significant differences between the genital structures of both sexes in *Dichagyris* and *Yigoga*, I return to the original taxonomical treatment of both as subgenera of one genus, as given by BOURSIN and

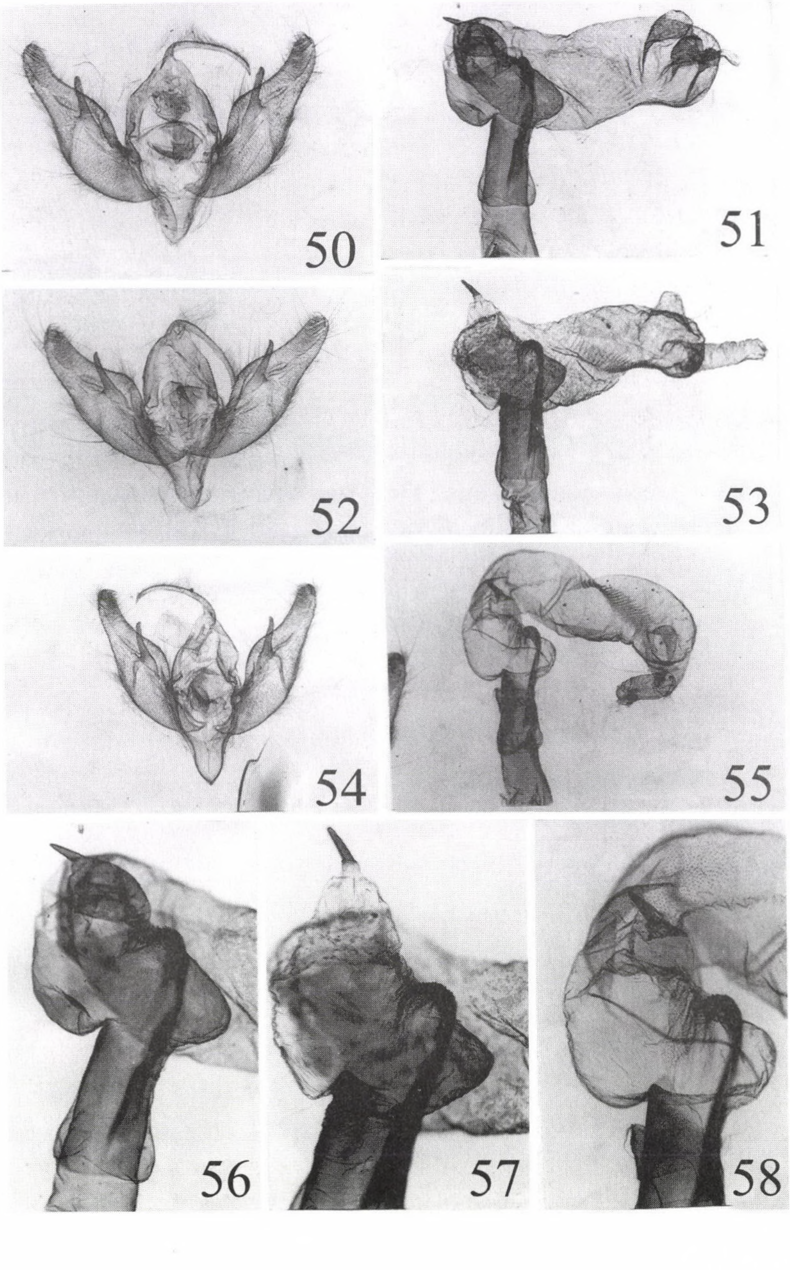
Figs 33–40. Male genital capsulae of the species of the *Dichagyris melanura*-group. 33–34 = *D. korshunovi* Varga, sp. n., paratypes, Turkmenistan, Kopet-Dagh Mts, Ipay-Kala valley (slides 6806, 6923, Varga); 35 = *D. leucomelas* Brandt, Turkmenistan, Kopet-Dagh Mts, Ipay-Kala valley (slide 6926, Varga); 36 = *D. melanura* (Kollar), Greece, Joannina (slide 3145, Varga); 37 = *D. melanuroides* Kozhantschikov, Kazakhstan (slide 7006, Varga); 38 = *D. rhadamanthys* (Reisser, 1958), paratype, Crete, Silva Rouva (slide 4882, Varga); 39 = *D. duskei* Moberg et Fibiger, paratype, Russia, Sarepta (slide 6342, Varga); 40 = *D. grisescens* (Staudinger) Turkmenistan, Kopet-Dagh Mts, Ipay-Kala valley (slide 6929, Varga)



Figs 41–49. Male genitalia (vesicae everted) of the *D. melanura*-group. 41 = *D. korshunovi* VARGA, sp. n., paratype, Turkmenistan, Kopet-Dagh Mts, Ipay-Kala valley (slide 6806, VARGA); 42 = *D. rhadamanthys* (REISSER), paratype, Greece, Crete, Silva Rouva (slide 4882, VARGA); 43 = *D. melanura hyrcanica* BOURSIN, Turkey, Prov. Van (slide 4888, VARGA); 44–45 = *D. grisescens* (STAUDINGER), Turkmenistan, Kopet-Dagh Mts, Ipay-Kala valley (slides 6925, 6929, VARGA); 46 = *D. melanuroides* KOZHANTSCHIKOV, Kazakhstan (slide 7006, VARGA); 47 = *D. leucomelas* BRANDT, Turkmenistan, Kopet-Dagh Mts, Ipay-Kala valley (slide 6926, VARGA); 48 = *D. stellans* (CORTI et DRAUDT), Chinese Turkestan, Korla (slide 5168, VARGA); 49 = *D. duskei* MOBERG et FIBIGER, paratype, Russia, Sarepta (slide 6342, VARGA)



Figs 50–58. Male genitalia of the species *D. scotographa* VARGA 1990 and *D. kautti* VARGA sp. n. 50–51 and 56 = *D. scotographa* VARGA, paratype, Afghanistan, Badakhshan, Wakhan valley (slide 5299, VARGA); 52–53 and 57 = *D. scotographa* VARGA, Pakistan, Karakoram Mts (slide 6959, VARGA); 53–54 and 58 = *D. kautti* VARGA, sp. n., paratype, India, Himachal Pradesh, Spiti valley (slide 6961, VARGA)



also followed by HACKER (1990). Neither the sclerotization of the papillae of the ovipositor (see: KOZHANTSCHIKOV 1937), a clearly adaptive feature which can develop independently in many cases, nor the orientation of the vesica (see FIBIGER 1990) which may also be rather different in obviously closely related species, are characters of generic rank in these cases. All characters mentioned by FIBIGER (1990) as distinctive characters of the genus *Yigoga* also occur in several species of *Dichagyris*, hence they cannot serve as a basis for correct differential diagnosis.

In addition, there are several groups of taxonomically closely related species in both subgenera; e.g. more than a dozen only in *Dichagyris*. If we regard *Dichagyris* and *Yigoga* as separate genera, all these species groups should also be regarded and named as subgenera (see FIBIGER & HACKER 1990), a solution which would only superfluously burden the nomenclature with many new names. It is obvious that not all levels of phylogenetic differentiation can be reflected by nomenclatorically fixed taxonomic categories, a fact which is recently often forgotten by authors of taxonomic papers (see BECK 1991, 1992, 1995). A phylogenetic analysis of this genus and other related genera (*Hemiexarnis* BOURSIN, 1948 *Protexarnis* MCDUNNOUGH, 1929 *Parexarnis* BOURSIN, 1946 etc.), including some taxonomic considerations, will follow in a monographic paper.

Distribution and bionomy – *D. (Y.) thylacina* sp. n. was hitherto found only in some arid, mountainous parts of Turkmenistan where it is sympatric and partly also synchronic with the closely related but much more widely distributed *D. (Y.) lupina* (BRANDT). The latter species was described from Iran but also occurs in Kirghisia, Tadjikistan and Afghanistan, but usually very locally.

Chersotis herczigi sp. n.

(Figs 21–22).

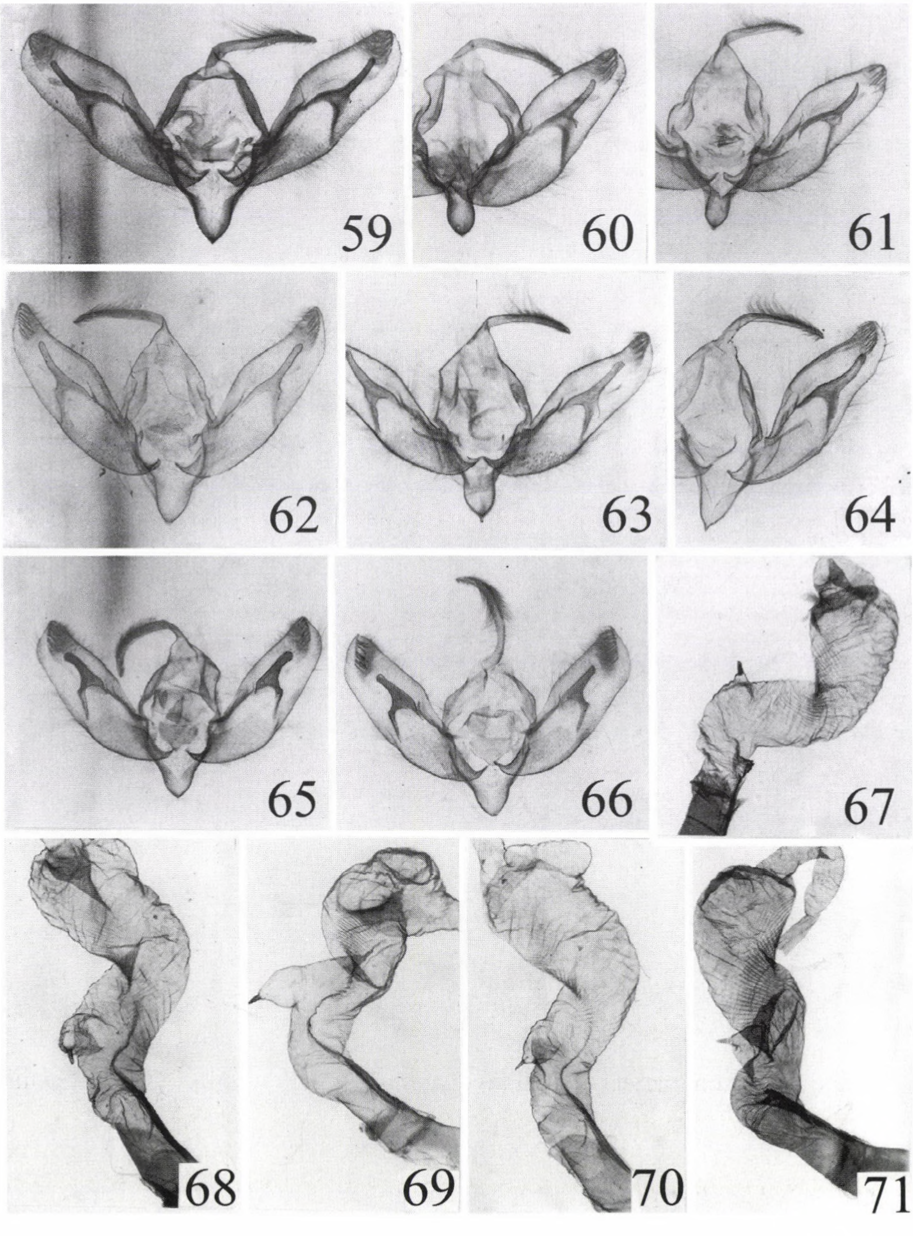
Holotype: male, "Pakistan, Himalaya Mts, 3200 m, Kaghan Valley, 12 km E Naran, Battakundi, 73°40'E, 34°57'N, 26. 07. 1994, leg. B. Herczig, Gy. M. László & G. Ronkay" (coll. B. HERCZIG, Baj, Hungary). Slide 6893 (VARGA).

Paratypes: 6 males and 4 females from the same locality as the holotype and one female from: Pakistan, Himalaya Mts, 2800 m, Deosai pass, 75°31'E, 35°16'N, 28. 07. 1994, leg. B. HERCZIG, LÁSZLÓ & G. RONKAY, coll. HNHM, Budapest, B. HERCZIG, G. RONKAY and Z. VARGA (DZUD). Slides: 6892, 6991 (VARGA), females.

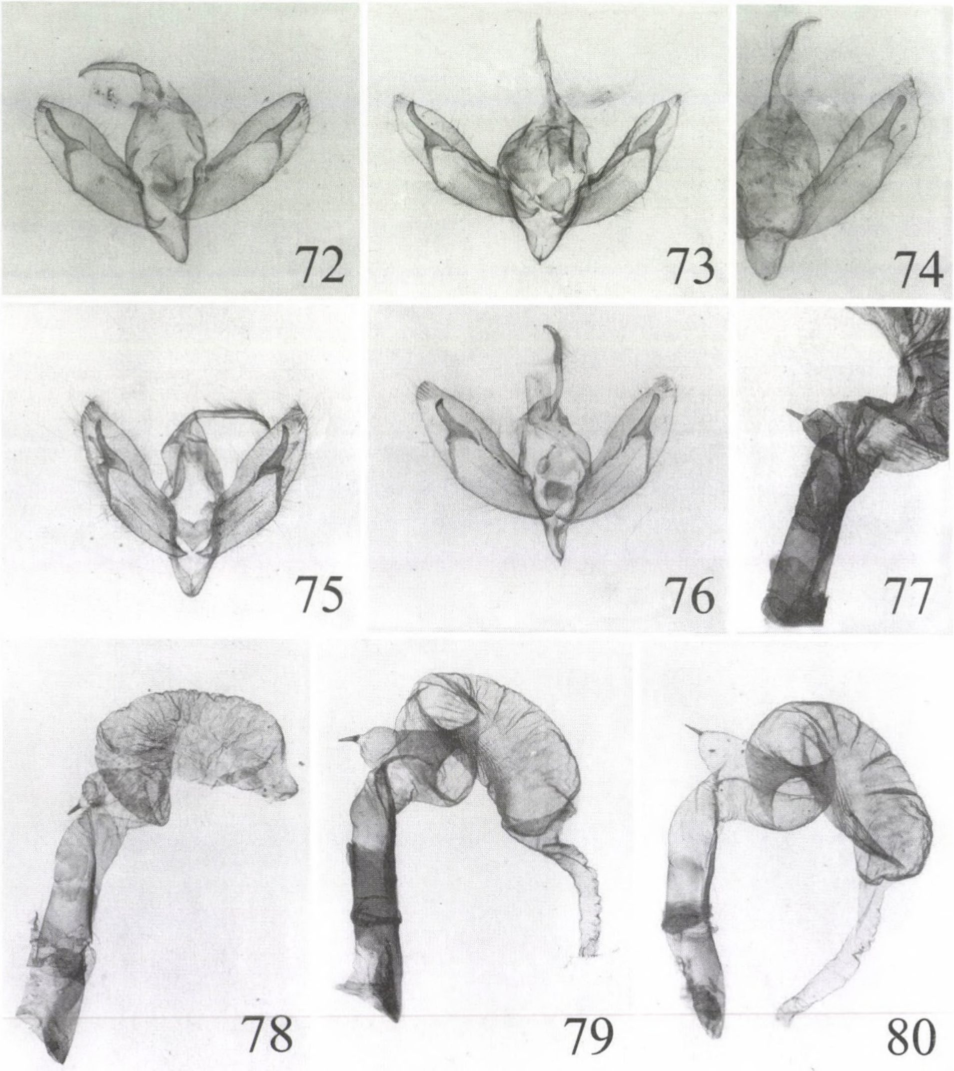
Etymology: The new species is dedicated to my colleague and friend, Dr. B. HERCZIG, entomologist and collector of the holotype.

Diagnostic characters – A relatively small species within *Chersotis* BOISDUVAL, 1840 which superficially resembles very dark and small specimens of *Chersotis oreina* DUFAY, 1984, *Ch. transiens* (STAUDINGER, 1896) or *Ch. stridula* (HAMPSON, 1903). The latter taxa, however, are more broad-winged with less

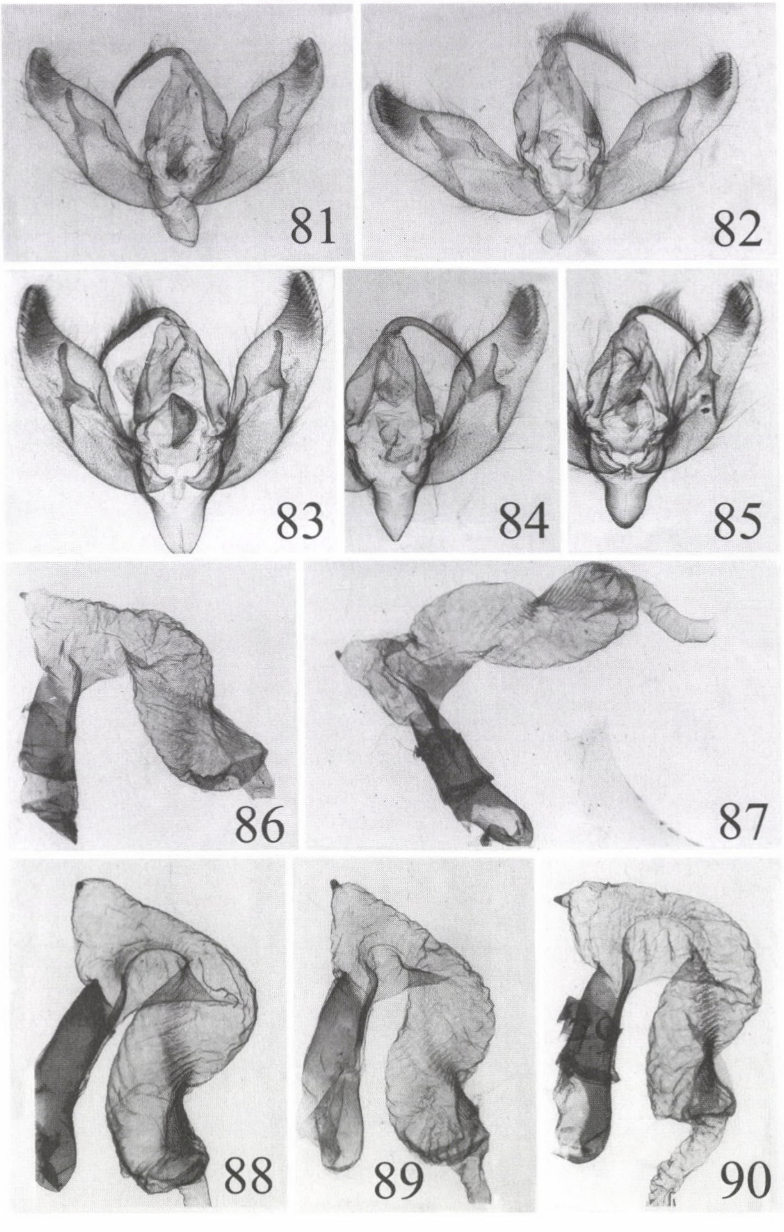
Figs 59–71. Male genitalia of the species of the *Dichagyris umbrifera*-group. 59–60 and 68 = *D. kaszabi* VARGA, Mongolia, Mongol Altay Mts (slides 4039, 4017, 4997, VARGA); 61 and 69 = *D. umbrifera* (ALPHERAKY), Kazakhstan, Bakanas (slide 6778, VARGA); 62–63 and 70 = *D. naumanni* VARGA, sp. n., paratype and holotype, Afghanistan, Prov. Samangan and Turkmenistan, Kugitang-Tau Mts (slides 4601, 6802, VARGA); 64 = *D. jacobsoni* KOZHANTSCHIKOV, paratype, Turkmenistan, Sumbar (slide 3388, VARGA); 65 and 67 = *D. achtalensis* (KOZHANTSCHIKOV), Turkey, Prov. Van (slide 4810, VARGA); 66 and 71 = *D. herzi* (KOZHANTSCHIKOV), Turkmenistan, Kara-Kala (slide 6783, VARGA)



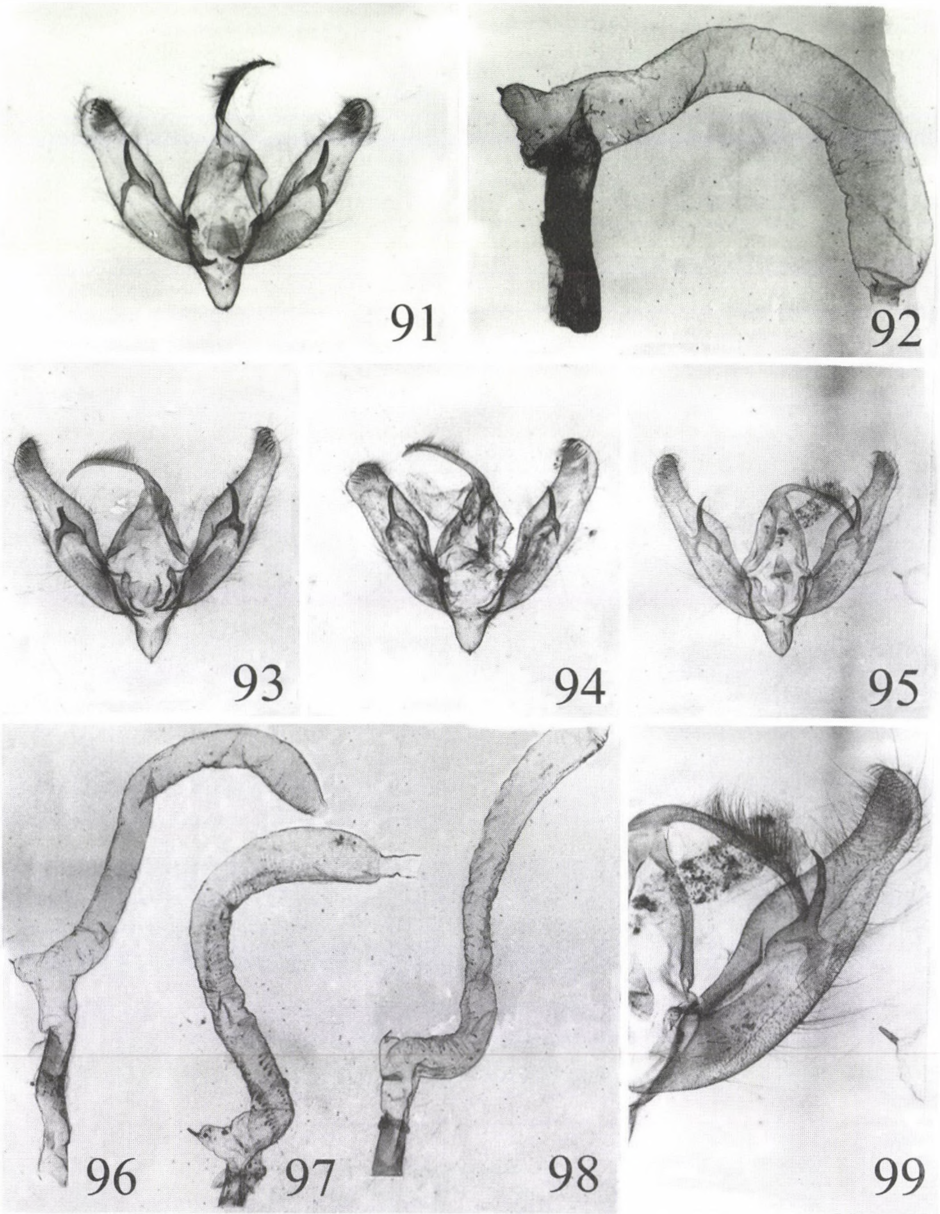
Figs 72–80. Male genitalia of the subspecies of *Dichagyris argentea* KOZHANTSCHIKOV. 72 and 78 = *D. argentea darius* BOURSIN 1940, Iran, Elburs Mts (slide 5227, VARGA); 73 and 80 = *D. argentea* ssp. Turkey, Prov. Van (slide 6862 VARGA); 74 and 77 = *D. argentea cf. argentea* KOZHANTSCHIKOV, Afghanistan, Dasht-i-Nawar (slide 6391, VARGA); 75–76 and 79 = *D. argentea acroptera* VARGA, ssp. n., paratypes, Turkmenistan, Kopet-Dagh Mts, Karayalchi valley (slides 6394, 6395, VARGA)



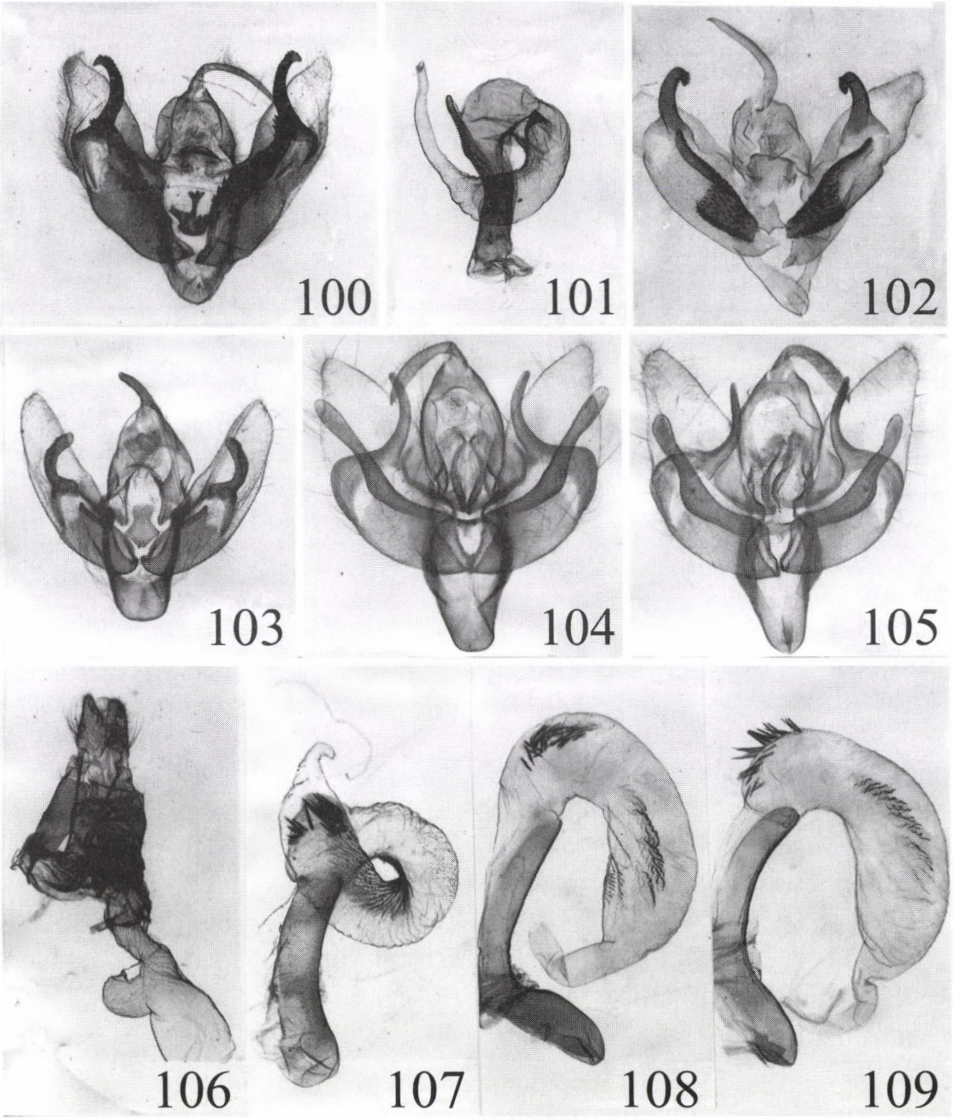
Figs 81–90. Male genitalia of the taxa of the *Dichagyris celebrata*-group. 81–82 and 86–87 = *D. kongur* VARGA, n. sp. paratypes, Kazakhstan, Alma-Ata region (slides 6766, 6774, VARGA); 83 and 88 = *D. celebrata assimilata* KOZHANTSCHIKOV, Turkey, Tuz Gölü (slide 6965, VARGA); 84 and 89 = *D. celebrata celebrata* (ALPHERAKY), Turkmenistan, Kopet-Dagh Mts, Ipay-Kala valley (slide 6957, VARGA); 85 and 90 = *D. celebrata pashtu* VARGA, n. ssp., paratype, Pakistan, Karakoram Mts, Huru, Hispar valley (slide 6982 VARGA)



Figs 91–99. Male genitalia of the *Dichagyris* (subg. *Yigoga*) spp. 91–92 = *D. (Yigoga) hissariensis* VARGA, sp. n., paratype, Tadjikistan, Hissar Mts (slide 7003, VARGA); 93 and 96 = *D. (Y.) lupina* (BRANDT), Turkmenistan, Kopet-Dagh Mts, Firjuza (slide 7015, VARGA); 94–95 and 97–99 = *D. (Y.) thylacina* VARGA, sp. n., holotype and paratype, Turkmenistan, Kopet-Dagh Mts, Firyuza and Ipay-Kala valley (slide 7013, 7016, VARGA)



Figs 100–109. Genitalia of *Chersotis* spp., 100–105 and 107–109: males, 106: female. 100–101 = *Chersotis herczigi* VARGA, sp. n., holotype, Pakistan, Himalaya Mts, Kaghan valley (slide 6893, VARGA); 102 = *Ch. firdussi* SCHWINGENSCHUSS 1937, Afghanistan, Paghman Mts (slide 5313, VARGA); 103 and 107 = *Ch. nekrasovi* VARGA, sp. n., holotype, Tadjikistan, Pamir Mts, Chorog (slide 1201, NEKRASOV, permanent slide 7012, VARGA); 104 and 108 = *Ch. laeta macini* RÁKOSY, Romania, Dobrogea, Macin Mts (slide 6624, VARGA); 105 and 109 = *Ch. fimbriola* (ESPER) ssp., Turkmenistan, Kopet-Dagh Mts, Dushak (slide 6613, VARGA); 106 = *Ch. herczigi* VARGA, sp. n., paratype, Pakistan, Himalaya Mts, Kaghan valley (slide 6892, VARGA)



distinctly marked maculation; the fine light ochreous surrounding of the spots is missing; females have a much more sclerotized ovipositor. The genitalia of both sexes of this species-group are very dissimilar (figured e.g. by DUFAY 1984) as compared with those of *C. herczigi*. The only truly closely related and slightly similar species is *Ch. firdussi* SCHWINGENSCHUSS, 1937 (Fig. 23), which has a more elongate shape of the forewing with more acute apex, lighter and more ochreous brown coloration, less distinctly marked maculation, shorter and often indistinct claviform spot; blackish brown markings only in the cell and at the inner margin of the postmedian, hindwings light ochreous-grey, sometimes almost white etc. Another related species, *Ch. sordescens* (STAUDINGER, 1899) is broad-winged and less distinctly marked, the maculation and transversal lines are not marked with light scales. The most significant differences of the male genitalia are as follows: both related species have less sclerotized genitalia, non-dentate harpe, more finely dentate dorsal process of sacculus and a less pronounced carina etc. (Figs 100–101 vs 102).

Description – Male: Wingspan 27.0–28.5 mm, length of forewing 13.0–13.5 mm. Antenna filiform, densely ciliate. Head and thorax dark greyish-brown, irrorated with blackish brown hairs, mostly at base of patagia and on tegulae. Forewing relatively narrow, triangular, greyish-brown, medially strongly suffused with blackish brown scales. Maculation well-expressed, surrounded by whitish ochreous scales. Reniform and orbicular stigmata basally connected with a double light ochreous stripe, claviform spot long, not acute. Transversal lines double with light greyish-ochreous filling. Antemedian acutely broken above cell, postmedian marked with black lunules basally; subterminal line with short arrowheads. Fine and not very distinct black spots at base of cilia, then a light ochreous grey stripe; cilia greyish brown. Hindwing greyish brown with obsolescent postdiscal stripe and terminal shadow.

Female: Wingspan 27.5–28.5 mm, length of forewing 13–13.5 mm. Generally similar to male, antenna filiform, forewing slightly broader, hindwing darker greyish brown, maculation slightly more obsolescent.

Male genitalia (Figs 100–101): uncus long, pointed, slightly curved; valva rounded, harpe long, curved, very strongly sclerotized, dorsally dentate on distal part; sacculus broad, costal part very strongly sclerotized, dentate with a long, broad and strongly dentate processus. Juxta broad, semilunar with a trifid dorsal processus. Aedeagus short and thick, carina elongate and strongly sclerotized; vesica long, recurved, with short medial cornutus.

Female genitalia (Fig. 106): papillae of ovipositor broad triangular, basally with long, curved setae; ostium bursae with bilateral U-shaped sclerotization; ductus bursae moderately sclerotized, rugulose; cervix bursae slightly recurved, bursa without signa.

Taxonomic relationships and distribution – The new species appears to be closely related to *Ch. firdussi* and *Ch. sordescens*, being the eastern sister-species of the former one. It also appears to be strictly allopatric to the two species mentioned above. The new species is only known from a relatively small area in Pakistan in the western part of the Himalaya Mts.

Chersotis anatolica transcaspiae ssp. n.
(Figs 27–28)

Holotype: male, "Turkmenistan, Kopet-Dagh Mts, Dushak, 1500 m, 57°56'E, 37°54'N, 07–08. 08. 1992., leg. M. Hreblay, GY. M. László & G. Ronkay" (coll. G. RONKAY, Budapest).

Paratypes: a large series of both sexes from the same locality and data, and from Turkmenistan, Kopet-Dagh Mts, 6 km S of Ipay-Kala, 1600 m, 57° 07'E, 38°17'N, 16–23. 08. 1992, leg. HREBLAY, LÁSZLÓ & G. RONKAY (colls HNHM, FÁBIÁN, GYULAI, HERCZIG, HREBLAY, G. RONKAY and VARGA, DZUD), slides 6793 (VARGA), 3529, 3549 (HREBLAY), males; 3530 (HREBLAY) female.

Etymology: from the geographical distribution of the new subspecies, east of the Caspian Sea.

Diagnosis – The very dark, blackish brown ground-colour of the forewing and the strongly suffused hindwing are very constant characters of this subspecies. Thus, the general appearance of this subspecies is quite distinct from all other known populations of *Ch. anatolica.* The whole large series of specimens appears to be very homogeneous in all characters mentioned.

Description – Male: Wingspan: 36–39 mm, length of forewing: 16–18 mm. Structural characters and wing pattern as in the nominate subspecies. All markings on the forewing very distinct, maculation and transversal lines well-expressed, contrasting with very dark, blackish brown ground-colour of forewings. Hindwing light, whitish, only with a slight brownish shadow near base, but with a distinct dark brownish grey marginal suffusion and with dark brown marked veins.

Female: of same size and general appearence, hindwing fuscous grey with dark, brownish grey postdiscal stripe and marginal suffusion.

Genitalia without any specific differences from the nominate subspecies.

Taxonomic relationships of the new subspecies – *Ch. anatolica* (DRAUDT) is a widespread Mediterranean – W Asiatic xeromontane species with only slight individual variation, without any clear trend to subspeciation over most of its range (see DUFAY & VARGA 1995). The subspecies *Ch. anatolica transcaspiae* is the only morphologically distinct and geographically isolated peripheric population. The neighbouring ones in Iran (Elburs Mts) and Azerbaijan (Talys Mts) cannot be separated from the nominate subspecies (type locality: Sultan Dagh, Akshehir in Central Turkey).

Distribution and bionomics – *Ch. anatolica transcaspiae* occurs only at medium high alitudes in the Kopet-Dagh Mts. It is, however, very common there in late summer, being one of the dominant species.

Chersotis nekrasovi sp. n.
(Fig. 24)

Holotype: male, "Tadjikistan, W. Pamir Mts, Chorog, Botanical Garden, 2300 m, 23. 09. 1988, leg. Zaprjagaev", coll. A. NEKRASOV (Moscow), slide 1201 (NEKRASOV).

Etymology: The new species is dedicated to Prof. A. V. NEKRASOV, Moscow, honoured lepidopterist and collector, who drew my attention into this new taxon.

Diagnosis – Phenotypically, the new species is quite different from all other species of the genus. *Chersotis friedeli* PINKER, 1974 is also autumnal, small and somewhat similar in coloration. *Ch. friedeli* has, however, pectinated antenna, is broad- and short-winged. *Ch. nekrasovi* can be easily distinguished from all other related species by the narrow shape of the forewing, the more distinct maculation and by several differences in the male genitalia. *Ch. friedeli* has shorter uncus, some setae of the reduced corona on the tip of the valva, smaller juxta, more elongate dorsal extension of sacculus and nearly completely reduced cornuti at the distal part of vesica. *Ch. gratissima* (CORTI, 1932) has much longer dorsal extension of sacculus, juxta not shield-shaped and a single row of large cornuti of nearly equal size (see: HACKER & VARGA 1990, Fig. 16). *Ch. stenographa* VARGA, 1979, externally very dissimilar, has a similar, short dorsal extension of the sacculus, but it has a completely different shape of the harpe and juxta, and has a very long row of huge cornuti (see: HACKER & VARGA 1990, Fig. 15).

Description – Male: One of the smallest species of the genus: wingspan 29 mm, length of forewing 13.5 mm. Antennae filiform, shortly ciliate. Head and thorax ochreous brownish grey, irrorated with darker brown hairs, abdomen light greyish-ochreous. Forewings greyish ochreous, densely irrorated by dark brown scales. Maculation regular, maculae surrounded with dark brown scales and with dark irroration centrally. Transversal lines dark brown, dissected by veins, simple. Arrowhead spots present but obsolescent. Dark spots at base of fringes. Hindwings very pale ochreous grey with a silky shine. Underside pale greyish ochreous, maculae slightly paler. Female unknown.

Male genitalia (Figs 103, 107): uncus strong, medium-sized, straight; valva broad, distal part rounded, without cucullus and corona; harpe strong, heavily sclerotized, laterally flattened and curved; dorsal extension of sacculus (modified clavus) very short, acute; juxta shield-like. Aedeagus broad, slightly curved; vesica proximally with two groups of cornuti.

Taxonomic relationships – This species belongs to a monophyletic group of autumnal species, analysed by HACKER & VARGA (1990). It represents the eastern sister-species of *Ch. gratissima* (type locality: Marash, Turkey; range: Central and Eastern Turkey and Transcaucasia).

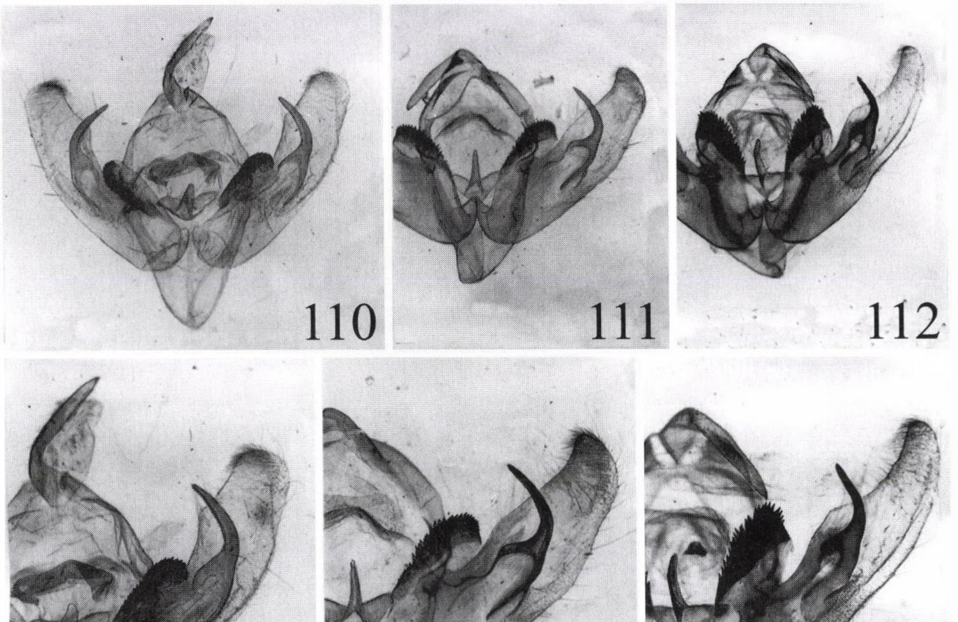
Rhyacia gabori VARGA, sp. n.

(Figs 29, 30)

Holotype: male, "Turkmenistan, Kopet-Dagh Mts, 6 km S of Ipay-Kala, 1600 m, 57°07'E, 38°17'N, 16–23. 08. 1992, leg. M. Hreblay, Gy. M. László & G. Ronkay" (coll. G. RONKAY, Budapest). Slide 6885 (VARGA).

Paratype: female, Turkmenistan, Kopet-Dagh Mts, Dushak, 1800 m, 57°56'E, 37°54'N, 06–08. 07. 1992., leg. FÁBIÁN, HERCZIG, PODLUSSÁNY & VARGA., coll. Z. VARGA (DZUD) Slide: 6829 (VARGA).

Figs 110–118. Male genitalia of *Rhyacia* spp.. 110, 113 and 116 = *Rhyacia gabori* VARGA, sp. n., holotype, Turkmenistan, Kopet-Dagh Mts, Ipay-Kala valley (slide 6885, VARGA); 111, 114 and 117 = *Rh. evartianae* VARGA, paratype, Afghanistan, Darwaz Mts (slide 4668, VARGA); 112, 115 and 118 = *Rh. oxytheca* BOURSIN, Pakistan, Karakoram Mts (slide 6979, VARGA)



Etymology: The new species is dedicated to my friend and colleague Mr. GÁBOR RONKAY, collector of the holotype and one of the best experts in Noctuidae, participant of several lepidopterological expeditions in Asia.

Diagnosis – Phenotypically *Rh. gabori* resembles very pale coloured specimens of *Rh. nyctimerides* (BANG-HAAS, 1922), with whom it occurs sympatrically, but the latter species is usually darker, more acute-winged and much more common. It also resembles *Rh. subdecora* (STAUDINGER, 1888), but is essentially larger, and also *Rh. evartianae* VARGA, 1990. It appears to be the sister group of the species pair *Rh. oxytheca* BOURSIN, 1957 – *Rh. evartianae* (the latter was described from Afghanistan and recently also discovered in Tadjikistan: Turkestan Mts, Shahristan Pass). It is, however, clearly different from these by the different shape of the thorny dorsal costa of the sacculus, by the larger hook-shaped extension of the carina of the aedeagus and mainly by the different curving and subbasal diverticula of the vesica (Figs 110, 113 and 116 vs. 111–112, 114–115 and 117–118). The female genitalia are also closely related to those of *Rh. nyctimerides* (Fig. 122); *Rh. oxytheca* (Figs 123–124) *Rh. evartianae* (Figs 120–121); but the characters of the ostium and ductus bursae allow an easy separation. Also the typical "lip-shaped" arcuate margin of the ostium shows a different shape than in the *oxytheca-evartianae* pair of species. Thus, it was possible to identify the paratype female as being conspecific with the male holotype.

Description – Male: Wingspan: 43 mm, length of forewing 18.5 mm. Antenna finely dentate and densely ciliate. Head and thorax greyish ochreous, some hairs with fine darker tips. Abdomen pale ochreous. Forewing light brownish ochreous with argillaceous greyish shine. All markings visible but obsolescent. Reniform stigma semilunar, in outer part with greyish shadow, orbicular stigma small, regular. Transversal lines double, broad, medial and terminal shadow very obsolescent. Hindwing light brownish ochreous, basal part lighter, shiny. Underside: forewings ochreous with darker veins, medial and terminal shadow, postmediane grey, straight; hindwings concolorous light ochreous.

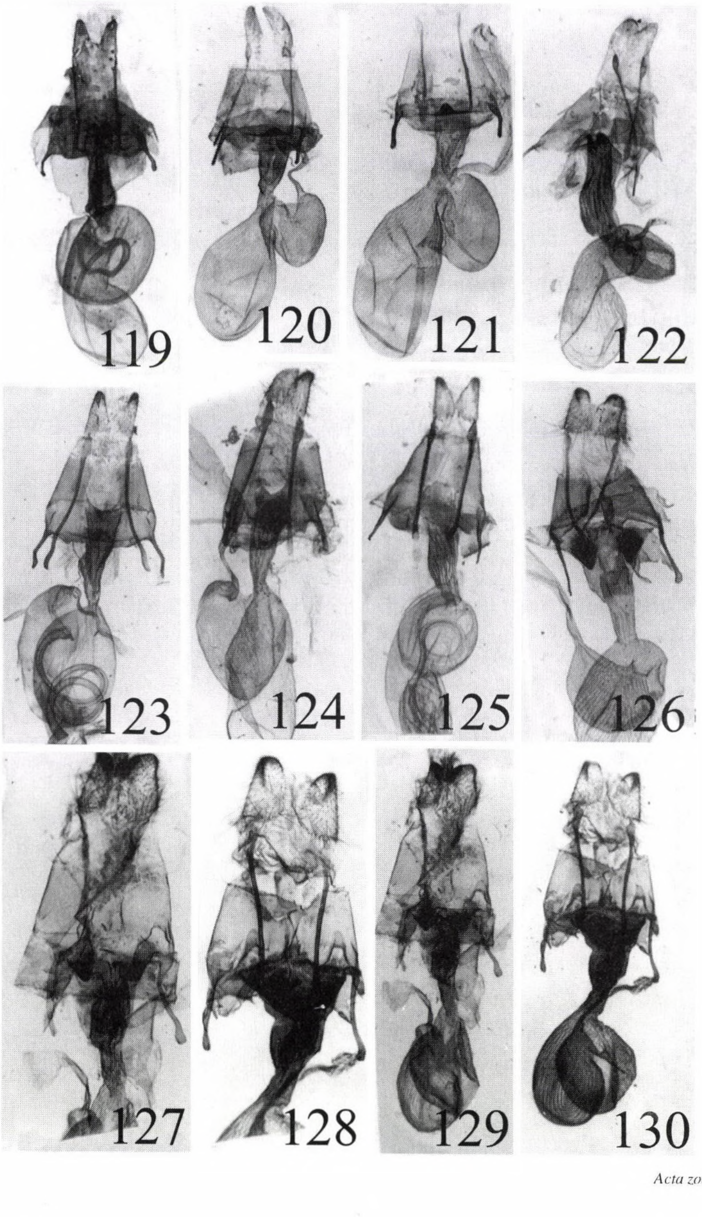
Female: Wingspan 42,5 mm, length of forewing 18 mm. Antenna filiform, colouration and pattern of forewing generally similar that in male, only slightly darker and with more argillaceous grey scales, hindwing slightly more suffused.

Male genitalia (Figs 110, 113, 116): similar to those of the large *Rhyacia* spp. with hook-shaped aedeagus. Valva broad, rounded; angular protuberance of costa reduced; harpe huge, sickle-shaped, dorsal extension of sacculus (modified clavus) rounded, broad by digitiform, strongly sclerotized, densely covered with fine spines; uncus strong, medium-sized; juxta broad, reniform, medial crest flattened, not acute; aedeagus long, straight, hook-shaped processus of carina huge, slightly curved; vesica long, tubular, recurved, its long subbasal diverticulum with a small digitiform secondary diverticulum.

Female genitalia (Fig. 119) with typical lip-formed sclerotization and V-shaped incision on ostium bursae; ductus sclerotized, rugulose; bursa moderately elongate, elliptical-globular; cervix recurved; papillae of ovipositor triangular, weakly sclerotized.

Taxonomic relationships – Phylogenetically, the species "triplet" *Rh. oxytheca – Rh. evartianae – Rh. gabori* appear to form the sister-group of the two species-pairs: *Rh. nyctimerides – Rh. nyctimerina* (STAUDINGER, 1888) + *Rh.*

Figs 119–130. Female genitalia of *Rhyacia* snpp.. 119 = *Rhyacia gabori* VARGA, sp. n., paratype, Turkmanistan, Kopet-Dagh Mts, Dushak (slide 6813, VARGA); 120–121 = *Rh. evartianae* VARGA, paratypes, Afghanistan, Darwaz Mts (slides 5864 and 5875, VARGA); 122 = *Rh. nyctimerides* (BANG-HAAS), Kirghisia, Issyk-Kul (slide 6853, VARGA); 123–124 = *Rh. oxytheca* BOURSIN, Afghanistan, Koh-i-Baba Mts and Pakistan, Karakoram Mts (slides 6980 and 6986, VARGA); 125 = *Rh. subdecora xanthopasta* BOURSIN, paratype, Afghanistan, "Sarakanda" Mts (slide 6988, VARGA); 126 = *Rh. ignobilis* (STAUDINGER), Uzbekistan, W Tien-Shan Mts (slide 6604, VARGA); 127 and 129 = *Rh. fabiani* VARGA, sp. n., paratype, Turkmenistan, Kopet-Dagh Mts, Dushak (slide 6829 VARGA); 128 and 130 = *Rh. fabiani* VARGA, sp. n., holotype, from the same place (slide 6762, VARGA)



subdecora – *Rh. scythropa* BOURSIN, 1963 and all these species may be opposed to the species pair *Rh. diplogramma* (HAMPSON, 1903) – *Rh. oromys* VARGA, 1990.

Rhyacia fabiani VARGA, sp. n.
(Figs 31, 32).

Holotype: female, Turkmenistan, Kopet-Dagh Mts, Dushak, Turkmenistan, Kopet-Dagh Mts, Dushak, 1800 m, 57°56'E, 37°54'N, 06–08. 07. 1992., leg. FÁBIÁN, HERCZIG, PODLUSSÁNY & VARGA, coll. Z. VARGA (DZUD), slide 6762 (VARGA).

Paratype: female from the same locality and data, coll. B. HERCZIG (Baj, Hungary), slide 6829 (VARGA).

Etymology: The species dedicated to my friend and colleague Mr. G. FÁBIÁN, participant of numerous lepidopterological expeditions to Asia.

Diagnostic characters – Externally, the new species is rather different from other species of *Rhyacia*. Superficially, the relatively broad forewings and the very smooth, shiny surface of the forewings resemble some species of *Standfussiana* BOURSIN, 1946. The wing-shape and the smooth, shiny coloration also resemble smaller, very light and concolorous specimens of *Rhyacia similis* (STAUDINGER, 1881). The genitalia, however, are very dissimilar, with some characters similar to *Rh. ignobilis* (STAUDINGER, 1888), such as the sclerotized lobes of the ostium bursae (Fig. 126), but the genitalia of *Rh. fabiani* are much larger, broader and the ductus bursae is more sclerotized.

Description of the new species: Female: Wingspan 41–42 mm, length of forewing 19.5–20 mm. Antenna filiform. Head and thorax brownish ochreous, concolorous. Some hairs with darker brown tips on the head and collar, tegulae concolorous. Abdomen light greyish ochreous. Forewing shiny brownish ochreous. All markings visible but very obsolescent. Reniform stigma and orbicular stigma broad, rounded, separated by a slightly darker medial shadow. Transversal lines double, crenulate. Hindwing shiny, brownish ochreous, basal part slightly lighter. Underside light brownish ochreous with greyish shadow dissected by veins on the medial part of the forewing and terminal part of the hindwing; postmedian grey, straight, well marked.

Male unknown.

Female genitalia (Figs 127–130): bursa bisaccate, both corpus and cervix broad, globular; ductus bursae moderately sclerotized, rugulose; ostium bursae with bilateral, triangularly sclerotized appendages; sternite VIII with bilateral, V-formed incisions.

Taxonomic relationships – A very distinct species within the genus *Rhyacia*. According to the characters of the female genitalia, it can provisionally be placed near *Rh. ignobilis*. This is somewhat surprising because one would not have expected a closer relationship of these species from the external characters.

Distribution and bionomics – Only known by two females from the type locality. Because both specimens are very fresh and were collected on the high plateau of the Kopet-Dagh Mts (Dushak, 2300 m a.s.l.), I consider that the habitat of this species is to be found at high altitudes.

Chersotis laeta macini RÁKOSY, 1996

Taxonomic note: This species and its new subspecies was originally discovered by S. and Z. KOVÁCS in Macin Mts (Romania, Dobrogea) on 12.07.1993, and a large series collected also on 27–28.05.1994. Unfortunately, these specimens were not included into the type series of the subspecies mentioned above (RÁKOSY 1996: 194). Specimens from this series are figured here (Figs 25–26). I have figured also the male and female genitalia of this subspecies (Figs 25–26), because unfortunately, the figures of the original description are extremely poor.

* * *

Acknowledgements – I am deeply indebted to my friends and colleagues Mr. G. FÁBIÁN (Budapest), Dr. P. GYULAI (Miskolc), Dr. B. HERCZIG (Baj), Dr. M. HREBLAY (Érd), Dr. K. MIKKOLA (Helsinki), Prof. Dr. C. M. NAUMANN (Bonn), Prof. Dr. A. V. NEKRASOV (Moscow), Mr. G. RONKAY (Budapest) for their kind help in studies and for the loan of valuable materials. Dr. L. RONKAY (Hungarian Natural History Museum) kindly permitted me to use the collection and technical facilities of the HNHM, Budapest, and also made many useful comments on and suggestions for improvement the manuscript. The valuable technical assistance of Mr. P. KOZMA is appreciated.

This research was supported by the Hungarian Scientific Research Fund (OTKA, No. 16465).

REFERENCES

BOURSIN, CH. (1940) Neue palaearktische Arten und Formen mit besonderer Berücksichtigung der Gattung Autophila Hbn. *Mitt. münchn. ent. Ges.* **30**: 474–543.

BRANDT, W. (1941) Beitrag zur Lepidopteren-Fauna von Iran (3). *Mitt. münchn. ent. Ges.* **31**: 835–863 + Taf. 23–27.

CORTI, A. & DRAUDT, M. (1933) Noctuidae, *In* SEITZ, A., *Die Palaearktischen eulenartigen Nachtfalter*, Suppl., Stuttgart, pp. 49–95.

DUFAY, CL. & VARGA, Z. (1995) A new noctuid species from Iran: Chersotis eberti sp. n. (Lepidoptera: Noctuidae). *Acta zool. hung.* **41**: 35–45.

FIBIGER, M. (1990) *Noctuidae Europaeae 1, Noctuinae I.* Entomological Press, Sorø, 208 pp.

FIBIGER, M. & HACKER, H. (1990) Systematic list of the Noctuidae of Europe. *Esperiana, Schwanfeld* **2**: 1–109.

HACKER, H. (1990) Die Noctuidae Vorderasiens (Lepidoptera). *Neue ent. Nachr.* **27**: 1–707 + Taf. 1–16.

HACKER, H., KAUTT, P. & WEISZ, V. (1996) Noctuidae gesammelt von Kautt und Weisz im Sommer 1994 in Spiti Valley in Himachal Pradesh. *Esperiana, Schwanfeld* **4**: 395–417.

HACKER, H. & LÖDL, M. (1989) Taxonomisch und faunistisch bemerkenswerte Funde aus der Sammlung Pinker im Naturhistorischen Museum Wien. 9. Beiträg zur systematischen Erforschung der Noctuidae (Lepidoptera) der Türkei. *Zschr. Arb. Gem. öst. Ent.* **40**: 65–82.

HACKER, H. & VARGA, Z. (1990) Die Gattung Chersotis Boisduval, 1840. 1. Die fimbriola (Esper, [1803])/laeta (Rebel, 1904) – Gruppe. *Spixiana, München* **13**: 277–327.

KOZHANTSCHIKOV, V. I. (1929) Anmerkungen zur systematischen Stellung mancher Agrotiden und neue Arten derselben aus dem Kaukasus und Turkestan. *Bull. Mus. georg. Tiflis* **5**: 87–97.

KOZHANTSCHIKOV, V. I. (1930) Übersicht über die Gattung Dichagyris Led. *Rev. russ. d'Ent.* **24**: 1–30.

KOZHANTSCHIKOV, V. I. (1937) Fam. Noctuidae (Subf. Agrotinae). In: *Faune de l'URSS, Ins. Lépidopteres* **13**(3). Acad. Sci. URSS, Moscou-Leningrad, 690 pp.

POOLE, R. W. (1989) Noctuidae I–III. *In* Heppner, J. B. *Lepidopterorum Catalogus (N.S.)* fasc. **118**, Leiden, New York, Kobenhavn, Köln, 1314 pp.

POPESCU-GORJ, A. (1964) *Catalogue de la collection de Lépidopteres "Prof. A. Ostrogovich" du Muséum d'Histoire Naturelle "Grigore Antipa"* Bucarest, p. 158.

RÁKOSY, L. (1996) *Die Noctuiden Rumaniens (Lepidoptera Noctuidae)*, Linz, pp. 647.

VARGA, Z. (1990) New species of Noctuidae from Afghanistan and adjacent territories I. The genera Euxoa Hübner [1821] 1816, Dichagyris Lederer, 1857, Rhyacia Hübner [1821] 1816 and Chersotis Boisduval, 1840 (Lepidoptera: Noctuidae, Noctuinae). *Esperiana, Schwanfeld* **1**: 167–198.

Received, 18th September 1996, accepted 19th December 1996

Acta Zoologica Academiae Scientiarum Hungaricae 42 (3), pp. 231–249, 1996

CONTRIBUTION TO THE KNOWLEDGE OF THE LEECHES OF NEPAL (ANNELIDA: HIRUDINEA)

NESEMANN, H.[1] and S. SHARMA[2]

[1]*Department for Hydrobiology, Fisheries and Aquaculture*
University of Agriculture, Forestry and Renewable Natural Resources
Max-Emanuel-Str. 17, A-1180 Vienna, Austria
[2]*Department of Biology, Kathmandu University, Dhulikhel, Kabre district, Nepal*

Nine species of leeches belonging to four families are reported from Nepal. Among Glossiphoniidae, *Hemiclepsis marginata* O. F. MÜLLER, *Batracobdelloides reticulatus* KABURAKI, *Placobdelloides fulvus* HARDING, *Alboglossiphonia weberi* BLANCHARD, *A. hyalina* O. F. MÜLLER and *Helobdella stagnalis* LINNAEUS are recorded with their distribution and ecology described. Similarly, *Barbronia weberi* BLANCHARD (Salifidae), *Haemadipsa sylvestris* BLANCHARD, *H. zeylanica* MOQUIN-TANDON (Haemadipsidae) and an unidentified specimen (?Hirudinidae) are also included.

Key words: Hirudinea, Glossiphoniidae, Haemadipsidae, Salifidae, Nepal

INTRODUCTION

Relatively little is known about the freshwater leech fauna of Nepal. For the neighbouring country of India, however, a number of publications on aquatic leeches exists e.g. BAUGH (1960*a, b*), BHATIA (1930, 1934, 1939), CHANDRA (1976, 1977, 1983*a*), HARDING and MOORE (1927), RAMANANDAN *et al.* (1989).

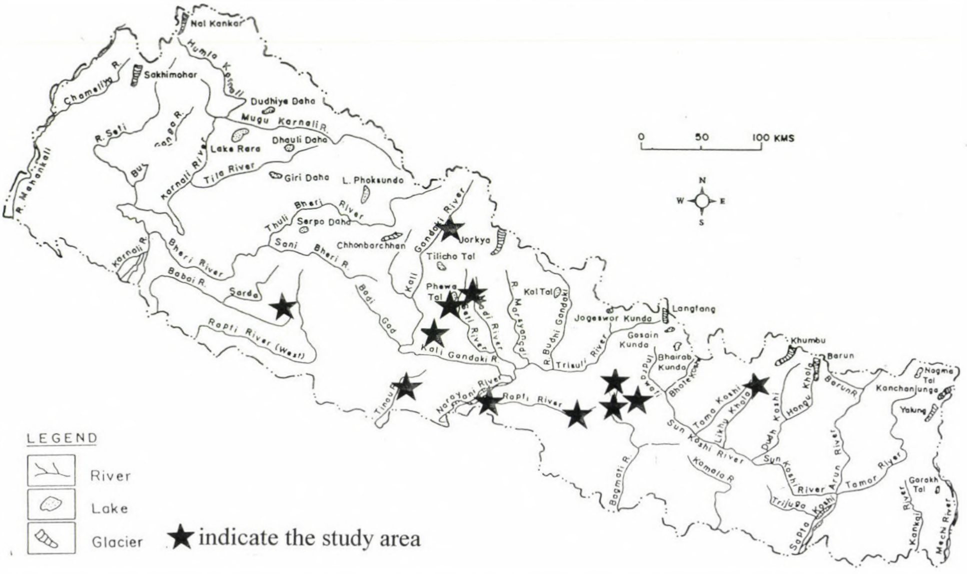
Except the publication of YADAV and MISHRA (1982), HARDING and MOORE (1927), who studied the freshwater leech fauna in Kathmandu and the paper of RUNDLE *et al.* (1993), who mentioned their presence in the Annapurna and Langtang Regions, no other references on the leech fauna fauna of Nepal are known to the authors. A recent contribution to the knowledge of leeches from Nepal is by NESEMANN (1995). Leeches are, however, mentioned in ancient Nepalese historic notes. Leech in Nepali "*Juko*", appears to have been derived from the Sanskrit "*Jaluka*" which means "having water at its home".

MATERIAL AND METHODS

Study area

The area studied covers tropical to subalpine zones ranging from an altitude of 80 m in the Central Terai to 3800 m above sea level in the Inner Himalayan

Map 1. The rivers of Nepal with the collecting localities



zone of the Tibetan Plateau (SHARMA 1996). The Eastern Midland rivers investigated were Bhotekosi near Namche bazar extending up to the valley of Arun Basin at Tumlingtar. The Central Midland rivers crossing Kathmandu-Kodari Rajmarg mountains and the water bodies of the Kathmandu valley were also included together with the Central Lowland rivers of Terai. The field work was also extended from the lower Marsyangdi Basin to the Pokhara valley and reaching up to the Tinau watershed, sampling along the course of the Andhi Khola. The untouched virgin rivers of the far-western and mid-western zones of the country, such as the Midland tributary of the Mahakali and the Lowland tributary of Karnali together with Surkhet valley and Phyuthan, were also examined. The Kaligandaki river, which flows through the world's deepest gorges and its tributaries bordering the Gulmi and Syangja districts of the western zone of Nepal, were also sampled during the course of the present study (Map 1).

Collecting methods and identification

The method used in collecting leeches was fairly simple i.e. hand picking from its substrate. Proper care has to be taken while picking the animal, for it clings to the substrate firmly and careless picking may cause rupturing of the delicate parts. Initially the leeches were properly killed in 15% ethanol and later transferred to 70% ethanol for preservation. The material was collected by U. GRASSER, W. GRAF, S. KHANAL, O. MOOG, H. NESEMANN, G. HUTTER, B. PRADHAN, A. RÖMER, A. SCHMIDT-KLOIBER and S. SHARMA on different occasions between November 1993 and April 1996. The material was identified by H. NESEMANN with the aid of the identification keys of HARDING and MOORE (1927), CHANDRA (1983*a*) and SAWYER (1986). All figures were drawn by H. NESEMANN. The material is deposited in the collection of the Department of Hydrobiology, University of Agriculture in Vienna.

DESCRIPTION OF TAXA FOUND IN NEPAL

Family GLOSSIPHONIIDAE

Hemiclepsis marginata (O. F. MÜLLER, 1774)
(Figs 1–3)

Material: Western region, Kaski district, Phewa Tal* effluent at Pokhara, 888 m, 21. 02. 1994, 5 specimens, leg. NESEMANN & SHARMA.

External characters: Small to medium-sized oval leeches, resting specimens reaching a body length of 8–24 mm. Anterior part of body rounded, head bulbous. Mouth pore is in posterior part of oral sucker. Two pairs of eyes present. Colour of living specimens green with seven longitudinal rows of yellow spots. Body rim characterised by white and dark spots. For a detailed description, see HARDING and MOORE (1927) and SINGHAL *et al.* (1985).

The specimens collected in Nepal resemble the European forms. There are no records of the subspecies *asiatica* MOORE, 1924, which is listed by CHANDRA (1983) for the fauna of Kashmir and Himachal Pradesh. Its relation to the nominate subspecies is yet doubtful.

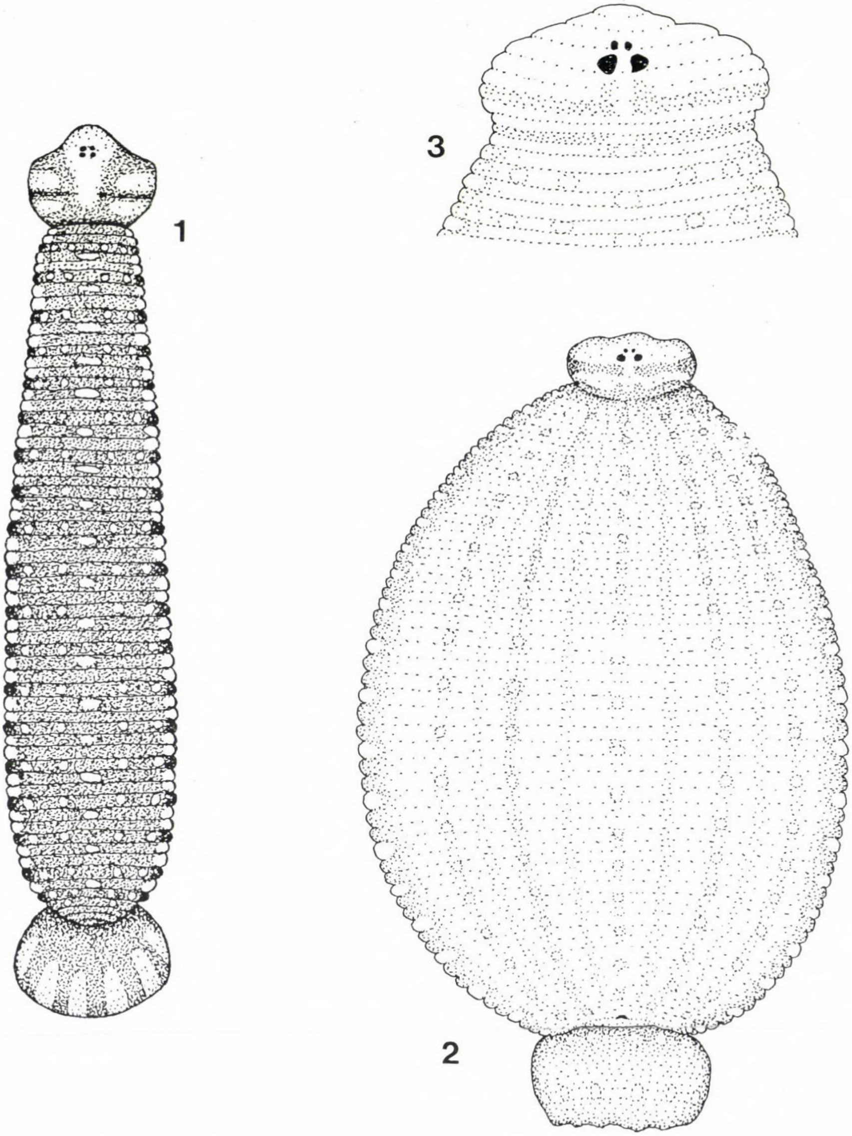
Distribution: *H. marginata* is distributed widely in the Palaearctic and Oriental regions. It is known from Europe, the eastern Mediterranean countries, Asia Minor, Russia, Japan and the Indian subcontinent. In India it was recorded from several localities in the Ganges river basin and Western Ghats (Bombay) by BAUGH (1960*a, b*), BHATIA (1939), CHANDRA (1976, 1977, 1983*a, b*), CHANDRA and MAHAJAN (1976), MAHAJAN and CHANDRA (1976), RAMANANDAN *et al.* (1989). SOOTA and BASKARAN (1982) and SOOTA and SAXENA (1984) reported the occurrence of *H. marginata* from four localities in the Indian desert near Jodhpur in Rajasthan. It is also known from the upper Indus river basin (MOORE 1924, SINGHAL *et al.* 1985). In Nepal, *H. marginata* was mentioned for the first time from Janakpur, Chitwan, and Chukei Mukei by HARDING and MOORE (1927).

Ecology: These aquatic leeches are temporary ectoparasites of fishes, amphibians and other aquatic animals. In India, this species was recorded as parasite

---

* Explanation of some Nepali terms: tal = lake, khola = small river, stream, nadi = larger river.

of the freshwater mud turtle *Trionyx gangeticus* CUVIER, 1825 (SINGHAL *et al.* 1985). According to CHANDRA (1983*a*) it also attacks certain molluscs. During the present investigations, it was found in the slowly running effluent of Lake Phewa. This habitat represents a metapotamal region (SHARMA 1996) which is rich in the typical mollusc species of lowland rivers e.g. the gastropods *Bellamya*



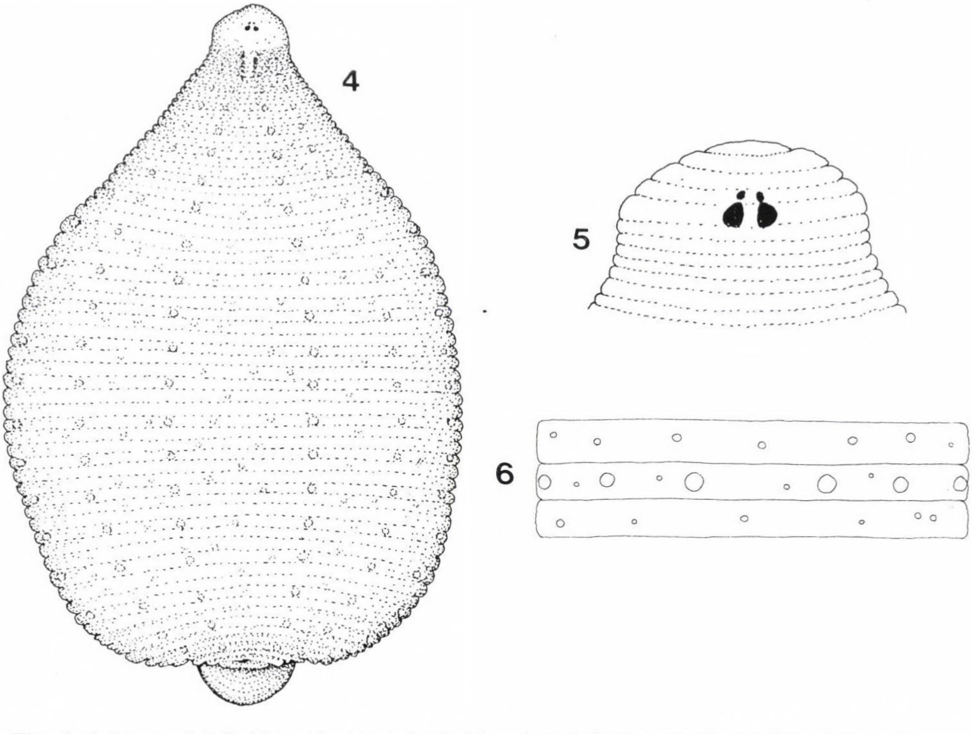
Figs 1–3. *Hemiclepsis marginata*: 1 = habitus dorsal, juvenile specimen (Austria, Lusthauswasser in Vienna), 2 = habitus dorsal, 3 = head with position of eyes (Nepal, Phewa Tal)

bengalensis (LAMARCK, 1882), *Melanoides tuberculatus* (O. F. MÜLLER, 1774), *Indoplanorbis exustus* (DESHAYES, 1834) and the bivalve *Parreysia (Radiatula) lima* (SIMPSON, 1900).

Batracobdelloides reticulatus (KABURAKI, 1921)
(Figs 4–6)

Material: Western region, Kaski district, Phewa Tal effluent at Pokhara, 888 m, 21. 02. 1994, 6 specimens, leg. NESEMANN & SHARMA, 11. 11. 1993, 2 specimens, leg. Nesemann; Western region, Kaski district, Begnas Tal effluent near Pokhara, 888 m, 21. 02. 1994, 6 specimens, leg. NESEMANN & SHARMA.

External characters: Small oval or rounded leeches, living extended specimens reaching a body length of 12 mm. Body very smooth, leeches are very active, moving fast like juveniles of *Theromyzon tessulatum* (O. F. MÜLLER, 1774). Head bulbous, mouth pore nearly central in oral sucker. Two pairs of eyes, first pair on annulus four very small and coalescent in preserved specimens, second pair of large eyes on annulus five. Dorsum of body unicoloured, dark greenish brown or greenish blue, preserved specimens pale greenish brown. Ventrum less coloured. On the dorsum six longitudinal rows of prominent papillae on the annulus a2. A detailed description of this species is given by HARDING and MOORE (1927).



Figs 4–6. *Batracobdelloides reticulatus*: 4 = habitus dorsal, 5 = head with position of eyes, 6 = one midbody segment (dorsal) with the typical arrangement of papillae (Nepal, Begnas Tal)

Remarks: *B. reticulatus* differs from the very similar species *Oosthuizobdella mahabiri* (BAUGH, 1960) in the colour and the presence of papillae. A closely related species of *B. reticulatus* is the European *B. moogi* NESEMANN and CSÁNYI, 1995. It is known from the Carpathian Basin in Hungary, Austria and Slovakia, as well as from Poland.

Distribution: Previously, *B. reticulatus* had been known only from several localities in India. The hitherto known records are from the Indus river basin and from Maharashtra (CHANDRA 1976, 1977, 1983*a*, *b*, CHANDRA and MAHAJAN 1976, HARDING and MOORE 1927). The material mentioned above is the first record for the Ganges river basin and for Nepal.

Ecology: This leech inhabits the littoral zone of lakes in the Pokhara basin. The crop caeca of the specimens were filled with blood. It seems to be an ectoparasite of the Indian ramshorn snail *Indoplanorbis exustus* (DESHAYES, 1834), which were collected numerously in the same habitat. HARDING and MOORE (1927) reported *B. reticulatus* from the mantle of a bivalve species of the Anodontinae. CHANDRA (1983*a*) mentioned this leech to be a parasite of molluscs.

Placobdelloides fulvus (HARDING, 1924)
(Figs 7–10)

Material: Western region, Kaski district, Kumle Khola at Khaerenitar, 500 m, 11. 11. 1993, 2 specimens, leg. GRAF, GRASSER, MOOG, NESEMANN & SHARMA; Western region, Syangja district, Araundi Khola at Syangja, 862 m, 22. 02. 1994, 1 specimen, leg. NESEMANN; Western region, Kaski district, Phewa Tal effluent at Pokhara, 888 m, 11. 11. 1993, 1 specimen, leg. NESEMANN; Western region, Gulmi district, Bakhre Khola near Kharjyang, 830 m, 17. 01. 1994, 4 specimens, leg. SHARMA; Central region, Kathmandu district, Taudaha pond near Pharping, 1400 m, 08. 11. 1993, 2 specimens, leg. GRAF, GRASSER, MOOG & NESEMANN.

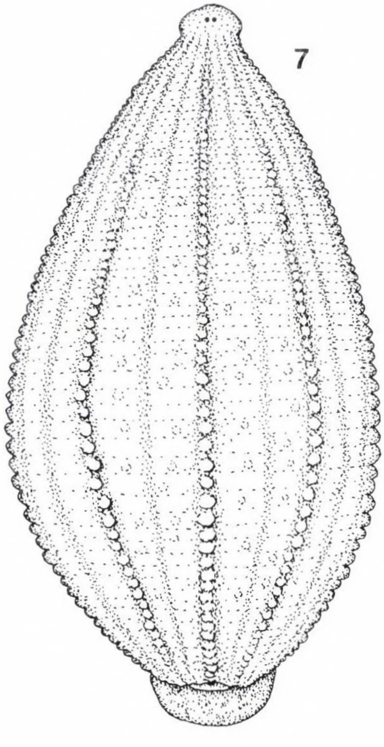
External characters: Small dorsoventrally flattened leeches, reaching a maximum body length of 7–13 mm (preserved specimens). One pair of eyes present. Mouth pore terminal on the anterior rim of oral sucker. Living specimens have a light reddish or yellowish colour. Six longitudinal dark stripes and three rows of prominent papillae on dorsum. A detailed description is given by HARDING and MOORE (1927).

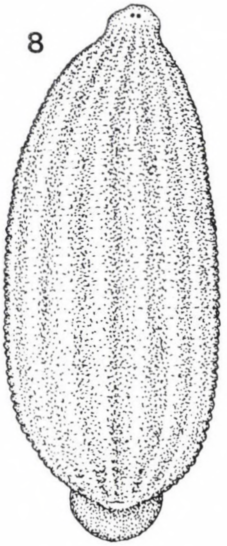
Distribution: *P. fulvus* had been known only from Manbhum district in Bihar in northern India (HARDING and MOORE 1927, CHANDRA 1983*a*). It was found during the present investigations for the first time in Nepal. Here it occurs in small rivers and streams of the midland. It was also collected from submerged vegetation of an artificial pond.

Ecology: This leech occurs mainly in unpolluted streams of water quality class I-II to II. In one case it was collected in a polluted river of the water quality class III (SHARMA 1996) The food of *P. fulvus* remains still unknown. According to CHANDRA (1983*a*), it is an ectoparasite of aquatic turtles.

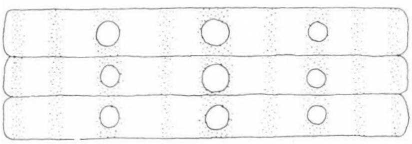
Alboglossiphonia weberi (BLANCHARD, 1897)
(Figs 11–18)

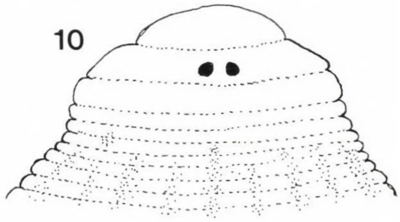
Material: Central region, Kathmandu district, Bagmati at Pashupatinath, 1320 m, 13. 12. 1995, 1 specimen, leg. MOOG; Western region, Kaski district, Phewa Tal effluent at Pokhara, 888 m, 21. 02. 1994, 12 specimens, leg. NESEMANN & SHARMA; Western region, Kaski district, Rupa Tal effluent near Pokhara, 888 m, 06. 04. 1996, 8 specimens, leg. GRAF & SCHMIDT-KLOIBER; Western region, Syangja district, Araundi Khola at Syangja, 862 m, 22. 02. 1994, 6 specimens, leg. NESEMANN & SHARMA; Western region, Kaski district, Begnas Tal effluent near Pokhara, 888 m, 21. 02. 1994, 1 specimen, leg. NESEMANN & SHARMA.





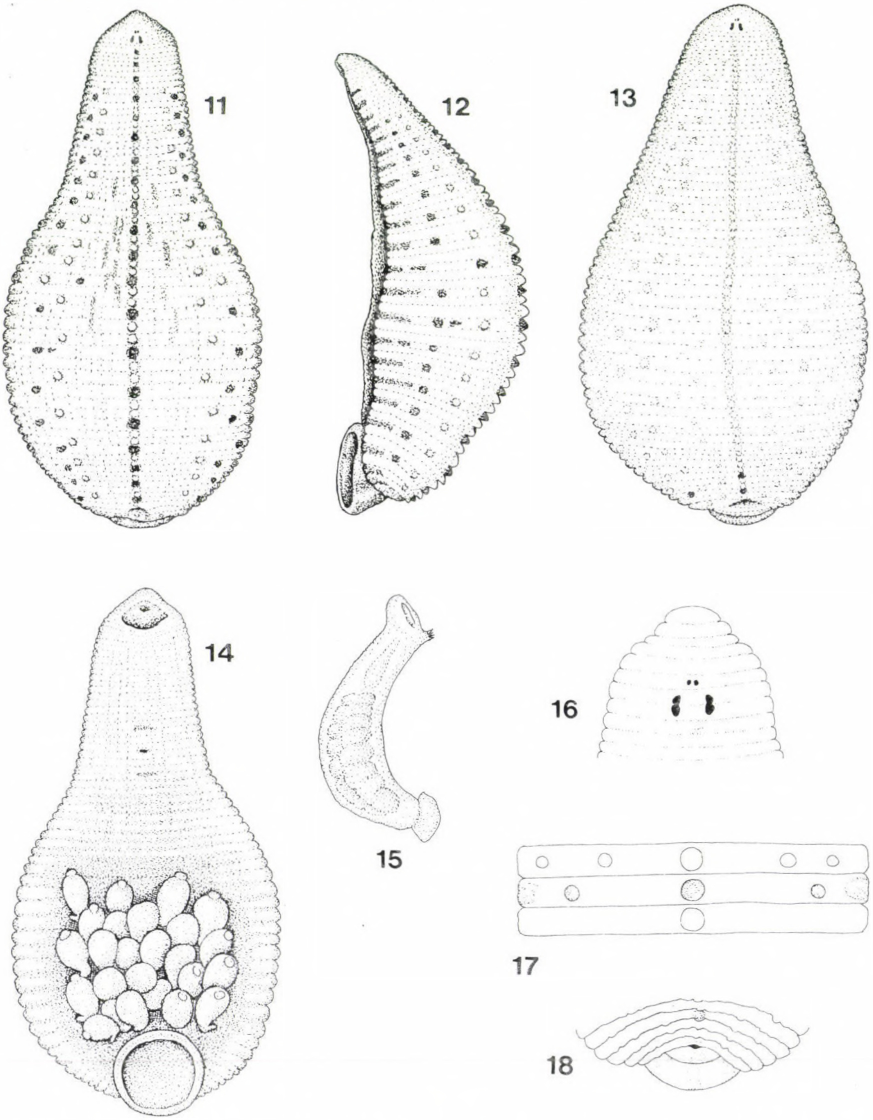
9





Figs 7–10. *Placobdelloides fulvus*: 7 = habitus dorsal, adult, 8 = habitus dorsal, juvenile, 9 = one midbody segment (dorsal) with the typical arrangement of papillae, 10 = head with position of eyes (Nepal, Taudah pond)

External characters: Small, dorsoventrally flattened and ovate leeches reaching a maximum body length of 13 mm. Head bearing three pairs of eyes as in *A. hyalina*. One median row of prominent tubercles on each annulus and three pairs of paramarginal rows of papillae on annuli a1 and a2 of each midbody somite. Living specimens with a pale white to yellowish colour with dark pigmented papillae of annuli a2. A detailed description of *A. weberi* was given by MOORE (1924), HARDING and MOORE (1927) and BAUGH (1960*a*).



Figs 11–18. *Alboglossiphonia weberi*: 11 = habitus dorsal, typical colour pattern, 12 = lateral, 13 = dorsal, specimen with reduced dark pigmentation, 14 = ventral, breeding leech with juveniles on venter, 15 = juvenile leech, lateral 0,6 mm body length, 16 = head with position of eyes, 17 = one midbody segment (dorsal) with the typical arrangement of papillae, 18 = posterior part of the body with position of anus and caudal sucker, dorsal, one postanal annulus (Nepal, Phewa Tal)

Remarks: *A. weberi* of the Indian subcontinent is closely related to *Alboglossiphonia lata* (OKA, 1910) from Japan and *Alboglossiphonia disuqi* EL-SHIMY, 1990, from Egypt.

Distribution: *A. weberi* is the most common member of the family Glossiphoniidae, known from nearly all freshwaters in India, Pakistan, Burma and Sumatra (BAUGH 1960*a*, CHANDRA 1977, 1983*a, b*, CHANDRA and MAHAJAN 1976, MAHAJAN and CHANDRA 1976, MOORE 1924, SOOTA and BASKARAN 1982, SOOTA and SAXENA 1984). In Nepal, its occurrence in Janakpur was already noted by HARDING and MOORE (1927). During the present investigations, it was collected from various types of running and stagnant waters all over Nepal. It is restricted to lowlands and midlands.

Ecology: This leech was mainly found in the lenitic zones of streams and rivers as well as in the littoral zone of the lakes. It is a predator or parasite of small aquatic molluscs. HARDING and MOORE (1927: 65) and CHANDRA (1983*a*: 275) mentioned *A. weberi* as a predator of aquatic beetles. This leech tolerates organic pollution, its saprobic range includes water quality classes I-II to III (SHARMA 1996).

Alboglossiphonia hyalina (O. F. MÜLLER, 1774)
(Figs 19–24)

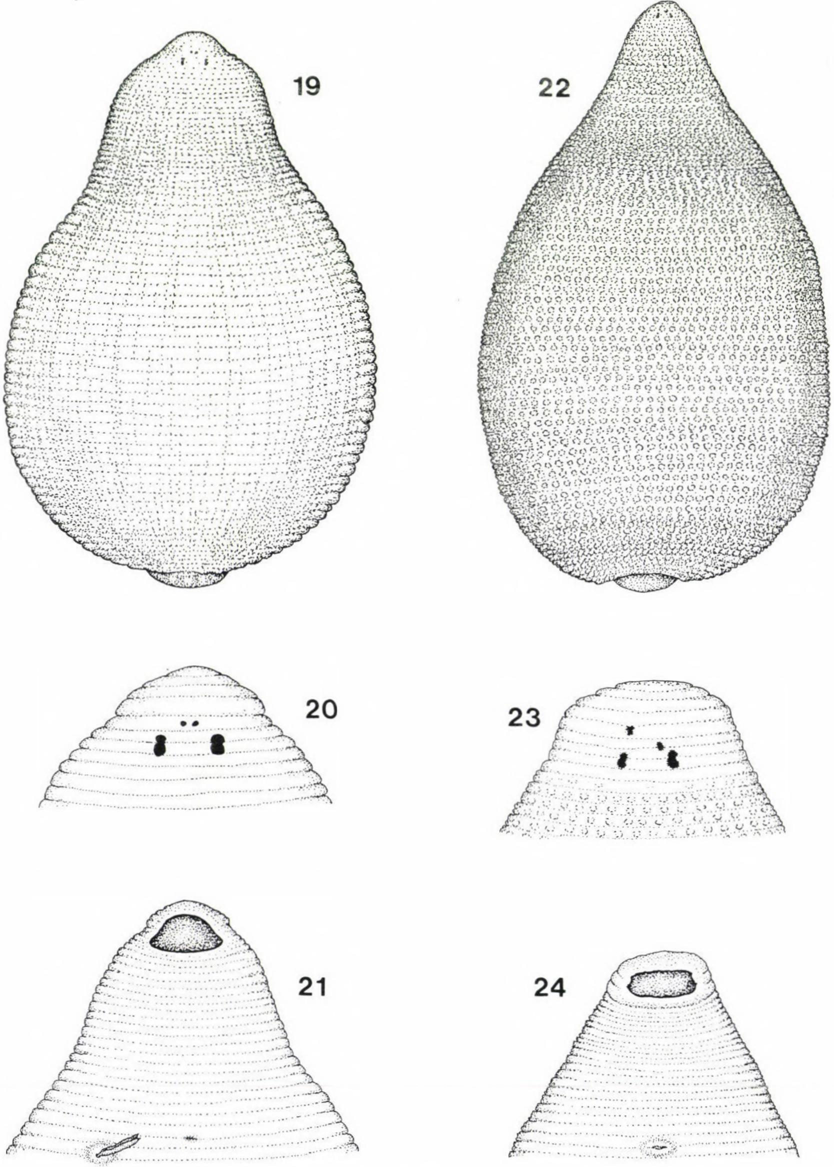
Material: Central region, Lalitpur district, Godawari Khola upstream holy spring, 1434 m, 17. 12. 1995, 1 specimen, leg. MOOG, 26. 03. 1996, 2 specimens, leg. MOOG.

External characters: Very small transculent leech with a body length of 9 mm. Head bulbous with a large cranial sucker. Six eyes, position of which very similar to that in *A. heteroclita* (LINNAEUS, 1761), but the distance between eyes of second and third pair larger. Seven pairs of crop caeca elongated, last pair with four prominent lobes. Genital pores joined, openings in furrow XII a1/a2. Unicoloured, white greyish, dark pigmentation lacking. Body surface granulated by very small fine papillae.

Remarks: The distribution of the two species *A. heteroclita* (LINNAEUS, 1761) and *A. hyalina* is still unclear. *A. hyalina* is often regarded a junior synonym of *A. heteroclita*. The two closely related species can be distinguished by the form of the head, the size of the cranial sucker and the dorsal colouration. *A. heteroclita* has an elongated head. The cranial sucker is significantly smaller than in *A. hyalina*. The position of the eyes differs from that in *A. hyalina*. Dark pigmentation dorsally always present, which is arranged in a typical pattern of one row of dorsomedian patches or segmental transverse stripes. Internally the two species *A. heteroclita* and *A. hyalina* differ in length and form of crop caeca.

Distribution: The similar species *A. heteroclita* is widely distributed in the Holarctic region, including the Indian subcontinent. It was also listed from

Burma by OKA (1922) and HARDING and MOORE (1927). In India it was collected for the first time in Bihar (Kharagpur hills) by RAY and PRADHAN (BAUGH 1960*a*). Additionally, some localities near Nagaur in Rajasthan were published by MAHAJAN and CHANDRA (1976).

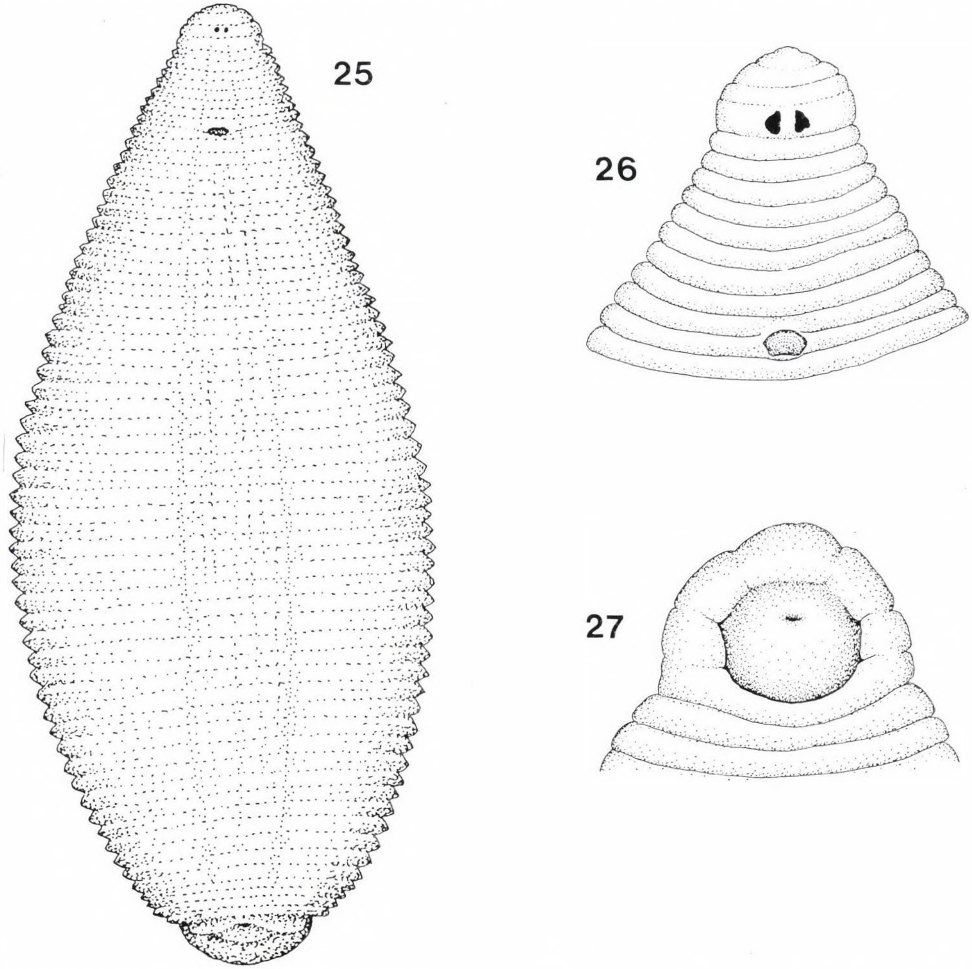


Figs 19–24. *Alboglossiphonia hyalina*: 19 = habitus dorsal, 20 = head with position of eyes, 21 = ventral with cranial sucker, genital porus and spermatophore (Austria, Lusthauswasser, Vienna), 22 = habitus dorsal, 23 = head with position of eyes, 24 = ventral with cranial sucker and genital porus (Hungary, Zala near Fenékpuszta)

Previously, *A. hyalina* had been known only from Europe. The separation of *A. hyalina* from *A. heteroclita* recently proved by NESEMANN and MOOG (1995) and NESEMANN and NEUBERT (in print). Therefore the hitherto known records from Nagaur may represent either *A. heteroclita* or *A. hyalina*. In contrast, the figure of the material mentioned by BAUGH (1960*a*: 298, Fig. 6) clearly shows *A. heteroclita*.

The material of *A. hyalina* collected in the Kathmandu valley is the first record for the fauna of Nepal and for the Indian subcontinent.

Ecology: In Austria, Hungary and Germany, *A. hyalina* was found to be an ectoparasite of certain pulmonate snails, mainly Lymnaeidae e.g. *Lymnaea stagnalis* (LINNAEUS, 1758) and *Stagnicola corvus* (GMELIN, 1791). In Nepal, *A.*



Figs 25–27. *Helobdella stagnalis*: 25 = habitus dorsal, 26 = head with position of eyes, praeclitellar region and scutum, 27 = cranial sucker with mouth porus, ventral (Nepal, Dhumba Tal)

hyalina is associated with species of the genera *Radix, Gyraulus* and *Tricula*. Here, it occurs in an unpolluted spring, representing the limnocrenal region with water quality class I-II.

Helobdella stagnalis (LINNAEUS, 1758)
(Figs 25–27)

Material: Western region, Mustang district, Dhumba Lake near Jomson, 2715 m, 21. 11. 1993, 1 specimen, leg. GRAF & GRASSER; Western region, Mustang district, Ponkyu Khola at Marpha, 2667 m, 01. 04. 1996, 1 specimen, leg. GRAF & SCHMIDT-KLOIBER.

External characters: Small flat leeches up to 15 mm. One pair of eyes on somite III/IV. Dorsally, a small horny plate (scutum) between annulus 13 and 14. Colour of living specimens very variable green, grey or brownish. Body surface smooth, with no papillae. A detailed description of this species is given by HARDING and MOORE (1927).

Distribution: Holarctic region. In India, *H. stagnalis* is known only from the transitional zone of the Palaearctic and Oriental region. It was listed for the Himalayan fauna of Himachal Pradesh, Jammu and Kashmir by HARDING and MOORE (1927) and by CHANDRA (1983*b*). All known localities are from tributaries of the Indus river system. In Nepal, *H. stagnalis* was found for the first time during the present studies. Thus the Nepalese specimens are the first records from the Ganges river basin. It is restricted to the Inner Himalayan zone (Kali Gandaki river basin) and occurs over 2500 m a.s.l.

Ecology: This species was collected from the limnocrenal and metarhithral region of running and stagnant waters. It occurs together with the amphipod *Gammarus lacustris* SARS, 1863, a true member of the Holarctic fauna of Nepal. *H. stagnalis* is a predator of small invertebrates. It lives in Nepal in water quality class I-II whereas it tolerates high organic pollution in Europe.

Family SALIFIDAE

Barbronia weberi (BLANCHARD, 1897)
(Figs 28–34)

Material: Central region, Kathmandu district, Sundarijal, 1450 m, Nov.-Feb. 1995–1996, 2 specimens, leg. PRADHAN; Central region, Kathmandu district, Balkhu Khola at Balkhu, 1295 m, 14. 12. 1995, 3 specimens, leg. MOOG, PRADHAN, RÖMER, SHARMA; Central region, Lalitpur district, Balkot, 1320 m, 17. 12. 1995, 1 specimen, leg. PRADHAN; Central region, Lalitpur district, Khodu Khola at Lubhu road, 1325 m, 16. 12. 1995, 8 specimens, leg. MOOG, PRADHAN, RÖMER, SHARMA; Central region, Kathmandu district, Balkhu Khola at Kalanki, 1335 m, Nov.-Feb. 1995–1996, 2 specimens, leg. PRADHAN; Central region, Kathmandu district, Balkhu Khola at Ringroad, 1312 m, Nov.-Feb. 1995–1996, 2 specimens, leg. PRADHAN; Central region, Kathmandu district, Bagmati at Sundarijal, 1450 m, Nov.-Feb. 1995–1996, 1 specimen, leg. PRADHAN; Central region, Kathmandu district, Dhobi Khola at Narayanthan/Buhanilkantha, 1470 m, Nov.-Feb. 1995–1996, 3 specimens, leg. PRADHAN; Central region, Lalitpur district, Godawari Khola at Balkot, 1320 m, 17. 12. 1995, 3 specimens, leg. MOOG, PRADHAN, RÖMER; Central region, Kathmandu district, Bagmati at Khokna, 1280 m, 14. 12. 1995, 1 specimen, leg. MOOG, PRADHAN, RÖMER, Sharma; Central region, Bhaktapur district, Sipadol Khola at Jagati, 1310 m, 12. 12. 1995, 1 specimen, leg. KHANAL, MOOG, RÖMER, SHARMA; Central region, Kathmandu district, Mahadev Khola at Budhanilkantha, 1470 m, Nov.-Feb. 1995–1996, 2 specimens, leg. PRADHAN; Central region, Kathmandu district, Bagmati below the confluence of Dhobi Khola, 1314 m, 13. 12. 1995, 1 specimen, leg. MOOG; Central region, Lalitpur district, Khodu Khola at Hattiban, 1360 m, 16. 12. 1995, 2 specimens, leg. MOOG, PRADHAN, RÖMER, SHARMA; Central region, Kathmandu district, Bishnumati at Budhanilkantha, 1470 m, 15. 12. 1995, 4 specimens, leg. MOOG, PRADHAN, RÖMER, SHARMA; Central region, Bhaktapur district, Mahadev Khola at Jagati, 1310 m, 12. 12. 1995, 7 specimens, leg. KHANAL, MOOG, RÖMER, SHARMA; Central region, Bhaktapur district, Khasyang Khusyung at Purano thimi road, 1310 m, 12. 12. 1995, 6 specimens, leg. KHANAL, MOOG, RÖMER, SHARMA; Central region, Kathmandu district, Bagmati at Tinkune, 1315 m, 13. 12. 1995, 9 specimens, leg. MOOG, PRADHAN, RÖMER, SHARMA; Central region, Kathmandu district, Dhobi Khola at Budhanilkantha, 1470 m, 15. 12. 1995, 4 specimens, leg. MOOG, PRADHAN, RÖMER, SHARMA; Central region, Kathmandu district, Bagmati at Pashupatinath, 1320 m, 13. 12. 1995, 1 specimen, leg. RÖMER; Central region, Lalitpur district, Nakhu Khola at Nakhu, 1300 m, 16. 12. 1995, 1 specimen, leg. SHARMA; Central region, Lalitpur district, Kotkhu Khola at Imadol, 1400 m, Nov.-Feb. 1995–1996, 8 specimens, leg. PRADHAN; Central region, Lalitpur district, Kotkhu Khola at Badegaon, 1405 m, Nov.-Feb. 1995–1996, 2 specimens, leg. PRADHAN; Western region, Kaski district, Phewa Tal effluent at Pokhara, 888 m, 21. 02. 1994, 3 specimens, leg. NESEMANN & SHARMA; Western region, Kaski district, Begnas Tal effluent near Pokhara, 888 m, 21. 02. 1994, 16 specimens, leg. NESEMANN & SHARMA, 10. 11. 1993, 2 specimens, leg. GRAF, GRASSER, MOOG, NESEMANN & SHARMA; Western region, Tanahu district, Chudi Khola upstream Bimalnagar, 370 m, 10. 11. 1993, 3 specimens, leg. GRAF, GRASSER, MOOG, NESEMANN & SHARMA; Western region, Rupandehi district, Sukaura Khola near Butwal, 188 m, 14. 11. 1993, 6 specimens, leg. GRAF, GRASSER, MOOG, NESEMANN & SHARMA; Western region, Syangja district, Araundi Khola at Syangja, 862 m, 22. 02. 1994, 1 specimen, leg. NESEMANN, 04. 01. 1994, 3 specimens leg. SHARMA; Western region, Kaski district, Kumle Khola near Khaerenitar, 500 m, 11. 11. 1993, 1 specimen, leg. MOOG; Western region, Makwanpur district, Karra Khola at Hetauda, 466 m, 28. 02. 1994, 4 specimens, leg. NESEMANN & SHARMA; Western region, Makwanpur district, Fishpond at Hetauda, 466 m, 28. 02. 1994, 3 specimens, leg. NESEMANN & SHARMA; Western region, Syangja district, Andhi Khola at Syangja, 862 m, 04. 01. 1994, 4 specimens, leg. SHARMA; Mid-western region, Dang district, Katuwa Khola at Deukhuri, 1200 m, 24. 12. 1993, 1 specimen, leg. SHARMA; Central region, Lalitpur district, Godawari Khola upstream holy spring, 1434 m, 26. 03. 1996, 1 cocoon with embryos, leg. MOOG; Central region, Kathmandu district, Bagmati near Gokharna, 1380 m, 27. 03. 1996, 1 specimen, leg. MOOG; Central region, Kathmandu district, Godawari Khola near Godawari, 1430 m, 27. 03. 1996, 2 specimens, leg. MOOG.

External characters: Small to medium-sized leeches, body cylindrical, rounded, with lateral fringes in the last third of the body. Maximum body length of 18–45 mm. Four genital pores always present, male genital porus in furrow XII b1/b2, accessory male porus in X/XI, female porus on XIII b1, accessory female porus in XII/XIV. Pharynx with three pairs of stylets (NESEMANN 1995). Head bearing six to eight eyes arranged in typical salifid position (HARDING and MOORE 1927: 139, Fig. 41). Size greatly variable. Colour of living specimens light reddish, brown or even nearly black.

Two different forms could be distinguished. The typical red form reaches a body length of 33 mm, the head is small and the eyes are always well-developed. Dark pigment is never present (Figs 33–34, NESEMANN 1995: 173, Figs 20–25).

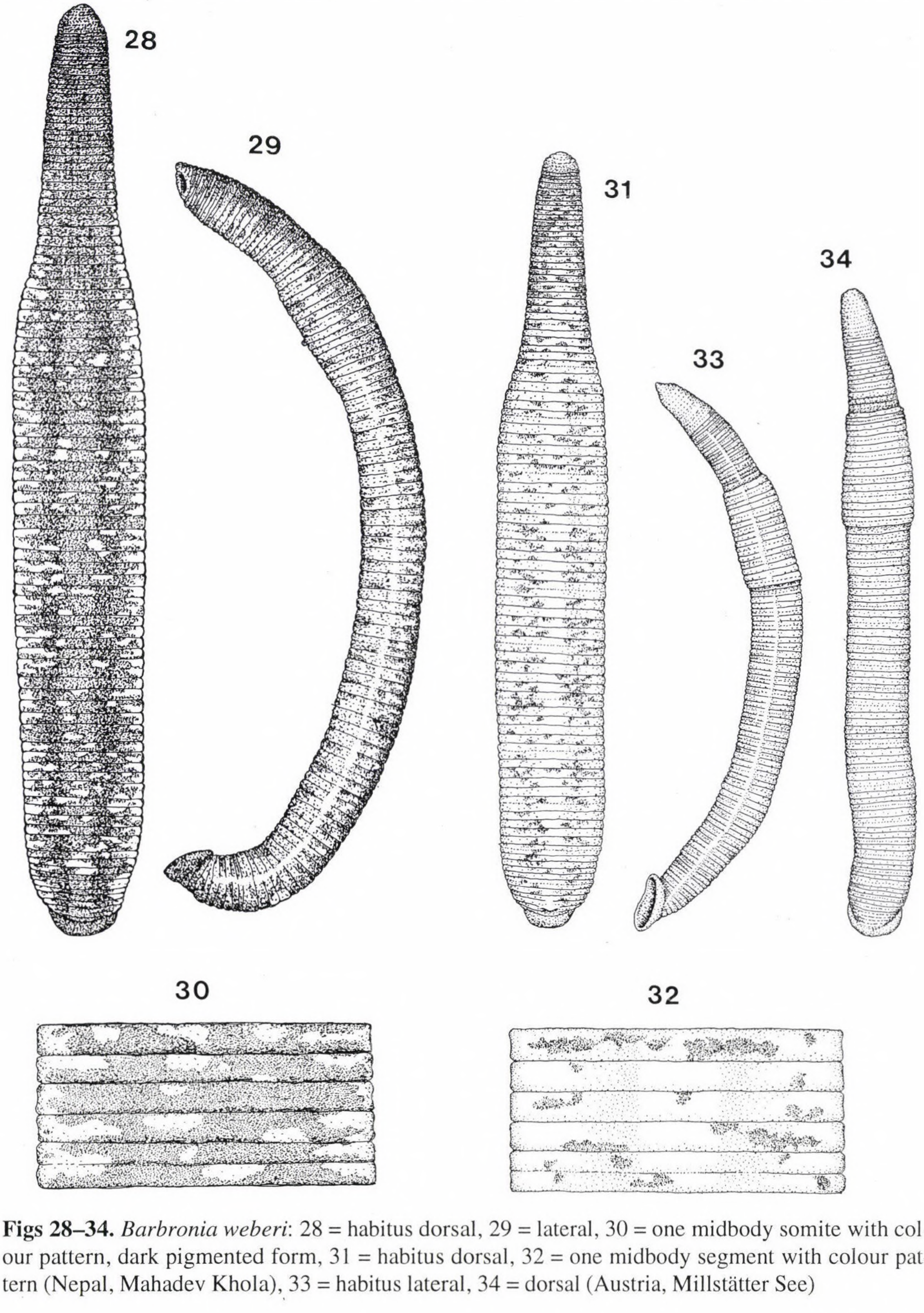
The second form has dark pigment and reaches 45 mm body length. The body is cylindrical with a blunt head region. In adult specimens the eyes are always reduced or not clearly visible (Figs 28–32). This form was exclusively collected in the Kathmandu valley. In the preserved specimens no differences were found to distinguish the two forms. Several intermediate populations were observed, which cannot be clearly identified as one of the two forms. Therefore the taxonomic status of these forms from the Kathmandu valley needs to be further clarified. It might be either a local variation, a subspecies or even a distinct species. The problems of the different described taxa of the genus *Barbronia* have already been mentioned (NESEMANN 1995: 172).

Variability: Although there was very little information about the colour forms and the habits of the living leeches, some interesting populations were already noted by HARDING and MOORE (1927: 138): "One specimen of the largest size from the Nepal Valley is marked with large, sprawly black blotches". During our investigation it was possible to compare the different leeches from the Bagmati river basin. Dark pigment may be present dorsally and ventrally, which is always irregularily arranged. The colour varies in the different populations. The black pigmented large form was collected in the rivers and streams of the Kathmandu valley, e.g. the Bishnumati, wherein the species reaches a maximum body length of 45 mm. In contrast, the small red form (18 mm) without black pigment was found in unpolluted fast-flowing streams, e.g. the Andhi Khola and Araundi Khola. Thus, the most common Erpobdelliformes of Nepal shows great similarity in the variation of colour patterns to the common European Erpobdellidae, e.g. *Erpobdella octoculata* (LINNAEUS, 1758) and *Dina punctata* JOHANSSON, 1927.

Distribution: *B. weberi* is widely distributed all over the Oriental Region. Its range stretches from the Indus river basin (Afghanistan, Pakistan) in the west to Borneo, Celebes and Japan in the east. In India it is known from the Western Himalayas in Jammu and Kashmir and Himachal Pradesh (MOORE 1924, CHANDRA 1976, 1983*a, b*, CHANDRA and MAHAJAN 1976). It also occurs in the Indian desert in Rajahstan (SOOTA and BASKARAN 1982, SOOTA and SAXENA 1984) and in Central India in Madhya Pradesh (HARDING and MOORE 1927). All localities known from India are restricted to the mountains and hills between the two river systems of Ganges and Indus (CHANDRA 1983*a*). In Nepal it was reported for the first time from the Kathmandu valley by HARDING and MOORE (1927). The present investigations showed its distribution from the Central to Midwestern regions in Nepal.

Recently, *B. weberi* was introduced to Europe, where it was recorded from Austria, Germany and Great Britain (SAWYER 1986). The relationship to the African *B. assiuti* HUSSEIN et EL-SHIMY, 1985, described from the Nile River in Egypt, remains doubtful (NESEMANN 1995).

Ecology: This is the most common leech species in Nepal. It was collected from various types of running waters and from the littoral zone of several lakes and ponds. In the Central region it was very abundant in the Bagmati river sys-



Figs 28–34. *Barbronia weberi*: 28 = habitus dorsal, 29 = lateral, 30 = one midbody somite with colour pattern, dark pigmented form, 31 = habitus dorsal, 32 = one midbody segment with colour pattern (Nepal, Mahadev Khola), 33 = habitus lateral, 34 = dorsal (Austria, Millstätter See)

tem in Kathmandu (1380 m) and Hetauda (465 m). In the Midwestern region it was plentiful in the lakes and in rivers from Katuwa Khola (1200 m) to Sukaura Khola (188 m). In the pharynx of the preserved specimens, numerous tubificids were found. This euryoecious leech occurs in slightly polluted rivers (water quality class I-II) as well as in water bodies with high organic pollution (water quality class III-IV).

Family HAEMADIPSIDAE

Haemadipsa sylvestris BLANCHARD, 1894
(Figs 35 and 36)

This terrestrial leech species was collected along the banks of one river (Budhi Rapati) and one pond (Taudaha) from the Inner Terai and Kathmandu valley, respectively. This species is known from the Western and Eastern Himalayas extending up to the Northeastern frontier provinces in India (CHANDRA 1983*a*). This species was found in two localities during the present study, which are the first records from Nepal. Live animals are unicoloured yellowish brown with three black longitudinal stripes. The preserved specimens reach a total body length of 9–11.5 mm.

Haemadipsa zeylanica (MOQUIN-TANDON, 1826)
(Figs 37 and 38)

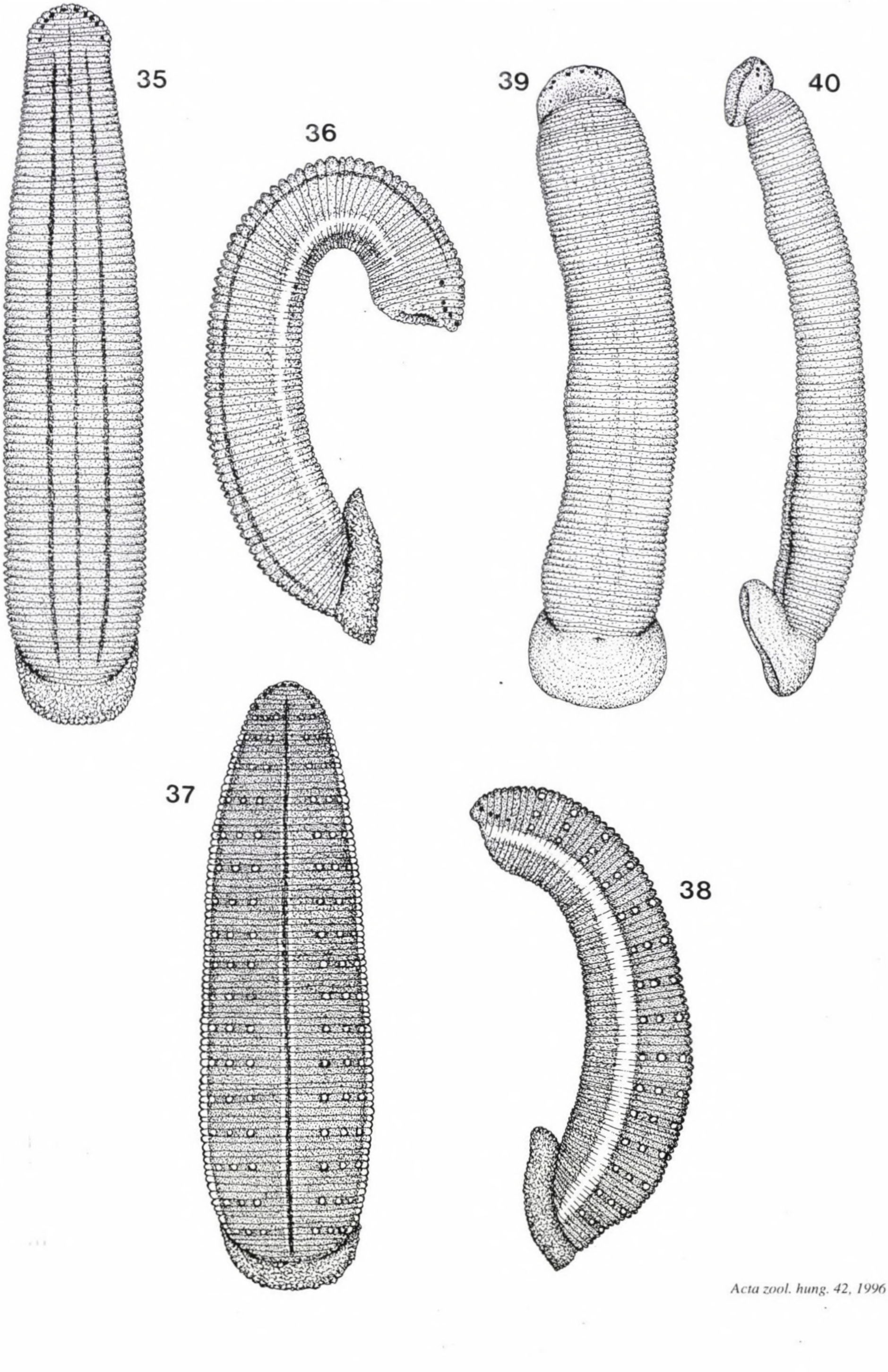
A single specimen (10 mm body length) was collected by G. HUTTER in Solukhumbu district (near Boskom Gumba), Eastern region. The species has already been reported from Nepal by CHANDRA (1983*a*). Several subspecies are known from different regions of the Himalayas (HARDING and MOORE 1927).

Family ? HIRUDINIDAE
(Figs 39 and 40)

Material: Central region, Kathmandu district, Mahadev/Dhobi Khola at Budhanilkantha, 1470 m, Nov.-Feb. 1995–1996, 1 specimen, leg. PRADHAN.

A very small hirudinid-like leech with a total body length of 8 mm. The elongated body is dorsoventrally flattened with quinqueannulate somites. The male and female genital pores are separated by five annuli. The cranial sucker is distinctly separated from the anterior part of the body as in many species of the Piscicolidae. The mouth porus is situated centrally in the sucker and the head

Figs 35–40. *Haemadipsa sylvestris*: 35 = habitus dorsal, 36 = lateral (Nepal, Taudah pond); 37–38 *H. zeylanica*: 37 = habitus dorsal, 38 = lateral (Nepal, Boskom Gumba); 39–40: unidentified specimen of the order Hirudiniformes: 39 = habitus dorsal, 40 = lateral (Nepal, Mahadev Khola)



bears eight eyes. This leech may be a juvenile specimen of a member of the family Hirudinidae. It could not be identified because of the number of eyes, that differs from all known Hirudinidae and Haemopidae.

DISCUSSION

Until now only four species of aquatic leeches (*Hemiclepsis marginata, Alboglossiphonia weberi, Babronia weberi* and *Poecilobdella granulosa*) had been reported for Nepal (CHANDRA 1983). All previous records are based on occasional collectings from the beginning of the 20th century (HARDING and MOORE 1927). YADAV and MISHRA (1982) reported the presence of four leech species in the Kathmandu valley. Most probably, all of the identifications published in that paper are incorrect. YADAV and MISHRA (1982: 120) based their identifications on several keys of the British fauna and did not mention any papers dealing with leeches of Nepal and India.

In the present study, it has been observed that the leeches in Nepal are distributed more towards the mountains and hillstreams. Their distribution in the lowland is unclear and further extensive research is necessary.

The Hirudiniformes (Hirudinidae, Haemadipsidae) are not sufficiently represented in the authors' collection. All of the species listed belonging to these families are accidentally collected.

* * *

Acknowledgements. – The authors acknowledge their sincere gratitude to W. GRAF, Dipl.-Ing. U. GRASSER, Dipl.-Ing. G. HUTTER, B. SC. S. KHANAL, Prof. Dr. O. MOOG, B. SC. B. PRADHAN, Dipl.-Ing. A. RÖMER and Dipl.-Ing. A. SCHMIDT-KLOIBER for the materials they made available for study. Univ. Prof. Dr. O. MOOG (Vienna) is thanked for his constant encouragements. This research was partly supported by the Austrian Academic Exchange Service.

REFERENCES

BAUGH, S. C. (1960*a*) Studies on Indian Rhynchobdellid leeches I. *Parasitology* **50**: 287–301.

BAUGH, S. C. (1960*b*) Studies on Indian Rhynchobdellid leeches II. *Zoologischer Anzeiger* **165**: 468–477.

BHATIA, M. L. (1930) Sur une nouvelle hirudinée rhynchobdelle, Glossiphonia cruciata n. sp., provenant du vivier a truites d'Achha Bal, Kashmir. *Annales de Parasitologie* **8**(3–4): 344–348.

BHATIA, M. L. (1934) Nouvelle sangsue rhynchobdellide Glossiphonia lobata n. sp. de l'établissement de pisciculture d'Achha Bal (Kashmir). *Annales de Parasitologie* **12**(2): 121–129.

BHATIA, M. L. (1939) On some leeches from the Dal lake, Kashmir. *University of the Punjab Lahore, Department of Zoology: Bulletin* **2**: 1–17.

CHANDRA, M. & K. K. MAHAJAN (1976) Leeches of Simla hills, Himachal Pradesh. *Records of the Zoological Survey of India*, Calcutta **69**: 255–259.

CHANDRA, M. (1976) A small collection of leeches from Maharashtra state, India. *Records of the Zoological Survey of India, Calcutta* **69**: 325–328.

CHANDRA, M. (1977) A check-list of leeches of Himachal Pradesh, India. *Records of the Zoological Survey of India, Calcutta* **73**(1–4): 189–195.

CHANDRA, M. (1983*a*) A check-list of Leeches of India. *Records of the Zoological Survey of India, Calcutta* **80**: 265–290.

CHANDRA, M. (1983*b*) The leech fauna of the Jammu region of Jammu and Kashmir state, India. *Records of the Zoological Survey of India, Calcutta* **81**: 289–298.

HARDING, W. A. & J. P. MOORE (1927) Hirudinea. *In* SHIPLEY, A. E. (ed.) *The fauna of British India, including Ceylon and Burma.* 302 pp., London.

MAHAJAN, K. K. & M. CHANDRA (1976) Report on a collection of leeches from Rajasthan, India. *Records of the Zoological Survey of India, Calcutta* **71**: 143–148.

MOORE, J. P. (1898) The leeches of the U.S. National Museum. *Proc. U.S. National Museum* **21**: 543–563.

NESEMANN, H. (1995) On the morphology and taxonomy of the Asian leeches (Hirudinea: Erpobdellidae, Salifidae). *Acta zool. hung.* **41**(3): 165–182.

NESEMANN, H. & O. MOOG (1995) Hirudinea, Teil III. *In* MOOG, O. (ed.) *Fauna Aquatica Austriaca*, Lieferung Mai/1995, Wasserwirtschaftskataster, Bundesministerium für Land- und Forstwirtschaft, Wien, 8 pp.

NESEMANN, H. & E. NEUBERT (in press) Branchiobdellida, Acanthobdellea, Hirudinea. *In* SCHWOERBEL, J. & P. ZWICK (eds) *Die Süßwasserfauna Mitteleuropas*, Stuttgart.

RAMANANDAN SHANAVAS, K., RAMACHANDRAN, P. & K. P. JANARDADAN (1989) Trypanoplasma ompoki sp. n. from freshwater fishes in Kerala, India, with observations on its vector-phase development and transmission. *Acta Protozoologica* **28**(3–4): 293–302.

RUNDLE S. D., A. JENKINS & S. J. ORMEROD (1993) Macroinvertebrate communities in streams in the Himalaya, Nepal. *Freshwater Biology* **30**: 169–180.

SAWYER, R. T. (1986) *Leech Biology and Behaviour, Vol II Feeding Biology, Ecology and Systematics.* pp. 419–793, Oxford.

SHARMA, C. K. (1990) Geology of Nepal Himalaya and adjacent countries. Published by Sangeeta Sharma, Kathmandu, Nepal.

SHARMA, S. (1996) Biological assessment of water quality in the rivers of Nepal. Ph.D thesis, University of Agriculture, Vienna.

SINGHAL, R. N., DAVIES, R. W. & K. I. SHAH (1985) The taxonomy and morphology of the leeches (Hirudinoidea: Glossiphoniidae) parasitic on turtles from the Beas river (India) including descriptions of two new species and one redescription. *Zool. Anzeiger, Jena* **215**(3–4): 147–155.

SOOTA, T. D. & M. M. SAXENA (1984) Leeches of some waters of Rajasthan and their ecology. *Geobios New Reports, Jodhpur* **3**(2): 125–127.

SOOTA, T. D., SAXENA, M. M. & S. BASKARAN (1982) Leeches of arid region around Jodhpur and their ecology. *Geobios New Reports, Jodhpur* **1**: 136–138.

YADAV, U. R. & P. N. MISHRA (1982) Studies on the freshwater leeches (Annelida: Hirudinea) of Kathmandu valley, Nepal. *J. Natural History Museum, Kathmandu* **6** (4): 119–123.

Received 18th July 1996, accepted 19th December 1996

Publications of the Hungarian Natural History Museum are available

Korsós, Z. and I. Kiss (eds) (1992): Proceedings of the 6th Ordinary General Meeting of the Societas Europaea Herpetologica, 19–23 August 1991, Budapest, Hungary. 531 pp. – ISBN 963 7093 12 5 (50 DM).

Mahunka, S. (ed.) (1991): The Bátorliget Nature Reserves – after forty years. Vols 1–2, 848 pp. – ISBN 963 7093 08 7, 963 7093 09 5 (USD 45).

Papp, L. and A. Szappanos (1992): Bagócslegyek – Gasterophilidae, Oestridae, Hypodermatidae. (in Hungarian), 56 pp. – ISBN 963 7093 11 7 (USD 15).

Soós, Á. and L. Papp (eds) (1992): Catalogue of Palaearctic Diptera. Vol. 1: Trichoceridae – Nymphomyiidae. 520 pp. – ISBN 963 7093 10 9 (USD 80).

Soós, Á. and L. Papp (eds) (1992): Catalogue of Palaearctic Diptera. Vol. 13: Anthomyiidae – Tachinidae. 624 pp. – ISBN 963 7093 21 4 (USD 85).

Zombori, L. and L. Peregovits (1992): Proceedings of the Fourth European Congress of Entomology and the XIII. Internationale Symposium für die Entomofaunistik Mitteleuropas, Gödöllő, Hungary, 1991. Vols 1–2, pp. 884. – ISBN 963 7093 14 1, 963 7093 15 X (USD 15).

Mahunka, S. and L. Zombori (eds) (1993): The fauna of the Bükk National Park. Vol. 1, 456 pp. – ISBN 963 7093 20 6 (USD 30).

Szujkó-Lacza, J. and D. Kováts (eds) (1993): The Flora of the Kiskunság National Park. Vol. 1. The Flowering Plants. 469 pp. – ISBN 963 7093 19 2 (USD 30).

Báldi, A., G. Csorba and Z. Korsós (1995): Magyarország szárazföldi gerinceseinek természetvédelmi szempontú értékelési rendszere. [Setting priorities for the conservation of terrestrial vertebrates in Hungary.] (in Hungarian with an extensive English summary), 59 pp. – ISBN 963 7093 26 5 (USD 10).

Mahunka, S. and L. Mahunka-Papp (1995): The Oribatid species described by Berlese (Acari). 325 pp. – ISBN 963 7093 27 3 (USD 40).

Verseghy, K. (1995): Magyarország zuzmóflórájának kézikönyve. [The lichen flora of Hungary.] (in Hungarian), 415 pp. – ISBN 963 7093 22 2 (USD 40).

Mahunka, S. (ed.) (1996): The fauna of the Bükk National Park, Vol. 2, 655 pp. – ISBN 963 70 93 32 x (USD 60)

Hably, L. (ed.) (1996): Emlékkötet Andreánszky Gábor (1895–1967) születésének 100. évfordulója alkalmából rendezett emlékülés előadásainak anyagából (Noszvaj, 1995. június 19–21). 183 pp. – ISBN 963 7093 33 8

Orders should be sent to:

The Library, Hungarian Natural History Museum
H–1088 Budapest, Baross u. 13, Hungary
Fax: +36-1-1171669

ACTA ZOOLOGICA
ACADEMIAE SCIENTIARUM HUNGARICAE

An international journal of animal taxonomy and ecology

Instruction to authors

Submission of a paper implies that it has not been published previously, that is not under consideration for publication elsewhere, and that if accepted for the Acta Zoologica Hungarica, the authors will transfer copyright to the Hungarian Academy of Sciences/the Hungarian Natural History Museum as is customary. Articles and illustrations become the property of the HAS/HNHM.

Papers must be in English with British spelling, and be original contributions in the field of animal taxonomy, systematics, zoogeography and ecology. All manuscripts must be submitted to one of the editors (editor, assistant editor).

Entire manuscripts must be submitted on IBM compatible floppy disk and in duplicate printed copies and the author should retain a copy. In the case of multiple authors, the corresponding author should be indicated. Series of numbered papers will not be considered.

Manuscripts must be printed with double spacing (including the reference list), and with wide margins (30–35 mm) on the left side of the paper only. Authors are requested to keep their communications as concise as possible. Footnotes should be avoided or minimized, and italics should not be used for emphasis. A running head of not more than 30 letters should be supplied.

The manuscript should contain the following information:

Title should be followed by the name and full address of the author(s). Where possible, the fax and/or e-mail number of the corresponding author should be supplied with the manuscript, for use by the publisher.

Abstract should be a brief summary of the contents and conclusions of the paper, and should not be longer than 200 words and should not contain references.

Key words should not be more than five (exceptionally 6) key word entries.

Introduction should contain a brief survey of the relevant literature and the reasons for doing the work.

Materials and Methods supply sufficient information to permit repetition of the experimental or field work. The technical description of methods should be given only when such methods are new.

Results should be presented concisely. Only in exceptional cases will it be permissible to present the same set of results in both table and a figure. The results section should not be used for discussion.

Discussion should be separate from the results section and should deal with the significance of the results and their relationship to the object of the work (and, this is the place of the identification key in taxonomic revisions).

Acknowledgements (at most in 10 lines).

References. In principle the Harvard system is to be followed. References should be detailed in the following order: authors' names and initials, date of publication (in parentheses), the title of the article, the name of the journal as abbreviated in the World List of Scientific Periodicals (4th edn 1963), the volume, and the first and last pages of the article, e.g.

NORRBOM, A. L. and KIM, K. C. (1985) Taxonomy and phylogenetic relationships of Copromyza Fallén (s.s.) (Diptera: Sphaeroceridae). *Ann. Entomol. Soc. Am.* **78**: 331–347.

For books the author's names, date of publication, title, edition, page reference, publisher's name and the place of publication should be given, e.g.

HINTON, H. E. (1981) *Biology of insect eggs*, vol. 2. Pergamon Press, New York.

or

MCALPINE, J. F. (1981) Morphology and terminology, adults, pp. 9–63. *In* MCALPINE *et al.* (eds) *Manual of Nearctic Diptera*, vol. 1. Agriculture Canada, Ottawa.

In the text references should be given as MARSHALL (1992) or (MARSHALL 1992). When a citation includes more than two authors, e.g. GREY, BLACK and WHITE, the paper should be referred to in the text as GREY *et al.*, provided that this not ambiguous. If papers by the same author(s) in the same year are cited, they should be distinguished by the letters, *a, b, c,* etc., e.g. MARSHALL (1992*a*).

References to papers "in press" must mean that the article has been accepted for publication. References to "personal communications" and unpublished work are permitted in the text only: references to papers in preparation or submitted are not permissible.

All necessary **illustrations** should accompany the manuscript, but should not be inserted in the text. All photographs, graphs and diagrams should be numbered consecutively in Arabic numerals in the order in which they are referred to in the text. Glossy photographs or positive prints should be sent unmounted wherever possible and should be kept to a minimum. Figures should be of good quality. Explanation of lettering and symbols should be given in the figure caption and only exceptionally in the figures. Lettering and symbols to appear on the illustration should be of sufficient size to allow for considerable reduction where necessary (usually proper for a 50% reduction in size). Scales must be indicated on micrographs, not by magnifications in the legends. Figure size must not exceed 24×30 cm. On the back of each illustration should be indicated the author's name, the figure number (in Arabic numerals), and the top of the illustration, where this is not clear. Halftones should be included only when they are essential. Details and quotation of publication of colour plates should be made to the editors. The following symbols should be used on line drawing: ● ■ ○ ❑ ▲ ◆ ♦ etc.

Legends to figures should be typed on a separate sheet. They should give sufficient data to make the illustration comprehensible without reference to the text.

Tables and appendices should be constructed so as to be intelligible without reference to the text, numbered in Arabic numerals and typed on separate sheets. Every table should be provided with an explanatory caption and each column should carry an appropriate heading. Units of measure should always be indicated clearly (metric units are preferred). All tables and figures must be referred to in the text.

Only standard **abbreviations** should be used. Arbitrary abbreviations and jargon will not be accepted.

The Latin names should be given for all species used in the investigation, although taxonomic affiliation and authority need not be provided in the title.

Page proofs will be sent to the author (or the first-mentioned author in a paper of multiple authorship) for checking. Corrections to the proofs must be restricted to printers' errors. Any substantial alterations other than these may be charged to the author. Authors are particularly requested to return their corrected proofs as quickly as possible in order to facilitate rapid publication. Please note that authors are urged to check their proofs carefully before return, since late corrections cannot be guaranteed for inclusion in the printed journal.

Fifty reprints free of charge will be sent to the first author; extra copies of the issue (at a specially reduced rate) can be ordered on the form which will accompany the proofs. These should be returned to: The Editorial Office of the Acta Zoologica, Hungarian Natural History Museum, Budapest, Baross u. 13, H–1088, Hungary

The **page charge** required from authors outside Hungary is USD 15 per printed page. In exceptional cases, the page charge may be waived. Please contact the editor in before submitting a paper if you ask for a waiver. Authors of papers exceeding 16 printed pages are asked to pay USD 40 (or HUF equivalent) for each such page, i.e. all costs of publication (irrespective of their nationality).

FOR FURTHER INFORMATION PLEASE CONTACT US
The Editorial Office of the Acta Zoologica
H–1088 Budapest, Baross u. 13, Hungary
Fax: (36–1) 1171669
E-mail: h7962per@ella.hu

SUBSCRIPTION INFORMATION

Orders should be addressed to

Editorial Office of the Acta Zoologica
Hungarian Natural History Museum
H-1088 Budapest, Baross u. 13, Hungary
Fax: (36–1) 1171669
E-mail: H7962PER@ELLA.HU

Typeset: Pars Ltd., Budapest.
Printed by Dabas Jegyzet Ltd., Hungary

CONTENTS

HU ISSN 1217–8837

Acta Zoologica Academiae Scientiarum Hungaricae

VOLUME 42 - NUMBER 4 - 1996

HUNGARIAN NATURAL HISTORY MUSEUM, BUDAPEST

ACTA ZOOLOGICA ACADEMIAE SCIENTIARUM HUNGARICAE

AN INTERNATIONAL JOURNAL OF
ANIMAL TAXONOMY AND ECOLOGY

Acta Zoologica Academiae Scientiarum Hungaricae is published quarterly from February 1994 (other issues in May, August and November) by the Hungarian Natural History Museum and the Biological Section of the Hungarian Academy of Sciences with the financial support of the Hungarian Academy of Sciences.

Acta Zoologica Academiae Scientiarum Hungaricae 42 (4), pp. 251–260, 1996

NEW SPECIES OF MICROZETIDAE (ACARI: ORIBATIDA) FROM MEXICO*

MAHUNKA, S.[1] and J. G. PALACIOS-VARGAS[2]

[1]*Department of Zoology, Hungarian Natural History Museum*
H–1088 Budapest, Baross u. 13, Hungary
[2]*Laboratorio de Ecología y Sistematíca de Microartrópodos*
Depto. Biología, Fac. Ciencias, UNAM. 04510 México, D. F., Mexico

Abstract: Descriptions of four new microzetid (Oribatida) species *Acaroceras oaxacanus, Kalyptrazetes lupitae, Protozetes clavatus* and *Schalleria mexicana* (Microzetidae) are given. With 17 figures.

Key words: Oribatida, Microzetidae, new species, Mexico, cave

INTRODUCTION

The family Microzetidae contains 47 known genera in the world, 30 of which (70 species) have been reported from the Neotropical Region. Many of these genera are monotypic and only a few (e.g. *Acaroceras* and *Schalleria*) are diverse in species. Of this family only *Kalyptrazetes desaussuri* MAHUNKA, 1983 was hitherto known from Mexico (BALOGH & BALOGH 1988).

These mites live mainly in decaying litter and soil but some of them have been found in other habitats such as mosses, epiphytic plants and on tree bark. One species, *Acaroceras feideri* CALUGAR et VASILIU, 1977 was described from guano samples in Cuban caves.

In this paper we report on mites deposited in the collection of the junior author at the Universidad Autonomica de México (UNAM) and specimens recently collected by the senior author in Mexico (BORHIDI *et al.* 1996, BORHIDI & MAHUNKA 1997). Most of these specimens were collected from soil samples but we also have found one *Acaroceras* species living in guano from caves of the Yucatan Peninsula (see the ecological notes).

Mites of four genera are discussed below. The genus *Acaroceras* is distributed mainly in the Neotropical Region, where there are with 16 known other species (including the new species described herein), and two further species are known from Africa. *Schalleria* is similarly distributed; it is represented in the Neotropical Region with 11 species (including the new one). The other two genera are less diverse. *Kalyptrazetes* has two species in the United States of Ameri-

---

* Collaborative agreement between CONCONACyT (Mexico)-OMFB (Hungary). Project: "Biodiversity of Mexican Mites"

ca and two further ones in Mexico. *Protozetes* had only two species known from Central America and Peru, the third one is described in this paper.

DESCRIPTION AND TAXONOMIC NOTES

Acaroceras oaxacanus sp. n.

(Figs 1–4)

Measurements. Body length: 235–247 µm, width: 190–198 µm.

Prodorsum: Rostrum with a sharp, medium long median apex. Lamellae very wide, touching medially and covering the whole prodorsum, except for the rostral apex. Outer lamellar cusps well-developed, inner margin of lamellae rounded anteriorly, thin like a membrane, with 1–3 irregular teeth laterally (Fig. 1). Interlamellar apophysis bifurcate, long, about half as long as interlamellar region. Rostral setae fine, smooth and curving inwards. Interlamellar setae arising close to bothridium, smooth and reaching outer cusps of lamellae. Sensilli setiform, distinctly but irregularly ciliate.

Lateral part of prodorsum: tutorium large and long, rostral part with a complicated structure consisting of sharp and rounded plates. Its surface with transversal rugae; similar ones observable on pedotecta I (Fig. 3).

Notogaster: semicircular without any ornamentation. Dorsosejugal suture nearly straight. Four pairs of notogastral setae long and thick (c_2 longest, *la* thickest of all), in marginal position. Setae in middle part of notogaster much thinner and shorter than others. Setae p_1 smallest of all (Fig. 1). Pteromorphae well-developed, with serrated margin, about 10 small teeth observable (Fig. 4).

Ventral region: Circumpedal carina long, posteriorly reaching to lateral margin of ventral plate (Fig. 2). Posterior part of coxisternal region and ventral plate striated. Epimeral and ventral setae, except anal and adanal ones, ciliate. Epimeral formula: 3–1–3–3. Genital setae g1 longest of all. Anogenital formula: 6–1–2–3.

Material examined: holotype – Mexico, Oaxaca State, close to Rabon Hill. Ex. litter. 1. 03. 1988. leg. C. CASTILLO et P. REYES. Eleven paratypes from the same sample. Holotype (1585–HO–96) and 6 paratypes (1585–PO–96) (with identification numbers of the specimens in the Collection of Arachnida) deposited in the Hungarian Natural History Museum, Budapest (HNHM) and 5 paratypes in the collection of J. G. PALACIOS-VARGAS (CPV).

Remarks: *A. oaxacanus* sp. n. is closely related to *A. hamifer* BALOGH et MAHUNKA, 1977 and *A. dechambrieri* MAHUNKA, 1983. However, it differs clearly in the length and form of the interlamellar apophysis, the form of the setae *in* (much longer in *hamifer*), and in the form of notogastral setae smooth and thick in *A. oaxacanus*, spiculate and clearly setiform in *hamifer* and in *dechambrieri*. *Acaroceras dechambrieri* also differs from the new species in the form of the rostral apex (much longer and narrower in *dechambrieri*) and the coxisternal sculpture (much weaker in *dechambrieri*).

Etymology: The species is named after the Mexican state where it was collected.

Figs 1–4. *Acaroceras oaxacanus* sp. n. – 1 = body in dorsal view, 2 = prodorsum in lateral view, 3 = pteromorpha, lateral view, 4 = body in ventral view

Kalyptrazetes lupitae sp. n.

(Figs 5–8)

Measurements – Body length: 261–272 μm; width: 95–213 μm.

Prodorsum: Rostral apex triangular, rostral setae arising on it, near each other (Fig. 7). Lamellae very wide, typical for genus, cover the whole prodorsum in dorsal view except for an oval basal region; surface with polygonal structure; lamellar cusps absent. Rostral setae thin and conspicuously ciliate. Lamellar setae short, bent inwards, thick and ciliate, interlamellar ones fine and smooth. Sensilli clavate, bent latero-posteriorly in their middle, their heads elliptical and barbed.

Lateral part of podosoma: Tutorium with three large teeth (Fig. 6), its surface ornamented by some wrinkles composing a weak polygonal ornamentation. Pedoctecta I large, pedoctecta II small and rounded.

Notogaster: Pteromorphae small, approximately triangular, without sharp distal end. Whole notogastral surface covered by cerotegument granules or short rugae forming a reticulate pattern, some larger hollows and protuberances also observable in lateral view, apparently undulating. Posterior surface with fine furrows. Nine pairs of small and fine notogastral setae present, two posterior pairs much smaller than others (clearly visible only in ventral view).

Ventral regions: Epimeral surface striated anteriorly (Fig. 7). Apodemes and epimeral borders well-developed. Setae short and simple, small and weak hollow present at their bases. Epimeral setal formula: 3–1–3–3. Anogenital formula: 6–1–2–3. All genital setae short.

Material examined – holotype: Mexico, Oaxaca, close to Pelon Hill, Ex. litter. 1. 03. 1988. leg. C. CASTILLO et P. REYES. Two paratypes from the same sample. Holotype (1586–HO–96) and 1 paratype (1586–PO–96) (with identification numbers of the specimens in the Collection of Arachnida) deposited in the Hungarian Natural History Museum, Budapest (HNHM) and 1 paratype in the collection of J. G. PALACIOS-VARGAS (CPV).

Remarks: The new species is well characterised by the anteriorly rounded and very wide lamellae, the form of the lamellar setae and the form of the uncovered basal part of the prodorsum. It is clearly distinguishable from the other *Kalyptrazetes* BALOGH, 1972 species by the following key:

1 (4) Lamellae sharply angulate laterally or with lateral cusps.
2 (3) Lamellae with long and strong lateral cusps *americanus* MAHUNKA, 1995

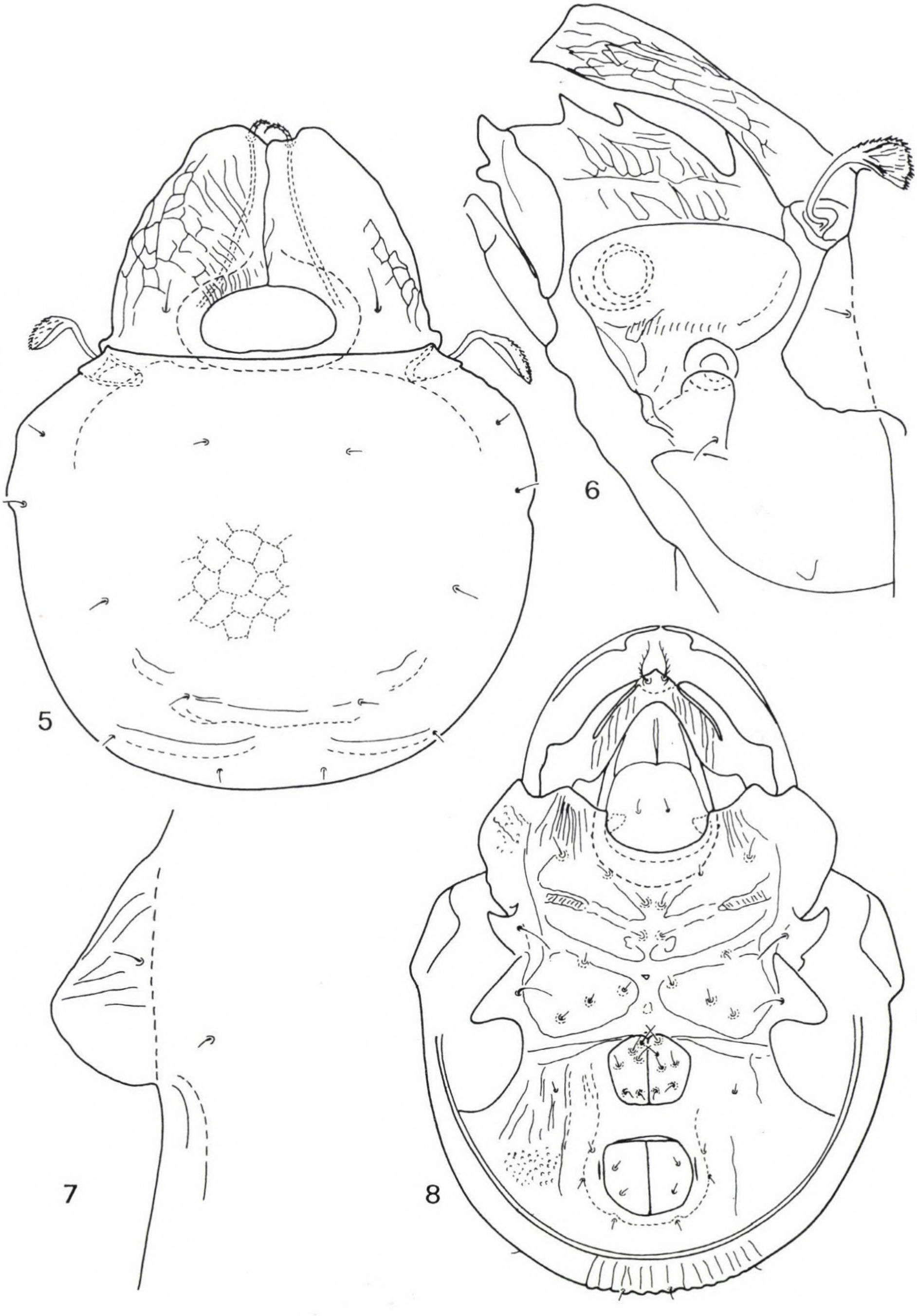
3 (2) Lamellae angulate laterally *harpezus* (HIGGINS, 1965)

4 (1) Lamellae rounded anteriorly
5 (6) Lamellae strongly narrowed anteriorly, uncovered interlamellar region much longer than wide *desaussurei* MAHUNKA, 1983

6 (5) Lamellae broad, without elongated distal part. The uncovered interlamellar region much shorter than long **lupitae** sp. n.

Etymology: We dedicate the new species to Mrs LUPITA PINEDA, the wife of the junior author.

Figs 5–8. *Kalyptrazetes lupitae* sp. n. – 5 = body in dorsal view, 6 = prodorsum in lateral view, 7 = pteromorpha, lateral view, 8 = body in ventral view



Protozetes clavatus sp. n.
(Figs 9–11)

Measurements – Body length: 201–207 µm; width: 110–117 µm.

Prodorsum: Habitus typical for the genus, lamellae comparatively narrow, located far apart. Typical lamellar cusps absent, distal end of lamellae (Fig. 9) with several long spines (apparently split). A pair of well developed lamellar apophyses directed inwards, lamellar setae arising at their bases. Rostral and lamellar setae long, fine, setiform and smooth, interlamellar setae short and simple, arising from lamellar surface. Basal part of prodorsum excavated medially. Pedicel of sensillus comparatively long and narrow, its head asymmetrically fusiform, with spicules.

Lateral part of prodosum: Tutorium simple, triangular, comparatively short; their cusps not reaching level of rostral setae insertions. The distal margin pedotecta I thickened, well-framed anteriorly, with polygonal sculpture (Fig. 11).

Notogaster: Dorsosejugal suture slightly concave medially. Notogastral surface ornamented by a pair of undulating lines of small tubercles medially surrounding insertions of setae *lm*. Pteromorphae simple, relatively small and triangular. Nine pairs of short, bacilliform and capitate notogastral setae present, two pairs of which observable only in ventral view.

Ventral regions: Apodemes typical for genus, epimeral borders hardly developed. Epimeral setal formula: 3–1–3–3, all setae short and simple. On surface of ventral plate, along genital aperture, 2–3 short longitudinal lines are observable. Anogenital setal formula: 6–1–2–3; setae g_1 very long, other genital setae represented only by their alveoli. Adanal setae ad_2 and ad_3 similar in form to notogastral setae, *ad*, like anal setae.

Material examined – holotype: Mexico, Chiapas, Chajul, Lacandone rain forest. Extracted from roots and soil near to the Maya ruins. 25. 06. 1996. leg. S. MAHUNKA et A. BORHIDI. Four paratypes from the same sample. Holotype (1587–HO–96) and 3 paratypes (1587–PO–96) (with identification numbers of the specimens in the Collection of Arachnida) deposited in the Hungarian Natural History Museum, Budapest (HNHM) and 1 paratype in the collection of J. G. PALACIOS-VARGAS (CPV).

Remarks: *Protozetes clavatus* sp. n. is a close relative of *Protozetes digitifer* MAHUNKA, 1985, described from the Antilles, but they are well-distinguishable by the form and number of the lamellar spines (smaller and fewer in *digitifer*) and the form of the notogastral setae (simply bacilliform in *digitifer*).

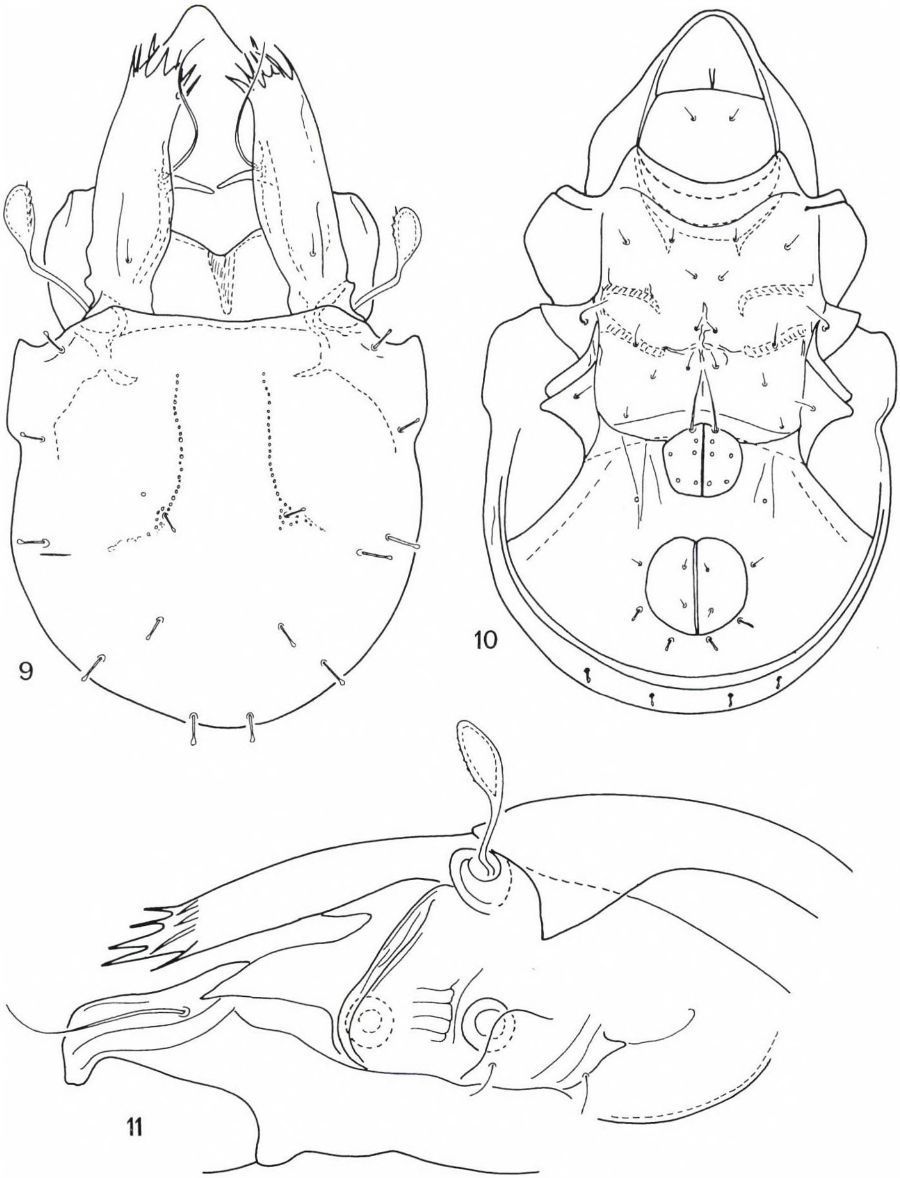
Etymology: The species is named after the form of the notogastral setae.

Schalleria mexicana sp. n.
(Figs 12–17)

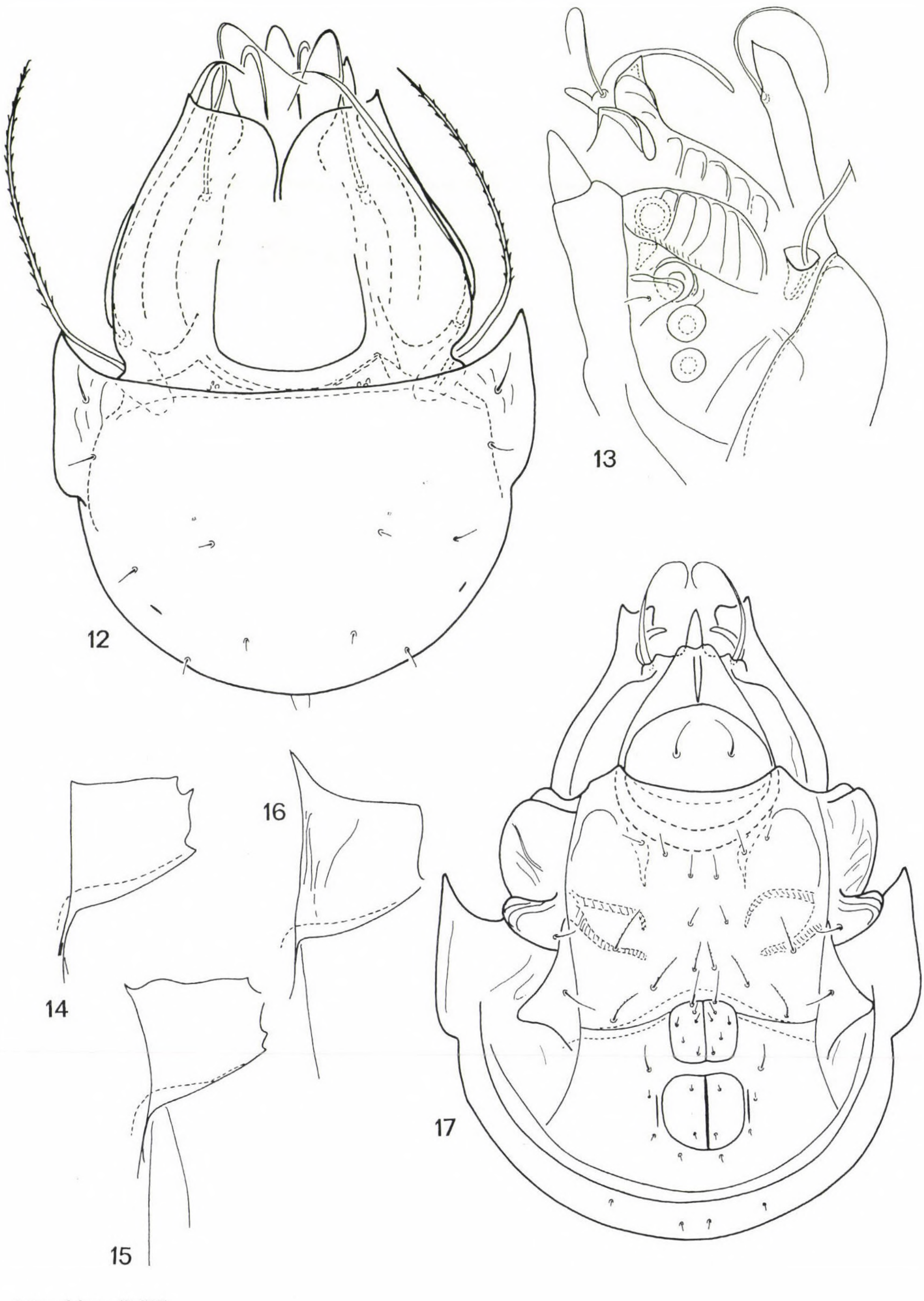
Measurements – Body length: 234–242 µm; width: 180–187 µm.

Prodorsum: Habitus typical for the genus. Rostrum with sharp median apex (observable laterally or ventrally) and a pair of horn-like structures. Lamellae very wide, the basal part without apophysis (Fig. 12). A thick secretion layer covering interlamellar region. Outer lamellar cusps short but sharply pointed, inner cusps absent, lamellar margin rounded. Rostral and lamellar setae very long, setiform; rostral setae located near rostral apex at bases of horn-like structure, lamellar setae arising beneath the lamellae. Interlamellar setae very long, their distal end very fine and bent inwards, arising beneath the ventro-lateral part of lamellae. Sensillus long, directed forwards, setiform and conspicuously ciliate.

Figs 9–11. *Protozetes clavatus* sp. n. – 9 = body in dorsal view, 10 = body in ventral view, 11 = prodorsum in lateral view



Figs 12–17. *Schalleria mexicana* sp. n. – 12 = body in dorsal view, 13 = prodorsum in lateral view, 14–16 = variation of the pteromorpha, lateral view, 17 = body in ventral view



Lateral part of prodorsum: Tutorium with complicated distal structure, cusps sharp. Several transverse lathes observable on their surface and also on the surface of the large pedotecta I (Fig. 13).

Notogaster: Dorsosejugal suture slightly concave. Pteromorphae well developed, their distal margin varying, mostly with sharp teeth (Fig. 13). Nine pairs of simple, smooth notogastral setae, two pairs of which observable only in ventral view. Setae c_2 longest, p_1 and p_2 shortest of all.

Ventral regions: Whole surface smooth, apodemes normally developed. Epimeral setal formula: 3–1–3–3. All setae simple, setiform, mostly finely ciliate. Anogenital setal formula: 6–1–2–3. Setae g_1 and *ag* longer and thicker than others.

Material examined – holotype: Mexico, Oaxaca, close to Pelon Hill, Ex. litter. 1. 03. 1988. leg. C. CASTILLO et P. REYES. One paratype from the same sample. Holotype (1588–HO–96) (with identification number of the specimen in the Collection of Arachnida) deposited in the Hungarian Natural History Museum, Budapest (HNHM) and the paratype in the collection of J. G. PALACIOS-VARGAS (CPV).

Remarks: The new species is well characterised by the absence of both the inner lamellar cusps and the interlamellar apophysis. This combination of characters was previously unknown for the genus *Schalleria* BALOGH, 1962.

Etymology: The species is named after the country where it was collected.

ECOLOGICAL NOTES

Caves in Yucatan Peninsula are developed horizontally, rather than vertically. The deepest cave is only about 100 m in length. This is due to the lack of chain mountains and to the uniformity of the lowlands of Yucatan. These caves usually have several entrances and therefore a remarkable amount of debris and organic material has been deposited inside them. This has resulted in the development of a very interesting fauna, especially where the darkness is complete (troglophorphic animals).

Close to the entrance of the caves, or inside them, large populations of several bird species can be found, mainly of swallows that nest and breed there. The excrement of these birds accumulate on the cave floor and form a thick layer of very soft guano. The guano is supplemented by egg shell remains and sometimes by small dead birds. This guano maintains a rich arthropod community in which mites, mainly Uropodidae and several oribatid mite families, are abundant.

Few studies dealing with the oribatid mites of Mexican caves have been published (WHARTON 1938, PALACIOS-VARGAS & IGLESIAS 1997), though it is well known that sometimes abundance and diversity of these mites is remarkable (PALACIOS-VARGAS 1994).

We have found very interesting microzetid species represented in the caves of the Yucatan Peninsula. In samples of detritus from *Atta* ants living in Ixmait Cave (Yucatan State), several specimens of *Acaroceras hamifer* BALOGH et MAHUNKA, 1977 occurred together with some Galumnatidae and other mites. In one of the swallow guano samples from Xtancumbilxunaan Cave (Campeche State), several hundred specimens of *Acaroceras hamifer* (including nymphs) and very few other mites were found. This is interesting, as only one species of this family had been known from caves in Cuba, also extracted from guano samples. The description of that species was based on only four specimens. This is the first time that a dense population of a microzetid mite has been found in swallow guano. The presence of large numbers of immatures indicates that this species is a true troglophile, the first such record for the Microzetidae.

REFERENCES

BALOGH, J. and P. BALOGH (1988) *Oribatid mites of the Neotropical Region I.* Akadémiai Kiadó, Budapest, 335 pp.

BORHIDI, A., MAHUNKA, S. and J. G. PALACIOS-VARGAS (1996) Report on the first year activity carried out in the framework of Hungarian-Mexican soil zoological co-operation: "Diversity of the Fauna of Mexico" 1995. *Folia ent. hung.* **57**: 79–85.

BORHIDI, A. and S. MAHUNKA (1997) A report on the second botanical and zoological collectings trip in Mexico, 1996. *Folia ent. hung.* **58** [in print].

PALACIOS-VARGAS, J. G. (1994) Los acaros oribatidos de Mexico. *An. Inst. Biol. UNAM, Mexico, Ser. Zool.* **65**(1): 19–32.

PALACIOS-VARGAS J. G. & R. IGLESIAS (1997) A new species of Malaconothrus (Acari: Oribatei: Malaconothridae) from Yucatan, Mexico. *Genus* [in press].

WHARTON, G. W. (1938) Acarina of Yucatan caves. *Carnegie Inst. Wash. Publ.* **491**: 137–152.

Received 1st February, 1996, accepted 5th May, 1997, published 18th November, 1997

Acta Zoologica Academiae Scientiarum Hungaricae 42 (4), pp. 261–270, 1996

NEW AMPHISTOME (TREMATODA) GENERA AND SPECIES FROM AMAZONIAN SERRASALMID FISHES, MYLEUS (MYLOPLUS)

THATCHER, V. E.[1], SEY, O.[2] and JÉGU, M.[3]

[1]*Instituto Nacional de Pesquisas da Amazõnia, Manaus, Amazonas, Brazil*
[2] *Department of Zoology, Faculty of Science, University of Kuwait, Kuwait*
[3]*ORSTOM, Paris, France*

Two new genera and three new species of amphistome trematodes (Cladorchiidae) are described from Amazonian serrasalmid fish. These species appear to be characteristically found in the subgenus *Myleus (Myloplus)* since they are nearly always found together in the three species in this subgenus (*rubripinnis, asterias* and an undescribed species). They have not been found in four other species of *Myleus* caught in the same localities. The new genera and species are: *Inpamphistoma papillatum* gen. et sp. n., *Annelamphistoma elegans* gen. et sp. n. and *Dadayius pacuensis* sp. n. The two new genera have ventral surfaces that are convex and covered with papillae which would appear to separate them from all other known genera among the amphistomes. They differ from each other by body shape and the number of muscular puckers in the body wall. Inpamphistoma is flattened, strongly concave dorsally and has one pair of muscular puckers. *Annelamphistoma*, on the other hand, is only slightly concave dorsally and is provided with five pairs of puckers. SEM studies showed that the ventral papillae are domed to conical and are neither cililated nor branched. Additionally, circles of domed papillae with pores are found around the mouth of *Inpamphistoma. Dadayius pacuensis* sp. nov. has the transverse tegumental folds in the botto mof the acetabular cavity that characterize the genus. The new species has a massive acetabulum which serves to distinguish it from the type and only species. It also differs from the type in being only one-half as large. The three amphistomes described here were found together in nearly every adult specimen of fish belonging to *Myleus (Myloplus)* and are as widely distributed geographically as their hosts.

Key words: fish parasites, parasite markers, trematodes, amphistomes, serrasalmids

INTRODUCTION

Fish of the family Serrasalmidae are found only in South American rivers and lakes and are known as "piranhas" or "pacus". Although the piranhas enjoy a certain notoriety as carnivores, the pacus are largely herbivorous and as such, are subject to infection by amphistome trematodes. The genus *Myleus* contains several species that are widely distributed in northern South America. GÉRY (1976) recognized four subgenera of *Myleus* mainly based on tooth shape and dentition. He placed *Myleus rubripinnis* in *Myleus (Myloplus)* GILL, 1895, with *M. asterias* as the type. The present study of intestinal trematodes suggests that this relationship is valid since the three species of amphistomes reported here were found exclusively in this group of fishes.

The suborder Paramphistomata SZIDAT, 1936 comprises a large group of primitive trematodes found in all vertebrate classes. According to SEY (1991), worldwide there are 52 species of amphistomes known from fishes, 36 from amphibians, 34 from reptiles, 133 from mammals and a single species from birds. TRAVASSOS *et al.* (1969) listed 8 genera of amphistomes from South American fishes and THATCHER (1992*a*, *b*) added 4 additional genera. The present study describes two new genera and three new species from Amazonian fishes.

MATERIAL AND METHODS

Fish hosts were netted, identified and eviscerated. They were then fixed in 10% formalin solution and later transferred to 70% alcohol. The fixed intestinal tracts were removed, opened and washed in tap water. Trematodes were recovered in finger bowls by hand sedimentation. Permanent slide preparations were made by the phenol-balsam method explained in THATCHER (1993). The systematics follow the system ptoposed by SEY (1988, 1991). Drawings were made with the aid of a camera lucida and are in micrometers (µm) except where indicated as millimeters (mm). The photographs (Figs 7–16) were made with a JEOL ISM–6300 scanning electron microscope. Holotype and paratype specimens were deposited in the Invertebrate Collection, Instituto Nacional de Pesquisas da Amaznia (INPA), Manaus, Amazonas, Brazil. Additional paratypes were placed in the Helminth Collection, University of Nebraska State Museum (UNSM), Harold W. Manter Laboratory, Lincoln, Nebraska.

SYSTEMATIC PART

Cladorchiidae SOUTHWELL et KIRSHNER, 1937

Dadaytrematinae YAMAGUTI, 1958

Inpamphistoma gen. n.

Diagnosis: With the characters of the family and subfamily. Body flattened, tapering anteriorly, concave dorsally and convex ventrally, with one pair of dorso-lateral muscular puckers near oral sucker and one lateral expansion on either side of acetabulum; tegument smooth dorsally and papillate ventrally. Acetabulum hemispherical, subterminal. Pharynx terminal, with external diverticula; esophagus short, bulb small; ceca long, slender. Testes two, large, lobate, tandem, largely intercecal, in middle third of body; cirrus sac ovoid; small genital atrium present; genital pore median, immediately postbifurcal. Ovary ovoid or weakly lobate, submedian, near level of cecal ends; vitellaria follicular, of limited extent, antero-lateral to ovary and ventral to ceca; uterus largely intercecal, proximal eggs small, distal eggs larger. Lymphatic system present. Excretory vesicle saccular, pore dorsal. Intestinal parasites of freshwater fish.

Type species: *Inpamphistoma papillatum* sp. n.

Inpamphistoma papillatum sp. n.
(Figs 1, 7–9)

Hosts: *Myleus (Myloplus) rubripinnis* (MÜLLER et TROSCHEL, 1844); *Myleus (Myloplus) asterias* (MÜLLER et TROSCHEL, 1844); *Myleus (Myloplus)* sp.: "pacu".
Site: Intestinal tract.
Localities: Jatapu River, Uatumã Basin, Amazonas State and Guapore River, Rondõnia State, Brazil.

Holotype and 6 paratypes are deposited at INPA, 3 additional paratypes at UNSM.

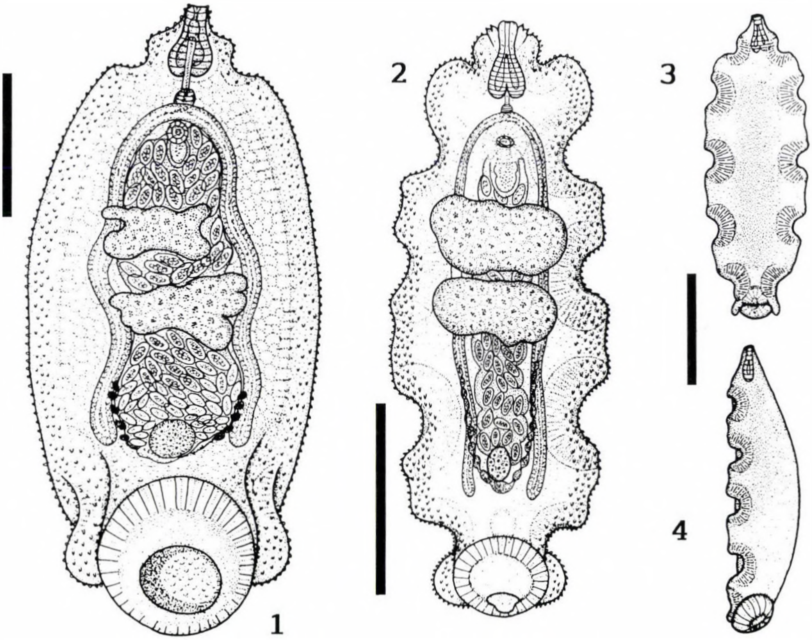


Fig. 1–4. 1 = *Inpamphistoma papillatum* gen. et sp. n. (ventral and internal view). Scale = 500 µm; 2–4 = *Annelamphistoma elegans* gen. et sp. n.: 2 = ventral and internal view; 3 = dorsal surface view; 4 = lateral surface view. Scales = 1000 µm

Etymology: The prefix Inpa, which is the acronym for the Instituto Nacional de Pesquisas da Amazõnia has been added to "amphistoma" (a classic designation for trematodes bearing a sucker at either extremity). The specific name is in reference to the papillae that cover the ventral surface of the body.

Diagnosis (10 specimens measured): Body 2.203 (1.768–3.774) long by 996 (850–1.258) wide: width across posterior expansions, 733 (588–1.020). Pharynx 218 (182–294) long and 133 (112–210) wide; esophagus 211 (168–350) long; bulb 64 (49–94) long by (44–72) wide. Ceca 99 (33–154) in maximum width. Acetabulum 539 (434–812) long and 557 (462–812) wide. Anterior testis 176 (110–280) long and 369 (192–490) wide; posterior testis 203 (110–350) long and 378 (165–484) wide; cirrus sac 125 (82–264) long and 64 (33–110) wide. Ovary 105 (82–168) long and 104 (60–168) wide; vitelline follicles 32 (28–38) in diameter; proximal eggs 70 × 38 (55–94 × 33–44); distal eggs 138 × 79 (121–154 × 66–94).

Annelamphistoma gen. n.

Diagnosis: With the characters of the family and subfamily. Body subcylindrical, flattened dorsally, convex ventrally, tapering anteriorly, with five pairs of muscular puckers dorsally and one lateral expansion on either sice of acetabulum; tegument smooth dorsally and papillate ventrally. Acetabulum hemispherical, subterminal. Pharynx with large external diverticula, mouth terminal; esophagus short, bulb small; ceca long, slender. Testes two, large, weakly lobate, inter and extracecal, tandem, in middle third of body; cirrus sac large, ovoid; genital atrium and small genital sucker present; genital pore median, immediately postbifurcal. Ovary spherical to ovoid, submedian, near level of cecal ends; vitellaria chain-like, antero-lateral to ovary and ventral to ceca, extending anteriorly to near posterior testis; uterus largely intercecal, eggs large. Lymphatic system present. Excretory vesicle saccular, pore dorsal. Intestinal parasites of freshwater fish.

Type species: *Annelamphistoma elegans* sp. n.

Annelamphistoma elegans sp. n.

(Figs 2–4, 10–12)

Hosts: *Myleus (Myloplus) rubripinnis* (MÜLLER et TROSCHEL, 1844), *Myleus (Myloplus) asterias* (MÜLLER et TROSCHEL, 1844); *Myleus (Myloplus)* sp.: "pacu".

Site: Intestinal tract.

Localities: Jatapu River, Amazonas State and Guapore River, Rondãnia State, Brazil.

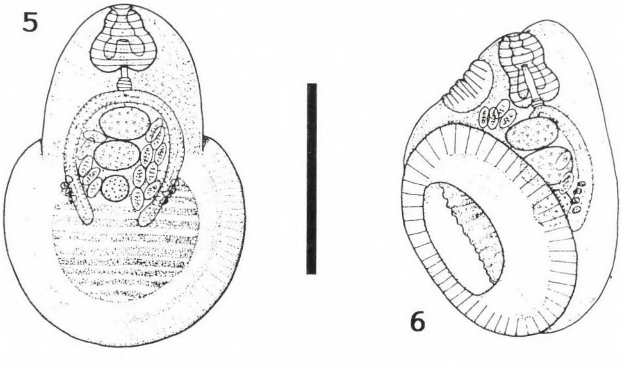
Holotype and 4 paratypes deposited at INPA. Two additional paratypes at UNSM.

Etymology: The generic name is formed from the Greek prefix "annel" meaning ringed and is in reference to the appearance caused by the paired muscular puckers. The species name means elegant or beautiful.

Diagnosis (7 specimens measured): Body 2.812 (2.516–3.094) long by 1.010 (748–1.326) wide. Acetabulum 416 (364–532) long by 464 (420–504) wide. Pharynx 382 (308–560 long by 208 (182–224) wide; esophageal bulb 75 (70–84) in diameter; ceca 106 (20–126) in maximum diameter. Anterior testis 308 (238–406) long by 495 (280–770) wide; posterior testis 301 (140–420) long by 425 (350–532) wide; cirrus sac 166 (140–193) in length and 113 (84–168) in width. Ovary 145 (126–165) loing by 121 (70–154) wide; eggs 123 × 57 (116–138 × 50–60).

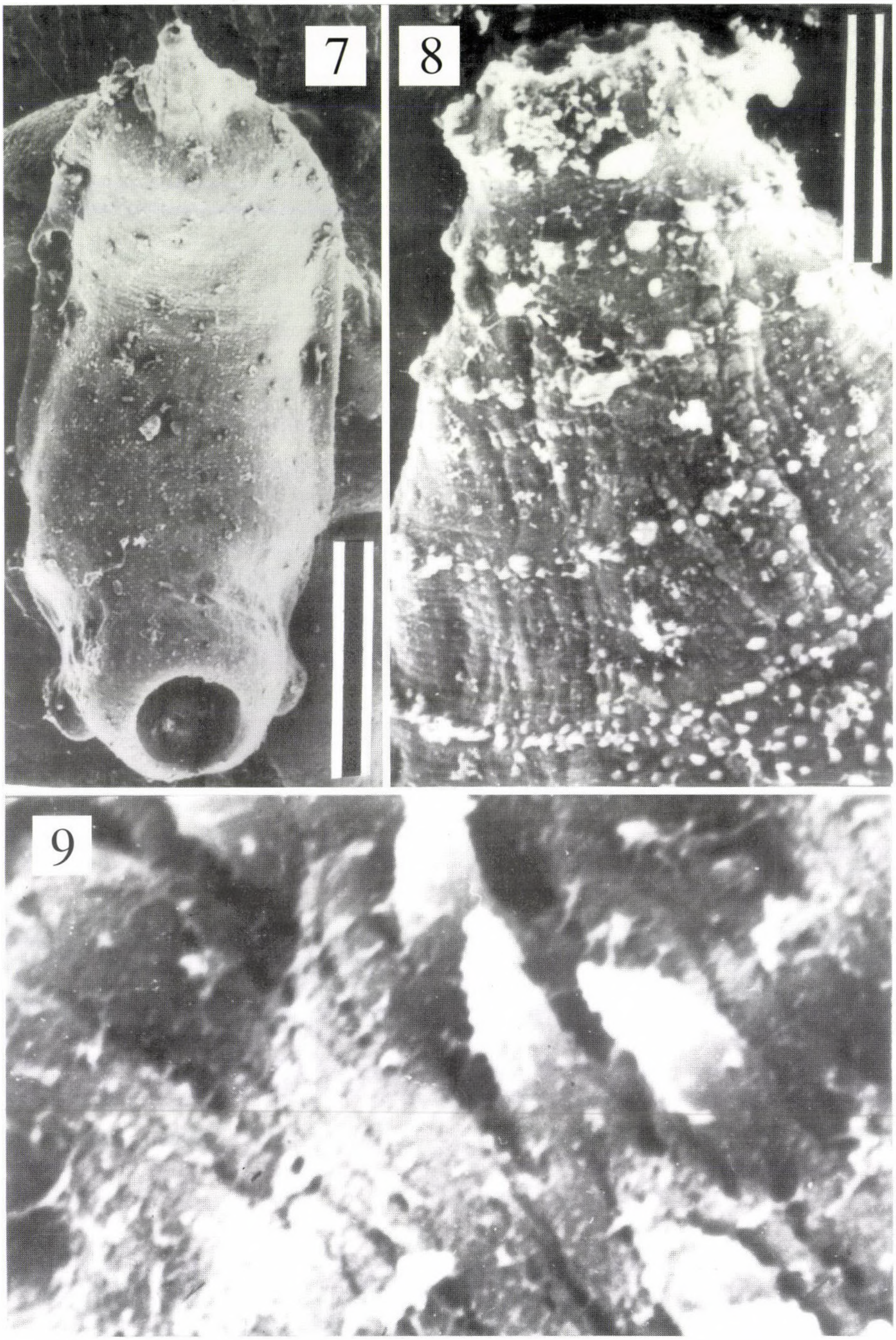
Remarks. Both of the new genera have an internal anatomy that would permit their inclusion in the subfamily Dadaytrematinae YAMAGUTI, 1958, as defined by SEY (1988, 1991). Both differ from other known amphistomes in having convex ventral surfaces covered with small papillae. Although *Dadaytrema* and several other genera have circles of sensory papillae around the mouth and the anterior extremity, these are larger and of a very limited distribution as compared to the extensive small papillae of the present new forms.

The two new genera differ considerably from each other even though they may be found together in the same host and both have similar ventral papillae and internal organs. Inpamphistoma gen. nov. is greatly flattened, strongly concave dorsally and has only one pair of muscular puckers. *Annelamphistoma* gen. n., on the other hand, has a body that is nearly cylindrical, is only slightly concave dorsally and has five pairs of muscular puckers.

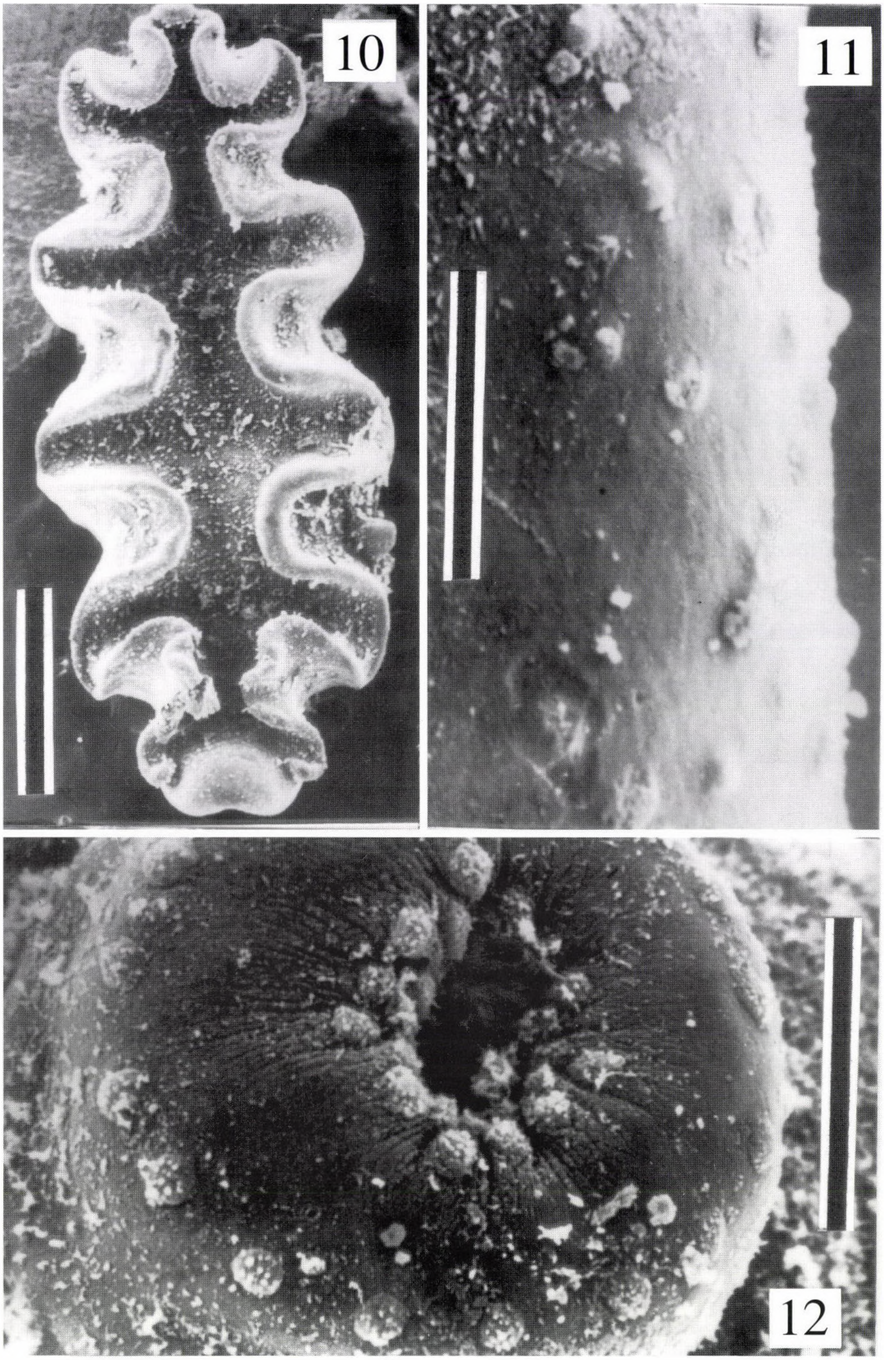


Figs 5–6. *Dadayius pacuensis* sp. n.: 5 = dorsal and internal view; 6 = lateral and internal view. Scale = 1000 µm

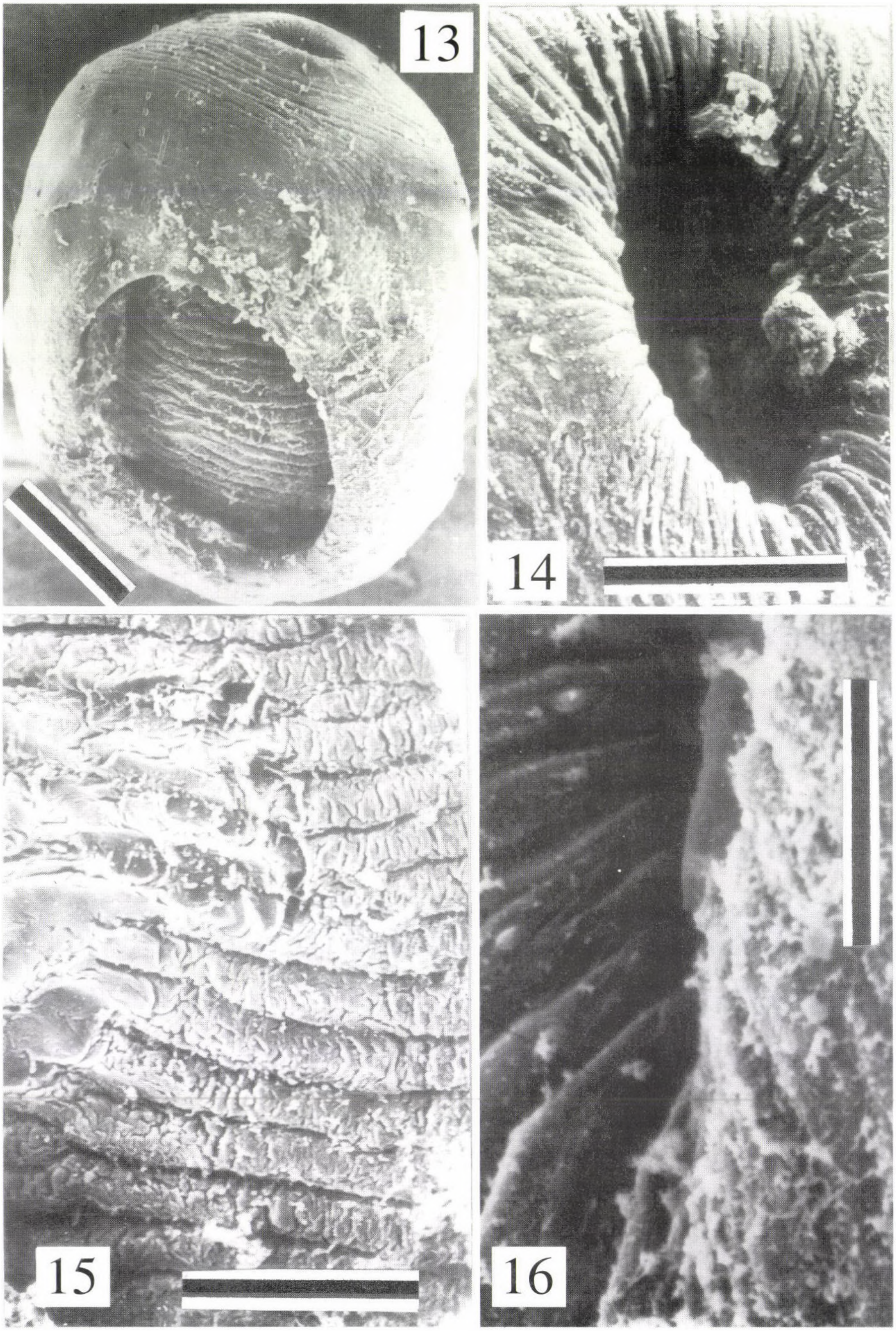
Figs 7–9. SEM photographs of *Inpamphistoma papillatum* gen. et sp. n.: 7 = ventral view (scale = 500 µm); 8 = anterior extremity (scale = 50 µm); 9 = ventral papillae (scale = 5 µm)



Figs 10–12. SEM photographs of *Annelamphistoma elegans* gen. et sp. n.; 10 = dorsal view (scale = 500 µm); 11 = papillae around acetabulum (scale = 3 µm); 12 = papillae around mouth (scale = 3 µm)



Figs 13–16. SEM photograps of *Dadayius pacuensis* sp. n.: 13 = ventral view (scale = 500 μm); 14 = mouth (scale = 100 μm); 15 = interior of acetabulum (scale = 200 μm); 16 = genital pore (scale = 50 μm)



Dadayius Fukui, 1929

Diagnosis: With the characters of the family and subfamily. Body conical. Acetabulum large, ventroterminal, with transverse tegumental ridges on interior bottom surface. Pharynx with external diverticula, mouth terminal; esophagus slender with small bulb; ceca shorter than body, but reaching acetabulum. Testes rounded to oval, not lobate; cirrus sac absent; genital sucker present; genital pore bifurcal. Ovary subspherical, anterior or dorsal to acetabulum; vitelline follicles lateral, between ovary and posterior testis; uterus intercecal; eggs large. Intestinal parasites of South American freshwater fish.

Type species: *Dadayius marenzelleri* (DADAY, 1907) FUKUI, 1929.

Dadayius pacuensis sp. n.
(Figs 5–6, 13–16)

Hosts: *Myleus (Myloplus) rubripinnis* (MÜLLER et TROSCHEL, 1844); *Myleus (Myloplus) asterias* (MÜLLER et TROSCHEL, 1844; *Myleus (Myloplus)* sp.: "pacu".
Site: Intestinal tract.
Type localities: Jatapu River, Amazonas State and Guapore River, Rondãnia State, Brazil.

Holotype and 6 paratypes deposited at INPA. Three additional paratypes deposited at UNSM.

Etymology: The species name was formed from the locally common name of the fish hosts.

Diagnosis (10 specimens measured): With the characters of the genus. Body 2.1 (1.5–3.0) mm long and 1.3 (1.1–1.9) mm wide. Acetabulum 1.2 (1.1–1.4) mm long and 1.2 (1.0–1.5) mm wide. Pharynx 409 (301–602) long and 383 (344–430) wide; esophagus 308 (258–430) long, bulb about 86 × 86; ceca 52–172 in diameter. Anterior testis 217 (172–344) long and 255 (172–344) wide; posterior testis 248 (172–344) long and 256 (172–344) wide; genital sucker 341 (310–430) long and 519 (344–688) wide. Ovary 166 (120–215) long and 160 (120–215) wide; vitelline follicles 26–86 in diameter; eggs 80 × 34 (69–86 × 26–43).

Remarks. *Dadayius pacuensis* sp. n. is only about one-half the size of the type species. It has a massive acetabulum and relatively much larger pharynx and genital sucker than has *D. marenzelleri*.

CONCLUSIONS

As shown in Table 1, thirteen different species of related "pacus" were examined. These included four subgenera of *Myleus*, namely: *M. (Myleus), M.*

Table 1. Prevalence and intensity of amphistomes in Amazonian "pacus" (Serrasalmidae)

Fish species	Prevalence	Intensity	Total *Amphistomes*
Acnodon normani	4/4 (100%)	3–11 (5)	18
Acnodon oligacanthus	1/1 (100%)	68	68
Acnodon senai	1/3 (33%)	1	1
Metynnis sp.	4/4 (100%)	4–85 (36)	144
Mylesinus paraschomburgkii	53/55 (96%)	4–412 (81)	4276
Myleus (Myleus) pacu	22/30 (73%)	1–40 (7)	156
Myleus (Myloplus) spp.	36/37 (97%)	3–360 (100)	3593
Myleus (Paramyloplus) ternetzi	12/14 (86%)	1–88 (35)	419
Myleus (Prosomyleus) rhomboidalis	31/47 (66%)	1–250 (18)	545
Myleus (Prosomyleus) schomburgkii	37/39 (97%)	1–54 (10)	376
Ossubtus xinguense	2/3 (66%)	4–9 (6)	13
Piaractus brachypomus	2/3 (66%)	4–4 (4)	8
Utiaritichthys sp.	2/2 (100%)	43–58 (51)	101
Total	207/242 (86%)	(32)	9718

(Myloplus), M. (Paramyloplus) and *M. (Prosomyleus)*, as well as six other genera. Since the three strikingly different amphistomes reported here were found only in *Myleus (Myloplus)* spp. it would appear that they mark this group of species and thus reinforce the subgeneric concept in this case.

REFERENCES

GÉRY, J. (1976) Les genres de Serrasalmidae (Pisces, Characoidei). *Bull. Zool. Mus. Amsterdam* **5**(6): 47–54.

SEY, O. (1988) Scope of and proposal for systematics of the Amphistomes (Lühe, 1909) Odening, 1974 (Trematoda). *Parasit. hung.* **21:** 17–30.

SEY, 0. (1991) *Handbook of the zoology of Amphistomes.* CRC Press, Boca Raton, Florida. 480 pp.

TRAVASSOS, L., J. F. Teixeira de Freitas & A. Kohn (1969) Trematódeos do Brasil. *Mem. Inst. Oswaldo Cruz.* **67:** 1–886.

THATCHER, V. E. (1992*a*) Two new genera of Paramphistomidae (Trematoda, Digenea) from freshwater fish of Rondãnia State, Brazil. *Mem. Inst. Oswaldo Cruz* (Suplemento em homenagem ao centenário de nascimento do Prof. Lauro Travassos). **87**(Suppl. 1): 287–291.

THATCHER, V. E. (1992*b*) Two unusual new genera of Paramghistomidae (Trematoda, Digenea) from freshwater fish of the Brazilian Amazon. *Acta Amazónica* **11:** 285–289.

THATCHER, V. E. (1993) *Treinatódeos Neotropicais.* INPA, Manaus, Brazil. 553 pp.

Received 17th July, 1996, accepted 30th December, 1996, published 18th November, 1997

Acta Zoologica Academiae Scientiarum Hungaricae 42 (4), pp. 271–279, 1996

BODY MASS AND FAT LOAD OF AUTUMN MIGRATING SEDGE WARBLERS (ACROCEPHALUS SCHOENOBAENUS) IN RELATION TO AGE IN SOUTH HUNGARY

J. GYURÁCZ[1] and L. BANK[2]

[1]*Department of Zoology, Berzsenyi College, Szombathely*
P.O.Box 170. H–9701, Hungary
[2]*Local Group of County Baranya, BirdLife Hungary*
Pécs, Felsőmalom u. 22, H–7621, Hungary.

Body mass change and fat accumulation of Sedge Warblers (*Acrocephalus schoenobaenus*) on autumn migration were studied at the Sumony Bird Observatory in the southern part of Hungary. The adult and juvenile birds differed with regard to fat loads upon first and last capture and fat deposition rate. Adult Sedge Warblers started accumulating fat earlier than did juveniles and adults departed with higher fat loads than juveniles. An average juvenile Sedge Warbler with wing length 69 mm and body mass 15 g should have a fat content 27%. This fat reserve should theoretically be sufficient for a 1389 km flight. This implies that with a south migration this bird should be able to cross the Mediterranean Sea from Sumony in a non-stop flight.

Key words: body mass, fat load, migration, Sedge Warbler

INTRODUCTION

Trans-Saharan migrant passerines differ in fat deposition and flight strategies to safely migrate to their overwintering areas. During stopover, birds must find adequate food supplies that can be utilised with net energy gain (BIBBY & GREEN 1981, BIEBACH *et al.* 1986, PETTERSON & HASSELQUIST 1985, ELLEGREN 1991, ELLEGREN & FRANSSON 1992).

Migration strategies and stopover behaviour may differ among species, but also within species. For example, the dynamics of migration and fat load are known to vary between age groups (HUSSEL 1991, LINDSTRÖM 1990, GYURÁCZ & CSÖRGŐ 1994, GYURÁCZ & BANK 1995).

The *Acrocephalus* project of the European Union for Bird Ringing was started in 1981. The Hungarian Ornithological and Nature Conservation Society joined this international research programme, which was started to assess the breeding areas, migratory route dynamics and stopover sites of different migrating populations of *Acrocephalus* warblers. This work is relevant to the research of alternative evolutionary strategies of related species, as well as to practical nature conservation (CSÖRGŐ 1991, KOSKIMIES & SAUROLA 1985, SPINA & BEZZI 1990).

The majority of Sedge Warblers (*Acrocephalus schoenobaenus*) migrating from southern Scandinavia and the Baltic region usually pass through Hungary at the end of August and in early September (CSÖRGŐ & UJHELYI 1991, GYURÁCZ & CSÖRGŐ 1994, GYURÁCZ & BANK 1995). We measured the body mass and fat accumulation of adult and juvenile Sedge Warblers investigated during their autumn passage through southern Hungary. We addressed the following questions: 1) Do the birds have enough fat reserves to successfully cross the Mediterranean Sea? 2) Are there differences between body mass change and fat accumulation of adult and juvenile Sedge Warblers during their stopover period?

STUDY SITE AND METHODS

The data were collected during 1988–1993 at Sumony Bird Observatory (Lake Sumony: 45°58'N, 17°56' E). In each year ringing was performed for more than one month to cover the main passage of migrating Sedge Warblers (July 31–September 9, 1988, July 30–September 10, 1989, July 28–September 9, 1990, July 27–September 8, 1991, July 26–September 13, 1992, July 17–September 19, 1993). The birds were caught with nets in reed beds and dry bushes. The surface area of the nets was 900 m^2 in each year. Trapping started at dawn and lasted to one hour after sunset every day.

All birds were ringed and aged according to SVENSSON (1984). Wing length was measured and fat deposit estimated visually (ranging from 0: no fat to 5: bulging fat) of the Actio Hungarica ringing project (SZENTENDREY *et al.* 1979).

The birds were weighed to the nearest 0.1 g with a 50 g Pesola spring balance. The fat reserve of the juveniles was calculated by taking the mean body mass of the birds with a fat score of 0 as free of metabolisable fat stores. A body mass above this fat-free body mass was assumed to be due to fat (and expressing the fat load as percentage fat of the fat-free body mass). The same information was taken from retrapped birds (birds retrapped 24 hours or more after ringing).

A total of 2096 Sedge Warblers were ringed annualy (sample sizes of 269, 478, 401, 147, 360 and 441 individuals). A total of 93 Sedge Warblers was retrapped in the year of ringing. Stopover time is defined as the period from ringing to the last recapture, and thus can only be regarded as the minimum stopover period (ELLEGREN 1991).

In comparisons of mean body mass, fat load and stopover period, a t-test was used. When reporting a difference between two groups, we imply statistical significance of at least $p<0.05$. We used linear regression analyses to examine the relationship between two variables (for example between body mass and fat index). A χ^2-test was used to test for association between numbers caught and fat index at capture and recapture, respectively. The statistical analyses were computed with help of the STATGRAF program package.

RESULTS

The relationship between body mass and fat showed an average weight increase of 0.89 g per index unit (Fig. 1). Fat-free body mass of juvenile Sedge Warblers and their wing length were positively correlated (Fig. 2).

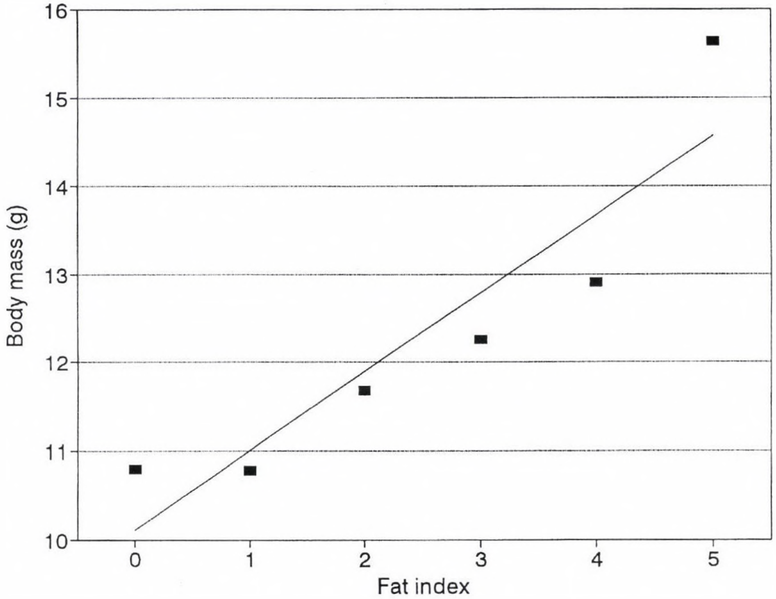


Fig. 1. Relationship between mean body mass and fat index of the Sedge Warblers. Y = 10.11+0.89x, r = 0.92, t = 4.66, d.f. = 3, p<0.01

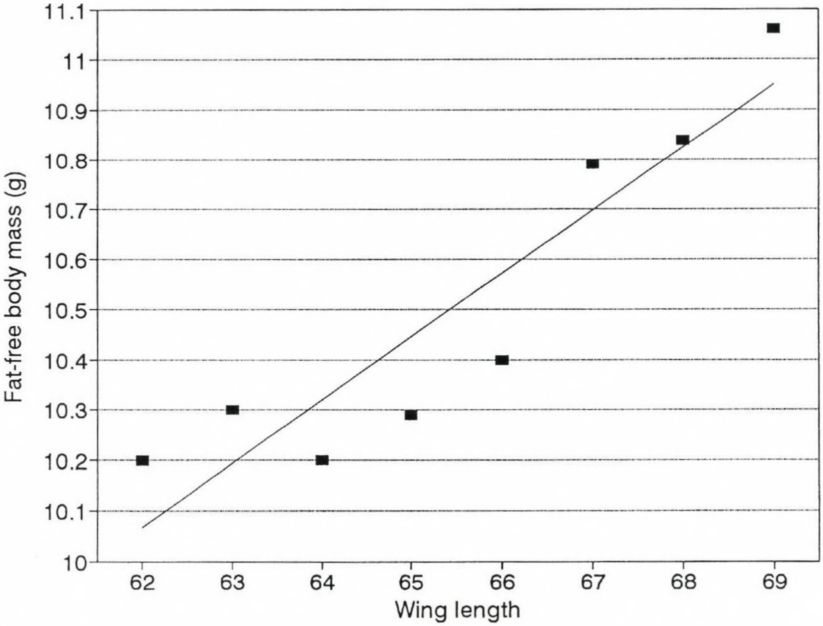


Fig. 2. Relationships between mean fat-free body mass and wing length of the Sedge Warblers. Y = 1.81+0.13x, r = 0.84, t = 3.85, d.f. = 3, P <0.05

Six percent of the adults and 4% of the juveniles were retrapped in the year of ringing. Adults and juveniles did not differ significantly as regards the length of the minimum stopover period (adults: 5.66±8.2 days, n = 25, juveniles: 6.69±5.4 days, n = 71, *t* = 1.16, d.f. = 94, $p>0.05$). At first capture 42% of the adults belonged to fat-index category 5 ($\chi^2 = 56.8$, d.f. = 4, $p<0.01$). This ratio was 62% at last recapture ($\chi^2 = 148$, d.f. = 4, $p<0.01$). More than 30% of the juveniles belonged to fat index category 2 at first capture ($\chi^2 = 32.5$, d.f. = 4, $p<0.01$) and also at last recapture ($\chi^2 = 32.25$, d.f. = 4, $p<0.01$, Figs 3 and 4).

The retrapped adult Sedge Warblers' mean body mass was significantly greater at last recapture (15.25±3.05 g, n = 23) than at first capture (13.82±2.62 g, n = 23, *t* = 2.07, d.f. = 44, $p<0.05$). The staying (birds recaptured 24 hours or more after ringing) juvenile birds' mean body mass was not significantly greater at last recapture (12.2±1.79 g, n = 68) than at first capture (11.88±1.44 g, n = 68, *t* = 1.15, d.f. = 134, $p>0.05$). Their mean fat load was also not significantly larger

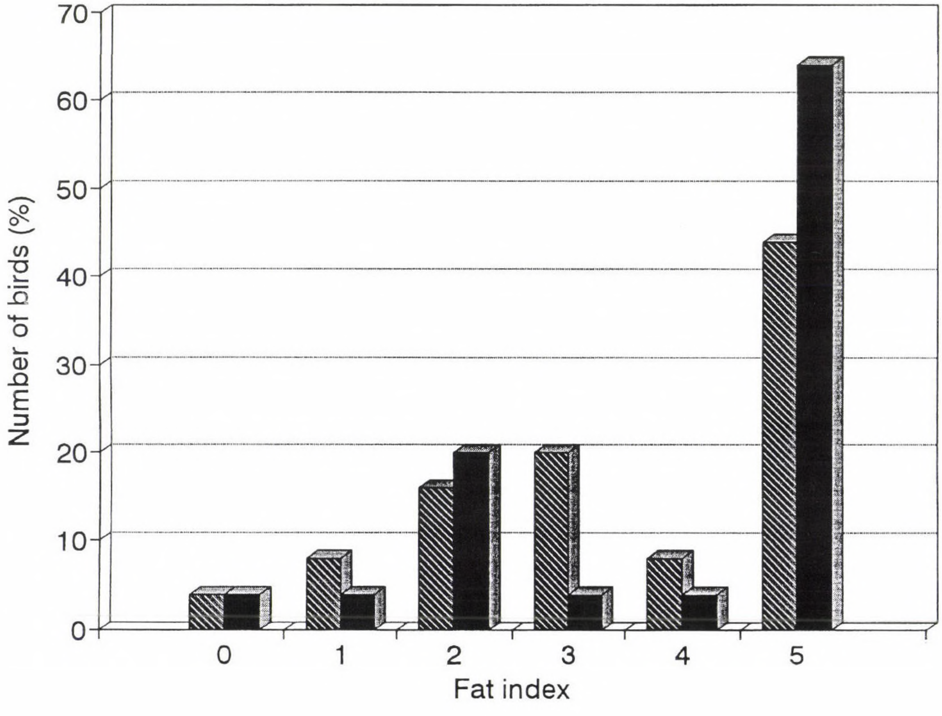
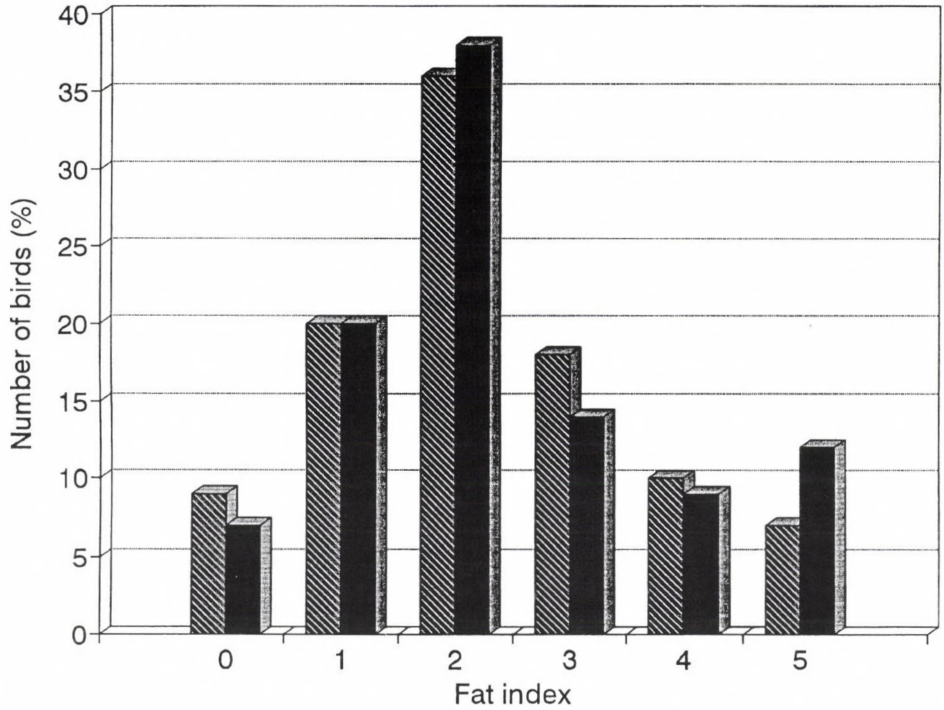


Fig. 3. Distribution of trapped adult Sedge Warblers belonging to different fat index classes during first capture (hatched bars), $\chi^2 = 56.8$, d.f. = 4, $p<0.01$ and last recapture (filled bars), $\chi^2 = 148$, d.f. = 4, $p<0.01$

Fig. 4. Distribution of trapped juvenile Sedge Warblers belonging to different fat index classes during first capture (hatched bars), $\chi^2 = 32.5$, d.f. = 4, $p<0.01$ and last recapture (filled bars), $\chi^2 = 32.25$, d.f. = 4, $p<0.01$



at last recapture (12.86±10.75 %, n = 66), than at first capture (10.42±8.68 %, n = 66, $t = 1.45$, d.f. = 130, $p>0.05$). The mean body mass change was greater among adults (0.17 g/day) than among juveniles (0.06 g/day, $\lambda^2 = 5.26$, d.f. = 1, $p<0.05$).

There were significant differences between mean fat index of the migrant (not retrapped) adults (3.21±1.4, n = 359) and juveniles (2.37±1.03, n = 1648, $t = 11.2$, d.f. = 2005, $p<0.05$). The average body mass and fat index of migrant adults and juveniles showed significant seasonal trend in 1989 (Figs 5 and 6).

DISCUSSION

Migrant Sedge Warblers come from southern Scandinavia and the Baltic region and arrive at the end of August and in early September at study site (GYURÁCZ & CSÖRGŐ 1994, GYURÁCZ & BANK 1995). The direction of migration is on the average 182°, almost exactly southward to the birds arriving from the Baltic region to Hungary (CSÖRGŐ & UJHELYI 1991). The recapture rate showed that only a small part of the migrating Sedge Warblers stayed longer than one week at the reedbeds of Lake Sumony. We found a positive correlation between the Sedge Warblers' body mass and fat load and the advance of the autumn. This is due to the increasing number of migrating birds with larger body size and fat deposit from northern areas at the stopover site, as the autumn migration season progresses (GYURÁCZ & BANK 1995).

BIBBY *et al.* (1976) and MCMILLAN (1977) have found that when a Sedge Warbler's weight is more than 13 g, it leaves the stopover site. A 16 g bird may be able to fly about 2000 km in still air (AIDLEY & WILKINSON 1987), 6 g fat is sufficient for a 3500 km non-stop flight at a speed of 40 km/h (PEARSON *et al.* 1979). An average juvenile Sedge Warbler with a wing-span 200 mm, wing length of 69 mm and body mass of 15 g has 27% fat content. According to

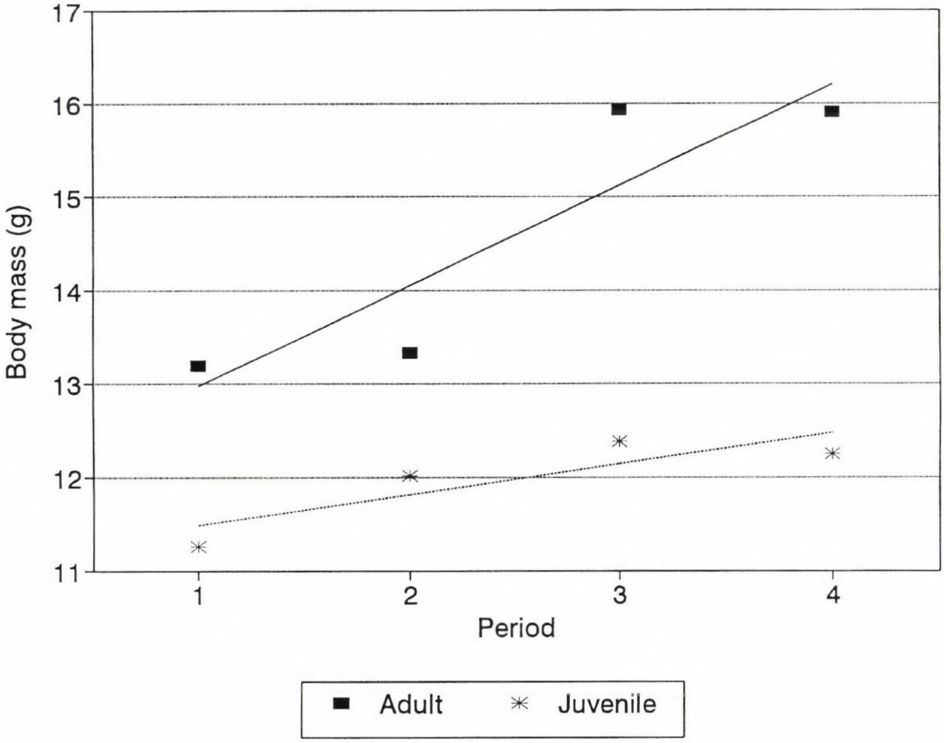
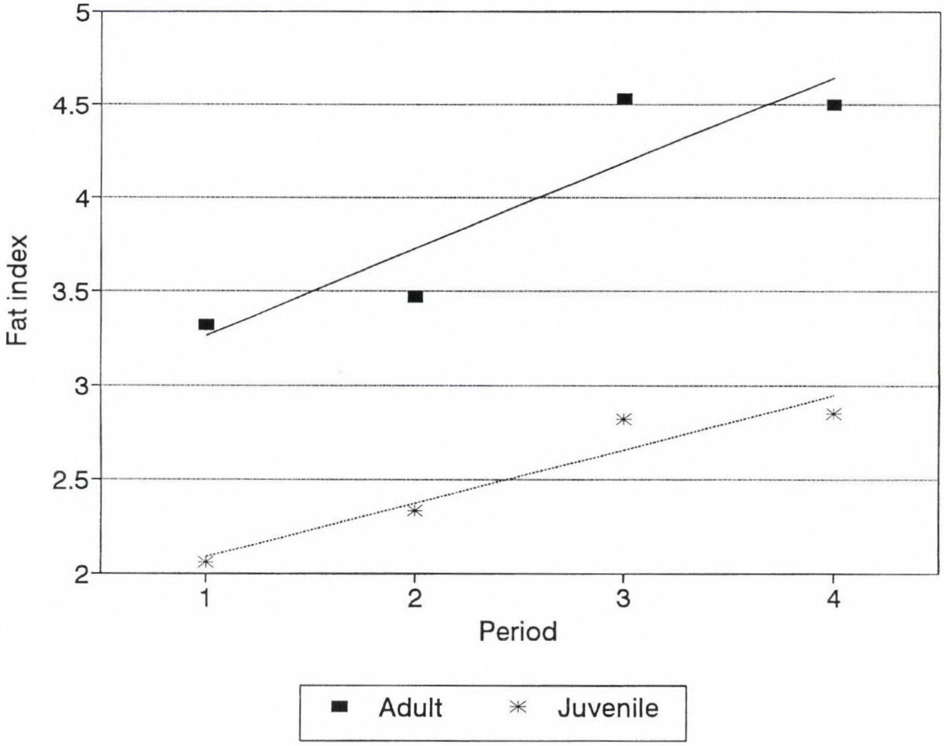


Fig. 5. Seasonal trend of mean body mass of migratory Sedge Warblers. Period: 1 = 30.7.-6.8., ad: S.D. = 2.47, n = 47, juv: S.D. = 0.99, n = 84, 2. = 7.8.-19.8., ad: S.D. = 2.71, n = 31, juv: S.D. = 1.79, n = 104, 3. = 20.8.-4.9., ad: S.D. = 3.1, n = 32, juv: S.D. = 1.76, n = 101, 4. = 5.9.-10.9., ad: S.D. = 2.92, n = 4, juv: S.D. = 1.66, n = 108 Adult: Y = 11.9+1.07x, r = 0.9, t = 2.95, d.f. = 2, $p<0.1$. Juvenile: Y = 11.15+0.33x, r = 0.85, t = 2.3, d.f. = 2, $p>0.1$

Fig. 6. Seasonal trend of mean fat load of migratory Sedge Warblers. Period: 1 = 30.7.- 6.8., ad: S.D. = 1.36, n = 44, juv: S.D. = 0.98, n = 65, 2. = 7.8.-19.8., ad: S.D. = 1.41, n = 30, juv: S.D. = 0.96, n = 101, 3. = 20.8.-4.9., ad: S.D. = 0.9, n = 30, juv: S.D. = 1.28, n = 93, 4. = 5.9.-10.9., ad: S.D. = 1, n = 4, juv: S.D. = 1.01, n = 106. Adult: Y = 2.85+0.46x, r = 0.91, $t = 3.17$, d.f. = 2, $p<0.1$. Juvenile: Y = 1.8+0.29x, r = 0.95, $t = 4.61$, d.f. = 2, $p<0.05$



PENNYCUICK's method (1975), this fat reserve should theoretically be sufficient for a 1389 km flight without feeding. This implies that with southward migration this bird should be able to cross the Mediterranean Sea from Sumony in a non-stop flight. It may be important for migrating Sedge Warblers because there is no suitable site for refuelling in the Middle-Mediterranean region (SPINA & BEZZI 1990).

According to our results the adult and juvenile birds differed with regard to fat load upon first and last capture and fat deposition rate. Adult Sedge Warblers started accumulating fat earlier than juveniles and adults departed with higher fat load than did juveniles. The adults might be expected to be heavier than the juveniles, partly because they migrated earlier (GYURÁCZ & CSÖRGŐ 1994), and partly because they had greater feeding efficiency than did juveniles (ALATALO *et al.* 1983). ALERSTAM and LINDSTRÖM (1990) argue that in case of social dominance, dominant individuals should depart with higher fat loads if dominance is associated with age and a higher fat deposition.

During their autumn migration, Sedge Warblers attain higher fat deposition rates close to their main prey, the aphids *Hyalopteris pruni* (BIBBY *et al.* 1976, KOSKIMIES & SAUROLA 1985, ORMEROD 1990). While aphids reach their peak abundance in southern Britain and northern France, the aphid populations of southern Europe will have already peaked and decreased in size by the time of the Sedge Warblers' autumn migratory passage. As should be expected where fat deposition rate and migration speed decrease along the route, these warblers deposit extremely large fat loads in southern England and northern France and may make a single long flight to the wintering 6 areas south of the Sahara (GLADWIN 1963, BIBBY & GREEN 1981). At Sumony where the fat accumulation of staging Sedge Warblers was expressive, aphids occurred in small number in the autumn migration season. According to brief observation, these insects are abundant in some Baltic sites, in others they are not (CHERNETSOV 1996). Therefore wes suppose that Sedge Warblers utilise other food beside aphids at stopover sites. Hence the diet of migrating Sedge Warblers during their stopover period at Sumony needs to be investigated.

* * *

Acknowledgements – We wish to express our gratitude to the members of the Hungarian Ornithological and Nature Conservation Society who helped in the field work. The research was sponsored by Foundation of Pro Renovanda Cultura Hungariae.

REFERENCES

AIDLEY, D. J. and WILKINSON, R. (1987) The annual cycle of six Acrocephalus warblers in a Nigerian reed-bed. *Bird Study* **34**: 226–234.

ALATALO, R., GUSTAFSSON, L. and LUNDBERG, A. (1983) Why do young passerine birds have shorter wings than older birds? *Ibis* **126**: 410–415.

ALERSTAM, T. and LINDSTRÖM, A. (1990) Optimal Bird Migration: The relative importance of time, energy, and safety. *In* GWINNER, E. (ed.) *Bird Migration*. Springer-Verlag, Berlin, pp. 331–351.

BIBBY, C. J. and GREEN, R. E. (1981) Autumn migration strategies of Reed and Sedge Warblers. *Ornis Scand.* **12**: 1–12.

BIBBY, C. J., GREEN, R. E., PEPLER, G. R. M. and PEPLER, P. A. (1976) Sedge Warbler migration and reed aphids. *Brit. Birds* **69**: 384–399. 7

BIEBACH, H., FRIDERICH, W. and HEINE G. (1986) Interaction of body mass, fat, foraging and stopover period in trans-sahara migrating passerine birds. *Oecologia* **69**: 370–379.

CHERNETSOV, N. (1996) Preliminary hypothesis on migration of the Sedge Warbler (Acrocephalus schoenobaenus) in the Eastern Baltic. *Die Vogelwarte* **38**(4): 201–210.

CSÖRGŐ, T. (1991) Alternative migration strategies of three related Acrocephalus species. *2nd Hungarian Ecological Congress*, Keszthely. Summaries of posters. p. 31. [In Hungarian]

CSÖRGŐ, T. and UJHELYI, P. (1991) Migration strategies of Acrocephalus species from an analysis of recaptures. *In* GYURÁCZ, J. (ed.) *The 3rd Scientific Meeting of the Hungarian Ornithological and Nature Conservation Society*, Szombathely, pp. 111–122. [In Hungarian with English summary]

ELLEGREN, H. (1991) Stopover ecology of autumn migrating Bluthroats Luscinia svecica in relation to age and sex. *Ornis Scand.* **22**: 340–348.

ELLEGREN, H. and FRANSSON, T. (1992) Fat loads and estimated flight-ranges in four Sylvia species analysed during autumn migration at Gotland, south-east Sweden. *Ringing & Migration* **13**:1–12.

GLADWIN, T. W. (1963) Increases in weights of Acrocephalus. *Bird Migration* **2**: 319–324.

GYURÁCZ, J. and CSÖRGŐ, T. (1994) Autumn migration dynamics of the Sedge Warbler (Acrpcephalus schoenobaenus) in Hungary. *Ornis Hungarica* **4**: 31–37.

GYURÁCZ, J. and BANK, L. (1995) Study of autumn migration and wing shape of Sedge Warblers (Acrocephalus schoenobaenus) in Southern Hungary. *Ornis Hungarica* **5**: 23–32.

HUSSEL, D. J. T. (1991) Fall migrations of Alder and Willow Flycatchers in Southern Ontario. *J. Field Ornithol.* **62**(2): 260–270.

KOSKIMIES, P. and SAUROLA, P. (1985) Autumn migration strategies of the Sedge Warbler Acrocephalus schoenobaenus in Finland: a preliminary report. *Ornis Fennica* **62**: 145–152.

LINDSTRÖM, A. (1991) Maximum fat deposition rates in migrating birds. *Ornis Scand.* **22**: 12–19.

MCMILLAN, R. L. (1977) Juvenile Sedge Warblers at Ralphepburn. *Tay R. G. Group*, pp. 11–15.

ORMEROD, S. J. (1990) Possible resource partitioning in pairs of Phylloscopus and Acrocephalus warblers during autumn migration through a South Wales reedswamp. *Ringing & Migration* **11**: 76–85.

PEARSON, D. J., BACKHURST, G. C. and BACKHURST, D. E. G. (1979) Spring weights and passage of Sedge Warblers Acrocephalus schoenobaenus in Central Kenya. *Ibis* **121**: 9–19.

PENNYCUICK, C. J. (1975) Mechanics of flight. *In* FARNER, D. S., KING, J. R. and PARKES, K. C. (eds) *Avian Biology*. Vol. 5. Academic Press, New York, pp. 1–73.

SPINA, F. and BEZZI, E. M. (1990) Autumn migration and orientation of the Sedge Warbler (Acrocephalus schoenobaenus) in Northern Italy. *J. Ornithology* **131**: 429–438.

SZENTENDREY, G., LÖVEI, G. and KÁLLAY, GY. (1979) Az "Actio Hungarica" madárgyűrűzőtábor mérési módszerei. *Állattani Közl.* **66**: 161–166. [in Hungarian]

Received 29th November, 1996, accepted 30th December, 1996, published 18th November, 1997

The oribatid species described by Berlese (Acari)

MAHUNKA, S. and L. MAHUNKA-PAPP

The authors had the opportunity for years to study the Oribatid species described by Berlese currently deposited in the Istituto Sperimentale per la Zoologia Agraria at Florence. The results of this series of studies are summarized in this volume.

The volume begins with an essay-like Introduction heavily relying on subjective opinions discussing the general questions of Oribatology. The following section lists Berlese's species placed in the modern system helping the specialists with morphological notes and many drawings; here also the condition of the specimens is discussed and lectotypes are designated.

The third, large section is the catalogue proper, wherein all the species are listed in the systematic order together with their combination and synonymic names. Here one may find all the literature data, usually missing from ordinary works, with reference to Description and Taxonomy, Distribution, with special emphasis on Catalogues whose references are partly unreliable. Where it was deemed necessary further information are added under the heading of Remarks. The volume closes with a very detailed list of literature.

ISBN 963 7093 27 3
325 pages with several figures. Soft bound.
© Hungarian Natural History Museum, Budapest, 1995
Price: 40 US dollars excl. p. & p.

Order should be sent
to the Hungarian Natural History Museum, Library
Baross u. 13., Budapest, H–1088 Hungary
Fax: (36–1) 1171669

Acta Zoologica Academiae Scientiarum Hungaricae 42 (4), pp. 281–287, 1996

A COMPARISON OF EXTRACTION METHODS OF FREE-LIVING TERRESTRIAL NEMATODES

P. NAGY

Department of Zoology and Ecology
Gödöllő Agricultural University,
H–2103 Gödöllő, Páter K. 1, Hungary

There are several methods used to extract free-living nematodes from soil. During a comparative study of efficiencies the following methods were tested: 1) BAERMANN-funnel technique; 2) COBB's modified decanting and sieving method; 3) decantation and cottonwool filter method; 4) SEINHORST's two flasks technique; 5) OOSTENBRINK elutriator.
Concerning total numbers of extracted nematodes, the decantation and cottonwool filter technique and the OOSTENBRINK elutriator were the most effective. These two techniques can absolutely be recommended for use, the choice between them should depend on the experimental profile and the financial sources of a given laboratory. SEINHORST's two flasks method also gave significantly higher results than other two techniques tested. Results obtained by BAERMANN-funnels were comparable to other methods only in terms of relative proportion of extracted Mononchida. Concerning any other parameter, BAERMANN-funnel technique gave much poorer results.

Key words: free-living terrestrial nematodes, extraction methods, efficiency

INTRODUCTION

Free-living nematodes are an important group of soil biota. Their handling raises several problems and alternative methods of different efficiency from sampling to identification (S'JACOB and van BEZOOIJEN 1984, SOUTHEY 1970). An important issue is the difficulty of their extraction from soil samples. During the past few decades a great amount of data has been collected and several review articles have been published on the topic of nematode extraction from soil samples (e.g. HARRISON and GREEN 1976, MCSORLEY and WALTER 1991, OOSTENBRINK 1960, OOSTENBRINK 1970, TOBAR JIMÉNEZ 1963, VIGLIERCHIO and SCHMITT 1983). There is not a single method to extract the whole nematode fauna from a soil sample, due to the large variability of nematode taxa, their behaviour and different physical properties of their habitats. VIGLIERCHIO and SCHMITT (1983) concluded: "It should be readily apparent that current extraction methodology is in urgent need of substantial improvement to achieve near quantitative status." Still, it is necessary to test available and generally accepted methods in order to learn more about their characteristics.

The objective of this study was to determine the efficiency of five extraction techniques with respect to the total number of extracted nematodes, quantities of nematodes belonging to certain taxonomic or functional groups, and their relative proportions to the total numbers of extracted nematodes.

MATERIALS AND METHODS

Soil extraction and counting of nematodes were carried out at the Nematology Department, Wageningen Agricultural University, The Netherlands, between 20–28 November, 1991. One bulk soil sample of approx. 3 kg, taken from the sand of an agricultural area (maize field) near Wageningen, was provided for the purpose of this study. After mixing the soil, 100–100 ml subsamples were extracted, in four replicates, using the following methods:

1) BAERMANN-funnel technique (BAERMANN 1917),

2) COBB's modified decanting and sieving method (or: COBB sifting and gravity method (THORNE 1961, COBB 1918),

3) Decantation and cottonwool filter technique (OOSTENBRINK 1960),

4) SEINHORST's two flasks method (or: SEINHORST's ERLENMEYER method) (SEINHORST 1955),

5) OOSTENBRINK's elutriator (OOSTENBRINK 1960).

Each method was performed according to the description in S'JACOB & VAN BEZOOIJEN (1984). The only exception was the BAERMANN-funnel technique, carried out as follows: 50–50 ml subsamples on cottonwool filter papers were placed into glass funnels, kept in a closed wooden box with a relatively constant temperature and humidity. Smaller sample size was necessary due to the size of the glass funnels. According to TOBAR JIMÉNEZ (1963), 50 ml is as good sample size as 100 ml. An extraction period of 5 days was applied. As preliminary studies (NAGY 1995) indicated, by prolonging slightly the usually applied extraction period of 1–2 days, a higher number of nematodes can be obtained. After counting nematodes extracted with this method, their numbers were multiplied by two in order to obtain an estimation comparable to 100 ml soil samples used in other techniques.

Extracted nematodes were counted under a stereo microscope (50 × magnification), in transmitted light.

Absolute and relative numbers of nematode groups were used to compare the extraction techniques, such as the total number of extracted nematodes by each technique, number of nematodes belonging to certain taxonomic or functional groups, and their relative proportions to the total numbers. The taxonomic or functional groups were: plant feeding nematodes of the order Tylenchida (as *Paratylenchus* spp., *Pratylenchus* spp. and *Rotylenchus* spp. occurring in the extracted samples), family Trichodoridae including virus transmitting plant nematodes, and order Mononchida (containing slow-moving relatively large predators). The rest of the extracted nematodes were categorized in one group as miscellaneous nematodes. This category was necessary due to the applied counting technique, that enabled a rapid screening of the extracted nematodes but masked details in the taxonomic composition of the samples.

As a statistical analysis, MANN-WHITNEY's U-test was performed to compare the median values of nematode numbers obtained with different techniques.

RESULTS

Means and standard deviation values for the nematode groups extracted using the different methods are given in Table 1. The data show that results from the BAERMANN-funnel technique were much lower than all the other methods.

Table 1. Mean numbers (and standard deviations) of nematods extracted by five different methods

Method	Nematode group				
	Tylenchida	Trichodoridae	Mononchida	miscellaneous	Nematoda
Baermann-funnels	34.5 (32.4)	0.3 (0.4)	8.5 (4.3)	302 (212)	345.3 (248.5)
Cobb's method	650 (43.2)	6.8 (4.1)	6.8 (12.5)	496.6 (139.1)	1160 (172.3)
Seinhorst's method	931 (197.3)	2.5 (4.3)	5.8 (5.8)	1104.1 (362.6)	2043.5 (533.9)
Decantation method	1249.8 (62.1)	3.3 (5.6)	13.3 (16.3)	1366.1 (222.1)	2632.4 (269.4)
Oostenbrink method	1190 (164.8)	0	5.0 (5.0)	1307.5 (277.2)	2502.5 (177.8)

The decantation and cottonwool filter technique and the OOSTENBRINK elutriator resulted in similarly high numbers of nematodes.

Table 2 shows relative values of nematode groups in percentage of total number of nematodes extracted using the different methods. The BAERMANN-funnel extracted much less Tylenchids related to other extracted nematodes (10%) than any other method (i. e. this technique recovered a smaller proportion of Tylenchids from the samples). The other four methods show only moderate differences in the ratio of Tylenchids and other extracted nematodes (44–54.5%).

Table 3 shows significant differences in numbers of the two main nematode groups obtained using the different extraction methods. These results confirm the above statements: the decantation technique and the OOSTENBRINK elutriator were significantly more effective than all other methods tested in this experiment. SEINHORST's two flasks method also belongs to this group, being generally more efficient than the BAERMANN-funnel and COBB's method (except for Tylenchids extracted by the COBB's sieves). Even the two least effective methods differed significantly from each other: in terms of extracted Tylenchids the BAERMANN-funnel technique gave much lower results.

Table 2. Relative extraction of nematode groups with different methods

Method	Nematode group			
	Tylenchida	Trichodoridae	Mononchida	miscellaneous
Baermann-funnels	10	0.1	2.5	87.4
Cobb's method	56	0.6	0.6	42.8
Seinhorst's method	45.5	0.1	0.3	54.1
Decantation method	47.5	0.1	0.5	51.9
Oostenbrink method	47.6	0	0.2	52.2

Table 3. Significance of differences in numbers of the two main groups of nematods extracted with different methods. Upper right triangle represents the values for tylenchids, lower left one those for miscellaneous). MANN-WHITNEY U-test – NS = non significant difference, * = P<5%

	Baermann-funnels	Cobb's method	Seinhorst's method	Decantation method	Oostenbrink method
Baermann-funnels		*	*	*	*
Cobb's method	NS		NS	*	*
Seinhorst's method	*	*		NS	NS
Decantation method	*	*	NS		NS
Oostenbrink method	*	*	NS	NS	

DISCUSSION

Among widely used methods the BAERMANN-funnel is considered to be quick, less laborious and inexpensive (MCSORLEY and WALTER 1991), generally resulting in a fairly clear final suspension which is necessary for the counting of nematodes. Moreover its water consumption is very low compared to the other techniques. On the other hand this is a probably less efficient method. Present data indicate that in nearly original form its efficiency is poor, only the relative proportion of certain groups (like Mononchida) can be comparable to other techniques. The low value of extracted tylenchids can be due to the slower movement of these animals compared to some bacterial feeding nematodes. In addition, the original conditions of the BAERMANN-funnel technique do not enduce nematodes to leave the mass of the soil during the extraction process. This may be especially true for mainly plant-feeding tylenchids, whose movement is orientated by plant exudates to a considerable extent (GREEN 1971).

There are several modifications that can be used to improve the results obtained by the BAERMANN-funnel technique (ANDERSON and COLEMAN 1977, NAGY 1995, ROBINSON and HEALD 1989, SOHLENIUS 1977). Through the control of certain factors (small sample size and thin layer of soil, proper oxygen supply, temperature gradient, longer extraction period) a more accurate estimation of nematode fauna in a given soil sample may be achieved. Thus this method is frequently used, mainly by soil biologists and taxonomists (ANDRÁSSY and FARKAS 1988, BLAIR *et al.* 1994, FRECKMAN *et al.* 1975, FYLES *et al.* 1988, HUHTA *et al.* 1989, HYVÖNEN and PERSSON 1990, SOHLENIUS 1977, WARDLE and YEATES 1993).

In the present study, COBB's method also gave significantly lower results than the most effective techniques. This finding does not confirm THORNE's (1961) statement about 50–90% efficiency of this technique. Considering its advantages as well, like reasonable water consumption, fairly clean final suspension and easy separability of nematode size-classes, this method is still popular among nematologists (J. V. BEZOOIJEN, pers. comm.)

Although the BAERMANN-funnels and COBB's method were in themselves less effective than the rest, in combination with other extraction techniques their application can still be effective (VAN GUNDY 1982, VIGLIERCHIO and SCHMITT 1983). Moreover, under certain circumstances (improved conditions, smaller sample size, demonstrative purposes) they can be appropriate tools for extracting nematodes from soil samples.

SEINHORST's two flask method recovered more nematodes from the samples than BAERMANN's and COBB's techniques, but its efficiency is lower than that of both the (decantation and) cottonwool filter technique and the OOSTENBRINK elutriator. TOBAR JIMÉNEZ (1963) found SEINHORST's two flasks method to recover somewhat more nematodes from comparable soil type at the present sample size, than the decantation method and the OOSTENBRINK elutriator. However, he admitted that in other parameters (as required time of extraction, constance in yielded nematodes, clearness of final suspension) the decantation technique and especially the OOSTENBRINK elutriator was preferable.

In the present study, the decantation and cottonwool filter technique and the OOSTENBRINK elutriator are significantly more effective than any other extraction method tested. However, differences observed in their efficiencies are neither so big nor so obvious that any of them could be recommended exclusively. When making a choice between them, one has to consider the low costs and the simplicity of the decantation and cottonwool filter technique versus the high expenses of the OOSTENBRINK elutriator. On the other hand the latter technique has remarkable advantages, like higher resistance to personal imbalances, usually cleaner final suspension, suitability for simultaneous application. These differences can be decisive depending on the experimental profile of the laboratory.

* * *

Acknowledgements – The present experiment was made possible through a student mobility program between the Wageningen and Gödöllő Agricultural Universities. The author is grateful to Mr. J. J. S'JACOB and Mr. J. VAN BEZOOIJEN (WAU, Department of Nematology) for teaching the basics of handling nematodes (including various extraction methods) and for their helpful attitude while staying in Wageningen. Also thanks are due to Prof. GÁBOR BAKONYI for his help in data processing and his useful comments during preparation the manuscript.

REFERENCES

ANDERSON, R. V. and D. C. COLEMAN (1977) The use of glass microbeads in ecological experiments with bacteriophagic nematodes. *J. Nematology* **9**: 319–322.

ANDRÁSSY, I. and K. FARKAS (1988) *Kertészeti növények fonálféreg kártevői* [Nematode pests of horticultural plants]. Mezőgazdasági Kiadó, Budapest. 418 pp.

BAERMANN, G. (1917) Eine einfache Methode zur Auffindung von Anchylostomum-(Nematoden)-Larven in Erdproben. *Geneesk. Tijdschr. Ned.-Ind.* **57**: 131–137.

BLAIR, J. M., PARMELEE, R. W. and R. L. WYMAN (1994) A comparison of the forest floor invertebrate communities of four forest type in the northeastern U.S. *Pedobiologia* **38**: 146–160.

COBB, N. A. (1918) Estimating the nema population of soil. *Agric. Tech. Circ. USDA* **1**: 1–48pp.

FRECKMAN, D. W., MANKAU, R. and H. FERRIS (1975) Nematode community structure in desert soils: Nematode recovery. *J. Nematology* **7**: 343–346.

FYLES, I. H., JUMA, N. G. and J.A. ROBERTSON (1988) Dynamics of microbial biomass and faunal populations in long-term plots on a gray luvisol. *Can. J. Soil Sci.* **68**: 91–100.

GREEN, C. D. (1971) Mating and host finding behavior of plant nematodes. *In* ZUCKERMAN, B. M., MAI, W. F. and R. A. ROHDE (eds): *Plant parasitic nematodes.* Vol. 2, Academic Press, New York, pp. 247–266.

HARRISON, J. M. and C. D. GREEN (1976) Comparison of centrifugal and other methods for standardization of extraction of nematodes from soil. *Ann. appl. Biol.* **82**: 299–308.

HUHTA, V., WRIGHT, D. H. and D. C. COLEMAN (1989) Characteristics of defaunated soil, I. A comparison of three techniques applied to two different forest soils. *Pedobiologia* **33**: 417–426.

HYVÖNEN, R. and T. PERSSON (1990) Effects of acidification and liming on feeding groups of nematodes in coniferous forest soils. *Biology and Fertility of Soils* **9**: 205–210.

S'JACOB, J. J. and J. VAN BEZOOIJEN (1984) *A manual for practical work in nematology.* Department of Nematology, Wageningen Agricultural University, 77 pp.

MCSORLEY, R. and D. E. WALTER (1991) Comparison of soil extraction methods for nematodes and microarthropods. *Agriculture, Ecosystems and Environment* **34**: 201–207.

NAGY, P. (1995) Time-linked extraction efficiency of the Baermann-funnel technique. *Nematologica* **41**: 323–324.

OOSTENBRINK, M. (1960) Estimating nematode populations by some selected methods. *In* SASSER, J. N. and W. R. JENKINS (eds): *Nematology.* The Univ. North Carolina Press, Chapel Hill, pp. 85–102.

OOSTENBRINK, M. (1970) Comparison of techniques for population estimation of soil and plant nematodes. *In* PHILLIPSON, J. (ed.) *Methods of study in soil ecology.* UNESCO, Paris, pp. 249–255.

ROBINSON, A. F. and C. M. HEALD (1989) Accelerated movement of nematodes from soil in Baermann funnels with temperature gradients. *J. Nematology* **21**: 370–378.

SEINHORST, J. W. (1955) Een eenvoudige method voor het afscheiden van aaltjes uit grond. *Tijdschr. Plziekt.* **61**: 188–190.

SOHLENIUS, B. (1977) Numbers, biomass and respiration of nematoda, rotatoria and tardigrada in a 120–year-old scots pine forest at Ivantjärnsheden, Central Sweden. *Swedish Coniferous Forest Project Technical Report* **9**: 40 pp.

SOUTHEY, J. F. (1977) *Laboratory methods for work with plant and soil nematodes.* Tech. Bull. No. 2, H. M. S. O., London, 148 pp.

THORNE, G. (1961) *Principles of Nematology.* McGraw-Hill, New York, 553 pp.

TOBAR JIMÉNEZ, A. (1963) The behaviour of a soil population and some plant parasitic nematodes in the processes of extraction of five different methods. *Revista Ibérica de Parasitología* **23**: 285–314.

VAN GUNDY, S. D. (1982) Nematodes. *In* PAGE, A. L., MILLER, R. H. and D. R. KEENEY (eds) *Methods of soil analysis.* Agronomy No. **9** (Part 2). Am. Soc. Agron. Inc., Madison, Wisconsin, pp. 1121–1130.

VIGLIERCHIO, D. R. and R. V. SCHMITT (1983) On the methodology of nematode extraction from field samples: Comparison of methods for soil extraction. *J. Nematology* **15**: 450–454.

WARDLE, D. A. and G. W. YEATES (1993) The dual importance of competition and predation as regulatory forces in terrestrial ecosystems: evidence from decomposer food-webs. *Oecologia* **93**: 303–306.

Received 19th June, 1996, accepted 30th December, 1996, published 18th November, 1997

Catalogue of Palaearctic Diptera

edited by Á. SOÓS and L. PAPP

Volume 13

Anthomyiidae–Tachinidae

The Catalogue contains the basic taxonomic, nomenclatorial and distribution data of all species occurring in the Palaearctic Region with the fundamental morphological features for the majority of the fly groups.

Volume 13 lists the names of 460 genera, 38 subgenera and 2389 species assigned to three families. Furthermore, 672 synonymous generic and 2477 specific names, 1807 emendations, errors, nomina dubia and doubtful genera and species are listed. The period of the Catalogue extends from 1758 to 31 December, 1982.

Contents: Explication to distribution. Type-species designations in Volume 13. New name proposed in Volume 13. Families: Anthomyiidae (Á. DELY–DRASKOVITS). Rhinophoridae (B. HERTING). Tachinidae (B. HERTING and Á. DELY–DRASKOVITS). Bibliography. Index.

December 15, 1993. 624 pages
US$ 85.00 plus US$ 8.00 for package and postage
(and an extra US$ 5.00 if you want it air mail)
ISBN 963 70 9321 4

Order should be sent

to the Hungarian Natural History Museum, Library
Baross u. 13., Budapest, H–1088 Hungary
Fax: (36–1) 1171669

Acta Zoologica Academiae Scientiarum Hungaricae 42 (4), pp. 289–330, 1996

BIOGEOGRAPHY AND EVOLUTION OF OREAL LEPIDOPTERA IN THE PALAEARCTIC

Z. VARGA

Department of Zoology and Evolution, Kossuth L. University
H–4010 Debrecen, Hungary

The concept of the oreal fauna can be defined as that typifying orographically caused non-arboreal biomes. It is considered here as a major biogeographical unit in its own right, not only as a component of the oreotundral fauna. The oreal fauna is correlated with orographically determined non-arboreal ecosystems and its members have, as a rule, insular, often strictly endemic or disjunct areas of distribution. Its chorological centres can be regarded mostly as only potential centres of dispersal. They can be recognised by accumulated occurrence of stenochorous species and by the high species-diversity of some typical genera. The oreal fauna can be subdivided into an *alpine* type, as the faunal type of humid high mountains with prevailing glacial morphology and with strong connections to the tundral zonobiome, and *xeromontane* type, as the faunal type of arid high mountains with prevailing physical weathering and with manifold connections to the *eremic* zonobiome. The formation of the *alpine* faunal type is closely connected to the Quaternary glaciations. Its history can be characterised by long-distance translocations and disjunctions, resulting in a great number of arctic-alpine species. On the contrary, the *xeromontane* faunal type displays a more continuous evolutionary history extending far back into preglacial times and also demonstrates a high potential for speciation in such groups which are adapted to the cold-arid conditions. A major part of the xeromontane fauna appears to have been stationary with a great number of relict-like species, especially in some core areas of Central and Inner Asia. Xeromontane species could only populate Central and Northern Europe during the extreme continental late-glacial and early post-glacial phases. In Europe and adjacent areas, most xeromontane species occur in the summer-dry Mediterranean high mountains from the Atlas to Asia Minor. The xeromontane fauna can be subdivided into a W Palaearctic (Mediterranean-xeromontane) and a Central- and Inner-Asiatic (Continental) subtype. This bifurcation arose through the influence of a "xeromontane filter" on a set of ancestral species coming mostly from seasonally humid, southeastern Asiatic mountains. Thus, the fauna of subtropical, monsoonic orobiomes (e.g. in southern China and the Himalaya region) displays a somewhat intermediate, less differentiated (ancestral) character. The core areas of allopatric speciation, dispersal and evolutionary history of Palaearctic xeromontane Noctuidae are considered.

Key words: biogeography, oreal fauna, core areas, alpine type, xeromontane type, Palaearctic xeromontane Noctuidae

OREAL FAUNA: CONCEPTS, PRINCIPLES AND DEFINITIONS

Zonobiomes and orobiomes

The fauna of high mountains deserves special attention as a kind of continental-insular fauna. It presents us with an important source for the study of the spatio-temporal aspects of evolution.

In lowlands the biotic composition of the most recent faunal range extensions predominate interacting with the prevailing zonobiomes. Even minor differences in the relief, e.g. canyon-like, deep, rocky valleys in table-lands, gorges or step-like escarpments of plateaux can result in a heterogeneity of the general faunal picture. The compositional homogeneity of the prevailing zonobiome breaks down in response to narrow-scale environmental factors which promote the survival of relict-like populations. We observe essentially the same phenomena in montainous regions, where the macroclimatically influenced zonal arrangement of major biomes is disturbed by orographic factors. These conditions are expressed in the high biotic diversity within a limited area and in the coexistence of different faunal types. Some of them are relicts of more ancient faunal invasions, which have survived in restricted refuges. They are, as a rule, often members of relict-like communities or community fragments, that were more widely distributed in some former phases of the Quaternary climatic fluctuations. During climatic oscillations the more successful fraction of such previously restricted populations can irradiate, hence mountains also often serve as centres of dispersal. Thus, several components of orobiomes could be transformed during their evolutionary history into components of zonobiomes. These facts provide the basis for several ideas concerning the origin and history of tundra, taiga and steppe zonobiomes (e.g. ANDER 1949, BORBÁS 1908, HEPTNER 1959, PETERSEN 1954, SOÓ 1929, 1940, 1959, STEGMANN 1932, 1938 1958, VARGA 1975*a, b*, 1989*a, c*, 1995*b*, ZÓLYOMI 1949, 1953, 1964).

The concept of the oreal fauna

The fauna specific to high mountains is often referred to as the "*oreal fauna*" in the zoogeographical literature, although mostly without a satisfactory definition of this notion. I will try to place this concept within the context of the basic of the biomes division.

Biomes not only represent types of ecosystems, but also types of primary production. Perhaps the most striking feature of the biosphere, shown on the map of RODIN & BAZYLEVICH (1965), is the relatively sharp delimitation of the regions with a rather low (i.e. less than 25 q ha^{-1} per year) level of primary production, caused by the restriction of the water circulation to less than 3 months per year (BUDYKO 1977). Essentially the same picture is presented on the map based on the life-zone concept of HOLDRIDGE (1962, see GROOMBRIDGE 1992). If we define all these regions of low bioproduction as "*non-arboreal*", as opposed to the *arboreal* ones (where primary production is more than 25 q ha^{-1} per year), we can define the oreal fauna as "*the faunal types of orographically caused non-arboreal biomes*" (VARGA 1975*a*, 1995*b:* Table 1).

This paper discusses the general features of distribution and faunal history of Palaearctic oreal Lepidoptera. A detailed analysis of the patterns of speciation in xeromontane Noctuidae with a survey of their biogeographical types will be presented in a subsequent paper.

Oreal and tundral fauna

Here I recognise the oreal fauna as a main zoogeographical unit, not only as a component of the "*oreotundral*" one (cf. DE LATTIN 1967), although a very intimate geographical and historical connection between the tundral and oreal biomes is evident. Their interaction can be seen during the entire Quaternary period as a vast faunal mixing in the periglacial belts still continuing at present along the mountain ranges of Eastern Siberia and Pacific North America (Fig. 1).

On the other hand, one also has to consider the main differences between tundral and oreal faunas. The tundral fauna belongs to one of the major zonobiomes, and most of its members have a circumpolar or amphi-Beringian distribution (the possibility of an amphi-Atlantic connection is rejected, see KONONENKO *et al.* 1989, LAFONTAINE & WOOD 1988, MIKKOLA 1987, MIKKOLA *et al.* 1991). The oreal fauna, in contrast, is essentially not of a zonal nature. Its members are connected to numerous orographically determined ecosystems and they occur, as a rule, in spot-like, "insular", often highly endemic or widely separated areas, with an essentially higher diversity of areal types (i.e. "faunal elements" in the German tradition), than the members of the generally more uniform tundral fauna (the exceptional position of Beringia is discussed in several recent papers of KONONENKO *et al.* 1989, LAFONTAINE & WOOD 1988 and MIKKOLA *et al.* 1991, see above). The frequently discussed arctic-alpine (or tundro-alpine) distribution is only a specific case of formerly expansive, but recently restricted and disrupted distribution ranges, occurring equally well as convergent area regressions in species of oreal and tundral origin, or sometimes having closely related sibling species in such areas (EHRLICH 1958, PETERSEN 1954, VARGA 1989*c,* 1995*a, b, c*).

There are, however, extended oreal biomes without any connection or any compositional or physiognomical similarity to the tundral ones, e.g. the *puna* vegetation, the tall Compositae-Euphorbiaceae formation in East African high mountains, the xerophytic "polster"-scrub vegetation in the mountains of the Middle East and Central Asia etc. (AGACHANJANTS 1981, BRECKLE 1974, MÜLLER 1977, VUILLEUMIER 1970, VUILLEUMIER & SIMBERLOFF 1980, WALTER & BRECKLE 1986). The oreal biomes which have no or rather poor connections with tundral ones (i.e. most of the arid or at least seasonally arid oreal biomes), are usually not delimited by a timberline, or (depending on the exposition) only by a rather scattered one (AGACHANJANTS 1981, WALTER & BRECKLE 1986). At the same time they usually have manifold contacts with deserts and semi-deserts (i.e. eremial biomes) and/or with the seasonally dry, unforested or only sparsely forested arboreal biomes (e.g. tall-grass steppe, savanna, some Mediterranean xerophytic formations). Thus, the widely accepted definition of the oreal biomes: "*biomes above the timberline*" is unsatisfactory for similar reasons (VARGA 1975*a, b*, 1977).

Survival and evolution of the oreal fauna

In the zoogeographical literature – influenced by the polemic sentences of some classic works (DANSEREAU 1957, DARLINGTON 1959, UDVARDY 1981 vs. CROIZAT 1978, CROIZAT *et al.* 1974, PLATNICK & NELSON 1978, ROSEN 1978) – a rather fruitless conflict of the categorical migrationist vs. the conservationist-vicarist views has taken place (see also: IABLOKOFF-KHNZORIAN 1968 vs. KRYZHANOVSKY 1969 on the origin and evolution of alpine Coleoptera). This debate is essentially similar to that over the faunal history of islands. It means that the faunal history of high mountains can also be described and discussed in terms of colonisation and survival vs. extinction and evolution (see also MACARTHUR & WILSON 1963,1967, VUILLEUMIER 1970, 1973).

Careful analyses of the European arctic-alpine insects (ANDER 1949, ASPÖCK 1963, BURESCH & ARNDT 1926, HOLDHAUS & LINDROTH 1939, HOLDHAUS 1954, WARNECKE 1959, VARGA 1989*c*, 1995*a*) have shown that the faunal diversity of an isolated mountain range depends in some cases on the distance from the "source" of the colonisation (see also: interaction between distance, survival and diversity, MACARTHUR & WILSON 1963, 1967). The comparatively low NW Dinarids, which also have a relatively small extension but lie near to the SE Alps, have e.g. a rich fauna of terricolous (often petrophilous) insects with low mobility (e.g. small, flightless Carabidae, see HOLDHAUS 1954, HOLDHAUS & LINDROTH 1939, MARAN 1946 etc.).

In other cases, conditions favourable for survival seem to be more significant, e.g. the more remote, but extensive and high massifs of the Balkan peninsula (Rila, Pirin, Šar-planina etc.) are much richer in alpine and tundro-alpine butterflies and "macro"-moths than the Dinarids or the Carpathians (VARGA 1975*b*, 1995*a*). The concept of "better survival" often implies the possibility of further evolutionary differentiation, leading either to more or less differentiated allopatric subspecies or to "autochtonous" neo-endemic species, often vicariants to related ones isolated in some other remote massifs (MARAN 1946, VARGA 1975*a*, 1989*c*).

Whether only a geographical subspeciation within the range of a widely distributed polytypic species, or a "punctuational" emergence of rapidly evolved species-flocks takes place, depends mainly on the tempo of the evolutionary changes in the group studied. The examples of the classical ("dumbbell model") geographical subspeciation are present in numerous families of "Macrolepidoptera", Orthoptera, passerine birds etc., while the latter are represented by numerous torrenticolous insects (e.g. the trichopteran genera *Drusus, Plectrocnemia,* *Rhyacophila*), by the petrophilous Carabidae and land snails, e.g. the limestone-rock inhabiting *Alopia* species in the East Carpathians (BOTOSANEANU 1962, HOLDHAUS 1954, MARAN 1946, SOÓS 1943, VARGA 1995*a, b*).

In summary, one may believe that mountain faunas provide several possibilities for both phenomena: survival of relict species belonging to ancient biota and – according to the *founder principle* – for rapidly evolving, "*peripatric*" neo-endemics. Both main types of "*allopatric*" (I prefer the term "*area-dynamic*", as opposed to the stasipatric model of speciation) evolution can be regularly observed:

- *refugial isolation* connected with evolving vicariant taxa by area regression and disjunction;
- *isolation by dispersal* ("post-dispersal", more exactly "propter"-dispersal) connected with the peripheric fluctuation of the range (VARGA 1971).

Faunistical and biogeographical survey of Palaearctic Noctuidae

The facts on which the following discussions and conclusions are based, come from two main sources.

The taxonomy and distribution of the European Noctuidae is relatively well-known. We have numerous check-lists from different parts of Europe (BOURSIN 1964, LERAUT 1980, HACKER 1990, TARMANN & HUEMER 1993 etc.), as well as some check-lists of all European species (HARTIG & HEINICKE 1973, FIBIGER & HACKER 1990). In recent years a monographic book series and an atlas of distribution maps have been started as well (FIBIGER 1990, 1994, RONKAY & RONKAY, 1994, 1995, SVENDSEN & FIBIGER 1993). There is much information on the Noctuidae of the Palaearctic (Mediterranean) Northern Africa and Asia Minor, too (e.g. HACKER 1986, 1987, 1990, HACKER *et al.* 1986, 1988, HACKER & WEIGERT 1986, RUNGS 1945, 1972, 1981, WILTSHIRE 1948, 1957). Data from huge areas of Asia are much more incomplete and scattered. Many species are known only from a few type specimens collected during the last decades of the 19th century and preserved in some "classic" collections (e.g. STAUDINGER, PÜNGELER and BANG-HAAS collections in the Zoological Museum of the Humboldt University in Berlin, many famous collections in The Natural History Museum, London, the collection of the Grand Duke NIKOLAI MICHAJLOVICH ROMANOFF in St. Petersburg, the CORTI collection in the Natural History Museum of Basel etc.).

After a long period of very scattered collecting in the first half of this century, the surveys of Palaearctic Noctuidae were intensified during the 1960s and the 1970s by systematic collecting trips with more modern tools (portable generators, mercury vapour lamps, fluorescent tubes) by several highly qualified entomologists in different parts of Western and Central Asia (Turkey, Armenia, Iran, Afghanistan, Pakistan, Mongolia e.g. by G. EBERT, G. FRIEDEL, F. KASY, Z.

KASZAB, C. M. NAUMANN, R. PINKER, J. PLANTE, E. VARTIAN) and by the immense taxonomical achievements of CH. BOURSIN. However, the majority of this material could only be evaluated during the last two decades, after the death of BOURSIN. Because the collection and taxonomic notes of this author unfortunately have become practically inaccessible in the meanwhile, the specialists who tried to continue his work were forced to re-study all the type materials originally examined and photographically documented by him.

These difficulties became, however, the starting block for new revisions with a more up-to-date attitude and with more sophisticated methods (e.g. the new information coming from the "*lock-and-key*" structures of the everted inner genitalia of both sexes: LAFONTAINE & MIKKOLA 1987, MIKKOLA 1992). The geopolitical changes of the last twenty years had two outcomes. Large areas became inaccessible to entomologists due to political unrest (e.g. SE Turkey, Afghanistan, Tibet), but very important new material could be collected by several expeditions and also by indigenous collectors in many parts of the former Sowiet Union (e.g. Turkmenistan, Kazakhstan, Kyrgyzstan, Uzbekistan, Tadjikistan, Siberian parts of Russia), in Pakistan, Northern India, Nepal, Mongolia, Korea, Taiwan etc.

Due to these recent faunistic investigations carried out in many, hitherto very poorly studied parts of Eurasia, a vast amount of new information on the taxonomic composition and geographical distribution of the Palaearctic noctuid fauna was obtained. The survey of these several tens of thousands of noctuid specimens resulted in the description of several hundred new species and thousands of data on the distribution of hitherto incompletely known species. This descriptive and data collecting work occurred during a very intensive phase (see: References). Due to the description of a very large number of new species and by the study of many taxonomically incompletely known or misinterpreted species, some monographic studies have been started on taxonomically complicated and highly diverse genera of Noctuidae. Thanks to these monographs, we can now understand better the evolutionary processes and phylogeographic relations in many groups of Noctuidae. A new, "*post*-BOURSIN" generation of noctuid specialists has emerged, for whom team-work and close cooperation is natural. This is the reason why a large part of the distributional data of Noctuidae materials preserved in different museums and private collections could be taken into consideration for the purposes of the present paper.

Taxonomic revisions of Palaearctic Noctuidae

The extraordinary richness of the new noctuid material, and the favourable conditions for a close cooperation in taxonomical surveys, made possible the publication, during the last ten to fifteen years, of a large number of longer revisional papers on many complicated and taxonomically-phylogenetically important genera (*Trichosilia, Eugnorisma, Xestia* [subg. *Anomogyna, Pachnobia, Schoyenia,*] *Xenophysa, Lasionycta, Hadena, Bryopolia, Bryoxena, Cucullia, Polymixis, Auchmis, Pseudohadena, Victrix* etc.) of Palaearctic/Holarctic Noctuidae (BEHOUNEK 1992, HACKER 1992*a*, 1995, HACKER & RONKAY 1991, 1992, HARDWICK 1970, HREBLAY 1992, 1994*a, b*, 1995, HREBLAY & RONKAY 1994, HREBLAY *et al.* 1994, LAFONTAINE 1981, 1987, LAFONTAINE & KONONENKO 1986, LAFONTAINE *et al.* 1983, 1986, MIKKOLA *et al.* 1987, RONKAY 1986, 1989, RONKAY & RONKAY 1994, 1995, RONKAY & VARGA 1989, 1990*a, b*, 1993*a, b*, RONKAY *et al.* 1995, VARGA 1983, 1989*b*, VARGA & RONKAY 1987, 1989, 1991*a, b, c*, 1996, VARGA *et al.* 1990, WILTSHIRE 1979).

Some of these papers contain maps of distribution, biogeographical and phylogenetic considerations which could be used for the areographic and faunal historic surveys of this paper. Further monographic works are imminent or are in a very intensive phase of preparation (*Euxoa, Dichagyris, Chersotis, Rhyacia, Diarsia, Cardiestra, Cardepia, Discestra, Hadula, Thargelia, Odontelia, Haderonia, Ctenoceratoda, Tricheurois, Polia, Saragossa, Sideridis, Conisania, Perigrapha, Harutaeaographa, Orthosia, Mythimna, Xylomoia* etc.) and will be published during the next few years. Because of these monographic works many hitherto unsolved phylogenetic problems and biogeographical questions can be answered (e.g. the major phylogenetic division of Noctuinae, Cuculliinae and Hadeninae s. str.).

The detailed results of the phylogenetic and biogeographical analyses of several xeromontane noctuid genera and species groups, based on these revisional works, will be discussed in a subsequent paper. Here, I can only present some general ideas about the taxonomic and biogeographic diversity of xeromontane Noctuidae, which is obviously one of the most ancient and important sources of the Palaearctic fauna.

Chorological principles: "core areas" in oreal biomes

In the zoogeographical literature the term "*core areas*" (in German: *Arealkerne, chorologische Zentren* etc: DE LATTIN 1957, 1967, MÜLLER 1973, 1974, REINIG 1950, SCHINTLMEISTER 1989, VARGA 1967, 1975*a, b*, 1977) is used for restricted areas of high species-diversity with a great number of *stenochorous* ("endemic") species. They are often interpreted as areas of survival (refuges) and, consequently, as "*centres of dispersal*" ("*Ausbreitungszentren*" in the German tradition) of a given faunal type. They are identified by an areographic analysis, consisting of some consecutive steps. The term "areas of endemism", widely employed in biogeographical literature, seems to me to be less clear-cut, because the notion of "endemism" can be referred to biogeographical regional units of very different size (realms, regions, provinces etc.). In addition, species of restricted range ("endemic" ones) and more or less expansive species can equally belong to the set of species with the same "core area" (cf. the principle of "*equiformal progressive areas*" of HULTÉN 1937). Repetitive geographical patterns of these "core areas" and their significance in survival, speciation and dispersal of biota can also be confirmed by a phylogenetic (cladistic) analysis (CRACRAFT 1982, 1983, CRACRAFT & PRUM 1988, ENGHOFF 1995, OOSTERBROEK & ARNTZEN 1992, ROSEN 1978 etc.). New possibilities of the combined areographical and phylogenetic analyses are supplied by the modern molecular "tool-box" of "phylogeography" (reviewed by RODERICK 1996).

The somewhat complex meaning of "*core areas*" contains the following main components:

1. Core areas are regions of *accumulated occurrence* of *stenochorous* ("endemic") species, which can equally be older *relict endemics* and "in situ" differentiated *neo-endemic* ones, respectively. A differentiation between these main types can usually be achieved by a phylogenetic analysis.

2. Core areas are regions of *accumulated occurrence* of isolated *subspecies* (or simply populations) of widely dispersed *polytypic species* with *disjunct* range and/or of *allopatric* members (i.e. *semispecies* or *sibling species*) of *superspecies* or *closely related species groups*.

3. Core areas are often *centres of high species-diversity* of characteristic *genera* of a given faunal type, e.g. in the oreal biomes: *Erebia, Parnassius, Psodos* and numerous noctuid genera, discussed below (cf. VARGA 1975*b*, 1977, 1989*b*, VARGA & RONKAY 1987, 1991*a, c*, VARGA *et al.* 1989 etc.). Such core areas can be regarded as especially valuable from a historical point of view due to the possibility of a phylogenetic analysis (see also: HENGEVELD 1990, "geographical nesting of species").

Core areas are usually *centres of survival of species and communities during regressive phases of the given biome* and *faunal type*, respectively, but in some cases they do not simultaneously represent centres of speciation and supraspecific differentiation (cf. cases 1 and 3, *partim*).

Because in hilly or montainous regions a short-distance shift ("creep") is often enough for survival, centres of survival and dispersal of the Palaearctic arboreal fauna often lie in hilly or montainous regions (cf. DE LATTIN 1949, 1952, 1957, 1967, REINIG 1937, 1938, 1950). Faunal richness and high level of endemism of European butterflies in mountainous regions of Southern Europe has also been clearly demonstrated by DENNIS *et al.* (1991) and DENNIS (1993). It is widely accepted that during the last glaciations the main survival centres of the Western Palaearctic arboreal fauna were restricted to e.g. some parts of the Mediterranean peninsulas. In this phase of the genesis of the fauna, the arboreal biomes were disconnected into several larger or smaller "islands". Due to the post-glacial re-afforestation, however, the *zonal character* of these biomes could be restituted, combined with the reorganisation of forested biocenoses.

On the other hand, the core areas of the oreal fauna at present hardly (or do not) represent centres of dispersal, as opposed to the arboreal and eremial ones, because the postglacial expansion of the arboreal biomes has fragmented these habitats into patches which could remain suitable for the biota of the orobiomes. Nevertheless, they may become expansive, e.g. in the case of a future glaciation or also by aridisation, which would lead to a retreat of the arboreal biomes.

From these general principles it can be concluded that the core areas of the oreal fauna in this phase of our work can be defined mainly as

i. centres of occurrence of a large number of stenochorous ("endemic") species,

ii. centres with an accumulated occurrence of disjunct subspecies of widely dispersed species with scattered distribution.

iii. centres with higher than average representation of genera, which are typical for orobiomes.

It seems quite evident that the same basic patterns are repeated in the distribution of the monophyletic, very closely related allopatric species groups and

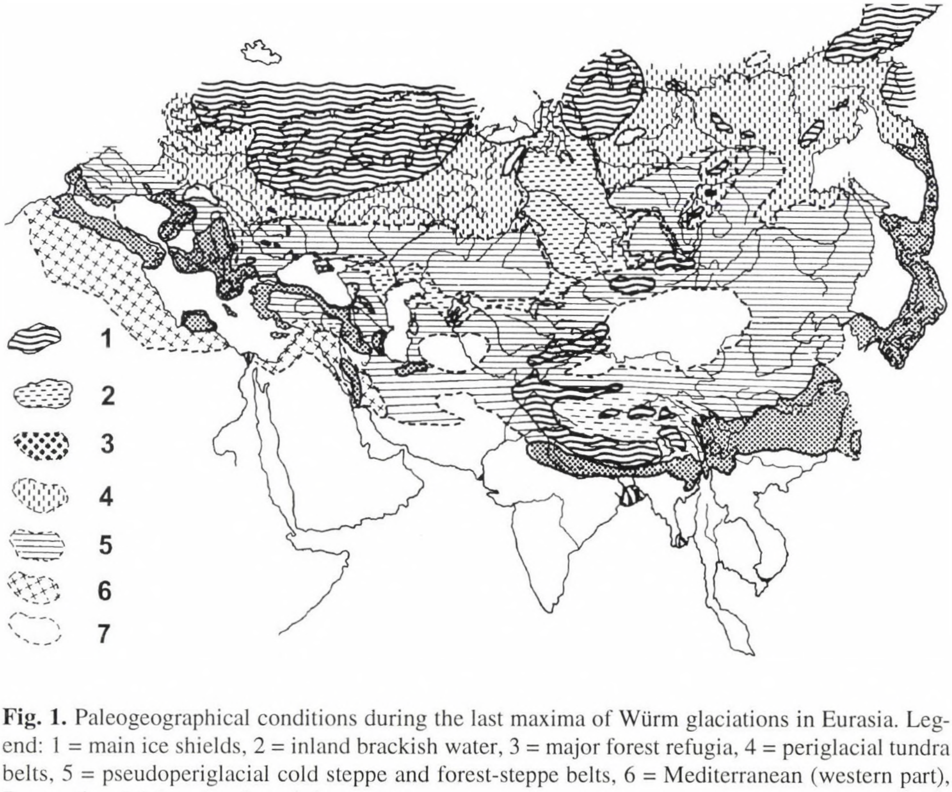


Fig. 1. Paleogeographical conditions during the last maxima of Würm glaciations in Eurasia. Legend: 1 = main ice shields, 2 = inland brackish water, 3 = major forest refugia, 4 = periglacial tundra belts, 5 = pseudoperiglacial cold steppe and forest-steppe belts, 6 = Mediterranean (western part), 7 = continental desert and semi-desert areas

also in the subspecific divisions of many widely distributed polytypic species with disjunct areas. A detailed chorological survey and the phylogeographical analysis of some monophyletic species groups, and polytypic species of the Palaearctic Noctuidae (mostly Noctuinae and Hadeninae) will be published in a subsequent paper.

The problem of the unit of the biogeographical analysis: the species, the genus or both?

Most biogeographical and taxonomic publications deal with the description, mapping and analysis of ranges of species. As "*faunal elements*", species (or subspecies of polytypic species, see DE LATTIN 1967) are usually considered as the units of biogeographical typisation. It appears to be evident that the ranges of species with some geographical congruences can be accepted as "imperfect repetitions", considered as basic objects of "Geographical Ecology" (MACARTHUR 1973: 77). There are numerous closely related concepts in the biogeographical literature which reflect essentially the same regularity: the partial overlap of a large number of ranges in well-defined regions (see the review of UDVARDY 1981). KULCZYNSKI (1923) demonstrated the regularities of overlap in a large number of boreal and arctic-alpine plant species. His method was "systematized" by HULTÉN (1937) who formulated the principle of "*aequiformal progressive areas*". They unite those species areas that reflect more or less concentric radiation from some core areas wherein all areas of a certain geographical pattern overlap. He considered these centres as glacial refugia from which "progressive" species irradiate, while "centrant" species remain within or near these refugia. Practically the same principle was nearly simultaneously applied by REINIG (1937, 1950), who outlined a number of climatically favourable areas of the Holarctic region as glacial refugia. STEGMANN (1938) designated the set of species having "aequiformal" areas as a *faunal type*, a term which has been used by several authors (e.g. DE JONG 1972, VOOUS 1960, 1963). I consider this term to be practically synonymous with DE LATTIN'S "*Faunenkreis*" which refers to the set of species (in polytypic species: subspecies) having the same "dispersal centre" ("*Ausbreitungszentrum*"). He emphasizes the continuous series of dispersal capacity of species which connect the "*stationary*" species, restricted to the core areas to those which could irradiate, i.e. the "*expansive*" members of the same faunal type. VARGA (1975*a*, *b*, 1977) suggested a simple model for the centrifugal decrease of species belonging to a given faunal type, describing it as an inverse function of the logistic equation, generally used in the population biology (Fig. 2).

Based on this model, the vicarious stationary species and the disjunct subspecies of polytypic species were characterised by a "*refugial*" type of speciation. On the other hand, the "*post-dispersal*" marginal isolates of the expansive species were contrasted with the former ones as cases of peripheric speciation and subspeciation, respectively. In addition, the necessity of the analysis of the core areas of species-rich genera was pointed out, especially in those ones which consist of a large number of "stationary" species (e.g. in the case of Lepidoptera species connected to orobiomes). The same conclusion can be drawn by the analysis of stenochorous high mountain species of Orthoptera (LA GRECA 1977, LA GRECA & MESSINA 1977, 1979, PRAVDIN & MISTSCHENKO 1980, WILLEMSE 1971, 1972, 1973, 1977, 1984).

The idea that supraspecific taxa can be considered as units of biogeographical analysis, is also possible. KOSTROWICKI (1969) considered genera as useful tools for statistical comparisons to outline faunal types and faunal regions as well. Other authors emphasized the phylogenetic significance of supraspecific taxa. KRYZHANOVSKY (1965) argued that genera are units of zoogeographical analysis by "common origin", by essentially the same morphology and ecology of species belonging to the same genus. PRAVDIN & MISHTSHENKO (1980) ex-

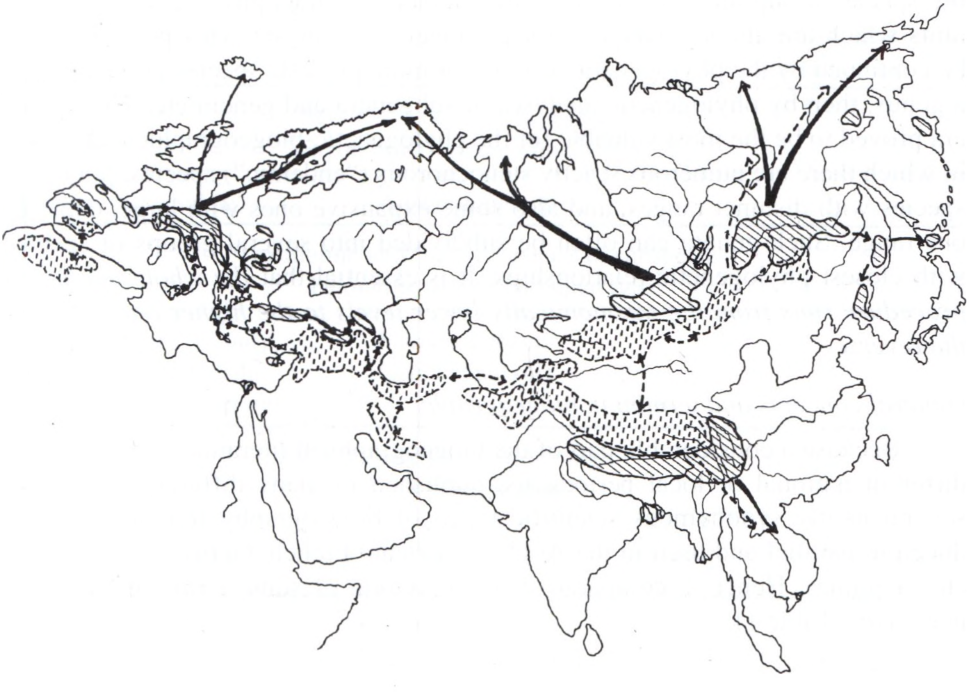


Fig. 2. Main areas of distribution and area connections of alpine and xeromontaneous biota. Legend: 1 = major areas of alpine biota (horizontally hatched with full lines), alpine and tundro-alpine area connections: black arrows; 2 = major areas of xeromontane biota (vertically stripped), xeromontane areal connections: broken arrows

tend this view with the idea that the centres of species diversity of genera give information on their origins and history, which is essentially not a new idea. Many new approaches deal with the area cladograms of species groups, genera or suprageneric groups in order to "translate" a phylogenetic hypothesis about organisms with a given geographical distribution into a hypothesis about distributional history of these taxa (ENGHOFF 1993, 1995, DE JONG 1974, 1978, OOSTERBROEK & ARNTZEN 1992 etc.). Noctuid moths, providing the bulk of the factual data of this paper, are also considered to be very suitable for a phylogenetic-biogeographical analysis LAFONTAINE 1981, LAFONTAINE & KONONENKO 1986, LAFONTAINE *et al.* 1983, VARGA 1989*b*, VARGA *et al.* 1989, 1990).

Thus, it appears to be evident that the integral biogeographical analysis consists of several subsequent steps (VARGA 1977). Working hypotheses outlined by comparative areographic methods can be tested by phylogenetic biogeographical methods. Units of the areographical analysis are the ranges of species. Core areas drawn by the distribution of stenochorous ("endemic") species can be affirmed by the allopatric subspecies of polytypic species, and by allopatric semi-species or sibling species of superspecies. Superspecies consisting of allopatric taxa of the species-group are considered as the elementary monophyletic supraspecific units which are already adequate for phylogenetic analysis. This procedure can be continued by the phylogenetic analysis of monophyletic species groups within a genus, then by phylogenetic analyses of subgenera and genera etc. Those genera proved to be the most valuable for the phylogenetic-biogeographical analysis, in which there are numerous strictly stenochorous ("endemic") species, polytypic species with disjunct ranges, and also some expansive ones with large, continuous range. Such genera can often be subdivided into several groups of species with closest phylogenetic relationships. It is essential that *the whole multi-step procedure runs from the taxonomically lower levels to the higher ones and not the reverse.*

General concepts and termini in biogeography

Because a considerable part of the biogeographical literature is dispersed in different national or local periodicals, published in many different languages, several nearly synonymous scientific terms of biogeography have been introduced in parallel and used in the Anglo-American, French, German and Russian etc. literature. Hence, a comparative interpretation of some terms seems to be necessary (Table 1).

Table 1. Comparative interpretation of some biogeographical terms

<table>
<tr><td colspan="3">Biogeographical entity consisting of taxa (species or subspecies) sharing the same core area</td></tr>
<tr><td>Faunal type (E)</td><td>Faunenkreis (G)</td><td>Tip fauny (R)</td></tr>
<tr><td colspan="3">Faunal unit (only nearly synonymous, see DENNIS <i>et al.</i> 1991) equiformal progressive areas (only nearly synonymous, see HULTÉN 1937, 1963)</td></tr>
<tr><td colspan="3">Area of congruence in ranges of species</td></tr>
<tr><td>Area nuclei, nuclear areas, core areas (E)</td><td>Arealkerne (G)</td><td></td></tr>
<tr><td colspan="3">Area of survival of a set of taxa (species or subspecies) or assemblies of species under unfavourable ecological conditions (e.g. glaciations)</td></tr>
<tr><td>Refuge (E)</td><td>Refugium (G)</td><td>réfuge (F)</td></tr>
<tr><td colspan="3">Core area of dispersal of a set of taxa (species or subspecies)</td></tr>
<tr><td>Dispersal centre (E)</td><td>Ausbreitungszentrum (G)</td><td>centre d'irradiation (F)</td></tr>
<tr><td colspan="3">Set of taxa (species or subspecies) expanding from the same core area</td></tr>
<tr><td>Type of dispersal (E)</td><td>Ausbreitungstyp (G)</td><td></td></tr>
<tr><td colspan="3">Taxonomic unit (mostly species or subspecies) belonging to a given faunal type:</td></tr>
<tr><td>faunal element (E; only rarely used in English biogeographical literature)</td><td>Faunenelement, Geoelement (G)</td><td></td></tr>
<tr><td colspan="3">Taxa with a wide range of distribution</td></tr>
<tr><td>extent group, widespread speciues (E)</td><td>expansive Arten (G)</td><td></td></tr>
<tr><td colspan="3">Taxa of very limited range, restricted to the core area</td></tr>
<tr><td>endemic, stenochorous (rarely used), stationary, "centrant" species (E)</td><td>stenochore Arten, stationäre Arten (G)</td><td></td></tr>
</table>

DIVISION AND BIOGEOGRAPHICAL CONNECTIONS OF THE OREAL FAUNA

The most plausible division of oreal biomes and faunal types is possible by reviewing the factors which determine the "non-arboreal" conditions.

The fauna of the humid high mountains (of alpine s. l. type)

Many high mountains extend to humid regions where fluviatile erosion predominates in lower and moderate altitudes, and the snow-line is relatively low. The alpine and higher belts are characterized by the well-known alpine geomorphological features, e.g. sharp ridges, glacial cirques and long glacier tongues reaching into the deep valleys (usually with a zone-inversion), sometimes down to the forested belts, especially in the regions of expressed oceanic climate. These high-lying open biomes are bordered, as a rule, by a timberline, and in the "*Kampfzone*" of arboreal and non-arboreal biomes, the zonation of a scrub-community ("*Krummholz" scrub-like Pinus, Juniperus, Betula, Rhododendron* and different Ericaceae) is characteristic. Seasonal humidity, solifluction, the occurrence of peat-bogs and the regular snow-cover of long duration resemble conditions in the tundral zonobiome. Hence, numerous members of alpine faunal complexes became pre-adapted for dispersal into tundral (i.e. periglacial) belts by the retreat of forests during glacial phases. Of course, upward migration of tundral species into alpine elevations was equally possible, brought about by extensive inter- and post-glacial re-afforestation, which has led to the formation of characteristic oreo-tundral disjunctions.

The alpine (s. l.) faunal type was subjected to the most extensive migrations and area translocations during the oscillating glacial and interglacial phases. This faunal type is, on the other hand, at present most restricted in its dynamics by arboreal belts (Fig. 2).

The oreal fauna of arid high mountains

The other basic type of oreal biome and faunal complex is the *xeromontane* one. The term "*eremoreal*" would be grammatically more correct (a Greek-Greek combination), but the former "chimaera-like" (Greek-Latin) notion has already been used in the zoogeographic literature (STEGMANN 1938, VOOUS 1963), although in a more restricted sense (as "*paleomediterran-xeromontane*").

In the oreal belts of *xeromontane* type, *physical weathering* processes predominate: thermal- (incl. frost) fluctuation, leading to the formation of vast masses of clastic rocks and gravels subjected to gravitational movements and to the establishment of gravel pediments, ravine pyramids etc. It is also important to note that *xeromontane biomes* often do not cover *whole* mountains, but form mosaic-like patterns of habitats, often surrounded by alpine belts, e.g. in several European or Southern Siberian high mountains. On mountains (or parts of mountains) of xeromontane character the snow-line lies essentially higher than in comparable mountains of the alpine type (cf. MANI 1968: 28), and the snow-cover is often irregular and sparse. Primary production is inhibited not only by the often extremely cold winter season, but also by the seasonal aridity. Hence, the level of bioproductivity is often lower here than in the mountains of the alpine type, and their vegetation is semidesert- or desert-like (e.g. Pamir plateau, Gobi Altaj Mts, parts of the Tibetan plateau etc., WALTER & BOX 1983, WALTER & BRECKLE 1986).

Because the xeromontane belts are now surrounded mostly by eremial zonobiomes, their ecosystems are not, or only insignificantly, delimited by the timberline. Hence their elements are not inhibited from dispersal into the zonal steppes and deserts. This situation was essentially similar during the whole Quaternary, less influenced by the alternation of the cold and temperate phases. Thus, the xeromontane fauna could serve as an important source for the genesis of the eremic one. We can observe a nearly continuous transition of xeromontane and eremic patterns of distributions in numerous genera of Noctuidae, being typical for arid belts in Central and Inner Asia.

Quaternary dynamics in the xeromontane fauna

Therefore, in the xeromontane fauna the range fluctuations and translocations have been, as a rule, not as extreme as in the alpine one. Only during the extremely continental late glacial and earliest postglacial ("kryoxerotic") phases (before the major postglacial re-afforestation) a major fraction of continental elements, connected to open habitats, could spread into Europe, and the most Mediterranean-xeromontane species could populate only the typical summer-dry Mediterranean mountainous regions (Atlas, arid parts of the Iberian peninsula, southern Balkan peninsula, Asia minor etc.). During the postglacial vegetation history of Central Europe, there was not a single climatic phase which could have promoted the dispersion of xeromontane species. Hence, no extra-Mediterranean zonobiome, as opposed to e.g. the southern Balkanic – W Asiatic *Astragalo-Acantholimetalia* orobiome, consists of a number of xeromontane species. Their scarce representatives in Central and Northern Europe are mostly "pre-Litorina" relicts, occurring either above the tree-line in xeric habitats (e.g. Central Alps) or in the unforested habitats of moderate and low altitudes, determined by extreme edaphic and/or microclimatic conditions.

However the largest and obviously richest xeromontane biomes of the Palaearctic occur, mostly in the mountainous massifs of Central and Inner Asia. The highlands of Inner Anatolia and Armenia already represent a fraction of this fascinating world, but the greatest part of the Tien-Shan mountain system, the Pamir-highland, the magnificent chains of Hindukush, Karakoram and Trans-Himalaya, the high massifs of Mongolia, Tibet and Ladakh are the true "homelands" of this faunal type: the faunal type of Marco Polo's Argali (Fig. 3), Altai Ibex, Snow leopard, Bearded and Griffon Vultures, Chukar Partridge, Snowcocks (*Tetraogallus*), Redstarts (*Phoenicurus*), many endemic flightless grasshoppers (e.g. *Conophyma, Paraconophyma, Bienkoia, Saxetania* etc., see: PRAVDIN & MISHTSHENKO 1980) and last but not least, grass-root feeding cutworms (Noctuidae, mostly Noctuinae).

We conclude that both the alpine and xeromontane faunal types are of general importance for the composition and genesis of the Palaearctic fauna, and despite the existing differences mentioned above, they also have some parallel features in their regional division (Fig. 2).

Disjunctions in the arboreal vs. oreal fauna

The macrogeographic division of the oreal biomes is obviously the consequence of their *antagonistic dynamics* in relation to the arboreal zonobiomes. The expansion of the arboreal ecosystems in temperate belts, iterating in intergla-

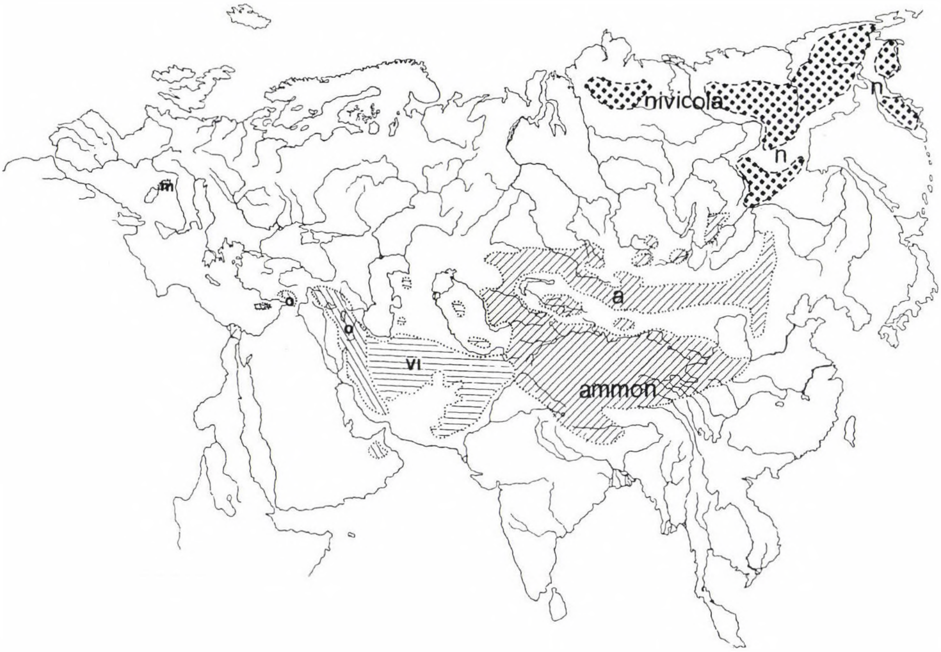


Fig. 3. Distribution of the major taxa of mountain sheep: *Ovis ammon* species-group. Legend: m = *O. musimon*, o = *O. orientalis* (probably conspecific with the former one) vi = *O. vignei*, ammon: *O. ammon ammon*, a = *O. ammon altaicus*, nivicola + n: *O. nivicola*

cial/interstadial periods and also in the Holocene, resulted, in these latitudes, in a general regression and disjunction of the oreal biomes and also of the distribution areas of their inhabitants. The expansion of the arboreal biomes caused a wide diversification of sizes and shapes in the ranges of their faunal elements with a nearly continuous variance. Hence, it is often not simple to recognize the stationary and expansive extremes of the same faunal type (cf. DE LATTIN 1975, 1964, 1967), e.g. stationary Mandzhurian species vs. trans-Palaearctic Eurosiberian ones, or stenochorous Mediterranean elements vs. widely distributed Mediterranean-Central European ones.

On the other hand, the regressive disjunctions caused superficially similar shapes of geographical ranges in oreal and oreo-tundral species of different origin. Thus, the revision of the stenochorous species, or of the genera rich in such species, may be highly significant for the analysis of the oreal fauna. The phylogenetic-biogeographical analysis of several such cases will be attempted in a subsequent paper.

Chorological review of the alpine fauna

Because the alpine fauna is generally better known and carefully analysed in its details, I will present only a short, thesis-like review of statements on its main features and tendencies here.

1. The tundro-alpine disjunction, analysed in numerous publications (e.g. ANT 1965, ANDER 1949, ASPÖCK 1963, EHRLICH 1958, HOLDHAUS 1954, HOLDHAUS & LINDROTH 1939, IVERSEN 1958, KULCZINSKY 1923, DE LATTIN 1957, 1967, VARGA 1975*a, b*, 1989*c*, 1995*b*, WALTER & STRAKA 1970, WARNECKE 1959), is a general phenomenon in vascular plants and also in most major groups of animals.

2. The tundro-alpine type of disjunction, and the Eurasian or even Holarctic extension of distribution show a strong positive correlation which confirms that both features must have a common historical background (VARGA 1975*b*, 1989*c*, 1995*a*) , i.e. capable these species were of spreading zonally into the periglacial belts during some more recent glacial phases (mostly Riss and/or Würm; Illinois and Wisconsin glaciations, resp.).

3. The purely alpine (s. l.) distribution is, on the other hand, strongly correlated with regional (e.g. European) or sub-regional size in range (often endemic in some high mountains with extended alpine elevations, e.g. Pyrenées, some parts of the Alps, the highest massifs of the Balkan peninsula or – in the eastern parts of the Palaearctic – the huge mountain systems of the Altai and Sajan, see: VARGA 1989*c*). These species could survive the glacial periods in mountainous refugia at the margin of the mountain glaciations (e.g. "massifs de refuge", in the less glaciated alpine belts (e.g. in the high mountains of the Mediterranean penin-

sula) or – in special cases – in refugial patches within the major glaciations (i.e.: "nunatak" refuges, JANETSCHEK 1956).

4. Numerous widely distributed alpine species do not occur in the Northern Calcareous Alps or in the Northern Carpathians. These mountains also seem to be poor in endemic high mountain species. The relatively small and scattered extension of the alpine belts, combined with unfavourable climatic conditions ("Nordstaulage") in these mountains can explain this fact. Numerous species groups which are mostly distributed in southern European high mountains of alpine type, are often represented by vicariant species pairs in southwestern and southeastern Europe, respectively, separated by this "gap". The presence of this N Alpine – N Carpathian "gap" gives us the possibility for basic regionalisation of the European oreal fauna of the alpine type (Fig. 4).

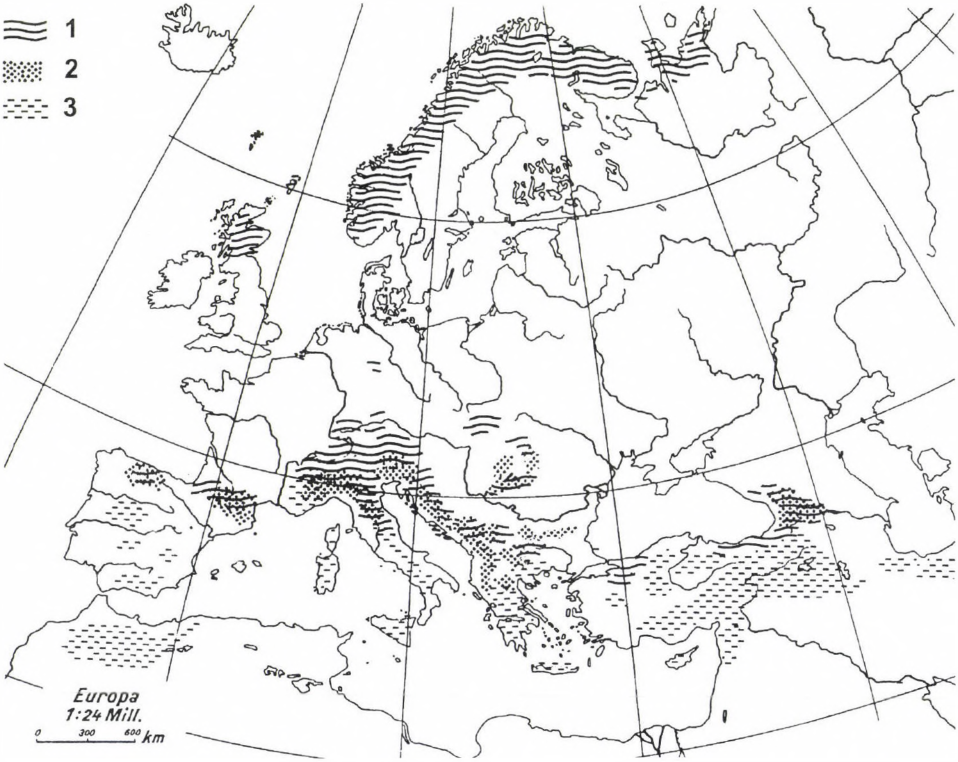


Fig. 4. Glacial events as factors of regional division in the Western Palaearctic oreal fauna. 1 = Territories directly influenced by glaciations: only alpine and arctic-alpine species; 2 = Areas of survival of relict-like alpine species displaying a western-eastern European subdivision, often with vicariant sister species/subspecies; 3 = Main areas of distribution of xeromontane species

5. The alpine type of fauna has a typical insular character. A high level of similarity was found among certain parts of the Alps, and also among some more remote mountain massifs (Pyrenées, Sar-planina, Rila and Pirin) which have extended "islands" of alpine belts, and thus permit the survival of numerous alpine species (VARGA 1975*b*, 1995*a*).

6. Preliminary considerations on phylogenetic patterns of some alpine Lepidoptera suggest the possibility of very large heterogeneity in their origins. Only some typical cases can be mentioned here:

- Long-distance isolates, with vicariant species (or only subspecies!) in Southern or Eastern Siberia and/or Northern America (*Erebia christyi* RÄTZIUS, *E. flavofasciata* HEYNE, *E. tyndarus* ESPER -group, *Euphydryas ichnaea wolfensbergeri* FREY, *Euxoa culminicola* STAUDINGER, *Agrotis fatidica* HÜBNER etc.).
- Alpine endemisms probably evolved from their arboreal relatives, distributed at medium altitudes in close proximity, e.g. *Mellicta varia* MEYER-DÜR (*M. parthenoides* KEFERSTEIN), *M. asteria* FREYER (*M. aurelia* NICKERL - group), *Euphydryas debilis* OBERTHÜR (*E. aurinia* ROTTEMBURG, in which the speciation process is seemingly not yet complete!), etc.
- Alpine endemisms with more widely dispersed oreal and/or oreotundral relatives which indicate their probably autochtonous evolution as neo-endemics, e.g. numerous species of *Setina, Psodos, Gnophos*.

An analogous heterogeneity is also evident among SE European ("*pontomediterranean oreal*") species. Ponto-atlantomediterranean or ponto-mediterranean-W-alpine disjunctions are often to be observed (*Boloria graeca* STAUDINGER, *Erebia ottomana* HERRICH-SCHAEFFER, *E. rhodopensis* NICHOLL / *aethiopella* HOFMANNSEGG, *Anaitis simpliciata* TREITSCHKE etc.), but some of the pontomediterranean oreal species have their closest relatives among the members of the Siberian faunal type (such species-pairs are e.g. *Lycaena candens* HERRICH-SCHAEFFER / *hippothoe* LINNAEUS, *Aricia montensis* VERITY / *artaxerxes* FABRICIUS, *Coenonympha rhodopensis* ELWES / *tullia* MÜLLER etc., see also VARGA 1989*c*).

Chorological review of the xeromontane fauna

Taxonomic and evolutionary aspects of biodiversity in the xeromontane fauna. Like its alpine counterpart, the xeromontane faunal type also has a general trans-Palaearctic (or trans-Holarctic) range of distribution, sometimes with marginally fragmented exclaves in tropical latitudes of Asia, Africa and South America. Its importance becomes evident from its richness of entirely xeromontane genera, e.g. Satyridae: Karanasa (AVINOFF & SWEADNER 1951), *Paralasa, Boeberia, Pseudochazara*; Noctuidae: *Pachyagrotis, Hemiexarnis, Ledereragrotis, Xenophysa, Bryopolia, Bryoxena, Margelana, Victrix,* etc.; (a large number of coleopteran groups of this nature is mentioned by KRYZHANOVSKY 1965), or by a large number of widely distributed, highly diverse genera, which have the highest number of species in the xeromontane belts, e.g. Papilionoidea: *Parnassius, Colias, Oeneis, Agrodiaetus* (examples: Fig. 5), *Polyommatus*; Noctuidae: *Euxoa, Dichagyris, Yigoga, Parexarnis, Protexarnis, Rhyacia, Chersotis, Eugnorisma, Discestra, Ctenoceratoda, Sideridis, Conisania, Polymixis, Dasypolia, Cucullia, Oncocnemis* etc. (HACKER 1993*a, b*, RONKAY 1988, RONKAY & VARGA 1986, 1989, 1990*a, b*, VARGA 1975, 1989*a*, 1990*a, b*, 1992*a, b*, VARGA & RONKAY 1987, 1989, 1991, VARGA *et al.* 1989, 1990 etc.).

It is quite typical that the noctuid fauna of Turkey, with its large xeromountainous areas, consists of about 1300 species (1032 spp. are enumerated by HACKER 1990), as opposed to the whole European fauna which can equally be estimated at about 1300 species (1104 spp. are mentioned by HARTIG & HEINICKE 1973, 1291 spp. are listed by FIBIGER & HACKER 1991). Good evidence for the high species-diversity of the xeromontane Noctuidae is shown by HACKER (1990).

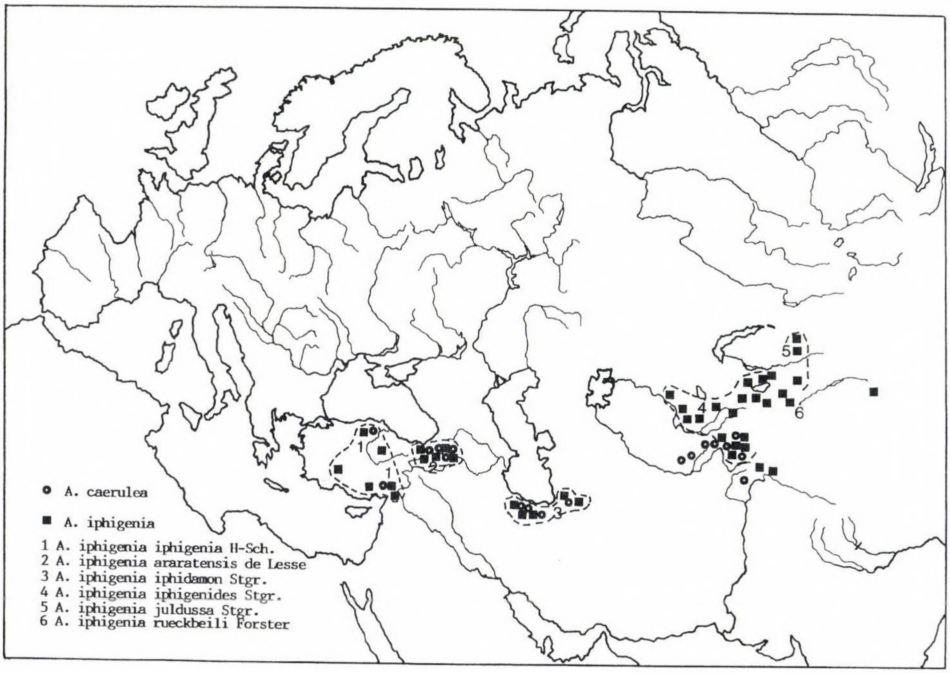


Fig. 5. Distribution of two polytypic-polycentric xeromontane species of the Lycaenidae genus *Agrodiaetus: A. caerulea* STAUDINGER and *A. iphigenia* HERRICH-SCHAFFER displaying an evident division according to the core areas of the xeromontane fauna. The boundaries of the eastern subspecies of *A. iphigenia* are not completely clarified

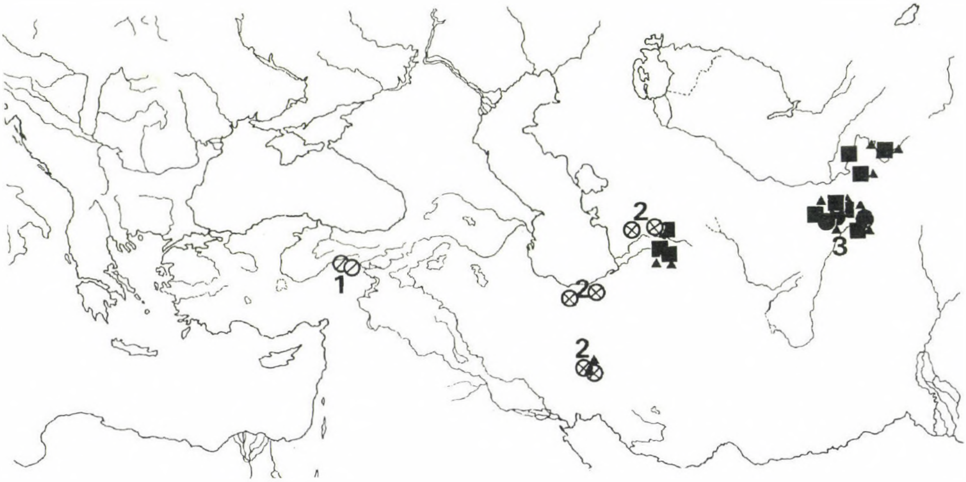
Numerous, obviously monophyletic groups of closely related species (i.e. groups of sibling species, pairs of sister-species, or simply subspecies of widely dispersed polytypic species) of these genera are exclusively xeromontane and are highly characteristic for some regional units of Palaearctic mountain systems, e.g. *Eugnorisma* subg. *Metagnorisma* (VARGA & RONKAY 1987), *Euxoa* subg. *Pleonectopoda hilaris* FREYER-group, *Dichagyris psammochroa* BOURSIN-group (VARGA 1993, Fig. 6), *Xenophysa junctimacula* CHRISTOPH -group (VARGA 1989), *Chersotis capnistis* LEDERER-group (VARGA & RONKAY 1996), *Rhyacia subdecora* STAUDINGER-group, *Dichagyris clara* STAUDINGER-group, the whole genus *Ostheldera* (RONKAY & VARGA 1991 several species-groups of the genera *Bryopolia* and *Bryoxena* for details and maps of distribution, see VARGA *et al.* (1990).

The relatively large number of completely or mainly allopatric distribution patterns in these pairs or groups of very closely related (*sibling*) species can surely be evaluated here as a strong evidence for the allopatric type of speciation. The great morphological similarity (e.g. only minor modifications of the same basic patterns of "*lock-and-key*" mechanisms in the male and female genitalia, of which there are many examples from the very diverse genera: *Euxoa, Dichagyris, Eugnorisma, Xestia, Apamea, Conisania, Sideridis* etc., see LAFONTAINE 1981, 1987, LAFONTAINE *et al.* 1983, LAFONTAINE & MIKKOLA 1987, VARGA & RONKAY 1987, 1991, VARGA 1991) and close taxonomic relations of members in these species groups suggest a relatively rapid speciation.

In some species groups the restricted occurrence of some closely related species is combined with a much wider distribution of a "successful" sister species which could transgress some ecological barriers. This fact becomes evident e.g. from the taxonomical-chorological analysis of the *Chersotis elegans* EVERSMANN – species-group in which the expansive, partially already overlapping, secondarily "Mediterranean-xeromontane" areas of two, "succesful" species (*Ch. anatolica* DRAUDT, *Ch. elegans* EVERSMANN), which were obviously separated earlier, is combined with the marginally isolated areas of two stenochorous species (*Ch. kacem* LE CERF, *Ch. eberti* DUFAY & VARGA), which are more closely related to *Ch. elegans* EVERSMANN (DUFAY & VARGA 1995, Fig. 7). This step in evolution is often combined with a change of life-strategy (aestivation of imagines, connected with a strong development of fat bodies: *Chersotis capnistis*-group, VARGA & RONKAY 1995, see also Fig. 10) or of the habitat (*Euxoa cursoria* HUFNAGEL– group, *Agrotis ripae* HÜBNER – group: a rapid, Quaternary adaptation and dispersal in riparian and halophytic habitats).

Here is the place to mention that not only are there numerous important cultivated plants of xeromontane origin (e.g. cereal crops, maize, alfalfa etc.) but so are some widely dispersed insect pests (e.g. from genera: *Euxoa, Agrotis, Discestra* etc.).

Fig. 6. Distribution of the *Dichagyris psammochroa* species-group (white circles with markings & black circles): 1 = *D. cataleipa*, 2 = *D. psammochroa*, 3 = *D. afghana*. Distribution of *Euxoa sigmata* (black squares) and *E. aneucta* (black triangles)



The xeromontane-eremic and xeromontane-tundral faunal connections

The xeromontane biomes and fauna have manifold contacts and connections with other open, non-arboreal belts. Most obvious is their contact with the eremic zonobiomes. A major fraction of prevailing xeromontaneous genera has widely dispersed representatives in the eremic regions, e.g. *Dichagyris imperator* BANG-HAAS, distributed from southern Spain and N Africa to the deserts of Arabia, closely related to the xeromontane *D. melanura* KOLLAR – *D. grisescens* STAUDINGER-complex; *Euxoa fallax* EVERSMANN, a desert species which occur from Transcaspia and Kazakhstan to the Dzhungarian and Transaltai Gobi in Mongolia, and is closely related to *E. praestigiosa* BRANDT (Iran) and *E. cespitis* SWINHOE (Afghanistan and W Pakistan). *Euxoa c. cursoria* HUFNAGEL and *Agrotis r. ripae* HÜBNER, generally occurring in littoral sand-dune or semidesert-like halophytic ecosystems, have closely related stenochorous vicariants (often only infraspecific taxa!) in Western and Central Asia. The taxonomic relations within the *Agrotis ripae*-group need further revision. Similar cases can also be mentioned in the eremic genera *Cardepia, Cardiestra, Hadula, Saragossa*.

It should be mentioned here that the species of xeromontane origin made an important contribution to the genesis of the steppe fauna. There are numerous species which have a wide range of distribution in the Palaearctic steppe belts as well, e.g. several species of the *Lycaenid* genus *Agrodiaetus* (Fig. 5), a great number of Noctuidae, Noctuinae: numerous *Euxoa*, *Dichagyris* (Fig. 6), *Eugnor-*

isma etc. species. The total number of such species in the Palaearctic certainly exceeds one hundred. The terricolous "*cutworm*" life-form of their larvae, probably evolved in xeric montainous regions, surely has an outstanding (but incompletely studied) importance in the trophic organisation of the temperate grassland ecosystems.

The tundral connections of some, originally xeromontane genera display a complicated picture. In the genera *Colias* and *Oeneis*, those species that have a southern-eastern Siberian and Mongolian high mountain distribution, are also dispersed through the tundra areas. The mountain tundras ("*goltsy*") of the eastern Siberian Pacific mountains could serve as "stepping-stones" for their dispersal to the north. Numerous species of *Colias* and *Oeneis* (e.g. *Colias tyche* BOEBER, *C. melinos* EVERSMANN, *C. mongola* ALPHERAKY, *C. hecla sulitelma* AURIVILLIUS, *Oeneis norna* THUNBERG, *Oe. jutta* HÜBNER, *Oe. tarpeia* PALLAS, *Oe. mongolica* OBERTHÜR, *Oe. sculda* EVERSMANN, *Oe. melissa* SAYER, *Oe. bore* SCHNEIDER) are inhabitants of southern Siberian – northern Mongolian high mountains. Some of the subspecies of *C. hecla, Oe. norna, Oe. jutta, Oe. melissa,*

Fig. 7. Distribution of the *Chersotis elegans* species-group Hatched areas: *Ch. elegans,* holomediterran-xeromontane species with wide area in the steppe zonobiome; black circles with white bar: *Ch. kacem,* Mauretanian-xeromontane species; black circles with white dot: *Ch. eberti,* Iranian-xeromontane species; dotted areas: *Ch. anatolica,* Holomediterranean-xeromontane species with local exclaves in the steppe zonobiome

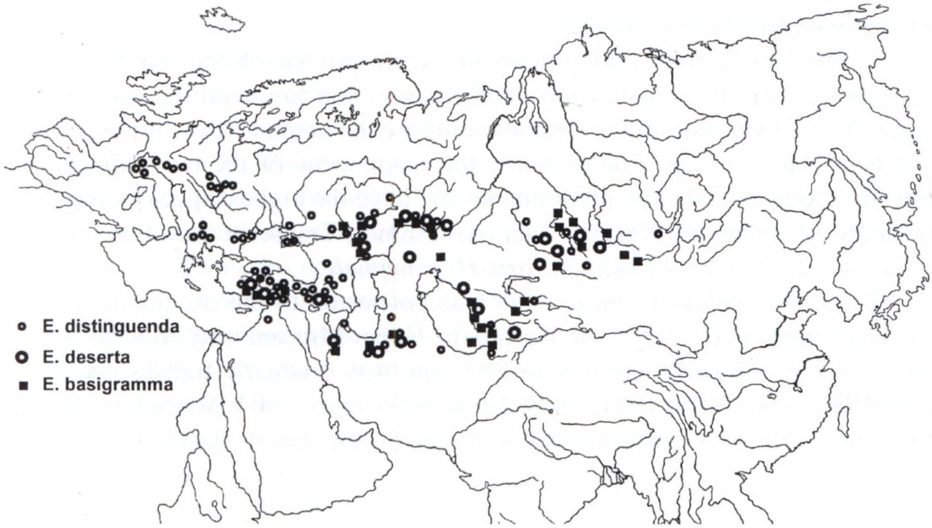
Oe. bore were also able to populate vast areas of the Eurasian and North American tundra belts. On the other hand, they do not occur in the European high mountains. They were obviously inhibited by some barriers (probably by the western Siberian – Caspian glacial sea, see Fig. 1, so they were unable to populate the Western Palaearctic periglacial belts. As a contrasting example we can mention the European alpine species *Colias phicomone* ESPER and *Oeneis glacialis* MOLL which – although closely related to the xeromontane and tundral species of their genera – do not occur in northern territories.

In Holarctic Noctuidae, the xeromontaneous origin of the *Anarta* (s. l.) generic complex (closely related to *Discestra*) and of the typical arctic-alpine *Sympistis* (almost impossible to separate from *Oncocnemis*) can be accepted as strong evidence supporting the importance of the continental xeromontane fauna in the formation of the Holarctic tundral faunal complex.

As a model example, the evolutionary history of the mountain sheep: *Ovis ammon–nivalis* species group can be mentioned here (HEPTNER 1966, NADLER *et al.* 1973, Fig. 3). They form a Holarctic superspecies of xeromontane origin with an eastern Siberian – North American irradiation into the tundra biome. The dis-

Fig. 8. Distribution of *Euxoa (Chorizagrotis) lidia* (incl. *E. [Ch.] inexpectata, arenacea, flavogrisea, expugnata* etc.). A polymorphic xeromontane species with littoral and montane exclaves in NW Europe

Fig. 9. Distribution of three *Euxoa* species: xeromontane species with irradiation into the zonal steppe areas *(E. distinguenda, E. basigramma, E. deserta)* and edaphic grasslands of S European mountains *(E. distinguenda)*



persal scenario of the well-known, highly polytypic Holarctic "hilltop" Green-Veined White *Synchloe callidice* HÜBNER (Fig. 10) with its Nearctic relatives (*S. occidentalis, S. nelsoni, S. protodice* and *S. orientalis*) must be a fairly similar story, judging from the picture of its distribution and subspecific division (cf. DESCIMON 1986, FORSTER 1958, KLOTS 1933, MANI 1968, SHAPIRO & GEIGER 1986, SHAPIRO 1989).

Geographical subdivisions and faunal connections in the Palaearctic xeromontane belts

The delimitation of the xeromontane belts from the alpine ones is sometimes rather sharp, e.g. the ADAMOVIC-line on the Balkan peninsula (ADAMOVIC 1908, VARGA 1975*b*, 1994), in other cases, however, it is more intricate. It is often determined by mesoclimatic factors, e.g. the influence of "Föhn" in Central Alpine valleys or the importance of exposure in several high mountain areas of Central Asia.

One of the most important features of the Palaearctic xeromontane fauna is a basic, *Mediterranean vs. Continental duality* (Fig. 2 see also VARGA 1995*b*, Fig. 1). Its historical background is probably connected to the basic fact that the Balkans and the western part of Asia Minor (the Helleno – Anatolian plate) were, since 17 MYBP, newly separated by the *Paratethys* from East Asia Minor and from the other eastern parts of the Eurasian continent (OOSTERBROEK & ARNTZEN 1992, RÖGL & STEININGER 1983, 1984, STEININGER *et al.* 1985). Further evolution (since approximately the latest Miocene) of this faunal type has been influenced by two main geological processes which have led to the establishment of huge open habitats in Eurasia:

1. The late Tertiary aridity crisis in the eastern Mediterranean basin which has largely reduced the extension of *Paratethys* and favoured the spread of savanna-like and xerophyllous formations. Before the breakdown of the Aegeis, the Helleno-Anatolian plate was probably the main scene of the radiation of those butterfly groups which now predominate and have the highest species diversity in arid high mountains of Western Asia (Asia minor, Transcaucasia, Iran etc.), e.g. *Agrodiaetus, Chazara, Pseudochazara, Hyponephele.*

2. Another fundamental process was connected to the orographic and climatical changes in Central Asia. During the Upper Miocene and Pliocene the arid zone, lying in the early Tertiary in SE Asia, was gradually translocated to the North/West (HSÜ YEN, 1981, 1984, LI XI-WEN *et al.* 1984, WANG XIAN-ZENG 1984, etc.). The originally tropical-subtropical hot desert changed into an ex-

Fig. 10. Eurasiatic distribution of the Holarctic Green-Veined "hilltop" White: *Synchloe callidice*

tremely continental, cool temperate one, surrounded by older (Tien Shan, Altai) and newly emerged mountain systems (Himalaya, Karakoram, Pamir).

The main consequences of these palaeogeographical processes are as follows.

- The xeromontane faunal type shows close biogeographical connections to the xeric (sub-mediterranean, ponto-mediterranean) arboreal biomes (sclerophyllous and scrub-forests, e.g. *Metagnorisma*, some groups of *Agrochola, Polymixis, Antitype,* etc.). Southern Balkanic – Anatolian connections and vicariances can be observed in xeromontane and xeric arboreal species. In many cases the circum-mediterranean xeromontane and xeric arboreal connections are evident, with the evolution of vicariant species (e.g. *Agrochola, Polymixis, Eumichtis* spp., *Xylena lunifera* WARREN).
- Core areas of stenochorous xeromontane species are dispersed in the Mediterranean high mountains from the Atlas and Sierra Nevada to Daghestan, Transcaucasia, W and N Iran and Transcaspia (Kopet-Dagh), e.g. the relict-like members of the subgenus *Pleonectopoda* (genus *Euxoa*): *E. nevadensis* ZERNY, *E. haverkampfi* STANDFUSS, *E. hilaris* FREYER, *E. conifera* CHRISTOPH, *E. rjabovi* KOZHANTSCHIKOW, *E. inclusa* CORTI, the species-pair *Chersotis rungsi* BOURSIN – *Ch. stenographa* VARGA, etc. The mountains of southern Greece (e.g. Parnassos, Tymphrystos, Chelmos, Taigetos) are especially rich in xeromontane species (Noctuidae: HACKER 1989; also in *Orthoptera,* see WILLEMSE 1971, 1972, 1973, 1984), due to the predominance of the xerophytic "*oromediterranean*" formations. A smaller "island" of mediterranean-xeromontane species can also be observed in the southwestern Alps (e.g. *Euxoa hastifera* DONZEL, *Dichagyris [Yigoga] celsicola* BELLIER, *Chersotis fimbriola* ESPER, Fig. 11, *Ch. larixia* GUENÉE, *Ch. elegans* EVERSMANN, *Ch. anatolica* DRAUDT, *Hadena clara* STAUDINGER, *Heterophysa dumetorum* GEYER) which is surely connected with the refugial character of this region.
- In contrast to the patterns of distribution of the xeromontane species in Mediterranean areas and in Asia Minor, their distribution appears to be quite irregular in European extra-Mediterranean territories, influenced mostly by the local edaphic conditions of the sites. This observation indirectly confirms our earlier formulated hypothesis (VARGA 1975*b*) that such species could expand into the extra-Mediterranean part of Europe only during the extreme continental late-glacial and earliest postglacial (kryoxerotic and protocratic, respectively GRICHUK & GRICHUK 1960, IVERSEN 1958) phases. Their relatively regular occurrence at rocky littoral habitats of Fennoscandinavia and the British Isles, as "*Pre-Litorina relicts*", also seems to support this explanation.

- Eastern borders of range in expansive, polycentric West-Palaearctic species or superspecies frequently occur in the western Tien Shan, eastern Hindukush, Nuristan or NW Pakistan (*Euxoa homicida* STAUDINGER, *Dichagyris leucomelas* BRANDT, *D. afghana* BOURSIN, *D. chrysopyga* BOURSIN, *Xenophysa junctimacula* CHRISTOPH, see VARGA 1989*b*). In many taxonomic groups a fairly sharp biogeographical borderline can be observed between the easternmost extensions of the Hindukush mountains and the eastern Pamir – Karakorum ranges, resp. (see: the distribution of western, smaller, "*mouflon*"-like and the continental, inner-asiatic, larger "*argali*"-like subspecies of the rather polytypic *Ovis ammon* LINNAEUS).
- Centres of species diversity of many typical xeromontane genera are concentrated into some Central and Inner Asiatic high mountains, e.g. Tien Shan, Hissaro-Darwaz, Pamir, Trans-Himalaya ranges (*Euxoa, Rhyacia, Chersotis, Dichagyris, Eugnorisma, Spaelotis, Discestra, Ctenoceratoda, Dasypolia* etc.)
- Close taxonomical connections can be observed between the allopatric species of some species groups of xeromontane Noctuinae and Hadeninae genera inhabiting the ranges of Tien Shan and Mongolian Altai (*Dichagyris umbrifera* ALPHERAKY-group, *D. clara* STAUDINGER-group, *Parexarnis candida* STAUDINGER-group, *Ctenoceratoda* and *Hadula* spp.).

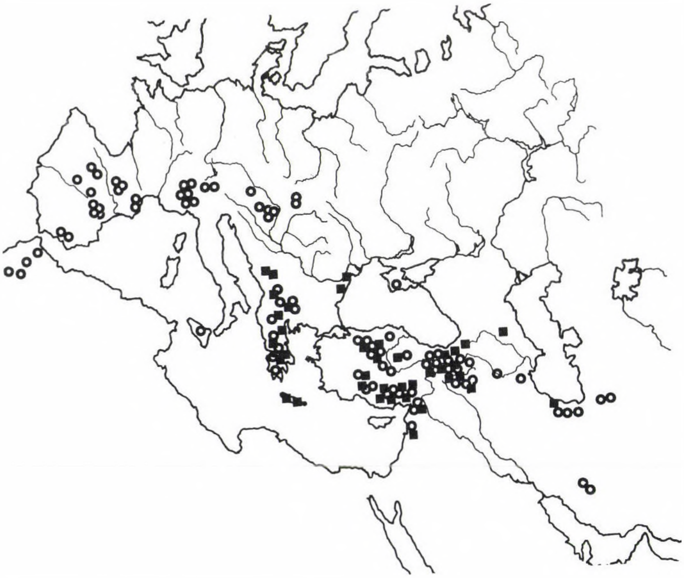


Fig. 11. A holomediterranean–pontomediterranean xeromontane sibling species pair: *Chersotis fimbriola* (black circles with white dots) and *Ch. laeta* (black squares)

- Numerous faunal connections are present among the mountain systems of Zerawshan, Hissaro-Darwaz, Eastern Hindukush and Western Pamir (e.g. species-groups of *Euxoa, Chersotis, Bryopolia, Bryoxena* etc.)
- Many xeromontaneous species of Nepal, W Himalaya, Transhimalaya (Ladakh) and the Karakoram region penetrate into the Pamir and Transalai ranges (*Euxoa tibetana* MOORE – *naumanni* VARGA-group, *Pamirorea eberti* RONKAY & VARGA, *Polymixis, Himalistra* and *Bryopolia-Bryoxena* spp., see: VARGA 1990, VARGA *et al.* 1991, HACKER & RONKAY 1993, HREBLAY & RONKAY 1995).
- A great number of relict-like monotypic or oligotypic genera occur in some parts of the Tien Shan-system (e.g. Alai Mts, Bolshoi Tshimgan) and in the Xizang-plateau (Tibet) (*Bryomixis, Pamirorea, Niaboma, Euxenistis* etc.)
- Numerous connections have been described between Central Asiatic xeromontane and eremic faunas (e.g. *Hadula, Cardiestra, Discestra, Thargelia, Odontelia*, VARGA & RONKAY 1989, 1991).

CONCLUSIONS AND HYPOTHESES ON THE ORIGIN AND EVOLUTIONARY HISTORY OF PALAEARCTIC XEROMONTANE NOCTUIDAE

It was revealed that the south-eastern part of the Palaearctic oreal biomes was especially rich in relict-like genera (*Erebophasma, Estimata, Palaeamathes, Perissandria, Hoeneidia, Oligarcha, Sinognorisma, Hadulipolia, Haderonia, Tricheurois, Niaboma, Euxenistis, Himalistra, Altipolia*) and in seemingly ancestral species from more widely distributed genera (*Dichagyris, Rhyacia, Xestia, Eugraphe, Conisania, Sideridis, Polia, Oncocnemis, Lophoterges*). They often have connections to the high mountains of Central and Inner Asia and Southern Siberia and also in many cases to the continental steppe areas. The strictly stenochorous, more ancestral taxa are regularly connected to the monsoonic forested biomes, while the more derived species or species groups are partially inhabitants of the unforested, at least seasonally dry orobiomes, and in part they are zonally distributed in the boreo-continental coniferous forests of the Palaearctic (or Holarctic).

A very similar case was already described by KOSLOWA (1966) in the passerine bird family Prunellidae. The presumably most ancestral taxa are restricted to the monsoonic mountain forests of W China. Some species could penetrate into the mountain taiga and scrub formations (e.g. *Prunella atrogularis, P. montanella*), while others became inhabitants of xeromontane biomes (*P. ocularis* in the mountain systems of Transcaucasia and Iran, *P. fulvescens* from Transcaucasia to Transbaicalia, *P. koslowi* in the extreme cold-continental Mongolian and

Tibetic high mountains). The members of the subgenus (related genus) *Laiscopus* could also populate alpine elevations, *P.(L.) collaris* in nearly all of the Palaearctic and *P. (L.) himalayanus* mostly in the Transhimalaya-Pamir area.

In the case of a group of four closely related, presumably monophyletic genera (*Trichoridia, Blepharosis, Bryoxena, Bryopolia*, see VARGA *et al.* 1990) we already described and also illustrated a stepwise "creep" from monsoonic areas into the arid central Asiatic regions, connected to the generic and subsequent specific differentiation. Based on taxonomical revision and phylogenetic survey of the genera mentioned above, we suggest some hypotheses for their possible evolutionary history.

We suppose that some basal groups of the "Trifid" Noctuidae must have evolved, jointly with some groups of Angiospermae, in the Eastern Gondwana. They could expand northwards after the earliest collision of the Gondwanian plates (e.g. Southern Tibet and some parts of southern China) with southeastern Asia (LI JI-JUN *et al.* 1981, HSÜ YEN 1981, LI XING-XUE & YAO ZHAO-QI 1981, LIU DONG-SHENG & DING MENG-LIN 1984, SHARMA 1984, etc.).

These processes of dispersal were canalised by the constraints of passing two main filter-corridors (VARGA 1995, Fig. 1).

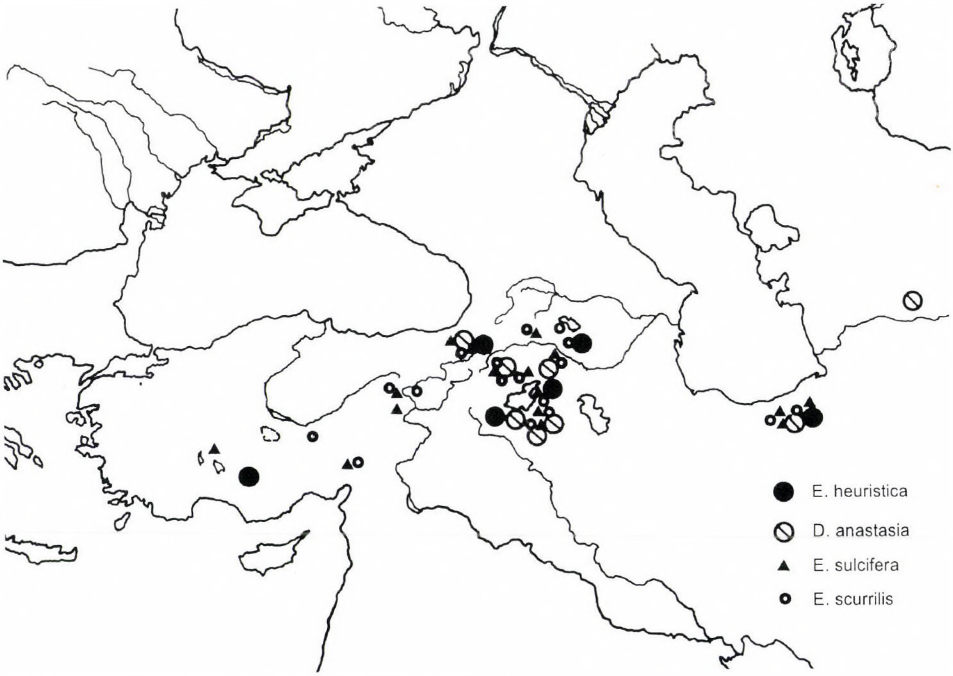


Fig. 12. Distribution of four Transcaucasian–Iranian xeromontane species: *Euxoa sulcifera, E. scurrilis, Dichagyris anastasia* and *Eugnorisma heuristica*

1. The "*Rhododendron*-corridor", also now characteristic for several evergreen Angiospermae, e.g. *Vaccinium, Empetrum, Rhododendron* incl. *Ledum* etc., which now compose a major part of the undergrowth of the Siberian (especially southern Siberian mountain) taiga, typical for a number of "taiga-birds" (e.g. *Ficedula, Phylloscopus, Luscinia calliope, Tarsiger cyanurus, Dumeticola thoracica* etc.) and also for a great number of taiga-inhabiting Lepidoptera (Geometridae: *Dysstroma, Chlorochlysta*; Noctuidae: several subgenera and species-groups of *Xestia: Pachnobia, Anomogyna; Polia, Lasionycta*, some species-groups of *Apamea* etc.).

It seems to be quite typical that some stenochorous species inhabit the southern Siberian mountain taiga (e.g. *Polia vesperugo* EVERSMANN, *P. vespertilio* DRAUDT, *P. malchani* DRAUDT, *Lasionycta hospita* BANG-HAAS, *L. alpicola* LAFONTAINE et KONONENKO, *L. buraetica* KONONENKO, *Apamea altijuga* KOZHANTSCHIKOW), while some of their relatives are widely dispersed, often having a Trans-Palaearctic or even Trans-Holarctic range of distribution (e.g. *Polia trimaculosa* ESPER, *P. bombycina* HUFNAGEL, *P. purpurissata* GROTE, *Lasionycta leucocycla* STAUDINGER, *L. skraelingia* HERRICH-SCHAEFFER, *Apamea rubrirena* TREITSCHKE, *A. zeta* TREITSCHKE etc.). The most recent views on the importance of Beringian refugia (KONONENKO *et al.* 1989, LAFONTAINE & WOOD 1988, MIKKOLA *et al.* 1991) do not contradict but only complement these views. The Southern Siberian mountain taiga and "goltsy" could have been the primary core areas of boreal-Holarctic Noctuidae species, while the ice-free Beringian areas could serve mainly as recent centres of survival and dispersal of these elements during the late-glacial and post-glacial phases.

2. The "xeromontane" route, leading from the Transhimalayan mountains, on one hand to the Karakoram, Pamir, Transalai or even to the Hissar, Zerawshan, Western Tien Shan and Eastern Hindukush ranges, or, on the other hand, via East-Turkestan to the Eastern Tien Shan and Altai-Sajan systems, resulting in a radiation of a rich continental xeromontane fauna. This bifurcation seems to be evident from the taxonomic division of the genera which are typical for these areas. In the xeromontane fauna of the first group of the Inner Asiatic mountains, such butterflies as *Parnassius, Karanasa, Paralasa* and many lycaenid genera, as well as some, often oligotypic genera of Noctuidae very much restricted to a few mountain ranges, e.g. *Hypsophila, Ferghana*, predominate. In the second group the typical butterflies belong to *Colias, Oeneis* and *Boloria*, which must also have a xeromontane origin but have penetrated deeply into the tundral zonobiomes, as well. The typical Noctuidae genera of this second, more "Siberian", secondarily "oreotundral" group of (originally) xeromontane Noctuidae are e.g. *Trichosilia, Lasionycta, Discestra, Anarta, Oncocnemis & Sympistis*.

Based on these biogeographical facts, I think that the connections of the Continental, Inner Asiatic xeromontane fauna must be historically more manifold and older than the "typical" oreotundral connections of the alpine faunal type which can be regarded mostly as a product of the Quaternary climatic fluctuations and area dislocations.

It seems very probable that the ancient groups of the Mediterranean xeromontane fauna can be derived partly from this primary bifurcation of the western continental xeromontane faunal complex and partly by the adaptation of diverse Mediterranean xerophilous arboreal groups due to the late Tertiary aridity crisis. This hypothesis is also supported by the "macro"-taxonomical duality of the Mediterrane xeromontane Noctuidae.

Those genera which belong to the Noctuinae and have "cutworm"-type larvae, have obviously originated in the continental orobiomes (e.g. *Euxoa, Agrotis, Dichagyris, Chersotis, Rhyacia, Standfussiana*) and their Mediterranean representatives often belong to different, divergently derived phyletic lines within these polytypic genera. The extreme taxonomic subdivision of such genera into several "new" oligo- or monotypic genera or subgenera by some "splitters" (see BECK 1991, 1992, FIBIGER & HACKER 1990), and the fruitless discussion about it, was the direct consequence of the ignorance of the high species diversity of the vast continental areas of Asia, because some authors can see only the "ends of twigs" and not the "trunks" from which these twigs originate. Other genera were probably originally connected to xerophilous scrub formations (*Eugnorisma, Auchmis, Lophoterges*) or thorny polster-scrub communities (*Xenophysa, Copiphana*. Their Mediterranean-Anatolian taxa also display western and central Asiatic connections, and only a marginal speciation in the Mediterranean ranges.

Other genera of the Mediterranean-xeromontane Noctuidae display an essentially autochtonous evolution which was influenced by the younger Tertiary aridisation of the Mediterranean basin. In such genera the Ponto-Mediterranean (incl. parts of Anatolia), the Atlanto-Mediterranean and Maghreb areas usually display a high level of species diversity. Examples of such genera are those of the tribe Oncocnemidini: *Calophasia* and closely related minor genera, *Ompalophana, Copiphana, Metopoceras* etc. (Cuculliinae) and some Xylenini-genera (*Eumichtis, Leucochlaena, Aporophila, Antitype, Ammoconia*, subgenera of *Mniotype, Polymixis, Agrochola, Conistra* etc.). This biogeographical group can be regarded as approximately equivalent to the "Palaeomediterrane-xeromontane" faunal type of some ornithologists (STEGMANN 1938, VOOUS 1960, 1963) and with the faunal type of the "ancient Mediterraneum" of the Russian biogeographical school (see KRYZHANOVSKY 1965).

We can only hope that by surveying the extremely rich expedition materials mentioned above and by the intensively proceeding taxonomic and phylogenetic revision of many groups of Noctuidae, a more analytical proof of our hypotheses will be possible in the near future.

Acknowledgements – I would like to thank Dr. KAURI MIKKOLA, Prof. Dr. CLAS M. NAUMANN and Dr. LÁSZLÓ RONKAY for the many inspiring discussions and for valuable suggestions on this paper. Criticisms and suggestions of three referees have greatly improved the manuscript.

I am grateful for having the opportunity to study of the very rich and valuable materials of Noctuidae from the collections and expedition materials, collected by Mrs EVA VARTIAN and by Mr. P. GYULAI, Gy. FÁBIÁN, M. FIBIGER, H. HACKER, B. HERCZIG, M. HREBLAY, A. MOBERG, C. M. NAUMANN, L. PEREGOVITS, G. RONKAY, L. RONKAY which I could evaluate for this paper.

Surveys were supported by the OTKA grant No 16465.

REFERENCES

ADAMOVIC, L. (1909) *Die Vegetationsverhältnisse der Balkanländer.* Leipzig, 210 pp.

AGACHANJANTS, O. E. (1981) *The arid high mountains of the URSS.* Moscow, 270 pp. [In Russian]

ANDER, K. (1949) Die boreo-alpinen Orthopteren Europas. *Opusc. ent., Lund* **14**: 89–104.

ANT, H. (1965) Der boreoalpine Verbreitungstyp bei europäischen Landgastropoden. *Verh. dtsch. zool. Ges., Kiel* (1964): 326–335

ASPÖCK, H. (1963) Zur Frage boreoalpiner Verbreitung bei Neuropteren. *Nachr. bl. bayr. Entomol.* **12**(9): 81–84.

AVINOFF, A. & W. R. SWEADNER (1951) The Karanasa butterflies. *Ann. Carnegie Mus.* **32**: 1–250.

BECK, H. (1991) Taxonomische Änderungen bei den Noctuinae, Cuculliinae und Plusiinae (Noctuidae, Lepidoptera). *Atalanta* **22**: 164–172.

BECK, H. (1992) New view of the higher classification of the Noctuidae (Lepidoptera). *Nota lepid.* **15:** 3–28.

BECK, H. (1996) Systematische Liste der Noctuidae Europas (Lepidoptera, Noctuidae). *Neue ent. Nachr.* **36**: 3–122.

BEHOUNEK, G. (1992) Die holarktischen Arten der Gattung Lacanobia Billberg, 1820. (Lep.: Noctuidae, Hadeninae). *Esperiana, Schwanfeld* **3**: 33–66.

BORBÁS, V. (1908) In: BORBÁS, V. & BERNÁTSKY, J. (eds): *Die pflanzengeographischen Verhältnisse des Balatonseegegends.* Budapest (cit.: SOÓ, 1959)

BOTOSANEANU, L. (1962) Analyse zoogeographique de la faune de Trichopteres de Roumanie. *Arch. Hydrobiol.* **58:** 136–161.

BOURSIN, CD. (1964) Les Noctuidae Trifinae de France et Belgique. *Bull. Soc. linn. Lyon* **33:** 204–240.

BRECKLE, S.-W. (1974) Notes on alpine and nival flora of the Hindu Kush, East Afghanistan. *Bot. Notiser* **127:** 278–284.

BRECKLE, S.-W. & FREY, W. (1974) Die Vegetationsstufen im zentralen Hindukush. *Afghanistan Journal* **1:** 75–80.

BUDYKO, M. I. (1977) *Global Ecology.* Moscow. [In Russian]

BURESCH, I. & ARNDT, W. (1926) Die Glazialrelicte stellenden Tierarten Bulgariens und Mazedoniens. *Zschr. Morph. Ökol. Tiere* **5:** 381–405.

BROWN, K. S. Jr. (1987) Biogeography and evolution of Neotropical butterflies. *In* WHITMORE, T. C. & PRANCE, G. T. (eds): *Biogeography and Quaternary History in Tropical America.* Clarendon Press, Oxford. pp. 66–104.

COOPE, G. R. (1975) Mid-Weichselian climatic changes in Western Europe, re-interpreted from coleopteran assemblages. *In* SUGGATE, R. P. & CRESWELL, M. M. (eds): *Quaternary Studies,* Wellington, pp. 101–108.

COOPE, G. R. (1979) Cenozoic fossil Coleoptera. Evolution, biogeography and ecology. *Ann. Rev. Ecol. Syst.* **10:** 247–267.

COOPE, G. R. (1987) The response of Late Quaternary insect communities to sudden climatic changes. *In* GEE, J. H. R & GILLER, P. S. (eds) *Organisation of communities: Past and present.* Oxford, Blackwell, pp. 421–438.

CRACRAFT, J. (1982) Geographic differentiation, cladistics and vicariance biogeography: Reconstructing the tempo and mode of evolution. *Amer. Zool.* **22**: 411–424.

CRACRAFT, J. (1983) Cladistic analysis and vicariance biogeography. *Amer. Sci.* **71:** 411–424.

CRACRAFT, J. & PRUM, R. O. (1988) Patterns and processes of diversification: Speciation and historical congruence in some Neotropical birds. *Evolution* **42**(3): 603–620.

CROIZAT, L.(1978) Deduction, induction and biogeography. *Syst. Zool.* **27:** 209–213.

CROIZAT, L., NELSON, G. & ROSEN, D. E. (1974) Centers of origin and related concepts. *Syst. Zool.* **23:** 265–287.

DANSEREAU, P. (1957) *Biogeography: an ecological perspective.* Ronald Press, New York, pp. 394.

DARLINGTON, P. J. (1959) Area, climate and evolution. *Evolution* **13:** 488–510.

DENNIS, R. L. H. (1993) *Butterflies and climate change.* Manchester Univ. Press, Manchester, 302 pp.

DENNIS, R. L. H., WILLIAMS, W. R. & SHREEVE, T. G. (1991) A multivariate approach to the determination of faunal structures among European butterfly species (Lep.: Rhopalocera) *Zool. J. Linn. Soc.* **101:** 1–49.

DESCIMON, H. (1986) Origins of Lepidopteran faunas in the high tropical Andes. *In* VUILLEUMIER, F. & MONASTERIO (eds): *High altitude tropical biogeography.* Oxford Univ. Press, New York, pp. 500–532.

DUFAY, CL. (1981) Chersotis grammiptera (Rambur, 1839) bona sp. en France et en Espagne (Lep.: Noctuidae). *Alexanor* **12:** 103–117.

DUFAY, CL. (1984) Chersotis oreina n. sp. noctuelle méconnue des montagnes de l'Europe occidentale (Noctuidae, Noctuinae). *Nota lepid.* **7:** 8–20.

DUFAY, CL. (1986) Révision de la nomenclature de deux Chersotis Boisduval distingués récemment (Noctuidae, Noctuinae). *Nota lepid.* **9:** 51–54.

DUFAY, CL. & VARGA, Z. (1995) A new noctuid species from Iran: Chersotis eberti sp. n. (Lep.: Noctuidae). *Acta zool. hung.* **41:** 35–45.

EBERT, G. (1978) Neue Taxa paläarktischer Noctuidae aus dem wissenschaftlichem Nachlaß von Charles Boursin (Lep.: Noct. Trifin.) *Beitr. naturk. Forsch. Südw. Deutschl., Karlsruhe* **37:** 193–207.

EBNER, R. (1951) Zur näheren Kenntnis einer boreo-alpinen Orthoptera-Art: Aeropedellus variegatus F. W. *Ann. nat.-hist. Mus. Wien* **58:** 108–117.

EHRLICH, P. R. (1958) Problems of arctic-alpine distribution as illustrated by the butterfly genus Erebia Dalm. *Proc. X. int, Congr. Entomol., Montreal* **1:** 683–686.

ENGHOFF, H. (1993) Phylogenetic biogeography of a Holarctic group: the julidan millipedes. Cladistic subordinateness as an indicator of dispersal. *J. Biogeogr.* **20:** 525–536.

ENGHOFF, H. (1995) Historical biogeography of the Holarctic: area relationships, ancestral areas and dispersal of non-marine animals. *Cladistics* **11:** 223–263.

FIBIGER, M. (1990) *Noctuidae Europaeae. Vol. 1, Noctuinae I.* Entomological Press, Sorø, 207 pp.

FIBIGER, M. (1993) *Noctuidae Europaeae. Vol. 2, Noctuinae II.* Entomological Press, Sorø, 230 pp.

FIBIGER, M. & HACKER, H. (1991) Systematic list of the Noctuidae of Europe. *Esperiana, Schwanfeld* **2:** 1–109.

FORSTER, W. (1958) Beiträge zur Kenntnis der Insektenfauna Bolivines XIX. Lepidoptera III. *Veröff. zool. Staatssamml., Münich* **8:** 51–188.

GRICHUK, M. P. & GRICHUK, V. P. (1960) Periglacial vegetation on the territory of the URSS. *In* Periglacial phenomena in the territory of the URSS. Akad. N. SSSR Moscow.

GROOMBRIDGE, B. (ed.) (1992) *Global biodiversity. Status of the Earth's living resources.* World Conservation Monitoring Centre. Chapman & Hall, London, 585 pp.

GYULAI, P., HREBLAY, M. & RONKAY, L. (1992) New taxa and synonyms in the Oncocnemis exacta Christoph, 1887 group (Lepidoptera, Noctuidae). *Acta zool. hung.* **38:** 33–46.

HACKER, H. (1986*a*) Erster Beitrag zur systematischen Erfassung der Noctuidae der Türkei. *Atalanta* **17:** 1–26.

HACKER, H. (1986*b*) 2. Beitrag zur Erfassung der Noctuidae der Türkei. *Spixiana* **9:** 25–81.

HACKER, H. (1987) Siebenter Beitrag zur systematischen Erfassung der Noctuidae der Türkei. *Atalanta* **18:** 121–167.

HACKER, H. (1989) Die Noctuidae Griechenlands. *Herbipoliana* **2:** 1–589.

HACKER, H. (1990) Die Noctuidae Vorderasiens (Lepidoptera). *Neue entomol. Nachr.* (Suppl. zu Atalanta) **27:** 1–707.

HACKER, H. (1992*a*) Systematik und Faunistik der Noctuidae (Lepidoptera) des himalayanischen Raumes. Beitrag II. *Esperiana, Schwanfeld* **3:** 67–214.

HACKER, H. (1992*b*) Revision der Gattung Hadena Schrank, 1802. Teil I. *Esperiana, Schwanfeld* **3:** 243–361.

HACKER, H., HUBER, K. & KUHNA, P. (1988) Achter Beitrag zur systematischen Erforschung der Noctuidae der Türkei. *Atalanta* **18:** 339–369.

HACKER, H., KUHNA, P. & GROSS, F. J. (1986) 4. Beitrag zur Erfassung der Noctuidae der Türkei. *Mitt. münchn. ent. Ges.* **76:** 79–141.

HACKER, H. & LÖDL, M. (1989) Taxonomisch und faunistisch bemerkenswerte Funde aus der Sammlung Pinker im Naturhistorischen Museum Wien. (Neunter Beitrag zur systematischen Erforschung der Noctuidae) der Türkei. *Zschr. Arbeitsgem. österr. Ent.* **40:** 65–82.

HACKER, H. & WEIGERT, L. (1986) Sechster Beitrag zur systematischen Erfassung der Noctuidae der Türkei. *Neue ent. Nachr.* **19:** 133–188.

HACKER, H. & RONKAY, L. (1993) Das Genus Polymixis (1820) mit Beschreibung einer neuen Art. *Esperiana, Schwanfeld* **3:** 473–496.

HACKER, H. & RONKAY, L. (1993) Beschreibungen neue Taxa der Spätherbst-Noctuidae-Fauna Zentralasiens und des Himalaya-Raumes (Cuculliinae sensu Hampson) (Lepidoptera). *Esperiana, Schwanfeld* **3:** 193–221.

HACKER, H. & VARGA, Z. (1990) Die Gattung Chersotis Boisduval, 1840. I. (Lep.: Noctuidae). *Spixiana, München* **13**(3): 277–327.

HAFFER, J. (1969) Speciation in Amazonian forest birds. *Science* **165:** 131–137.

HAFFER, J. (1978) Distribution in Amazonian forest birds. *Bonn. zool. Beitr.* **29:** 38–78.

HAFFER, J. (1981) Aspects of Neotropical bird speciation during the Cenozoic. *In* NELSON, G. & ROSEN D. E. (eds) *Vicariance biogeography: a critique.* Columbia Univ. Press, New York, pp. 371–412.

HAFFER, J. (1987) Biogeography of Neotropical birds. *In* WHITMORE T. C. & PRANCE, G. T. (eds) *Biogeography and Quaternary history in tropical America.* Clarendon Press, Oxford. pp. 105–150.

HARDWICK, D. F. (1970) The genus Euxoa (Lepidoptera: Noctuidae) in North America I. *Mem. ent. Soc. Canada* **67**, 175 pp.

HARTIG, F. & HEINICKE, W. (1973) Systematisches Verzeichnis der Noctuiden Europas. *Entomologica, Bari* **9:** 187–214.

HENGEVELD, R. (1990) *Dynamic biogeography.* Cambridge Univ. Press, Cambridge, 249 pp.

HEPTNER, V. G. [= Geptner] (1959) Centres of speciation in the Palaearctic steppe and desert zone. *Proc. XI. int. zool. Congr. London* **1958**: 155–157.

HEPTNER, V. G. (1966) Gattung Ovis Linnaeus 1758, Schafe. In: HEPTNER, V. G., NASIMOVIC, A. A. & BANNIKOV, A. G.: *Die Säugetiere der Sowjetunion* I. G. Fischer, Jena, pp. 739–824.

HOLDHAUS, K. (1954) Die Spuren der Eiszeit in der Tierwelt Europas. *Abh. zool.-bot. Ges. Wien* **18:** 1–493.

HOLDHAUS, K. & LINDROTH, C. (1939): Die europäischen Koleopteren mit boreo-alpiner Verbreitung. *Ann. nat.-hist. Mus. Wien* **50:** 123–293.

HREBLAY, M. (1992) Revision der Gattung Valerietta Draudt 1938 (Lepidoptera: Noctuidae) *Esperiana, Schwanfeld* **3:** 235–241.

HREBLAY, M. (1992) Paläarktische Taxa der Mythimna (Aletia) pallens L. – impura Hb. -Artengruppe (Lepidoptera: Noctuidae). *Esperiana, Schwanfeld* **3:** 513–519.

HREBLAY, M. (1994*a*) Neue Taxa aus der Gattung Orthosia Ochsenheimer, 1816 (s. l.) (Lepidoptera: Noctuidae) III. *Acta zool. hung.* **40:** 21–27.

HREBLAY, M. (1994*b*) New taxa of the tribe Orthosiini IV. (Lepidoptera: Noctuidae). *Acta zool. hung.* **40:** 241–252.

HREBLAY, M. (1995) Neue palaearktische Taxa aus der Gattung Perigrapha Lederer 1857 (Lepidoptera: Noctuidae). *Esperiana, Schwanfeld* **4:** 65–94.

HREBLAY, M. & RONKAY, L. (1995) On the taxonomy of the genera Himalistra Hacker et Ronkay, 1993 and Estagrotis Nye, 1975. *Acta zool. hung.* **41:** 237–253.

HREBLAY, M., PLANTE, J. & RONKAY, L. (1994) New taxa of the genus Himalistra Hacker et Ronkay, 1993. *Acta zool. hung.* **40:** 253–264.

HSÜ JEN (= XU REN) (1981) Vegetational changes in the past and the uplift of the Qinghai-Xizang Plateau. *In*: *Geological and ecological studies of Qinghai-Xizang Plateau.* Science Press, Beijing, pp. 139–144.

HSÜ JEN (= XU REN) (1984*a*) Changes of the palaeoenvironment of Southern East Asia since the late Tertiary. *In* WHITE, R. O. (ed.) *The Evolution of the East Asian Environment.* Hong Kong, University Press. pp. 419–425.

HSÜ JEN (= XU REN) (1984*b*) Changes in the vegetation of China since the late Tertiary. *In* WHITE, R. O. (ed.) *The Evolution of the East Asian Environment*, Hong Kong, University Press. pp. 426–432.

HULTÉN, E. (1937) *Outline of the history of the arctic and boreal biota during the Quaternary period.* Stockholm, 380 pp.

HULTÉN, E. (1963) Phytogeographical connections of the North Atlantic. *In* LÖWE A. & LÖWE, D. (eds) *North Atlantic biota and their history.* Oxford, pp. 45–72.

IABLOKOFF-KHNZORIAN, S. M. (1968) Considerations sur la faune alpine des Coleopteres et sa genese. *Beitr. Ent.* **18:** 177–211.

IVERSEN, J. (1958) The bearing of glacial and interglacial epochs on the formation and extinction of plant taxa. *In* HEDBERG, O. (ed.) *Systematics of today. Uppsala Univ. Arsskr.* **6:** 210–215.

JONG, R. DE (1972) Systematics and geographical history of the genus Pyrgus in the Palaearctic region (Lepidoptera: Hesperiidae). *Tijdschrift voor Entomologie* **115:** 1–60

JONG, R. DE (1974) Systematics and evolution of the Palaearctic Spialia species (Lepidoptera: Hesperiidae). *Tijdschrift voor Entomologie* **117:** 225–271.

JONG, R. DE (1978) Monograph of the genus Spialia Swinhoe (Lepidoptera: Hesperiidae) *Tijdscchrift voor Entomologie* **121:** 23–146.

JANETSCHEK, H. (1956): Das Problem der inneralpinen Eiszeitsüberdauerung durch Tiere. Ein Beitrag zur Geschichte der Nivalfauna. *Österr. zool. Zschr.* **6**(315): 421–506.

KONONENKO, V. S. (1979) On the taxonomy of the subfamily Cucullinae (Lep.: Noctuidae). *Entomol. Obozr.* **58:** 599–608. [In Russian]

KONONENKO, V. S., LAFONTAINE, J. D. & MIKKOLA, K. (1989) An annotated checklist of noctuid moths (Lepidoptera: Noctuidae) of Beringia. *Entomol. Obozr.* **48:** 549–567. [In Russian] *Entomol. Rev.* (1990) **69:** 117–138.

KOSLOWA, E. V. (1966) Relationships between species of the family Prunellidae and possible history of their populations. *Zool. Zhurn.* **45**: 706–722. [In Russian]

KOSTROWICKI, A. S. (1969) *Geography of the Palaearctic Papilionoidea (Lepidoptera).* Panstwowe Wydawnictwo Naukowe, Warszawa, 380 pp.

KRAMPL, F. (1992): Boreal macro-moths in central Europe (Czechoslovakia) and their eco-geographical characteristics (Lepidoptera: Geometridae, Noctuidae, Notodontidae). *Acta ent. bohemoslov.* **89:** 237–262.

KRYZHANOVSKY, O. A. (1965) *Composition and origin of the terrestrial fauna of Central Asia.* Nauka, Moscow-Leningrad, 419 pp. [In Russian]

KRYZHANOVSKY, O. A. (1969) A contribution to the composition and origin of alpine faunas of Coleoptera. *Zool. Zhurn.* B48: 1156–1165. [In Russian]

KULCZINSKI, S. (1923) Das boreale und arktisch-alpine Element in der mitteleuropäischen Flora. *Bull. Acad. Polon. Cracow (B)* **3:** 127–214.

KURENTZOV, A. J. (1963) On the origin of the Angarian high mountain fauna. *Thes. III. all-union Conf. Zoogeogr.* pp. 160–163.

LAFONTAINE, J. D. (1981) Classification and phylogeny of the Euxoa detersa-group (Lep.: Noctuidae). *Quaest. entomol.* **17:** 1–120.

LAFONTAINE, J. D. (1987) Noctuoidea, Noctuidae (part), Noctuinae (part Euxoa). *In* The moths of America North of Mexico including Greenland. The Wedge Foundation, Washington, fasc. 27, 237 pp.

LAFONTAINE, J. D. & KONONENKO, V. S. (1986) A revision of the genus Trichosilia Hampson (Lepidoptera: Noctuidae) with descriptions of four new species. *Can. Entomol.* **118**(11): 1079–1113.

LAFONTAINE, J. D. & KONONENKO, V. S. (1988) A revision of the Lasionycta skraelingia (Herrich-Schaeffer) species complex (Lepidoptera: Noctuidae). *Can. Entomol..* **120:** 903–916.

LAFONTAINE, J. D. & MIKKOLA, K. (1987) Lock-and-key systems in the inner genitalia of Noctuidae (Lepidoptera) as a taxonomic character. *Entomol. Meddelser* **55:** 161–167. [In Swedish with an English summary]

LAFONTAINE, J. D., MIKKOLA, K. & KONONENKO, V. S. (1983) A revision of the genus Xestia subgen. Schoeyenia Auriv. (Lep.: Noctuidae) with descriptions of four new species and a new subspecies. *Ent. scand.* **14:** 337–369.

LAFONTAINE, J. D., MIKKOLA, K. & KONONENKO, V. S. (1987) A revision of the genus Xestia subgen. Pachnobia (Lep.: Noctuidae) with descriptions of two new subspecies. *Ent. scand.* **18:** 305–331.

LAFONTAINE, J. D. & WOOD, D. M. (1988) A zoogeographic analysis of the Noctuidae (Lepidoptera) of Beringia and some inferences about past Beringian habitats. *Mem. ent. Soc. Canada* **144:** 109–123.

LA GRECA, M. (1962) Tipi fondamentali di distribuzione geografice degli elementi della fauna italiana. *Arch. bot. biogeogr. ital.* **38:** 1–19.

LA GRECA,, M. (1977): L'evoluzione Plio-Pleistocenica degli Insetti di alta montagna. *Boll. zool.* **44:** 261–285.

LA GRECA, M. & MESSINA, A. (1976) Due nuove specie di Oropodisma (Orthoptera, Acridoidea) di Grecia. *Animalia, Catania* **3**(1–3): 5–16

LA GRECA, M. & MESSINA, A. (1979) Origine et évolution des Orthopteres des haute montagnes de Grece. *Acrida, Association d'Acridologie* **8:** 227–240.

LERAUT, P. (1980) Liste systematique et synonymique des Lépidopteres de France, Belgique et Corse. *Alexanor* (Suppl.): 1–334.

LATTIN, G. DE (1949) Beträge zur Zoogeographie des Mittelmeergebietes. *Verh. dtsch. zool. Ges., Kiel* **1948:** 143–151.

LATTIN, G. DE (1952) Zur Evolution der westpaläarktischen Lepidopterenfauna. *Decheniana* **105–106:** 115–164.

LATTIN, G. DE (1957) Die ausbreitungszentren der holarktischen Landtierwelt. *Verh dtsch. zool. Ges. Hamburg* **1956:** 380–410.

LATTIN, G. DE (1964) Die Verbreitung des sibirischen Faunenelements in der Westpaläarktis. *Natur und Museum* **94:** 104–125.

LATTIN, G. DE (1967) *Grundriß der Zoogeographie.* Jena–Stuttgart, 602 pp.

LI, JI-JUN *et al.* (1981) The process of the uplift of the Quinghai-Xiyang plateau. *In Geological and ecological studies of Quinghai-Xizang plateau, Vol. I,* Science Press, Beijing, pp. 111–117.

LI, XI-WEN, SUN XIANG-YUN & WALKER, D. (1984) The potential for palaeobotany in the explanation of China's plant geography. *In* WHITE, R. O. (ed.) Evolution of the east Asian environment. Hong Kong, University P. pp. 433–447.

LI, XING-XUE & YAO ZHAO-QI (1981) Discovery of Cathaysia flora in the Quinghai-Xizang plateau. *In Geological and ecological studies of Quinghai-Xizang plateau, Vol. I,* Science Press, Beijing, pp. 145–151.

LINDROTH C. H. (1972) Reflections of glacial refugia. *Ambio* **2:** 51–54.

LIU DONGSHENG & DING MENGLIN (1984) The characteristics and evolution of the palaeo-environment of China since the late Tertiary. *In* WHITE, R. O. (ed.) *Evolution of the East Asian environment,* Hong Kong, University P. pp. 11–40.

MANI, M. S. (1968) Ecology and biogeography of high altitude insects. Junk, The Hague, 527 pp.

MACARTHUR, R. H. (1972) *Geographical ecology: Pattern in the distribution of species.* Harper and Row, New York, 269 pp.

MACARTHUR, R. H. & WILSON , E. O. (1963) An equilibrium theory of insular zoogeography. *Evolution* **17:** 373–384.

MACARTHUR, R. H. & WILSON, E. O. (1967) *The theory of island biogeography.* Princeton Univ. Press, Princeton, 203 pp.

MATJUSHKIN, E. N. (1972) *Heterogenity of the theriofauna of the Ussuri-land. Sborn. Trud. zool. Muz. MGU* **13:** 86–144. [In Russian]

MATJUSHKIN, E. N. (1982) Regional differentiation of the Palaearctic forest-fauna in the past and present. *In Theoretical and applied aspects of biogeography.* Lomonosov University, Moscow, pp. 59–80.

MAYR, E. & O'HARA, R. J. (1986) The biogeographic evidence supporting the Pleistocene forest refuge hypothesis. *Evolution* **40:** 55–67.

MARAN, J. (1946) Le role importante de la variation géographique des insectes pour les questions zoogeographiques et évolutives. *Sborn. ent. Odd. nar. Mus. v Praze* **23:** 23–128.

MIKKOLA, K. (1987) Pattern of noctuid species common between the extremities of the Palaearctic zone: a result of glacial and postglacial movements. *Tinea* **12**(Suppl.): 310–315.

MIKKOLA, K. (1989) The subarctic and boreal components of the noctuid communities of the southern Siberian mountains as indicators of postglacial movements of noctuid faunas (Lepidoptera: Noctuidae). *Report No. 3 from the joint Soviet-Finnish entomological expeditions to Siberia,* Akad. N. SSSR pp. 104–111.

MIKKOLA, K. (1992) Evidence for lock-and-key mechanisms in the internal genitalia of the Apamea moths (Lep.: Noctuidae). *Syst. Ent.* **17:** 145–153.

MIKKOLA, K., LAFONTAINE, J. D. & GROTENFELT, P. (1987) A revision of the Holartic Chersotis andereggi complex (Lep.: Noctuidae). *Nota Lepid.* **10:** 140–157.

MIKKOLA, K., LAFONTAINE, J. D. & KONONENKO, V. S. (1991) Zoogeography of the Holarctic species of the Noctuidae (Lepidoptera): importance of the Beringean refuge. *Entomol. fenn.* **2:** 158–173.

MÜLLER, P. (1971) Ausbreitungszentren und Evolution in der Neotropis. *Mitt. biogeogr. Abt. Univ. Saarbrücken* **1:** 1–20.

MÜLLER, P. (1973) The Dispersal centres of terrestrial vertebrates in the Neotropical Realm. *Biogeographica* **2:** 1–244.

MÜLLER, P. (1974) *Aspects in zoogeography.* Junk, The Hague, 128 pp.

MÜLLER, P. (1977) *Tiergeographie. Struktur, Funktion, Geschichte und Indikatorbedeutung der Areale.* Teubner, Stuttgart, 268 pp.

MÜLLER, P. (1981) *Arealsysteme und Biogeographie.* Ulmer, Stuttgart, 704 pp.

NADLER, C. F., KOROBITSINA, K. V., HOFFMANN, R. S. & VORONTSOV, N. N. (1973) Cytogenetic differentiation, geographic distribution and domestication in Palaearctic sheep (Ovis). *Z. Säugetierkunde* **38:** 109–125.

OOSTERBROEK, P. & ARNTZEN, J. W. (1992) Area-cladograms of Circum-Mediterranean taxa in relation to Mediterranean palaeogeography. *J. Biogeogr.* **19:** 3–20.

PETERSEN, B. (1954) Some trends of speciation in the cold-adapted Holarctic fauna. *Zool. Bidr. Uppsala* **30:** 233–314.

PRANCE, G. T. (1987) Biogeography of Neotropical plants. *In* WHITMORE, T. C. & PRANCE, G. T. (ed.) *Biogeography and Quaternary history in tropical America.* Clarendon Press, Oxford, pp. 46–65.

PLATNICK, N. I. & NELSON, G. (1978) A method of analysis for historical biogeography. *Syst. Zool.* **27:** 1–16.

PRAVDIN, F. N. & MISHTSHENKO, L. L. (1980) *Formation and evolution of the ecological faunal types of insects in Central Asia.* Nauka, Moscow, 156 pp. [In Russian]

REINIG, W. (1937) *Die Holarktis.* G. Fischer, Jena, 124 pp.

REINIG, W. (1950) Chorologische Voraussetzungen für die Analyse von Formenkreisen. *Sylleg. biol. (Festschr. Kleinschmidt),* pp. 346–378.

RODERICK, G. K. (1996) Geographic structure of insect populations: gene flow, phylogeography and their uses. *Ann. Rev. ent.* **41:** 325–352.

RODIN, L. E. & BAZILEVICH, N. I. (1965) *Dynamics of organic matter and biological turnover of ash elements and nitrogen in the main types of the world vegetation.* Acad. Sci., Leningrad, 253 pp.

RÖGL, F. & STEINIGER, F. F. (1983) Vom Zerfall der Tethys zu Mediterran und Paratethys. Die neogene Palaeogeographie und Palinspastik des Zirkum-Mediterranen Raumes. *Ann. Naturhist. Mus. Wien (A)* **85:** 135–163.

RONKAY, G. & RONKAY, L. (1987) Taxonomic studies on the palaearctic Cuculliinae. II. (Lepidoptera: Noctuidae). *Acta zool. hung.* **33:** 463–484.

RONKAY, G. & RONKAY, L. (1994) *Noctuidae Europaeae. Vol. 6, Cuculliinae I.* Entomological Press, Sorø, 282 pp.

RONKAY, G. & RONKAY, L. (1995) *Noctuidae Europaeae. Vol. 7, Cuculliinae II.* Entomological Press, Sorø, 224 pp.

RONKAY, L. (1986) Taxonomic studies on the genus Autophila Hübner, 1823 (Lepidoptera: Noctuidae). *Acta zool. hung.* **32:** 141–159.

RONKAY, L. (1988) Two new Oncocnemis Lederer, 1853 species from Central Asia (Lep.: Noctuidae). *Acta zool. hung.* **34:** 285–296.

RONKAY, L. (1989) Taxonomic studies on the genus Autophila Hübner, 1823 (Lepidoptera: Noctuidae). *Acta zool. hung.* **35:** 111–141.

RONKAY, L. & VARGA, Z. (1989) Studies on the Palearctic Noctuidae. Sect. Amphipyrinae, I. The genus Pseudohadena Alpheraky, 1889. The laciniosa-group. *Acta zool. hung.* **35**(3–4): 339–353.

RONKAY, L. & VARGA Z. (1990*a*) Studies on the Palearctic Noctuidae. Sect. Amphypyrinae II. Investigations on the genus Auchmis HÜBNER, [1821] 1816 with two new taxa (Lep.: Noctuidae, Amphypyrinae). *Acta zool. hung.* **36**(1–2): 121–134.

RONKAY, L. & VARGA, Z. (1990*b*) Taxonomic and zoogeographical studies on the subfamily Cuculliinae (Lep.: Noctuidae). *Esperiana, Schwanfeld* **1:** 471–497.

RONKAY, L. & VARGA, Z. (1993) On the taxonomy of the genus Ostheldera Nye, 1975 (Lep., Noctuidae, Cuculliinae). *Acta zool. hung.* **40:** 157–170.

RONKAY, L. & VARGA, Z. (1993) Taxonomic studies on the genera Pseudohadena Alpheraky, 1889 and Auchmis Hübner, [1821] 1816 (Lep.: Noctuidae), Part IV. *Acta zool. hung.* **39**(1–4): 211–248.

RONKAY, L., VARGA, Z. & FÁBIÁN, GY. (1995) Taxonomic studies on the genus Pseudohadena Alphéraky, 1889. Part V. The revision of the genus Pseudohadena s. str. *Acta zool. hung.* **41**(3): 251–282.

ROSEN, D. (1978) Vicariant patterns and historical explanations in biogeography. *Syst. Zool.* **27:** 159–188.

RUNGS, C. E. E. (1945) Contribution a la connaissance des Lépidopteres du Sahara Nord Occidental. Noctuidae. *Eos, Madrid* **21:** 7–43.

RUNGS, C. E. E. (1957) Notes de lépidopterologie marocaine. 22. Nouvelles additions a la faune marocaine. *Bull. Soc. sci. nat. phys. Maroc* **36:** 277–298.

RUNGS, C. E. E. (1972) Lépidopteres nouveaux de Maroc et de la Mauretanie. *Bull. Mus. natn. Hist. nat. Paris, Sér. 3, Zoologie* **46:** 669–698.

RUNGS, C. E. E. (1981) Catalogue Raisonnée des Lépidopteres du Maroc. 2. vol. *Trav. Inst. Sci. Sér. Zool.* **40:** 223–588.

SCHINTLMEISTER, A. (1989) Zoogeographie der palaearktischen Notodontidae (Lepidoptera). *Neue entomol. Nachr.* **25:** 5–117.

SHAPIRO, A. M. (1991) The zoogeography and systematics of the Argentine Andean and Patagonian pierid fauna. *J. Res. Lep.* **28**(3): 137–238.

SHAPIRO, A. M. (1994) Why are there so few butterflies in the High Andes? *J. Res. Lepid.* **31**(1–2): 35–56.

SHARMA, K. K. (1984) The sequence of phased uplift of the Himalaya. *In* WHITE, R. O. (ed.) *The evolution of the East Asian environment.* Hong Kong, University Press, pp. 56–70.

SOÓ, R. (1929) Die Vegetation und die Entstehung der ungarischen Puszta. *J. Ecol.* **17:** 329–350.

SOÓ, R. (1940) Vergangenheit und Gegenwart der pannonischen Flora und Vegetation. *Nova Acta Leopoldina* **9:** 1–49.

SOÓ, R. (1959) Streitfragen über die Entstehung der Vegetation des Alföld und ihre heutige Beurteilung. *Földr. Ért.* **8:** 1–26.

SOÓS, L. (1943): *A Kárpát-medence Mollusca-faunája.* (The Mollusca Fauna of the Carpathian Basin.) Természettud. Társulat, Budapest, 478 pp. [In Hungarian]

STEGMANN, B. (1932) Herkunft der paläarktischen Taiga-Vögel. *Arch. Naturgesch. (N. F.)* **1:** 392–397.

STEGMANN, B. (1938) Grundzüge der ornithogeographischen Gliederung des paläarktischen Gebietes. Fauna SSSR, nov. ser. **19:** 1–158.

STEGMANN, B. (1958) Herkunft der europäischen Steppenvögel. *Bonner zool. Beitr.* **9:** 208–230.

STEININGER, F. F. & RÖGL, F. (1984) Paleogeography and palinspatic reconstruction of the Neogene of the Mediterranean and Paratethys. *In* DIXON, J. E. & ROBERTSON, A. H. F. (eds) *The geological evolution of the eastern Mediterranean.* Blackwell, Oxford, pp. 659–668.

STEININGER, F. F., RABEDER, G. & RÖGL, F. (1985) Land mammal distribution in the Mediterranean Neogene: a consequence of geokinematic and climatic events. *In* STANLY, D. J. & WEZEL, F. C. (eds) *Geological evolution in the Mediterranean basin.* Springer, New York, pp. 559–571.

SUKHAREVA, I. L. (1973) On the taxonomy of the subfamily Hadeninae Guenée, 1837 (Lep.: Noctuidae). *Entomol. Obozr.* **52:** 400–415. [In Russian]

SVENDSEN, P. & FIBIGER, M. (1992) The distribution of European Macrolepidoptera. Noctuidae, Noctuinae 1. *Faunistica Lepidopterorum Europaeorum, Kobenhavn* **1.** 296 pp.

TARMANN, G. & HUEMER, P. (1993) Die Schmetterlinge Österreichs (Lepidoptera). *Veröffentlichungen des Museums Ferdinandeum*, Beil. 5, 224 pp.

UDVARDY, M. D. F. (1981) The riddle of dispersal: Dispersal theories and how they affect vicariance biogeography. *In* NELSON, G. & ROSEN, D. E. (eds) *Vicariance biogeography: a critique*. Columbia Univ. Press, New York, pp. 6–39.

VARGA, Z. (1972) Extension, isolation, micro-évolution. *Acta biol. debr.* **8–9**(1971): 195–211.

VARGA, Z.(1975*a*) Geographische Isolation und Subspeziation bei den Hochgebirgslepidopteren der Balkanhalbinsel. *Acta ent. jugosl.* **11:** 5–39.

VARGA, Z. (1975*b*) Zoogeographische Gliederung der paläarktischen Orealfauna. *Verh. int. Symp. Entomofaun. Mitteleur. (Lunz a. S.),* Junk, The Hague (1976): 263–294.

VARGA, Z. (1977) Das Prinzip der areal-analytischen Methode in der Zoogeographie und die Faunenelemente-Einteilung der europäischen Tagschmetterlinge. *Acta biol. debr.* **14:** 223–285.

VARGA, Z. (1989*a*) Die Waldsteppen des pannonischen Raumes aus biogeographischer Sicht. *Düsseldorfer geobot. Kolloq.* **6:** 35–50.

VARGA, Z. (1989*b*) Zweiter Beitrag zur Kenntnis der Gattung Xenophysa Boursin, 1969 (Lep.: Noctuidae) mit Beschreibung fünf neuer Arten. *Z. Arbg. österr. Ent.* **41**(1–2): 48–77.

VARGA, Z. (1989*c*) The origin and division of the northern-montane disjunct areas in Palaearctic Lepidoptera. Their importance in solving zoogeographical and evolutionary problems. *Acta biol. debr.* **21:** 91–116.

VARGA, Z. (1990) New species of Noctuidae from Afghanistan and adjacent territories I. The genera Euxoa Hübner (1821) 1816, Dichagyris Lederer, 1857, Rhyacia Hübner (1821) 1816. (Lep.: Noctuidae, Noctuinae). *Esperiana, Schwanfeld* **1:** 167–198.

VARGA, Z. (1992) Taxonomic notes on the genus Haderonia Staudinger, 1896 with the description of a new genus Ctenoceratoda and four new species (Lep.: Noctuidae). *Acta zool. hung.* **38**(1–2): 113–124.

VARGA, Z. (1993) Beiträge zur Kenntnis der gattung Dichagyris Lederer, 1857 (Lep.: Noctuidae) I. *Acta zool. hung.* **39**(1–4): 289–300.

VARGA, Z. (1995*a*) Isolates of arctic-alpine and alpine Lepidoptera in SE Europe. *Proc. EIS Colloquium, Helsinki,* pp. 140–151.

VARGA, Z. (1995*b*) Geographical patterns of biological diversity in the Palearctic region and the Carpathian Basin. *Acta zool. hung.* **41**(2): 71–92.

VARGA, Z. (1996*a*) Entomologische Aspekte der räumlichen und biotischen Diversität in einer mitteleuropäischen Mosaiklandschaft. *Verh. 14. Int. Symp. Entomofaunistik in Mitteleuropa, SIEEC in München* (1994), pp. 33–67.

VARGA, Z. (1996*b*) New species and subspecies of Dichagyris, Chersotis and Rhyacia (Lepidoptera, Noctuidae) from Central Asia. *Acta zool. hung.* **42**(3): 195–230.

VARGA, Z., PEREGOVITS, L. & RONKAY, L. (1989) Zoogeographical survey of the Mongolian Noctuidae fauna. *Nota lepid.* **12**(Suppl. 1): 63–64.

VARGA, Z. & RONKAY, L. (1987) Revision of the genus Eugnorisma Boursin, 1946 (Lep.: Noctuidae). *Acta zool. hung.* **33**(1–2): 187–262.

VARGA, Z. & RONKAY, L. (1989) Taxonomical notes on the genus Victrix Staudinger, 1879 (Lep.: Noctuidae) I. *Nota lep.* **12**(1): 65–82.

VARGA, Z. & RONKAY, L. (1991*a*) Taxonomic studies on the genera Sideridis Hübner, Saragossa Staudinger and Conisania Hampson (Lep.: Noctuidae, Hadeninae). *Acta zool. hung.* **37**(1–2): 145–172.

VARGA, Z. & RONKAY, L. (1991*b*) Taxonomic studies on the Palearctic Noctuidae I. New taxa from Asia. *Acta zool. hung.* **37**(3–4): 263–312.

VARGA, Z. & RONKAY, L. (1991*c*) Taxonomical notes on the genus Victrix Staudinger, 1879 (Lep.: Noctuidae) II. *Nota lep.* **14**(2): 144–170.

VARGA, Z. & RONKAY, L. (1996) New and revised taxa from genera Chersotis Boisduval, 1840 and Dichagyris Lederer, 1857 from Central Asia (Lep.: Noctuidae). *Esperiana, Schwanfeld* **4**: 103–132.

VARGA, Z., RONKAY, L. & HACKER, H. (1990) Revision of the genus Bryopolia Boursin, 1954 (Lep.: Noctuidae). *Esperiana, Schwanfeld* **1:** 427–469.

VARGA, Z., RONKAY, L. & PEREGOVITS, L. (1992) Biogeographische Untersuchung der Noctuidae (Lepidoptera) der Mongolei. *Abstr. 2. internat. Symp.: Erforschung biologischer Ressourcen der Mongolei*, Halle, pp. 160–162.

VARGA, Z., RONKAY, L. & YELA, J. L. (1989) Revision of the genus Eugnorisma Boursin, 1946. Part II. Taxonomic news, biogeographic and phylogenetic considerations and descriptions of two new genera: Ledereragrotis and Pseudohermonassa (Lep.: Noctuidae). *Acta zool. hung.* **36**(3–4): 331–360.

VOOUS, K. H. (1960) Atlas of European birds. Nelson, London, 284 pp.

VOOUS, K. H. (1963) The concept of faunal elements or faunal types. *Proc. 13 int. Congr. Ornithol.* pp. 1104–1108.

VUILLEUMIER, F. (1970) Insular biogeography in continental regions. I. The northern Andes of South America. *Am. Nat.* **104:** 373–388.

VUILLEUMIER, F. (1973) Insular biogeography in continental regions. II. Cave faunas from Tessin, southern Switzerland. *Syst. Zool.* **22:** 64–76.

VUILLEUMIER, F. & SIMBERLOFF, D. S. (198O) Ecology versus history as determinants of patchy and insular distribution in High Andean birds. *In* HECHT, M. K., STEERE, W. C. & WALLACE, B. (eds) *Evolutionary biology.* **12:** 235–379.

WALTER, H. & BOX, E. O. (1983) Overview of Eurasian continental deserts and semideserts. *In* Ecosystems of the world, Vol. V. Elsevier, Amsterdam, pp. 3–269.

WALTER, H. & BRECKLE, S.-W. (1986) *Ökologie der Erde, Bd. 3. Spezielle Ökologie der gemäßigten und arktischen Zonen Euro-Nordasiens.* G. Fischer, Stuttgart, 587 pp.

WALTER, H. & STRAKA, H. (1970) *Arealkunde. Floristische-historische Geobotanik.* Stuttgart, 478 pp.

WANG XIAN-ZENG (1984) The palaeoenvironment of China from the Tertiary. *In* WHITE, R. O. (ed.) *The evolution of the East Asian environment, II.* Hong Kong, pp. 472–482.

WARNECKE, G. (1953) Über postglaziale Arealdisjunktionen europäischer Makrolepidopteren. *Deutscher Entomologentag, Hamburg*, pp. 33–47.

WARNECKE, G. (1959) Verzeichnis der boreoalpinen Lepidopteren. *Zschr. wiener ent. Ges.* **44**: 17–26.

WILLEMSE, F. (1971) The genus Oropodisma Uvarov, 1942, with the description of two new species (Orthoptera, Acridiidae, Catantopinae). *Publ. natururhist.Genoot., Limburg* **20:** 15–17.

WILLEMSE, F. (1972) Further records of the genus Oropodisma Uverov, 1942 (Orthoptera, Acrididae, Catantopinae). *Publ. natururhist.Genoot., Limburg* **22:** 27–31.

WILLEMSE, F. (1973) A study of the genus Paracaloptenus Bolivar, 1876 (Orthoptera, Acridoidea, Calliptaminae). *Beaufortia* **20:** 179–192.

WILLEMSE, F. (1977) Interesting distribution records of Orthoptera from the Greek mainland and some neighbouring islands. *Ent. Ber., Amsterdam* **37:** 52–59.

WILLEMSE, F. (1984) Catalogue of the Orthoptera of Greece I. *In* DROSOPOULOS, S. *et al.*: *Fauna Graeciae*, Hellenic Zoological Society, Athens, 275 pp.

WILTSHIRE, E. P. (1948) The Lepidoptera of the Kingdom of Egypt. I. *Bull. Soc. Fouad Ier ent.* **32:** 203–294.

WILTSHIRE, E. P. (1957) *The Lepidoptera of Iraq.* Dorking, London, 162 pp.

WILTSHIRE, E. P. (1979) A revision of the Armadini (Lep.: Noctuidae). *Entomonograph* **2:** 7–78.

ZÓLYOMI, B. (1953) Die Entwicklungsgeschichte der Vegetation Ungarns seit dem letzten Interglazial. *Acta biol. Acad. Sci. Hung.* **4:** 367–413.

ZÓLYOMI, B. (1964) Pannonische Vegetationsprobleme. *Verh. zool.-bot. Ges. Wien* **103–104:** 144–151.

Received 22nd September, 1996, accepted 30th December, 1996, published 18th November, 1997

Acta Zoologica Academiae Scientiarum Hungaricae 42 (4), pp. 331–340, 1996

OBSERVATIONS ON THE MATE RECOGNITION AND COPULATORY BEHAVIOUR OF AESHNA CYANEA (MÜLLER) (ANISOPTERA: AESHNIDAE)

A. AMBRUS

Jurisich u. 16, H–9495 Kópháza, Hungary

Two different flight patterns of *Aeshna cyanea* (MÜLLER) were studied at the mating place with the application of capture-mark-release techniques.
The mate recognition ability of the males was investigated experimentally with the fishing-line technique and females in hand: the male turned out to recognize the sitting (egglaying) female with a special female-searching flight.
The males tried to copulate with a tethered female, a female held in hand and even a male held in hand.
Super 8 mm movie film was taken on certain acts of the life cycle of *A. cyanea*, including the recognition of sitting females and other acts of the mating. The hypothesis of the dual function of the precopulatory sperm translocation – as a tool of mate recognition – is detailed here. Steps of the hypothetical mate recognition system are drafted for closely related aeshnid, gomphid, corduliid and cordulegasterid species based on preserved insects.

Key words: *Aeshna cyanea*, Odonata, mate recognition, copulatory behaviour

INTRODUCTION

Aeshna cyanea (MÜLLER) is one of the most rapid vigorously flying large dragonflies in Central Europe. It is no wonder that there are many papers dealing with this species, especially the territoriality of the males. Studies have been made on the time-sharing system of patrolling males at the mating place (POETHKE & KAISER 1985), the density-dependent behaviour of males (POETHKE 1988), the behaviour of females at the mating place (KAISER 1985) and so on.

The well-developed density-dependent territoriality of the males and the recognition ability of sitting females makes this species useful for investigating the mate recognition and copulatory behaviour of a large dragonfly. This paper presents the non-quantitative records of capture–mark–release (CMR) studies combined with experimental studies on the reproductive behaviour of the adults.

The working hypothesis was that the precopulatory movements (including intra-male sperm translocation) are the most important factors in the mate recognition process when the male gets close to the female. Therefore experiments were designed to imitate the natural male–female encounters to achieve copulations within reach. They were documented on Super 8 mm movie film. The low-speed replays made it possible to study the movements of copulation in details, which have led to a new interpretation of the precopulatory sperm translocation.

STUDY SITES AND METHODS

Two typical habitats of *A. cyanea* were studied in Hungary, one at Tatabánya [described in AMBRUS (1992)], another on Sopron, at the NW border of Hungary. The latter consists of two ponds of nearly 0.1 and 0.3 hectares of open water, several hundred meters away from each other. The legth of the shoreline of the two ponds could allow approximately 9 and 17 males (maximum) to patrol at the same time.

Multiple CMR studies were carried out in Tatabánya in 1986, and in Sopron in 1987, 1989 and 1990. Experimental studies with females and movie film were carried out in the last two occasions. The most extensive study was made between 4 August and 26 October, 1989, with 47 samples concerning more than 500 captures, and recaptures or registrations without capture of 204 individuals, including 28 captures or registrations of 24 females.

As many as 50 females were observed when performing such activities as egglaying, feeding or mating. Eight specimens of the captured females were used as attractant for males flying on fishing-line, fastened to the trunk on the ground or held in hand, to attract males. Other females were simply released from hand when males came close to them or just when grasped them. Some moments were filmed with a Sankyo ES 44–XL camera with a filmspeed of 18 frames/sec.

The study was repeated in 1990 with some extensions and refinements to the methods. Males in hand were used also to attract patrolling males. Females were fastened to a telescope stick installed on the camera (fixed focus).

Frames of the movie film were studied and counted to estimate the length of certain acts.

OBSERVATIONS ON PATROLLING MALES

The males show two main flight patterns at the mating place, distinguished here. One is the well-known energetic random patrol flight on a certain path of the shoreline (POETHKE 1988). Here it is called the "Here I Am" (HIA) display. It can take place anywhere on the shoreline. The other typical flight pattern is restricted to the suitable egglaying places. This is a special, direct female-searching flight, it is called here the "Where Are You" movement (WAY). During WAY display the males proceed slowly but the moves are quick, keeping close to the ground, moss and roots of alder and willow trees, often making loops. WAY movement usually takes place in fully shaded sites, sometime near to darkness, when there are no conspecific males.

Encounters with any kind of flying insects

During HIA display the males are interested in almost all flying objects, they usually try to come close to them. The next steps are any of the agressive, feeding or sexual activities, depending on the existence(type?) of the flying object, whether it is a conspecific or other male dragonfly, a possible prey or a conspecific female. In 1989 a geometrid butterfly *Colostygia olivata* DENIS et SCHIFFERMÜLLER was determined as a frequent prey, which was eaten after accurate removal of the wings.

Encounters with conspecific females

The males are very responsive to the straight, dynamic flight path of females when they cross the open water or come to the pond oblique from the surrounding forest. One male was observed when he was rushed and forced into tandem by another male while taking off after an accidental bath with straight, not too fast flight because of his wet wings. In contrast, the too slow flight of a "tired" female, flying on a fishing-line, finally became neutral for HIA males after three or four mating attempts by different males. (The multiple copulations and the fishing-line technique seemed to be quite exhausting for females, so I released the females just after performing the first refusal display, raising their abdomen up in tandem.) Most of the released females after marking could not avoid the successful mating attempt of a HIA male, if there was any nearby.

Encounters with conspecific males

Two neighbouring HIA males, returning to the previous patrolling zones after a clash, tend to avoid the next encounter with each other. They seem to accept each other for a while (unquantified observations).

Direct search for females

WAY males have the ability of recognizing the sitting, egglaying females. (Numerous observations on natural encounters and imitations with female in hand and fastened females.) In the case of natural encounter, the females approached by WAY males are either forced to take off by the swinging males and grasped in the air, or grasped on the ground (!) and take off in wheel. The steps of the precopulatory movements are so quick normally that there is no chance to investigate them in-depth, that is why the experimental approach was necessary.

OBSERVATIONS ON COPULATION

Precopulatory tandem flight

The tandem flight of freely moving pairs seems to be extremely short or completely absent (based on several dozen observations). It takes place in some abnormal event, such as homosexual attempts (one registration) and encounters with exhausted females on fishing-line showing refusal display (some 4–5 cases). Tandem position was performed with females-in-hand, after the unsuccesful attempt of pairing. Normally the wheel form can be completed within few seconds, but accurate timing was made only in one case. A female was released from hand just when a male approached her and the movements were filmed. It lasted for 2 seconds (36 frames) from the grasping and landing on the thorax of the female to the completed wheel.

Movements of taking the female

Based on filmed events with fastened females the motions of a male that has recognized a female are:

1. landing on the thorax of the female,
2. selecting the right direction (if necessary),
3. grasping the head of the female with final appendages (lower on the occiput, upper behind the compound eyes),
4. taking off from the thorax and moving forward with a very short stop ($x = 0.15$ sec, $n = 10$, $sd = 0.05$ sec), after which

4/a. the sperm translocation may be performed. In the same moment the head of the female can touch the ventral side of the metathorax and 1–2 abdominal segments of the male.

In the case of tethered females, the males returned to the thorax of the females and tried to bring them to copulation by stimulating the head with opened mandibles inconsiderately.

In the case of freely moving females, the last step, the irrigation of the head, is absent because the female bends her abdomen just when the male moves forward, and the wheel is completed without clear tandem (some dozen cases without accurate timing).

Copulation

The duration of copulation is known to be long (KAISER 1974). Here are two incomplete timing (accurate starting time of the copulations unknown) which show that the pairing must last for at least one hour. The durations of copulations with females on fishing-line were not timed, but the movements of the 2–3 abdominal segments of males were detected. The process of sperm translocation is presumable.

Post-copulation behaviour

After copulation neither tandem, nor guarding flight were observed above the egglaying females, the males lost their interest in their mate.

OTHER RELATED OBSERVATIONS

Sperm translocation (ST) performed by HIA males alone at the shoreline or near the shore was observed in two occasions in both 1986 and 1989, and on one occasion in 1990. The sperm content of the copulatory organ of the males was not isvestigated.

Two males were observed (one in 1989 and another in 1990) when settling down on the ground on a spot used by females as egglaying place, and stung it with their curved abdomen. They looked like egglaying females or males searching for the right clasp with the appendages on the head of the females.

An impression gained during making non-quantitative observations was, that the males can individually differ in their ability to recognize the sitting females (or females in hand), and they may differ from each other in their temper. One male was observed three times which has a native fault on his abdomen preventing him to perform ST. This specimen was always extremely agressive.

Sometimes, at the early stage of the flying season the females can show HIA display at the egglaying sites also mentioned by KAISER (1985), later, when the density of patrolling males becomes high it was no longer observed.

Some females performed special flights in order to avoid copulation. When they noticed an approaching male while looking for suitable egglaying sites, they suddenly made a sharp turn and quickly started to fly away from the water, through the vegetation of the shore, then within 3–4 m they made a quick turn again and returned to the shoreline. In 3 out of 4 cases the chasing males lost the track of the female, but in one case the male also returned to the shoreline quickly and grasped the female.

DISCUSSION

As regards mating success, the optimal strategy is that the males should have as many encounters with females as possible. It can take place most easily at the egglaying sites, which the females are supposed to visit regularly.

The behaviour of *A. cyanea* seems to support hypothesis (3) of CAMPANELLA & WOLF (1974), that is: both sexes are equally attracted by oviposition sites. Another verification of the hypothesis (3) of CAMPANELLA & WOLF is given by UTZERI & DELL'ANNA (1989) who studied *Libellula depressa*. *A. cyanea* females can obviously recognize the suitable places as they lay eggs alone and frequently use the same substrate in a given biotope. The WAY males usually visit just the same, sheltered places looking for females. The ability of males to recognize the sitting females can give evidence for this hypothesis in the case of *A. cyanea*. But we have no information about the causes of individual differences between the mate recognition ability of *A. cyanea* males mentioned before. In case of the *A. cyanea*, the inductive effect of previous mating success (quasi learning process), and/or the amount of produced/stored sperm (as stimulant; see the case of the male with abdominal malformation) could be possible causal factor of individual differences.

The general recognition ability of *A. cyanea* males of the sitting females and the clear WAY display is not a common attribute of anisopteran males. UTZERI & RAFFI (1983) have reported that *Aeshna affinis* males gave up taking the female if she had landed before he grasped her. UBUKATA (1983) has found similar behaviour in *Cordulia aenea amurensis. Anaciaeschna isosceles* males lose interest in the landed females and fly away, as demonstrated by fishing-line experiments (AMBRUS, unpublished). Simple observations of *Orthetrum cancellatum* showed that the males were not interested in the sitting female while resting as close to her as 30–40 cm, but immediately started to chase her and grasped her when she took off (AMBRUS, unpublished).

The mate recognition ability of *A. cyanea* males offered good opportunity for investigating the mating procedure in-depth, and to analyse it step-by-step from the view-point of reproductive isolation barrier (in the sense of TENNESSEN 1982).

Visual stimuli must be essential factors of mate recognition. The remote visual stimulus may be first of all the flight manner of the female, as the male tends to lose interest in the exhausted, unusually slowly flying female on a fishing-line, despite of her correct colouration, but is interested sexually in the male flying in female-manner (escaping from the water) despite of his male colouration.

This study cannot give evidence for the recognition of conspecific flight pattern and/or colouration as remote visual stimuli, as it should be studied in a mixed population with such similar species as *Aeshna juncea, A. subarctica* or *A. viridis*. In this case *Aeshna mixta* was the single aeshnid species present at the pond which was never attacked sexually by *A. cyanea* males.

While only the existence of the remote visual stimuli is certain, the close visual stimuli are known better as regards their functioning. The males recognizing the conspecific individual in hand (with abdomen covered by fingers) come closer, land on the thorax and try to copulate should the "mate" be a female or a male. As the abdomen was invisible, covered by fingers except for the very basal area, the thorax must hold the specific (unisexual) visual stimuli on the dorsal side: the complex pattern of wingbase and the mesepisternal stripes. Furthermore, the colour pattern of the head and the abdomen base may offer additional specific information, but the significant difference between the colouration of the sexes seems not to affect the interest of the approaching male in the individual held in hand. It was also found in the case of the male in hand with the abdomen less covered, so the distinctive colouration of the male acting as close visual stimuli without agressive behaviour, does not provoke the attack of the approaching male. But the colour pattern of the dorsal view of the thorax may give clue about the right direction of landing and placing the final appendages.

The next steps in mate recognition are clasping the head of the female by the final appendages and the precopulatory ST which is usually combined with the movement of the female's abdomen curving forward to the wheel position. As this is one of the most important phases of pairing when the pre-copula turns out to become copula or not depending on the readyness of the female through reflex-like actions, we should pay more attention to this stage.

There is the exact print of upper appendages of male on the back side of the head (of both sexes), including the final curved spine. The lower appendage fits to the occiput as well. Presumably there are receptors which can be stimulated only with the specific appendages (as correct keys). As the final appendages of males are species-specific, the tactile stimuli may work with the lock-and-key mechanism. It is not easy to test this supposition, but the process may be looked at indirectly: the incompatibility of the final appendages to the head of the female alone does not prevent the tandem linkage. But the heterospecific tandem does not make copula too frequently, as it is mentioned by BICK & BICK (1981). I have registered heterospecific tandem between *Leucorrhinia pectoralis* male and *L. caudalis* female, *Sympetrum sanguineum* male and *S. fonscolombii* female, *Orthetrum coerulescens* male and young *Sympetrum vulgatum* female. The case of *Orthetrom coerulescens* × *Sympetrum vulgatum* tandem was observed in a mixed *O. coerulescens* and *O. brunneum* population strongly dominated by *O. brunneum*, where there were very few *O. coerulescens* females. The *O. coerulescens* male did the same as the *cyanea* male with female in hand: performed ST repeatedly, but without any cooperation of the female in mating. As the multiple precopulatory ST occurs together with some troubles in the normal way of mating, it should be reviewed from this side.

Aeshna cyanea males can perform ST alone, so this is not an obligatory step of mating. UTZERI (1985) has reported 11 observations by different authors on ST performed by a male dragonfly alone. AMBRUS (1990) considered the ST to be common at the end of the pre-reproductive period of *Cordulia aenea* away from the water. MILLER (1984) found sperm in the secondary genitalia of some males of libellulid dragonflies and supposed that they could control the amount of sperm released. The sperm amount stored in the secondary genitalia of *A. cyanea* was not investigated here, but obviously *A. cyanea* males can hold it as the pre-copulatory ST may be performed alone. Nevertheless the males do ST before copulation; but why, does it have another function?

During pre-copulatory ST the head of the female come close to the ventral side of the 1–2 abdominal segments and metathorax of the male or really the vertex of the female gets in touch with this surface. The moves are too quick to clearly recognize on normal-speed film footages, but whether contact takes place or not, this step usually produces the acceptance of the male by the female in a normal way. If female doesnot cooperate, the male repeatedly does "ST" which strengthens the stimuli rather than accomplishes real sperm translocation. These stimuli may be any of the following ones:

1. Visual stimuli arising from certain locus of the ventral side of the male,
2. Tactile stimuli on the head of the female which do not work in simple tandem linkage but are strengthened by special moves of the male,
3. Visual and tactile stimuli together,
4. Simple agressive irritation of head of the female.

Copulation in the natural way seems to support the first hypothesis. Preserved material do the same: there is substantial difference in the ventral view of the metathorax and the abdomen base among closely related aeshnid, gomphid, corduliid and cordulegasterid dragonflies. (These differences are less definite among libellulid species.) There are surfaces which seem to match to vertex. Thus irrespective of whether the pre-copulatory ST takes place or it is imitation only, it should have a dual function: sperm filling (or refreshment) and letting the female identify the specific colour pattern/structural code of the male. If it is the case, the colour pattern and structure of the mentioned surfaces could be used in the systematics.

The unsuccessful copulation attempts seem to support hypothesis 2, but there is no information about the locality and the function of the receptors (if there are any) on the head of female. The hand-pairing technique (OPPENHEIMER & WAAGE 1987) cannot be used in the case of *A. cyanea* and other large dragonflies because the males will not cooperate (except for hand-pairing without wheel, with simple touching of the copulatory organs). The alteration of the final appendages of the males in a natural population has very low efficiency, so it is not too easy to test the second hypothesis.

Hypothesis 4, the simple irritation of the head of the female is obviously not the normal way of mating. It can be an extreme reaction to the abnormal behaviour of fastened female prevented from showing acceptance or refusal display. However, it may exist in natural conditions as well, because I have found adult females with some spots on their frons which might have been caused by agressive males. This can occur in such cases as mentioned by KAISER (1985), when the seized females "stubbornly clasp the substratum". Such a female cannot show refusal display, similarly to the fastened one, so the female-to-male communication (if any) cannot be performed. There is a possibility that the violant irritation, used by agressive males or caused by incomplete communication, finally can convince the reluctant female to copulate, even in heterospecific tandem.

If MILLER's (1984) hypothesis of the controlling ability of certain male dragonflies of the sperm release was correct and widespread in Odonata, one can speculate that why not the amount of sperm carried in male, in correlation with the achieved copulations would influence the behaviour, agressivity of males. In this sense such peculiar phenomena could get meaning as the extremely agressive male which was not able to perform ST, and the substitution of normal copulation with heterospecific pairing or mating imitation (?) on the bare ground.

Further, more detailed studies are needed on the sensory abilities of dragonflies, the individual differences in behaviour, with experimental studies using modified individuals.

* * *

Acknowledgements – Thanks are due to the referees of the previous version of the manuscript for suggestions and correction of the English.

REFERENCES

AMBRUS, A. (1990) Capture-mark-recapture studies on insect populations with special respect to harmful forest macrolepidoptera. Unpublished PhD thesis.

AMBRUS, A. (1992) Dragonfly fauna of a small artificial fishing-pond (Lake Kacsa at Tatabánya, Hungary). In *Conserving and managing wetlands for invertebrates*, Council of Europe Press pp. 98.

BICK, G. H. & BICK, J. C. (1981) Heterospecific pairing among Odonata. *Odonatologica* **10**(4): 259–270.

CAMPANELLA, P. J. & WOLF, L. L. (1974) Temporal lek as a mating system in a temperate zone dragonfly (Odonata: Anisoptera) I. Plathemis lydia (Drury). *Behaviour* **51**(1–2): 49–87.

KAISER, H. (1985) Availability of receptive females at the mating place and mating chances of males in the dragonfly Aeshna cyanea. *Behav. Ecol. Sociobiol.* **18**: 1–7.

MILLER, P. L. (1984) The structure of the genitalia and the volumes of sperm stored in male and female Nesciothemis farinosa (Foerster) and Orthetrum chrysostigma (Burmeister) (Anisoptera: Libellulidae). *Odonatologica* **13**(3): 415–428.

OPPENHEIMER, S. D. & WAAGE, J. K. (1987) Hand-pairing: a new technique for obtaining copulations within and between Calopteryx species (Zygoptera: Calopterygidae). *Odonatologica* **16**(3): 291–296.

POETHKE, H.-J. (1988) Density-dependent behaviour in Aeshna cyanea (Müller) males at the mating place (Anisoptera: Aeshnidae). *Odonatologica* **17**(3): 205–212.

POETHKE, H.-J. & KAISER, H. (1985) A simulation approach to evolutionary game theory: the evolution of time-sharing behaviour in a dragonfly mating system. *Behav. Ecol. Sociobiol.* **18**: 155–163.

POETHKE, H.-J. & KAISER, H. (1987) The territoriality threshold: a model for mutual avoidance in dragonfly mating systems. *Behav. Ecol. Sociobiol.* **20**: 11–19.

TENNESEN, K. J. (1982) Review of reproductive isolating barriers in Odonata. *Adv. Odonatol.* **1**: 251–265.

UBUKATA, H. (1983) An experimental study of sex recognition in Cordulia aenea amurensis Selys (Anisoptera: Corduliidae). *Odonatologica* **12**(1): 71–81.

UBUKATA, H. (1984) Intra-male sperm translocation and copulatory behaviour in the dragonfly Cordulia aenea amurensis Selys (Odonata: Corduliidae). *J. Hokkaido Univ. Educ. (Sect. II. B)* **35**: 43–52.

UTZERI, C. (1985) Field observation on sperm translocation behaviour in the males of Crocothemis erythraea (Brullé) and Orthetrum cancellatum (L.) (Libellulidae), with a review of the same in Anisoptera. *Odonatologica* **14**(3): 227–237.

UTZERI, C. & DELL'ANNA, L. (1989) Wandering and territoriality in Libellula depressa L. (Anisoptera: Libellulidae). *Adv. Odonatol.* **4**: 133–147.

UTZERI, C. & RAFFI, R. (1983) Observations on the bahaviour of Aeshna affinis (Vander Linden) at a dried-up pond (Anisoptera: Aeshnidae). *Odonatologica* **12**(2): 141–151.

Received 28th June, 1996, accepted 30th December, 1996, published 18th November, 1997

ACTA ZOOLOGICA ACADEMIAE SCIENTIARUM HUNGARICAE

AN INTERNATIONAL JOURNAL OF ANIMAL TAXONOMY AND ECOLOGY

CUMULATIVE INDEX FOR VOLUME 42, 1996

HU ISSN 1217–8837

SUBSCRIPTION INFORMATION

Orders should be addressed to

Editorial Office of the Acta Zoologica
Hungarian Natural History Museum
H-1088 Budapest, Baross u. 13, Hungary
Fax: (36–1) 1171669
E-mail: perego@zoo.zoo.nhmus.hu

ACTA ZOOLOGICA
ACADEMIAE SCIENTIARUM HUNGARICAE

An international journal of animal taxonomy and ecology

Instruction to authors

Submission of a paper implies that it has not been published previously, that is not under consideration for publication elsewhere, and that if accepted for the Acta Zoologica Hungarica, the authors will transfer copyright to the Hungarian Academy of Sciences/the Hungarian Natural History Museum as is customary. Articles and illustrations become the property of the HAS/HNHM.

Papers must be in English with British spelling, and be original contributions in the field of animal taxonomy, systematics, zoogeography and ecology. All manuscripts must be submitted to one of the editors (editor, assistant editor).

Entire manuscripts must be submitted on IBM compatible floppy disk and in duplicate printed copies and the author should retain a copy. In the case of multiple authors, the corresponding author should be indicated. Series of numbered papers will not be considered.

Manuscripts must be printed with double spacing (including the reference list), and with wide margins (30–35 mm) on the left side of the paper only. Authors are requested to keep their communications as concise as possible. Footnotes should be avoided or minimized, and italics should not be used for emphasis. A running head of not more than 30 letters should be supplied.

The manuscript should contain the following information:

Title should be followed by the name and full address of the author(s). Where possible, the fax and/or e-mail number of the corresponding author should be supplied with the manuscript, for use by the publisher.

Abstract should be a brief summary of the contents and conclusions of the paper, and should not be longer than 200 words and should not contain references.

Key words should not be more than five (exceptionally 6) key word entries.

Introduction should contain a brief survey of the relevant literature and the reasons for doing the work.

Materials and Methods supply sufficient information to permit repetition of the experimental or field work. The technical description of methods should be given only when such methods are new.

Results should be presented concisely. Only in exceptional cases will it be permissible to present the same set of results in both table and a figure. The results section should not be used for discussion.

Discussion should be separate from the results section and should deal with the significance of the results and their relationship to the object of the work (and, this is the place of the identification key in taxonomic revisions).

Acknowledgements (at most in 10 lines).

References. In principle the Harvard system is to be followed. References should be detailed in the following order: authors' names and initials, date of publication (in parentheses), the title of the article, the name of the journal as abbreviated in the World List of Scientific Periodicals (4th edn 1963), the volume, and the first and last pages of the article, e.g.

NORRBOM, A. L. and KIM, K. C. (1985) Taxonomy and phylogenetic relationships of Copromyza Fallén (s.s.) (Diptera: Sphaeroceridae). *Ann. Entomol. Soc. Am.* **78**: 331–347.

For books the author's names, date of publication, title, edition, page reference, publisher's name and the place of publication should be given, e.g.

HINTON, H. E. (1981) *Biology of insect eggs*, vol. 2. Pergamon Press, New York.

or

MCALPINE, J. F. (1981) Morphology and terminology, adults, pp. 9–63. *In* MCALPINE *et al.* (eds) *Manual of Nearctic Diptera*, vol. 1. Agriculture Canada, Ottawa.

In the text references should be given as MARSHALL (1992) or (MARSHALL 1992). When a citation includes more than two authors, e.g. GREY, BLACK and WHITE, the paper should be referred to in the text as GREY *et al.*, provided that this not ambiguous. If papers by the same author(s) in the same year are cited, they should be distinguished by the letters, *a, b, c,* etc., e.g. MARSHALL (1992*a*).

References to papers "in press" must mean that the article has been accepted for publication. References to "personal communications" and unpublished work are permitted in the text only: references to papers in preparation or submitted are not permissible.

All necessary **illustrations** should accompany the manuscript, but should not be inserted in the text. All photographs, graphs and diagrams should be numbered consecutively in Arabic numerals in the order in which they are referred to in the text. Glossy photographs or positive prints should be sent unmounted wherever possible and should be kept to a minimum. Figures should be of good quality. Explanation of lettering and symbols should be given in the figure caption and only exceptionally in the figures. Lettering and symbols to appear on the illustration should be of sufficient size to allow for considerable reduction where necessary (usually proper for a 50% reduction in size). Scales must be indicated on micrographs, not by magnifications in the legends. Figure size must not exceed 24×30 cm. On the back of each illustration should be indicated the author's name, the figure number (in Arabic numerals), and the top of the illustration, where this is not clear. Halftones should be included only when they are essential. Details and quotation of publication of colour plates should be made to the editors. The following symbols should be used on line drawing: ● ■ ○ ❑ ▲ ◆ ♦ etc.

Legends to figures should be typed on a separate sheet. They should give sufficient data to make the illustration comprehensible without reference to the text.

Tables and appendices should be constructed so as to be intelligible without reference to the text, numbered in Arabic numerals and typed on separate sheets. Every table should be provided with an explanatory caption and each column should carry an appropriate heading. Units of measure should always be indicated clearly (metric units are preferred). All tables and figures must be referred to in the text.

Only standard **abbreviations** should be used. Arbitrary abbreviations and jargon will not be accepted.

The Latin names should be given for all species used in the investigation, although taxonomic affiliation and authority need not be provided in the title.

Page proofs will be sent to the author (or the first-mentioned author in a paper of multiple authorship) for checking. Corrections to the proofs must be restricted to printers' errors. Any substantial alterations other than these may be charged to the author. Authors are particularly requested to return their corrected proofs as quickly as possible in order to facilitate rapid publication. Please note that authors are urged to check their proofs carefully before return, since late corrections cannot be guaranteed for inclusion in the printed journal.

Fifty reprints free of charge will be sent to the first author; extra copies of the issue (at a specially reduced rate) can be ordered on the form which will accompany the proofs. These should be returned to: The Editorial Office of the Acta Zoologica, Hungarian Natural History Museum, Budapest, Baross u. 13, H–1088, Hungary

The **page charge** required from authors outside Hungary is USD 15 per printed page. In exceptional cases, the page charge may be waived. Please contact the editor in before submitting a paper if you ask for a waiver. Authors of papers exceeding 16 printed pages are asked to pay USD 40 (or HUF equivalent) for each such page, i.e. all costs of publication (irrespective of their nationality).

FOR FURTHER INFORMATION PLEASE CONTACT US
The Editorial Office of the Acta Zoologica
H–1088 Budapest, Baross u. 13, Hungary
Fax: (36–1) 1171669
E-mail: perego@zoo.zoo.nhmus.hu

SUBSCRIPTION INFORMATION

Orders should be addressed to

Editorial Office of the Acta Zoologica
Hungarian Natural History Museum
H-1088 Budapest, Baross u. 13, Hungary
Fax: (36–1) 1171669
E-mail: perego@zoo.zoo.nhmus.hu

Typeset: Pars Ltd., Budapest.
Printed by Mondat Ltd., Hungary

CONTENTS

HU ISSN 1217–8837