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Heterotardigrada of Venezuela (Tardigrada)

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About 100 species of tardigrades are known from South America from the countries of Argentina, Bolivia, Brazil, Chile, Columbia, and Paraguay (Ramazzotti, 1972). In 1979 tardigrades were collected primarily in mosses and lichens from 10 sites in the northwestern section of Venezuela. The area collected represents only one-third of the country but over 20 species were identified in the class Eutardigrada and 14 in the Heterotardigrada. Only Brazil shows a larger species representation in the literature.

The Heterotardigrada found in Venezuela includes species in *Oreella, Mopsechiniscus, Bryodelphax, Echiniscus,* and *Pseudechiniscus.* Of the 14 species, five are new—one species each of *Oreella* and *Bryodelphax,* and three species of *Echiniscus* in the arctomys complex. Holotypes are deposited at the University of California, Davis, and voucher specimens at the University of Zulia, Maracaibo.

MATERIALS AND METHODS

Mosses, lichens, and liverworts were removed from various plant and mineral substrates, placed in paper bags, and air dried—at times with artificial heat. Specimens were processed in the United States and prepared for light microscopy and scanning electron microscopy as indicated in Horning, Schuster and Grigarick (1978). One or more species of Heterotardigrada were collected from the following sites:

El Tucuco, Zulia. VI-24-79. Tropical forest in foothills of Sierra De Perija, bordering a grassland biome, alt. 700 m, precipitation 2000 mm.

La Carbonera, Merida. VI-30-79. Subtropical cloud forest in Sierra Nevada range of Andes, alt. 2000 m, precipitation 1800 mm.

Merida, Merida. VII-3-79. Sierra Nevada range of Andes, alt. 1627 m, precipitation 1800 mm.

La Mucuy, Merida. VII-4-79. Sierra De St. Domingo range of Andes, alt. 1800 m, precipitation 1800 mm.

Barrancas, Barinas. VII-6-79. Foothills of Sierra De St. Domingo range and edge of Llanos Planes, alt. 200 m, precipitation 1280 mm.

Yacambu, Lara. VII-9-79. Subtropical rainforest, alt. 1500 m, precipitation 1300 mm.

Rancho Grande, Aragua. VII-14-79. Tropical rainforest, alt. 1130 m, precipitation 1720 mm.

Tardigrades in the class Heterogardigrada are recognized by the presence of a lateral clava and cirrus between the head and scapular segments. Both families, Echiniscidae and Oreellidae, of the Order Echiniscoidea occur in Venezuela.

The Echiniscidae typically have five transverse segments, designated by letters A through E, also referred to as the head (A), scapular (B) and terminal (E) segments. Median plates are numbered from anterior to posterior. Lateral spines occur at the post-lateral angles of the transverse segments and bear the same letter. Dorsal spines are identified by the segment letter and superscript "d." *Pseudechiniscus* has an additional segment (pseudosegmental plate) between segments D and E. The following keys will distinguish the taxa found in this study.

Key to Families and Genera

1. Dorsum without distinct plates ..... Oreellidae—*Oreella*
– Dorsum with distinct plates ..... Echiniscidae—2
2. Head without buccal cirri ..... *Mopsechiniscus*
– Head with buccal cirri 3
3. Pseudosegmental plate present ..... *Pseudechiniscus*
– Pseudosegmental plate absent 4
4. Median plates 1 and 2 transversely divided ..... *Bryodelphax*
– Median plates 1 and 2 not divided ..... *Echiniscus*

Key to *Pseudechiniscus*

1. Posterior margin of pseudosegmental plate with two spines or lobes; granulation large (0.7–1.25 μm); cuticle without pores ..... *P. novaezeelandiae* (Richters)
– Posterior margin of pseudosegmental plate without spines or lobes; granulation small (0.5–0.8 μm); cuticle with pores ..*P. suillus facettalis* Peterson

Key to *Echiniscus*

1. Lateral spines present only on plate A (cirrus A) 2
– Lateral spines present on plate A and one or more other plates 6
2. Cuticle not green 3
– Cuticle green 5
3. Cuticle of dorsal plates consists of pores (light spots) and granules (dark spots); spines smooth 4
– Cuticle of dorsal plates consists of pores only; E spines barbed dorsally and sometimes ventrally ..... *E. angolensis* da Cunha and Ribeiro
4. Some dorsal or lateral spines as long as spine E; legs II and III without minute spine ..... *E. virginicus* Riggin
– Dorsal and/or lateral spines shorter than spine E; legs II and III with minute spines ..... *E. perarmatus* Murray
5. Cuticle of dorsal plates with pores ..... *E. viridissimus* Péterfi
– Cuticle of dorsal plates without pores .....*E. viridus* Murray
6. Cuticle of dorsal plates with pores (light spots only) 7
– Cuticle of dorsal plates with pores (light spots) and granules (dark spots) 8
7. Scapular and terminal plates with longitudinal and transverse bands lacking pores ..... *E. kofordi* Schuster and Grigarick
– Scapular and terminal plates without such bands ..... *E. mosaicus* Grigarick, Schuster, and Nelson, n. sp.
8. Cuticle of dorsal plates with regularly distributed pores; anterior margins

of plates C and D with pores .....
..... *E. aliquantillus* Grigarick, Schuster, and Nelson, n. sp.
– Cuticle of dorsal plates with irregularly distributed pores; anterior margins of plates C and D without pores .....
..... *E. marginoporus* Grigarick, Schuster, and Nelson, n. sp.

Genus *Oreella* Murray, 1910

The genus *Oreella* is in the family Oreellidae. It is distinguished from the other genera in the family, which are aquatic, by its indistinctly eight-segmented body lacking dorsal plates and by the presence of a short median caudal projection. According to the diagnostic characters of the genus (Ramazzotti, 1972:136), the claws are not spurred; however, the inner claws of the New Zealand specimens (Horning *et al.,* 1978) of *Oreella minor* Ramazzotti do have spurs, as does the single specimen of *Oreella* from Venezuela.

Oreella breviclava Grigarick, Schuster, and Nelson, New Species
(Figs. 1, 2)

Holotype female.—Length excluding legs IV, 174 μm; including legs IV, 191 μm; width, 81 μm. No eyes. Cuticle colorless, with very fine granulation over entire surface; small hemispheric tubercles visible along margins of cuticle, present on dorsal and lateral cuticle; short, median, conical, caudal papilla between legs IV. Head with acuminate buccal cirri; internal cirrus 10 μm long; external cirrus, 14 μm long; buccal papilla 5.7 μm long by 2 μm wide. Cirrus A, 19 μm long; clava short, 5 μm long by 2 μm wide. Leg I apparently without spine; papilla on leg IV 2 μm long by 1 μm wide; without dentate fringe on legs IV. Strong spurs on internal claws of all legs; claws 10 μm long.

Etymology.—Latin: *brevi,* short; *clava,* for the short clava.

Discussion.—A single specimen was collected from one locality in Venezuela. It is very similar to *Oreella minor* but differs in the following respects: relative lengths of the internal and external cirri, the presence of buccal papillae, claw length, the absence of a spine on leg I, and the length of the clava. The internal cirrus is half the length of the external in *O. minor,* but greater than half the length (⅔) in the Venezuelan specimen. In his illustration of *O. minor* from Chile, Ramazzotti (1964) omitted the buccal papillae because he was unable to detect them on the eight specimens he studied; our specimen has distinct buccal papillae. The claws of *O. minor* are smaller (3–4 μm) than those of our specimen (10 μm). An obvious spine is present on leg I of *O. minor*; no such spine is apparent on our specimen. Ramazzotti (1972) suggested that specimens with long, more or less curved clavae (11–18 μm) are probably males of *O. minor,* while those with short straight clavae (3.5–5 μm) are females, corresponding to the hypothesis for *Halechiniscus* proposed by Richters (1909) and Schulz (1955). The specimen from Venezuela is a female based on the structure of the gonopore, and therefore may actually be *O. minor* if Ramazzotti's hypothesis is correct.

Another species, *Oreella vilucensis* Rahm, was described from Chile. This species is characterized by the presence of two lateral conical spines and the absence of clavae, which, if correct, would be unique in the Echiniscoidea.

A third species, *Oreella mollis* Murray, is a larger species that has a long thin

clava, very long cirri A, no fine granulation (although it may have been overlooked), marked body segmentation, and internal claws without spurs.

Distribution.—Holotype, La Carbonera, 1 specimen.

Genus *Mopsechiniscus* du Bois-Reymond Marcus, 1944

The genus *Mopsechiniscus* in the family Echiniscidae is characterized by the absence of the buccal cirri and the presence of two lateral oval cephalic structures and a small median process dorsal to the buccal aperture. Two species have been reported from South America: *Mopsechiniscus imberbis* (Richters) from Chile and Brazil; *Mopsechiniscus granulosus* Mihelčič from the Andes in Argentina.

Mopsechiniscus imberbis (Richters), 1907
(Figs. 3–5)

Our specimens illustrate a wide range of variability in the presence and lengths of the spines and filaments. Ramazzotti (1972) reported variations found in three populations of *M. imberbis,* from South Georgia, Brazil and Chile. The South Georgia specimens have lateral C spines and D filaments; the Brazilian, with C spines only (sometimes missing); and the Chilean, with lateral C and D filaments and sometimes small B spines. Our specimens have a combination of no spines; lateral spines at D only or C and D; short lateral spines at C and D and a strong spine at the posterior margin of the pseudosegmental plate; or strong or short spines only on the pseudosegmental plate. A single larva has dorsal spines at the posterior margins of median plates 1 and 2 and the pseudosegmental plate. In general, the number and length of the spines decrease with an increase in the body length of the animal. The opposite situation occurs in other armored tardigrades such as *Echiniscus* and *Pseudechiniscus.* Our specimens also have spurs at the base of the inner claws on all legs, but they are much less developed on legs I–III. The cuticle is ornamented with irregular-sized raised dark granules.

The cuticle of *Mopsechiniscus granulosus* is ornamented, according to Mihelčič (1967), *inside* the cuticle itself, not on the surface. There are short B spines, long lateral C and D filaments, and the caudal margin of the pseudosegmental plate has two lobes bearing a distal spine.

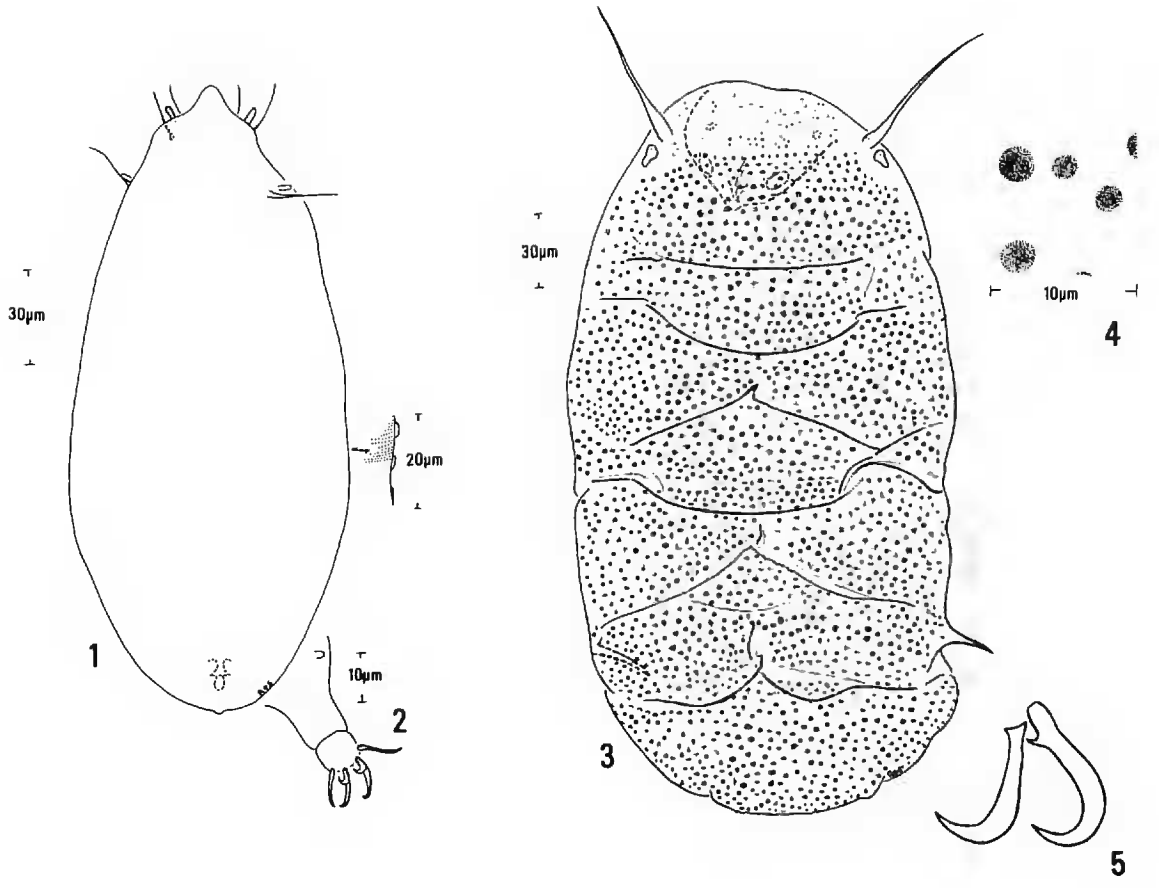
Distribution.—La Carbonera, 5 specimens; Merida, 1.

Genus *Pseudechiniscus* Thulin, 1911

The genus *Pseudechiniscus* in the family Echiniscidae is characterized by the presence of a transverse pseudosegmental plate between the second paired plates (D) and the terminal plate. Six species have been reported from South America from Chile, Bolivia, Argentina, Brazil, and Columbia. The two species collected in Venezuela were recovered from samples at four of the seven areas heterotardigrades were found. Most of the collections were made in the higher mountainous areas of the Andes.

Pseudechiniscus novaezeelandiae (Richters), 1908
(Figs. 6–8)

Our specimens agree with the description in Ramazzotti's monograph (1972), and with specimens from New Zealand in our collection. The cuticular granulation



Figs. 1–11. 1, 2. *Oreella breviclava.* 1, dorsal aspect; 2, detail of legs and claws IV. 3–5. *Mopsechiniscus imberbis.* 3, dorsal aspect; 4, cuticle of scapular plate; 5, exterior and interior claws leg IV. 6–8. *Pseudechiniscus novaezeelandiae.* 6, dorsal aspect; 7, cuticle of scapular plate; 8, exterior and interior claws leg IV. 9–11. *Pseudechiniscus suillus facettalis.* 9, dorsal aspect; 10, cuticle of scapular plate; 11, exterior and interior claws leg IV.

is coarser than on *Pseudechiniscus s. facettalis.* The granules are larger on the interior margin of the scapular plate, median plates 1 and 2 and the anterior halves of the paired plates. Two spines, variable in size, are usually, but not always, present on the posterior margin of the pseudosegmental plate. A thin basal spur is present on the inner claw of all legs.

Discussion.—Pseudechiniscus n. novaezeelandiae has been previously reported

in South America from Brazil, Columbia and Argentina. It is difficult to distinguish from the subspecies *P. n. marinae* Barros and *P. pseudoconifer* Ramazzotti and according to Ramazzotti (1972), the specimens from Brazil identified as *P. n. marinae* by Barros were probably *P. pseudoconifer*. The cuticular granule size and absence of cuticular pores are useful in separating *P. n. novaezeelandiae* from *P. s. facettalis*.

Distribution.—La Mucuy, 26 specimens; Merida, 13; Barrancas, 1; La Carbonera, 5.

Pseudechiniscus suillus facettalis **Petersen, 1951**
(Figs. 9–11)

Our specimens agree with the description in Ramazzotti's monograph (1972). The terminal plate is faceted, and there is a tiny spur at the base of the inner claws on all legs. The cuticle has a fine granulation with ridged areas of thickened cuticle; a few pores are scattered irregularly in the cuticle.

Discussion.—The *suillus* group includes *Pseudechiniscus suillus facettalis* Petersen and *Pseudechiniscus suillus franciscae* Barros. The nominate subspecies is known from five South American countries. The subspecies *P. s. facettalis* has been reported from Tierra del Fuego (Ramazzotti, 1972). Originally described from Brazil, *P. s. franciscae* differs from our specimens by the presence of smooth cuticle between the plates and the absence of spurs on all claws. A similar species, *Pseudechiniscus juanitae* Barros, also described from Brazil, has "large" granules, especially on the pseudosegmental plate and the terminal plate (Barros, 1939).

Distribution.—La Mucuy, 31 specimens; Merida, 39; Barrancas, 1; La Carbonera, 6.

Genus *Bryodelphax* Thulin, 1928

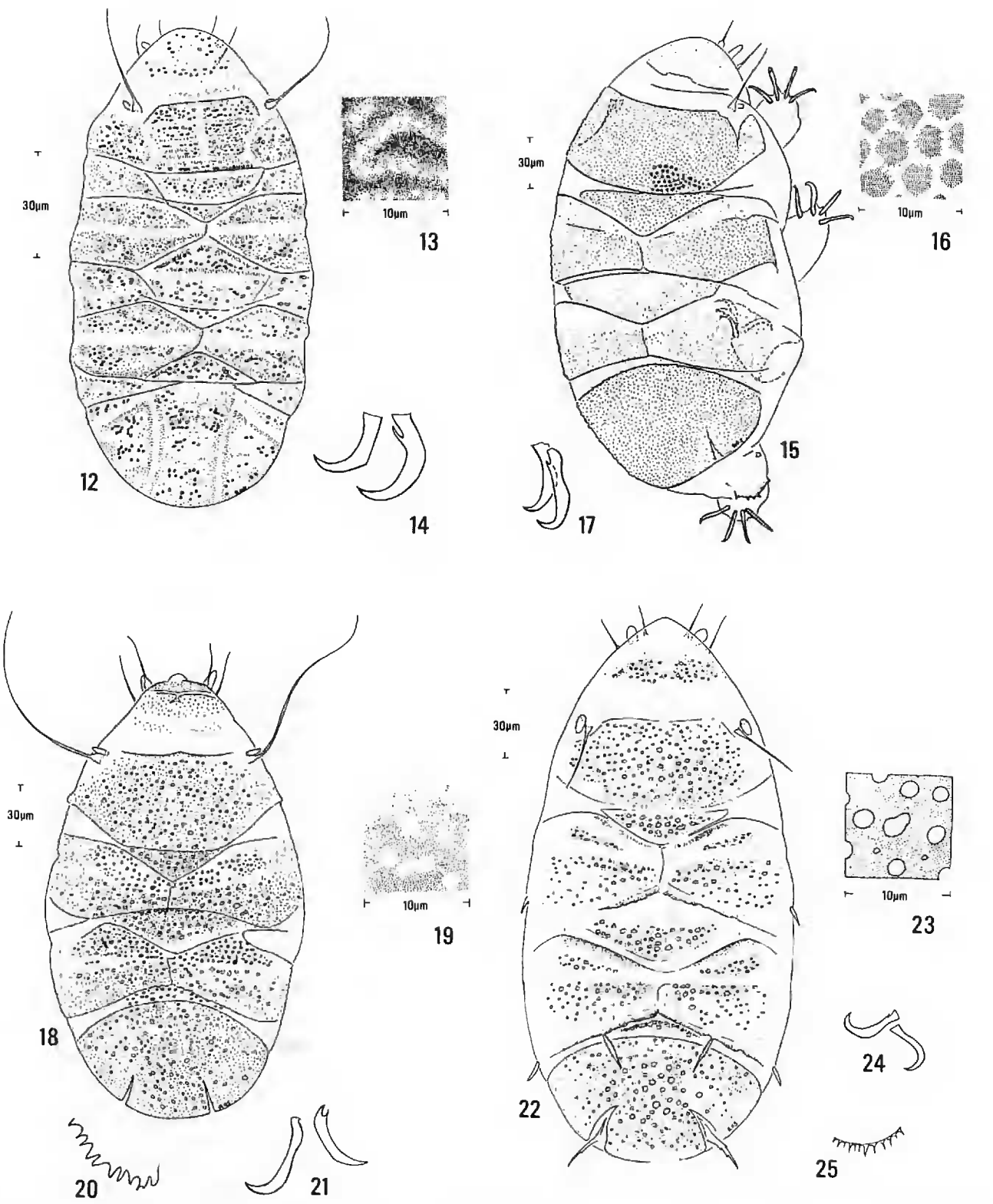
The genus *Bryodelphax* is in the family Echiniscidae. *Bryodelphax* is distinguished from other genera in the family by the transverse division of the first and second median plates with the third median plate undivided and highly developed; in addition, the terminal plate lacks the two notches along the posterior margin.

Bryodelphax crossotus **Grigarick, Schuster, and Nelson,** NEW SPECIES
(Figs. 12–14)

Holotype female.—Length excluding legs IV, 135 μm. Cuticle colorless, with granulation and pores on all plates, forming indistinct ridges on scapular and terminal plates. Median plates 1 and 2 divided, median plate 3 undivided, triangular in shape. Head with acuminate buccal cirri internal cirrus 5 μm long, external cirrus, 10 μm long; buccal papilla 2 μm long by 1.9 μm wide. Cirrus A, 30 μm long; clava, 2.5 μm long by 1.9 μm wide. No apparent spine on leg I; papilla on leg IV, 4.8 μm long by 2.8 μm wide; non-dentate fringe on leg IV, thickened irregular, almost scalloped edge, granulate above. Claws 8 μm long; inner claws with spurs at base on all legs; all legs microgranulate.

Etymology.—Greek: *krossotus*, fringed, for the non-dentate fringe on legs IV.

Discussion.—*Bryodelphax ortholineatus* Bartos, *B. parvulus* Thulin and *B. dominicanus* Schuster & Toftner are species from South or Central America that have the dorsal collar of leg IV with a smooth distal margin. This margin is somewhat irregular on *B. crossotus* but not dentate. The cuticles of *ortholineatus*



Figs. 12–25. 12–14. *Bryodelphax crossotus.* 12, dorsal aspect; 13, cuticle of scapular plate; 14, claws of leg IV. 15–17. *Echiniscus viridis.* 15, dorsal aspect; 16, cuticle of scapular plate; 17, claws leg IV. 18–21. *Echiniscus viridissimus.* 18, dorsal aspect; 19, cuticle of scapular plate; 20, dorsal denticles leg IV; 21, claws leg IV. 22–25. *Echiniscus augolensis.* 22, dorsal aspect; 23, cuticle of scapular plate; 24, claws leg IV; 25, dorsal denticles leg IV.

and *parvulus* and the shape of the median plates are different from *crossotus.* This species is similar to *dominicanus* but the cuticle does not have the large depressions (fossae) of *dominicanus.*

Distribution.—Holotype, Rancho Grande; paratypes: El Tucuco, 13 specimens; Rancho Grande, 1.

Genus *Echiniscus* C. A. S. Schultze, 1840

The genus *Echiniscus* is in the family Echiniscidae Thulin, 1928. *Echiniscus* is distinguished from the other genera by undivided median plates 1, 2, and 3, and

by the presence of notches along the posterior margin of the terminal plate. In Ramazzotti's key (1972), species of *Echiniscus* are grouped according to Marcus: the groups *arctomys, spinulosus, scrofa, blumi, trisetosus,* and *biunguis.* The *arctomys* group consists of the species of *Echiniscus* that have no lateral appendages other than cirrus A, although dorsal appendages may be present. The other groups are distinguished by the number and type (spine, filament) of lateral appendages. Nine species of *Echiniscus* were collected in Venezuela, three of which are new species in the *arctomys* group.

Echiniscus viridis Murray, 1910
(Figs. 15–17)

Our specimen fits the description in Ramazzotti's monograph (1972). Cirrus A is 38 μm long. The cuticle is green and ornamented with clusters of small dark green granules which form slight tubercles which appear as dark spots. A minute basal spur is present on the inner claws of all legs. The dentate fringe has short uneven spines with very irregular spacing in between the spines; the arrangement of these dorsal leg spines is very distinctive and unique in the species complex.

Discussion.—*Echiniscus viridis,* known from Brazil, is one of four described species in the *viridis* complex. The complex consists of green *Echiniscus* with no lateral or dorsal appendages other than cirrus A. *Echiniscus perviridis* Ramazzotti has a pattern of raised granules similar to that of *E. viridis*; however cirri A are up to 150–170 μm long. *Echiniscus rufoviridis* Bois-Reymond Marcus, described from Brazil, is green caudally only, with short cirri A (30–40 μm). The cuticular pattern of *Echiniscus viridissimus* Péterfi consists of both pores and dark raised granules. The cuticle of *E. viridis* is pigmented in areas indicated by denser stippling (Fig. 15) and the dorsal plates, except for the head, show a rather uniform pattern of discrete granules.

Distribution.—Rancho Grande, 1 specimen.

Echiniscus viridissimus Péterfi, 1956
(Figs. 18–21)

Our specimens fit the description of Ramazzotti's monograph and agree with determined specimens in the collections at ETSU and UCD. Cirrus A is 75 μm long. The cuticle is green and ornamented with a very fine regular granulation. The scapular and terminal plates have pores, which appear as light spots. The paired plates have an anterior zone of dark granules which appear separated from the posterior zone by a transverse stripe.

Discussion.—The dorsal plating of this species is greenish in the same areas as *E. viridis.* Whereas the cuticular pattern of the dorsal plates of *E. viridis* consists of discrete granules, that of *E. viridissimus* is predominantly of pores (light spots) except for a minutely granular head and granules on the anterior of plate pairs C and D and on the area between plates D and the terminal plate.

Distribution.—Rancho Grande, 11 specimens.

Echiniscus angolensis da Cunha and Ribeiro, 1964
(Figs. 22–25)

Body length excluding legs IV, 225 μm. Cuticle with pores only, slightly larger on median plates. Cephalic plate with rostral zone of pores. Cirrus A, 29 μm long.

Short C, D spines (5–6 μm); robust D^d spine, 17 μm, may have rough or spiny appearance; robust, rough (spiny) E spine, 16 μm. Terminal plate with distinct notches. Dentate fringe on legs IV with 16–17 slender, sharp, short teeth. Very slender spur on internal claws of all legs.

Discussion.—The distinction between *Echiniscus angolensis* from West Africa and *Echiniscus crassispinosus fasciatus* Marcus from Brazil and East Africa is difficult. Based on the illustrations in Ramazzotti's monograph (1972), the Venezuelan specimens more closely resemble *E. angolensis*, although there are some discrepancies not yet resolved. The description of *E. angolensis* does not mention the presence of the C spine, yet it is clearly illustrated in their drawing; the C^d spine which is mentioned is very small or missing on the illustration.

We have not seen the type of either species and have elected to use the name *E. angolensis* at this time.

Distribution.—Merida, 4 specimens.

Echiniscus virginicus **Riggin, 1962**

(Figs. 26–29)

Cuticle with characteristic ornamentation of pores and granules. Area of median plate 3 also ornamented. Posterior margins of paired plates minutely scalloped. The dorsal and lateral spines are variable, both in occurrence and development. Lateral spine B is sometimes absent on one or both sides; C, D, E are present. Dorsal spines C^d and D^d are of variable length and rarely absent; the spines may be the same length or either may be considerably shorter than the other. Spur present at base of internal claws of all legs. Leg I with spine and leg IV with large papilla. Dentate fringe with 8–10 teeth.

Discussion.—The Venezuelan specimens agree with Riggin's holotype deposited in the Smithsonian Institution and with other specimens from Florida and Tennessee. The cuticular ornamentation differs from that of *Echiniscus quadrispinosus brachyspinosus* Bartos, which Ramazzotti considered the same as *E. virginicus*.

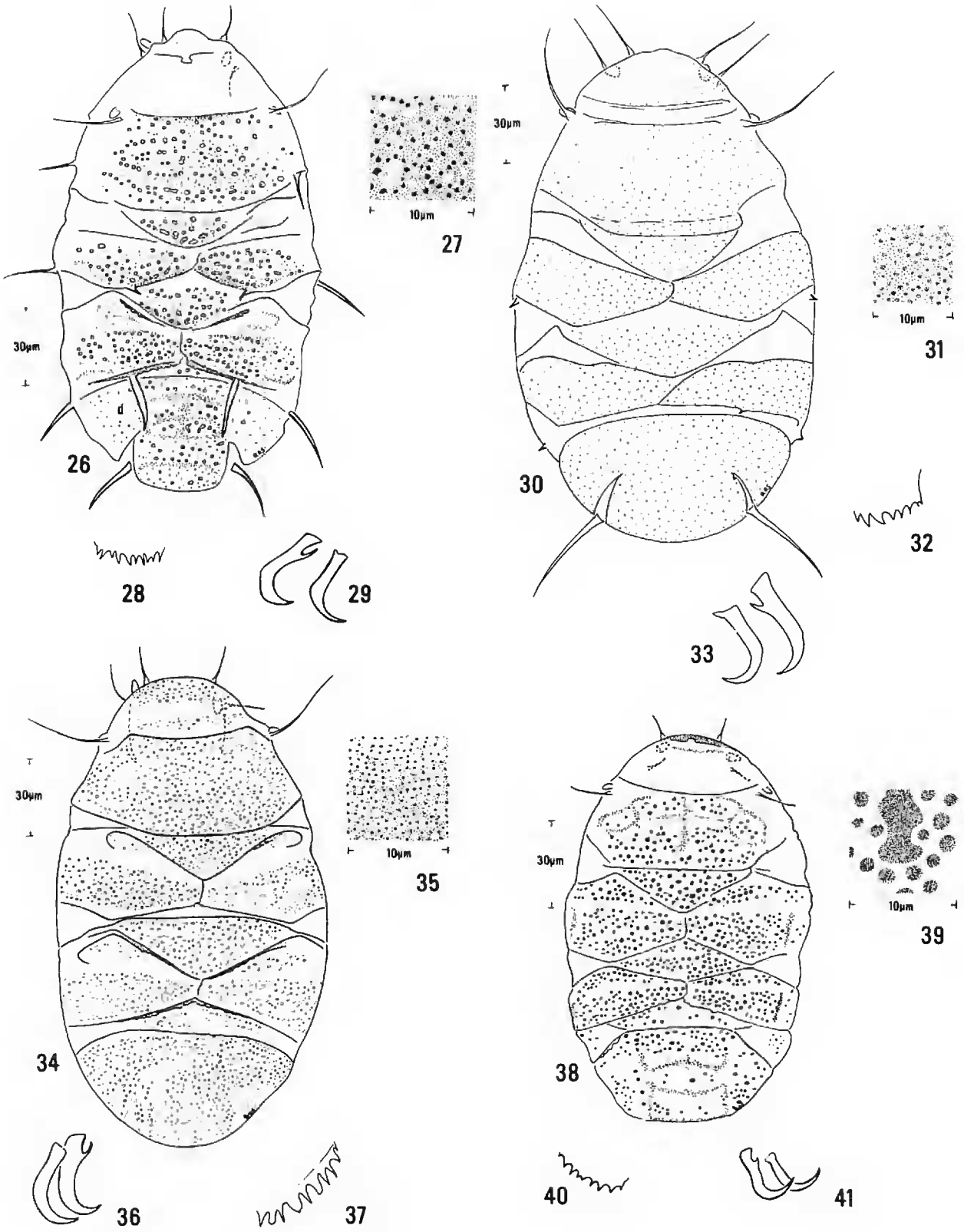
Distribution.—La Carbonera, 9 specimens; La Mucuy, 15; Merida, 19; Barrancas, 4; El Tucuco, 1; Yacambu, 5; Rancho Grande, 2. *Echiniscus virginicus* was the most widely distributed heterotardigrade and was only surpassed by *Pseudechiniscus suillus facettalis* in numbers collected.

Echiniscus perarmatus **Murray, 1907**

(Figs. 30–33)

The Venezuelan specimens agree with the description in Ramazzotti's monograph (1972). The cuticle is ornamented with a very fine uniform granulation, larger regularly distributed granules, and a few light pores. Each pore appears bordered by four of the larger granules. Although pores are not mentioned in the original description, they are present as surface structures. Short C, D teeth are present and occasionally very short D^d spines. The E spines are curved and as long or longer than cirrus A. A distinguishing character is the presence of a short thorn-like papilla on legs I–III; legs II and III should be observed carefully.

Discussion.—The species was described from South Africa and another report from Hawaii is uncertain. Dr. Deidre Christenberry has collected *E. perarmatus* from the Southeastern United States. Her specimens, deposited at the Smithsonian Institution, agree closely with ours.



Figs. 26–41. 26–29. *Echiniscus virginicus.* 26, dorsal aspect; 27, cuticle of scapular plate; 28, dorsal denticles of leg IV; 29, internal and external claws leg IV. 30–33. *Echiniscus perarmatus.* 30, dorsal aspect; 31, cuticle of scapular plate; 32, dorsal denticles of leg IV; 33, internal and external claws leg IV. 34–37. *Echiniscus aliquantillus.* 34, dorsal aspect; 35, cuticle of scapular plate; 36, internal and external claws leg IV; 37, dorsal denticles leg IV. 38–41. *Echiniscus kofordi.* 38, dorsal aspect; 39, cuticle of scapular plate; 40, dorsal denticles of leg IV; 41, internal and external claws leg IV.

Distribution.—Yacambu, 10 specimens.

Echiniscus aliquantillus **Grigarick, Schuster, and Nelson,** NEW SPECIES
(Figs. 34–37)

Holotype female.—Length excluding legs IV, 185 µm. Cuticle colorless; all plates with very fine regular granulation and random distribution of small but distinct pores. Cephalic plate with rostral zone of pores and granules and posterior band

of very fine granulation and very small pores. Pattern of granulation and pores similar on median plates 1 and 2; median plate 3 absent or not well-defined but the area between the paired plates and the terminal plate has the same cuticular pattern as the other median plates. Paired plates have clear zone separating the anterior (with few pores) from the posterior part. Granulation and pores extend onto legs. Posterior margin of median plate 2 and paired plates D is scalloped. Head with acuminate buccal cirri; internal cirrus 14 μm long; external cirrus, 16 μm long; buccal papilla, 7 μm long by 3 μm wide. Cirrus A, 34 μm long; clava, 7.6 μm long by 2.4 μm wide, longer and thinner than buccal papilla. Slender spine on leg I; papilla on leg IV 5 μm long by 2 μm wide. Dentate fringe on leg IV with 10–12 short sharp spines; area above fringe with pores and granules. Spurs on internal claws of all legs, very distinct and well-developed on legs IV; claws 12 μm.

Etymology.—Latin: *aliquantillus,* very small; named for the numerous small pores.

Discussion.—Several species in the arctomys group are very similar but can be distinguished by their cuticular patterns. Previously named species differ from the Venezuelan specimens in the following ways. *Echiniscus arctomys* Ehrenberg and *Echiniscus wendti* Richters, both reported from South America, have granulations but no pores; both have longer cirri A, especially *E. wendti* which has a cirrus A length up to 55–70% of the body length. *Echiniscus phocae* Bois-Reymond Marcus, described from Brazil, has a characteristic ornamentation consisting of circular groups of small granules. Mihelčič (1967) described several similar species from Argentina, including *Echiniscus bellus, insuetus, roseus,* and *speciosus*; these species are practically indistinguishable on the basis of their descriptions, and slides identified and labeled by Mihelčič do not correspond to each other or the descriptions. All have cirrus A much longer than in the Venezuelan specimens.

The cuticular pattern of *Echiniscus kerguelensis* Richters, reported from Australia and SW Africa at 1600–2000 m and other localities, most clearly resembles that of the Venezuelan specimens. The description in Ramazzotti (1972), however, is unclear and may represent a combination of two or more species. For example, the ornamentation can appear granulated or porous; the two paired plates have, or do not have, a smooth unornamented transverse stripe; lateral cirrus A is 50–80 μm; claws, 18 μm long. The Venezuelan specimens have very fine granulation and pores, an unornamented stripe on the paired plates, shorter cirrus A, and shorter claws.

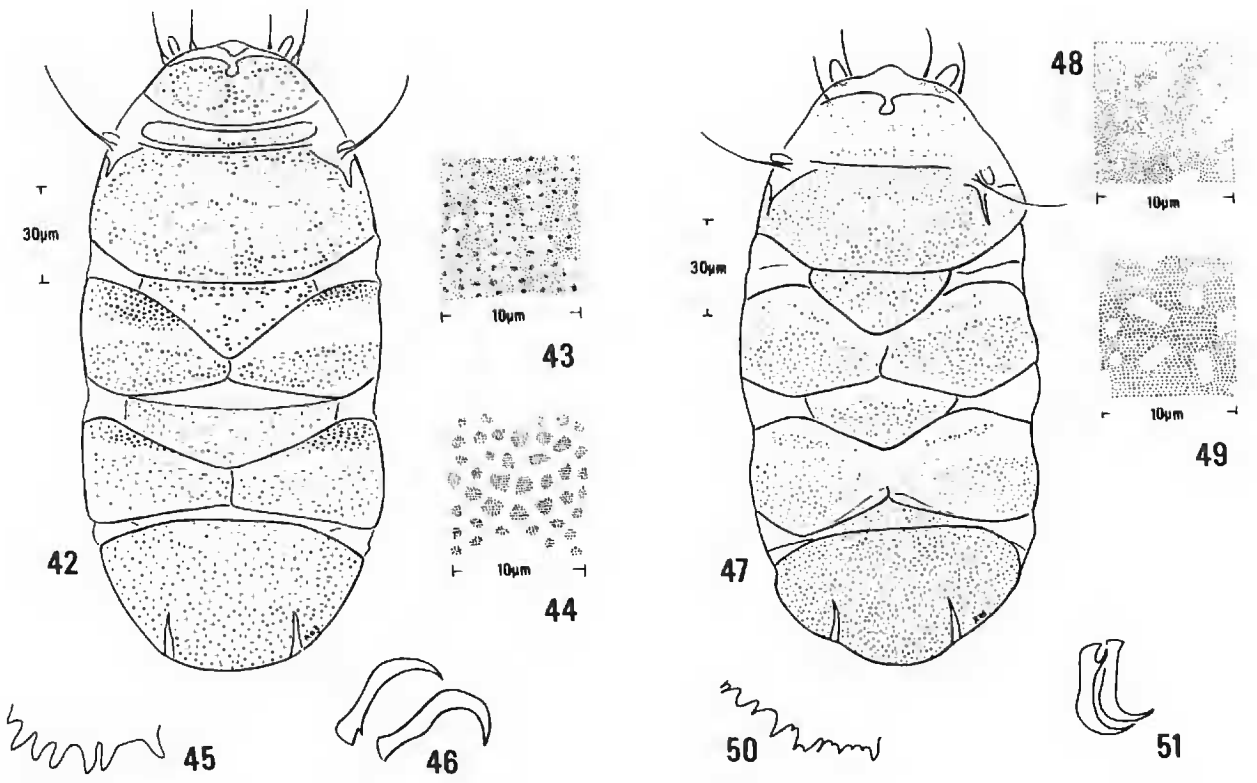
Distribution.—Holotype, La Carbonera; paratypes: La Carbonera, 36 specimens; Merida, 4.

Echiniscus kofordi Schuster and Grigarick, 1966

(Figs. 38–41)

This species has only lateral cirrus A. The dorsal plates are granular with distinctive patterns (fine stipple on Fig. 38) on the head, scapular and terminal plates, and lateral margins of C and D.

Discussion.—This species is related to *E. tesselatus* J. Murray but differs by having a shorter spine A and by the divisions of the scapular and terminal plates. The single specimen compared favorably with the type from the Galápagos Islands.



Figs. 42–51. 42–46. *Echiniscus marginoporus*. 42, dorsal aspect; 43, cuticle of scapular plate; 44, cuticle of anterior margins of plates C and D; 45, dorsal denticles of leg IV; 46, internal and external claws leg IV. 47–51. *Echiniscus mosaicus*. 47, dorsal aspect; 48, 49, variation in pores of cuticle of scapular plate; 50, dorsal denticles of leg IV; 51, internal and external claws leg IV.

Distribution.—El Tucuco, 1 specimen.

Echiniscus marginoporus **Grigarick, Schuster, and Nelson, NEW SPECIES**
(Figs. 42–46)

Holotype female.—Length excluding legs IV, 200 µm. Cuticle colorless; cuticular pattern consists of granulation and pores. Cephalic plate consists of a rostral zone with regular granulation and a few small pores, separated by a clear zone from a posterior band of granules and pores. Scapular plate with regular granulation and marginal pores (Fig. 43), especially on posterior part, and irregular median row of pores. Anterior portion of plates C and D with irregular shaped granules only (no pores) and posterior portion with granules and marginal pores, especially along posterior margin. Paired plates entirely granulated, no unornamented stripe present. Median plates 1 and 2 with regular granules and pores; median 3 absent but area between D and E plates with granules. Terminal plates with granules and scattered small pores. Head with internal acuminate buccal cirrus 12 µm; external cirrus, 18 µm; buccal papilla 6.6 µm long by 2.8 µm wide. Spine on leg I a small thorn; papilla on leg IV present. Dentate fringe on leg IV with 7–8 well-defined large sharp teeth; area above fringe granulated. Dorsal surface of all legs granulate; internal claws of all legs with spurs, internal claws, 16 µm; external claws, 14 µm.

Etymology.—Latin: *marginoporus* was named for the marginal pores on the plates.

Discussion.—The Venezuelan specimens are in the arctomys group, but the cuticular pattern differs from all other described species. See also the discussion of *Echiniscus aliquantillus* n. sp.

Distribution.—Holotype, La Mucuy; paratypes: La Mucuy, 2 specimens; Rancho Grande, 1; Barrancas, 2.

Echiniscus mosaicus Grigarick, Schuster, and Nelson, New Species
(Figs. 47–51)

Holotype female.—Length excluding legs IV, 190 μm; including legs IV, 218 μm. Cuticle colorless. Cephalic plate with small pores and granules on rostral zone of head. Scapular plate with large pores 1–2.8 μm, and large black granules 2–3 μm; 4–6 pores surround granule, larger on posterior margin (Figs. 48–49). Paired plates with clear (unornamented) transverse stripe that separates smaller anterior part from posterior portion of plate. Median plates 1 and 2 with pattern similar to posterior margin of scapular plate. Median 3 small but area has pattern similar to other median plates. Terminal plate with pronounced pores. Interpore area triangular or hexagonal. Cuticular pattern forms a mosaic appearance; hexagonal pattern is more apparent in some areas where pore size is smaller. Interpore areas are joined, forming a reticulate pattern. Slight lateral hemispherical pouch may be seen on some specimens between legs II and III and between legs III and IV. Head with acuminate buccal cirri, internal cirrus, 15 μm long; external cirrus, 19 μm long; buccal papilla prominent, 9.5 μm long by 5.7 μm wide, larger than clava. Cirrus A, 33 μm; clava, 7.6 μm long by 3.8 μm wide. Spine on leg I a short thorn; papilla on leg IV 3.8 μm long by 2 μm wide. Dentate fringe on leg IV with 10–12 sharp spines of irregular size. Spurs on internal claws of all legs; internal claws, 14 μm; external claws, 13 μm.

Etymology.—Latin: *mosaicus,* mosaic; named for the mosaic cuticular pattern.

Discussion.—The cuticular pattern of *E. mosaicus* somewhat resembles that of *Echiniscus elegans* Richters and *Echiniscus reticulatus* Murray, and is reminiscent of the gameboard for Chinese checkers. The smaller sized cuticular pattern and transverse clear stripes on the paired plates of *E. mosaicus* readily distinguish it from these species.

Distribution.—Holotype, La Carbonera; paratype, Merida, 1 specimen.

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