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Review of the genus *Microchilus* Blanchard (Coleoptera: Scarabaeidae: Rutelinae: Geniatini)

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Review of the genus *Microchilus* Blanchard (Coleoptera: Scarabaeidae: Rutelinae: Geniatini)

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Review of the genus *Microchilus* Blanchard (Coleoptera: Scarabaeidae: Rutelinae: Geniatini)

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Abstract: The Brazilian scarab beetle genus *Microchilus* Blanchard (Rutelinae: Geniatini) is reviewed. Based on examination of type specimens, *Microchilus beckeri* Martínez is transferred to the genus *Leucothyreus* becoming *L. beckeri* (Martínez), **new combination**; *Leucothyreus bucki* Machatschke is a **new junior synonym** of *L. beckeri* (Martínez). *Microchilus* is limited to two species, *M. beckeri* (Martínez) and a **new species**, *Microchilus rodmani* Jameson, here described. Characters that circumscribe the genus, biology, and species distribution are discussed. A key to the species is provided.

Resumen: El género de escarabajos brasileño *Microchilus* Blanchard (Rutelinae: Geniatini) es revisado. Basado en la examinacion de los especimenes tipos, *Microchilus beckeri* Martínez es transferido al género *Leucothyreus* (*L. beckeri* [Martínez], **nueva combinación**) y *Leucothyreus bucki* Machatschke es considerado un **nuevo sinónimo junior** de *L. beckeri* (Martínez). Una **nueva especie**, *Microchilus rodmani* Jameson es descrita. Así, el género incluye dos especies. Los caracteres que circunscriben el género, la biología, y la distribución de las especies son discutidos, y una clave para las especies es presentada.

Key words Scarabaeidae, Rutelinae, Geniatini, systematics, taxonomy, Brazil

Introduction

The genus *Microchilus* Blanchard is one of thirteen genera in the leaf chafer tribe Geniatini (Scarabaeidae: Rutelinae), an exclusively New World taxon (Jameson and Hawkins 2005). This research results from a recent review of the tribe Geniatini (Jameson and Hawkins 2005) that provided a foundation for continued revisionary research in this group. Recent synthetic or monographic research on the Geniatini includes a revision of the genus *Trizogeniates* Ohaus (Villatoro 2002), synopsis of the genus *Geniatosoma* Costa Lima (Lacroix 2000), and description of *Xenogeniates* Villatoro and Jameson (Villatoro and Jameson 2001). Here I provide a synopsis of the obscure geniatine genus *Microchilus*.

The genus *Microchilus* currently includes two species that occur in southern Brazil: *M. lineatus* Blanchard (type species) and *M. beckeri* Martínez. The generic name *Microchilus* is derived from the Greek words "mikros" (meaning small) and "cheilos" or "chilos" (meaning lip), in reference to the short, wide mentum. The characteristic that is most notable in the genus and which makes it unusual within the Rutelinae is the internal and external claws are incised (Fig. 11). This character state is shared with members of the scarab subfamilies Melolonthinae and Phaenomeridinae, and it could make phylogenetic analyses as well as taxonomic identification difficult. It is possible that this character is indicative of a phylogenetic relationship between these groups, but this remains to be elucidated with higher-level phylogenetic analyses.

In addition to the incised claws, several other characters serve to diagnose species of *Microchilus* as members of the tribe Geniatini: 1) labrum vertically and ventrally produced with respect to the clypeus (Fig. 8; also see Fig. 15-16 in Jameson and Hawkins 2005) and more or less fused to the clypeus, 2) protarsomeres of males and females dorsoventrally flattened, enlarged, and densely pilose ventrally (Fig. 15-16, 19-20; also see Fig. 30-31, 33-34 in Jameson and Hawkins 2005), 3) mentum and labrum each with median, apical tooth (Fig. 8-9; also see Fig. 16 in Jameson and Hawkins 2005), and 4) margin of elytra with membranous border (see Fig. 47 in Jameson and Hawkins 2005).

Species of *Microchilus* are among the smallest members of the Geniatini (8.0 mm or less in length). In overall *gestalt*, they are most similar to small species of *Bolax* Fischer von Waldheim due to their small eyes and form of the fifth protarsomere that is dorsoventrally flattened and setose ventrally (Figs. 15-16,

19-20). However, species of *Microchilus* are clearly separated from species of *Bolax* by the following characters: antennal club of male longer than antennomeres 2-7, bidentate protibia, and both claws incised on all legs.

Materials and Methods

Specimens for this research are deposited at the BMNH (The Natural History Museum, London, England); CASC (California Academy of Sciences, San Francisco, CA, USA); CMNC (Canadian Museum of Nature, Ottawa, Canada); UCCC (Museo de Zoologia, Universidad de Concepcion, Chile); ISNB (Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium); LACM (Los Angeles County Museum, Los Angeles, CA, USA); UNSM (University of Nebraska State Museum, Lincoln, NE, USA); MACN (Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina); and ZMHB (Museum für Naturkunde der Humboldt Universitat, Berlin, Germany).

Body measurements, puncture density, puncture size, and density of setae are based on the following standards. *Body length* was measured from the apex of the clypeus to the apex of the elytra. *Body width* was measured across the elytral humeri. *Puncture density* was considered "dense" if punctures were nearly confluent to less than two puncture diameters apart, "moderately dense" if punctures were from two to six puncture diameters apart, and "sparse" if punctures were separated by more than six puncture diameters. *Puncture size* was defined as "small" if punctures were 0.02 mm or smaller; "moderate" if 0.02-0.07 mm, "moderately large" if 0.07-0.12 mm, and "large" if 0.12 mm or larger. *Setae* were defined as "dense" if the surface was not visible through the setae, "moderately dense" if the surface was visible but with many setae, and "sparse" if there were few setae. Minute setae are defined as those that are observable at 50X or higher. The *interocular width* measures the number of transverse eye diameters that fit on the frons between the eyes. *Tarsomeres* are labeled from the base of the tarsus to the apex of the tarsus and are referred to as tarsomeres I, II, III, IV, and V (respectively).

Characters and specimens were observed with 6.3-50.0X magnification and fiber-optic illumination. A 2X objective was used to examine mouthparts (12.6-100.0X magnification). Digital images for plates (specimens and structures) were captured using the Auto-Montage imaging system by Syncroscopy. Images were edited in Adobe Photoshop CS2 (background removed, contrast manipulated, etc.).

Specimens of *Microchilus* species are not common in collections; many specimens for this research were gleaned from unidentified or unsorted material. Out of the 58 specimens from major collections that comprised this study, 43% of the specimens had never been identified. Out of the 29 specimens that were identified, 18% were incorrectly identified owing to misidentification (12%) or synonymy (6%).

Description of taxa (genus and species) follows standards adopted in Villatoro and Jameson (2001) and Villatoro (2002) for members of the tribe Geniatini. To ensure the greatest retrieval of data from now and into the future, I describe the holotype and variation as observed in the allotype and paratypes. These data together comprise the description of the species.

The phylogenetic species concept (Wheeler and Platnick 2000) was applied in this work: "A species is the smallest aggregation of (sexual) populations or (asexual) lineages diagnosable by a unique combination of character states."

Taxonomic History

Blanchard (1851: 240) described the genus *Microchilus*, providing morphological details associated with mouthparts and also noting that the external claws were incised ("tarsi omnes, ungue externo fisso"). He described one species in the genus, *M. lineatus* Blanchard.

Lacordaire (1856) characterized the genus, separating it from *Bolax*, *Leucothyreus*, *Evanos* Ohaus, and *Geniates* Ohaus based on the dilated tarsomeres in both males and females and lack of a frontoclypeal suture. Lacordaire was in error with regard to the latter character. Specimens of *Microchilus* do, in fact, have a complete and evident frontoclypeal suture.

Ohaus (1908) discussed the "many inaccuracies and mistakes" in Blanchard's generic diagnosis. He attributed these errors to the method of imbedding specimens in Canada balsam for examination under light microscope, a method that sharpened certain features but obscured others. Ohaus corrected Blanchard's description of the maxillae in *Microchilus*, noting that these structures are more weakly

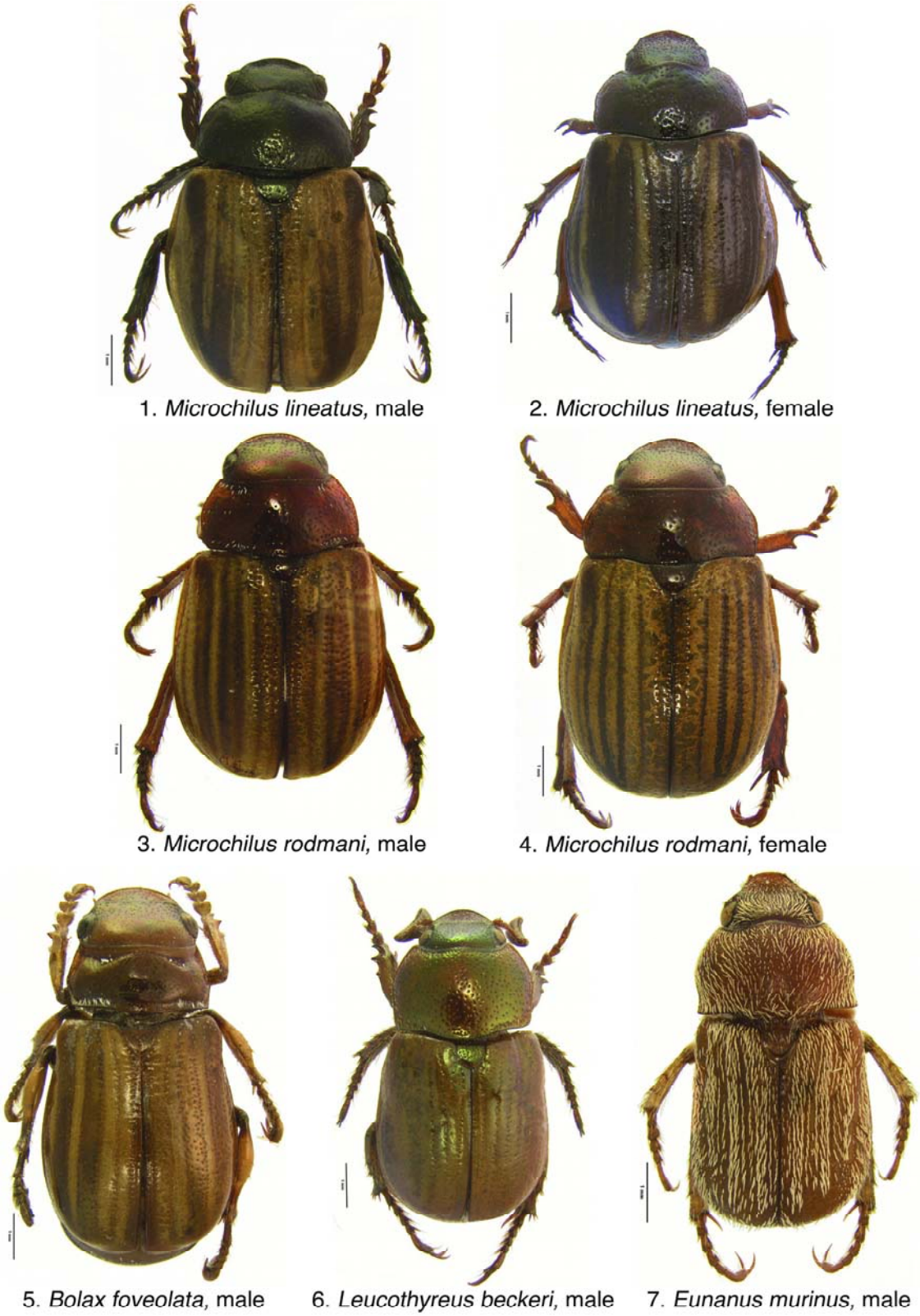

Figure 1-7. Habitus images *Microchilus* species and other Geniatini. **1)** *Microchilus lineatus*, male. **2)** *M. lineatus*, female. **3)** *M. rodmani*, holotype male. **4)** *M. rodmani*, allotype female. **5)** *Bolax foveolata* Blanchard, male. **6)** *Leucothyreus beckeri*, male. **7)** *Eunanus murinus* Ohaus, male. Scale line = 1.0 mm.

curved externally than in *Bolax* and *Leucothyreus*. In his discussion, Ohaus also noted that the number of antennal segments in *M. lineatus* varied from eight to ten due to partial fusion of segments. Most importantly, Ohaus noted the "peculiar" nature of the claws in both sexes: all claws (inner and outer) on all legs are deeply incised. This character, according to Ohaus, set *Microchilus* and *Bolax flavolineata* (Mannerheim) apart from all other Rutelinae and allied them with the scarab subfamily Phaenomeridinae.

Martínez (1964), as part of his revision on the tribe Geniatini, described *M. beckeri* Martínez from a unique male specimen which he compared with *M. lineatus*. He provided a lengthy and detailed description of the species, differentiated the new species based on the form of the male genitalia, and included a drawing of the male parameres. He described the claws on all legs as being weakly subdentate (external claw) and simple (internal claw), thus the form of the claws was not consistent with *M. lineatus* in which the external and internal claws are incised on all legs, but Martínez did not note this. In his discussion, Martínez stated that the specimen carried an Ohaus label with the name "Leucothyreus bucki Ohaus". Because this name was unpublished and because he believed that Ohaus would not incorrectly identify a specimen of *Microchilus* as *Leucothyreus* (he did not elaborate on his rationale for generic placement of the species), he supposed that the specimen was incorrectly determined. He concluded that the name "L. bucki" had not been published, but it may be a name *in litteris*.

One year after the publication of Martínez's new species, Machatschke published the *Genera Insectorum* for the orthochilous Rutelinae (Machatschke 1965). The work included only *M. lineatus* in the genus *Microchilus*. It is quite possible that the *Genera Insectorum* went to press prior to Martínez's publication of a new species of *Microchilus*. It is also possible that scientific turf battles between Martínez and Machatschke resulted in lack of communication (see Martínez 1977; Jameson and Hawkins 2005) and oversight on Machatschke's part regarding the new species.

Before his death in 1974, Machatschke (Machatschke 1974) published descriptions of new species of Geniatini. These were species discovered by Ohaus but not yet published. In this publication Machatschke described *L. bucki*, noting that the species was taken from Ohaus *in litteris*. This was the same name that Martínez (1964) noted on the specimen he named *Microchilus beckeri*.

Status of *Microchilus beckeri*

The classification status of *M. beckeri* is affected by two historical complications: 1) lack of robust discussion regarding shared characters that established generic placement of the species, and 2) synonymy of *M. beckeri* and *L. bucki* as alluded to by Martínez (1964).

The proper generic assignment for *M. beckeri* and *L. bucki* was an issue not well addressed by Martínez (1964) or Machatschke (1974). Martínez (1964) considered the species a member of the genus *Microchilus*, but Machatschke (1974) considered it a member of the genus *Leucothyreus*. Neither provided evidence that established justification for placement of the species in either genus.

Although research on the genera of Geniatini has laid the basic foundation for taxonomic characters for the geniatine genera (Jameson and Hawkins 2005), phylogenetic characters (shared, derived characters based on phylogenetic analyses) would greatly assist in circumscription of the genera. Lacking a phylogenetic hypothesis, I examined exemplars of several genera within the Geniatini. Genera of Geniatini that are easily distinguished from *Microchilus* based on taxonomic characters (see the key to genera of Geniatini in Jameson and Hawkins 2005) are: *Evanos*, *Geniates*, *Geniatosoma*, *Heterogeniates* Ohaus, *Lobogeniates* Ohaus, *Mimogeniates* Martínez, *Rhizogeniates* Ohaus, *Trizogeniates*, and *Xenogeniates*. This enigmatic species, "beckeri" (Fig. 6), could be keyed to the following genera or confused with the following genera: *Microchilus* (Figs. 1-4), *Leucothyreus*, *Bolax* (Fig. 5), or *Eunanus* Ohaus (Fig. 7). The following discussion provides generic characters and a comparison of characters observed in "beckeri" as a means of aiding placement of the species in the genus with which it shares the most characters.

The species "beckeri" resembles *Microchilus* based on its small size (less than 8 mm), distribution in southern Brazil, apex of the labrum with a narrow tooth, and interocular width greater than 6 transverse eye diameters. But "beckeri" does not share the form of the claws (internal and external claws on all legs are incised in *Microchilus*; internal claws simple, external claws incised in "beckeri"), the form of the clypeal apex (broadly rounded in *Microchilus*; narrowly parabolic in "beckeri"), length of antennal club in the male (club 1.5 times length of segments 2-7 in *Microchilus*; club 2 times length of segments 2-7 in

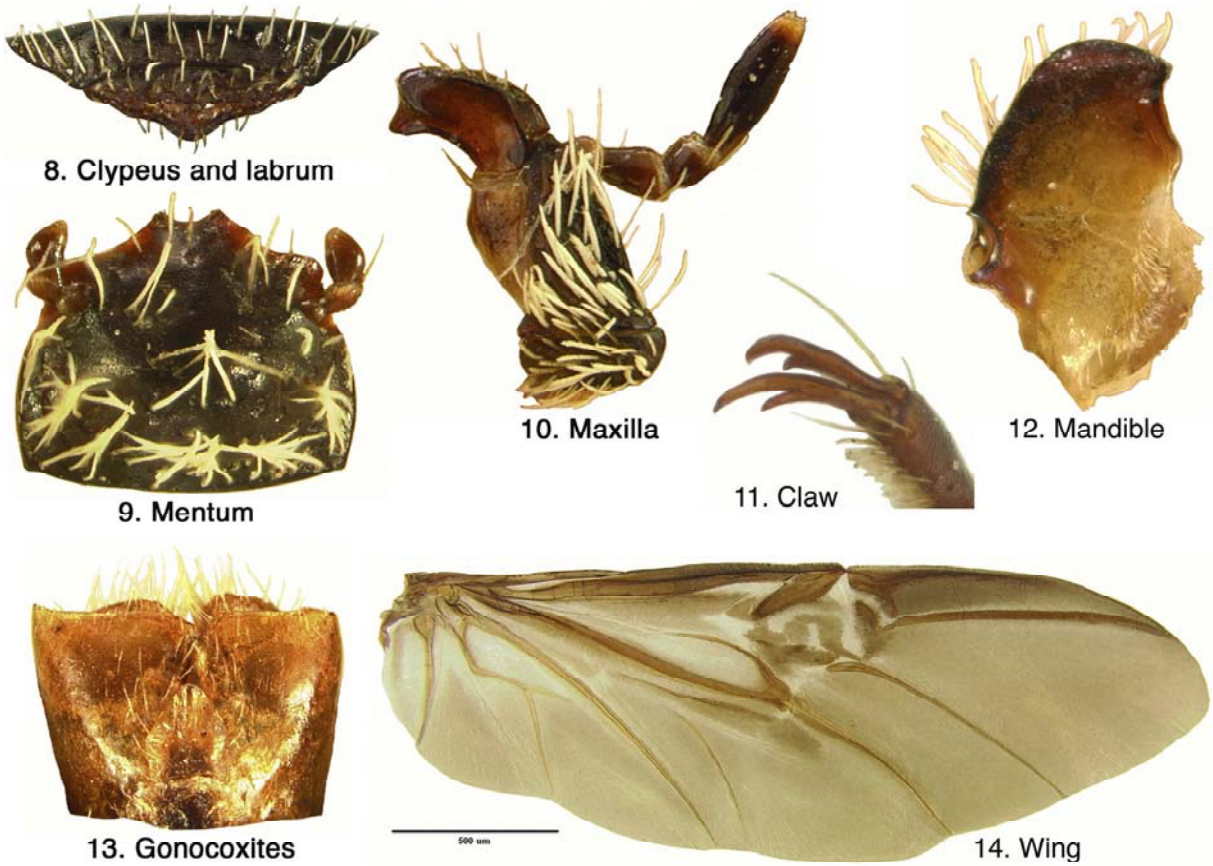

Figure 8-14. Generic characters for members of the genus *Microchilus*. **8)** Labrum and clypeus, frontal view of *M. lineatus*. **9)** Mentum, ventral view of *M. lineatus*. **10)** Right maxilla, ventral view of *M. lineatus*. **11)** Claws, dorsal oblique view of *M. lineatus*. **12)** Left mandible, dorsal oblique view of *M. lineatus*. **13)** Gonocoxites, dorsal view of *M. lineatus*. **14)** Left wing, ventral view of *M. rodmani*. Scale line = 0.5 mm.

"beckeri"), and protibial teeth (two external teeth in *Microchilus*; three external teeth in "beckeri"). These characters preclude placement of "beckeri" in the genus *Microchilus*.

Several characters observed in "beckeri" are shared with members of the genus *Eunanus*: the narrowly parabolic clypeus, form of the meso- and metatibia, interocular width greater than 6 transverse eye diameters, male antennal club two times the length of segments 2-7, apex of the labrum with a narrow tooth, and small size. But "beckeri" does not share the simple claws observed in members of *Eunanus* nor the form of the mandible which possesses a rounded, apical tooth. These characters preclude placement of "beckeri" in the genus *Eunanus*.

A few species of *Bolax* are small (*B. foveolata* Blanchard, *B. incogitata* Dohrn, *B. mutabilis* Burmeister, *B. vittipennis* [Laporte]) and vaguely resemble "beckeri" based on size. However, "beckeri" does not share the form of the labrum (apex with a narrow tooth in *Microchilus*; apex with a broad tooth in *Bolax*), length of antennal club in the male (club 1.5 times length of segments 2-7 in *Microchilus*; club subequal to segments 2-7 in *Bolax*), form of the pronotum (lacking longitudinal constrictions in *Microchilus*; often with longitudinal constrictions at apex and base in *Bolax*). These characters preclude placement of "beckeri" in the genus *Bolax*.

This leads us to the genus *Leucothyreus*, the largest genus in the Geniatini with 164 described species. It is a heterogeneous assemblage of species, and several characters are variable within the group (perhaps indicating that the group is not monophyletic). Several characters observed in "beckeri" are shared with members of the genus *Leucothyreus*: the form of the claws are simple and incised on all legs; protibia with three external teeth; length of protarsomeres 2-5 greater than length of protarsomere 5;

base of pronotum not constricted; and surface of pygidium with decumbent, white setae and horizontal striae (striae weak in "beckeri"). No characters observed in "beckeri" necessarily preclude placement in the genus *Leucothyreus*, but they may be unusual for the genus *Leucothyreus*: the form of the clypeus (narrowly parabolic in "beckeri"; variable in *Leucothyreus* including rounded, parabolic, or quadrate) and interocular width (greater than 6 transverse eye diameters in "beckeri"; generally less than 5 transverse eye diameters in *Leucothyreus*). Based on the shared characters of "beckeri" and members of *Leucothyreus,* as well as the few conflicting characters that preclude placement of "beckeri" in the genus, I transfer *M. beckeri* Martínez to the genus *Leucothyreus* (*Leucothyreus beckeri* [Martínez], **new combination**).

Based on examination of type specimens, it is clear that *L. beckeri* and *L. bucki* are conspecific (see "Taxonomic History"). Although Martínez (1964) noted Ohaus' label that identified the specimen as "Leucothyreus bucki", the name was not published. Additionally, he thought that this specimen clearly represented a new member of the genus *Microchilus* rather than *Leucothyreus* and that the determination by Ohaus was in error. Machatschke (1974), in his description of *L. bucki* (a name that was *in litteris* by Ohaus), did not make a connection with *M. beckeri* because the two species were placed in different genera. Based on examination of type specimens for *L. beckeri* and *L. bucki*, these species are conspecific. *Leucothyreus bucki* Machatschke is herein considered a **new junior synonym** of *Leucothyreus beckeri* Martínez.

Type specimen data for *Leucothyreus beckeri* (Martínez), 1964: 425

Microchilus beckeri Martínez. **NEW COMBINATION**
BRAZIL: Rio Grande do Sul
Leucothyreus bucki Machatschke 1974: 143-146. **NEW SYNONYMY**

Holotype male of *M. beckeri* Martínez at MACN labeled: a) abdomen, head, some mouthparts, some legs card-mounted beneath specimen, b) "BRASIL Eº de R. G. do Sul Saimbi J. Becker-legit. Coll. Martínez 10-II-950" (handwritten, white label), c) "Leucothyreus bucki Ohaus Rutelidae Saimbi" (handwritten on vellum), d) "10.2.50" (handwritten on vellum), e) "HOLOTYPUS" (typeset, red paper), f) "Microchilus beckeri [male symbol] sp. nov. M. Martínez-Det. 1963 (handwritten and typeset, red paper), g) "fichado" (handwritten, white card), my determination label, "Leucothyreus bucki Machatschke". The specimen is badly damaged. On the right side of the body, all legs are missing. On the left side, mesotarsi and metatarsi are card-mounted. The head is card-mounted and missing both antennae. Mouthparts were extracted previously (probably by Martínez) and card-mounted. Remaining on the card are one maxilla, mentum, one mandible, and the abdomen. Male genitalia are missing. Despite the poor condition of the type, enough parts remain to conclusively identify essential characters. Martínez named the species based on one specimen, thus this is the holotype.

Holotype male of *Leucothyreus bucki* Machatschke at NHMB (Naturhistorisches Museum, Basel, Switzerland) labeled: a) "Rio grande d.S. S. Francisco d.P. P.P. Buck S." (front side of label, typeset, white paper), b) "Cima da Serra 940 m. 15.I.1935." (obverse side of label "a", handwritten, white paper), c) male genitalia card-mounted, d) "Leucothyreus Bucki Ohs. Cotype [male symbol]" (handwritten, red paper). Perhaps because Machatschke died before the publication was printed, the specimen does not have Machatschke's holotype or determination label. However, this specimen matches the description in every respect. Machatschke (1974) stated that the male holotype was known from Rio Grande do Sul, Brazil; the female was unknown. He stated that the type was placed in his collection which was transferred from the Zoologische Staatssammlung (ZSMC) in Munich, Germany with the Georg Frey collection to the Naturhistorisches Museum in Basel in 1999. Two invalid type specimens (both males) are at ZMHB with Ohaus type labels. These are conspecific with *L. bucki* but were not included in the type series.

Genus *Microchilus* Blanchard, 1851
(Fig. 1-4, 8-25)

Microchilus Blanchard 1851: 240. Type species *Microchilus lineatus* Blanchard, 1851 (by monotypy).

Description. Scarabaeidae, Rutelinae, Geniatini. FORM (Figs. 1-4): Body elongate oval, sides subparallel, dorsum convex, pygidium exposed, elytral apex broadly rounded. Surface shagreened. HEAD: Surface

Figure 15-24. Diagnostic characters of *Microchilus* species. **15)** Right protarsomeres of male *M. lineatus*, dorsal view. **16)** Right protarsomeres of male *M. rodmani*, dorsal view. **17)** Right metatibia of *M. lineatus*, ventral view. **18)** Right metatibia of *M. rodmani*, ventral view. **19)** Right protarsomeres of female *M. lineatus*, ventral view. **20**) Right protarsomeres of female *M. rodmani*, ventral view. **21-22)** Parameres of *M. lineatus*, dorsal view and lateral view, respectively. **23-24**) Parameres of *M. rodmani*, dorsal view and lateral view, respectively. Scale line = 0.5 mm.

punctate. *Frons* weakly convex (not weakly concave as in *Xenogeniates*). Frontoclypeal suture complete, straight. Eye canthus simple, not carinate. *Clypeus* with apex reflexed, lacking bead. *Mandible* (e.g., Fig. 12) with baso-external edge rounded, apical margin rounded, inner apex with 1 tooth; inner teeth lacking; molar region poorly or well defined. *Labrum* (e.g., Fig. 8) apicomedially with forward-projecting, acute tooth. *Maxilla* (e.g., Fig. 10) with baso-external edge of mala round, inner apex with 2-4 ridges; stipes with margins subparallel. *Mentum* (e.g., Fig. 9) in ventral view subhexagonal; disc greatly convex. Apex with well developed median, dorsally-produced tooth. *Antenna* 9-segmented with 3-segmented club, some fusion of segments 2-7 (stem); club elongate-oval in lateral view; sexual dimorphism apparent in club length (club of male longer than club of female). PRONOTUM: Widest at middle; anterior angles rounded. In frontal view, dorsal surface weakly convex. Surface variably punctate. Marginal bead incomplete at apex and base. SCUTELLUM: Parabolic, apex weakly acute, width about 1.5 times longer than length in the middle; surface variably punctate. ELYTRON: Surface with variably defined punctures and striae. Elytral suture length subequal to width of both elytra. Margins beaded; bead obscured at apex. Elytral apex weakly rounded. *Epipleuron* rounded in cross section; ventral side bare, lacking setose ridge or hairs, membrane present from metacoxa to apex. PYGIDIUM: Shape broadly triangular. Surface variably sculptured. Margin with sides and apex beaded. VENTER: *Prosternal shield* present, ventrally produced, hidden between procoxae. Mesometasternal keel lacking. Mesosternum not invaginated or forming a pit. In lateral view, male abdominal sternites flat or weakly convex, female abdominal sternites weakly or strongly convex. *Terminal sternite* in male with apex weakly emarginate, not emarginate in female. LEGS (e.g., Fig. 11, 15-20): *Protibia* with 2 teeth, weak swelling occasionally present in location of third tooth; inner apex with spur (not ventrally curved); base without notch. *Protarsomere I* variable in length (subequal to 3 times longer than protarsomere 2). *Protarsomeres II-IV* dorsoventrally flattened (less so in female), moderately densely or densely setose ventrally; setae short, tawny. *Protarsomere V* weakly flattened, with sparse ventral pilosity, inner apex with broad longitudinal slit. Protarsus with inner and outer claws unequally incised dorsoventrally (Fig. 11); unguitractor plate laterally flattened, weakly exposed beyond apex of protarsomere V, bisetose. *Meso- and metatibia* each expanded apically (mesotibial apex slightly more expanded in females); external edge with or without 1-2 weakly developed carinae; apex with spurs and spines; outer spur (male and female) half length or less than half length of inner spur; inner apex placed in depression. Surface variably punctate. *Male meso- and metatarsomere I* ventrally flattened or cylindrical, tarsomeres II-IV flattened, tarsomere V cylindrical with weakly developed sub-basal tooth, setose ventrally or not (tarsomeres I and V less setose), setae short, tawny; mesotarsus with inner and outer claws unequally incised dorso-ventrally; inner apex with weak longitudinal slit. *Female meso- and metatarsomeres I-V* subconical or weakly flattened ventrally, setose ventrally or not, setae short, tawny; metatarsomere V with weakly developed sub-basal tooth; mesotarsus with inner and outer claws unequally incised dorsoventrally; inner apex with weak longitudinal slit. *Metafemur* with dorsal, apicolateral area smooth, lacking stridulatory file. HIND WING (Fig. 14): Sparse, weakly developed hooks on precostal membrane present. Anterior edge from medial fold to apex of wing lacking setae. Vein AA_{1+2} about 1/3 length of vein AA_{3+4}. PARAMERES (Fig. 21-24): Shape symmetrical, diagnostic at the species level. FEMALE GONOCOXITES (Fig. 13): Shape symmetrical, not diagnostic at the species level.

Diagnosis. Within the Geniatini, members of *Microchilus* are diagnosed by the following characters: both claws on all legs (males and females) incised (shared only with members of the *Bolax campicola* group); protibia with two external teeth; protarsomeres dorsoventrally flattened, fifth protarsomere weakly flattened (most geniatines have some tarsomeres dorsoventrally flattened, but flattening of the fifth protarsomere is not commonly observed), and small size (less than 8.1 mm in length).

Distribution (Fig. 25). Central to eastern and southeastern Brazil.

Natural History. Ohaus (1908) reported that *M. lineatus* feeds on *Aristida pallens* Cav. (Poaceae). Ohaus (1900) reported that *M. lineatus* is diurnal and can be found on vegetation.

Remarks. *Microchilus* is unusual among the Rutelinae based on its small size (less than 8.1 mm), both claws on all legs incised in males and females, fifth protarsomere weakly flattened, and protibia with two

external teeth. These characters serve to diagnose the genus.

Among the Geniatini, the genus differs from members of the genus *Eunanus* due to form of the claws (all claws simple in *Eunanus*; all claws incised in *Microchilus*) and form of the mandibular apex (with a rounded, apical tooth in *Eunanus*; lacking rounded, apical tooth in *Microchilus*).

The genus differs from members of the genus *Leucothyreus* due to the form of the claws (one claw simple and one claw incised on all legs in *Leucothyreus*; all claws incised in *Microchilus*) and surface of pygidium (with well defined horizontal striae in *Leucothyreus*; with punctures or poorly defined horizontal striae in *Microchilus*).

The genus differs from members of the genus *Bolax* due to the form of the labrum (apex with a broad tooth in *Bolax*; apex with a narrow tooth in *Microchilus*), length of antennal club in the male (1.5 times length of segments 2-7 in *Microchilus*; subequal to segments 2-7 in *Bolax*), form of the protibial teeth (two external teeth in *Microchilus*; three external teeth in *Bolax*), and form of the pronotum (lacking longitudinal constrictions in *Microchilus*; often with longitudinal constrictions at apex and base in *Bolax*). *Microchilus* species share a few characters with members of the *Bolax campicola* group (*B. campicola* Machatschke, *B. flavolineata* [Mannerheim], and *B. saucia* Ohaus). Species in the *Bolax campicola* group and members of *Microchilus* share the unusual incised internal and external claws on all legs. Whether the character of the claws is convergent or synapomorphic in *Microchilus* and *Bolax* will require phylogenetic analyses. Based on the characters that separate the genera *Bolax* and *Microchilus*, I treat *Microchilus* as a valid, monophyletic genus.

Other genera of Geniatini that are easily distinguished from *Microchilus*. See "Taxonomic History", "Status of *Microchilus beckeri*", and "Diagnosis" for additional discussion of the genus.

Key to the species of *Microchilus* Blanchard

Males: Terminal sternite with apex emarginated.
Females: Terminal sternite with apex entire, not emarginated.

1. Male protarsomere II less than twice width of protarsomere I (Fig. 15). Female protarsomere I subequal in length to protarsomeres II-IV combined (Fig. 19); metatibia with 2 transverse, external carinae ..... ***M. lineatus* Blanchard**

— Male protarsomere II more than twice width of protarsomere I (Fig. 16). Female protarsomere I subequal in length to protarsomeres II-III (Fig. 20); metatibia lacking 2 transverse, external carinae ..... ***M. rodmani* Jameson, new species**

Microchilus lineatus Blanchard, 1851

(Fig. 1-2, 8-13, 15, 17, 19, 21-22, 25)

Microchilus lineatus Blanchard 1851: 240. Type specimens not examined. Probably at Paris. Blanchard's description provided no indication regarding the number of specimens or gender of specimens used in the original description. The only locality information in the original description is "Brésil".

Description. Length 6.1-7.9 mm; width at humeri 3.2-4.2 mm. COLOR: Head, pronotum, scutellum, pygidium, and venter red-brown to castaneous; elytra tan with well-defined or poorly defined longitudinal, castaneous vittae; elytra rarely entirely castaneous. HEAD: *Frons* in lateral view with base and disc flat or weakly convex, punctate; punctures small and moderate in size, moderately dense, some setose; setae minute, tawny. Interocular width of male 5.8-6.7 transverse eye diameters; female 8.1-10.9. *Clypeus* in lateral view with base and disc weakly convex or flat, margins weakly concave; in dorsal view, apex broadly rounded, moderately reflexed. Surface densely punctate, punctures small and moderate in size, some setose; setae minute, tawny. *Mandible* (Fig. 12) with poorly developed molar region and poorly developed lamellae. Apex with weakly developed, ventrally produced tooth. *Labrum* (Fig. 8) at middle apex with triangular, ventrally-produced tooth. *Maxilla* (Fig. 10) with 2 poorly defined ridges; terminal segment of palpus elongate-oval, kidney-shaped, subequal in length to segments 1-3; basistipes with length about 1.5 times width at base. *Male antenna* with club 1.7-1.9 times longer than segments 2-7 combined

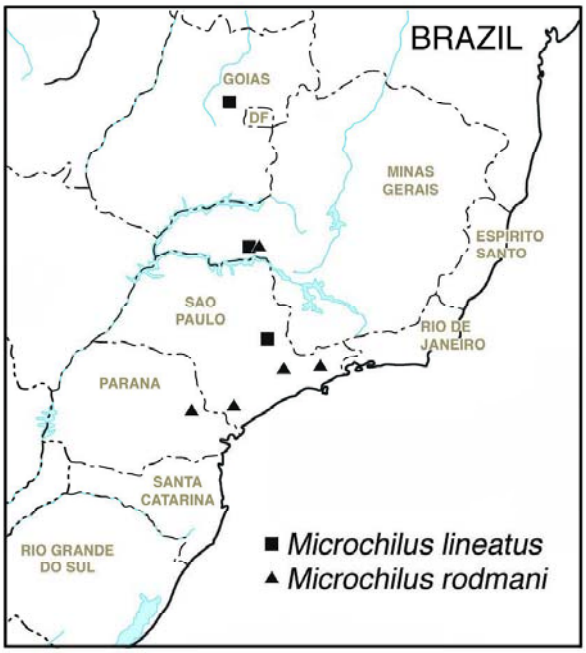

Figure 25. Distribution of *Microchilus* species.

(rarely 1.5 times longer than 2-7 segments combined in specimens in which segments 2-7 are fused). *Female antenna* with club about 1.3 times longer than segments 2-7 combined. PRONOTUM: Surface punctate; punctures minute (sparse) to moderate in size (moderately dense) (except for small area at mid-margin that is confluent). *Scutellum* with surface moderately densely punctate, punctures moderate in size. ELYTRON: Surface punctate with weakly to moderately defined striae. Punctures round or ocellate, small, moderately dense, some setose; setae minute, tawny. Striae indicated by depressed, punctate line; punctures round or ocellate, small, moderately dense, some setose: 2 striae adjacent to suture (neither reaching apex), 4 striae on disc in male (neither reaching apex; 4-6 striae in female), single stria laterad of humerus in male (1-2 in female). Intervals moderately densely punctate; punctures round or ocellate, small, moderately dense or occasionally confluent, some setose; setae minute, tawny. Odd intervals suffused with castaneous color or not. *Elytral sutural length* 6.9-8.3 times length of scutellum. PYGIDIUM: Surface convex in lateral view, moderately densely punctate; punctures on mid-disc irregularly rounded, moderately large, moderately dense; punctures laterally and at margin transversely elongate, moderately large to large, moderately dense (laterally) to confluent (at margin). Apical bead complete. VENTER: Mesosternum not invaginated, not forming a rounded pit. *Base of first sternite* at middle simple, not produced ventrally. *Last sternite of male* at apex with moderately deep to deep emargination (middle of emargination subequal to 1/2 length of sternite or entire length of sternite); middle of emargination rounded. LEGS (Fig. 11, 15, 17, 19): *Male protarsomere I* elongate (about 1.5 times longer than protarsomere II), weakly flattened dorsoventrally; protarsomeres II-III weakly elongate (slightly longer than wide), dorsal surface weakly convex; protarsomere V elongate (subequal to protarsomeres III-IV), subcylindrical (weakly flattened dorsoventrally). *Female protarsomere I* subequal to protarsomeres II-IV combined, shape subcylindrical; protarsomere II moderately elongate (about 1.5 times longer than wide), protarsomeres III-IV weakly elongate (slightly longer than wide), shape nearly subconical; protarsomere V slightly elongate (about 1.5 times longer than protarsomere IV), subcylindrical (weakly flattened dorsoventrally). *Metatrochanter* with apex not produced beyond posterior border of femur. *Male metatibia* with moderately developed, external carina near apical third. *Female metatibia* with poorly developed, external carina in basal third and well developed, external carina near apical third. Inner apical spur about 1/3 length of apical spur in male; 1/3 to 1/2 length of apical spur in female. PARAMERES (Fig. 21-22): Shape asymmetrical.

Diagnosis. *Microchilus lineatus* is distinguished from *M. rodmani* by the following characters: second protarsomere elongated in the male (Fig. 15) (subequal in width and length in *M. rodmani* [Fig. 16]); male metatibia with carinae in apical third (Fig. 17) (lacking external carinae in male *M. rodmani* [Fig. 18]); female metatibia with carinae in basal third and near apical third (lacking external carinae in female *M. rodmani*); pronotum lacking white, scale-like setae (sparse, white scale-like setae present on pronotum in *M. rodmani*); and form of male parameres (Fig. 21-22). Additional characters that separate the species are: mandible with molar region and lamellae poorly developed (moderately developed in *M. rodmani*) and labrum at middle apex with triangular, ventrally-produced tooth (quadrate, ventrally produced tooth in *M. rodmani*).

Distribution (Fig. 25). Southeastern Brazil in the Atlantic Coastal Forest.

Locality Data. 41 specimens examined from BMNH, CASC, CMNC, ISNB, LACM, UCCC, UNSM, ZMHB. **BRAZIL** (36). MINAS GERAIS (11): Uberaba (10); no data (1). PARANA (3): Ponta Grossa (3). SÃO PAULO (22): Batatais (2); Itu, Fazenda Pau d'Alho (1); Sao José dos Campos (6); Yporanga (9); no data (4). **NO DATA** (5).

Temporal Data. January (1), February (2), October (9), November (8), December (2).

Natural History. *Microchilus lineatus* feeds on *Aristida pallens* Cav. (Poaceae) (Ohaus 1908). The species is diurnal and can be found on vegetation during the day (Ohaus 1900).

Remarks. Color variation in *M. lineatus* ranges from reddish-brown to brown, thus overlapping with color in *M. rodmani*. Based on locality information, *M. lineatus* and *M. rodmani* are apparently sympatric in a portion of their range (from Uberaba south to near São Paulo).

***Microchilus rodmani* Jameson, new species**
(Fig. 3-4, 14, 16, 18, 20, 23-25)

Type Material. Holotype, allotype, 6 male paratypes, and 5 female paratypes. *Holotype male* from ZMHB labeled: a) "GOYAZ L. Bulhoes R. Spitz S." (front side, white label, type set), b) "8.X1.35." (obverse side, white label, handwritten), c) male genitalia card mounted, d) wing card mounted, e) "Kamp Naturseite n. Blättern" (white label, handwritten in pencil), f) "Microchilus Spitzi Ohs. Cotype [male symbol]" (red label, handwritten), g) my holotype label. *Allotype female* from ZMHB labeled: a) "GOYAZ L. Bulhoes R. Spitz S." (front side, white label, type set), b) "25.X1.37." (obverse side of "a", white label, handwritten), c) "Microchilus Spitzi Ohs. Cotype [female symbol]" (red label, handwritten), g) my allotype label. *Three paratypes* (1 females at ISNB, 1 male and 1 female at UNSM) labeled: a) "Brésil - Uberaba Minas Geraes Coll. LeMoult" (white label, type set), b) "Coll. R. I. Sc. N. B." (faded purple label, typeset), c) my paratype label. *Four paratypes* (3 males and 1 female at ISNB) labeled: a) "Brésil - Uberaba" (white label, type set), b) "R. Mus. Hist. Nat. Belg. I. G. 12.595" (white purple label, typeset), c) my paratype label. *One male paratype* at UCCC labeled: a) "Leopoldo Bulhoes Est. Goyaz Dec. 37 Dr. Nick." (white label, typeset), b) legs card mounted, c) genitalia in glycerin vial, d) "Brasil" (handwritten, white label), e) "Sud-America" (typeset, white label), f) "Ohaus determ. Microchilus Spitzi Ohs. Cotype [male symbol]" (handwritten and typeset, white label), g) my paratype label. *One male paratype* at CMNC labeled: a) male genitalia card-mounted, b) "Leopoldo Bulhoes Est. Goyaz Dec. 37 Dr. Nick." (white label, typeset), c) "H. & A. HOWDEN COLLECTION ex. A. Martínez coll." (white label, typeset, with border), d) "cotype" (handwritten, orange label), e) "Microchilus Spitzi Ohs. Cotype [male symbol]" (white label, handwritten and typeset), f) my paratype label. *One female paratype* at UCCC labeled: a) "Leopoldo Bulhoes Est. Goyaz Dec. 37 Dr. Nick." (white label, typeset), b) mouthparts and one egg card mounted and handwritten text that reads, "10 eggs" c) "Ohaus determ. Microchilus Spitzi Ohs. Cotype [female symbol]" (handwritten and typeset, white label), g) my paratype label. *One female paratype* at CMNC labeled: a) "BRASIL Eº São Paulo Rio Claro R. Pereira leg. Coll. Martínez Dic. 942" (handwritten, white label), b) "Microchilus lineatus Bl. [female symbol] A. Martínez Det. 1963" (handwritten and typeset, white label), c) "H. & A. HOWDEN COLLECTION ex. A. Martínez coll." (white label, typeset, with border), d) "Microchilus spitzi Ohaus det. M.E. Jameson 1998" (handwritten and type set, white label), e) my paratype label.

Holotype Male (Fig. 3). Length 7.3 mm; width at humeri 4.0 mm. COLOR: Head, pronotum, scutellum, legs, and pygidium reddish-brown; venter castaneous; elytra tan with well-defined, reddish-brown, longitudinal vittae. HEAD: *Frons* in lateral view with base and disc flat, punctate; punctures minute (base) to small (apex), moderately dense, sparsely setose; setae minute, tawny. Interocular width 6.1 transverse eye diameters. *Clypeus* in lateral view with base and disc flat, margins weakly concave; in dorsal view, apex broadly rounded, moderately reflexed. Surface densely (base) to confluently punctate (apex), punctures moderate to moderately large in size. *Mandible* with molar region and lamellae moderately developed. Apex with weakly developed ventrally produced tooth. *Labrum* at middle apex with quadrate, ventrally-produced tooth. *Maxilla* with 3 poorly defined ridges; terminal segment of palpus elongate-oval, kidney-shaped, subequal in length to segments 1-3; basistipes with length subequal to width at base.

Antenna with club 1.9 times longer than segments 2-7 combined. PRONOTUM: Surface punctate; punctures on disc minute (sparse) to small (moderately dense), punctures on base and margins dense, some setose; setae on disc minute and tawny, setae on margins moderate in length, scale-like, white. *Scutellum* with surface moderately densely punctate, punctures minute and small, some setose; setae short, scale-like, white. ELYTRON: Surface punctate, with weakly to moderately defined striae. Punctures round or ocellate, small, moderately dense, some setose; setae minute, tawny. Striae indicated by depressed, punctate line; punctures round or ocellate, small, moderately dense, some setose: 2 striae adjacent to suture (reaching apex), 4 striae on disc (reaching apex), 2 striae laterad of humerus. Intervals moderately densely punctate; punctures round or ocellate, small, moderately dense or occasionally confluent, some setose; setae minute, tawny. Striae suffused with dark reddish-brown color. *Elytral sutural length* 9.0 times length of scutellum. PYGIDIUM: Surface convex in lateral view, densely (mid-disc) to confluently punctate (margins); punctures transversely elongate, moderately large to large, some setose near margins; setae white, scale-like, short. Apical bead complete. VENTER: Mesosternum not invaginated, not forming a rounded pit. *Base of first sternite* at middle simple, not produced ventrally. *Last sternite of male* at apex with moderately deep emargination (middle of emargination subequal to 1/2 length of sternite); middle of emargination rounded. LEGS (Fig. 16, 18, 20): *Male protarsomere I* subequal in length and width (length subequal to length of protarsomere II), dorsoventrally flattened; protarsomeres II-III slightly wider than long (1.2 wider than long), dorsal surface weakly convex; protarsomere IV subequal in width and length; protarsomere V elongate (1.6 times longer than protarsomere IV), weakly flattened dorsoventrally. *Metatrochanter* with apex not produced beyond posterior border of femur. *Metatibia* lacking external carina. Inner apical spur about 1/3 length of apical spur in male. PARAMERES (Figs. 23-24): Shape asymmetrical.

Allotype Female (Fig. 4). The allotype differs from the male holotype in the following respects: Length 7.3 mm; width at humeri 3.8 mm. HEAD: Interocular width 8.4 transverse eye diameters. *Antenna* with club 1.4 times longer than segments 2-7 combined. ELYTRON: Intervals densely punctate. LEGS: *Protarsomere I* elongate (subequal in length to protarsomeres II-III), weakly dorsoventrally flattened; protarsomeres II-IV subequal in width and length, weakly dorsoventrally flattened; protarsomere V elongate (about 1.7 times longer than protarsomere IV), weakly flattened dorsoventrally. *Metatibia* lacking external carinae. Inner apical spur about 1/3 to 1/2 length of apical spur.

Paratypes (6 males, 5 females). The paratypes differ from the allotype and holotype in the following respects: Length 6.6-8.1 mm; width at humeri 3.7-4.4 mm. COLOR: Light reddish-brown to dark reddish-brown; venter castaneous; elytral vittae reddish-brown or castaneous. HEAD: *Frons* in lateral view with base and disc flat or weakly convex. Interocular width of male 6.1-8.7 transverse eye diameters; female 6.7-7.9. *Clypeus* in lateral view with base and disc weakly convex or flat. *Male antenna* with club 1.9-2.0 times longer than segments 2-7 combined. *Female antenna* with club about 1.4-1.8 times longer than segments 2-7 combined. ELYTRON: Striae suffused with castaneous or dark reddish-brown color. *Elytral sutural length* 6.8-9.8 times length of scutellum. LEGS: Male protarsomeres II-III slightly wider than long (1.2-1.3 wider than long); male protarsomere V elongate (1.5-1.7 times longer than protarsomere IV). *Female metatibia* occasionally with poorly developed, external carina near apical 1/3.

Diagnosis. *Microchilus rodmani* is separated from *M. lineatus* by the following characters: second protarsomere in the male subequal in width and length (Fig. 16) (second protarsomere elongated in male *M. lineatus* [Fig. 15]); male metatibia lacking external carinae (Fig. 18) (male of *M. lineatus* with carina near apical third [Fig. 17]); female metatibia lacking external carinae (female *M. lineatus* with carinae in basal third and near apical third); sparse, white scale-like setae on pronotum (not present in *M. lineatus*); and form of male parameres (Fig. 23-24). Additional characters separating the species are: mandible with molar region and lamellae moderately developed (poorly developed in *M. lineatus*) and labrum at middle apex with quadrate, ventrally-produced tooth (triangular, ventrally produced tooth in *M. lineatus*).

Etymology. *Microchilus rodmani* is named in honor of James Rodman, former program director at the National Science Foundation, for his enduring passion for systematics and for implementing the NSF-PEET program model that has helped address global problems associated with the biodiversity crisis by

training new systematists, monographing poorly known taxonomic groups, and disseminating biodiversity data electronically (Rodman and Cody 2003). As stated by Wheeler (2004), "a renaissance in taxonomy is impossible without visionary and courageous leadership." Rodman provided this leadership.

Distribution (Fig. 25). Central to southeastern Brazil.

Locality Data. 13 specimens examined from CMNC, UCCC, ISNB, UNSM, ZMHB. **BRAZIL** (13). GOIAS (5): Leopoldo Bulhões [Kamp Naturseite] (5). MINAS GERAIS (7): Uberaba (7). SÃO PAULO (1): Rio Clara (1).

Temporal Data. November (4), December (4).

Natural History. Unknown.

Remarks. Based on locality information, *M. lineatus* and *M. rodmani* are apparently sympatric in a portion of their range (from Uberaba south to near São Paulo).

Conclusions

As a result of this research, *Microchilus* is considered a natural group that includes *M. lineatus* and *M. rodmani* and is characterized by both claws on all legs in males and females incised (shared only with members of the *Bolax campicola* group), protibia with two external teeth, form of the fifth protarsomere that is dorsoventrally flattened and setose ventrally, and small size (less than 8.1 mm in length). Based on character examination, *Microchilus beckeri* is transferred to *Leucothyreus* (*Leucothyreus beckeri* [Martínez], new combination) and *L. bucki* Machatschke is a new junior synonym of *Leucothyreus becker*i (Martínez). Characters that support the new combination are discussed. The Geniatini catalog (Jameson and Hawkins 2005) should be updated as follows:

***MICROCHILUS* Blanchard, 1851: 240**
[Gender: Masculine] 2 species
***M. lineatus* Blanchard, 1851: 240**
BRAZIL: Minas Gerais, Paraná, São Paulo
***M. rodmani* Jameson, n. sp.**
BRAZIL: Goias, Minas Gerais, São Paulo

***LEUCOTHYREUS* Macleay, 1819: 145**
[Gender: Masculine] 164 species and subspecies
***Leucothyreus beckeri* (Martínez), 1964: 425**
Microchilus beckeri Martínez. **NEW COMBINATION**
BRAZIL: Rio Grande do Sul
Leucothyreus bucki Machatschke 1974: 143-146. **NEW SYNONYMY**

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