

TAXONOMY AND BIOLOGY OF SOME PYEMOTIDAE
(ACARINA : TARSONEMOIDEA) INHABITING BARK BEETLE GALLERIES
IN NORTH AMERICAN CONIFERS

BY

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AND

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ABSTRACT.

The pyemotid genera *Pygmephorus* and *Pyemotes* are redefined. The former is divided into two morphologically and ecologically distinct subgenera, *Pygmephorus sensu stricto* and *Pygmephorus* (*Pygmephorellus*), new subgenus. Three new species, *Pyemotes parviscolyti*, *Pygmephorus* (*Pygmephorellus*) *bennetti* and *P. (P.) brachycercus* are described.

Among the numerous mite species found in galleries of North American bark beetles are those of the family Pyemotidae. Since taxonomy and biology of the family were last outlined (CROSS, 1965), important observations have been made, particularly about the several genera which inhabit these galleries. At least three species of *Pyemotes* (*P. scolyti* (Oudemans),? *ventricosus* (Newport), and *parviscolyti*, n. sp.) are known. We found *P. scolyti* with *Scolytus multistriatus* (Marsch.) brood in elm bark. *P. ?ventricosus* was found attacking broods of *Phthorophloeus dentifrons* Blkm. and a buprestid, *Agrilus lecontei* Saund. in hackberry twigs (BISHOP, 1969). *P. parviscolyti* n. sp. was reported to be specific to *Pityophthorus bisulcatus* Eichh. in pine twigs (MOSER and ROTON, unpublished). E. E. LINDQUIST (personal communication) collected unidentified species from *Phloeosinus* sp., *P. cupressi* Hopk., *Pityophthorus* sp., *Polygraphus rufipennis* Kby., and *Ips pini* Say; we have undetermined material from *Scolytus unispinosus* Lec., *S. ventralis* Lec., *Monarthrum fasciatum* (Say), and the tip moth, *Rhyacionia frustrana* (Comst.).

The subgenus *Pygmephorellus* ³, described here, is represented in our material by three species. One of these, *P. bennetti*, is the most widely distributed and frequently encountered pyemotid in scolytid galleries. Two other species, *P. brachycercus*, described here, and *Pygmephorellus* sp. (undescribed) seem to be much less common under bark. *Bakerdania sellnicki* (Krczal), a cosmopolitan form known from a wide variety of habitats, was recorded once, as was *Siteroptes* sp., both from Louisiana. We have specimens of *Paracarophenax* (prob.) *ipidarius* (Redikortsev, 1947) from Ontario and California, and of *Acarophenax* sp. from Honduras.

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3. MAHUNKA's description of *Elattoma* (Reichenbachia 12 : 83, 1969) appeared shortly after the submission of this manuscript. *Pygmephorellus* is therefore a synonym of *Elattoma*.

The biology of most pyemotids is unknown. Exceptions are certain *Pyemotes*, which gained early notoriety when their bites were found to cause "grain itch" in granary workers. When WEBSTER (1883) found that these mites were actually parasites of grain-inhabiting insects, the general assumption was that all pyemotids are parasites. However, parasitism by pyemotids is probably restricted to members of the genus *Pyemotes*, most or all members of the subfamily Acarophenacinae, and certain Microdispini.

In an earlier paper, CROSS (1965) outlined the feeding habits of various pyemotid groups. Since that time, ELBADRY and TAWFIK (1966) have found that a species of *Adactylidium* parasitizes the eggs of *Gynaikothrips ficorum* (Marchal) in the United Arab Republic, and FLECHTMANN and de ARRUDA (1967) recorded an association between *A. beeri* Cross and *G. ficorum* in Brazil. RACK (1967) believes *Dolichocybe hippocastani* Rack, 1967, to be a fungivore or a saprophage. GURNEY and HUSSEY (1967) have cultured two species of Pygmephorinae upon fungi in the laboratory. SPEIR (*in litt*) has conducted studies which indicate that *P. (P.) bennetti* is also a fungivore, although he was not able to rear the mites *en masse* consistently. CROSS (1965) stated that *Trochometridium tribulatum* Cross was a parasite of larval Hymenoptera. Recently CROSS and BOHART (unpublished) have reared this species upon an unidentified fungus taken from bee cells, although the mite is not found in association with healthy bee larvae and may overtly or indirectly kill the egg or young larva.

This paper redefines the genera *Pygmephorus* and *Pyemotes*, taking into account new findings, and describes three new species associated with bark beetles or their galleries.

The scheme of classification, method of description, terminology, and system of measurements are largely those of CROSS (1965). There are some exceptions :

1. Length of body of females. Taken from the ventral junction of apodemes I ("V" of throat) to posterior margin of hysterosoma.
2. Length of body of males. Taken from junction of apodemes I to anterior sternocoxal condyles IV (fig. 4, SC).
3. Length of gnathosoma. Taken with palpi extended except in *Pyemotes*, in which the palpi appear fused to the gnathosoma. Other exceptions are listed in the text where applicable.

All measurements are in microns.

We gratefully acknowledge the USDA Forest Service, Southern Forest Experiment Station, which supported this research in part (Grant FS-SO-2203-1.9) ; Dr. Herbert KRCZAL, Institut für Obstkrankeheiten, Heidelberg, Germany, for lending us specimens of *Pygmephorus karafiati* (Krczal, 1959) ; Mr. Franco Rossi, The Engis Equipment Co., for figures 6 and 7. These photomicrographs were made with the Engis scanning electron microscope.

Pyemotes Amerling, 1861.

CROSS (1965) described both sexes of the genus *Pyemotes*, but the description of males was based upon only one species. Examination of new material, including males of at least two additional species, has led to several changes in the descriptions.

Female. As in CROSS (1965, p. 95) except :

Hysterosoma. Dorsum. Apodemes III and IV short ; III gently arcuate to gently sigmoid.

Male. As in CROSS (1965, pp. 96-97) except :

Propodosoma. Dorsum. Large, trapezoidal or hemispherical or with sides sinuate, bearing three¹ but usually four pairs of setae, the most anterior mesal pair often tiny.

Hysterosoma. Dorsum. Dorsal segmentation modified, first plate variable in shape (sub-circular, bandlike, or trapezoidal), and bearing sometimes two but usually three pairs of setae; second plate reaching base of genital capsule, bearing one to (rarely) four pairs of setae. *Venter.* Genital capsule with one dorsal pair and one ventral pair of suckerlike structures or not.

Legs. Coxa IV quadrate to thickly crescentic; trochanter IV distinctly arcuate; width uniform.

***Pyemotes parviscolyti*, n. sp.**

(figs. 1-7).

This species is most closely related morphologically to *P. scolyti* (Oudemans, 1936), a relationship not unexpected in view of the host preferences of the two species. It was first found by MOSER in the tunnels of the coniferous twig beetle *Pityophthorus bisulcatus* Eichh., in central Louisiana, where it was found to attack all immature stages of the beetle. Mite-infested beetle galleries were found in twigs of *Pinus taeda* L., *P. palustris* Mill., *P. elliottii* Engelm., and *P. echinata* Mill.

Diagnosis. Females are separable from those of *scolyti* in several ways. The posterior margin of the propodosomal dorsum is rounded, the posterior margin of tergum III is produced or truncate but not emarginate, the solenidium of tarsus I arises from the dorsoapical angle of the segment, and internal ventrals II arise from the posterior portions of apodemes II. They are separable from all other females in the genus by these characteristics: poststernals are distinctly closer together than the hysterosomal ventrals, parts of the propodosomal dorsum and terga I-III have longitudinal striae, and internal ventrals II arise from apodemes II. Males are immediately separable from those of all other known members of the genus by the pattern and dimensions of the dorsal setae (fig. 5).

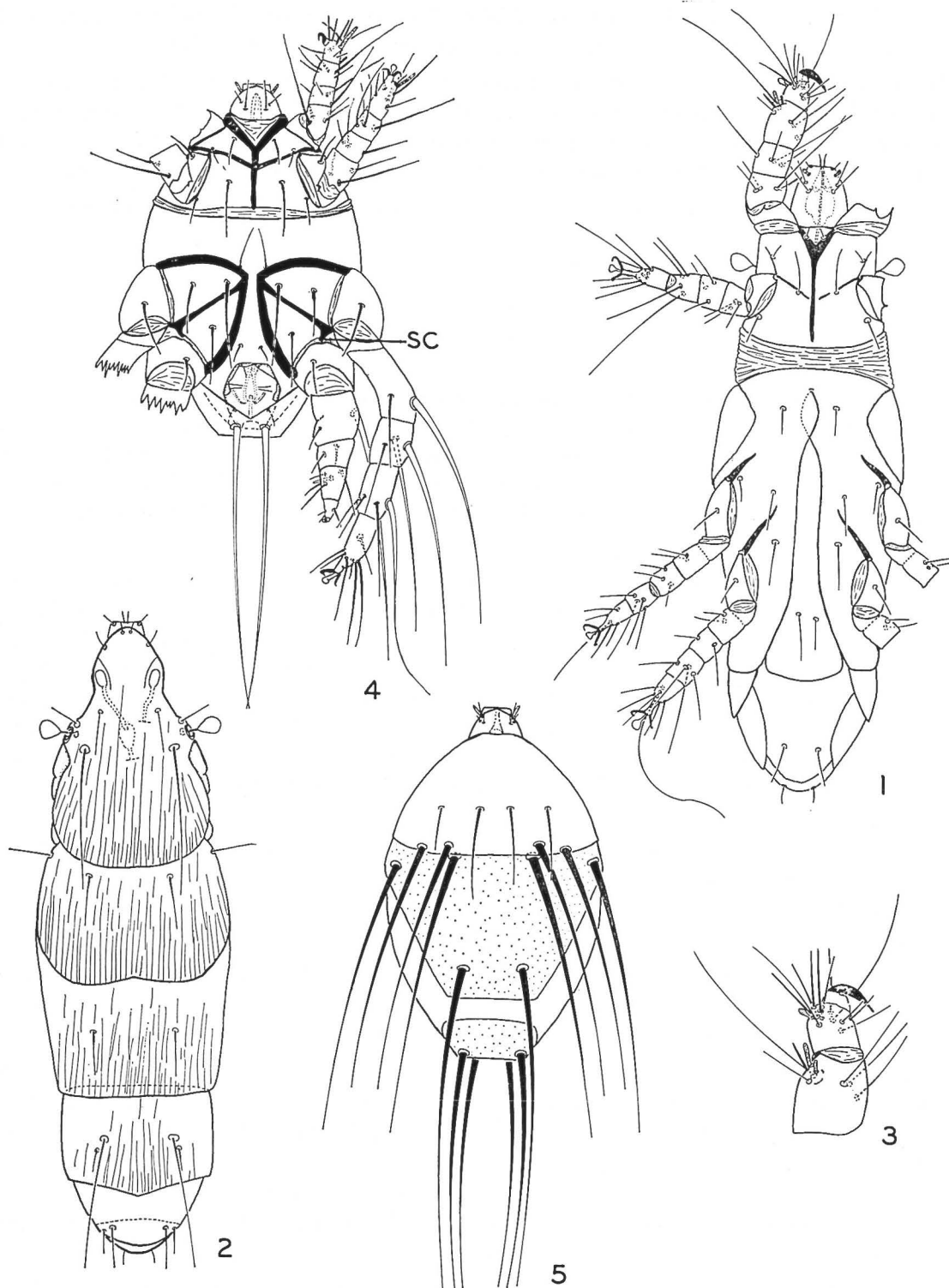
Description of non-gravid female. Length, 216 (216-240); body moderately sclerotized; propodosomal dorsum and terga I-III with coarse, parallel striae, heaviest on posterior two-thirds; striae lacking on terga IV and V and on the entire ventral surface; all body setae thin, nude, and flagellate.

Gnathosoma. Comparatively narrow, length (measured from "lower lip" to posterior margin of dorsal surface) 31 (29-32); width 25 (25-27); first palpal seta extending well beyond gnathosomal margin; palpal solenidium (probably solenidium 1) moderately slender, clavate.

Propodosoma. Dorsum. Anterior margin indistinct, posterior margin rounded. *Venter.* Angle between apodemes I acute; apodemes II distinctly oblique, not (or weakly) meeting anterior median apodeme; internal ventrals II arising from (or their areolae contiguous with) apodemes II.

Hysterosoma. Dorsum. Posterior margin of first tergum shallowly and broadly emarginate; posterior margin of segment II truncate; hind margin of segment III produced slightly dorso-medially (or truncate), not emarginate; dorsals I distinctly posterior to laterals I, distance between former setae subequal to that between dorsals II; dorsals III distinctly longer than remain-

1. KRCZAL (1959) indicates *P. scolyti* to have but one pair of propodosomal dorsals, but specimens in collection of senior author thought to belong to that species have at least three, and possibly four pairs.



FIGS. 1-5 : *Pyemotes parviscolyti*, n. sp.

1-2. — Holotype female, ventral and dorsal aspects; 3. — Right tibiotarsus I, holotype, ventral aspect;
4-5. — Allotype male, ventral and dorsal aspects. SC = anterior sternocoxal condyles IV.

ning dorsal setae, about a fourth shorter than posterior pseudostigmatal setae ; dorsals III slightly closer together than dorsals I and II ; laterals III short, not (or barely) reaching posterior margin of segment ; dorsals IV distinctly longer and stouter than laterals IV but less than half as long as dorsals III. *Venter*. Apodemes III and IV subparallel, well developed laterally, straight (or weakly sigmoid), not anastomosing medially, poststernals distinctly closer together than opisthosomal sternals.

Legs. Leg I, 15.8 (12.4-15.8) wide ; leg II, 12.4 (7.9-12.4) wide ; fege I, 13.6 (13.6-14.7) long ; ti I, 15.8 (15.8-20.3) long ; leg IV, 63.3 (63.3-67.8) long ; solenidium of ta I arising near latero-distal angle of segment ; the two solenidia of ti I arising in a transverse line, a blade seta arising dorsally near them ; solenidium of ta II arising on transverse or subtransverse line with two flagellate dorsal setae and midway between them ; solenidia of ti II and III lacking.

Description of male. Length, 112 (85-116) ; body well sclerotized, ventral apodemes heavy ; all body setae nude and flagellate ; body ovoid in dorsoventral aspect, tapering posteriorly ; dorsal striae lacking.

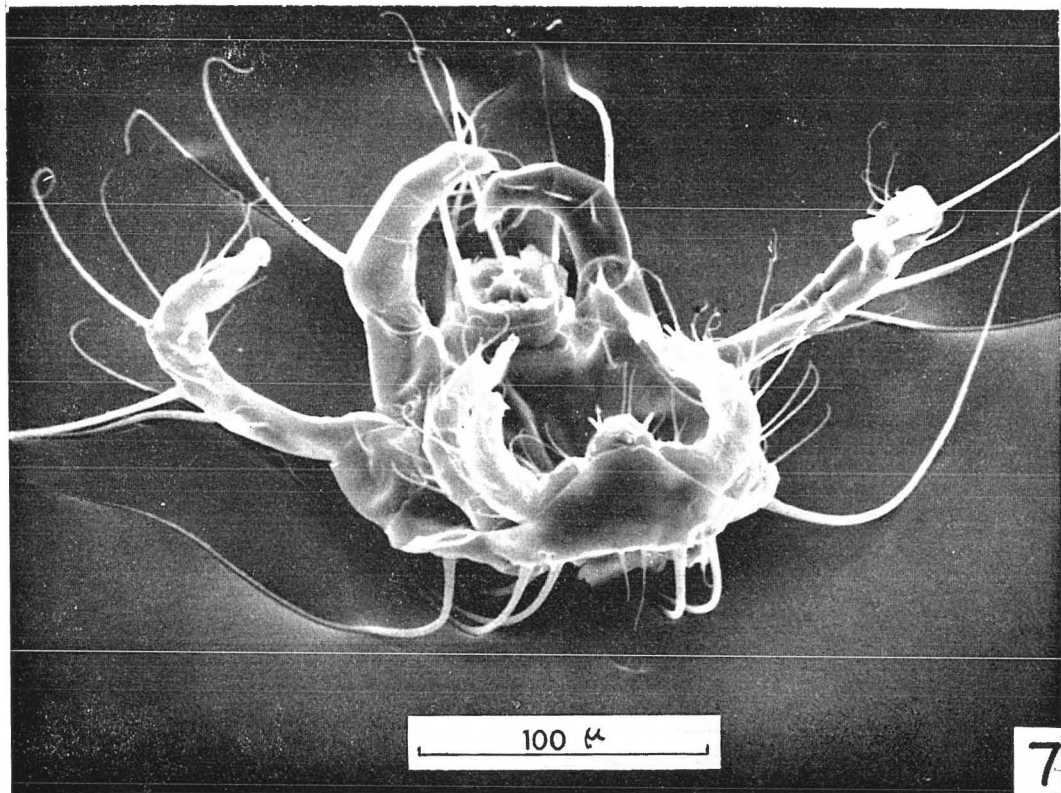
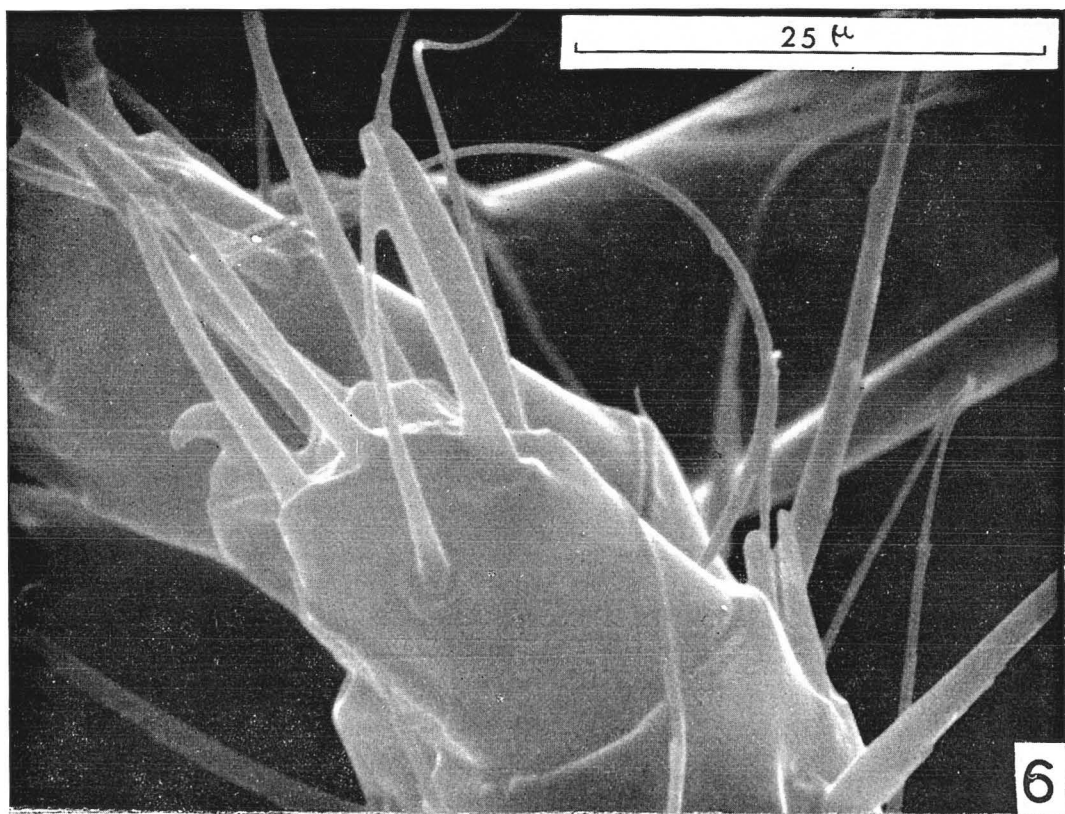
Gnathosoma. Subglobose as seen from above ; two pairs of dorsals nearly in a transverse line ; second palpal seta dorsal, arising above base of palpal solenidium ; palpal solenidium apicolateral, cylindrical, elongate, extending beyond gnathosomal margin by most of its length.

Propodosoma. *Dorsum*. Broad, subhemispherical in dorsal aspect ; posterior margin gently (to strongly) rounded ; four pairs of setae arranged in two subtransverse series of two pairs each, those of the anterior row subequally spaced, less than a third as large as those of the posterior row ; setae of anterior row asymmetrically unequal (to subequal) in size ; anterior median pair of setae arising on (or in front of or behind) line drawn between anterior lateral pair ; internals of posterior row arising slightly anterior to externals ; setae of posterior row thick and elongate, extending beyond areolae of setae of second dorsal plate. *Venter*. External ventrals I appearing to arise from apodemes II (or usually distinctly anterior to apodemes II) ; internal ventrals II distinctly larger than other setae of plate.

Hysterosoma. *Dorsum*. First hysterosomal plate broadly trapezoidal, the sides tapering medially behind, the posterior margin truncate (to weakly rounded¹) ; all three pairs of setae of dorsal plate greatly enlarged, elongate, similar to those of second row of propodosomal dorsals ; anterior dorsals rising slightly ahead of the laterals (or appearing in transverse line) ; posterior dorsals arising well in front of (to close to) hind margin of plate, slightly closer together than anterior dorsals ; second hysterosomal plate bearing two pairs of stout, elongate setae similar to but shorter than those of the first segment, its hind margin seemingly ventral when genital capsule retracted. *Venter*. Apodemes III-V fused on each side to form two pairs of ventral fields ; (or at least apodemes III and IV joined) ; areolae of internal presternals on (or contiguous with) apodemes III and smaller than other setae of posterior ventral plate ; the single pair of poststernals much smaller than and arising distinctly behind the second axillaries.

Legs. Leg II, 84 (58-84) long ; leg IV, 86 (63-90) long. Leg II, 19 (12-19) wide ; leg IV, 25 (12-26) wide. Ta I distinctly longer than wide ; claw I small but free and on a short pedicel (fig. 6) ; tarsi II and III obliquely truncate apically when viewed from the side ; tarsi I and II each with an elongate, rodlike, apicolateral solenidium, usually slightly larger on ta I ; tr III distinctly arcuate ; ti IV with middorsal, medially-directed solenidium, which is rodlike and but

1. Shape difficult to characterize because it is variable, dependent upon mount.



FIGS. 6-7 : *Pyemotes parviscolyti*, n. sp.
 6. — Right tibiotarsus I of male, dorsal aspect ; 7. — Ventral view of male showing genital capsule.

little shorter than the most basal dorsal seta of the segment ; claw IV (usually) atrophied, without distinguishable free apex.

Variation. In addition to the usual variability in overall body size, apparent variation is considerable in the length and thickness of the legs, most noticeable in females, due partly to coverslip pressure. The dorsal setae of males may vary considerably in size and are difficult to measure because of their thin apices. Those of the anterior row of the propodosomal dorsum in males are usually asymmetrical in size and the inner pair varies in its placement relative to the outer pair. The shape of the male propodosomal dorsum and dorsal hysterosomal plates is especially susceptible to distortion caused by coverslip pressure.

On slide mounts, the male genital capsule of both *scolyti* and *parviscolyti* appears in an array of positions ranging from terminal and "open" to ventral and "closed." We assume that, at least in these forms, this structure is capable of being protracted and retracted. Its many positions, together with the fact that its component parts are easily distorted in mounting, make its composition difficult to determine. Figure 7 clearly shows, however, its concave, "bowl-like" surface in the open position with the tubelike aedeagus projecting from its bottom. The dorsal, seta-bearing flanges appear to be covered by the second dorsal plate when the capsule is retracted.

Distribution. Known only from central Louisiana.

Type material. Female holotype, female paratypes 1-9, male allotype, and male paratypes 10-24 all from Elizabeth, Allen Parish, Louisiana, from galleries and immatures of *Pityophthorus bisulcatus* in *Pinus taeda* cut February 18-19, 1966, and examined March 10, 1966, J. C. MOSER and L. M. ROTON.

Type repositories. Holotype, allotype, and paratypes 1, 2, 10, 11, 12, and 13 in the U. S. National Museum, Washington. Paratypes 3, 4, 14, and 15 in the Snow Entomological Museum, The University of Kansas, Lawrence. Paratypes 5, 16, and 17 in the Zoological Institute, The University of Erlangen, Germany. Paratypes 6, 18, and 19 in the British Museum (Natural History), London. Paratypes 7, 20, and 21 in the Field Museum, Chicago. Paratypes 8, 22, and 23 in the Hungarian National Museum, Budapest, and paratypes 9 and 24 in the personal collection of the senior author.

Pygmephorus Kramer, 1877.

In his 1959 work, KRCZAL realized that a group of species of *Pygmephorus* (*soricis*, *erlangensis*, *forcipatus*, *islandicus*, *stammeri*, *microti*) are closely related to the type of that genus, *P. spinosus* Kramer. Later, CROSS (1965) redefined the genus *Pygmephorus*, limiting it to those forms of his Tribe Pygmephorini having seta *c* of trochanter I short and bladelike or proflexed apically, and possessing claws on both legs I and IV.

As thus defined, the genus contained two well-defined groups : (1) that typified by *spinosus* and (2) another exemplified by *P. ceratophyi* Krczal, 1959, and by *P. (P.) brachycercus*, described here. Those in the second group differ from those in the first morphologically in general aspect, in the shape and size of tita I, in the size of claw I, in the presence or absence of striae on claw I, and (usually) in the engravure of the integument.

Distinct ecological preferences are also apparent. Mites of the *spinosus* group generally are associated with small mammals, their nests, or their food caches. Those of the second group are most commonly associated with Coleoptera and with trees or wood. Acquisition of undes-

cribed material since 1965, together with forms already described, brings the number of species in the second group to approximately 10. Hence, the 1965 description of the genus must be revised entirely, although the diagnosis remains as originally given.

In addition to this redescription, the genus *Pygmephorus* is divided here into two subgenera, largely based upon the characters given above.

Description of non-gravid female. Length, 110-520 ; width, 68-220 ; width between anterior sternocoxal condyles of coxae III, 47-170 ; hysterosoma oval to elliptical, its posterior margin broadly rounded or truncate ; integument sometimes with large, deep punctae, appearing "pebbled."

Gnathosoma. Distinct, quadrate or but slightly longer than wide ; normally directed antero-ventrally or ventrally ; palps distinct, with one or more apical teeth ; chelicerae tiny, indistinct ; large ventral esophageal pump absent, esophagus usually plainly visible as a simple tube.

Propodosoma. Dorsum. Distinct dorsal sclerite present or not ; dorsum variously shaped, anterior margin prolonged over gnathosoma ; margins of circumgnathosomal foramen heavily sclerotized, at least laterally, to form "collar" that encloses basal third to quarter of gnathosoma ; posterior margin covering, merely touching, or covered by anterior margin of first hysterosomal tergum ; peritremes widely separated, dorsal and circular, capitate, ovoid, linear, or elongate troughlike and terminating anteriorly in propodosomal shoulders. *Venter.* Anterior ventral plate with four to six pairs setae ; external ventrals I forked or not ; coxa I articulated at nearly a right angle to the longitudinal axis of the body or distinctly obliquely ; apodemes II strong, straight or weakly arcuate, complete medially ; secondary transverse suture absent ; anterior median apodeme strong, complete ; posterior marginal apodemes strong and usually complete.

Hysterosoma. Dorsum. First segment entire ; fifth segment bearing two or three pairs of ventral or apicoventral setae ; vulva apical or nearly so ; vagina enclosed apically by a distinct, sclerotized enlargement whose shape is partly dependent upon mount ; posterior genital sclerite, if visible, often globose ; anterior genital sclerite on or posterior to line drawn between posterior margins of coxal foramina IV ; median genital sclerite absent. *Venter.* Posterior ventral plate bearing four to six pairs of setae, its hind margin entire or bipartite ; external presternals arising well posterior to internal presternals ; apodemes III and IV variable, both usually incomplete ; opisthosoma longer than distance between anterior margin of coxa III and posterior margin of coxa IV or not.

Legs. All legs with claws ; leg I shorter and thicker than leg II ; tibiotarsus I elliptical, quadrate, or subtriangular, often enormously enlarged, always distinctly wider than other segments of leg ; pinnacula present or not ; mediolateral sclerotized area present on tibiotarsus I ; claw I enormously developed, inner margin sometimes striate ; claw I furnished with an equally well-developed bladelike thumb that may be toothed along its inner margin, trochanter I with three or (usually) four setae ; seta *c* short, bladelike, semimembranous, the apical margin often proflexed ; solenidia of tibiae II and III present or absent ; tarsus II with five to seven setae and a solenidium, tarsus III with five to seven setae ; claws II to IV simple or (usually) with rounded basal lobes ; pulvilli II-IV well-developed ; coxa III subtriangular or subcordate ; coxa IV short-rectangulate, subcordate, or elongate and slightly bulbose basally ; tarsus IV slightly to distinctly longer than tarsus III, tapering abruptly ; ratio of femurogenu IV to tarsus IV 1 : 3.0 to 1 : 5.0.

Pygmephorus (Pygmephorellus) n. subg.

Type : *P. (P.) ceratophyi* Krczal, 1959.

This new subgenus contains those species of *Pygmephorus* mentioned in the group typified by *P. (P.) ceratophyi* Krczal, 1959. At least 10 forms belong here, many of them yet undescribed. In the females of many species, the dorsal posterior propodosomal margin is prolonged, meeting or overlapping the first hysterosomal, tergum, but it is not possible to judge all species in this respect. Of the known species not described here, *P. (P.) karafiati* is found associated with adults and in tunnels of *Ips*, *P. (P.) ceratophyi* was taken from a specimen of *Ceratophyus* sp., (Coleoptera), and *P. (?P.) ursulae*, apparently unique both morphologically and ecologically, came from the soil in a potato field.

Diagnosis. Females are separable from those of *Pygmephorus* s. str. in that tita I is elliptical or quadrate rather than wedge-shaped, and because claw I lacks striae on its inner surface. Males of only two species are known; they are notable for their small size (approximately 90), the short, lobate character of the genital capsule and gnathosoma, and the short legs. In addition, both show a characteristic pair of basal solenidia on tarsus I.

Description of non-gravid female. Like that of the genus except for the following: length, 120-205; width, 70-120; width between anterior sternocoxal condyles of coxae III, 45-80; posterior margin of hysterosoma rounded; integument rarely with large, deep punctae, not appearing "pebbled."

Propodosoma. Dorsum. Posterior margin often covering or appearing to meet anterior margin of first hysterosoma segment.

Legs. Tibiotarsus I elliptical or quadrate, always distinctly wider than other segments of leg; claw I very stout, its inner margin not striate; coxa IV short-rectangulate or subcordate.

Species belonging to Pygmephorus (Pygmephorellus);

ceratophyi Krczal, 1959.

?ursulae Krczal, 1959.

karafiati Krczal, 1959.

bennetti Cross and Moser, n. sp.

brachycercus Cross and Moser, n. sp.

In addition to these described forms, these undescribed species are in our collection: *Sp. 1.* (nr. *bennetti*). Georgia, from the ambrosia beetle *Monarthrum fasciatum* (1 ♀); *Sp. 2.* No collecting data (1 ♀); *Sp. 3.* Lawrence, Kansas, from "dung beetle" (1 ♀); *Sp. 4.* Brewster Co., Texas, from *Nasutitermes* sp. (3 ♀); *Sp. 5.* Costa Rica, from Cativo logs (5 ♀, 6 ♂); *Sp. 6.* Moengo, Surinam, from under bark of dead tree (1 ♀).

Key to Females of *Pygmephorus* (*Pygmephorellus*).

1. With two pairs of caudals; hind margin of posterior ventral plate bipartite, the division medial; solenidia 1 and 2 of tita I lacking 2.
1. With three pairs of caudals; hind margin of posterior ventral plate entire (may be notched) or tripartite; either solenidium 1 or 2 (usually both) present 3.
2. Solenidium 4 narrowly clavate *P. (P.) bennetti*, n. sp.
2. Solenidium 4 attenuate apically, subsetiform *P. (P.) karafiati* Krczal, 1959

3. Claw I twisted ventrally and arising from apicomedial portion of tibiotarsus.....
P. (? P.) ursulae Krczal, 1959
3. Claw I normally placed and directed medially..... 4.
4. Areolae of internal caudals and external caudals I contiguous or nearly so, both widely separated from external caudals II ; with 5 or 6 spiniform setae each on legs III and IV ; hind margin of posterior ventral plate with a deep notch..... *P. (P.) ceratophyi* Krczal, 1959
4. External caudal I only slightly closer to internal caudal than to external caudal II ; legs III and IV without 5-6 spiniform setae ; hind margin of posterior ventral plate without a deep notch.....
P. (P.) brachycercus, n. sp.

***Pygmephorus (Pygmephorellus) bennetti*, n. sp.**

(figs. 8-17).

This species is morphologically very close to *P. (P.) karafiati*, taken from the tunnels of *Ips acuminatus* in France, and to a single specimen taken from the ambrosia beetle *Monarthrum fasciatum* (Say) in Georgia. Further research may prove all three forms to be conspecific. The species is widely distributed and catholic in its association with the beetles that distribute it as well as with the coniferous species beneath whose bark it completes its life cycle (see end of description).

The biology of this species has been studied by SPEIR and others and will be published elsewhere.

Diagnosis. Closest to *karafiati* (Krczal) and to an unnamed form (see above), from either of which it may be separated by the shape of solenidium 4. In *bennetti* this solenidium is narrowly clavate, in *karafiati* it is attenuate, subsetiform, and in the Georgia species it is short and bullet-shaped. Separable from all other species of *P. (Pygmephorellus)* by the following combination of characters : posterior margin of posterior ventral plate tripartite, only two pairs of caudals present, solenidia 1 and 2 of tita I lacking.

Description of non-gravid female. Length, 156 (130-185) ; oval ; mites tan in life ; integument well sclerotized and with fine, faint punctae ; other integumental markings lacking.

Gnathosoma. Length (palps extended), 20 (18-20) ; width, 16 (14-18) ; one pair of widely-separated propodosomal dorsals ; palpal solenidium 1 not identified (lacking ?), solenidium 2 subcylindrical.

Propodosoma. Dorsum. Anterior half platelike, more heavily sclerotized than posterior half ; anterior portion with thickly sclerotized areas posterior to and laterad of peritremes and posteromesad of pseudostigmata (fig. 9) ; peritremes drop-shaped ; posterior margin shallowly excavated (or subtruncate), overlapping hysterosoma ; all dorsal setae nude, flagellate ; posterior pseudostigmata stouter than stigmata, 20-30 long, arising posterior to and distinctly mesad of internal pseudostigmatal socket ; distance between anterior and posterior pseudostigmata much less than that between anterior pseudostigmata and stigmata. *Venter.* Anterior ventral plate with five pairs of thin, short, nude, flagellate setae subequal in length ; internal ventrals I arising from the posterior margin of apodemes I ; median ventrals I barely lateral to (or on) a line drawn between internal ventrals I and internal ventrals II ; external ventrals I not forked ; internal ventrals II nearly touching (or touching) apodemes II, arising well anterior to external ventrals II.

Hysterosoma. Dorsum. Setae of first four segments nude, flagellate ; dorsals III longest, about 31 ; laterals IV often lacking, shortest, about 7 ; laterals III next shortest, about 12 ; late-

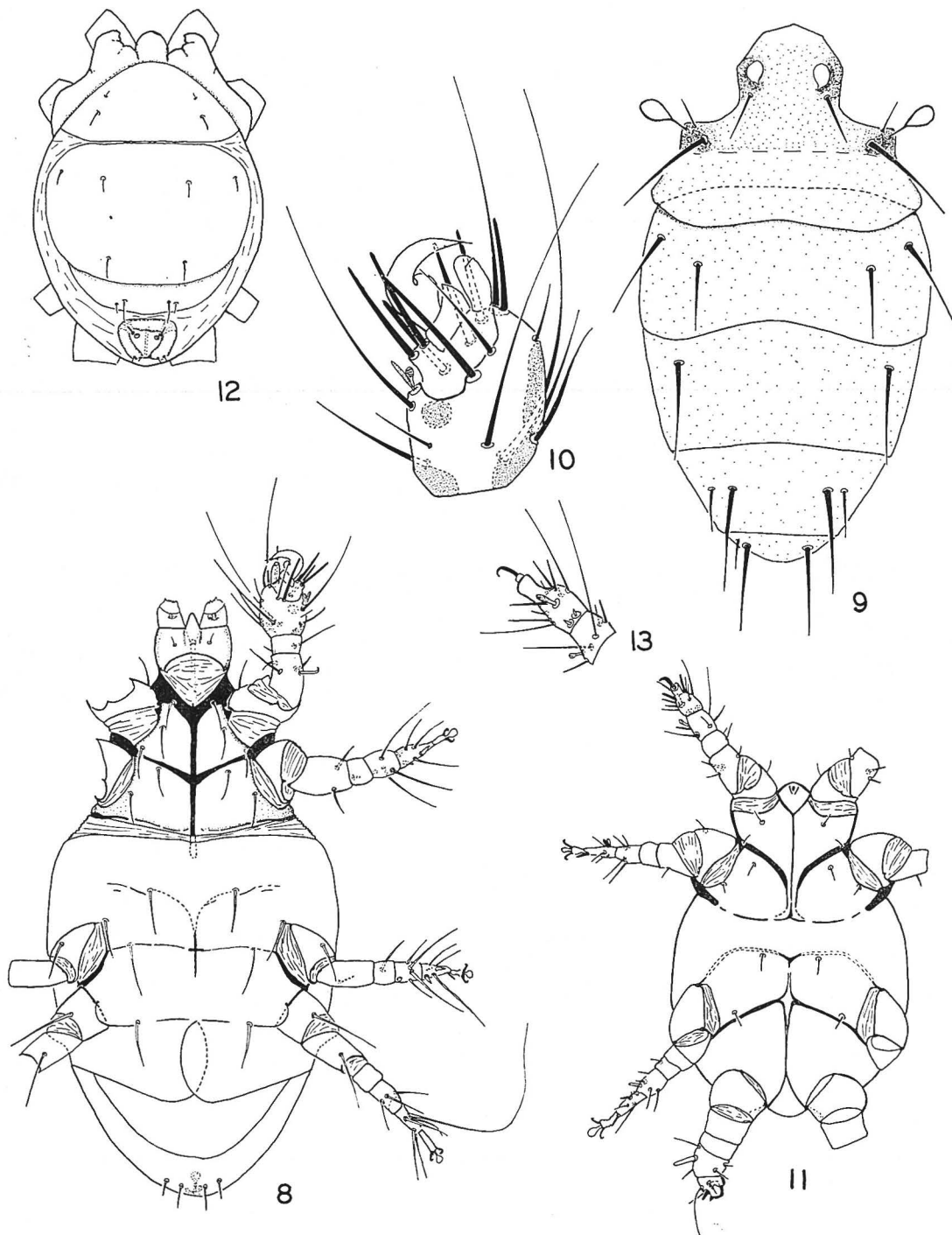


FIG. 8-13 : *Pygmephorus* (*Pygmephorellus*) *bennetti*, n. sp.

8-9. — Holotype female, ventral and dorsal aspects ; 10. — Right tibiotarsus I, holotype, ventral aspect ;
11-12. — Allotype male, ventral and dorsal aspects ; 13. — Left tibia and tarsus I, allotype, dorsal aspect.

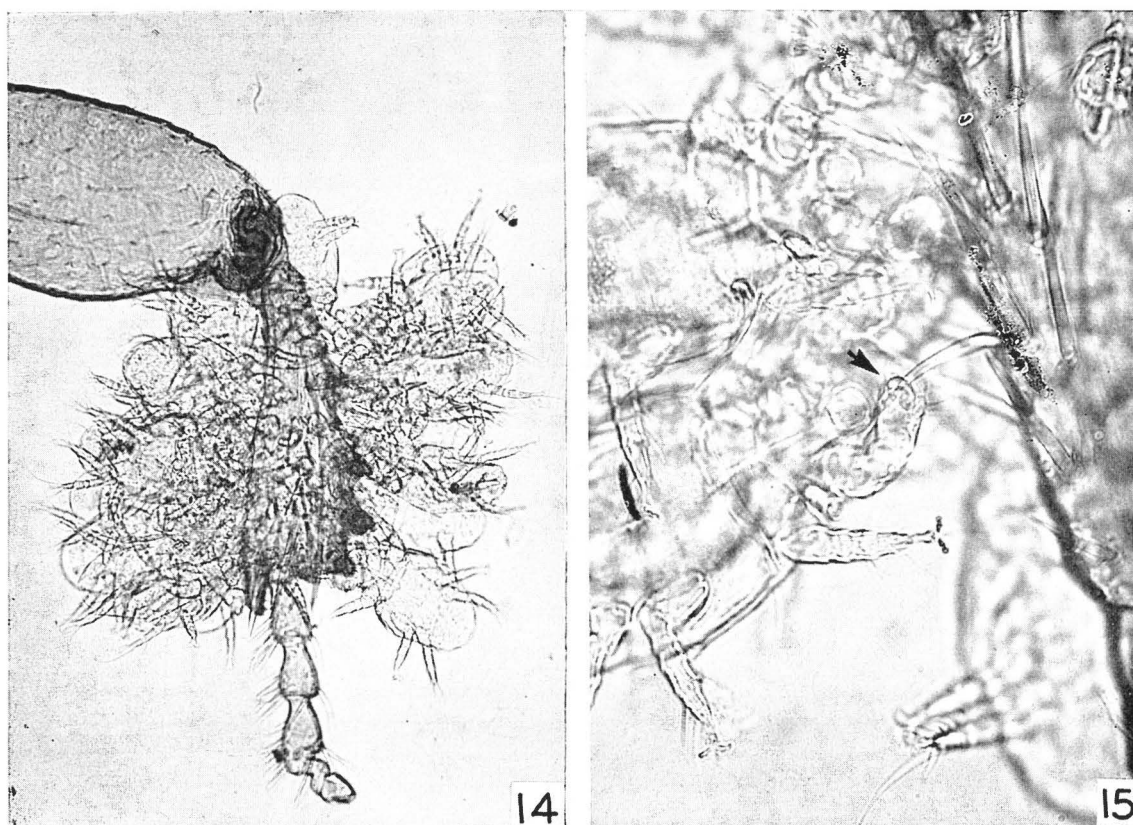


FIG. 14-15 : *Pygmephorus* (*Pygmephorellus*) *bennetti* n. sp.

14. — Tibia II of *Ips avulsus* with clustered females ;

15. — Arrow points to claw of mite tarsus I firmly grasping seta of *Ips avulsus* leg.

rals I arising well anterior to dorsals I ; setae of segment III in a transverse line (or laterals arising slightly before dorsals) ; laterals IV lacking on one side (usually lacking on both sides, sometimes present on both sides) ; dorsals III distinctly closer together than dorsals I and more widely separated than dorsals IV ; only two pairs of caudals, thin and bristlelike, arising ventrally, the inner pair about 6 long, the outer pair well laterad of these and slightly smaller. *Venter*. All setae of posterior ventral plate thin, nude, flagellate, the longest resembling laterals III in conformation and size ; posterior ventral plate with but four pairs of setae, the second axillaries and one pair of poststernals lacking ; distance between poststernals subequal to that between external presternals ; posterior margin of posterior ventral plate bipartite, divided along midline ; hind margin of opisthomal sternum distinct, rounded.

Legs. Leg I, 44 (35-47) long ; leg II, 59 (47-60) long ; leg IV, 61 (50-64) long. Leg I, 16 (9-19) wide ; leg II, 14 (8-16) wide. Width, cx IV, 15 (11-15) ; length, cx IV, 19 (16-19). Solenidia 3 and 4 of tita I arising from same level ; 4 narrowly clavate, twice the length of (to barely longer than) solenidium 3, the latter racquet-shaped ; solenidia 1 and 2 of tita I lacking ; tr II with two setae, tr III with one ; fege II and III each with one seta ; ta II and III each with a stout basodorsal and apicoventral spine, those of III longer and more slender than those of II ; solenidium of ta II short, distinctly shorter than dorsobasal spine, clavate ; seta *p* of ta IV greatly elongate, whiplike, at least thrice as long as other setae of segment.



FIG. 16 : *Pygmephorus* (*Pygmephorellus*) *bennetti* n. sp., numerous females attached to *Ips avulsus*.

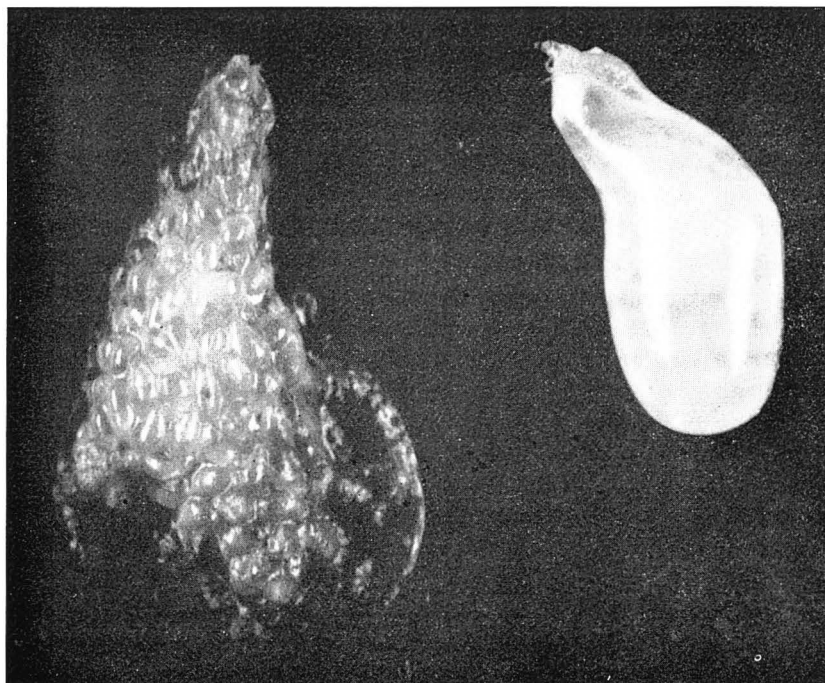


FIG. 17 : *Pygmephorus* (*Pygmephorellus*) *bennetti*, n sp.

Gravid females, milky specimen above showing partially-developed embryos, lower female showing adult progeny shortly before birth. Note gnathosoma and propodosoma (left) of upper specimen and outline of opisthosoma (right) of lower specimen.

Variation. In addition to the usual variation in body size and in setal length, females differ in the presence or absence of lateral setae IV. In most specimens these setae are lacking entirely, but others may have one or both. Specimens from populations in the southeastern U. S. may be more likely to have both missing, while those from west-central Canada may be likely to have both present.

Description of male. Length, 87 (82); weakly sclerotized, pearly.

Gnathosoma. A rounded lobe, palpi, setae, and solenidia apparently lacking, but esophagus visible as a simple tube appearing to terminate externally.

Propodosoma. Dorsum. Plate small, not reaching either coxal margins or base of gnathosomal lobe; plate with two pairs of setae, the larger pair short, bristlelike, about 6 long, the smaller pair anterior and mesad of these, scarcely visible. *Venter.* Apodemes II stout, procurved, joining anterior median apodeme about on line with posterior sternocoxal condyles II; all setae of anterior ventral plate short, bristlelike, ventrites I and II each with two pairs; external ventrals I appearing to arise from apodemes II; posterior marginal apodeme most heavily developed at the sides.

Hysterosoma. Dorsum. All setae of dorsum short, bristlelike; first hysterosomal plate elliptical, much the largest of all dorsal plates; laterals arising in front of anterior dorsals; posterior dorsals not (or scarcely) reaching hind margin of plate; second hysterosomal plate bandlike, dorsal and lateral setae close together (fig. 12); dorsals of second plate distinctly longer than the laterals, which barely surpass the posterior margin of the plate; distance between laterals of second plate about two-thirds that between posterior dorsals of first plate; genital capsule apparently dorsal, narrow, tapering posteriorly, posterior margin truncate and bearing two pairs of tiny setae, the usual tiny solenidium and a blade seta present basally on each side in addition. *Venter.* Apodemes of posterior ventral plate only moderately developed, apodemes III largely indistinct, apodemes IV incomplete laterally (or complete); legs IV subterminal, hind margin of posterior ventral plate not seen; posterior ventral plate with but two pairs of short, bristlelike setae, the anterior pair arising near remnants of apodemes III, only slightly farther apart than setae of ventrites I, the posterior pair arising in front of apodemes IV, about 26 apart; a spherical dense structure present internally between propodosoma and hysterosoma (or this structure seemingly absent); apodemes V distinct, terminal, posterior ventral plate terminating as a lobe between legs IV, its posterior margin not visible.

Legs. Leg I, 36 (34-36) long (excludes pedicel); leg II, 42 (41-42) long; leg III, 42 (40-42) long; leg IV, 42 (40-42) long (includes claw, which cannot be satisfactorily separated from rest of leg). Leg I, 8 (8-9) wide; leg II, 10 (8-10) wide; leg IV, 11 (11-15) wide. Solenidium 1 of ti I clavate, pedicellate; solenidium 2 not seen; solenidium 3 of ta I large, arising from apical half of segment; solenidium 4 not visible; ta I with a pair of small, spinelike solenidia arising basally from the dorsal surface; claw I moderately sized, arising from a thick pedicel about half (one-third to two-thirds) as long as the tarsus itself; solenidium of ta II short-clavate, arising close beside a stout spine, a second spine arising near the apex of the segment; ti III with a long, stout, subcylindrical solenidium arising in the apical half and projecting well beyond apical margin of the segment; ta III with two basal spines, one distinctly shorter than the other; cx IV, tr IV, and fege IV lacking setae; lateral solenidium of ti IV elongate, subcylindrical; median ventral seta and medial marginal setae setiform, not greatly thickened, rodlike or spinelike; lateral margin of ta IV with two toothlike spines (claw remnants?).

Distribution. Range apparently congruent with that of bark beetles infesting the Pinaceae and other Coleoptera inhabiting their tunnels, at least in the United States and Canada.

Type material. Female holotype and female paratypes 1-3 from Pineville, Rapides Parish, Louisiana, September 16, 1965, J. MOSER, in beetle galleries under bark of lightning-struck pine. Male allotype, male paratypes 10 and 11, and female paratypes 5 and 7 from Tioga, Rapides Parish, Louisiana, November 4, 1963, J. MOSER, in galleries of *Ips* (at least two species) in *Pinus taeda*. Female paratypes 4 and 8 from Athens, Georgia, January 4, 1962, P. HUNTER, from *Ips avulsus*. Female paratype 6, same collecting data as preceding but from tunnels of *I. grandicollis*. Female paratype 9 from Grovedale, Alberta, Canada, August 19, 1964, R. REID, phoretic on *Trypodendron lineatum* (Oliver) in *Picea glauca*.

Type repositories. Holotype, allotype, and paratypes 8 and 9 in the U. S. National Museum. Paratypes 1 and 10 in the National Museum of Canada, Ottawa. Paratypes 2 and 11 in the Zoological Institute, University of Erlangen, Germany. Paratype 3 in the British Museum (Natural History). Paratypes 4 and 5 in the Snow Entomological Museum, The University of Kansas. Paratype 6 in the Field Museum of Natural History, Chicago, and paratype 7 in the Hungarian National Museum, Budapest.

Specimens examined. In addition to the type series, as follows: CANADA. ALBERTA: Grande Prairie, phoretic on *Ips perroti* in *Pinus banksiana*. U.S.A. COLORADO: Castle Rock, Douglas Co., phoretic on *Ips calligraphus*. IDAHO: Moscow, from *Pseudotsuga taxifolia* infested with *Dendroctonus pseudotsugae*. TEXAS: Tyler Co., phoretic on *I. avulsus*; Hardin Co., from gallery of bark beetle in *Pinus taeda*. LOUISIANA: Alexandria, Rapides Parish, galleries of *Ips* sp. in *P. taeda* and phoretic upon both sexes of *Pityophthorus bisulcatus* Eichh.; Winnfield, Winn Parish, phoretic on teneral *I. grandicollis* in *P. taeda*. ALABAMA: Auburn, phoretic on teneral *I. avulsus* in *P. echinata*. VIRGINIA: Accomac, ex galleries of *D. frontalis* in *P. echinata*.

Pygmephorus (Pygmephorellus) brachyeercus, n. sp.

(fig. 18).

This species is uncommon in our samples, a single specimen being known from the inner bark of *Pinus palustris*, and a cluster of specimens being attached to the tenebrionid beetle *Corticeus glaber* Lec., a common subcortical associate of various southern pine bark beetles.

Description of non-gravid female. Length 130 (130-138); elongate-oval; integument moderately sclerotized, with very faint, rather coarse punctae, other integumental markings lacking.

Gnathosoma. Slightly longer than wide, length, 25 (23-25), width, 20 (17-20); palpal solenidium 1 small, clavate, solenidium 2 arising nearly mesad of 1, subcylindrical, tapering slightly, elongate, often difficult to see; gnathosomal ventral setae lacking; two pairs of gnathosomal dorsals, the internals arising anterior to the externals.

Propodosoma. Dorsum. Anterior half platelike, more heavily sclerotized than posterior half, its hind limit marked by a heavy, transverse apodeme; posterior portion of propodosomal dorsum arcuate, overlapping first hysterosomal segment; peritremes large, drop-shaped, distinctly divergent; except for marginal apodemes, heavily sclerotized cuticular areas not prominent; all dorsal setae weakly spiculate, setiform; posterior pseudostigmatal 27 (21-27) long; anterior pseudostigmatal long, about 19, stigmatal nearly as long, about 17; distance between anterior and posterior pseudostigmatal greater than that between anterior stigmatal and stigmatal.

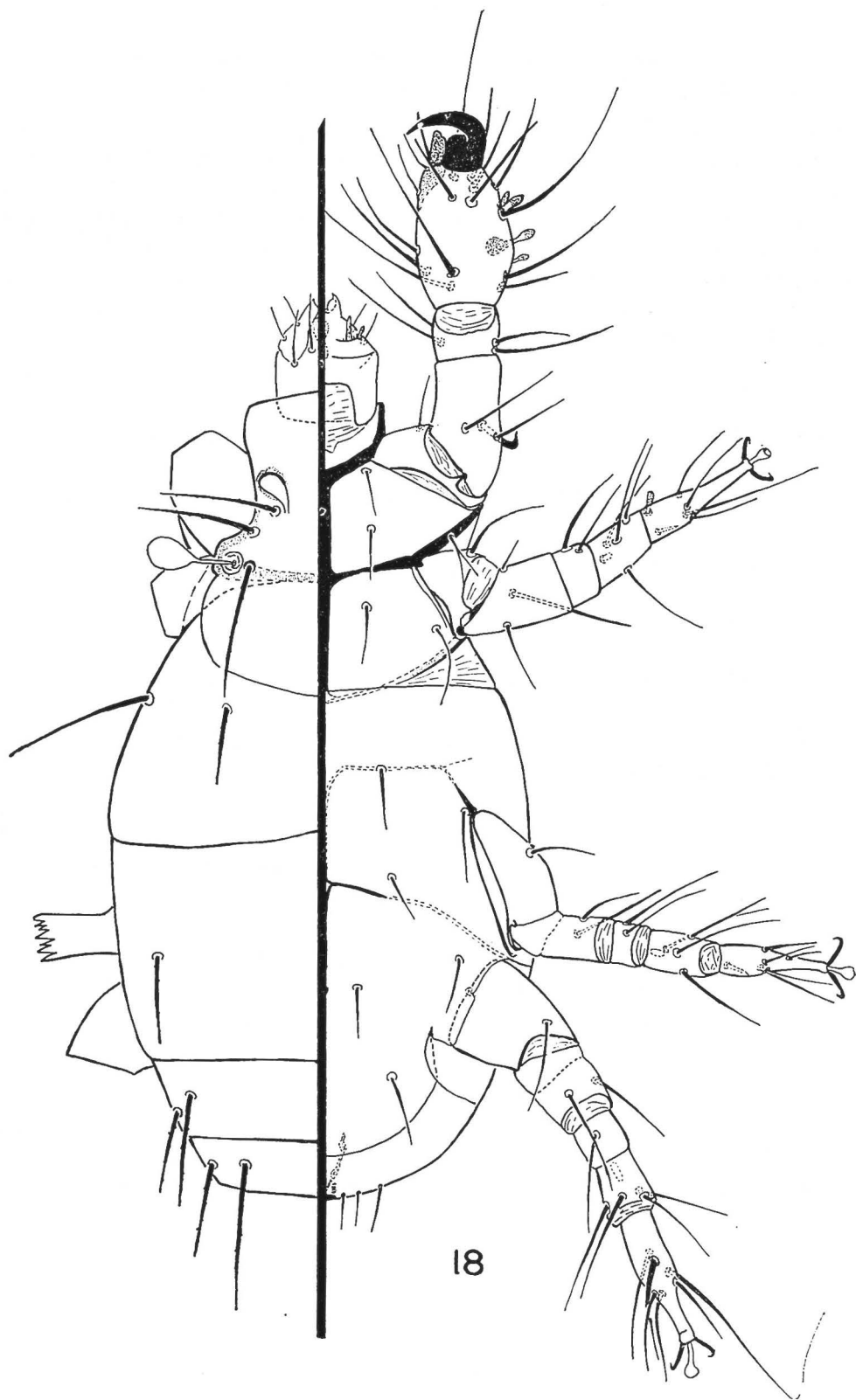


FIG. 18 : *Pygmephorus* (*Pygmephorellus*) *brachycercus*, n. sp. ;
holotype female, dorsal and ventral composite.

Venter. Anterior ventral plate with five pairs of thin, nude, flagellate setae, external ventrals II distinctly longer than other pairs, external ventrals I bifurcate; internal ventrals II arising well posterior to apodemes II; internal ventrals I, median ventrals I, and internal ventrals II nearly on the same line.

Hysterosoma. Dorsum. Setae of first four segments weakly spiculate, setiform except for laterals I and dorsals IV, which tend to be flagellate (or all dorsal setae setiform); laterals I longest, subequal to posterior pseudostigmata, dorsals I and laterals III and IV subequal, about 15; dorsals III arising well anteriorly to laterals III and farther apart than dorsals I; three pairs of nude, setiform caudals, externals I slightly closer to the internals than to externals II; external caudals II distinctly larger than other two pairs, about 10. *Venter.* All setae of posterior ventral plate nude, flagellate (or setiform), the external poststernals longer than the others, about 14 (9-14); posterior ventral plate with six pairs of setae; distance between internal poststernals distinctly less than that between external presternals; posterior margin of posterior ventral plate tripartite, the divisions arising near the posterolateral angle of the hind coxal foramen; hind margin of posterior ventral plate indistinct.

Legs. Leg I, 54 (50-54) long; leg II, 57 (51-59) long; leg IV, 75 (70-80) long. Leg I, 14 (11-14) wide; leg II, 10 (9-10) wide; leg IV, 12 (12-15) wide. All four solenidia of tita I present; solenidia 1 and 2 clavate, similar in shape, the lower (number 1?) smaller than the other; areolae of solenidium 3 and 4 contiguous, 3 dorsal of and slightly distal to 4; solenidium 3 narrowly clavate, solenidium 4 strobiloid, slightly longer than 3; tita I elliptical, without pinnaculum or apicolateral protuberance extending laterad alongside claw; seta *c* of tr I sharply proflexed, characteristically spoon-shaped; tr II with 3 setae, tr III with 2; fege II and III each with 2 setae; ta II and III each with a thinly spinose basal seta, all other setae of these segments (except for solenidium of ta II) arising from their distal halves; solenidium of ta II short and stoutly clavate, arising near the basal margin of the segment; seta *p* of ta IV elongate, whiplike, at least twice as long as other setae of segment.

Variation. In addition to the usual variation in size, the holotype differs slightly from the paratypes in that the dorsal and caudal setae are thinner, more flagellate, and less spiculate.

Distribution. Known only from central Louisiana and east Texas.

Type material. Female holotype and eight female paratypes. Holotype from Pineville, Rapides Parish, Louisiana, no date, R. THATCHER, collector, from "inner bark of lightning-struck long-leaf pine (*Pinus palustris*) infested with *Ips calligraphus*." All paratypes from Sourlake, Hardin Co., Texas, March-April, 1963, J. MOSER. These were attached to the leg setae of *Corticeus glaber* (Tenebrionidae) inhabiting bark beetle tunnels in *P. taeda*.

Type repositories. Holotype and paratypes 1 and 2 in the U. S. National Museum. Paratype 3 in the Snow Entomological Collections, The University of Kansas. Paratype 4 in the Zoological Institute, The University of Erlangen. Paratype 5 in the British Museum (Natural History). Paratype 6 in the Field Museum. Paratype 7 in the Hungarian National Museum, and paratype 8 in the personal collection of the senior author.

Specimens examined. TEXAS: Sourlake, same data as paratypes, five additional specimens.

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