Four New Species of *Dicranocentrus* and *Heteromurus* from the State of Mérida, Venezuela (Collembola: Entomobryidae)[1]

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ABSTRACT

The new species *Dicranocentrus paramoense*, *D. bidentatus*, *Heteromurus* (*Heteromurtrella*) *echinatus* and *H.* (*H.*) *pruinosus* are described from specimens collected in the State of Mérida, Venezuela. A new species of each genus comes from a cloud forest near the city of Mérida and a new species of each taxon was collected in páramos northeast of Mérida. Congeneric species are phyletically very near and their closest relatives live in Central America and the West Indies. *Dicranocentrus bidentatus* is the sole species of its genus with only two teeth (the basal pair) along the inner margin of the unguis. *Heteromurus* (*Heteromurtrella*) *echinatus* is unique among members of its subgenus in possessing dental spines, although some individuals lack these structures. This is the first record of such intraspecific variation. Four tables detail variations of a number of characters and 41 figures complement the text.

INTRODUCTION

During a recent visit to Mérida, Venezuela, the author collected springtails at two ecologically very different localities. The first, Mount Serpa, is a cloud forest in the area of La Hechicera, near the city of Mérida. Several leaf litter samples were taken between 2,100 and 2,125 meters elevation and processed in berlese funnels.

A few days later collections were made at 3,535 meters on Paŕamo de Mucubají, approximately 50 km northeast of Mount Serpa and Mérida. Here, specimens were collected by removing dead leaves along the stem of *Espeletia schultzii* plants (Compositae). A visit was made to the nearby Páramo de Piedras Blancas (fig. 2) and, although no collecting was done, specimens that had been taken there earlier by Dr. Judith Najt were available for this study. Also, Dr. Alba Díaz forwarded specimens collected at Páramo de La Culata, some 20 km northeast of the city of Mérida. All the material studied remains in the author's collection.

The specimens at hand represent four new species of scaled Orcheselinae. A new *Dicranocentrus* and a new *Heteromurus* were discovered in

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the sample from Mount Serpa and a new species of each genus was discovered in the samples from the páramos. As shown below, these congeneric species are phyletically very near. Their closest relatives live in Central America and the West Indies.

DESCRIPTIONS

DICRANOCENTRUS PARAMOENSE NEW SPECIES

Length to 3.2 mm. Background color light ochre. Deep dark-blue pigment distributed over head, body and appendages as in figure 1. Head dorsally with pigment only around and between eye patches. Collophore pigmented except for tip. Live specimens appear uniformly black. Antennae about 2.4× diameter of head (table 1). Ratio lengths Ant. 5/Ant. 6 ≅ 1.2. Outer pair of labral papillae rounded, inner pair conelike (fig. 8). Differentiated seta of outer labial papilla not reaching apex of its papilla

TABLE 1.—Dicranocentrus paramoense *n. sp. Variation in some taxonomic characters*

Specimen	Length in mm.[1]	Ratio length Ant. 5/Ant. 6	Ratio length Ant./Diam. head	Unpaired Ungual teeth	Setae left/right Trochanteral organs
1	---	1.3	2.2	1	---
2	---	---	---	1–2	44/46
3	2.2	1.2	2.2	1–2	35/35
4	2.7	1.0	2.2	1	37/44
5	3.0	1.3	2.8	1	37/44
6	3.0	1.2	2.55	1	44/---
7	3.1	1.35	2.55	2	44/43
8	3.2	1.3	2.4	1	52/50

[1] Dashed lines signal missing data because the position of the specimen did not permit accurate observation. All the specimens are from Páramo de Mucabají.

(fig. 7, 9). Anterior labial row follows formula a_1–a_5. Posterior labial row to seta e with up to 10 setae of which 1–3 are smooth (fig. 10, 16); L_1 and L_2 ciliate. Setae of postlabial quadrangle (PLQ, fig. 12) smooth, long. Behind PLQ, on each side near posterior margin of head, a pair of long. smooth setae. Head macrochaetotaxy as in figure 6. A_5 present or absent (see Comments). Eyes g and h extremely reduced or absent. Inner margin of unguis with basal pair of small teeth and 1–2 distal unpaired teeth (fig. 15). Unguiculus with small basal outer tooth. Tenent hair lanceolate. Inner margin of tibiotarsi with many erect, smooth, apically pointed setae. Trochanteral organ (fig. 11) with up to 52 setae (table 1). Body macrochaetotaxy as in figure 5. Dorsum of manubrium with many scales and double row of erect smooth setae (fig. 13); pair of similar setae on proximal section of dentes. Inner margin of dentes with 2 rows of spines (fig. 17), those of inner row fewer and shorter. Mucro (fig. 14) with 2 teeth and basal spine.

Diagnosis

The species is very close to *D. bidentatus* but may be distinguished by its pigmentation, number and length of setae behind the postlabial quadrangle, ungues with unpaired teeth and the ratio length of antennae/diameter of head. The next closest relative is *D. marias* Wray 1953; known from Puerto Rico and Central America. Both species share almost identical macrochaetotaxy of head and Abd. 1-4, claw structure and the presence of rows of smooth setae along inner face of tibiotarsi. However, *D. marias* is less heavily pigmented, its Ant. 5 is approximately 2.7× longer than Ant. 6, has many more dental spines, and the chaetotaxy of Th. 2 and Th. 3 is different (see Mari Mutt 1979a). Wray's species lacks scales on the dorsum of manubrium and head macrochaetae A_5 and P1.

Dicranocentrus paramoense is superficially similar to *D. nigritus* Mari Mutt 1979a; known only from the environs of Lake Titicaca in Peru. Both possess very similar color patterns, but can be readily distinguished by the length of the antennae, various elements of the body chaetotaxy and,

TABLE 2.—Dicranocentrus bidentatus *n. sp. Variation in some taxonomic characters*

Specimen	Length in mm.	Ratio length Ant. 5/Ant. 6	Ratio length Ant./Diam. head	Unpaired Ungual teeth	Setae left/right Trochanteral organs
1	2.0	1.2	3.6	Absent	42/42
2	2.2	1.2	3.85	Absent	41/35
3	2.3	1.1	3.1	Absent	34/33

in the Peruvian species, Ant. 6 subequal to Ant. 5, eyes g and h well developed, clavate tenent hairs, tibiotarsi and manubrium devoid of smooth setae, and presence of 5 P setae on the head (Mari Mutt 1979a, 1981).

Comments

Table 1 presents the variability of some taxonomic characters. The number of setae forming the trochanteral organ increases with the length of the specimen and the number of setae on the organs of both metathoracic legs is not always equal (tables 2 and 3).

Two consistent differences occur between the specimens from Páramo de La Culata, and those of Mucubají and Piedras Blancas. The former lack head seta A_5 and their ungues are quadridentate. The latter have seta A_5 and their ungues are tridentate.

Material Examined

Venezuela, Mérida State, Páramo de Mucubají, 3,535 m, 15.vii.1981, among dead leaves of *Espeletia schultzii*, J. A. Mari Mutt and A. Díaz.

TABLE 3.—Heteromurus (Heteromurtrella) echinatus *n. sp. Variation in some taxonomic characters*

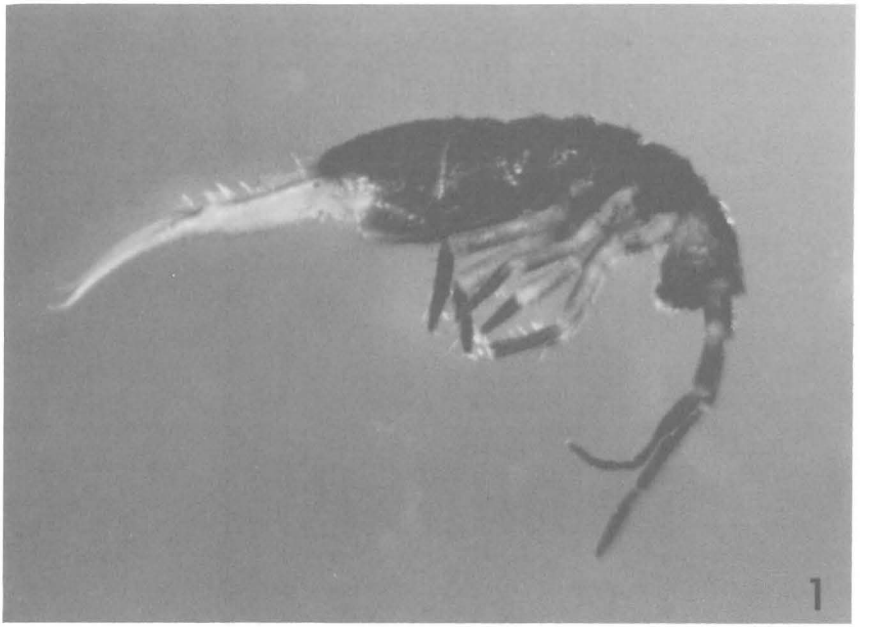
Specimen	Length in mm.	Dental spines Left/Right dens[1]	Left Labial base[2]	Right Labial base	Third seta Abd. 4	Outer labial papilla[3]	Posterior Setae head[4]	Setae left/right Trochanteral organs
1	1.25	Absent	$P_1p_3esl_1$	$P_1p_3P_5l_1$	Absent	---	2	---
2	1.3	5/5	$P_1P_2p_3P_5l_1$	$P_1P_2p_3P_5l_1$	Absent	0.25/0.20	2	16/---
3	1.4	6/---	$P_1P_2p_3P_4P_5P_6l_1$	$P_1P_2p_3P_4P_5P_6l_1$	Absent	0.33/---	2	20/---
4	1.4	5/4	$P_1p_3P_5l_1$	$P_1P_2p_3P_5l_1$	Absent	0.20/0.25	2	---/20
5	1.4	5/5	$P_1p_3P_5l_1$	$P_1p_3P_5l_1$	Present	0.20/0.20	2	20/20
6	1.45	Absent	---	---	Absent	0.50/---	---	20/---
7	1.5	7/6	$P_1P_2p_3P_4P_5l_1$	---	Absent	0.25/0.20	2	25/---
8	1.6	4/4	$P_1P_2p_3P_5l_1$	$P_1P_2p_3P_4P_5l_1$	Present	0.20/0.25	3/2	---/20
9	1.9	7/10	$P_1P_2p_3P_4P_5P_6l_1$	$esP_2p_3P_4P_5P_6l_1$	Present	R/R	3	32/34
10	2.0	8/8	---	---	Present	0.17/0.20	3	---/38

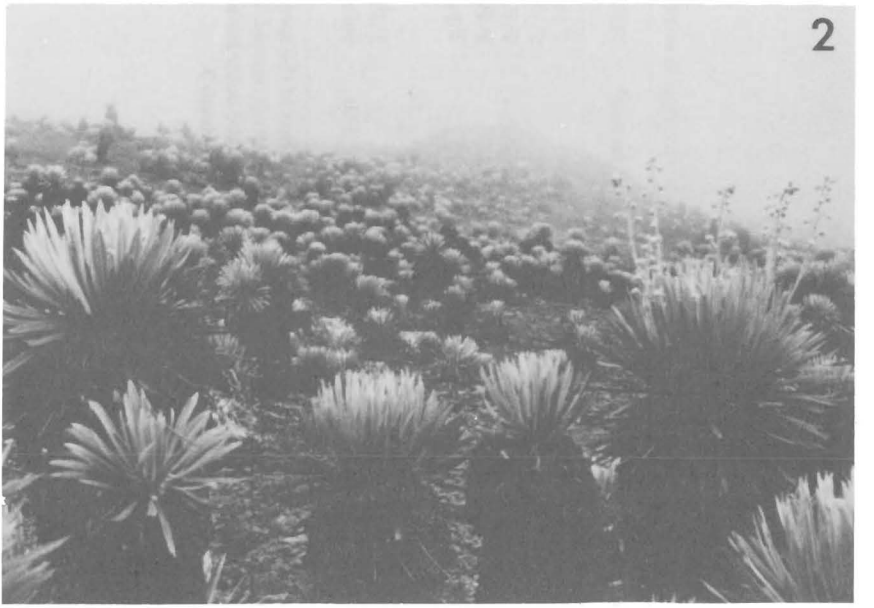
[1] Dashed lines signal missing data because the position of the specimen did not permit accurate observation.

[2] Capital letters stand for ciliate setae, lower case letters represent smooth setae. es = empty socket.

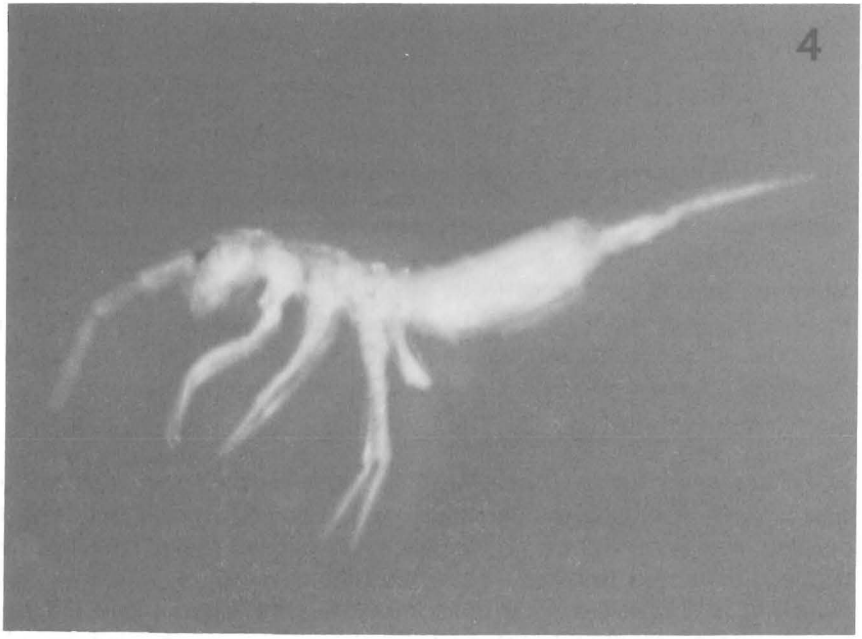
[3] Fraction of the length of the differentiated seta of the outer labial papilla. If this distance is added to the differentiated seta its tip will be level with the tip of its papilla; the latter occurs in specimen 9.

[4] Setae behind Postlabial Quadrangle, see Fig. 37.

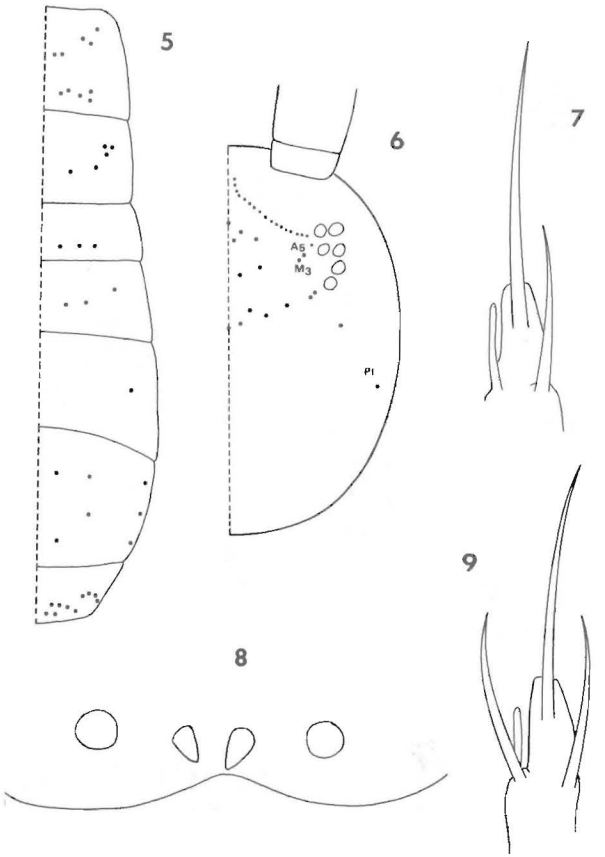




FIGS. 1-2.—1. *Dicranocentrus paramoense*. 2. *Espeletia schultzii* plants at Páramo de Piedras Blancas.



FIGS. 3–4.—3. *Dicranocentrus bidentatus*. 4. *Heteromurus* (*Heteromurtrella*) *echinatus*.



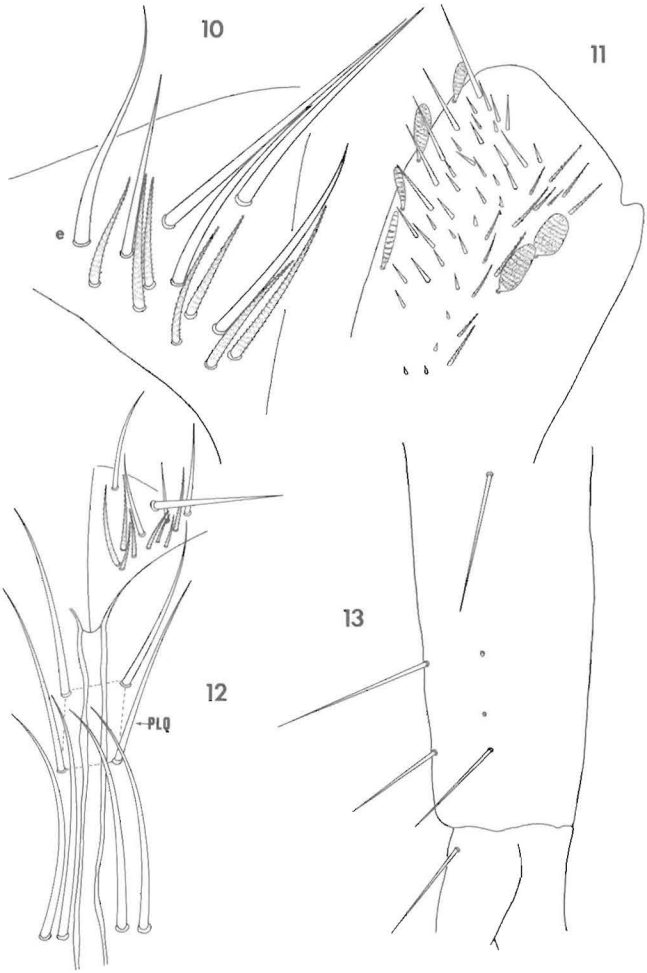
FIGS. 5–9.—*D. paramoense*. 5. Body macrochaetotaxy. 6. Head macrochaetotaxy. 7. Differentiated seta of outer labial papilla and adjacent seta. 8. Dorsal view of labral papillae. 9. Differentiated seta of outer labial papilla and two adjacent setae.

Holotype and 15 paratypes (8 in alcohol). As preceding, but Páramo Piedras Blancas, 4,070 m, 12.xi.1980, under *Espeletia* plants, J. Najt. 1 paratype. As preceding but Páramo de La Culata, 3,250 m, leaf litter of *Espeletia schultzii*, 27.xi.1980, A. Díaz, 78 paratypes (10 on slides).

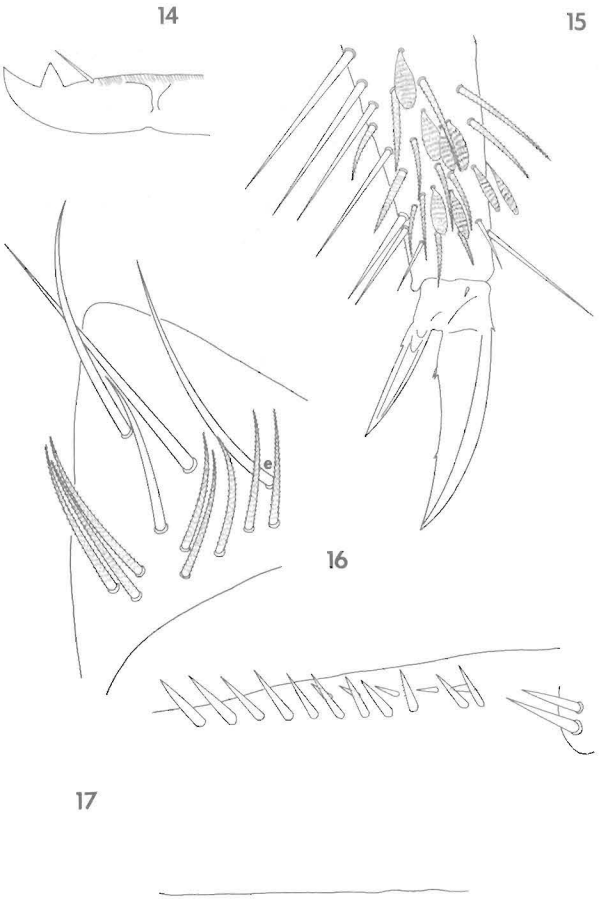
DICRANOCENTRUS BIDENTATUS NEW SPECIES

Habitus as in figure 3. Length to 2.3 mm. Background color white. Scarce dark blue pigment on thorax and abdomen. Ant. 5 and Ant. 6 deeply colored, Ant. 2–4 with pigment concentrated distally. Head with pigment restricted to eye patches, area along bases of antennae, and mouth cone. Legs with some color on all segments but pigment more heavily concentrated on tibiotarsi. Collophore lightly pigmented, furcula

white. Length of antennae about 3.5× diameter of head (table 2). Ratio lengths Ant. 5/Ant. 6, labral papillae, differentiated seta of outer labial papilla (fig. 19), formula of anterior labial row, development of eyes, body macrochaetotaxy, distribution of smooth setae on dorsum of manubrium (fig. 21), distribution of dental spines, and mucronal structure as in *D. paramoense*. Posterior labial row to seta e with up to 9 setae of which 1 is smooth (fig. 22); L_1 and L_2 ciliate. Setae of PLQ smooth. Behind PLQ, on each side near posterior margin of head, a group of 5 short, stout,



FIGS. 10-13.—*D. paramoense*. 10. Chaetotaxy of labial triangle. 11. Trochanteral organ. 12. Setae along ventral groove of head, PLQ-postlabial quadrangle. 13. Distribution of smooth setae on dorsum of manubrium.



FIGS. 14–17.—*D. paramoense*. 14. Mucro. 15. Metathoracic claws and some of the smooth setae along inner margin of tibiotarsus. 16. Chaetotaxy of labial triangle, compare with Fig. 10. 17. Dental spines.

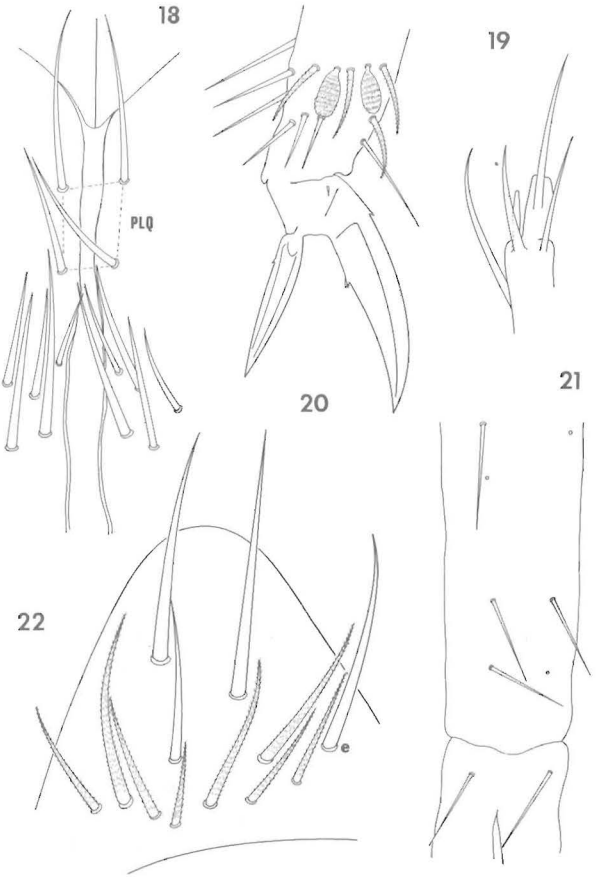
smooth setae (fig. 18). Head macrochaetotaxy as in *D. paramoense*, A_5 absent. Inner margin of unguis with basal pair of small teeth (fig. 20). Unguiculus with small basal outer tooth. Tenent hair thin, lanceolate. Trochanteral organ with up to 42 setae (table 2). Dorsum of manubrium with many scales.

Diagnosis

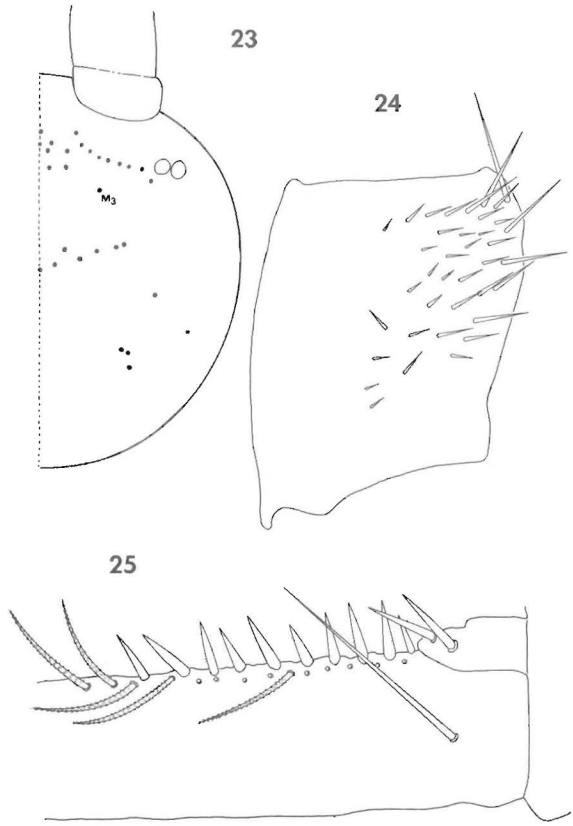
The species is most closely related to *D. paramoense*; see the latter's diagnosis for a list of differences between both species. A more distant relative is *D. marias* Wray 1953; both species share similar pigmentation,

head and abdominal macrochaetotaxy and presence of smooth setae along inner face of tibiotarsi. However, Wray's species has Ant. 5 approximately 2.7× longer than Ant. 6, eyes g and h are reduced but still clearly visible, head macrochaeta P1 is absent, the ungues are tridentate, and scales are absent from the manubrium.

Dicranocentrus bidentatus is the sole species of the genus with only the basal pair of teeth along the inner surface of the unguis. *D. pilosus* Mari Mutt 1980 (see Mari Mutt and Bhattacharjee 1980) altogether lacks teeth in this region and all the other species have 1–2 unpaired teeth distal to the basal pair.



FIGS. 18–22.—*D. bidentatus*. 18. Setae along ventral groove of head, compare with Fig. 12. 19. Differentiated seta of outer labial papilla and three adjacent setae. 20. Metathoracic claws and some of the smooth setae along inner margin of tibiotarsus. 21. Distribution of smooth setae on dorsum of manubrium.



FIGS. 23–25.—*H. echinatus*. 23. Head macrochaetotaxy. 24. Trochanteral organ. 25. Dental spines.

Comments

Table 2 details the variability of some taxonomic characters as observed in the few specimens available. Compare with the data in table 1 the ratio length of antennae/diameter of head and the number of unpaired ungual teeth.

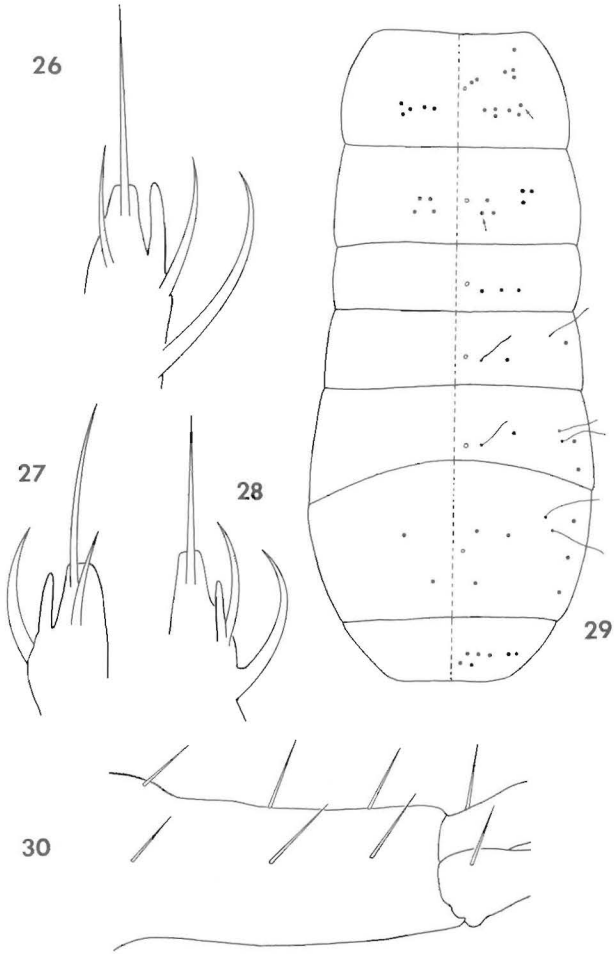
Material Examined

Venezuela, Mérida State, Mt. Serpa (cloud forest near La Hechicera campus of the University of the Andes), 2,100–2,125 m, 11.vii.1981, leaf litter, J. A. Mari Mutt and J. Najt. Holotype and 9 paratypes (6 in alcohol, 5 are immatures).

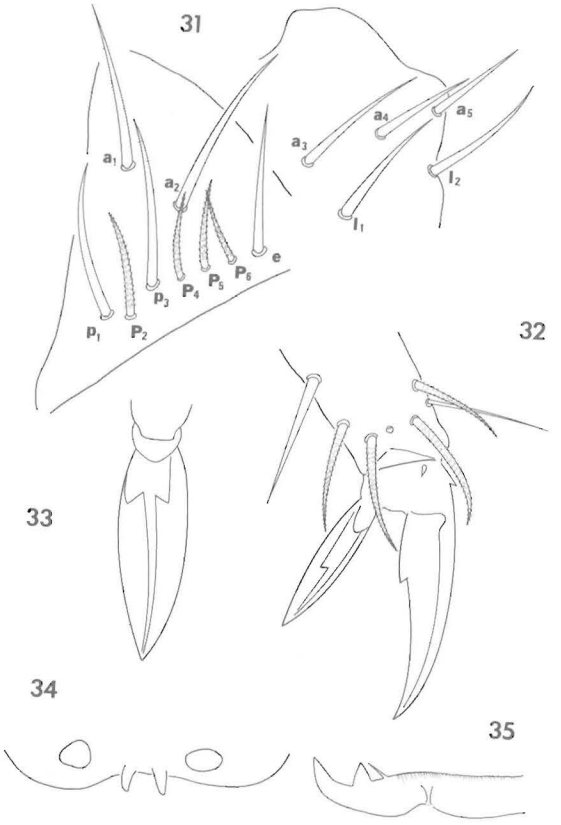
HETEROMURUS (*HETEROMURTRELLA*) *ECHINATUS* NEW SPECIES

Length to 2.0 mm. Background color white (fig. 4). Antennae (especially Ant. 4 and Ant. 5) with dark pigment. Eye patches black. Head and all

body segments more or less evenly covered with pigment ranging in intensity from light salmon ochre to olive green. Precoxae and coxae lightly colored. Manubrium with some pigment along proximal ventral portion. Collophore white. Live specimens appear uniformly white. Labral papillae as in figure 34, outer pair appears domelike in frontal view (fig.



FIGS. 26-30.—*H. echinatus*. 26. Differentiated seta of outer labial papilla and some adjacent setae. 29. Body macrochaetotaxy; circles represent pseudopores, the innermost anterior seta of Abd. 4 is the "third seta Abd. 4" of tables 3 and 4. Left side is a composite of variation observed in three specimens. Arrows on right half point to setae absent in a specimen of *H. pruinosus* from Piedras Blancas. 30. Distribution of smooth setae on dorsum of manubrium.



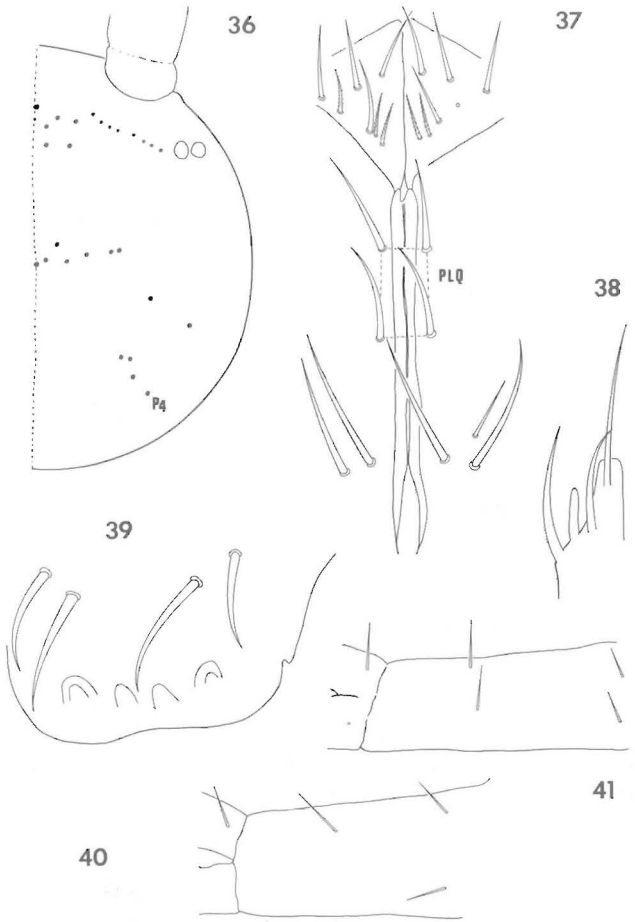
FIGS. 31–35.—*H. echinatus*. 31. Labial chaetotaxy, see tables 3 and 4. 32. Metathoracic claws. 33. Ventral view of unguis detailing size and position of inner pair of teeth. 34. Dorsal aspect of labral papillae. 35. Mucro.

39). Distance between apex of differentiated seta of outer labial papilla and apex of its papilla variable (fig. 26–28, table 3). Anterior labial row follows formula a_1–a_5 (fig. 31). Posterior labial row to seta e with variable number of ciliate setae (table 3 and Comments); p_3, l_1 and l_2 smooth. Setae of postlabial quadrangle smooth. Behind PLQ, on each side near posterior margin of head, 2 long and occasionally 1 short smooth setae (fig. 37, table 3). Head macrochaetotaxy as in figure 23; M_3 present, P_4 (fig. 36) absent. Eyes 2 + 2. Inner margin of unguis with 2 large teeth (fig. 32, 33). Unguiculus with large outer tooth. Tenent hair lanceolate. Metathoracic tibiotarsi with smooth seta opposite tenent hair; other setae in all tibiotarsi ciliate. Trochanteral organ with up to 38 setae (fig. 24, table 3). Body macrochaetotaxy as in figure 29 (see table 3 and Comments).

Dorsum of manubrium with scales and double row of 3 smooth setae (fig. 30); pair of similar setae on proximal section of dentes. Inner margin of dentes with up to 10 spines (fig. 25, table 3 and Comments). Mucro (fig. 35) with 2 teeth and basal spine.

Diagnosis

The species is very close to *H. pruinosus*, but a number of characters distinguish both species. In *H. echinatus* head macrochaeta M_3 is present



FIGS. 36–41.—Fig. 36, 38, 40, 41- *H. pruinosus*. Fig. 37, 39- *H. echinatus*. 36. Head macrochaetotaxy. 37. Setae along ventral groove of head. 38. Differentiated seta of outer labial papilla and two adjacent setae. 39. Anterior view of labral papillae and distal row of labral setae. 40–41. Distribution of smooth setae on dorsum of manubrium.

and P_4 is absent, dorsum of manubrium bears two rows of 3 smooth setae each, dental spines are present (see comments below), labial seta l_1 is always smooth and the differentiated seta of the outer labial papilla is somewhat shorter (tables 3 and 4).

Heteromurus echinatus is also close to *H. puertoricensis* Mari Mutt 1979b. Both species have the same head and body macrochaetotaxy, but the Puerto Rican species has tri- or quadridentate ungues, 4 smooth setae in each manubrial row, fewer setae on the labial triangle, and dental spines are always absent.

Comments

Table 3 shows variation of several taxonomic characters. Note changes in labial chaetotaxy, but also note that seta l_1 is always smooth and that setae P_1 and P_2 do not switch positions as it happens in *H. pruinosus* (table 4).

TABLE 4.—Heteromurus (Heteromurtrella) pruinosus *n. sp. Variation in some taxonomic characters*

Specimen	Length in mm.[1]	Left Labial base[1]	Right Labial base	Third seta Abd. 4	Outer labial papilla[1]	Posterior setae head[1]
1	---	$p_1P_2p_3P_4P_5l_1$	$P_1P_2p_3P_4P_5L_1$	---	---/0.5	3
2	1.0	$p_1p_3L_1$	$P_1p_3L_1$	Present	0.5/0.5	---
3	1.3	$P_2P_1esP_5l_1$	$P_1P_2p_3P_5l_4$	Present	0.5/0.5	3
4	1.5	$p_0P_2P_1p_3esL_1$	$P_1P_2p_3P_5L_1$	Present	0.3/0.3	2/3
5	1.6	$P_1P_2p_3esl_1$	$esP_2p_3P_5L_1$	Absent	---/0.5	3/2
6	1.6	---	---	Present	---	3
7	1.6	$P_1P_2p_3P_5es$	$P_1P_2p_3P_5L_1$	Absent	---	---
8	1.7	$P_1p_3P_4P_5l_1$	$P_1p_3P_5L_1$	Present	0.5/0.5	---
9[2]	1.5	$p_2P_1p_3P_5l_1$	$P_2P_1p_3P_5l_1$	---	0.5/0.5	---
10[2]	1.3	---	$p_0P_1p_3P_5L_1$	Absent	---	3

[1] See Table 3 for the corresponding explanations.
[2] Specimens for Piedras Blancas.

Table 3 also shows that two specimens lack dental spines. Presence or absence of these spines has been used to define genera of Entomobryidae although *Dicranocentrus* houses species which have and species which lack, such structures. Presence or absence of dental spines within a species was, however, heretofore unrecorded. In an attempt to determine whether the absence of spines in these two specimens is abnormal or due to acquisition of spines during postembryonic development, ten additional specimens were mounted for a study of the furcula. Dental spines were seen in only one individual, but these specimens did not clear properly and it is impossible to state definitely that spines are absent in all the others. All 10 specimens measured less than 1.4 mm.

The occurrence of dental spines in the new species suggests that it be placed in the subgenus *Alloscopus*. Members of that taxon, however, lack the P group of head macrochaetae (Mari Mutt 1979c, 1980). Since dental spines have originated repeatedly among the Entomobryidae, it is preferable to assign more importance to head chaetotaxy and keep *H. echinatus* within the subgenus *Heteromurtrella*.

The left side of figure 29 shows the variation in body macrochaetotaxy observed in three specimens; one lacks a seta on Th. 2, the other on Th. 3 and the third on Abd. 4.

Material Examined

The specimens bear the same collection data as those of *Dicranocentrus bidentatus*. The holotype and 9 paratypes are on slides and 55 paratypes are in alcohol (ten of the latter were mounted temporarily).

HETEROMURUS (*HETEROMURTRELLA*) *PRUINOSUS* NEW SPECIES

Length to 1.7 mm. Pigmentation, labral papillae, formula of anterior labial row, setae along ventral cephalic groove, number of eyes, claw structure, tenent hair, tibiotarsal chaetotaxy, body macrochaetotaxy, trochanteral organ and mucronal structure as in *H. echinatus*. Differentiated seta of outer labial papilla not reaching apex of its papilla by approximately 0.5× of seta's length (fig. 38, table 4). Posterior labial row to seta e with variable number of ciliate setae (table 4); p_3 and l_2 smooth, l_1 smooth or ciliate. Head macrochaetotaxy as in figure 36. M_3 (fig. 23) absent, P_4 present. Dorsum of manubrium with scales and double row of 2 erect smooth setae (fig. 40, 41); pair of similar setae on proximal portion of dentes. Dental spines absent.

Diagnosis

The species is a very close ally of *H. echinatus* and the latter's diagnosis lists the differences between both. Also closely related is *H. puertoricensis* Mari Mutt, but in this species head macrochaeta M_3 is present and P_4 is absent, the ungues are tri- or quadridentate, and there are 4 smooth setae on each manubrial row.

Comments

Table 4 presents the variability of some taxonomic characters. Note that labial seta l_1 may be smooth or ciliate and that setae P_1 and P_2 (which can be distinguished by their lengths, fig. 31) sometimes switch positions. In a few specimens a small smooth seta (p_0) was observed some distance in front of P_1.

Note also the variation in the presence of a third seta on Abd. 4, and in the number of smooth setae behind the postlabial quadrangle. The

usual number of setae behind the PLQ is three in this species and two in *H. echinatus.*

The arrows on the right side of figure 29 point to setae absent in a specimen from Piedras Blancas.

Material Examined

The specimens were taken at the first two localities listed for *Dicranocentrus paramoense.* The holotype and eight paratypes from Mucubají are mounted on slides. The three paratypes from Piedras Blancas are on slides.

RESUMEN

Las nuevas especies *Dicranocentrus paramoense, D. bidentatus, Heteromurus (Heteromurtrella) echinatus* y *H. (H.) pruinosus* se describen a base de ejemplares colectados en el Estado de Mérida, Venezuela. Una especie de cada género proviene de una selva nublosa cerca de la ciudad de Mérida y una especie de cada taxón fue encontrada en páramos al noreste de Mérida. Las especies del mismo género están estrechamente relacionadas y sus parientes más cercanos viven en Centroamérica y las Indias Occidentales. *Dicranocentrus bidentatus* es la única especie de ese género con solo dos dientes (el par basal) en el margen interno de la uña. *Heteromurus (Heteromurtrella) echinatus* es peculiar entre los miembros de su subgénero porque presenta espinas en los dentes; aunque algunos individuos no tienen espinas, ésta es la primera vez que se informa tal variación intraspecífica. Se incluyen cuatro cuadros que detallan la variación de algunos caracteres y 41 figuras complementan el texto.

LITERATURE CITED

Mari Mutt, J. A., 1979a. A revision of the genus *Dicranocentrus* Schött (Insecta: Collembola: Entomobryidae). Agric. Exp. Stn. Univ. P.R. Bull. 259, 79 p.

Mari Mutt, J. A., 1979b. *Heteromurtrella,* a new tropical subgenus of *Heteromurus* with descriptions of two new species (Insecta: Collembola: Entomobryidae). J. Agric. Univ. P.R., 63 (2): 214–22.

Mari Mutt, J. A., 1979c. The taxonomic status of *Alloscopus* and redescriptions of its two species (Collembola: Entomobryidae). Pan-Pac. Entomol. 57 (4): 241–49.

Mari Mutt, J. A., 1980. A classification of the Orchesellinae with a key to the tribes, genera and subgenera (Collembola: Entomobryidae). Ann. Entomol. Soc. Am. 73 (4): 455–59.

Mari Mutt, J. A., 1981. New genus, a new species, and complements to the descriptions of seven Neotropical *Dicranocentrus* (Collembola: Entomobryidae: Orchesellinae), J. Agric. Univ. P.R., 65 (2): 90–107.

Mari Mutt, J. A. and R. K. Bhattacharjee, 1980. Four new species of *Dicranocentrus* from northeast India and Nepal (Collembola: Entomobryidae: Orchesellinae). Pac. Insects 22 (1–2): 162–70.

Wray, D. L., 1953. New Collembola from Puerto Rico, J. Agric. Univ. P.R., 37 (2): 140–50.