

GERHARD BRETTFELD &amp; ULRICH GAUER

# Diagnostic description of the males of new *Sphaeridia* species (Insecta, Collembola) from South America

## Abstract

This description of new *Sphaeridia* species is part of an ecological study of the Collembola of the Amazon inundation forests. The species are described after the male characters. Collections from Colombia and Paraguay supplement those from Brazil. We have added 18 new species to the 14 known in South America, and suggest dividing all the species described into several species groups. The ecology of the new species is briefly characterized. A key considers all species from South America.

## Kurzfassung

### Diagnostische Beschreibung von Männchen neuer

### *Sphaeridia*-Arten (Insecta, Collembola) aus Südamerika

Als erster Schritt zu einer Darstellung der Ökologie der Collembolen der Überschwemmungswälder des Amazonas werden die Arten der Gattung *Sphaeridia* nach den Merkmalen der Männchen beschrieben. Material aus Kolumbien und Paraguay ergänzt die Sammlungen aus Brasilien. Zu den 14 aus Südamerika bekannten Arten kommen 18 neue hinzu. Wir schlagen vor, alle beschriebenen Arten in mehrere Artengruppen aufzuteilen. Die Ökologie der neuen Arten wird kurz charakterisiert. Für alle südamerikanischen Arten ist eine Bestimmungstabelle aufgestellt worden.

## Resumo

### Descrição diagnóstica de machos de espécies novas do gênero *Sphaeridia* (Insecta, Collembola) da América do Sul

Como primeiro passo para um entendimento da ecologia de colêmbolos em florestas inundáveis da Amazônia, as espécies do gênero *Sphaeridia* são descritas com as características dos machos. O material do Brasil é complementado por material da Colômbia e do Paraguai. Às 14 espécies conhecidas da América do Sul juntam-se 18 novas espécies. Propomos distribuir todos as espécies descritas em alguns grupos de espécies. A ecologia das novas espécies é caracterizada de forma breve. Para todas as espécies da América do Sul é feita uma chave de identificação.

## Authors

Dr. GERHARD BRETTFELD, Zoologisches Institut der Universität, Olshausenstraße 40, D-24098 Kiel, Germany;  
Dipl.-Biol. ULRICH GAUER, Staatliches Museum für Naturkunde, Postfach 6209, D-76042 Karlsruhe, Germany.

## Contents

1. Introduction
2. Material and Methods
3. History
4. Description of the new species
  - 4.1 The species from Brasil
    - Sphaeridia cerastes* nov. spec.
    - Sphaeridia clara* nov. spec.
    - Sphaeridia coronata* nov. spec.
    - Sphaeridia fibulifera* nov. spec.
    - Sphaeridia franklinae* nov. spec.
    - Sphaeridia irmleri* nov. spec.
    - Sphaeridia martii* nov. spec.
    - Sphaeridia pileata* nov. spec.
    - Sphaeridia robusta* nov. spec.
    - Sphaeridia squamifera* nov. spec.
  - 4.2 The species from Paraguay
    - Sphaeridia boettgeri* nov. spec.
  - 4.3 The species from Colombia
    - Sphaeridia catapulta* nov. spec.
    - Sphaeridia chisacae* nov. spec.
    - Sphaeridia lobata* nov. spec.
    - Sphaeridia mandibulata* nov. spec.
    - Sphaeridia neopumilis* nov. spec.
    - Sphaeridia spira* nov. spec.
    - Sphaeridia sturmi* nov. spec.
5. Systematic comparison
  - pumilis*-group
  - brevipila*-group
  - irmleri*-group
  - spira*-group
  - Male incompletely known
  - Male not known
6. Ecology
7. Key of *Sphaeridia* males of South America
8. Literature

## 1. Introduction

The soil is an integral and highly diagnostic stratum of terrestrial ecosystems. It is generally rich in arthropods and can be easily studied. In tropical regions knowledge of the soil and its fauna is increasingly important because the destruction of the forests and the ensuing destruction of the soils wipes out numerous species

which are both functional components of the ecosystem and the basis for an understanding of its evolution.

Among the arthropods of tropical soils the Collembola are frequent but little known. In large parts of South America, the Collembola are completely unknown; they were mostly found on small scale excursions or as additional catch during ecological studies, and often remained unexamined due to their large numbers and taxonomical problems.

A current ecological study of the Collembola of the inundation forests of central Amazonia by the junior author requires an examination of the taxonomy of some genera of this group.

This paper deals with the genus *Sphaeridia* LINNANIE-MI, 1912. We have added 18 new species from Brazil, Colombia, and Paraguay to the 14 known in South America; thus, the number of *Sphaeridia* species of South America increases to 32. We have, for practical purposes, these and the 23 species described from other regions of the world, subdivided into several species groups.

## 2. Material and Methods

The specimens studied belong to four collections:

1. Coll. K. BÖTTGER, Kiel, Germany: Paraguay, one sample taken near Concepción, 1985.
2. Coll. U. GAUER, Karlsruhe, Germany: Brazil, samples from the inundation forests várzea and igapó near Manaus, 1989-1991.
3. Coll. U. IRMLER, Kiel, Germany: Brazil, same locality and biotopes as in coll. GAUER, 1971.
4. Coll. H. STURM, Hildesheim, Germany: Colombia, samples from the Andean páramo regions near Bogotá, 1985, 1986, and 1989.

Types of the following species were also studied (they will be redescribed in a later paper): *Sphaeridia denisi* MASSOUD & DELAMARE DEBOUTTEVILLE, 1964, *Sph. schalleri* MASSOUD & DELAMARE DEBOUTTEVILLE, 1964, *Sph. winteri* MASSOUD & DELAMARE DEBOUTTEVILLE, 1964, *Sph. spec.* MASSOUD & DELAMARE DEBOUTTEVILLE, 1964.

In this paper we offer a preliminary description of the males of the new species. We fully describe the ventral tube and tibiotarsus III because these parts show singular species specific characters (MURPHY 1966); these structures may be used during sperm transfer (BLANQUAERT & MERTENS 1977), but because of their minute dimensions their exact role is unknown and is likely to remain so.

We add some features of the head, antennal segment II and III, and furca to distinguish the males when the ventral tube and tibiotarsus III are similar, and to facilitate the later placement of the females. We did not study the antennae in detail as there were mostly proportional differences between the species.

The following measurements are taken: total length, measured from alcohol specimens, from the antennal base to the posterior tip of the small abdomen; head length from the head apex to the lower edge of the sclerotic margin of the clypeus; antennal segments II and III measured ventrally; dens measured anteriorly, mucro posteriorly. After „Marc André I“ as in-

termedium, „Hoyer's mixture“ was the preparation fluid (BRET-FELD 1991). The figures of the ventral tube mainly show the posterior side as most of its structures lie on this side. On tibiotarsus III the setae Ia, li, Ip, IIIp, Va, Vai, Vp and all secondary ones are missing; in position 2ae and 2pe small papillae without setae are present. The chaetotaxic nomenclature is that of the previous papers of the senior author (BRET-FELD 1990, 1992a, 1992b), but counting the setae of dens starts distally with E1, P1, J1 instead of E0, P0, J0; the chaetotaxic nomenclature of the tibiotarsus combines that of the senior author with that of NAYROLLES (1988).

The types have been deposited at the Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil (INPA); the Museo de Historia Natural, Universidad Nacional de Colombia, Bogotá, Colombia (MNCB); the Muséum National d' Histoire Naturelle, Paris/Brunoy, France (MNHN); the Senckenberg Museum, Frankfurt/Main, Germany (SMF); and in the authors' collections; the collection GAUER is deposited at the Staatliches Museum für Naturkunde Karlsruhe (SMNK).

## Acknowledgements

We gratefully acknowledge the opportunity to study the collections of K. BÖTTGER, U. IRMLER, and H. STURM. The junior author expresses his gratitude to the Working Group Tropical Ecology of the Max-Planck-Institut für Limnologie, Plön, Germany, and the Instituto Nacional de Pesquisas da Amazônia, INPA, Manaus, Brazil, for supporting his stay in Manaus. Our thanks are also due to J.-M. BETSCH for lending types of *Sphaeridia* species. We thank P. F. BELLINGER, Northridge, J.-M. BETSCH, Brunoy, W. N. ELLIS, Amsterdam, and H. STURM, Hildesheim, for their valuable comments on our manuscript. We thank also Mrs. D. OLIMART, who made the ink drawings of the figures (except Fig. 1, which is drawn by the junior author), and D. O'BRIEN, who corrected our English.

## 3. History

The view that only the Palaearctic or Holarctic *Sphaeridia pumilis* (KRAUSBAUER) occurs in South America (summary in MARI MUTT & BELLINGER 1990) was refuted by MASSOUD & DELAMARE DEBOUTTEVILLE, who in 1964 noted the special setae of the male tibiotarsus III and described three new species (*denisi*, *schalleri*, *winteri*) and an unnamed male (spec.) from the Peruvian Amazon lowland and the Andean Amazon region. In the same year, 1964, DELAMARE DEBOUTTEVILLE & MASSOUD added *Sph. gladiolifer* and an uncertain *Sph. pumilis* from Surinam. In 1966, MURPHY introduced the study of the male ventral tube structures. Then, in 1984, ARLÉ described another six new species from Southern Brazil (*betschi*, *cardosi*, *carioca*, *fluminensis*, *heloisae*, *paroara*), he mentioned *Sph. biniserrata* (SALMON) from Minas Gerais and Rio de Janeiro, and noted specimens looking like *Sph. pumilis* (KRAUSBAUER). The last species described from South America was *Sph. aserrata* by MARI MUTT 1987.

The problematic group remains „*Sphaeridia pumilis* (KRAUSBAUER)“, the males of which have only 1+1 small vesicles on the posterior ventral tube (this is also the only special structure of the female ventral tube of

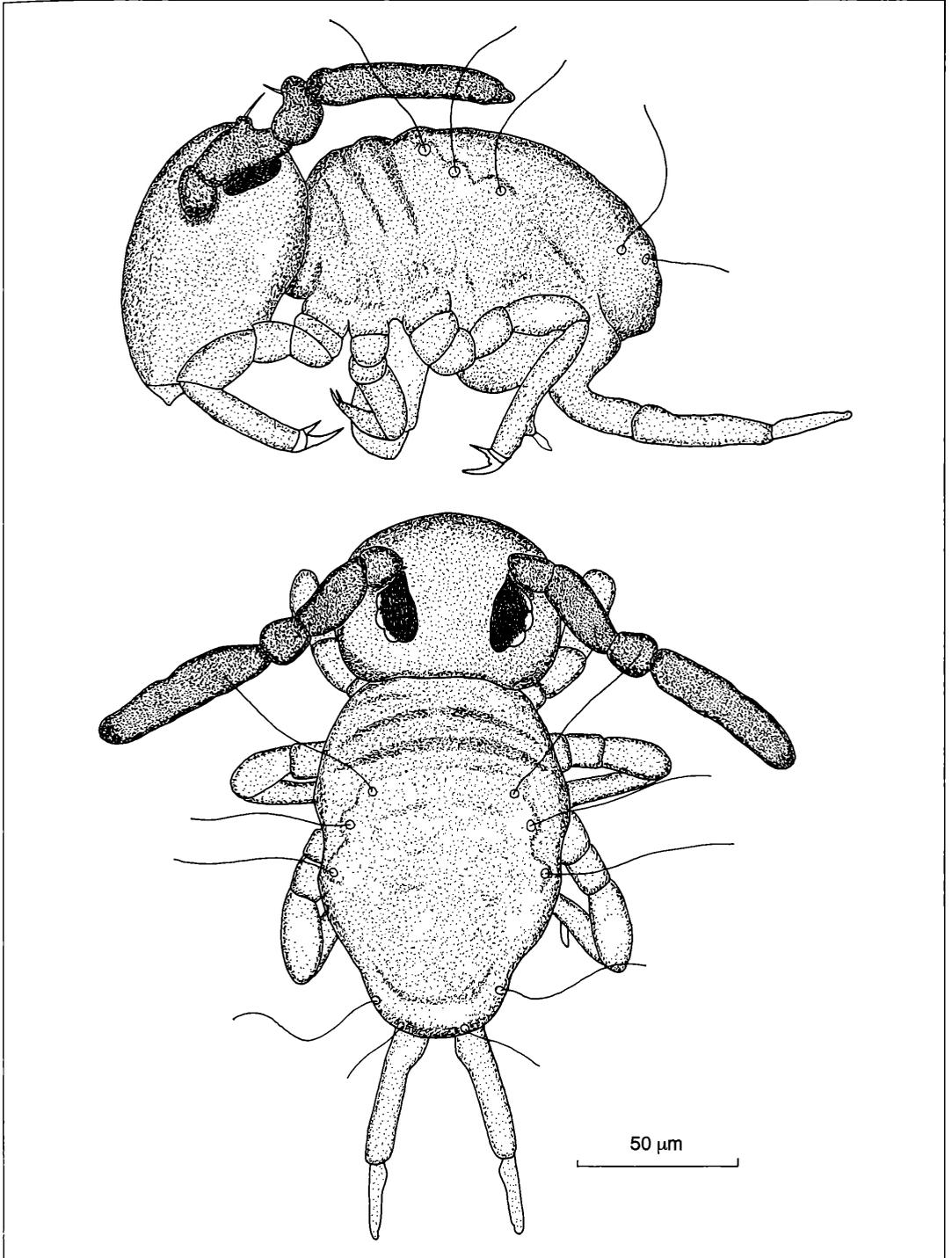


Figure 1. *Sphaeridia squamifera* n. sp.: male: habitus

all known *Sphaeridia* species) and an outer, long seta (Ilpe) besides other normal ones on the tibiotarsus III (these characters apply to specimens from Western Europe, see DUNGER & BRETTFELD 1989). This „species“ has been found in large parts of South America (MARI MUTT & BELLINGER 1990). Our material also contains such specimens, but characters other than those of ventral tube and tibiotarsus III allow us to distinguish several new species.

#### 4. Description of the new species

##### 4.1 The species from Brazil

###### *Sphaeridia cerastes* nov. spec.

Type locality: Brazil, Amazonas, Manaus.

Type material: Holotype: Male (alcohol), Brazil, Amazonas, Igapó of Rio Tarumã Mirim near Manaus, 3. X. 1989 leg. GAUER (no. 3.1.2. II F), at INPA. – Paratypes: 1 male (slide) from the holotype sample, in coll. BRETTFELD; 1 male (slide), same locality, 29. VIII. 1989 leg. GAUER (no. 3.1.2.), in coll. GAUER; 5 males (slides), same locality, 10. – 24. IX. 1971 leg. IRMLER, 1 and 2 m above water level: 1 (3 slides) at SMF (Ap 2419), 1 at MNHN, 2 at INPA (these 4 have coll. BRETTFELD no. 26/90), 1 in coll. BRETTFELD (no. 25/90).

Further material: 1 male (slide), Brazil, Amazonas, Manaus, Ilha de Marchantaria, soil from Várzea forest, 17. I. 1991 leg. GAUER (no. 1.2.1. K 10), at INPA.

Total male 0.2 mm, dark blue (sometimes only laterally). Ventral tube (Fig. 2 a, b, c) posteriorly with 1+1 round vesicles and a slightly knobbed, median process; anteriorly with 1+1 lateral processes bifurcated at their tips; 1+1 setae. Tibiotarsus III with normal setae, only Ilpe slightly longer and stronger than others. Head frons setae a+d 2, 3, 4 and b+c 2 with thickened basal half (Fig. 2 d). Dens as in Fig. 4 c, but seta E1 long; tip of mucro a shrunk cap (Fig. 2 e); dens mucro = 2.6.

The name of this new species is derived from Greek *kerastes* = horned, relating to its ventral tube processes.

*Sphaeridia cerastes* clearly differs from other species by its ventral tube structures.

###### *Sphaeridia clara* nov. spec.

Type locality: Brazil, Amazonas, Manaus.

Type material: Holotype: Male (alcohol), Brazil, Amazonas, Igapó of Rio Tarumã Mirim near Manaus, 31. X. 1990 leg. GAUER (no. 1.1.3./2), at INPA. – Paratypes: 7 males, same locality, leg. GAUER: 1 (slide), 21. IX. 1989 (no. 3.1.2.), at SMF (Ap 2420); 1 (slide), same sample, at MNHN; 1 (slide), 29. VIII. 1989 (no. 3.1.2.), in coll. GAUER; 4 (alc.), 3. X. 1989 (no. 3.1.2. II F), at INPA.

Further material: 9 males (slides), same locality as the types, 10. – 24. IX. 1971 leg. IRMLER, 2 m above water level, coll. BRETTFELD 26/90: 5 in coll. BRETTFELD, 4 at INPA.

Total male 0.18 mm, pale. Ventral tube posteriorly with 1+1 small vesicles (as in *Sphaeridia pumilis*); 1+1 se-

tae. Tibiotarsus III seta Ilpe of normal shape, Illpi and IVpi slender, with few teeth (Fig. 3 a). Head large (100  $\mu$ m, n = 10); frons setae a+d 1, 2, b+c 1, 2 stronger than others, setae of rows a, b and c, d clearly separated and setae b+c 1 – 3 not so far dorsally shifted as in *Sphaeridia pilleata* (Fig. 3 b). Antennae long with segment II III = 2.0 (n = 16). Dens as in Fig. 4 c, but basal papilla small; mucro with about 15 inner teeth, tip a separated, shrunk cap (Fig. 3 c); dens mucro = 2.5. The name of this new species is derived from Latin *clarus* = clear, relating to its weak pigmentation.

*Sph. clara* resembles *Sphaeridia pilleata* n. sp., but differs by its larger body size and its characters of head, antenna, and mucro.

###### *Sphaeridia coronata* nov. spec.

Type locality: Brazil, Amazonas, Manaus.

Type material: Holotype: Male (alcohol), Brazil, Amazonas, Igapó of Rio Tarumã Mirim near Manaus, 29. VIII. 1989 leg. GAUER (no. 3.1.2.), at INPA. – Paratypes: 12 males from the holotype sample: 6 (alc.) at INPA, 1 (no. 1, slide) at MNHN, 1 (no. 2, slide) at SMF (Ap 2426), 1 (no. 3, 3 slides) in coll. BRETTFELD, 3 (no. 4, 5, 6; 8 slides) in coll. GAUER.

Total male 0.14 – 0.18 mm, great abdomen with dark blue horizontal band. Ventral tube (Fig. 4 a) posteriorly with 1+1 small vesicles connected by a membrane, anteriorly of which a larger semicircular membrane and 1+1 small points; 1+1 setae. Tibiotarsus III (Fig. 4 b) seta Ilpe slightly stronger than others, Illpi and IVpi strong, toothed; also Illi a strong seta. Dens (Fig. 4 c) with large basal papilla, distal setae J proximally thickened, seta E1 with normal shape, length of seta P1 > P2 > P3; mucro with few inner teeth, tip a round tooth (Fig. 4 d); dens mucro = 2.2.

The name of this new species is derived from Latin *coronare* = to wreath, relating to its pigmentation.

*Sphaeridia coronata* differs from other species by the membrane connecting its 1+1 ventral tube vesicles.

###### *Sphaeridia fibulifera* nov. spec.

Type locality: Brazil, Amazonas, Manaus.

Type material: Holotype: Male (alcohol), Brazil, Amazonas, Igapó of Rio Tarumã Mirim near Manaus, 3. X. 1989 leg. GAUER (no. 3.1.2. II P), at INPA. – Paratypes: 1 male (4 slides) from the holotype sample in coll. GAUER; 1 male (slide), same locality, 31. X. 1990 leg. GAUER (no. 1.1.3./2), at MNHN; 4 males, same locality, 31. X. 1990 leg. GAUER (no. 1.1.3./5): 1 (slide) at SMF (Ap 2421), 3 (alc.) at INPA.

Further material: 11 males, same locality as the types, 10. – 24. IX. 1971 leg. IRMLER, 1 and 2 m above water level: 4 (slides) in coll. BRETTFELD (no. 25/90, 26/90), 7 (alc.) at INPA; 2 males (slides), Brazil, Amazonas, inundation forest of mixed white and black waters at Lago Janauari near Manaus, 6. – 21. IX. 1971 leg. IRMLER, 1 m above water level, in coll. BRETTFELD (no. 31/90).

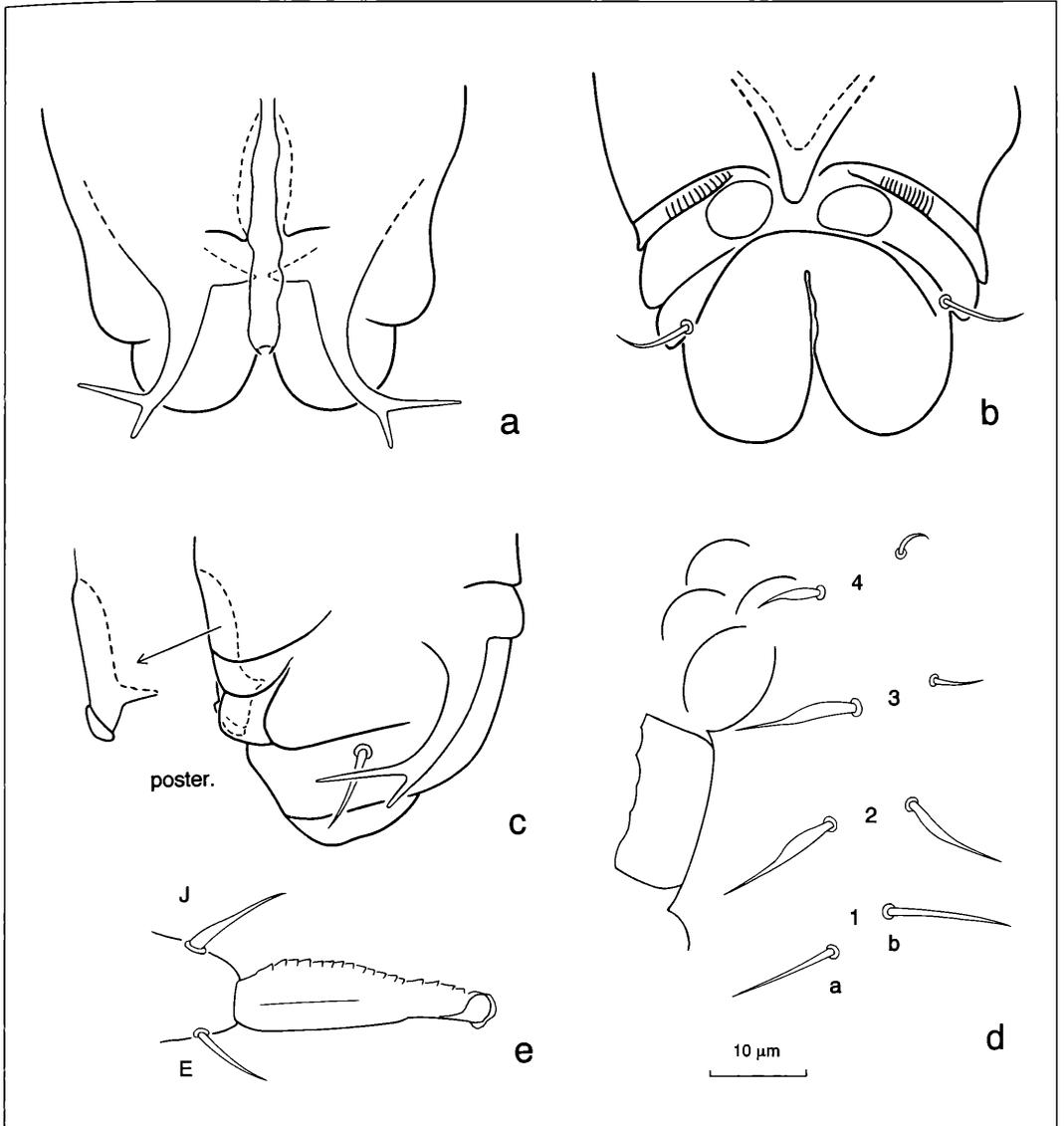


Figure 2. *Sphaeridia cerastes* n. sp.: male: a) ventral tube from anterior; b) from posterior; c) from the right; d) right setae of head frons; e) tip of dens and mucro

Total male 0.2 mm, lateral great abdomen dark. Ventral tube (Fig. 5 a, b) posterolaterally with 1+1 long, waved processes; laterally with 1+1 thick knobs like an abutment of the lateral processes; anteriorly with 1+1 vesicles; 1+1 setae. Tibiotarsus III (Fig. 5 c, d) seta IIpe slightly stronger than others, IIIpi and IVpi strong, toothed. Head setae near the antennae longer and stronger than in most other species. Dens as in Fig. 4 c, but basal papilla small; mucro with many inner teeth

and distal half slender, tip a shrunk cap (Fig. 5 e); dens : mucro = 2.2.

The name of this new species is derived from Latin *fibula* = clasp, and *ferre* = to wear, relating to the shape of its ventral tube processes.

*Sphaeridia fibulifera* clearly differs from other species by its ventral tube structures.

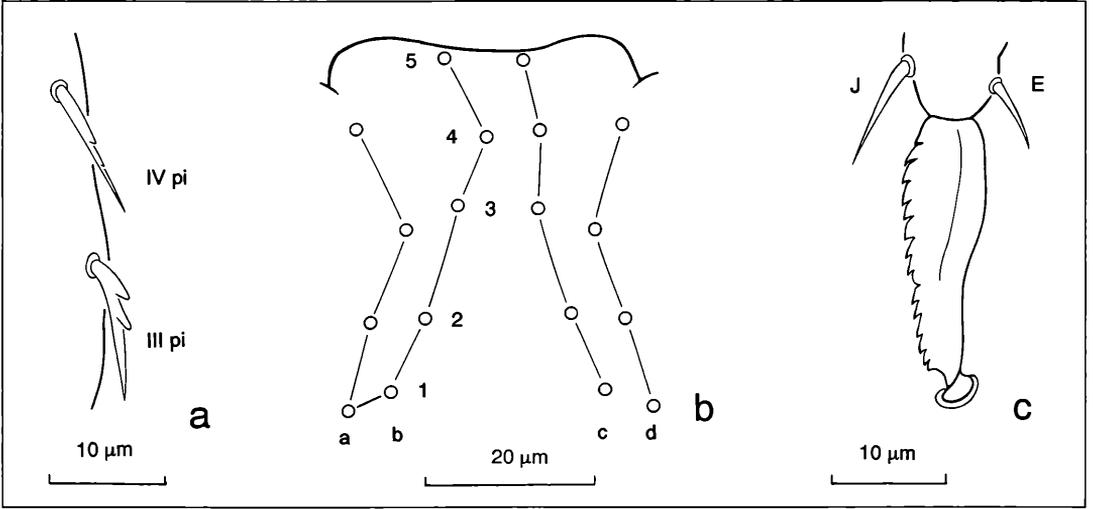


Figure 3. *Sphaeridia clara* n. sp.: male: a) tibiotarsal setae; b) head frons; c) tip of dens and mucro

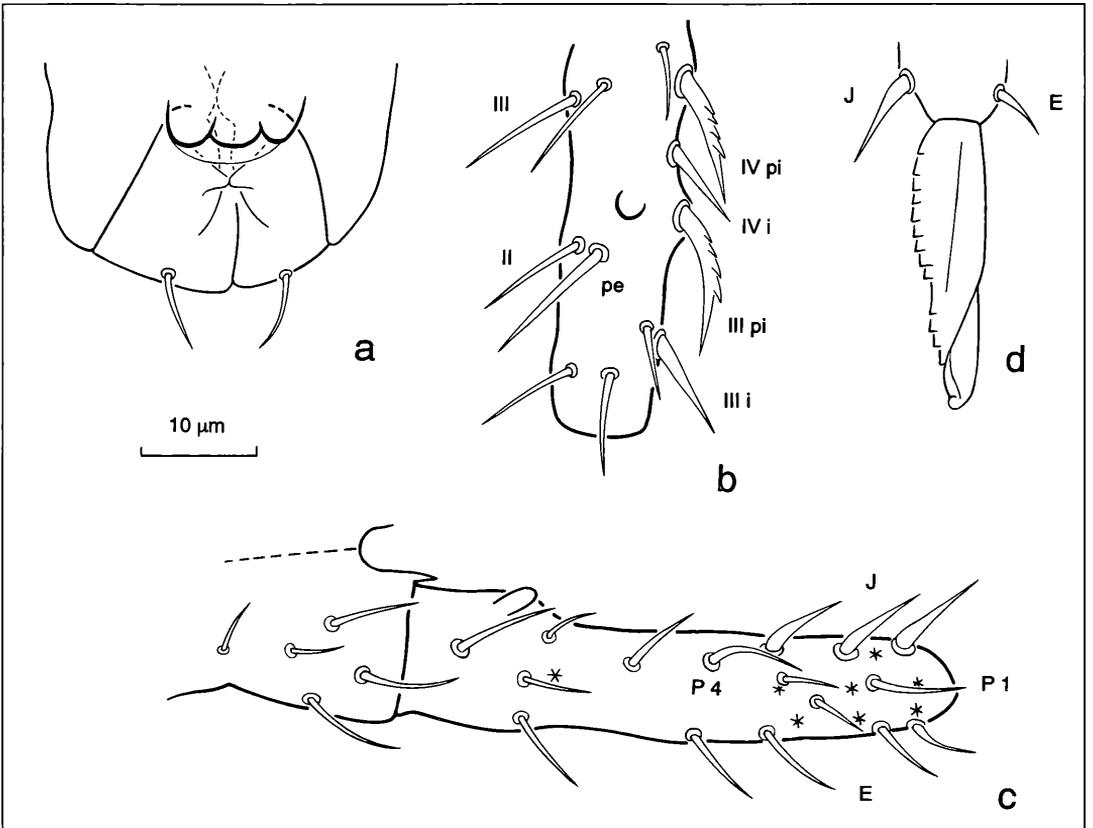


Figure 4. *Sphaeridia coronata* n. sp.: male: a) ventral tube from posterior; b) modified setae of tibiotarsus III; c) left half of furca from posterior; d) tip of dens and mucro

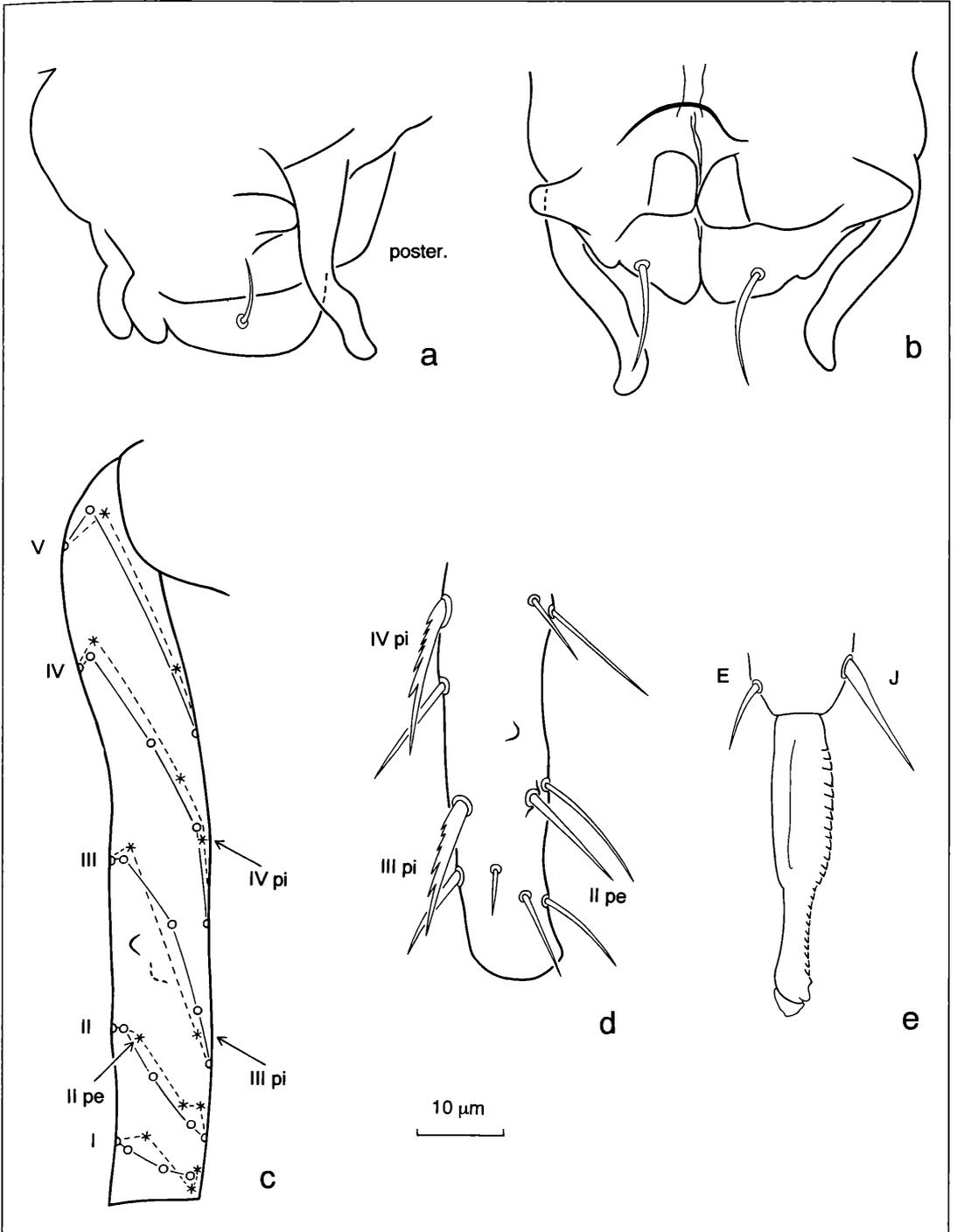


Figure 5. *Sphaeridia fibulifera* n. sp.: male: a) ventral tube from the left; b) from anterior; c) chaetotaxy of tibiotarsus III; d) modified setae of tibiotarsus III; e) tip of dens and mucro

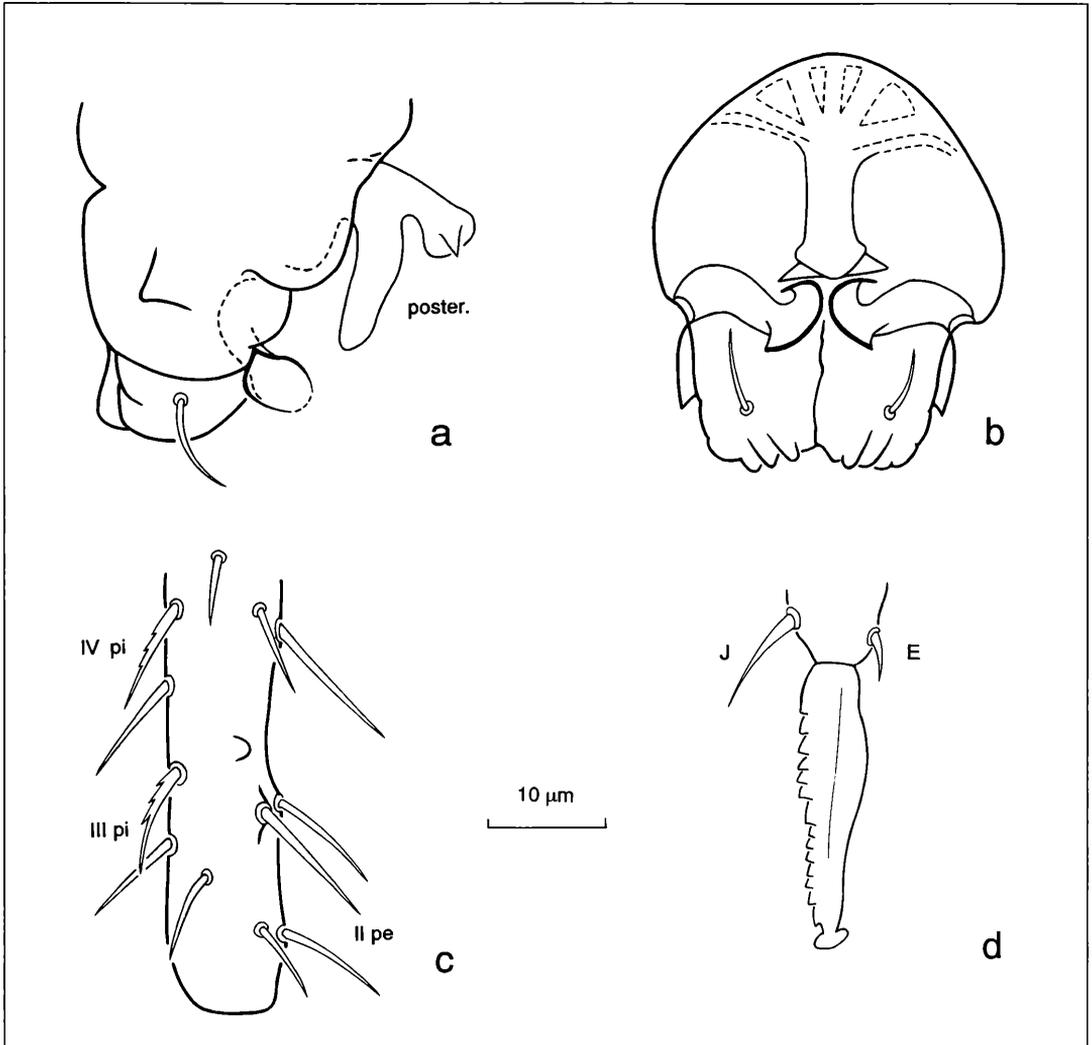


Figure 6. *Sphaeridia franklinae* n. sp.: male: a) ventral tube from the left; b) from posterior; c) modified setae of tibia-tarsus III; d) tip of dens and mucro

***Sphaeridia franklinae* nov. spec.**

Type locality: Brazil, Amazonas, Manaus.

Type material: Holotype: Male (alcohol), Brazil, Amazonas, Igapó of Rio Tarumã Mirim near Manaus, 31. X. 1990 leg. GAUER (no. 1.1.3./5), at INPA. – Paratypes: 4 males (3 alc., 1 slide) from the holotype sample, at INPA; 4 males (alc.), same locality, 31. X. 1990 leg. GAUER (no. 1.1.3./2) in coll. GAUER; 1 male (slide), same locality, 10. X. 1990 leg. GAUER (no. 1.1.3./1), at MNHN; 1 male (slide), same locality, 15. XII. 1989 leg. GAUER (no. 1.1.1. K 22), at SMF (Ap 2422).

Further material: 2 males (slides), same locality as the types, 10. – 24. IX. 1971 leg. IRMLER, 1 m above water level, in coll.

BRETFELD (no. 25/90); 19 males (slides), same data, 2 m above water level: 10 at INPA and 9 in coll. BRETFELD (no. 26/90); 1 male (slide), Brazil, Amazonas, inundation forest of mixed white and black waters at Lago Janauari near Manaus, 17. XI. – 2. XII. 1971 leg. IRMLER, 5 m above water level, coll. BRETFELD 37/90, at INPA.

Total male 0.16 mm, light blue or brownish. Ventral tube (Fig. 6 a, b) posteriorly with a thick median process, having a broadened tip with 1+1 lateral teeth, a strong fanlike root, and an anterior branch; posterolaterally with 1+1 curved processes, each with an earlike medial border; laterally with 1+1 small teeth; 1+1 se-

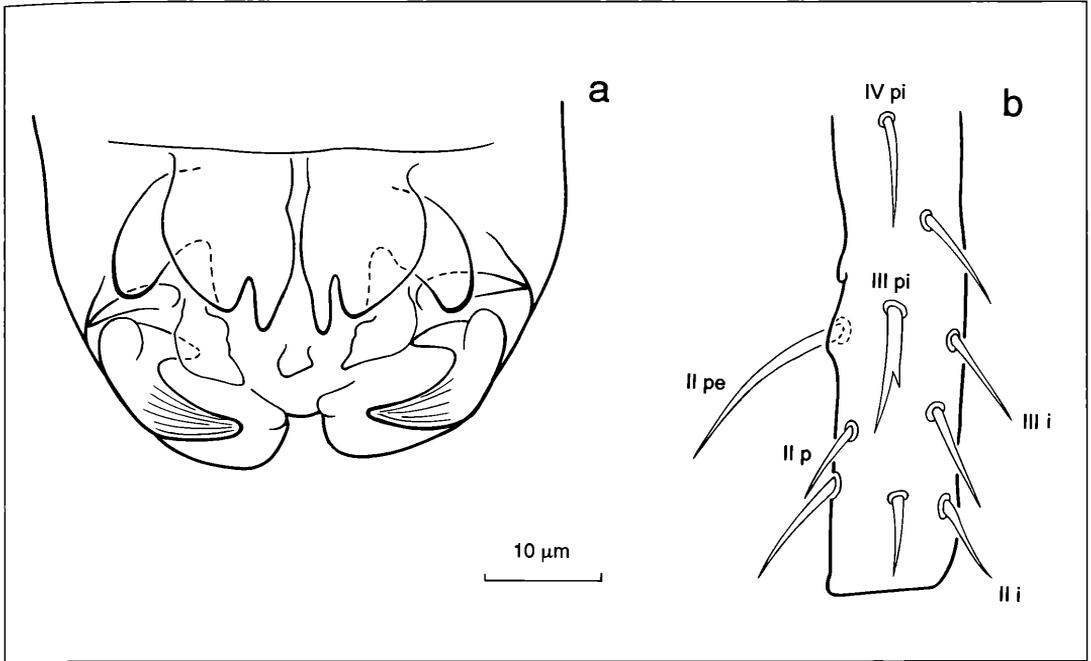


Figure 7. *Sphaeridia irmleri* n. sp.: male: a) ventral tube from posterior; b) modified setae of tibiotarsus III

tae. Tibiotarsus III (Fig. 6 c) seta IIpe slightly longer than others, IIIpi and IVpi with small teeth, not always observable at low magnification. Dens as in Fig. 4 c, but basal papilla small; mucro with few inner teeth, tip a shrunk cap (Fig. 6 d); dens mucro = 2.2.

This new species is gratefully dedicated to Dr. ELIZABETH FRANKLIN, head of the Laboratory of Entomology (casa 20), INPA, Manaus, Brazil.

The ventral tube of *Sphaeridia franklinae* resembles that of *Sph. cardosi* ARLÉ, 1984, but differs by a long branch (instead of short) of the posterior, median process directed towards anterior, and 1+1 lateral processes (instead of 2+2). *Sph. franklinae* also differs from that species by its toothed tibiotarsal setae (instead of smooth).

#### ***Sphaeridia irmleri* nov. spec.**

Type locality: Brazil, Amazonas, Manaus.

Type material: Holotype: Male (slide), Brazil, Amazonas, Igapó of Rio Tarumã Mirim near Manaus, 10. – 24. IX. 1971 leg. IRMLER, 1 m above water level, coll. BRETTFELD 25/90/5, at INPA. – No further specimen known.

Total male 0.18 mm, deep black. Ventral tube (Fig. 7 a) with several complicated but symmetrical structures: posteriorly with 1+1 cuticular blades with 3 lobes each, of these blades one median and 1+1 lateral cuticular processes reach into the ventral tube towards anterior (not figured); anteriorly with 1+1 strong bor-

ders with laterally 1+1 large doubled teeth; without setae. Tibiotarsus III (Fig. 7 b) seta IIpe long, IIIpi strong with one tooth, IVpi of normal shape without teeth. Head setae obscured by the pigment. Furca not clearly observed due to preparation, but dens without basal papilla, seta E1 thick, mucro with about 20 inner teeth, tip a shrunk cap.

This new species is gratefully dedicated to its collector, the senior author's colleague, Dr. ULRICH IRMLER, Kiel, Germany.

*Sphaeridia irmleri* clearly differs from other species by its ventral tube structures.

#### ***Sphaeridia martii* nov. spec.**

Type locality: Brazil, Amazonas, Manaus.

Type material: Holotype: Male (slide), Brazil, Amazonas, Igapó of Rio Tarumã Mirim near Manaus, 10. – 24. IX. 1971 leg. IRMLER, 2 m above water level, coll. BRETTFELD 26/90/36, at INPA. – Paratype: 1 male (3 slides) from the holotype sample, coll. BRETTFELD 26/90/7, at SMF (Ap 2423).

Total male 0.16 mm, light grey. Ventral tube posteriorly with 1+1 small vesicles; 1+1 setae. Tibiotarsus III (Fig. 8 a) seta IIpe of normal shape, IIIpi and IVpi with teeth. Head frons (compare Fig. 3 b) without setae a4, d4; the setae near the antennae longer than in most other species. Antennal segment II with two additional spines (Fig. 8 b); ant. II much longer than

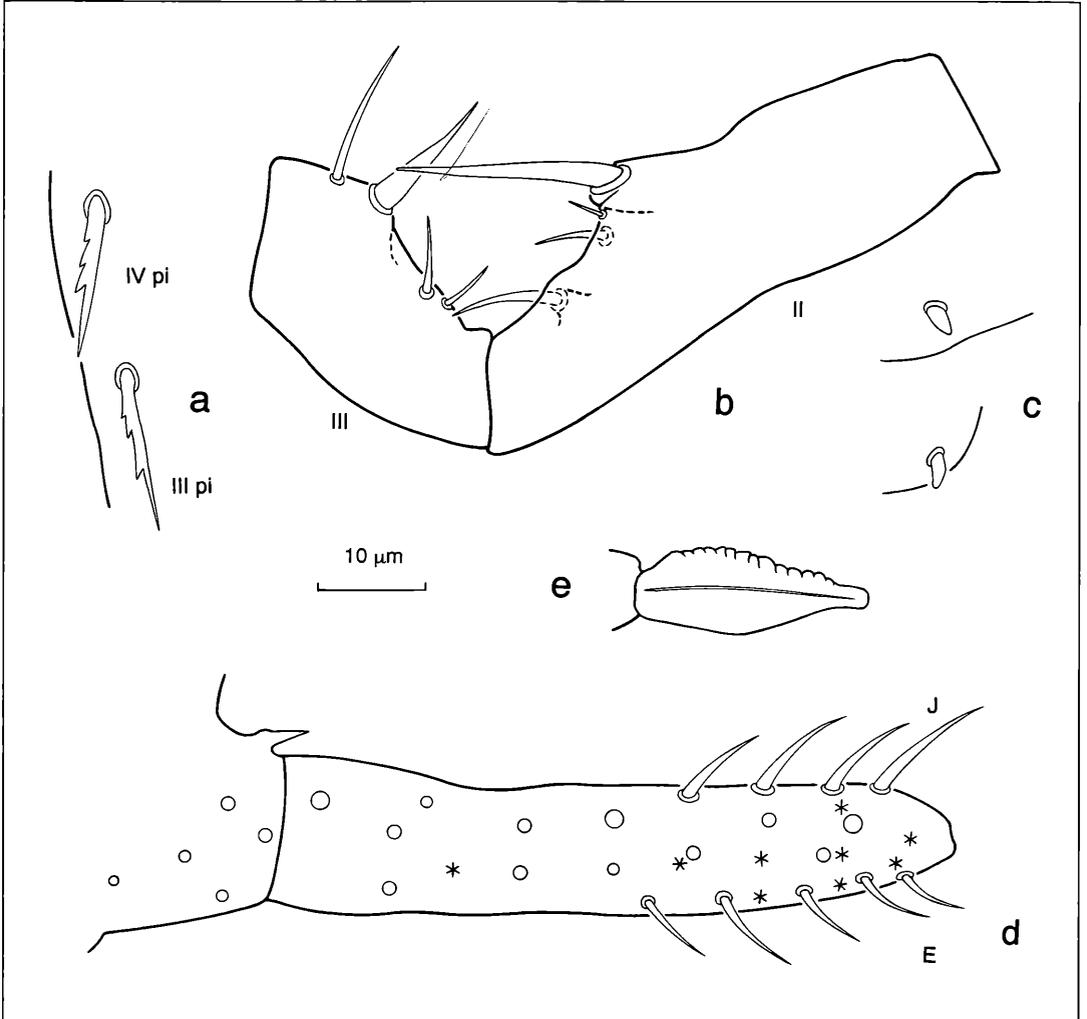


Figure 8. *Sphaeridia martii* n. sp.: male: a) modified setae of tibiotarsus III; b) antennal segments II and III; c) spine of femur III; d) left half of furca from posterior; e) mucro

ant. III (3 1); ant. IV as long as the head (130 µm). Femur III posterior side (Fig. 8 c) with a short, blunt spine instead of a small seta as in other species. Dens distal part with more setae than in most other species (the setae varied, J 2 – 5, P 7 – 9, E 4 – 5, Fig. 8 d), without basal papilla, seta E1 of normal shape, inner setae strong; mucro with irregular, inner teeth, tip a long tooth (Fig. 8 e); dens mucro = 3.2.

We gratefully dedicate this new species to Dr. CHRISTOPHER MARTIUS, Manaus, Brazil, who as a friend supported the junior author during his two-year stay in Manaus.

*Sphaeridia martii* resembles *Sphaeridia robusta* n. sp. by its setae of head frons, but differs from this and other species by its characters of antenna, femur, and dens.

#### *Sphaeridia pilleata* nov. spec.

Type locality: Brazil, Amazonas, Manaus.

Type material: Holotype: Male (alcohol), Brazil, Amazonas, Igapó of Rio Tarumã Mirim near Manaus, 3. X. 1989 leg. GAUER (no. 3.1.2. II F), at INPA. – Paratypes: 1 male (slide), same locality as the holotype, 31. X. 1990 leg. GAUER (no. 1.1.3./2), at SMF (Ap 2424); 1 male (slide), same locality, 10. X. 1990 leg. GAUER (no. 1.1.3./1), at MNHN; 1 male (slide), same locality, 31. X. 1990 leg. GAUER (no. 1.1.3./5), in coll. GAUER; 3

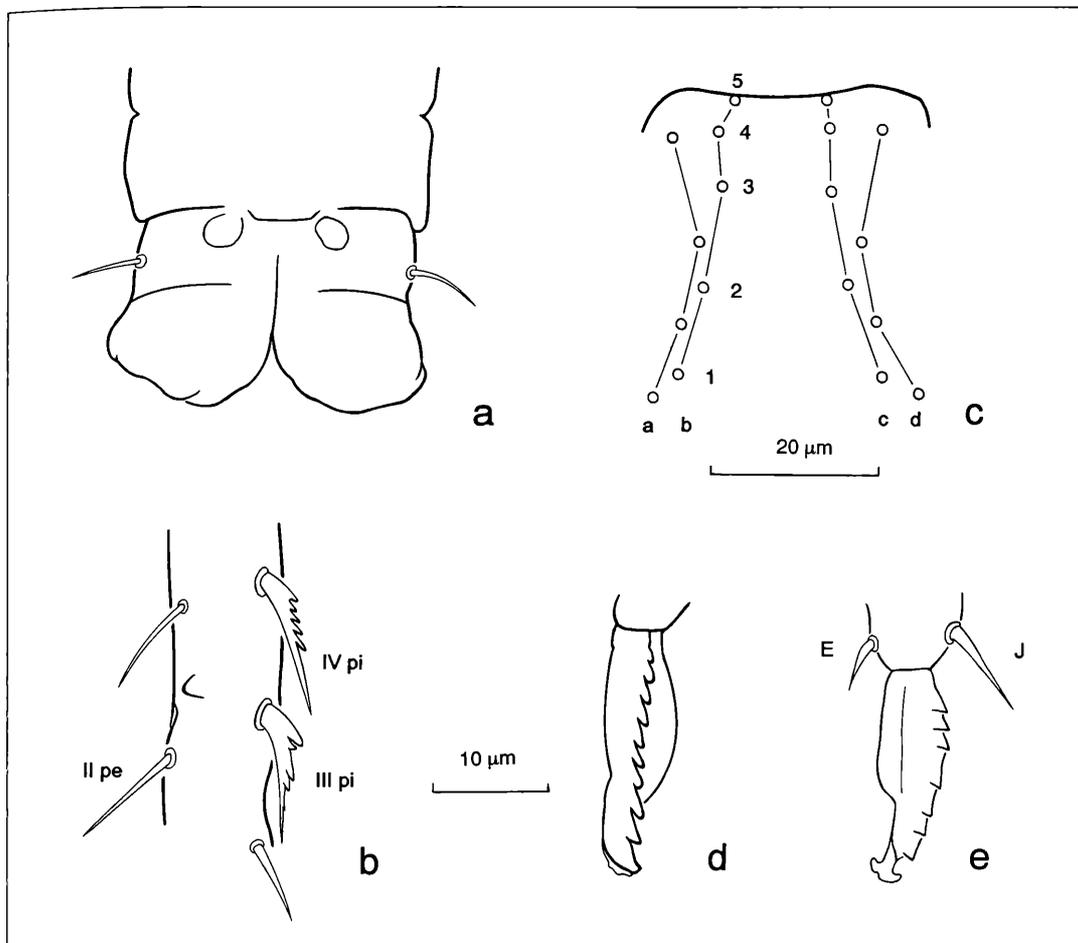


Figure 9. *Sphaeridia pilleata* n. sp.: male: a) ventral tube from posterior; b) modified setae of tibia III; c) setae of head frons; d) muco from the inner side; e) tip of dens and muco.

males (2 alc., 1 slide), same locality, 15. XII. 1989 and 31. X. 1990 leg. GAUER (no. 1.1.1. K 10 and 1.1.3./5, resp.), at INPA.

Total male 0.12 – 0.16 mm, great abdomen often with a blue dorsal cap (like *Sphaeridia carioca* ARLÉ) but also completely blue, only with a blue lateral band, or brownish, grey, or nearly white. Ventral tube (Fig. 9 a) posteriorly with 1+1 small vesicles. Tibiotarsus III (Fig. 9 b) seta IIpe of normal shape, IIIpi and IVpi strong, toothed. Head small (80 µm, n = 10); setae near the antennae longer than in most other species; frons (Fig. 9 c) with setae of rows a, b and c, d close together and setae b+c 1 – 3 shifted dorsally. Antennae short with segment II III = 1.4 (n = 7). Dens as in Fig. 4 c, but basal papilla small; muco with about 10 inner teeth, tip a separated, shrunk cap (Fig. 9 d, e); dens muco = 2.4.

The name of this new species is derived from Latin *pilleatus* = wearing a cap, relating to its pigmentation.

*Sphaeridia pilleata* differs from *Sphaeridia carioca*, by its simple ventral tube (instead of complicated). It resembles *Sphaeridia clara* n. sp., but differs by its small body size and its characters of head, antenna, and muco.

#### ***Sphaeridia robusta* nov. spec.**

Type locality: Brazil, Amazonas, Manaus.

Type material: Holotype: Male (3 slides), Brazil, Amazonas, Igapó of Rio Tarumã Mirim near Manaus, 10. – 24. IX. 1971 leg. IRMLER, 2 m above water level, coll. BRETTFELD 26/90/3, at INPA. – No further specimen known.

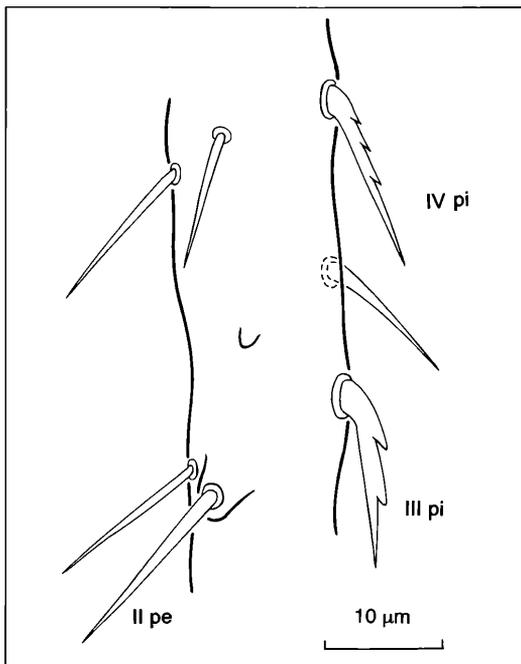
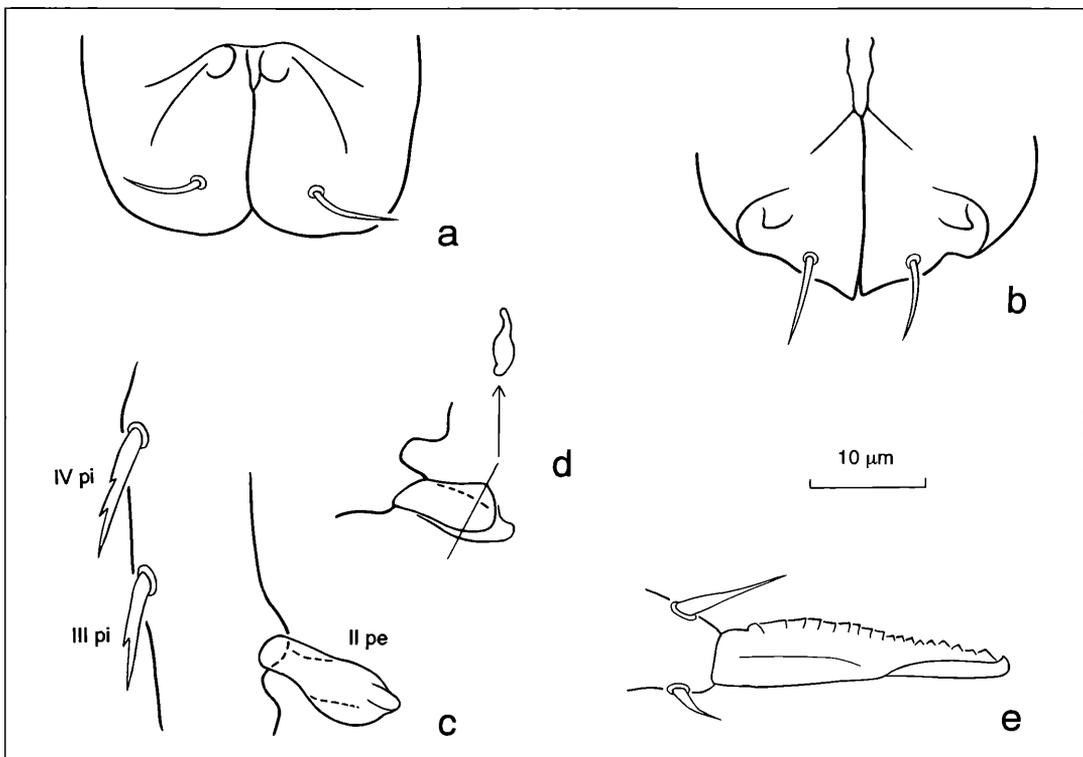


Figure 10. *Sphaeridia robusta* n. sp.: male: modified setae of tibiotarsus III.

Figure 11. *Sphaeridia squamifera* n. sp.: male: a) ventral tube from posterior; b) from anterior; c) modified setae of tibiotarsus III; d) other view of seta II pe of tibiotarsus III; e) tip of dens and mucro.



Total male 0.22 mm, dark blue. Ventral tube posteriorly with 1+1 small vesicles; 1+1 setae. Tibiotarsus III (Fig. 10) seta IIpe strong, IIIpi strong with few large teeth, IVpi thin with small teeth. Head frons (compare Fig. 3 b) without setae a4, d4; all setae longer and stronger than in other species, the setae near the antennae longer than others. Dens as in Fig. 4 c, but basal papilla small and round; mucro with few inner teeth, tip a separated, shrunk cap; dens mucro = 2.7. The name of this new species is derived from Latin *robustus* = robust, relating to its large body parts.

*Sphaeridia robusta* resembles *Sphaeridia martii* n. sp. by its setae of head frons, but differs by its tibiotarsal setae and because the other special characters of *Sph. martii* are missing. It differs from other species by its large body size and equivalent larger body parts.

#### *Sphaeridia squamifera* nov. spec.

Type locality: Brazil, Amazonas, Manaus.

Type material: Holotype: Male (alcohol), Brazil, Amazonas, Igapó of Rio Tarumã Mirim near Manaus, 3. X. 1989 leg. GAUER (no. 3.1.2. II F), at INPA. – Paratypes: 2 males (alc.) from the holotype sample, at INPA; 4 males (slides), same locality, 10. – 24. IX. 1971 leg. IRMLER, 1 and 2 m above water level: 1 at SMF (Ap 2425), 2 at INPA (these 3 have coll. BRETTFELD no. 26/90), 1 at MNHN (coll. BRETTFELD no. 25/90).

Further material: 1 male (slide), Brazil, Amazonas, Manaus, Ilha de Marchantaria, soil of várzea forest, 1. XI. 1990 leg. GAUER (no. 1.2.3.), in coll. BRETTFELD; 1 male (slide), same locality, 17. I. 1991 leg. GAUER (no. 1.2.1. K 22), in coll. GAUER.

Total male 0.16 mm, grey-blue. Ventral tube (Fig. 11 a, b) posteriorly with 1+1 small vesicles, anteriorly with 1+1 small points; 1+1 setae. Tibiotarsus III (Fig. 11 c, d) seta IIpe a large, thick and blunt blade observable at low magnification, IIIpi and IVpi strong with few strong teeth. Dens as in Fig. 4 c, but basal papilla varied (without or with a large one); tip of mucro a round tooth (Fig. 11 e); dens mucro = 2.1.

The name of this new species is derived from Latin *squama* = scale, and *ferre* = to wear, relating to its tibiotarsal blade.

The tibiotarsal blade of *Sph. squamifera* resembles those of *Sph. denisi* MASSOUD & DELAMARE DEBOUTTEVILLE, 1964, *Sph. spec.* MASSOUD & DELAMARE DEBOUTTEVILLE, 1964, and *Sph. heloisae* ARLÉ, 1984, but their fine structures differ: in *denisi* long, asymmetrical, in *spec.* short, with two different tips, in *heloisae* long, bent and tip cut. The simple ventral tube of *Sph. squamifera* differs from that of *Sph. heloisae*, which has a posterior, median process (the ventral tubes of *Sph. denisi* and *Sph. spec.* are also simple).

## 4.2 The species from Paraguay

### *Sphaeridia boettgeri* nov. spec.

Type locality: Paraguay, Concepción, Estancia Ybú.

Type material: Holotype: Male (no. 2, slide), Paraguay, 4.5 km SE Concepción, Estancia Ybú, mixed sample of Berlese extraction and sweeping the vegetation, X/1985 leg. BÖTTGER, coll. BRETTFELD 1085-59, at SMF (Ap 2427). – Paratypes: 1 male (no. 1, slide) from the holotype sample, at MNHN; 7 males (3 alcohol, 4 slides) from the same sample in coll. BRETTFELD.

Further material: 2 males (slides), Brazil, Amazonas, Manaus, Ilha de Marchantaria, soil of várzea forest, 1. XI. 1990 leg. GAUER (no. 1.2.3.), no. 1 at INPA, no. 2 in coll. GAUER.

Total male 0.2 mm, dark blue. Ventral tube (Fig. 12 a, b, c, d) posteriorly with a straight, knobbed median process; posterolaterally with 1+1 striated blades; anteriorly with 1+1 mandible-like processes, laterally pointed, medially strongly cuticularized; 1+1 setae. Tibiotarsus III without special setae. Head frons setae a+d 2, 3 and b+c 2 slightly stronger than others. Dens with basal papilla small, up to 5 setae missing (Fig. 12 e, compare Fig. 4 c), seta E1 thick (Fig. 12 f); mucro slender, tip a round tooth (Fig. 12 f); dens mucro = 1.8.

We gratefully dedicate this new species to its collector, the senior author's former fellow-student and present colleague, Prof. Dr. KLAUS BÖTTGER, Kiel, Germany.

*Sphaeridia boettgeri* clearly differs from other species by its ventral tube structures.

## 4.3 The species from Colombia

### *Sphaeridia catapulta* nov. spec.

Type locality: Colombia, Bogotá, Páramo de Chingaza.

Type material: Holotype: Male (4 slides), Colombia, Páramo de Chingaza, 20 km W Bogotá, 4° 40' N, 73° 47' W, epiphytes (mosses and ferns) in a mountain forest remainder at 3250 m near Laguna de Chingaza, 22. VIII. 1985 leg. STURM (sample 85/132), coll. BRETTFELD 16/89, at SMF (Ap 2428). – Paratypes: 2 males (slides), from the holotype sample, coll. BRETTFELD 63/92: no. 1 in coll. BRETTFELD, no. 2 at MNHN.

Total male 0.25 mm, light blue. Ventral tube complicated: in lateral view the inner, posterior part occupied by a large, semicircular muscle; in posterior view (Fig. 13 a, only the main structures are figured) behind a strong wall with a median, broad, bifurcated process (which has 3 processes directed towards anterior = a in Fig. 13 a) and with 1+1 thinner ones; more laterally with 2+2 processes (= p in Fig. 13 a, which have a process each directed towards posterior), and 1+1 vesicles (= b in Fig. 13 a); 1+1 setae. Tibiotarsus III seta IIpe large, IIIpi and IVpi with small teeth. Head setae near the antennae longer than in most other species. Dens as in Fig. 4 c, but basal papilla small, seta E1 thick; tip of mucro a shrunk cap (Fig. 13 b); dens mucro = 2.1.

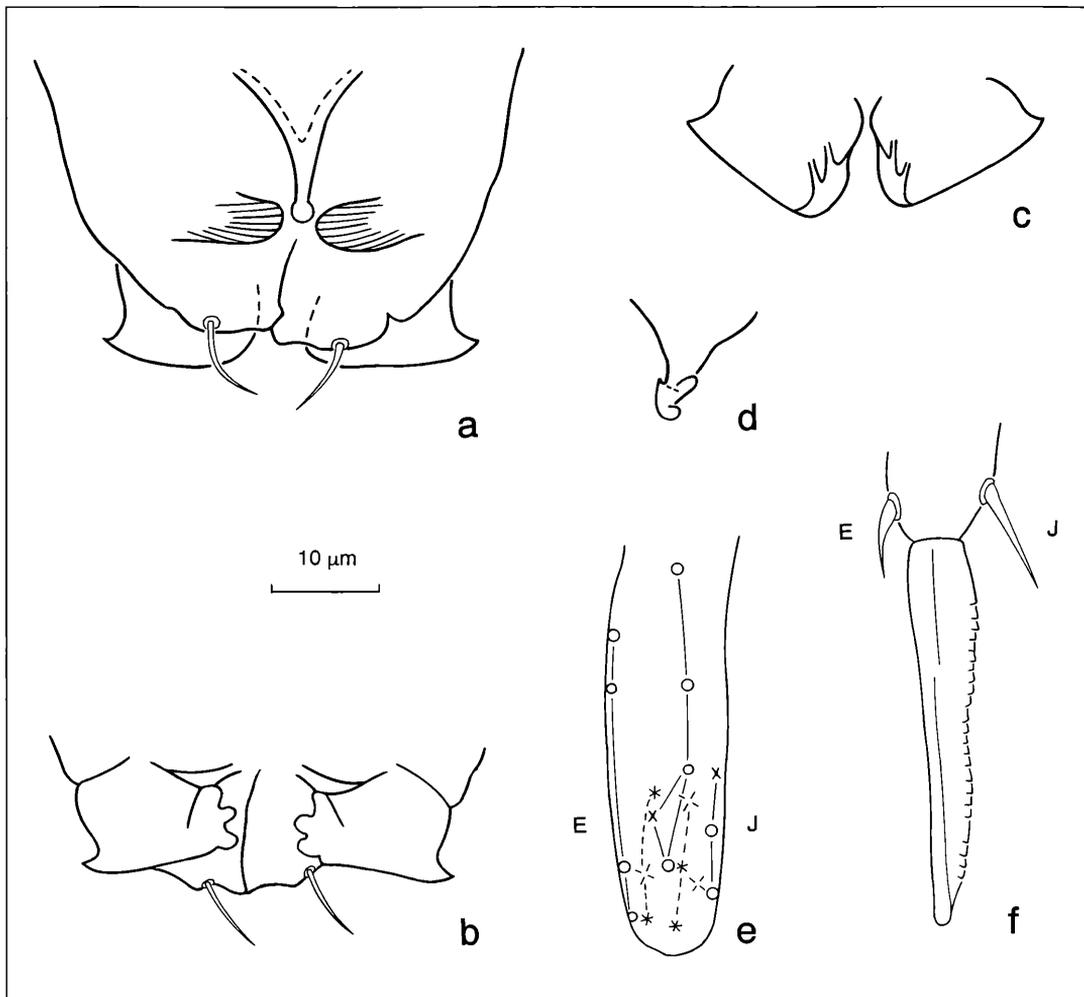


Figure 12. *Sphaeridia boettgeri* n. sp.: male: a) ventral tube from posterior; b) from anterior; c) other view of mandible-like processus; d) other view of posterior median processus; e) left dens from posterior; f) tip of dens and mucro.

The name of this new species is derived from Latin *catapulta* = catapult, relating to the posterior process of its ventral tube.

*Sphaeridia catapulta* clearly differs from other species by its ventral tube structures.

#### ***Sphaeridia chisacae* nov. spec.**

Type locality: Colombia, Bogotá, Páramo de Chisacá.

Type material: Holotype: Male (no. 2, 4 slides), Colombia, Páramo de Chisacá, about 40 km SSW Bogotá, 4° 17' N, 74° 12' W, low vegetation on soil surface (mosses, herbs) of grassland (pajonal) near Laguna Negra at 3720 m, 18. IX. 1986 leg. STURM (sample 86/97), coll. BRETTFELD 22/89, at SMF (Ap 2429). – No further specimen known.

Total male 0.2 mm, blue, laterally darker. Ventral tube (Fig. 14 a, b) posteriorly with two median and 1+1 middle processes; laterally with 1+1 short, blunt processes; anterolaterally with 1+1 pointed teeth; 1+1 setae. Tibiotarsus III seta IIpe long (see *Sph. lobata*, Fig. 15 b), the other setae normal, without teeth. Dens as in Fig. 4 c, but basal papilla small, without seta P2; mucro with many small, inner teeth, tip a shrunk cap (Fig. 14 c); dens mucro = 2.5.

This new species is named after its type locality, the Páramo de Chisacá.

*Sphaeridia chisacae* resembles *Sphaeridia lobata* n. sp. by its tibiotarsus III seta IIpe, but clearly differs from this and other species by its ventral tube structures

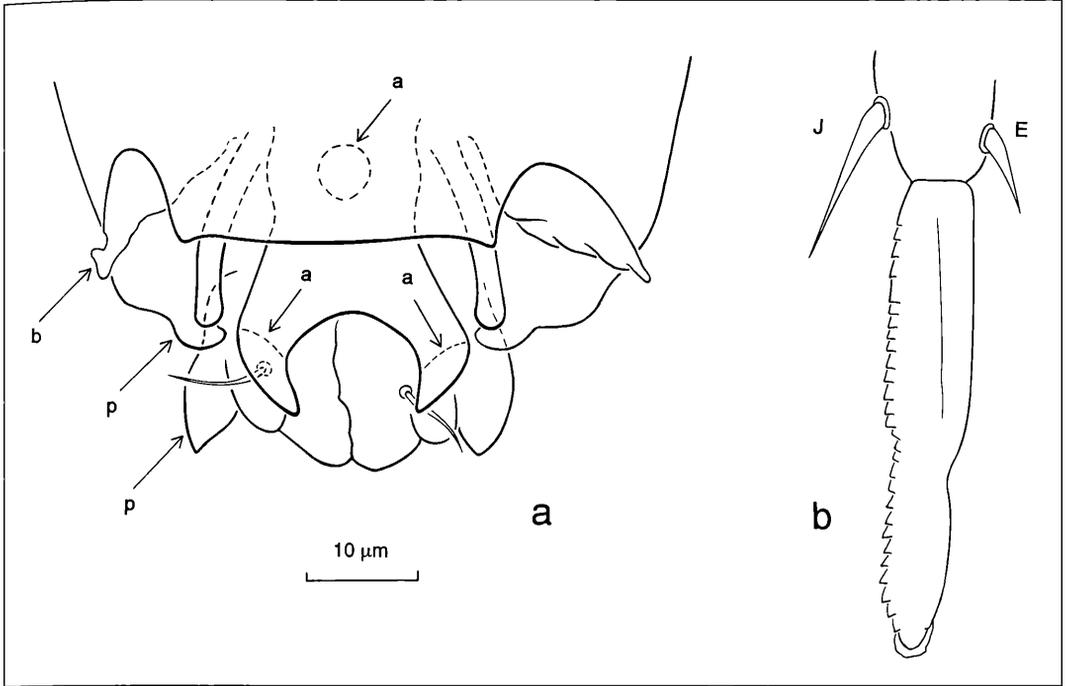


Figure 13. *Sphaeridia catapulta* n. sp.: male: a) ventral tube from posterior, see text; b) tip of dens and mucro.

***Sphaeridia lobata* nov. spec.**

Type locality: Colombia, Bogotá, Páramo de Chingaza.  
 Type material: Holotype: Male (no. 1, 2 slides), Colombia, Páramo de Chingaza, 20 km W Bogotá near Chuza, 4° 40' N, 73° 47' W, epiphytes (mosses and ferns) in a mountain forest remainder at 3000 m, 21. IX. 1989 leg. STURM (sample 89/94), coll. BRETFELD 13/90, at SMF (Ap 2430). – Paratypes: 1 male (no. 2, slide) from the holotype sample, in coll. BRETFELD; 3 males, same locality and biotope as the holotype but at 3250 m, 22. VIII. 1985 leg. STURM (samples 85/37, 85/132), coll. BRETFELD 58/92, 63/92: 1 (slide) at MNCB, 1 (slide) at MNHN, 1 (alc.) in coll. BRETFELD; 1 male (3 slides), same locality and biotope but at 3550 m, 14. IX. 1985 leg. STURM (sample 85/178), in coll. BRETFELD (no. 64/92).

Total male 0.2 mm, dark blue. Ventral tube (Fig. 15 a) posteriorly with a median process; laterally with 2+2 main lobes; 1+1 setae. Tibiotarsus III (Fig. 15 c) seta IIpe long, IIIpi and IVpi short and strong. Dens as in Fig. 4 c, but basal papilla small, seta E1 thick; mucro with irregular, inner teeth, tip a long tooth (Fig. 15 b); dens mucro = 2.1.

The name of this new species is derived from New Latin lobatus = lobe-like, relating to the lateral processes of its ventral tube.

*Sphaeridia lobata* resembles *Sph. chisacae* n. sp. by its tibiotarsus III seta IIpe, but clearly differs from this and other species by its ventral tube structures.

***Sphaeridia mandibulata* nov. spec.**

Type locality: Colombia, Bogotá, Páramo de Monserrate.  
 Type material: Holotype: Male (4 slides), Colombia, Páramo de Monserrate 7 km NE Bogotá, 4° 15' N, 74° 1' W, litter of mountain forest remainder at 3230 m, 10. IX. 1986 leg. STURM (sample 86/116), coll. BRETFELD 24/89a3, at SMF (Ap 2431). Further material: 4 males (1 alc., 3 slides), Colombia, Páramo de Chingaza, 20 km W Bogotá, 4° 40' N, 73° 47' W, epiphytes (mosses and ferns) in a mountain forest remainder at 3250 m near Laguna de Chingaza, 22. VIII. 1985 leg. STURM (sample 85/37, 85/132), in coll. BRETFELD (no. 58/92, 63/92).

Total male 0.2 mm, with violet median and horizontal bands, the latter reaching from the posterior tip of small abdomen to the head behind the eyes, antennae and legs blue, furca pale. Ventral tube (Fig. 16 a) posteriorly with a thin, protruding membrane in form of a hand-glass; more anteriorly with one short, median and 1+1 slender, lateral processes; laterally with 1+1 blunt, tridentate processes; anteriorly with several symmetrical cuticular lobes (simplified in Fig. 16 b); 1+1 setae. Tibiotarsus III (Fig. 16 c) seta IIpe long, IIIpi and IVpi strong with one tooth each, setae IIpi and IIIi also strong. Head setae of frons and apex strong and basal third thickened. Dens as in Fig. 4 c, but basal papilla small, seta E1 thick, J1 thicker than usual, P3 thinner (Fig. 16 d); tip of mucro a small cap (Fig. 16 e); dens mucro = 2.4.

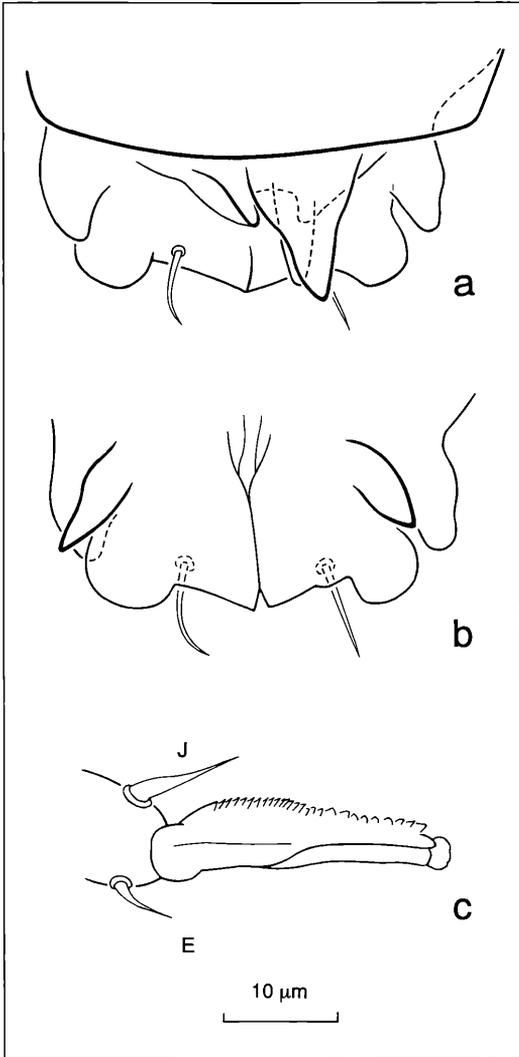


Figure 14. *Sphaeridia chisacae* n. sp.: male: a) ventral tube from posterior; b) from anterior; c) tip of dens and mucro.

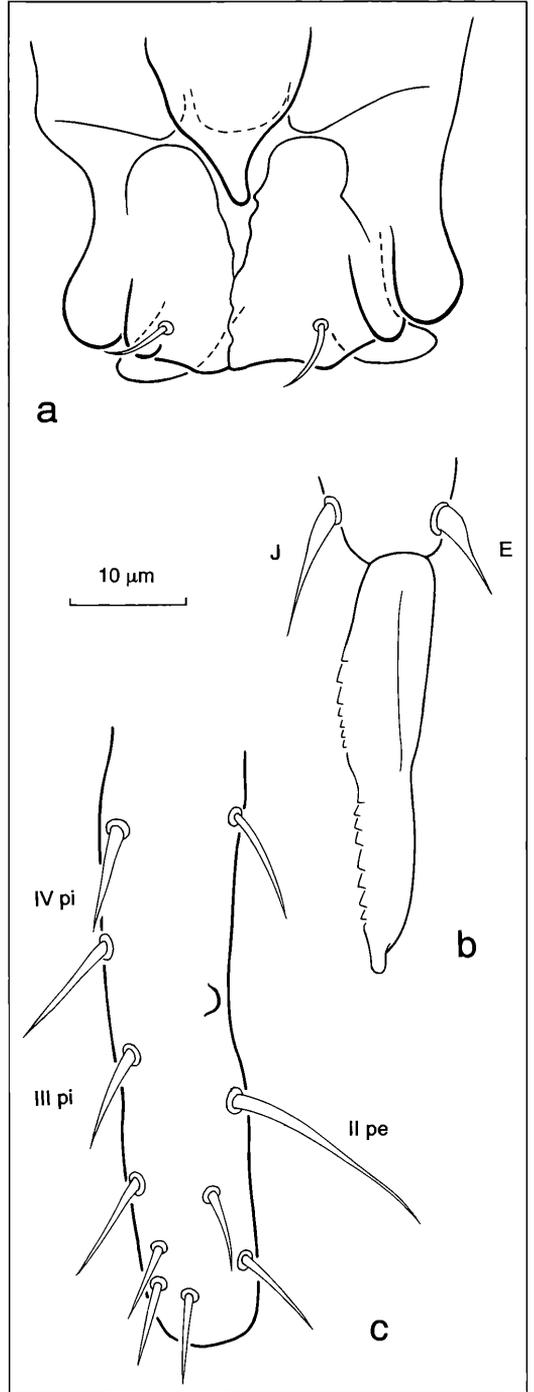


Figure 15. *Sphaeridia lobata* n. sp.: male: a) ventral tube from posterior; b) tip of dens and mucro; c) modified setae of tibiotarsus III.

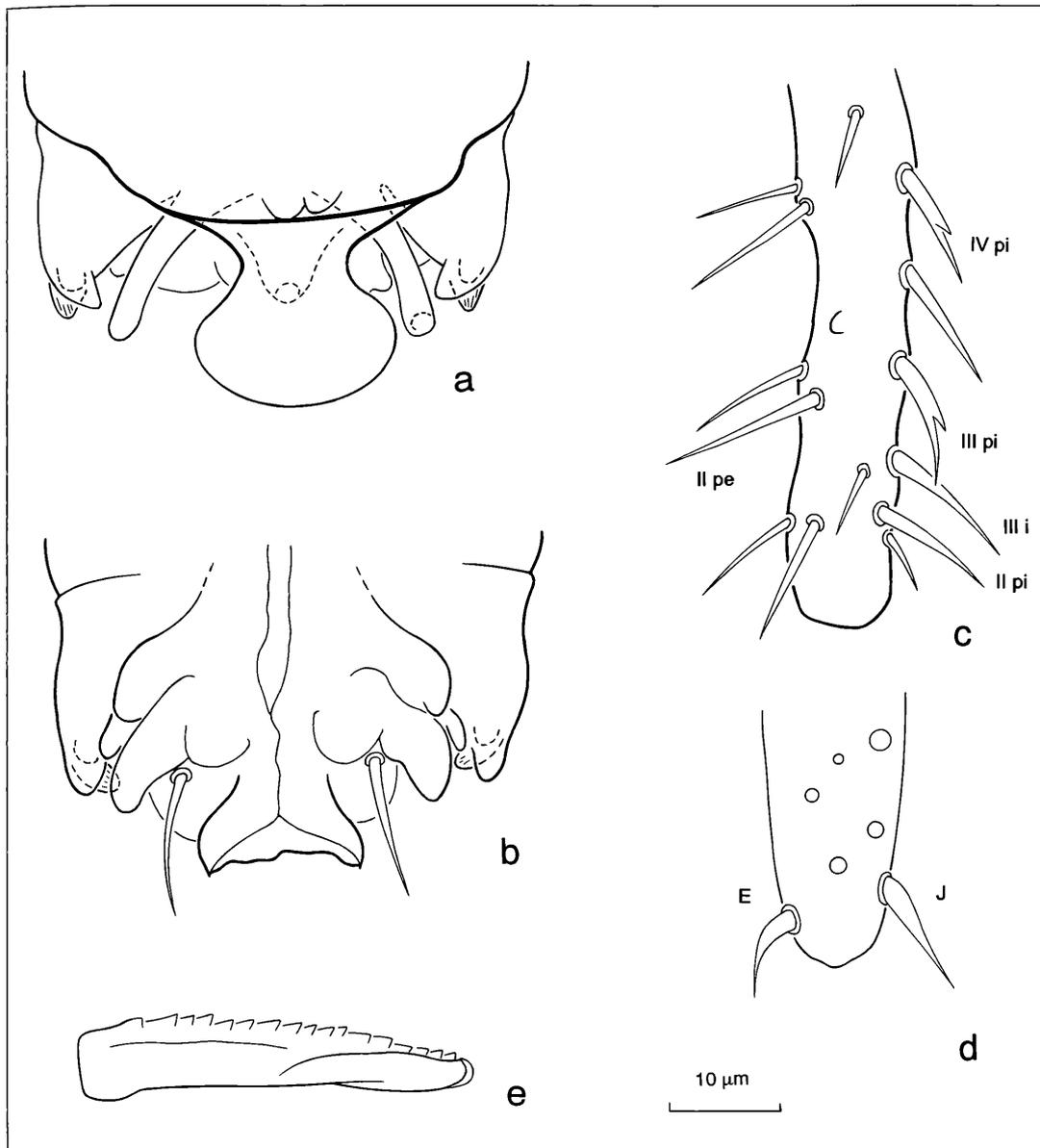


Figure 16. *Sphaeridia mandibulata* n. sp.: male: a) ventral tube from posterior; b) from anterior; c) modified seta of tibiotarsus III; d) tip of dens; e) mucro.

The name of this new species is derived from Late Latin *mandibula* = mandible, jaw, relating to the mandible-like processes of its ventral tube.

*Sphaeridia mandibulata* clearly differs from other species by its ventral tube structures.

***Sphaeridia neopumilis* nov. spec.**

Type locality: Colombia, Bogotá, La Calera.

Type material: Holotype: Male (no. 2, 3 slides), Colombia, La Calera (region of the Páramo de Monserrate), 7 km NE Bogotá, raw humus of a mountain forest remainder at 3080 m, 25. VIII. 1985 leg. STURM (sample 85/17), coll. BRETTFELD

11/89, at SMF (Ap 2432). – Paratypes: 3 males (slides) from the holotype sample: no. 1 in coll. BRETFFELD, no. 3 at MNCB, no. 4 at MNHN.

Total male 0.2 mm, dark blue, but paler between the eyes and on dorsal great abdomen, ventral side palest. Ventral tube with 1+1 small vesicles as in *Sphaeridia pumilis*. Tibiotarsus III seta Ilpe long and thin, Illpi and IVpi strong without teeth. Head apex with thin setae. Dens as in Fig. 4 c, but basal papilla small and pointed, seta E1 thick; mucro with small inner teeth, tip

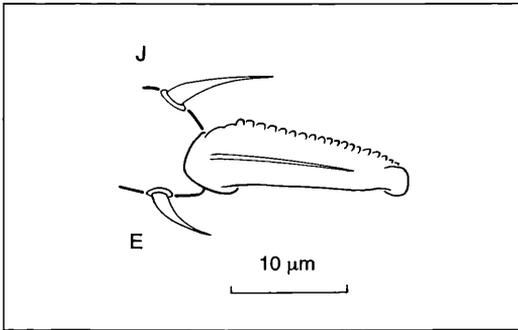


Figure 17 *Sphaeridia neopumilis* n. sp.: male: tip of dens and mucro.

a broad, shrunk cap (Fig. 17); dens mucro = 2.3 – 3.1 (length of mucro varied).

The name of this new species relates to its resemblance to *Sph. pumilis*.

*Sphaeridia neopumilis* resembles *Sphaeridia pumilis* (KRAUSBAUER), but differs by its thin tibiotarsal III seta Ilpe (instead of strong) and its short mucro (instead of long, DUNGER & BRETFFELD 1989).

### *Sphaeridia spira* nov. spec.

Type locality: Colombia, Bogotá, Páramo de Monserrate.

Type material: Holotype: Male (no. 1, 4 slides), Colombia, Páramo de Monserrate 7 km NE Bogotá, 4° 15' N, 74° 1' W, litter of a mountain forest remainder at 3230 m, 10. IX. 1986 leg. STURM (sample 86/116), coll. BRETFFELD 24/89a1, at SMF (Ap 2434). – Paratypes: 1 male (no. 2, slide) from the holotype sample, at MNCB; 3 males, same locality but wet mosses on soil surface at 3300 m, 14. X. 1985 leg. STURM (sample 85/180), coll. BRETFFELD 65/92: 2 (alc. and slide) in coll. BRETFFELD, 1 (no. 1, slide) at MNHN.

Further material: 1 male (4 slides), Colombia, Páramo de Chisacá about 40 km SSW Bogotá, 4° 17' N, 74° 12' W, low vegetation on soil surface (mosses and herbs) of grassland (pajonal) near Laguna Negra at 3720 m, 18. IX. 1986 leg. STURM (sample 86/97), in coll. BRETFFELD (no. 22/89).

Total male 0.18 mm, pale with some violet pigment as a horizontal band or as lateral spots; in sample 85/180 eye-patches slightly pigmented, i. e. the single omma-

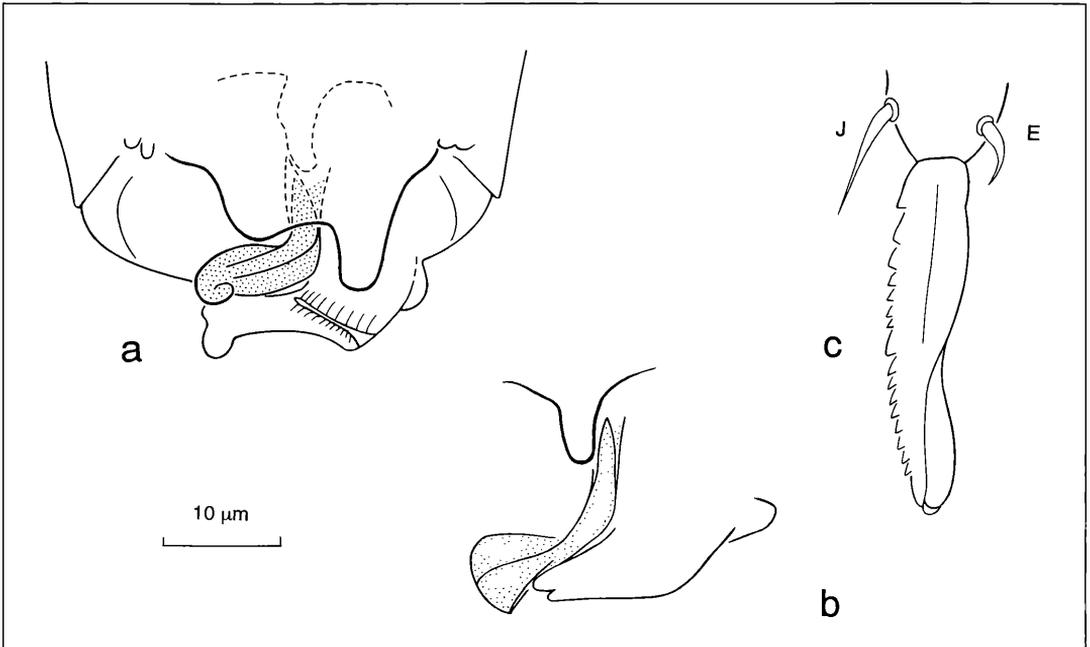


Figure 18. *Sphaeridia spira* n. sp.: male: a) ventral tube from posterior; b) ventral tube, other view of the two asymmetrical lobes, posterior membrane omitted; c) tip of dens and mucro.

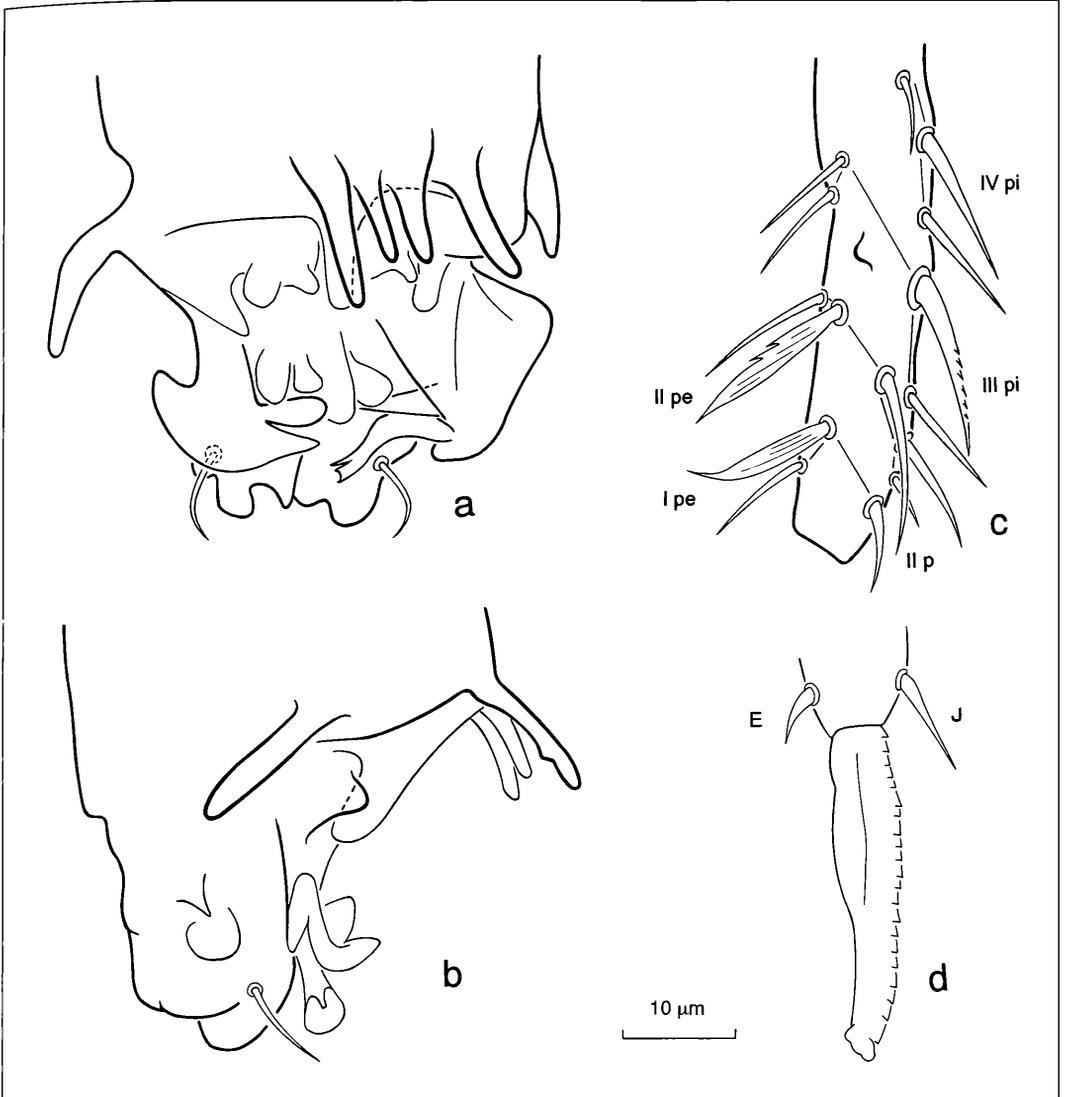


Figure 19. *Sphaeridia sturmi* n. sp.: male: a) ventral tube from posterior; b) from the left; c) modified seta of tibiotarsus III; d) tip of dens and mucro.

tidia observable. Ventral tube with asymmetrical structures (Fig. 18 a, b): posteriorly with an asymmetrical membrane, anteriorly of which a small median process; medially with a twisted lobe bent to the left with a basal spine directed towards posterior; anteriorly with a second asymmetrical lobe bent from the right to the left; without setae. Tibiotarsus III (see *Sph. sturmi*, Fig. 19 c) with other setae modified than in most other species: setae Ipe and IIpe long, daggerlike blades, IIp long, IIIpi strong and toothed, IVpi strong. Head setae

strong. Dens as in Fig. 4 c, but without basal papilla, seta E1 thick, P3 a microchaeta; tip of mucro a small cap (Fig. 18 c); dens mucro = 2.2.

The name of this new species is derived from Latin *spira* = whorl, relating to the twisted process of its ventral tube.

*Sphaeridia spira* resembles *Sph. sturmi* n. sp. in that both have asymmetrical ventral tube structures and the same modification of the tibiotarsal setae. It differs from that species by the fine structures of its ventral tube.

***Sphaeridia sturmi* nov. spec.**

Type locality: Colombia, Bogotá, Páramo de Monserrate.

Type material: Holotype: Male (no. 2, 4 slides), Colombia, Páramo de Monserrate 7 km NE Bogotá, 4° 15' N, 74° 1' W, litter of a mountain forest remainder at 3230 m, 10. IX. 1986 leg. STURM (sample 86/116), coll. BRETFFELD 24/89a2, at SMF (Ap 2433). – Paratypes: 3 males (slides) from the holotype sample: no. 1 in coll. BRETFFELD, no. 3 at MNHN, no. 4 at MNCB.

Further material: 2 males (slides), Colombia, Páramo de Chisacá about 40 km SSW Bogotá, 4° 17' N, 74° 12' W, mountain forest remainder near Laguna Negra at 3720 m, 17. IX. 1986 leg. STURM by bearing branches (sample 86/57), in coll. BRETFFELD (no. 18/89).

Total male about 0.2 mm, horizontal band and ventral side blue. Ventral tube with complicated, asymmetrical structures (Fig. 19 a, b): posteriorly with 3 – 5 finger-like processes, anteriorly of which a median process; medially with 1+1 processes ending in asymmetrical medial tips: the right ending in a band, the left in a lobe; laterally with 1+1 thin processes of different length. Tibiotarsus III (Fig. 19 c) with other setae modified than in most other species: setae Ipe and Ilpe long, daggerlike blades, Ilp long, IIIpi strong and toothed, IVpi strong. Dens as in Fig. 4 c, but without basal papilla, seta E1 thick; tip of mucro a shrunk cap (Fig. 19 d); dens mucro = 2.2.

We gratefully dedicate this new species to its collector, Prof. Dr. HELMUT STURM, University of Hildesheim, Germany, whose expeditions to Colombia contributed so much to our knowledge of the Arthropoda of the Andean páramo regions.

*Sphaeridia sturmi* resembles *Sphaeridia spira* n. sp. in that both have asymmetrical ventral tube processes and the same modification of the tibiotarsal setae. It differs from that species by the fine structure of its ventral tube processes.

The pattern of the modified tibiotarsal setae of *Sphaeridia spira* and *Sph. sturmi* resembles that of *Sph. schalleri* MASSOUD & DELAMARE DEBOUTTEVILLE, 1964, *winteri* MASSOUD & DELAMARE DEBOUTTEVILLE, 1964, and *betschi* ARLÉ, 1984, because there are other setae modified than in the other species.

The ventral tube of *Sph. betschi* is simple (ARLÉ 1984), whereas the tubes of *Sph. schalleri* and *winteri* (after the re-examination of the types) have complicated but symmetrical structures with a posterior median process.

Thus *Sph. spira* and *sturmi* remain isolated within the known species, and *Sph. schalleri* and *winteri* seem to occupy an intermediate position between *Sph. spira* and *sturmi* and the other species. Whether the ventral tube of *Sph. betschi* is really simple should be shown by the types or by new collections.

**5. Systematic comparison**

For practical purposes the genus *Sphaeridia* is divided into several species groups by the structure of the male ventral tube.

***pumilis*-group**

These species have a male ventral tube with 1+1 posterior, small vesicles. The group is named after *Sphaeridia pumilis* (KRAUSBAUER, 1898). The following species belong to this group (a short characterization of the tibiotarsus III structures is added: seta Ipe-setae IIIpi, IVpi): *Sphaeridia pumilis* (KRAUSBAUER, 1898) (strong and long-normal); *proxima* (MURPHY, 1960) (long-toothed); *denisi* MASSOUD & DELAMARE DEBOUTTEVILLE, 1964 (asymmetrical lobe, proximal part short and round, distal part long and pointed-toothed); spec. MASSOUD & DELAMARE DEBOUTTEVILLE, 1964 (asymmetrical lobe on a large papilla, proximal part of lobe short and round, distal part short and pointed [new observations after re-examination of the type which will be described in detail in a later publication]-toothed); *spinifrons* MURPHY, 1966 (long-one toothed); *zaheri* YOSII, 1966 (long and straight-normal); *asiatica* RUSEK, 1971 (symmetrical fork-normal); *aserrata* MARI MUTT, 1987 (asymmetrical fork-normal); *clara* n. sp. (normal-toothed); *coronata* n. sp. (stronger-toothed); *martii* n. sp. (normal-toothed); *neopumilis* n. sp. (long and thin-strong without teeth); *pilleata* n. sp. (normal-strong, toothed); *robusta* n. sp. (strong-toothed); *squamifera* n. sp. (large blade-toothed).

*Sph. betschi* ARLÉ, 1984, may be provisionally added to this group (see for a discussion of its characters above).

***brevipila*-group**

These species have a male ventral tube with a posterior, median process. The group is named after *Sphaeridia brevipila* (MURPHY, 1960). The following species belong to this group (tibiotarsus III structure is added as above): *Sphaeridia brevipila* (MURPHY, 1960) (normal); *cornuta* MURPHY, 1966 (normal); *fernandoi* MURPHY, 1966 (normal-toothed); *massoudi* MURPHY, 1966 (normal); *obtusa* MURPHY, 1966 (normal); *pippetti* MURPHY, 1966 (normal-toothed); *serrata* (FOLSOM & MILLS, 1938), sensu CHRISTIANSEN & BELLINGER, 1980 (normal); *cardosi* ARLÉ, 1984 (normal); *carioca* ARLÉ, 1984 (normal-toothed); *fluminensis* ARLÉ, 1984 (one curved seta); *heloisae* ARLÉ, 1984 (long, tip cut-one toothed); *paroara* ARLÉ, 1984 (long, thick, blunt-toothed); *furcata* DUNGER & BRETFFELD, 1989 (long, knob-normal); *leutrensis* DUNGER & BRETFFELD, 1989 (long, knob-normal); *boettgeri* n. sp. (normal); *catapulta* n. sp. (long-toothed); *cerastes* n. sp. (normal); *chisacae* n. sp. (long-normal); *franklinae* n. sp. (longer-small teeth); *lobata* n. sp. (long-short, strong); *mandibulata* n. sp. (long-toothed).

*Sphaeridia schalleri* MASSOUD & DELAMARE DEBOUTTEVILLE, 1964, and *winteri* MASSOUD & DELAMARE DEBOUTTEVILLE, 1964, may be provisionally added to this group, but both species have other modifications of the tibiotarsus III setae (see p. 132 for a discussion of their characters).

#### **irmleri-group**

These species have a male ventral tube with posterior and lateral, complicated, symmetrical structures. The group is named after *Sphaeridia irmleri* n. sp. Also *Sphaeridia fibulifera* n. sp. belongs to this group.

#### **spira-group**

These species have a male ventral tube with complicated asymmetrical structures and other tibiotarsal setae modified than the other species. The group is named after *Sphaeridia spira* n. sp. Also *Sphaeridia sturmi* n. sp. belongs to this group.

#### **Male incompletely known**

We are not able to classify the following species into groups because the male ventral tube is unknown and the types were not yet available (tibiotarsus III structure is added as above): *Sphaeridia minima* (SCHÖTT, 1893) (unknown); *biniserrata* (SALMON, 1951) (asymmetrical fork-normal); *pumilis* (KRAUSBAUER, 1898) sensu DELAMARE DEBOUTTEVILLE & MASSOUD, 1964 (unknown); *salmoni* MASSOUD & DELAMARE DEBOUTTEVILLE, 1964 (long, waved-normal); *spinifer* (GAMA, 1964) (unknown); *murphyi* YOSII, 1966 (long, thick, pointed-toothed); *pumilis* (KRAUSBAUER, 1898) sensu ARLÉ, 1984 (unknown).

#### **Male not known**

We are also not able to classify the following species because they were described only after females: *Sphaeridia sphaera* (SALMON, 1946), MASSOUD & DELAMARE DEBOUTTEVILLE, 1964; *tunicata* (YOSII, 1954); *gladiolifer* DELAMARE DEBOUTTEVILLE & MASSOUD, 1964; *posterospina* MURPHY, 1966; spec. YOSII, 1966; *indica* PRABHOO, 1971.

## **6. Ecology**

*Sph. boettgeri* from Paraguay was found in a mixed sample, therefore its ecology is unknown; we note, however, that this species was also found in Brazil near Manaus.

The new species from Brazil were collected in the inundation forests of central Amazonia near Manaus. We mention briefly (see IRMLER 1975, ADIS 1984, JUNK 1984) that the water of the Rio Solimões – Rio Amazonas, which is loaded with nutrient-rich minerals (white-water), deposits a fertile soil and covers and condenses the litter layer with clay (várzea-region, Ilha de Marchantaria studied here). On the other hand, the water of the Rio Negro and its tributaries, which is very poor in minerals (blackwater), deposits a soil poor in nutrients with a loose litter layer of some cm thickness (igapó-region, forests at Rio Tarumã Mirim studied here). The region of Lago Janauari is inundated by the mixed water of both river systems.

We cannot give detailed ecological data because of the still low number of samples studied definitively, and refer to the paper which the junior author is preparing.

The new *Sphaeridia* species from Colombia occur in small numbers in all the strata studied in the Andean páramo region: in raw humus, litter, mosses and herbs on soil, on tree branches, and in epiphytes (mosses and ferns).

The species are distributed in the biotopes as follows: raw humus at 3080 m, *Sph. neopumilis*; litter at 3230 m, *Sph. mandibulata*, *sturmi*, *spira*; mosses and herbs on soil at 3300 m and 3720 m, *Sph. spira*, *chisacae*; tree branches at 3720 m, *Sph. sturmi*; epiphytes at 3000 m, 3250 m, and 3550 m, *Sph. mandibulata*, *lobata*, *catapulta* (accompanied by *Sturmius epiphytus* BRETTFELD, in press).

*Sph. neopumilis*, *chisacae*, and *catapulta* were collected only in one stratum or at one altitude, *Sph. lobata* only in epiphytes but at all altitudes, *Sph. sturmi* in litter and on branches, *Sph. spira* in litter and soil mosses, i. e. always near the soil surface, and *Sph. mandibulata* in litter and epiphytes at one altitude.

The data show that altitude does not restrict occurrence; most species, however, were found in the strata with a large inner surface (litter, mosses on soil or as epiphytes).

## 7. Key of Sphaeridia males of South America

(Abbreviations: Ant. II or III = antennal segment II or III, post. = posterior, proc. = process or processes; Tita III = tibia III; VT = ventral tube)

Four species are not included in this key because the males were not at all or not completely described:

- *Sph. biniserrata* SALMON, 1951, sensu ARLÉ, 1984 (Tita III seta IIpe asymmetrically furcated, both parts pointed, the proximal one shorter than the distal, Tita III without toothed setae, VT unknown)
  - *Sph. pumilis* (KRAUSBAUER, 1898) sensu DELAMARE DEBOUTTEVILLE & MASSOUD, 1964 (no significant male characters described)
  - *Sph. gladiolifer* DELAMARE DEBOUTTEVILLE & MASSOUD, 1964 (described only after females)
  - *Sph. pumilis* (KRAUSBAUER, 1898) sensu ARLÉ, 1984 (no significant male characters described)
1. VT with asymmetrical structures; Tita III setae IIpe, IIIpe long, daggerlike blades: *spira*-group 2
    - VT with symmetrical structures; Tita III with normal setae or other setal modifications: 3
  2. VT with 3 – 5 fingerlike post. proc. sturmi n. sp.
    - VT with an asymmetrical post. membrane and two distal lobes bent from the right to the left spira n. sp.
  3. VT with 1+1 small post. vesicles: *pumilis*-group 4
    - VT with more or less complicated structures 14
  4. VT with two post. membranes; Tita III seta IIpe stronger than normal setae, IIIpi and IVpi strong, toothed coronata n. sp.
    - VT with only the 1+1 post. vesicles 5
  5. Tita III seta IIpe of normal setal shape 6
    - This seta of other shape 10
  6. Setae of Tita III without teeth, seta IIpe long and thin; head apex with thin setae neopumilis n. sp.
    - Tita setae IIIpi, IVpi strong and toothed 7
  7. Head with setae a4, d4 8
    - Head without setae a4, d4 9
  8. Head frons rows a, b and c, d close together; length of Ant. II III = 1.4; mucro with 10 inner teeth pilleata n. sp.
    - Head frons rows a, b, c, d clearly separated; length of Ant. II III = 2.0; mucro with 15 inner teeth clara n. sp.
  9. Ant. II with two additional spines, length of Ant. II III = 3.0; femur III with a short blunt post. spine martii n. sp.
    - Without these characters; total length up to 0.22 mm; Tita III seta IIIpi strong with few large teeth, IVpi thin with small teeth robusta n. sp.
  10. (5.) Tita III seta IIpe an asymmetrical fork, proximal part short (and blunt?), distal part longer and pointed aserrata MARI MUTT, 1987
    - Seta IIpe a large blade 11
  11. Tita III seta IIpe sickle-shaped, IIIpi and IVpi toothed, IIpe and IIIp (?) longer than others betschi ARLÉ, 1984
    - Tita III seta IIpe of other shape, IIIpi and IVpi toothed, other setae of Tita III normal 12
  12. Tita III seta IIpe a thick and blunt blade, IIIpi and IVpi strong with few teeth squamifera n. sp.
    - Tita III seta IIpe an asymmetrical lobe, proximal part round, distal part pointed 13
  13. Tita III seta IIpe with long distal tip denisi MASSOUD & DELAMARE DEBOUTTEVILLE, 1964
    - Tita III seta IIpe with short distal tip spec. MASSOUD & DELAMARE DEBOUTTEVILLE, 1964
  14. (3.) VT with a median post. proc.: *brevipila*-group 15
    - VT without such a proc.: *irmleri*-group 24
  15. Tita III seta IIpe of normal setal shape 16
    - This seta long and thin, or of other special shape 21

16. Tita III with toothed setae 17  
 – Tita III setae without teeth 20
17. VT with 1+1 or 2+2 lateral and anterior proc. 18  
 – VT with more lateral proc. 19
18. VT post. proc. with 1+1 furcated lateral parts; Tita III with one toothed seta *carioca* ARLÉ, 1984  
 – VT post. proc. with 1+1 apical teeth, strong fanlike root, and a large anterior branch,  
 VT also with 1+1 curved post.-lateral proc. with an earlike medial border each;  
 Tita III setae IIIpi and IVpi with small teeth *franklinae* n. sp.
19. VT post. proc. in front of a strong wall, broad furcated, VT also with 1+1 thin post.-lateral proc.  
 and 2+2 lateral lobes; Tita III setae IIIpi and IVpi with small teeth *catapulta* n. sp.  
 – VT post. proc. in front of a thin membrane in form of a handglass, VT also with 1+1 thin  
 post.-lateral proc., 1+1 tridentate lateral proc., and several symmetrical anterior lobes;  
 Tita III setae IIIpi and IVpi strong with one tooth each *mandibulata* n. sp.
20. (16.) In lateral view, VT post. proc. in form of a semicircle, VT also with 2+2 bidentate  
 lateral proc.; Tita III with a curved seta *fluminensis* ARLÉ, 1984  
 – VT post. proc. with a short anterior branch, VT also with 2+2 lateral lobes *cardosi* ARLÉ, 1984  
 – VT post. proc. simple, VT also with 2+2 or 3+3 lateral lobes; Tita III seta IIpe long,  
 IIIpi and IVpi short and strong *lobata* n. sp.  
 – VT with two median post. proc. and 3+3 other proc. (post., lateral, anterior) *chisacae* n. sp.  
 – VT post. proc. with a knobbed tip, VT also with 1+1 striated post. blades and  
 1+1 mandible-like anterior proc. *boettgeri* n. sp.  
 – VT post. proc. only slightly knobbed, VT also with 1+1 large post. vesicles and  
 1+1 long, furcated anterior proc. *cerastes* n. sp.
21. (15.) Tita III with toothed setae 22  
 – Tita III setae without teeth 23
22. Tita III seta IIpe a long, thick spine, IIIpi and IVpi with only one tooth each;  
 VT post. proc. thick with 1+1 vaulted lateral blades *paroara* ARLÉ, 1984  
 Tita III seta IIpe long, leaflike, distal part long and narrow, tip cut, one seta toothed (IVpi?);  
 VT post. proc. with a narrowing in basal third, tip blunt, VT also with 1+1 lateral proc.  
 with a long, curved, acuminate tip each; dens seta E1 a thick spine *heloisae* ARLÉ, 1984
23. Tita III seta IIpe long and thin, IIIpi a long, thick spine, IIp thicker than normal setae  
*winteri* MASSOUD & DELAMARE DEBOUTTEVILLE, 1964  
 – Tita III setae Ipe, IIpe, IIp thick with a long acuminate tip each  
*schalleri* MASSOUD & DELAMARE DEBOUTTEVILLE, 1964
24. (14.) VT with 1+1 post. blades with three lobes each and 1+1 strong anterior lobes with large,  
 doubled teeth; Tita III seta IIpe long, IIIpi strong with one tooth, IVpi normal, without teeth *irmleri* n. sp.  
 – VT with 1+1 post.-lateral, long, waved proc., 1+1 lateral, thick knobs, and 1+1 anterior vesicles;  
 Tita III seta IIpe stronger than normal setae, IIIpi and IVpi strong, toothed *fibulifera* n. sp.

## 8. Literature

- ADIS, J. (1984): Seasonal igapó-forests of Central Amazonian blackwater rivers and their terrestrial arthropod fauna. – In: SIOLI, H. (ed.): The Amazon. Limnology and landscape ecology of a mighty tropical river and its basin: 245-268; Dordrecht.
- ARLÉ, R. (1984): O gênero *Sphaeridia* LINNANIEMI, 1912 no Brasil com descrição de novas espécies (Collembola, Symphypleona). – Bol. Mus. Paraense Emilio Goeldi, Zool., **1** (2): 229-255.
- BLANQUAERT, J.-P. & MERTENS, J. (1977): Mating behaviour in *Sphaeridia pumilis* (Collembola). Pedobiol., **17**: 343-349.
- BRETFELD, G. (1990): Chaetotaxy of four species of the genera *Heterosminthurus*, *Bourletiella*, *Deuterosminthurus*, and *Prorastriones* (Insecta, Collembola, Symphypleona). Zool. Jb. Syst., **117**: 441-489.
- BRETFELD, G. (1991): A preparation method for Symphypleona (Insecta, Collembola) with some comments on the history of this method. – Rev. Ecol. Biol. Sol, **28**: 217-219.
- BRETFELD, G. (1992a): Description of old and new European taxa of the genus *Fasciosminthurus* GISIN, 1960 n. comb. (Collembola, Symphypleona) mainly based on chaetotaxy. – Mitt. Zool. Mus. Kiel, Suppl., **4**: 7-36.
- BRETFELD, G. (1992b): Generic division of *Prorastriones* [sensu] BETSCH, 1977 with description of *Cyprania* n. g. from Cyprus (Collembola, Symphypleona). – Mitt. Zool. Mus. Kiel, Suppl., **4**: 37-60.
- BRETFELD, G. (in press): *Sturmius epiphytus* n. gen. n. spec. from Colombia, a taxon of the Symphypleona (Insecta, Collembola) with an unexpected character combination: Description and position of the new taxon in non-Linnean and Linnean classifications of the Symphypleona. – Z. Zool. Syst. Evolutionsforschung.
- DELAMARE DEBOUTTEVILLE, C. & MASSOUD, Z. (1964): Collemboles Symphypléones du Surinam. – Stud. Fauna Suriname, No. **26**: 56-81.
- DUNGER, W. & G. BRETFELD (1989): Zwei neue Arten der Gattung *Sphaeridia* LINNANIEMI, 1912 aus Europa (Insecta, Collembola). – Abh. Ber. Naturkundemus. Görlitz, **62** (4): 1-15.
- IRMLER, U. (1975): Ecological studies of the aquatic soil invertebrates in three inundation forests of Central Amazonia. – Amazoniana, **5**: 337-409.
- JUNK, W. J. (1984): Ecology of the várzea, floodplain of Amazonian whitewater rivers. – In: SIOLI, H. (ed.): The Amazon. Limnology and landscape ecology of a mighty tropical river and its basin: 215-243; Dordrecht.
- MARI MUTT, J. A. (1987): Collembola from two localities near Buenaventura, Colombia. – J. Kans. Ent. Soc., **60**: 364-379.
- MARI MUTT, J. A. & BELLINGER, P. F. (1990): A catalog of the Neotropical Collembola, including Nearctic areas of Mexico. – Flora & Fauna Handbooks No. **5**, Gainesville, Florida, 237 pp.
- MASSOUD, Z. & DELAMARE DEBOUTTEVILLE, C. (1964): Contribution à l'étude du genre *Sphaeridia* (LINNANIEMI, 1912). – Rev. Ecol. Biol. Sol, **1**: 85-116.
- MURPHY, D. H. (1966): Taxonomy and bionomics of eight species of *Sphaeridia* (Collembola, Sminthuridae) in a Singapore flood-plain. – Rev. Ecol. Biol. Sol, **3**: 65-95.
- NAYROLLES, P. (1988): Chétotaxie tibiotarsale des Collemboles Symphypléones. – Travaux du Laboratoire d'Ecobiologie des Arthropodes Edaphiques, Toulouse **5** (4): 1-19.

# ZOBODAT - [www.zobodat.at](http://www.zobodat.at)

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Andrias](#)

Jahr/Year: 1994

Band/Volume: [13](#)

Autor(en)/Author(s): Bretfeld Gerhard, Gauer Ulrich

Artikel/Article: [Diagnostic description of the males of new Sphaeridia species \(Insecta, Collembola\) from South America 113-136](#)