#69

New Tarsonemids Associated with Bark Beetles (Acarina: Tarsonemidae)[1]

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ABSTRACT

The generic characters for *Ununguitarsonemus* Beer and Nucifora are emended and *U. peacocki* n. sp. is described. Descriptions and illustrations for *Heterotarsonemus milleri* and *H. nakaharai* n. spp. are presented, as well as a key to species for this genus.

A lectotype is designated for *Pseudotarsonemoides eccoptogasteris* Vitzthum, the type for the genus. Illustrations and a redescription for this taxon are included. A key to species for this genus is included. New *Pseudotarsonemoides* spp. are: *scolyti, americanus,* and *fechteri.* The adult male of *Tarsonemus ips* is described and illustrations for the pupa and immature stages are given. New *Tarsonemus* spp. are: *kennedyi, krantzi, wilkinsoni,* and *suskii.*

Tarsonemid mites have been collected from bark beetles, but very little is known about their biology and importance to agriculture. Here we present descriptions of new species of these mites with additional taxonomical information for some of the known taxa. Included are descriptions for 1 new species of *Ununguitarsonemus* Beer and Nucifora, 2 new species of *Heterotarsonemus* Smiley, 4 new species of *Tarsonemus* Canestrini and Fanzagio, the description of the male of *T. ips* Lindquist and a redescription of the genus *Pseudotarsonemoides* Vitzthum. For this genus we designate a lectotype for *P. eccoptogasteris* Vitzthum and include 3 new species.

Although the nomenclature for leg setation by Suski (1966, 1968), Lindquist (1969–70), and Mahunka (1970) shows merit for certain genera, it must be modified to include *Pseudotarsonemoides* and other taxa. Therefore we make no effort to apply names or symbols or adapt the present leg chaetotaxy nomenclature. Mahunka (1970) erected the family Acarapidae and we agree that taxonomically it should be recognized as a separate family.

Genus *Ununguitarsonemus* Beer and Nucifora

Ununguitarsonemus Beer and Nucifora, 1965: 24.

Type-species.—Tarsonemella beameri Beer, 1958.

Although this genus is close to *Tarsonemella* Hirst and *Pseudotarsonemoides* Vitzthum, whose males are unknown, the female of this genus differs from *Tarsonemella* by the possession of pseudostigmata and different ventral chaetotaxy, and from *Pseudotarsonemoides* by different dorsal chaetotaxy and the distal segment of leg IV. Smiley (1967) redescribed and illustrated the female of *Ununguitarsonemus beameri* (Beer); he also described and illustrated the male for this species. The misinterpretation of a flange on leg IV of the male previously illustrated, requires that the generic characters be emended as follows: Male with venter of propodosoma with 2–3 pairs of setae and hysterosoma with 5 pairs of setae. The opisthosoma dorsally with 2 pairs of setae on a transverse plane, the inner pair shorter. Femur IV robust with a large flange on the lateral outer margin. Gnathosoma of female partly covered by propodosomal shield. Tibiotarsus I terminating in a stout strongly recurved basally recessed claw truncated distally, and without pulvillus; tarsi II and III may possess pulvilli with 1 or 2 distal claws; apical segment of leg IV about ½ the length of subapical segment and terminating with 1 long whip-like seta, 1 anterior daggar-shaped seta, and 1 short stout dagger-shaped seta dorsoventrally; venter of propodosoma with 2 pairs of setae; venter of hysterosoma with 3 pairs of setae and 3 pairs of genital-anal setae.

Ununguitarsonemus beameri (Beer)

(Figs. 1–7)

Tarsonemella beameri Beer, 1958: 188; Smiley, 1967: 127.

Ununguitarsonemus beameri, Beer and Nucifora, 1965: 24.

The female of this species may be recognized by the single lateral claw on tarsi II and III.

Female.—Dorsum of body oval and finely punctated, broadest at anterior hypterosoma; with 4 distinct tergites. Dorsal body setae lobe-like or barbed, and as figured; 2nd pair of propodosomals (or scapular setae) longest, ca. ⅓ longer than 1st (or vertical) pair. First pair of hysterosomal setae shorter than 2nd pair; 3rd medial pair shortest; laterally and adjacent to 2nd and 3rd pair of setae 2 pairs of subequal barbed setae, longer than 3rd medial pair of setae. Dorsum of propodosoma subtriangular-shaped and covering half of gnathosoma. Pharynx slender with a pair of lobe-like glands near base. Pseudostigmatic organs mace-like, with spicules more numerous anteriorly. Ventral apodemes as figured, 1st pair shorter than 2nd pair, forming a Y-shaped juncture with anteromedian apodeme. Posteromedian apodeme forming a C-shaped juncture anteriorly; apodemes III and IV weakly developed. Leg I robust, with strong recurved claw. Leg II subequal in length to leg I; distinctive by tarsus possessing only 1 strong spine-like seta. Leg

[1] Received for publication Dec. 4, 1973.

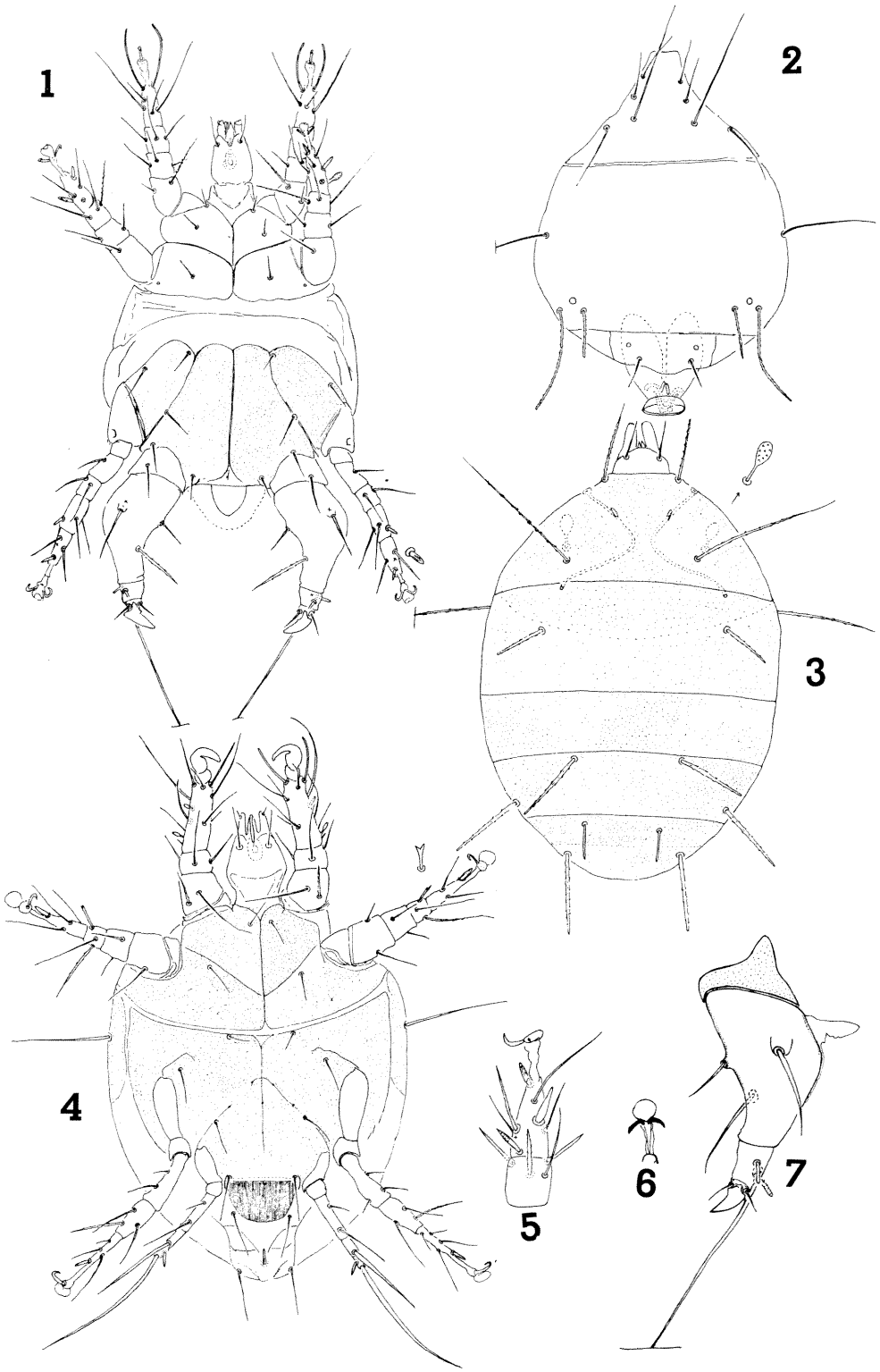

FIG. 1–7.—*Ununguitarsonemus beameri* (Beer). Male. 1, venter; 2, dorsum; 7, right dorsal leg IV. Female. 3, dorsum; 4, venter; 5, tarsus and tibia II; 6, distal segment of tarsus II (after Beer).

IV distinctive in that apical segment terminates with 1 short spine-like seta and 1 long whip-like seta. Body 197 μ long by 133 μ wide.

Male.—The male is as illustrated and described by Smiley (1967) except there is a flange on the outer margin of femur IV as illustrated in figure 7.

Locality and Host Records. Based on the collection in the U.S. National Museum of Natural History.

South America.—Cimeira, Brazil. 1 ♀ in pineapple with gum disease, 1 May 1967, C. J. Rosetta. *South Pacific:* Cook Island. 5 ♂, 4 ♀, and 2 larvae in chestnut, 10 April 1964, R. F. Winch. Saipan, Mariana Islands. 3 ♀ with *Brontispa mariana* Spaeth on *Cocus nucifera* L., 14 November 1947, W. H. Lange. *South East Asia:* Hong Kong. 1 ♀ on water chestnut 22 April 1964, R. J. Spencer.

Ununguitarsonemus peacocki, new species

(Figs. 8–19)

The female differs from *U. beameri* in possessing 2 claws on tarsi II and III and in having small slender dorsal setae. The male differs from the male of *beameri* in possessing dorsally an extra pair of setae in the region of the opisthosoma and in femur IV possessing an inner flange.

Female.—Dorsum of body oval and densely covered with fine punctations, broadest at anterior hysterosoma; with what appears to be 4 distinct tergites. Dorsal body setae slender and barbed; 2nd pair of propodosomal setae slender and longer, ca. ⅓ longer than 1st pair, which are stouter. First and 2nd pairs of hyterosomal setae subequal in length; 3rd pair shorter and smaller than other setae; laterally and slightly above the plane of 3rd pair setae, a pair of barbed setae, thicker and longer than the setae anteriorly; laterally and below 3rd pair setae, and on terminal tergite, a pair of long barbed setae longer than other anterior hysterosomal setae. Propodosomal shield sub-triangular and covering half of gnathosoma. Pharynx with a pair of lobe-like glands near base. Pseudostigmatic organs spherical, with smaller spicules than those of *beameri.* Ventral apodemes as figured; 1st pair shorter than 2nd, forming Y-shaped juncture with anteromedian apodeme; transverse apodeme with a series of U-shaped bends as figured. Posteromedian apodemes indistinct as illustrated. Leg I robust, with strong recurved claw. Leg III subequal in length to leg I; distinctive by tarsus possessing only 1 strong spine-like seta. Leg IV distinctive in that apical segment terminates with 2 dagger-shaped setae and 1 long whip-like seta. Body 229 μ long by 133 μ wide.

Male.—Body elongate and broadest in region of metapodosoma. Dorsal propodosomal setae lightly barbed; 3rd pair ca. twice the length of others; 2nd and 4th pairs subequal in length, slightly shorter than 1st pair. Dorsal hysterosoma with a pair of lateral simple setae; 2 pairs of barbed setae on a transverse plane, outer pair twice the length of inner pair. Dorsal opisthosoma with 2 pairs of lightly barbed setae as figured. Dorsum and venter densely covered with punctation. Venter as figured. Apodeme I forming Y-shaped juncture with anteromedian apodeme; part of anteromedian not connecting with apodeme II; below broken portion of anteromedian apodeme, apodemes II form a Y-shaped juncture with remainder of anteromedian apodeme. Coxal plates I and II with a pair of simple setae. Transverse apodeme well defined; posterior setae and apodemes as figured. Legs I and II subequal in length and as figured; legs III smallest; tarsi II and III with dorsal spine-like seta; tibia III with dorsal spine-like seta. Leg IV as figured; femur with an inner flange, adjacent to flange a small simple seta; below this seta a larger and longer lightly barbed seta; outer margin of femur lightly sclerotized with a flange as figured. Body 172 μ long by 121 μ wide.

Holotype.— Female, U. S. National Museum of Natural History no. 3501, collected from inner bark of a bolt of American elm with *Scolytus multistriatus* Marsh, Marion Co., Ohio, 1 February 1970, by Jimmy G. Galford.

Paratypes.—Nine ♀ and 4 ♂ with the above data. Two ♀ phoretic on *Monarthrum fasciatum* (Say) on *Quercus rubra* L. collected by J. G. Gulford, 1 February 1967, Guernsey Co., Ohio. The species is named for Dr. J. Peacock, Northeast Forest Station, Forest Service, USDA, Delaware, Ohio.

Genus ***Heterotarsonemus*** Smiley

Heterotarsonemus Smiley, 1969: 224–227; Lindquist 1970: 812–822.

Type-species.—Heterotarsonemus lindquisti Smiley 1969.

Females are distinctive by having tarsi I modified with a single vestigial claw. Tarsi II and III each with a single outer lateral claw. The male and larva with stout serrate setae on the propodosomal and hysterosomal shields. Leg IV robust, with a triangular flange on inner margin. Although we have not studied type material of *Tarsonemus schaarschmidti* Mahunka we suspect this species to be a member of *Heterotarsonemus.*

Key to Females

1. Posteromedial lobe of metapodosomal venter broadly rounded or semicircular shaped 2
   Posteromedial lobe of metapodosomal venter narrowly rounded or almost pointed .... *coleopterorum* Scharrschmidt
2. Propodosomal shield without a conspicuous subtriangular projection on anterolateral margin 3
   Propodosomal shield with a conspicuous subtriangular projection on anterolateral margin .... *bicornis* Lindquist
3. Apical subterminal seta of leg IV longer than the subapical segment 4
   Apical subterminal seta of leg IV not as long as the subapical segment ..... *nakaharai,* n. sp.
4. Femoral apophysis of leg II elongated, dorsal and ventral body setae stout, terminal seta of leg IV stout ..... *lindquisti* Smiley

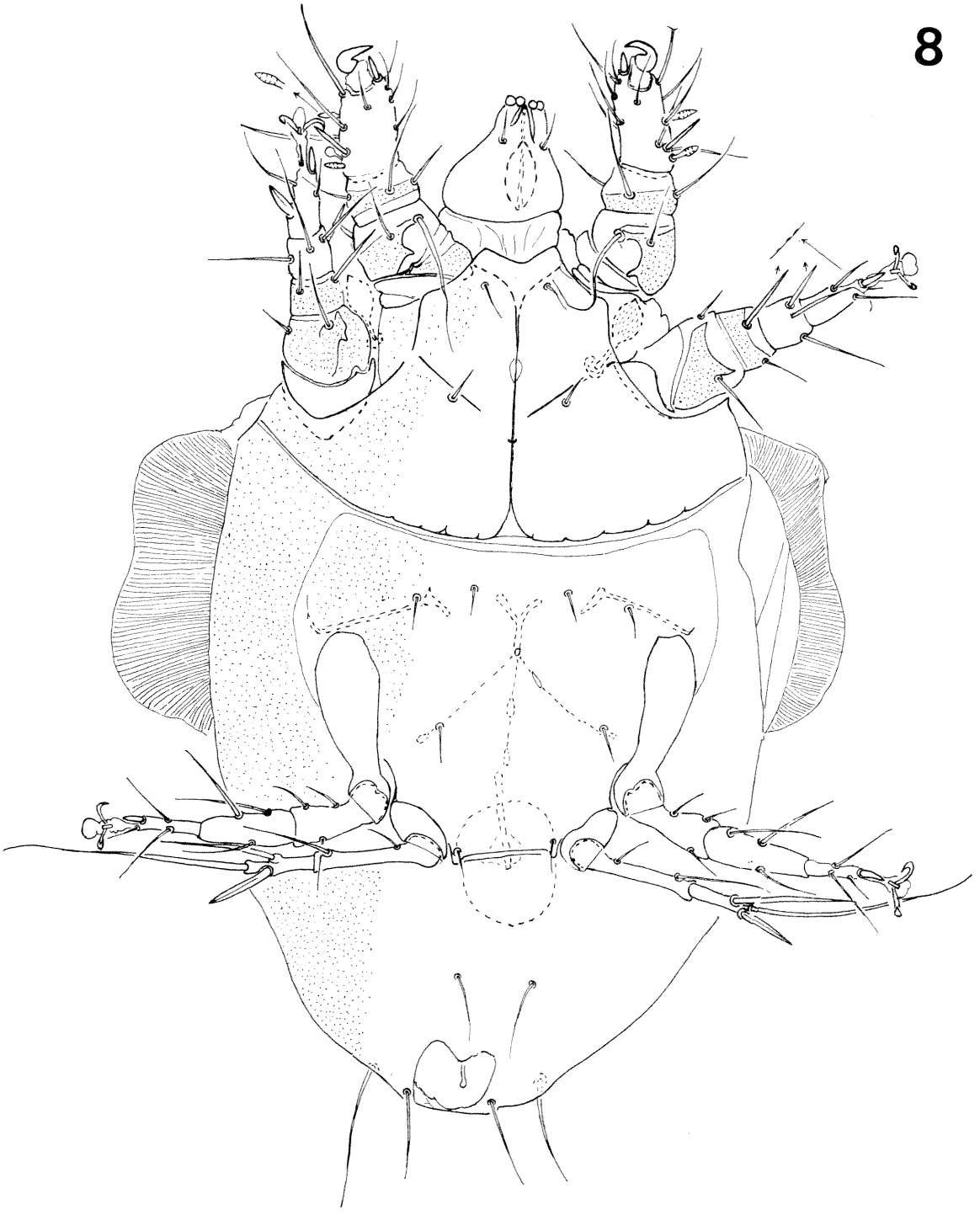

FIG. 8.—*Ununguitarsonemus peacocki,* new species. Female, venter.

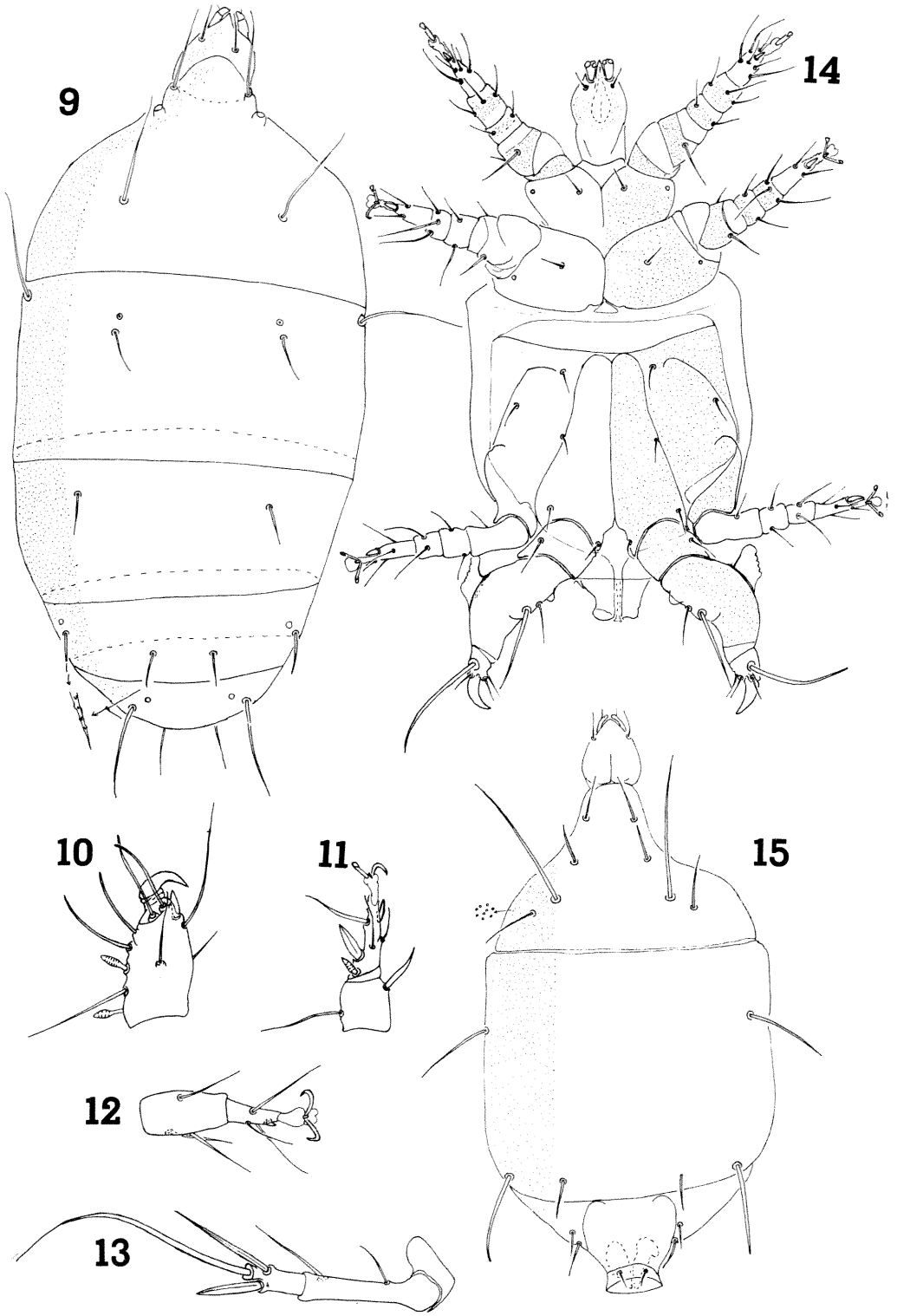

FIG. 9–15.—*Ununguitarsonemus peacocki*, new species. Female. 9, dorsum; 10, left tarsus I; 11, left tarsus and tibia II; 12, left tarsus and tibia III; 13, left leg IV. Male. 14, venter; 15, dorsum.

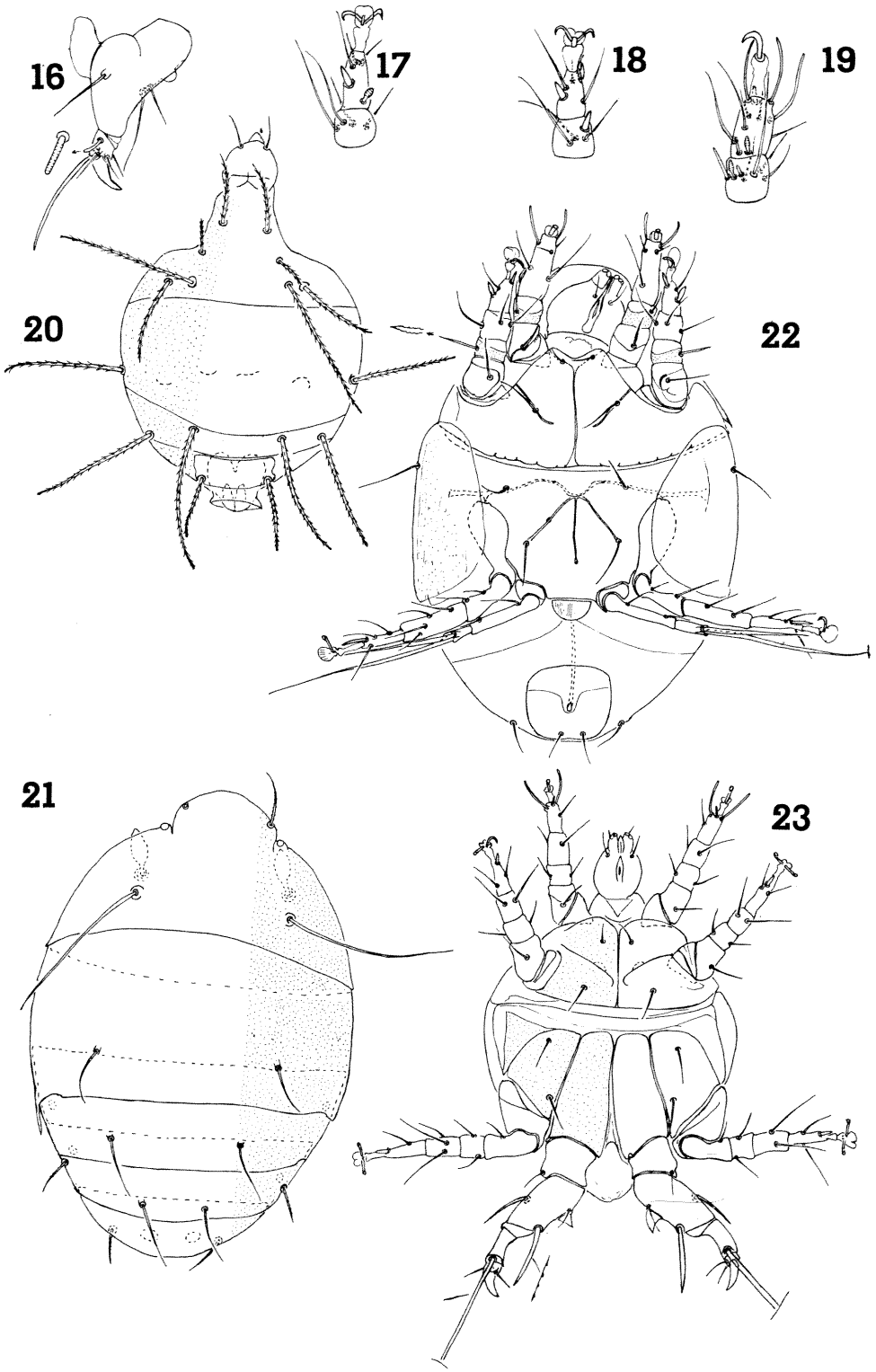

FIG. 16–19.—*Ununguitarsonemus peacocki,* new species. Male. 16, left leg IV; 17, left tarsus and tibia II; 18, left tarsus and tibia III; 19, left tarsus and tibia I. FIG. 20–23.—*Heterotarsonemus milleri,* new species. Male. 20, dorsum; 23, venter. Female. 21, dorsum; 22, venter.

Femoral apophysis of leg II truncated, dorsal and ventral body setae slender, terminal seta of leg IV slender ..... *milleri*, n. sp.

Key to Males

1. Third pair of propodosomal setae long, but not extending beyond metapodosoma 2
   Third pair of propodosomal setae long, extending beyond metapodosoma ..... *milleri*, n. sp.
2. Anterolateral seta of metapodosoma short and almost subequal in length to fourth pair of propodosomal setae, second pair of propodosomals short and slender ..... *bicornis* Lindquist
   Anterolateral seta of metapodosoma longer and stronger than fourth pair of propodosomal setae, or second pair of propodosomals short and stout ..... *lindquisti* Smiley

Heterotarsonemus milleri, new species

(Figs. 20–23)

The female of *milleri* is very similar to *lindquisti* Smiley from which it is distinguished by the truncate ventral apophysis or flange on femur IV, by the smaller ventral body setae, by the ellipsoidal shape of the pseudostigmatic organs, and by the smaller and slender terminal seta of leg IV. The male is distinguished from other known males by the 3rd pair of propodosomals extending to the lateral hysterosoma setae and the smaller semi-triangular flange on femur IV.

Female.—Dorsum of body oval and finely punctate. Propodosoma with 2 pairs of finely barbed setae; anterior pair short and slender, less than ½ length of posterior pair; posterior pair longer than length between their bases. Pseudostigmatic organs narrowly ellipsoidal, sparsely spiculate, without conspicuous spicules apically. Hysterosoma dorsally with inconspicuously finely barbed setae; 1st tergite largest, with a pair of slender setae medially and a pair of lateral setae which are longer; 2nd tergite with a pair of setae medially, stouter and longer than setae of 1st tergite; 3rd tergite with a pair of setae medially subequal in length to those of 2nd tergite and a pair of lateral setae which are thicker and shorter; 4th tergite with a pair of lateral setae subequal to those on 3rd tergite. Venter of propodosoma and hysterosoma as figured. Apodeme I short, converging with anteromedian apodeme; apodeme II stout and longer, not converging with anteromedian apodeme; anteromedian apodeme converging with transverse apodeme. Seta on coxal plate II longer than seta on coxal plate I; seta on coxal plate III not as long as seta on coxal plate IV; seta on coxal plate IV subequal to seta of coxal plate II. Leg I strong and robust; tarsus and tibia fused; femur ventrally with small dagger-shaped seta (smaller than seta on femur of *lindquisti*). Leg II subequal in length to leg I; dorsomedially with 1 stout spine-like seta; femur with strong truncate ventral apophysis on flange. Leg III longest, with small spine-like projection on anterolateral extremity. Leg IV slender, terminating at apical segment with stout, saber-like subterminal seta and long, smooth whip-like terminal seta. Body 153 μ long by 102 μ wide.

Male.—Body elongate and broadest in region of metapodosoma, densely covered with fine punctations. Dorsal propodosomal and hysterosomal setae serrate. Propodosomal setae shorter and more slender than serrated setae of hysterosoma (with exception of 3rd pair); 3rd pair longer and stronger than 1st, 2nd, and 4th pairs; 2nd pair shortest, ca. ½ length of 1st pair; 1st pair slightly shorter than 4th pair. Hysterosoma with a pair of anterolateral setae almost subequal in length to 2 pairs on metapodosoma; opisthosoma with rectangular shaped plate, bearing 1 pair setae which are stouter; but subequal in length to 4th pair on propodosoma; venter of propodosoma as figured; with punctation arranged to give striated appearance. Apodeme I forming Y-shaped juncture with anteromedian apodeme; apodeme II stronger, not connecting with anteromedian apodeme; seta on coxa I shorter than seta on coxa II; apodeme III uniting anteriorly with apodeme IV, which unites with posterior apodeme; coxal plate III with 2 setae; coxal plate IV without setae. Legs I and II subequal in length; legs III longer than legs I and II; tarsus II with short spine-like seta dorsolaterally and adjacent to sensillum; tarsi I-II each ventrodistally with small spur; leg IV robust, femur as figured with triangular shaped flange, small simple seta projecting adjacently and above flange, dagger-shaped barbed seta and dorsolateral simple seta; tibia with short dorsal sensory rod and terminating in long barbed whip-like seta; tarsal claw strong. Body 121 μ long by 76 μ wide.

Holotype.—Female, U. S. National Museum of History no. 3502, collected from inner bark of a bolt of American elm with *Scolytus multistriatus* Marsh, Marion Co., Ohio, 1 February 1970, by John C. Moser.

Paratypes.—One ♂ and 1 ♀ with the above data.

The species is named for Dr. Douglass R. Miller, Coccidologist, Systematic Entomology Laboratory, Agricultural Research Service, Beltsville, Maryland.

Heterotarsonemus nakaharai, new species

(Figs. 24–25)

The short subterminal seta of the apical segment of leg IV will separate this species from other species of this genus.

Female.—Dorsum of body oval and finely punctate. Propodosoma covering the gnathosoma; dorsally with 2 pairs of finely barbed setae; anterior pair stout, very short, not extending beyond apex of gnathosoma; posterior pair long and slender, more than 4 times length of anterior pair. Pseudostigmatic organs narrowly ellipsoidal, sparsely spiculated with large spicules apically. Hysterosoma dorsally with inconspicuous finely barbed setae; 1st tergite largest, with pair of slender setae medially and pair of lateral setae; 2nd tergite with pair of medial setae, stouter, and subequal in length to medial setae of 1st tergite; 3rd tergite with pair of short lateral setae, medial

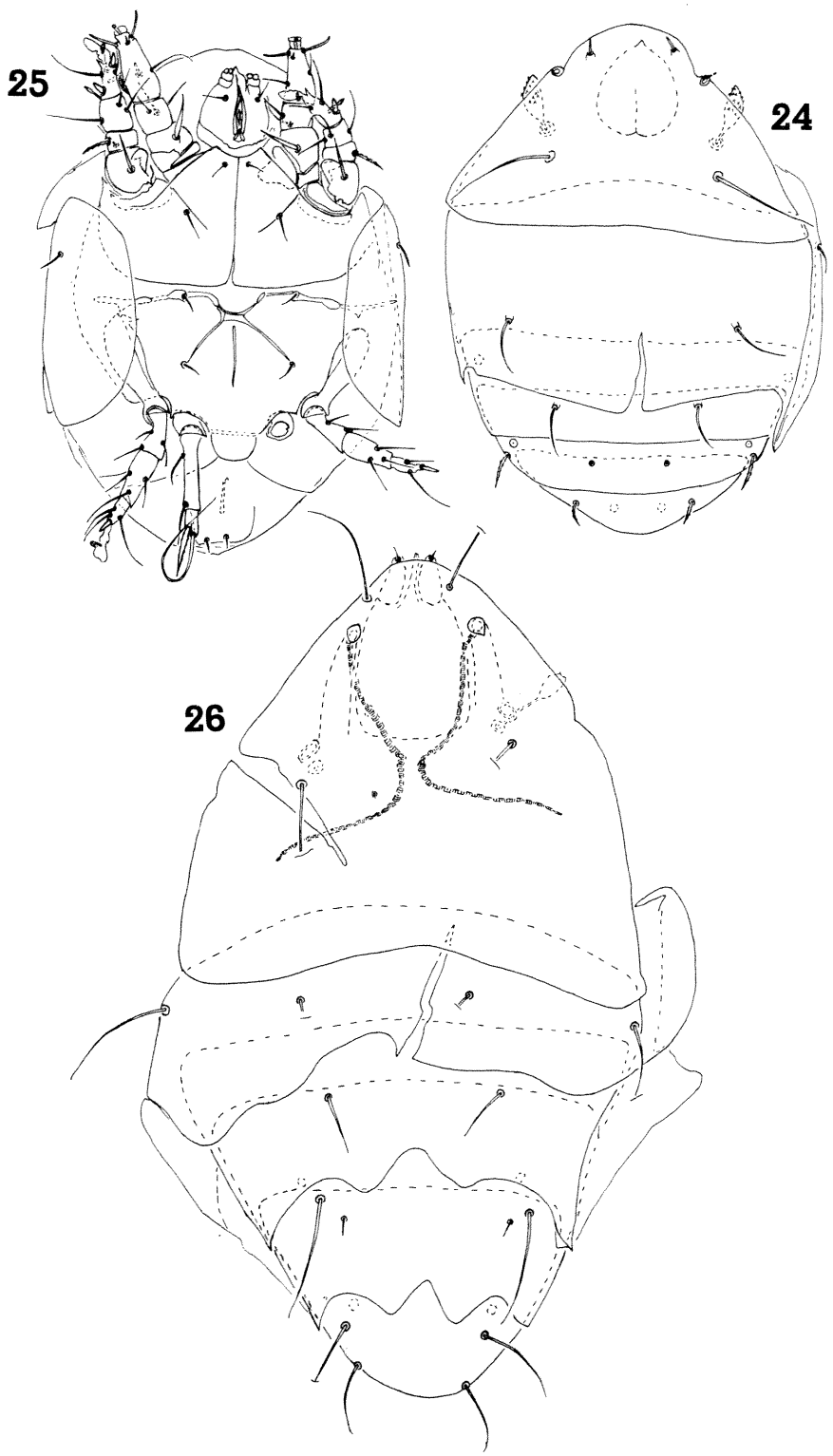

FIG. 24–25.—*Heterotarsonemus nakaharai,* new species. 24, dorsum; 25, venter. 26, *Pseudotarsonemoides eccoptogasteris* Vitzthum. Female, dorsum.

setae for this tergite broken off; 4th tergite with pair of lateral setae subequal to those of 3rd tergite. Venter of propodosoma and hysterosoma as figured. Apodeme I short converging with anteromedian apodeme; apodeme II stronger and longer, not converging with anteromedian apodeme; anteromedian apodeme converging with transverse apodeme. Seta on coxal plate II more than twice length of seta on coxal plate I; seta on coxal plate III not as long as seta on coxal plate IV; seta on coxal plate IV subequal to seta of coxal plate II. Apodeme III and IV partly submerged beneath cuticle and forming X-like configuration. Leg I strong and robust; tarsus and tibia fused; femur ventrally with strong dagger-shaped seta (larger than seta on femur of *milleri*). Leg II subequal in length to leg I; dorsomedially with 1 stout spine-like seta; femur with flange or apophysis similar to that of *lindquisti* but broader. Leg III longest with small spine-like projection on anterolateral extremity. Leg IV slender; subterminal seta small, short, smooth and whip-like. Body 159 μ long by 114 μ wide.

Holotype.—Female, Canadian National Collection no. 13177, collected from *Ips knausi* Swaine in *Pinus ponderosa* Douglas at Grand Canyon, Arizona. The collector and date collected are unknown. This species is named for Mr. Steve Nakahara, Agricultural Quarantine Inspection Division, APHIS, USDA, Plant Industry Station, Beltsville, Maryland.

Genus ***Pseudotarsonemoides*** Vitzthum

Pseudotarsonemoides Vitzthum, 1921: 72–76.

Type-species.—Pseudotarsonemoides eccoptogasteris Vitzthum, 1921.

The genus *Pseudotarsonemoides* based on females is here redescribed: Idiosoma large and elongated, propodosomal shield subrectangular, longer than wide, narrowing anterolaterally and semicircular-shaped or truncate at apex. Vertical setae simple and not as long, or strong as scapular setae; gnathosoma completely or partly covered by propodosomal shield; stigmata extremely large and without adjacent pits, but connecting with conspicuous, well developed tracheal system. Pseudostigmatic organs ellipsoidal or globe-like with small spicules evenly distributed. Hysterosoma with 4 tergites; tergites I-III indented medially. Tergites I-II each with 1 pair simple setae. Tergite III with 2 pairs of setae, outer pair longer than inner pair; inner pair have migated downward and slightly off transverse plane. Tergite IV with 2 pairs of subequal setae posterolaterally. Anteromedian apodeme uniting with apodemes I and transverse apodeme, but not with apodeme II. Posteromedian apodeme not clearly uniting with apodeme II and IV. Leg I robust, with large strong recurved claw and large basal spine, tibia and tarsus fused. Leg I setation on femur, genu, and tibiotarsus 3-4-10+1 solenidion, 3 or 4 bothridia, sensory triplet (see figure 27) and 1 basal spine. Leg II setation, femur, genu, tibia and tarsus, 2-3-4-4+1 solenidion, 1 dorsoproximal spine and 1 basal spine. Leg III setation on femur, genu, tibia, and tarsus 1-3-4-4+1 basal spine. Leg IV setation trochanter 1, femorogenu 1, tibiotarsus 3+1 subapical and 2 apical. Leg IV distinctive from that of other females in the family in tibiotarsus consisting of 3 setae; the subapical or tibial seta being short and the apical portion of the segment or (tarsus) with 1 minute seta and 1 long whip-like seta.

Discussion.—This genus was established by Vitzthum in 1921 and prior to our study only 4 species had been included. They are: *P. eccoptogasteris* Vitzthum, *P. innumerabilis* Vitzthum, *P. spinitarsus* Hirst and *P. cryptocephalus* Ewing. There are no holotypes or paratypes for any of these species. According to Dr. H. Fechter (personal communication), Curator for the Vitzthum Collection (Zoologische Sammlung des Bayerischen Staates München, West Germany), Vitzthum did not designate a holotype for *eccoptogasteris,* the type-species for this genus. Vitzthum's illustration of the type-species, although not completely accurate, has served to distinguish this genus from other genera in the family. Through the courtesy of Dr. Fechter we were able to study 3 syntype specimens of *eccoptogasteris.* We here designate slide No. V 1666 as a lectotype which is selected from material on which the original description was based. The data for this specimen can be found with our redescription of *eccoptogasteris.*

With the exception of Ewing's (1939) *P. cryptocephalus,* all known species were based on females and were associated with scolytid beetles. Ewing did not illustrate the female of his species. His description of the female does not suggest affinity with the other known species of this genus. His description of the male of this species and the illustration of leg IV of the male is characteristic of males of *Tarsonemus* and we consider Ewing's species to be a species of that genus.

Hirst (1923) described and illustrated *P. spinitarsus* (figure 34). According to Dr. K. H. Hyatt (personal communication), Curator for the Acarina Collection, British Museum of Natural History, Hirst's holotype is not in existence. His taxon was erected on a single female specimen. In this study we consider this species a *nomen dubium.*

Key to Species

1. Dorsal idiosoma without conspicuous longitudinal ridges 2
   Dorsal idiosoma with conspicuous longitudinal ridges ..... *innumerabilis* Vitzthum
2. Dorsal hysterosomal setae smooth 3
   Dorsal hysterosomal setae barbed ..... *scolyti,* n. sp.
3. Tibia III without sclerotized notches 4
   Tibia III with sclerotized notches .. *americanus,* n. sp.
4. Idiosoma long and slender, pseudostigmatic organ globe-like, or, trachea long and slender ..... *fechteri,* n. sp.
   Idiosoma short and oval, pseudostigmatic organ ellipsoidal, trachea long and stout ..... *eccoptogasteris* Vitzthum

Pseudotarsonemoides eccoptogasteris Vitzthum

(Figs. 26–27)

The minute inner seta on the 3rd tergite will separate this species from other species of this genus.

Female.—Dorsum of body oval, without obvious punctations. Propodosomal shield semicircular apically; with 2 pairs of simple setae; anterior pair shorter than posterior pair. Pseudostigmatic organs ellipsoidal, sparsely covered with small spicules. Trachea long, slender, originating at base of large dorsal stigmata. Gnathosoma covered by propodosomal shield; longer than wide; with pair of large kidney-shaped glands at base of pharynx; palp 2 segmented, longer than wide; anterolaterally with 3 short spine-like setae. Hysterosoma with 4 tergites; tergites I-III indented. Tergite I with lateral and medial pair simple setae; 2nd tergite with 1 pair medial simple setae; 3rd tergite with 2 pairs of simple setae, inner pair minute; 4th tergite with 2 pairs of subequal simple setae. Ventral apodemes as figured; 1st pair shorter than 2nd, forming Y-shaped juncture with anteromedian apodeme; 2nd pair not uniting with anteromedian apodeme. Posteromedian apodeme not clearly uniting with apodeme III and IV. Ventrocaudal lobe between leg IV, longer than wide; spade-shaped distally. Leg I robust, with large strong recurved distal claw and large basal spine, tibia and tarsus fused. Setation on femur, genu and tibiotarsus of leg I: 3-4-8+1 solenidion, 4 bothridia, sensory triplet and 1 basal spine, Leg II: femur, genu, tibia and tarsus, 2-3-4-7; leg III: femur, genu, tibia and tarsus 1-3-4-5; leg IV: trochanter, femorogenu, and tibiotarsus, 1-1-3. Body 242 μ long by 121 μ wide.

Lectotype.—Female, Zoologische Staatssammlung, München, no. V 1666, collected from *Eccoptogasteris* sp., Klosterneuberg, Nider-Ostereich, by H. Wichmann, date unknown, determined by Vitzthum 28 May 1914.

Paralectotypes.—Two ♀, no. V 1665 and V 1667 with the above data, except determined by Vitzthum 29 May 1914.

Pseudotarsonemoides scolyti, new species

(Figs. 28–29)

The lightly barbulate dorsal hysterosomal setae will separate this species from other species in the genus.

Female.—Dorsum of body oval, without obvious punctations. Propodosomal shield semicircular-shaped apically; with 2 pairs of simple setae; anterior pair shorter than posterior pair. Pseudostigmatic organs globe-like sparsely covered with small spicules. Trachea long, stout, originating at base of large dorsal stigmata. Gnathosoma covered by propodosomal shield; ca. as long as wide; with pair of large kidney-shaped glands at base of pharynx; palpi 2 segmented, longer than wide, anterolaterally with 3 short spine-like setae. Hysterosoma with 4 tergites; tergites I-III indented. Tergital setae stronger than tergital setae for *eccoptogasteris*. Tergite I with lateral and medial pair of simple setae; 2nd tergite with 1 pair of short simple setae; 3rd tergite with 2 pairs of simple setae, inner pair ca. ¼ length of outer pair; 4th tergite with 2 pairs of simple setae, anterior pair longer than posterior pair. Ventral apodemes as figured; 1st pair shorter than 2nd, forming Y-shaped juncture with anteromedian apodeme; 2nd pair stout, not uniting with anteromedian apodeme. Posteromedian apodeme not clearly uniting with apodeme III and IV. Ventrocaudal lobe between legs IV, ca. as long as wide, spade-shaped distally. Leg I robust, with large strong recurved claw and basal spine; tibia and tarsus fused. Setation on femur, genu and tibiotarsus of leg I: 3-4-8+1 solenidion, 4 bothridia, sensory triplet and 1 basal spine; leg II: femur, genu, tibia, and tarsus, 2-3-4-7; leg III: femur, genu, tibia and tarsus, 1-3-4-5; leg IV: trochanter, femorogenu, and tibiotarsis, 1-1-3. Body 248 μ long by 121 μ wide.

Holotype.—Female, U. S. National Museum of Natural History no. 3503, collected from *Scolytus multistriatus* Marsh, on elm, Delaware, Ohio, 1 March 1966, by Bruce Kennedy.

Paratypes.—Four ♀ with the above data; 3 ♀ with the above data were collected in 1963.

Pseudotarsonemoides fechteri, new species

(Figs. 30–31)

This species is distinguished from others in the genus by having long slender tracheae.

Female.—Dorsum of body long, oval, without obvious punctations. Propodosomal shield truncated apically; with 2 pairs of slender simple setae; anterior pair shorter than posterior pair. Pseudostigmatic organs globe-like, sparsely covered with small spicules. Trachea long, slender originating at base of large stigmata. Gnathosoma not entirely covered by propodosomal shield; longer than wide; with pair of large kidney-shaped glands at base of pharynx; palpi 2 segmented, longer than wide; anterolaterally with 3 short spine-like setae. Hysterosoma with 4 tergites; tergites I-III indented. Tergite I with lateral and medial pair simple setae; 2nd tergite with 1 pair medial simple seta; 3rd tergite with 2 pairs of simple setae, inner pair minute; 4th tergite with 2 pairs of setae, anterior pair longer than posterior pair. Ventral apodemes as figured; 1st pair shorter than 2nd, forming Y-shaped juncture with anteromedian apodeme; 2nd pair short, stout, not uniting with anteromedian apodeme. Posteromedian apodeme not clearly uniting apodeme III and IV. Ventrocaudal lobe between legs IV longer than wide; spade-shaped distally. Leg I robust, with large strong recurved claw and basal spine; tibia and tarsus fused. Setation on femur, genu and tibiotarsus of leg I: 3-4-8+1 solenidion, 4 bothridia, sensory triplet and 1 basal spine; leg II: femur, genu, tibia and tarsus, 2-3-4-7; leg III femur, genu, tibia and tarsus, 1-3-4-5; leg IV: trochanter, femorogenu and tibiotarsus, 1-1-3. Body 248 μ long by 102 μ wide.

Holotype.—Female, U. S. National Museum of

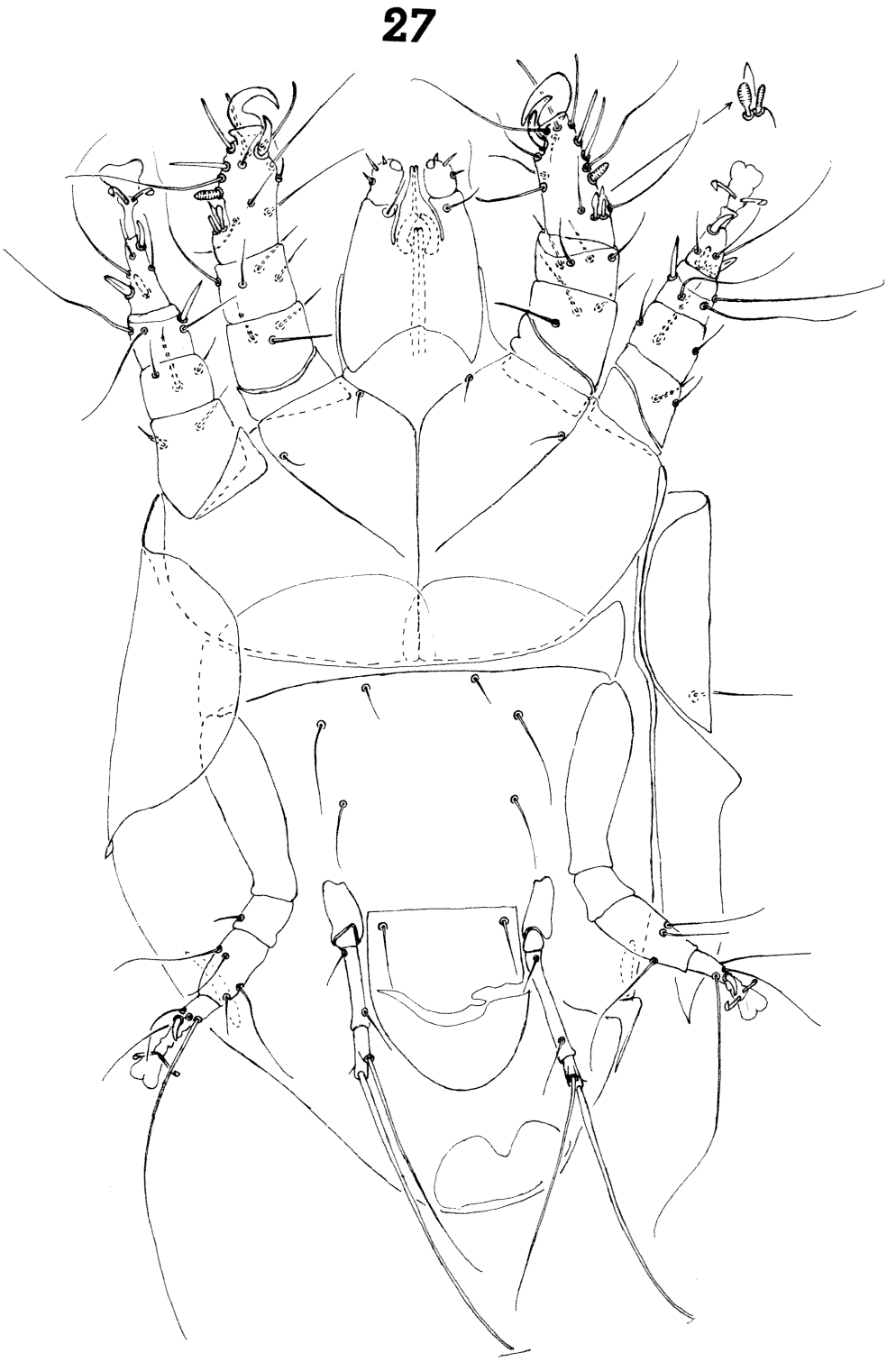

FIG. 27.—*Pseudotarsonemoides eccoptogasteris* Vitzthum. Female, venter.

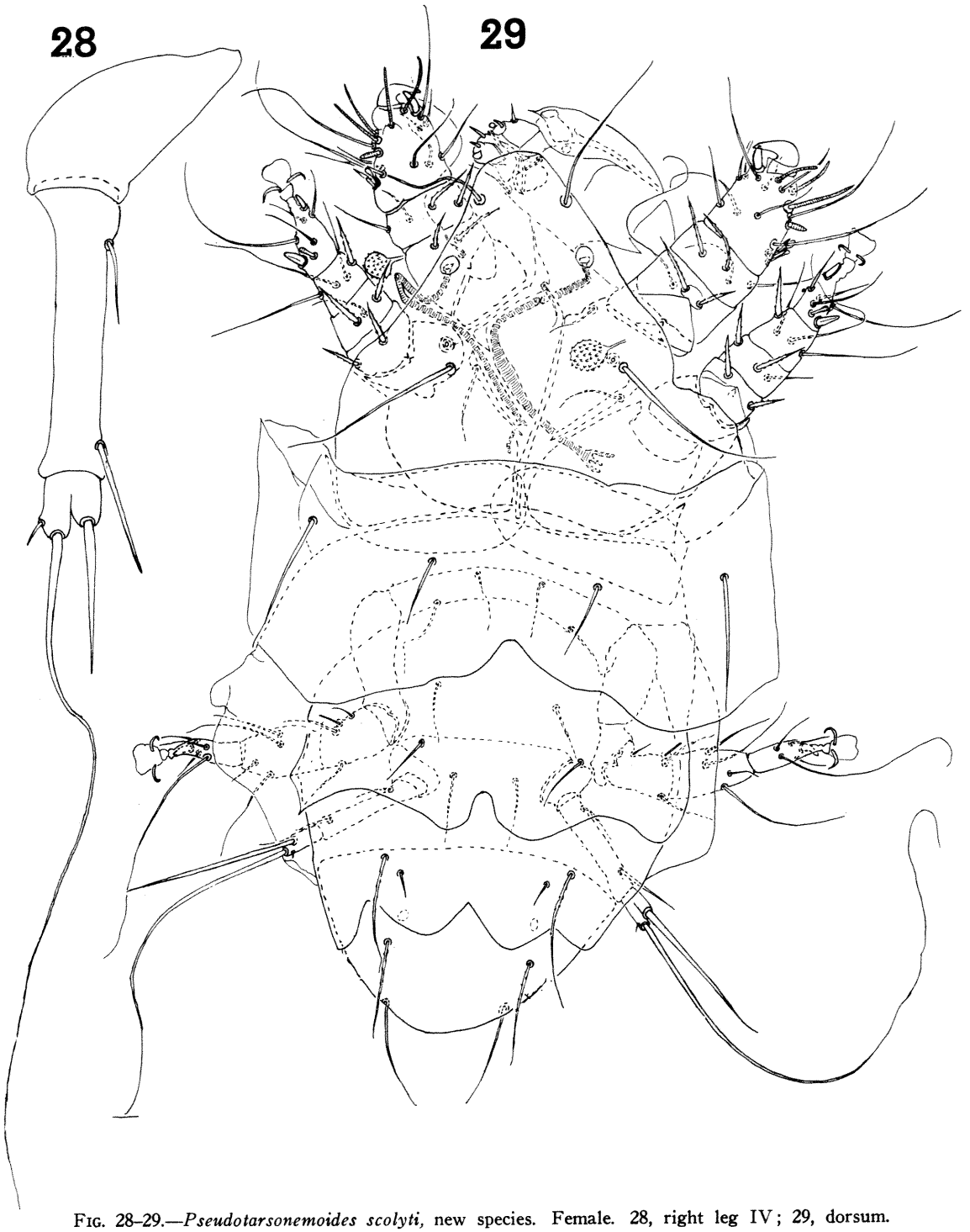

FIG. 28–29.—*Pseudotarsonemoides scolyti,* new species. Female. 28, right leg IV; 29, dorsum.

Natural History no. 3505, collected from *Neoclytus acuminatus* Fab., on white ash, Alexandria, Louisiana, 4 April 1964 by John C. Moser.

Paratype.—Five ♀ with the above data.

The species is named for Dr. H. Fechter, Zoologische Sammlung des Bayerischen Staates, München, West, Germany.

Pseudotarsonemoides americanus, new species

(Figs. 32–33)

The sclerotized notches on tibia III will separate this species from other known species in the genus.

Female.—Dorsum of body oval, without obvious punctations. Propodosomal shield semicircular-

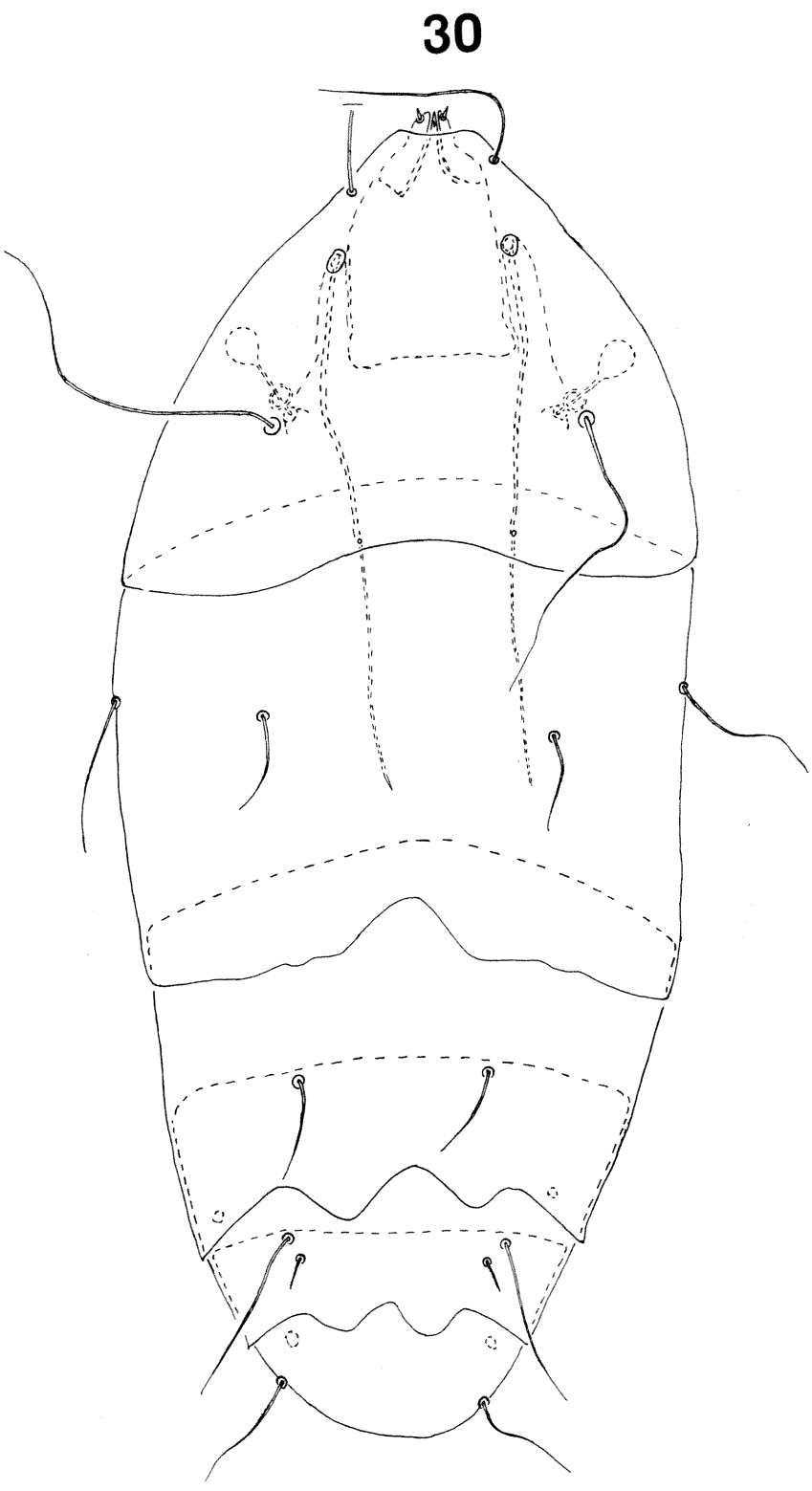

FIG. 30.—*Pseudotarsonemoides fechteri*, new species. Female, dorsum.

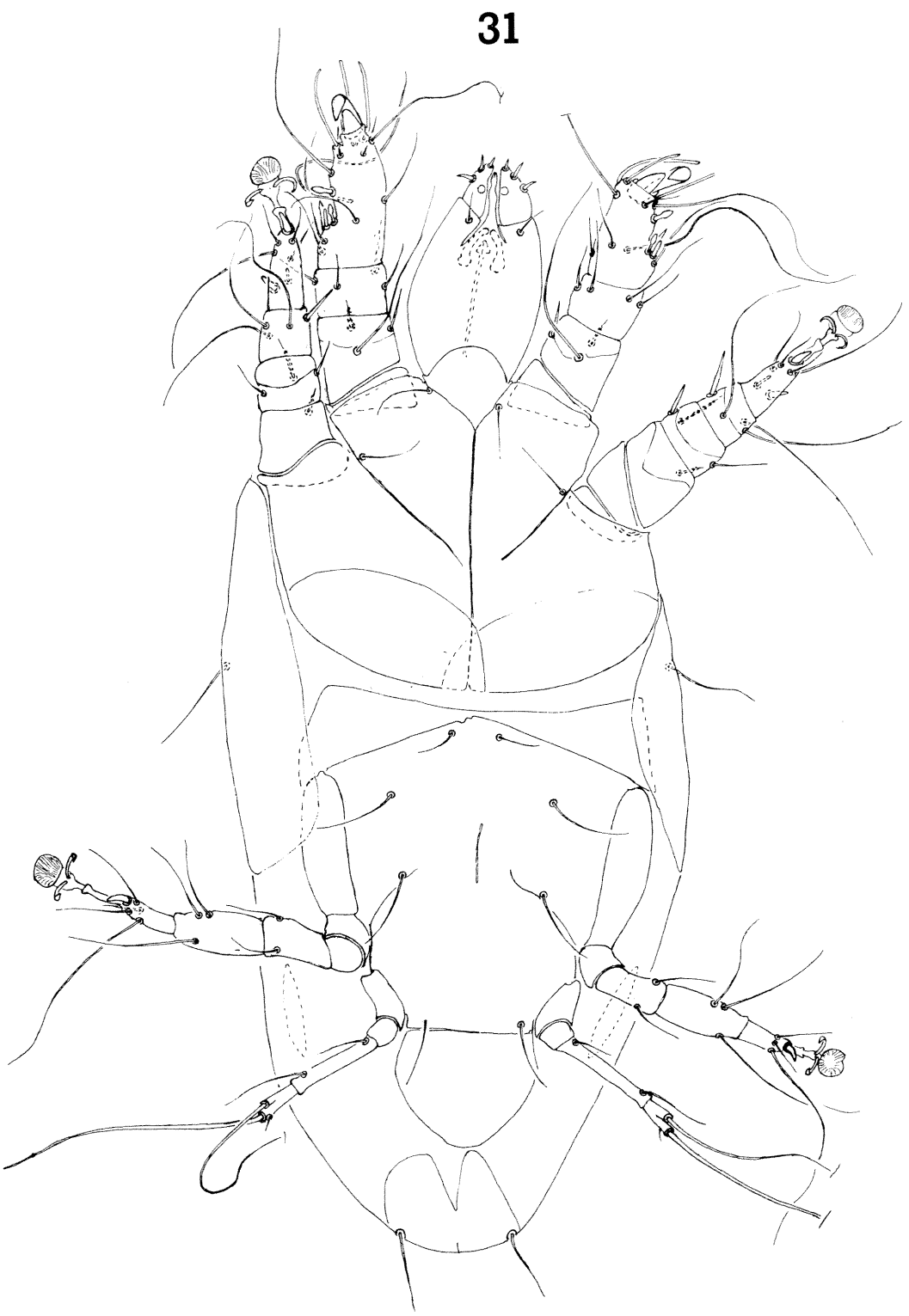

FIG. 31.—*Pseudotarsonemoides fechteri,* new species. Female, venter.

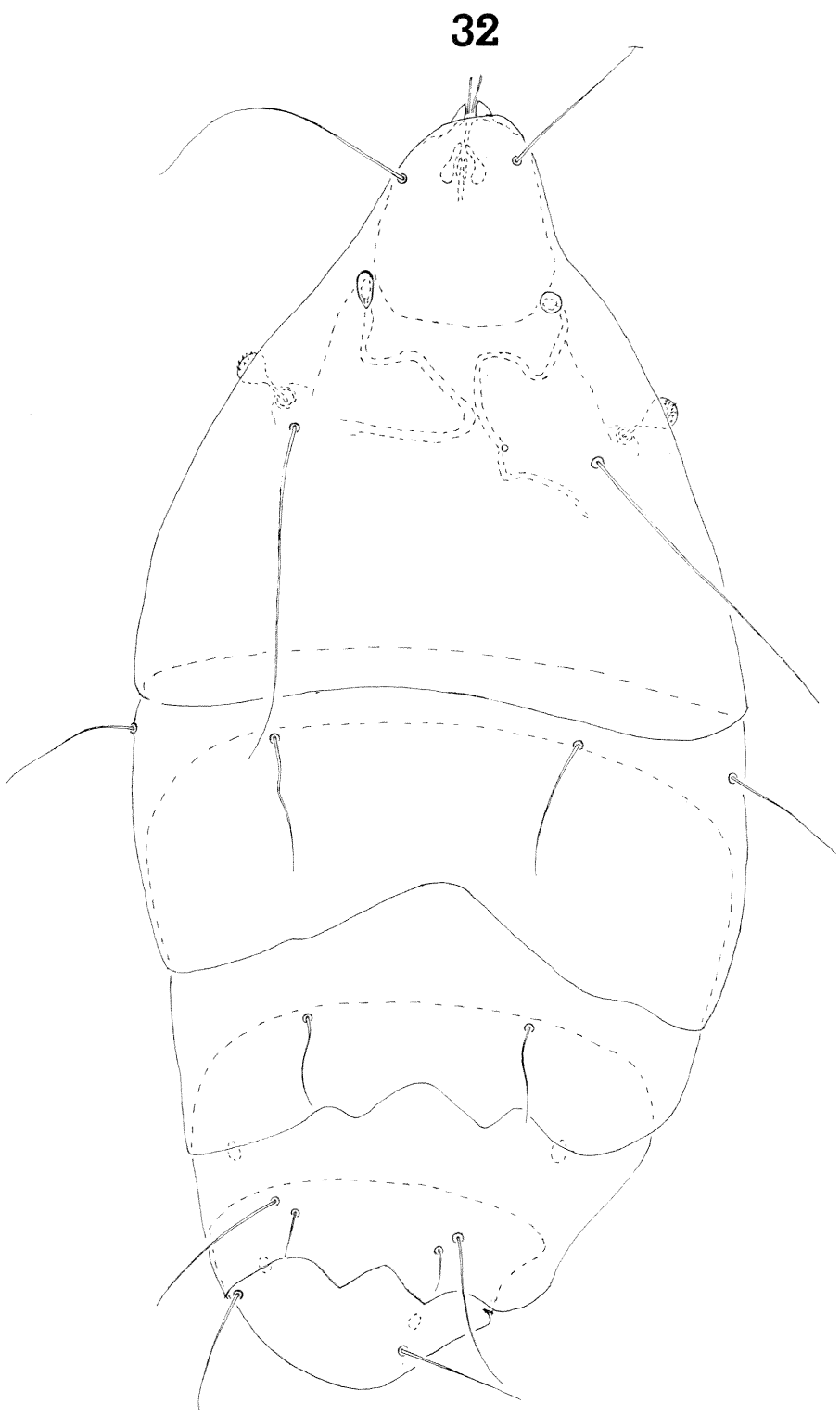

FIG. 32.—*Pseudotarsonemoides americanus*, new species. Female, dorsum.

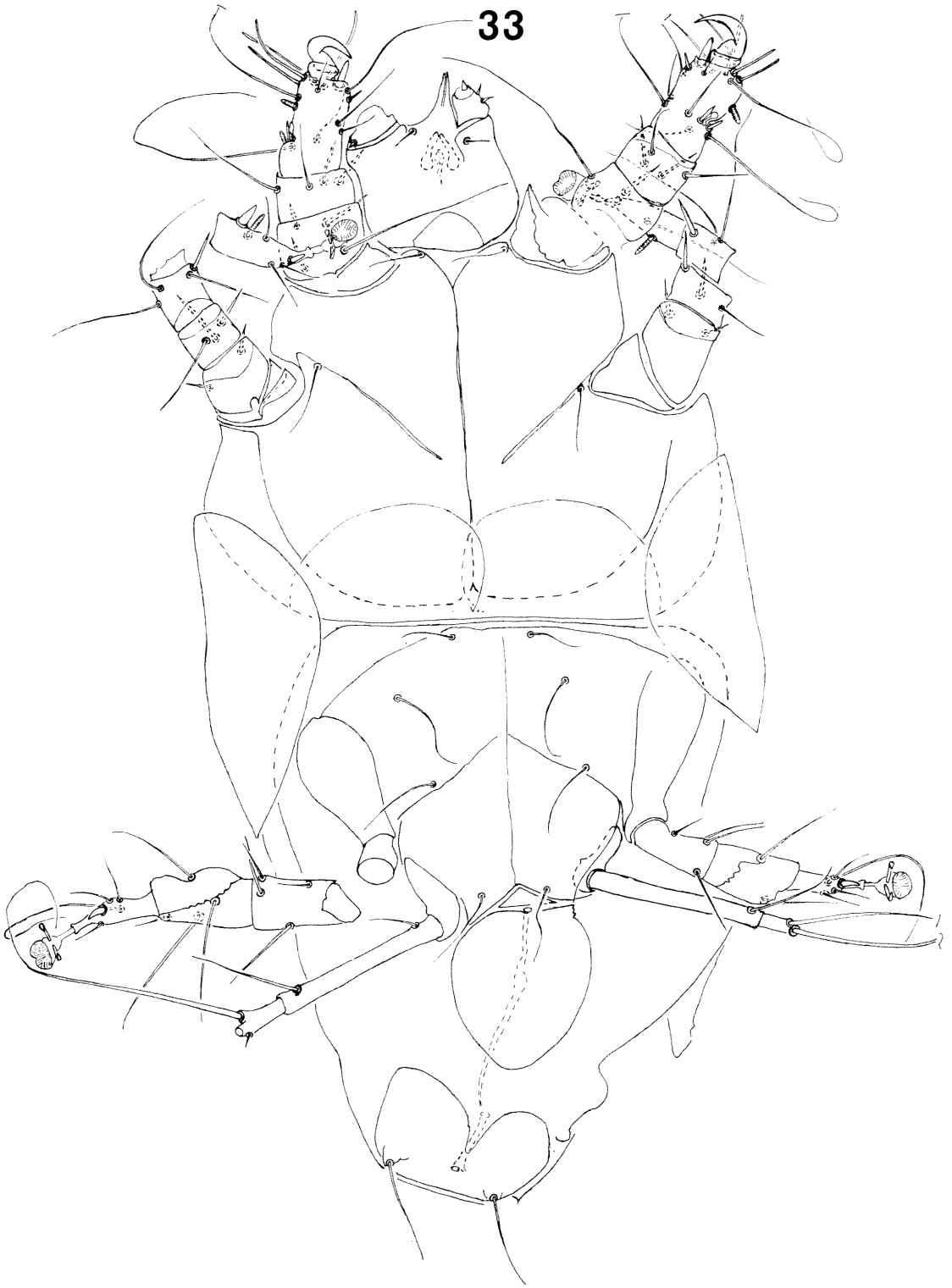

FIG. 33.—*Pseudotarsonemoides americanus,* new species. Female, venter.

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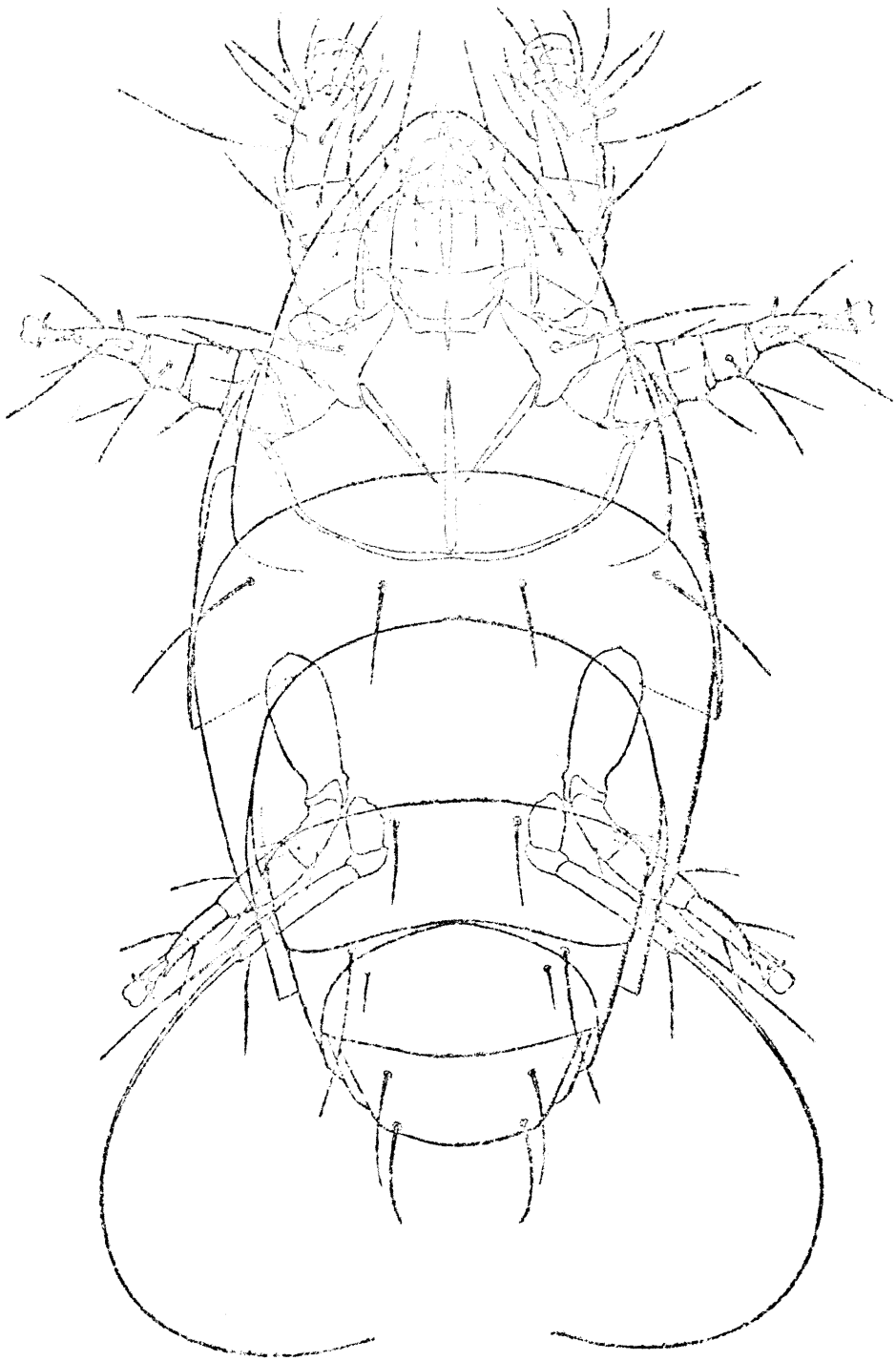


FIG. 34.—*Pseudotarsonemoides spinitarsus* Hirst. Female, dorsum, (after Hirst).

shaped apically; with 2 pairs of simple setae; anterior pair shorter than posterior pair. Pseudostigmatic organs globe-like, sparsely covered with small spicules. Trachea long, stout, originating at base of large dorsal stigmata. Gnathosoma not entirely covered by propodosomal shield; ca. as long as wide; with pair of large kidney-shaped glands at base of pharynx; palpi 2 segmented, ca. as wide as long, anterolaterally with 3 short spine-like setae. Hysterosoma with 4 tergites; tergites I-III indented. Tergite I with lateral and medial pair simple setae; 2nd tergite with 1 pair short, simple setae; 3rd tergite with 2 pairs of simple setae, inner pair ca. ¼ length of outer pair; 4th tergite with 2 pairs of simple setae, anterior pair shorter than posterior pair. Ventral apodemes as figured; 1st pair shorter than 2nd, forming Y-shaped juncture with anteromedian apodeme; 2nd pair stout, not uniting with anteromedian apodeme. Posteromedian apodeme uniting with apodeme III, but not with apodeme IV. Ventrocaudal lobe between legs IV, ca. as long as wide, spade shaped distally. Leg I robust, with large recurved claw and basal spine. Setation on femur, genu, and tibiotarsus of leg I: 3-4-8+1 solenidion, 4 bothridia, sensory triplet and 1 basal spine; leg II: femur, genu, tibia and tarsus, 2-3-4-7; leg III: femur, genu, tibia and tarsus, 1-3-4-5; leg IV trochanter, femorogenu, and tibiotarsus, 1-1-3. Body 300 μ long by 140 μ wide.

Holotype.—Female, Canadian National Collection no. 13178 collected from *Ips grandicollis* (Eichhoff) in *Pinus strobus* L., Falls Church, Virginia, 22 July 1924, by R. St. George.

Genus ***Tarsonemus*** Canestrini and Fanzago

Tarsonemus Canestrini and Fanzago, 1876a: 99–111.

Type-species.—Chironemus minusculus Canestrini and Fanzago, 1876.

Females of this genus can be recognized by the following characters: Propodosomal shield semicircular-shaped and sometimes covering more than half of the gnathosoma. Palpi never forming an elongated beak. Pseudostigmatic organs ellipsoidal shaped with many spicules. Dorsum punctated but never reticulated. Legs I-III with tarsal claws normal developed. Ventrocaudal or posteromedial lobe of metapodosoma semicircular or pointed distally behind the base of legs IV. The males possess the following characters: Propodosomal shield with four pairs of simple setae. Palpi never forming an elongated beak. Dorsum punctated or with longitudinal striae. Legs I-IV with tarsal claws normal developed. Femur IV with or without flange on inner margin. The flange may be buttonlike or triangular. Leg IV with tibia and tarsus separated and their combined length not more than half the length of the femur.

Tarsonemus kennedyi, new species

(Figs. 35–44)

The female of this species is closely related to *Tarsonemus ips* Lindquist. It is similar by apodemes III not extending laterally beyond anterior extremities of trochanter III. It is dissimilar by having a short posteromedial lobe on the venter of the metapodosoma and longer terminal setae on tergite IV.

Female.—Dorsum of body oval and without conspicuous punctation; broadest in region of metapodosoma shield semicircular, with anterior portion hoodlike and covering ½ of gnathosoma; vertical setae long and slender, ca. ½ as long as scapular setae; scapular setae twice as long as vertical setae; with inconspicuous apodeme posteromedially. Pseudostigmatic organs ellipsoidal with small spicules. Dorsum of hysterosoma with 4 tergites, with simple setae. Anterolateral setae of tergite I longer than other hysterosomal setae; posterior setae of tergite I longer than setae of tergite II, but not as long as setae of tergite IV; setae of tergite IV ca. ¾ length of anterolateral setae of tergite I, and longer than other tergital setae. Venter of propodosoma and hysterosoma as figured. Apodemes I short and converging with anteromedian apodeme forming a Y-shaped juncture, and adjacently with a short pair of simple setae. Apodemes II stout and distinct, not converging with anteromedian apodeme, and with a pair of simple setae subequal in length to those of apodeme I. Transverse apodeme inverted with U-shaped bends on each side of juncture before connecting with anteromedian apodeme. Apodemes III not connecting with posteromedian apodeme; apodeme IV connecting with posteromedian apodeme. Setae adjacent to apodeme III and IV simple, but longer than setae adjacent to apodemes I and II. Ventrocaudal lobe of metapodosomal ventral plate not as long as distance between base of legs IV. Genital-anal plate distinctive by possessing a pair of long simple setae, ca. ½ length of dorsal setae on tergite IV. Legs I and II similar in size, chaetotaxy as figured. Body 197 μ long by 95 μ wide.

Male.—Idiosoma oval, broadest in region of metapodosoma; dorsum with longitudinal striae as figured. Propodosomal shield subtriangular without conspicuous ornamentation; with 2 pairs of lightly barbed vertical setae; anterior pair subequal in length to posterior pair of scapular setae; posterior pair of vertical setae ca. ½ length of anterior pair with 2 pairs of scapular setae, anterior pair lightly barbed stout at base and gradually becoming slender distally; posterior pair lightly barbed, subequal in length to anterior vertical pair, but not as strong at base. Hysterosoma with 3 pairs of conspicuously barbed setae and lateral pair of long slender simple setae. Venter of idiosoma as figured. Setation on femur, genu, tibia and tarsus of leg I: 3-4-8-10; leg II; 3-3-4-6; leg III: 1-3-4-5; sensillus for tarsus II twice the size as sensillus for tarsus I. Leg IV atypical for genus: femur distinctive by possessing small triangular flange on inner margin with small simple seta. Setation for leg IV trochanter, femur, tibia and tarsus 1-4-2-3. Body 159 μ long by 76 μ wide.

Larva.—Body elongate, broadest in the region of

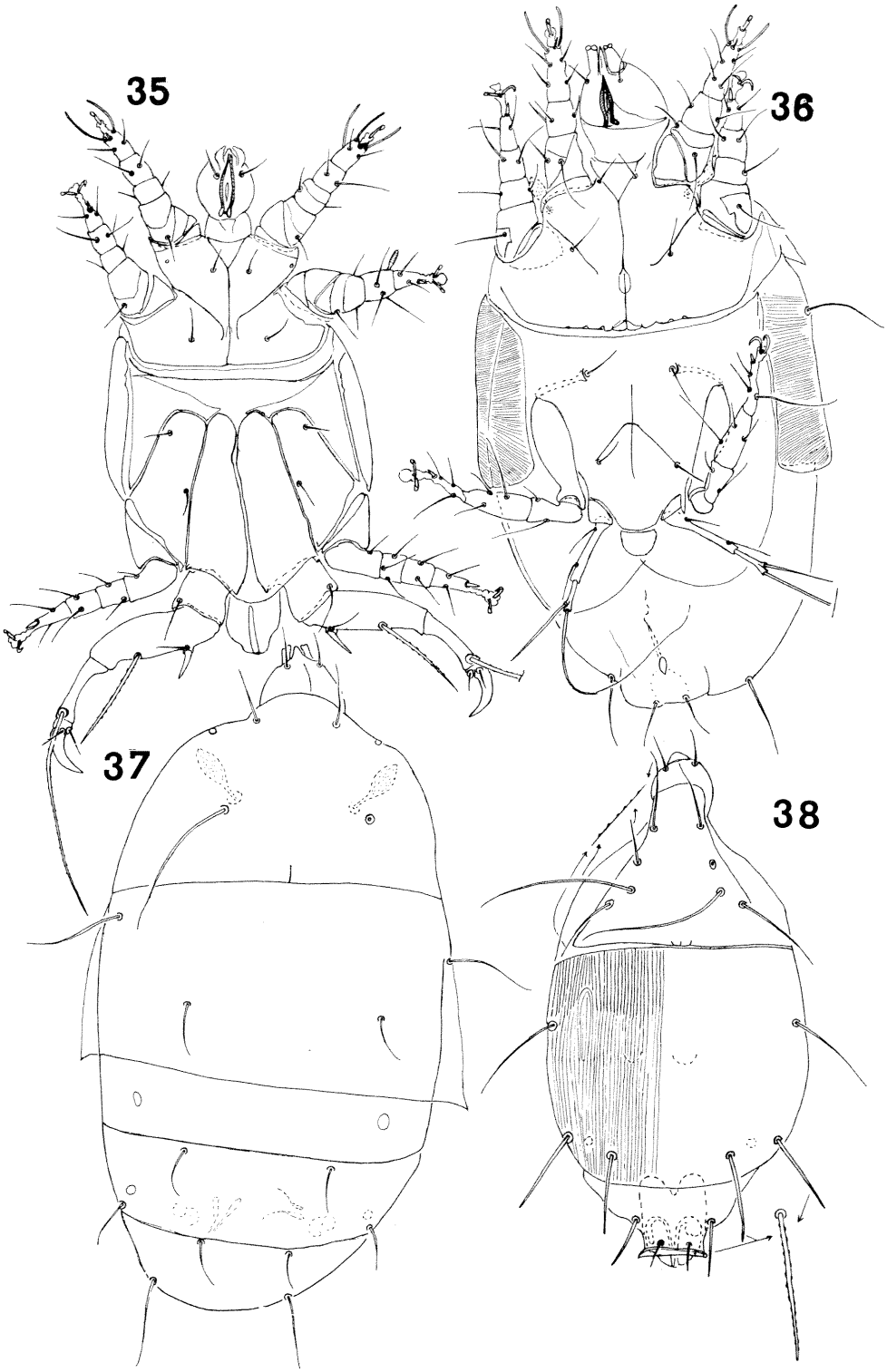


FIG. 35–38.—*Tarsonemus kennedyi,* new species. Male. 35, venter; 38, dorsum. Female. 36, venter; 37 dorsum.

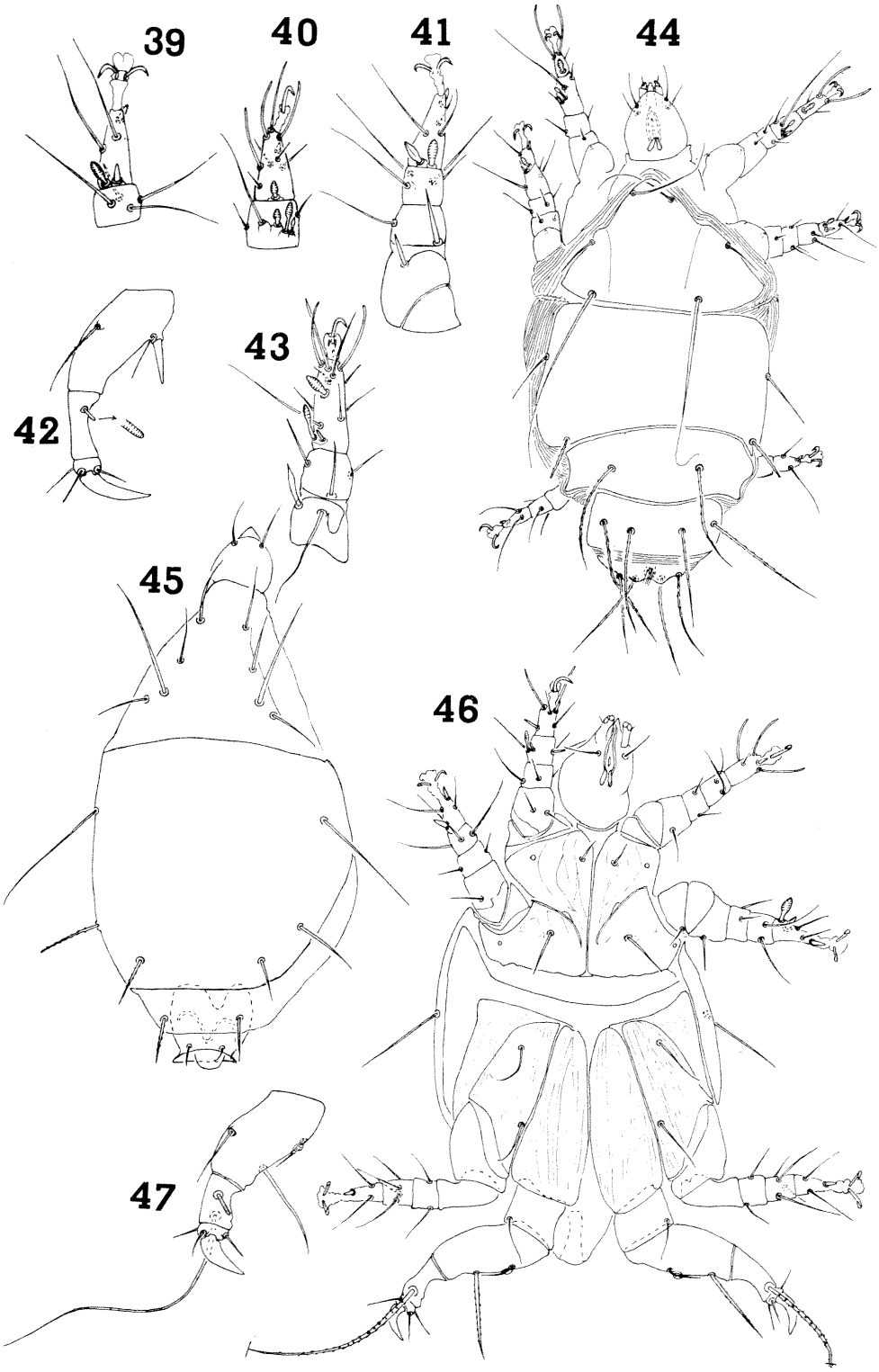
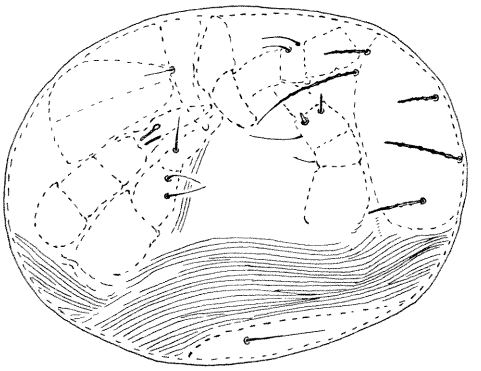


FIG. 39–44.—*Tarsonemus kennedyi*, new species. Male. 39, tarsus and tibia II; 40, tarsus and tibia I; 42, leg IV. Female. 43, leg I. Larva. 44, dorsum. FIG. 45–47.—*Tarsonemus ips* Lindquist. Male. 45, dorsum; 46, venter; 47, leg IV.

48

FIG. 48.—*Tarsonemus ips* Lindquist. Scan photograph distal idiosoma.

49



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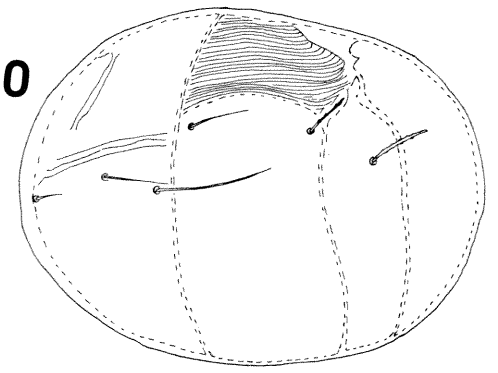

FIG. 49–50.—*Tarsonemus ips* Lindquist. Prepupa. 49, internal ventral development; 50, internal dorsal development.

51

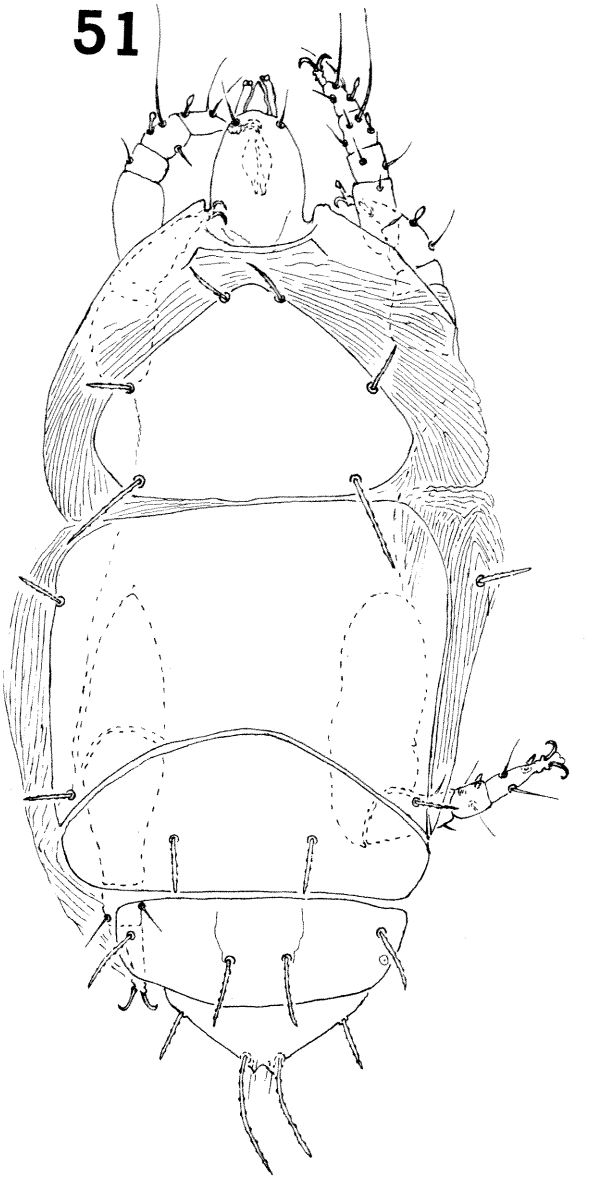

FIG. 51.—*Tarsonemus ips* Lindquist. Larva, dorsum.

the hysterosoma. Propodosomal shield triangular with 3 pairs of simple setae. Vertical setae ca. ⅓ longer in length than mediolateral setae; scapular setae extremely long, extending beyond base of setae on tergite II. Integument adjacent to shield with fine striae. Hysterosoma divided into 4 distinct tergites. Tergite I largest with 2 pairs of lateral setae, anterior pair simple and longest, posterior pair barbulate. Second tergite with a single pair of barbulate setae, subequal in length to the setae on tergite III. Third tergite with 2 pairs of barbulate setae. Fourth tergite distally with 2 pairs of barbulate setae, but not as long as setae for other hysterosomal tergites. Setation on femur, genu, tibia,

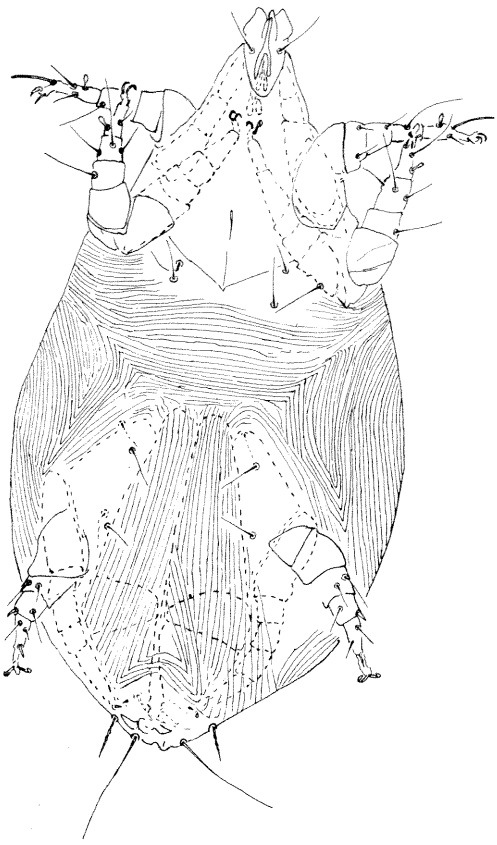

FIG. 52.—*Tarsonemus ips* Lindquist. Larva, venter.

and tarsus of leg I: 4-4-7-7; leg II: 3-3-4-6; leg III: 1-3-4-4. Body 148 μ long by 76 μ wide.

Holotype. — Female, U. S. National Museum of History, no. 3504, collected from inner bark of American elm with *Scolytus multistriatus* Marsh, Marion Co., Ohio, 1 February 1970, by John C. Moser.

Paratypes.—Five ♀ and 4 ♂ were collected from inner bark of American elm with *Scolytus multistriatus* Marsh, Delaware, Ohio, 1 January 1965, by John C. Moser.

The species is named for Dr. Bruce Kennedy, Northeastern Forest Experiment Station, Forest Service, USDA, Delaware, Ohio.

Tarsonemus ips Lindquist

(Figs. 45–55)

Tarsonemus ips Lindquist, 1969: 1292–1297.

The femur of *ips* is distinctive from other known species by having a small button-like flange (or modified seta) on femur IV. It is similar to the female by possessing conspicuous gland-like structures associated with the pharynx.

Male.—Idiosoma oval broadest in the region of the metapodosoma and with fine punctations. Propodosomal shield subtriangular; with 2 pairs of simple vertical setae, anterior pair longer than posterior pair and posterior pair of scapular setae; posterior vertical setae subequal in length to posterior scapular setae; anteroscapular setae ca. as long as length of shield but not extending beyond the anterior margin. Hysterosomal anterolateral setae simple, ca. equal in length to anteroscapular setae; setae in the region of the metapodosoma lightly barbed and as figured except for the simple pair on genital papilla. Venter of the idiosoma as figured. Setation on femur, genu, tibia and tarsus of leg I: 3-4-7-9; leg II: 2-3-4-6; leg III: 1-3-4-3. Leg IV robust and angulate; setation for trochanter, femur, tibia and tarsus: 1-4-2-3. Body 172 μ long by 89 μ wide.

Prepupa.—As figured (Figs. 49–50).

Larva.—Pharyngeal structure similar to that of female. Body elongate, broadest in the region of the hysterosoma. Dorsal propodosomal shield with 3 pairs of barbulate setae as figured; integument adjacent to shield with fine striae. Hysterosoma divided into 4 distinct tergites or shields. Tergite I largest, with 2 pairs of lateral subequal barbulate setae. Tergite II semicircular anteriorly, with a single pair of barbulate setae. Tergite III with 2 pairs of barbulate setae. Tergite IV with 2 pairs of barbulate setae, anterior pair ½ the length of the

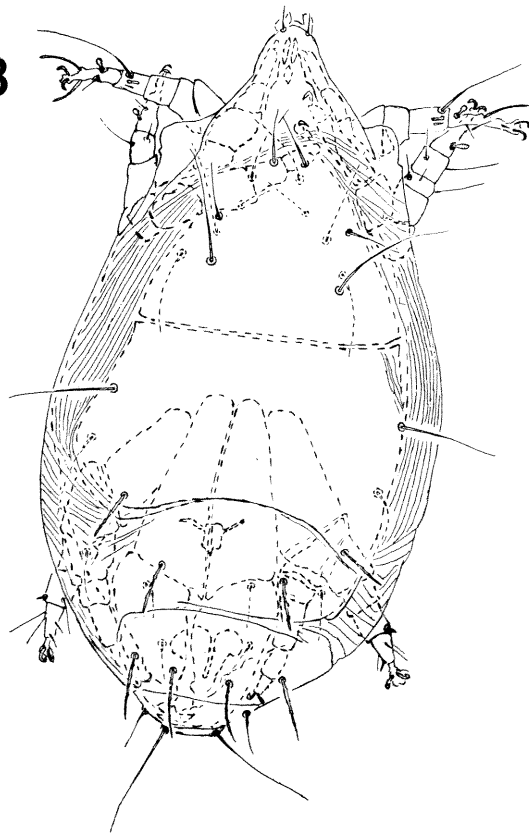

FIG. 53.—*Tarsonemus ips* Lindquist. Preadult, dorsum of male.

ventrodistal pair. Setation on femur, genu, tibia and tarsus of leg I: 4-4-7-7; leg II: 3-3-4-6; leg III: 1-3-44. Body 186 μ long by 93 μ wide.

Preadult stages.—(Figs. 53–55).

See Lindquist (1969) for the original collection data and distribution for the female of this species.

Locality and Host Records.—Based on the collection in the U. S. National Museum of Natural History.

Southern USA.—Elizabeth, Louisiana. 3 ♂, 1 ♀, 1 ♂ and 1 ♀ preadult stage from inner bark of loblolly pine with *Dendroctonus frontalis* Zimmerman, 4 March 1966, J. C. Moser. Bude, Mississippi. 2 ♀, 1 ♂ and 1 ♀ larvae from loblolly pine with *D. frontalis* Zimmerman, 30 September 1964 by John C. Moser.

Tarsonemus krantzi, new species

(Figs. 56–60)

The male and female of this species are closely related to the corresponding sexes of *T. subcorticalis* Lindquist as defined by Lindquist (1969), but differ by possessing strongly curved ventrodistal spine-like setae on tibiotarsus I and tarsus II. Lindquist

FIG. 54.—*Tarsonemus ips* Lindquist. Preadult, dorsum of female.

FIG. 55.—*Tarsonemus ips* Lindquist. Preadult, venter of female.

(1969) refers to the female of this species in the last couplet of his key to the females of the common tarsonemid associates of nearctic ipine beetles and illustrates tibiotarsus I and tarsus II of the female. His figure 11 for the male tibia and tarsus III is that of *T. suskii,* a species being here described and not of *krantzi.* The male of *krantzi* is similar to the male of *T. endophloeus* Lindquist but differs by having larger and stronger sensory setae for leg I.

Female.—Dorsum of body oval and with very fine punctations; broadest in metapodosoma region. Propodosomal shield semicircular shaped, with anterior portion hoodlike and covering ½ of gnathosoma; vertical setae stouter than scapular setae and not as long as distance between their bases; scapular setae slender, twice as long as vertical setae; with a conspicuous apodeme posteromedially. Pseudomatic organs ovoid with small spicules. Dorsum of hysterosoma with 4 tergites, with slender simple setae; anterolateral setae of tergite I subequal in length to posterior setae of this tergite. Setae of tergite II not as long as medial setae of tergite III. Lateral setae of tergite III short and stronger but not as

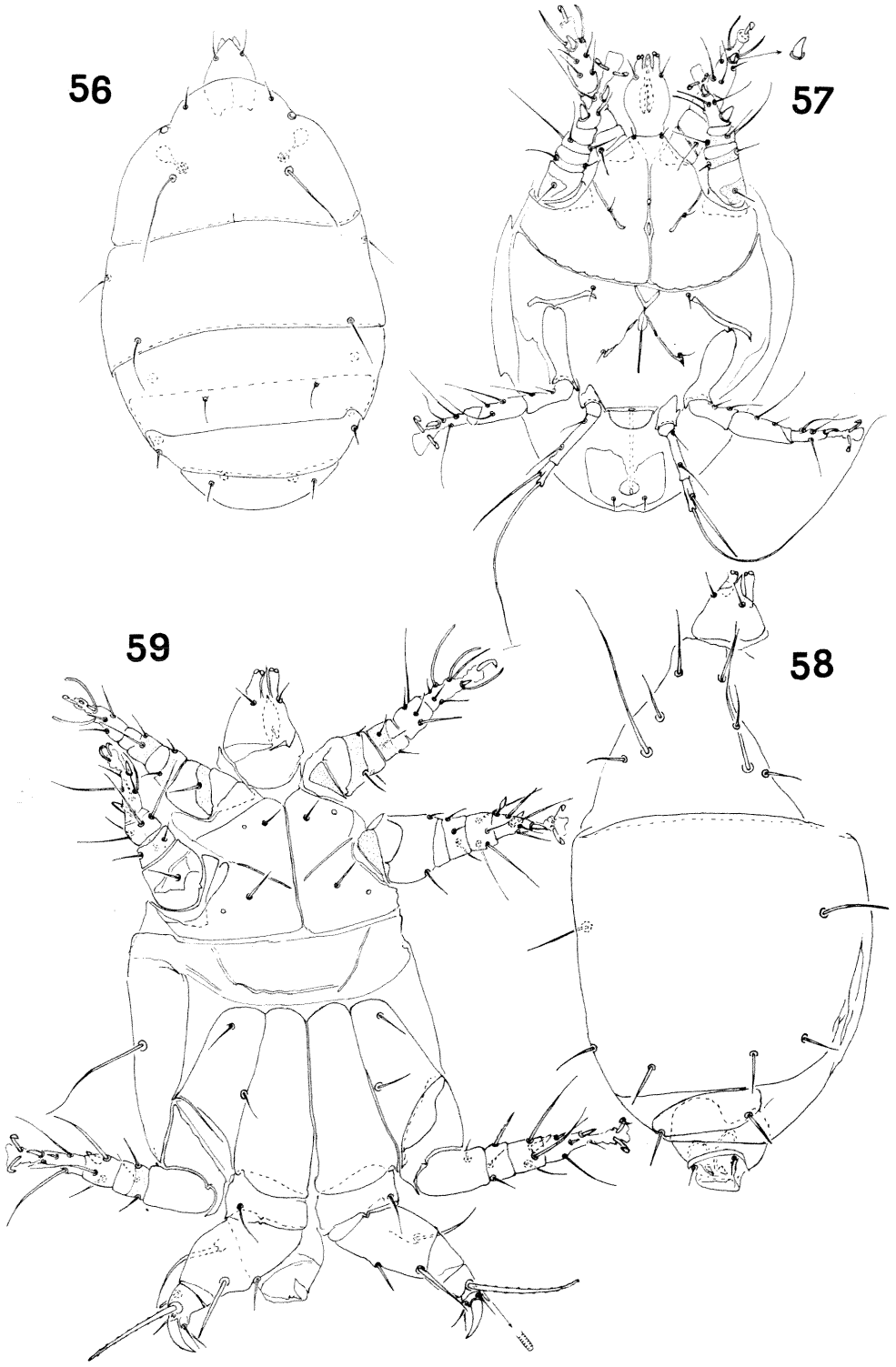

FIG. 56–59.—*Tarsonemus krantzi,* new species. Female. 56, dorsum; 57, venter. Male. 58, dorsum; 59, venter.

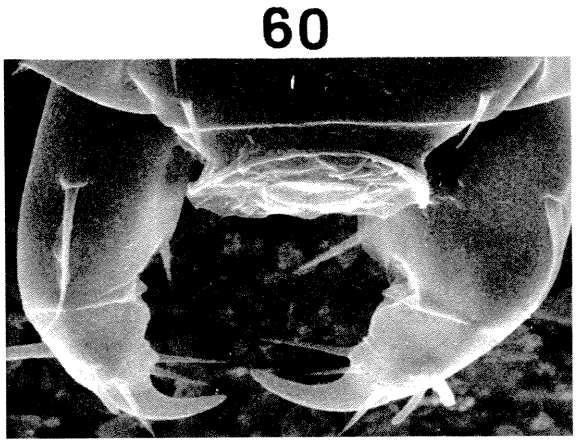

FIG. 60. — *Tarsonemus krantzi,* new species. Scan photograph of distal idiosoma.

long as setae of tergite IV. Venter of propodosoma and hysterosoma as figured. Apodeme I short and converging with anteromedian apodeme. Anteromedian apodeme with nodule between apodemes I and II. Transverse apodeme continuous with a few small vertical indentations on anterior ridge. Apodeme III strong and distinct and not converging with posteromedian apodeme, and extending beyond anterior portion of trochanters III. Setae adjacent to apodemes III and IV subequal in length. Ventrocaudal lobe of metapodosoma ventral plate not as long as distance between base of leg IV. Legs I and II similar in size and distinctive by having strong ventradistal spine-like setae on tarsal segments. Setation on femur, genu, tibia and tarsus of leg I: 4-4-8+8; leg II: 3-3-4-8; leg III: 1+3-4-5. Leg IV stout and reaching posterolateral edge of idiosoma. Body 146 μ long by 95 μ wide.

Male.—Idiosoma oval, broadest at metapodosoma. Propodosomal shield subtriangular and without conspicuous ornamentation; with 2 pairs of vertical setae, anterior pair longer than the posterior pair; with 2 pairs of scapular setae, anterior pair exceptionally long, almost as long as propodosomal shield; posteromedial pair short ca. ⅔ length of posterovertical pair. Hysterosoma with 5 pairs of simple setae, lateral pair longest; with 2 subequal pairs on a transverse row near the anterior region of metapodosoma; terminal tergite with a semirectangular shield. Venter of idiosoma as figured. Anteromedian apodeme strong and distinct, connecting with apodemes I and transverse apodeme, but not with apodemes II. Metapodosoma with 2 pairs of simple coxal setae; coxal setae III located behind apodemes III; coxal setae IV located laterad of apodemes IV. Legs moderately long and robust. Setation on femur, genu, tibia and tarsus of leg I: 3-4-8-10; leg II: 3-3-4-8; leg III: 1-3-4-5. Setation for leg IV trochanter, femur, tibia and tarsus 1-3-2-4. Body 173 μ by 79 μ wide.

Holotype. — Female, U. S. National Museum of Natural History no. 3506, collected on *Ceratocysis minor* from inner bark of loblolly pine, Bude, Mississippi 13 October 1969, by John C. Moser.

Paratypes.—Four ♂ collected from loblolly pine, Bude, Mississippi, 29 September 1964, by John C. Moser. Eight ♂ and 5 ♀ collected from inner back of loblolly pine feeding on *Ceratocysis minor,* Olla, Louisiana, 30 December 1969 by John C. Moser.

The species is named for Dr. G. W. Krantz, Department of Entomology, Oregon State University, Corvallis.

Discussion.—Tarsonemus krantzi is one of the mites commonly associated with southern pine bark beetles and was mistakenly identified as *T. subcorticalis* Lindquist by Moser and Roton (1971).

Tarsonemus wilkinsoni, new species

(Figs. 61–65)

This species, which is known only from the male, is characterized by the ventral punctations and the long slender dorsal setae.

Male. — Idiosoma oval, broadest at anterior of hysterosoma. Propodosomal shield subtriangular and without conspicuous ornamentation; with 2 pairs of slender simple vertical setae, anterior pair subequal in length to posterior pair of scapular setae; posterior pair of vertical setae ca. ½ length of anterior pair; with 2 pairs of scapular setae; anterior pair ca. as long as length of shield; posterior pair subequal in length to anterior pair of vertical setae. Hysterosoma with 3 pairs of simple setae and a lateral pair which are subequal in length to those in region of the metapodosoma. Venter of idiosoma as figured. Setation on femur, genu, tibia and tarsus of leg I: 3-4-8-10; leg II: 2-4-4-6; leg III: 1-3-4-3. Leg IV robust and angulate; setation for trochanter, femur, tibia and tarsus: 1-3-2-3. Body 146 μ long by 63 μ wide.

Holotype.—Male, U. S. National Museum of Natural History, no. 3507, collected from boring dust made by *Dendroctonus frontalis* Zimmerman and *Ips cribricollis* (Eichhoff) in *Pinus oocarpa* Schiede, Tegucigalpa, Honduras, 17 March 1966 by R. Wilkinson.

Paratype.—One ♂ with the above data. The species is named for Dr. R. C. Wilkinson, Department of Entomology, University of Florida, Gainesville.

Tarsonemus suskii, new species

(Figs. 66–69)

This species, known only from the male, is distinctive from other species of the genus by possessing three ventral spine-like structures (setae) on tarsus III.

Male.—Idiosoma oval broadest in the region of the metapodosoma and with fine punctation. Propodosomal shield subtriangular with 2 pairs of simple vertical setae, anterior pair twice the length of posterior pair; anterior pair of scapular setae longer than other propodosomal setae; posterior pair of scapular setae not as long as the posterior pair of vertical setae. Hysterosoma with a lateral pair of

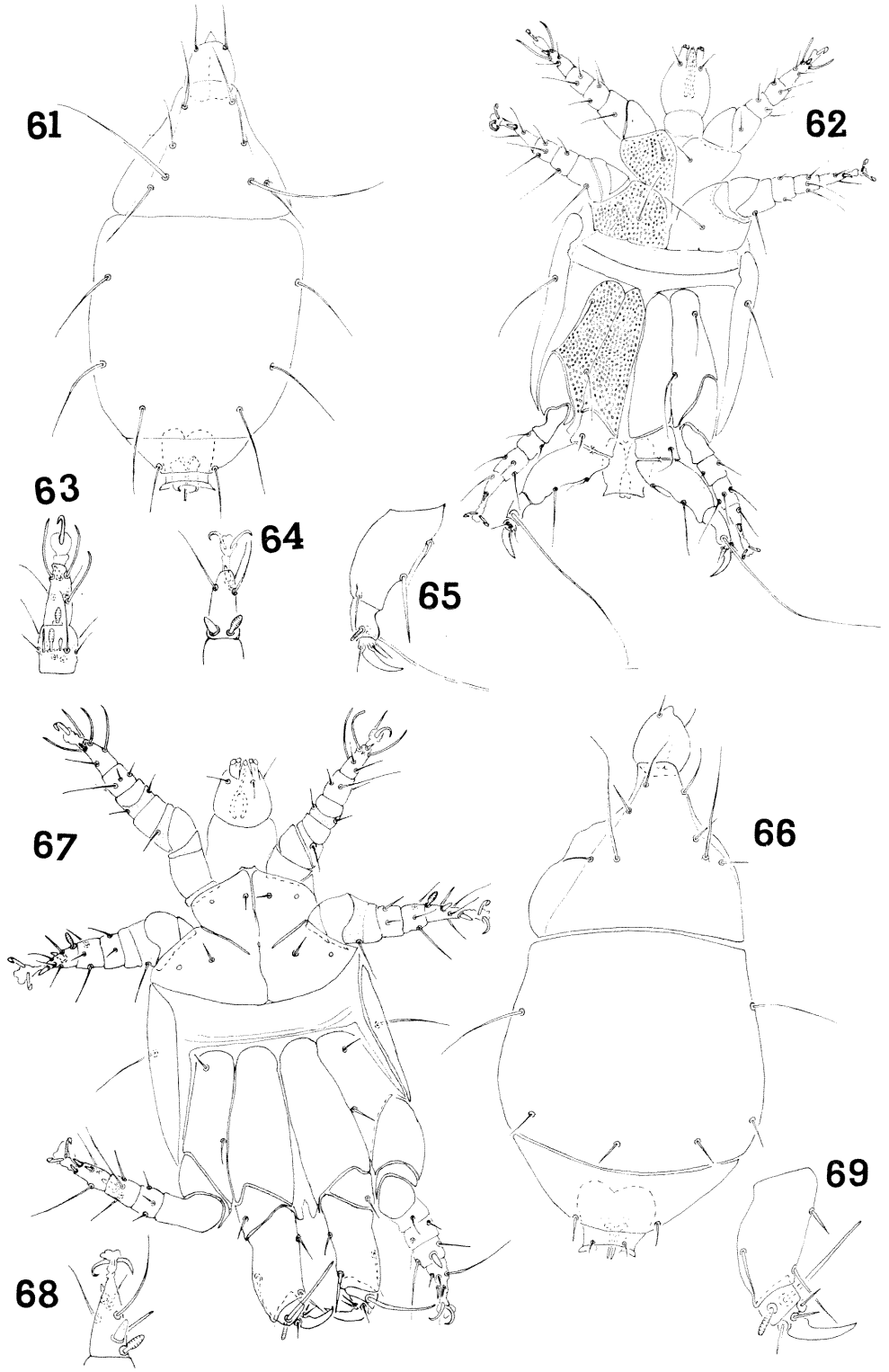

FIG. 61–65.—*Tarsonemus wilkinsoni*, new species. Male. 61, dorsum; 62, venter; 63, tarsus and tibia I; 64, tarsus II; 65, leg IV. FIG. 66–69.—*Tarsonemus suski*, new species. Male. 66, dorsum; 67, venter; 68, tarsus II; 69, leg IV.

simple setae, and 3 short pairs of simple setae, excluding the pair on the genital papilla. Venter of the idiosoma as figured. Setation on femur, genu, tibia and tarsus of leg I: 3-4-8-10; leg II: 1-3-4-7; leg III: 1-3-4-5. Leg IV robust and rectangular-shaped; setation for trochanter, femur, tibia and tarsus: 1-3-2-4. Body 172 μ long by 89 μ wide.

Holotype. — Male, Canadian National Collection no. 13179 collected from galleries of *Dendroctonus frontalis* Zimmerman in short leafpine, Acomac, Virginia, 14 April 1965, by R. Beckwith.

The species is named for Dr. Z. W. Suski, Institute of Pomology, Skierniewice, Poland, who has contributed greatly to our knowledge of this family.

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