

PROCEEDINGS OF THE BIOLOGICAL SOCIETY OF WASHINGTON
118(4):814–853. 2005.

**New Species of Pauropoda (Pauropodidae, Brachypauropodidae)
from great Smoky Mountains National Park (Tennessee,
North Carolina, U.S.A.), and a list of known species**

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Abstract—Forty-five species of pauropods were identified or recorded from Great Smoky Mountains National Park as part of the All-Taxa Biodiversity Inventory taking place within this park. Thirteen of these species are new to science and are described: *Allopaupopus (Allopaupopus) cataloocheensis* Scheller, A. (A.) *hilteneae* Scheller, *Allopaupopus (Decapaupopus) bernardi* Scheller, A. (D.) *chauiosetus* Scheller, A. (D.) *parkeri* Scheller, A. (D.) *portersensis* Scheller, A. (D.) *purchasensis* Scheller, A. (D.) *stocksii* Scheller, A. (D.) *virgulatus* Scheller, *Stylopaupopus (Stylopaupopus) divaricatus* Scheller, S. (S.) *sulcatoidus* Scheller, S. (S.) *quadrius* Scheller, and *Brachypauropopus andrewsensis* Scheller. *Pauropopus jukensis* Starling is transferred to *Allopaupopus* and a new subgenus, *Desmopaupopus*, is established to accommodate it. A list of species known from the park is provided.

Great Smoky Mountains National Park (GSMNR), an International Biosphere Preserve, possesses great biodiversity brought about by topography, temperate location, and weather patterns that allow for abundant precipitation (see <<http://www.nps.gov/grsm/gsmsite/home>>). Elevations range from 270 to 2025 m, and most of the highest peaks in eastern North America are within GSMNP. The Park contains a wide range of plant communities, including boreal forest at its highest elevations; each elevation increase of 300 m is equivalent to moving 400 km north. Small areas of the park receive more than 215 cm of precipitation each year, and thus are considered temperate rainforest. About 25% of the park is classified as old-growth stands, which have never been logged or seriously disturbed. The park has an extraordinarily diverse biota. More than 130 species of trees grow in GSMNP, and the park has the world's greatest diversity of salamanders (30 species). Great Smoky Mountains Na-

tional Park is by far the most heavily visited national park in the U.S., with 9–10 million visitors each year. The park also is impacted by significant acid precipitation, frequent elevated ozone levels, and the introduction of many exotic pests and plant pathogens.

The All-Taxa Biodiversity Inventory (ATBI) in Great Smoky Mountains National Park has as its goal the comprehensive inventory of all life in the park, from Archaea to vertebrates (see <<http://www.dlia.org>>). Hundreds of scientists and volunteers are engaged in the process of collecting and cataloging every species that occurs within park boundaries. Specialists have estimated that there are up to 100,000 species in GSMNP exclusive of prokaryotes; of this 100,000, three-quarters are invertebrates (Sharkey 2001). Of the estimated 75,000 species of invertebrates, only about 5,000 were recorded prior to the beginning of the ATBI in 1998. Prominent among the many uncollected or poorly known invertebrate taxa are soil arthropod

taxa. The goal of this paper is to provide a more comprehensive picture of Pauropoda in GSMNP. Pauropods comprise a class of minute myriapod arthropods that often are quite common but usually overlooked in surveys (Scheller 1990).

There has been no comprehensive study of the Pauropoda of the U.S.A., and only a few papers refer to material collected from the Southern Appalachian region. Pauropods were unknown in GSMNP until the 1950s, when the French zoologist P.A. Remy reported seven species: *Allopauropus carolinensis* (Starling) from Cherokee Orchard (Remy 1956), Newfound Gap (Remy 1957) and Greenbrier Cove (Remy 1958), *Allopauropus* cf. *causeyae* Starling from Greenbrier Cove (Remy 1958), *Allopauropus vulgaris* (Hansen) from "non loin de Headquarters" (Remy 1959), "*Pauropus*" *dukensis* from Cherokee Orchard (Remy 1956), *Stylopauropus quadrisulcus* Remy from Newfound Gap (Remy 1957), *Deltopauropus macswaini* Remy from Cherokee Orchard (Remy 1956), and *Eurypauropus spinosus* Ryder from the summit of Mt. LeConte (Remy 1957). Although Remy's material was meager in terms of numbers of specimens (20, of which 12 were from Cherokee Orchard), the number of species (7) suggested a high pauropod diversity in GSMNP.

Collecting in recent years has confirmed that pauropods are indeed diverse in the southern Appalachian region. With the current study, 48 species-level taxa have now been collected from GSMNP (see Appendix), of which 32 have been described previously, three are of uncertain identity, and 13 are described in this paper (number of described species worldwide ~720). High diversities of pauropods seem to occur wherever intensive collecting is made. For instance, 57 specimens comprising 11 previously described species and five undescribed species were collected in mountain regions of Georgia, North Carolina, and West Virginia (Scheller 1985). Recently, limited collecting along the North Shore re-

gion of GSMNP yielded 95 specimens among nine species, of which two appear to be undescribed (U. Scheller, unpublished).

Materials and methods.—The new species described below derive from collections made in the Ravensford area near Oconaluftee, Porter's Flat, Andrews Bald, and a number of sites visited by the senior author in September 2002. Most of the specimens were collected by means of Tullgren funnels, but others were gathered by direct collection with a paintbrush moistened with preservative, or by water flotation. The sole author of all descriptions is Ulf Scheller.

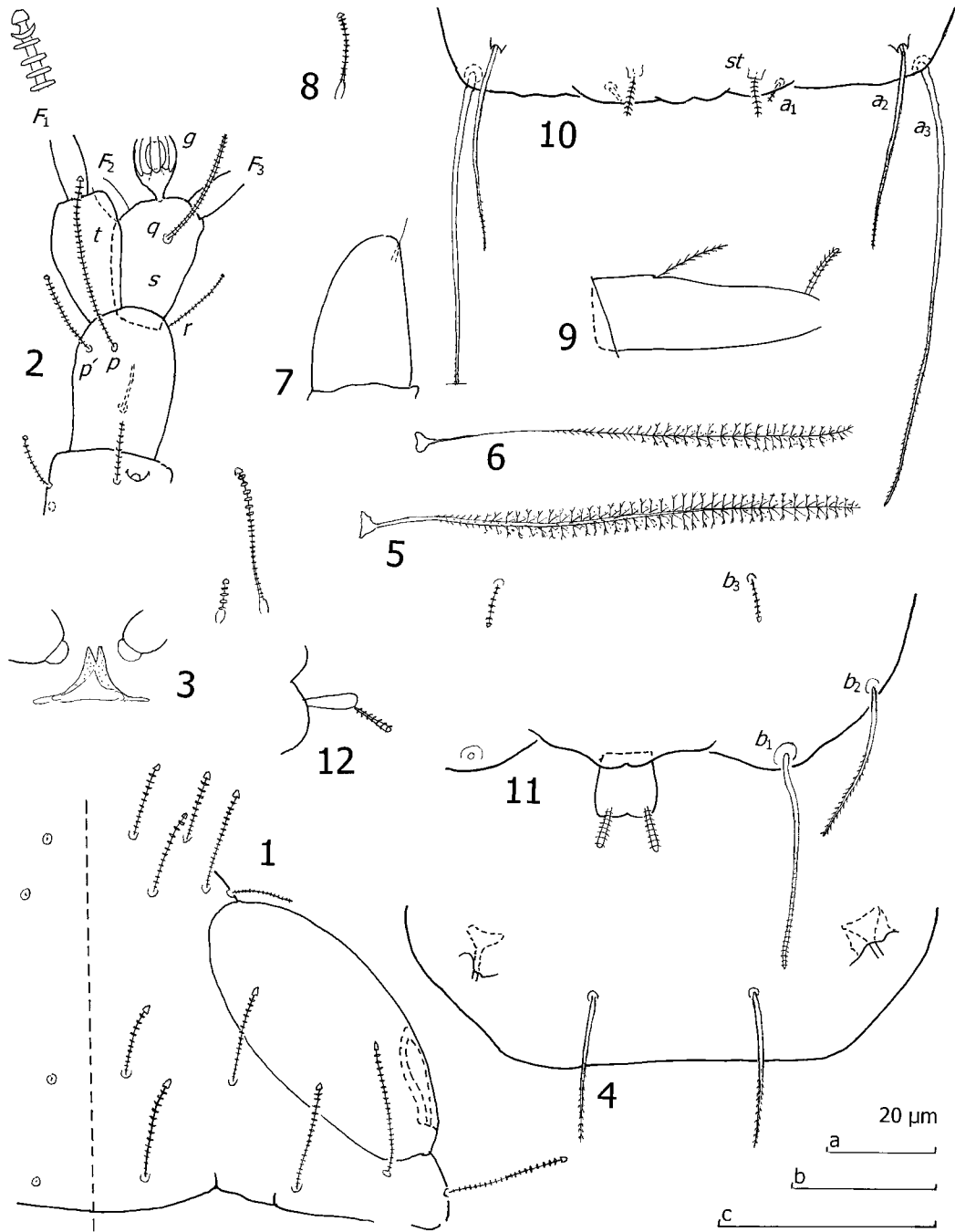
The type material has been deposited in the U.S. National Museum of Natural History. Specimens listed as type specimens or in the collection data are categorized by life stage (adult, subadult, juvenile), followed by the number of pairs of legs. Measurements are given for holotypes, with ranges of variation in adult paratypes given in parentheses. \times = times.

Allopauropus (Allopauropus)
cataloocheensis Scheller, new species
Figs. 1–12

Length.—0.80–0.86 mm.

Head.—Tergal setae subcylindrical, annulate, blunt. Relative lengths of setae, first row: $a_1 = 10$, $a_2 = 9$; second row: $a_1 = 11$, $a_2 = 13$, $a_3 = 8$; third row: $a_1 = 10$, $a_2 = (11–)13$; fourth row: $a_1 = (13–)14$, $a_2 = 14$, $a_3 = 17(–)18$, $a_4 = 16$; lateral group setae: $I_1 = ?$, $I_2 = 10$, $I_3 = 14$. The ratio $a_1/a_1 - a_1$ in first and second rows 0.9, in third and fourth rows 1.0. Temporal organs large, ovoid, their length in tergal view (1.3–) 1.4 \times the shortest distance between them; posterior part with long pistil one-quarter the length of temporal organ (Fig. 1). Head cuticle glabrous.

Antennae.—Third segment with three setae and rudimentary g' on distal part of tergal side. Fourth segment with four cylindrical, striate-annulate setae, r thinnest (Fig.



Figs. 1–12. *Allopauropus (A.) cataloocheensis*. Figs. 1–6, 8–12, Holotype female; Fig. 7, Paratype male. 1, Head, median and right part, tergal view; 2, Right antenna, tergal view; 3, Collum segment, median and left part, sternal view; 4, Tergite VI, posterior part; 5, Bothriotrix T_3 ; 6, Bothriotrix T_4 ; 7, Genital papilla, lateral view; 8, Seta on trochanter of leg 9; 9, Tarsus of leg 9; 10, Pygidial tergum, tergal view; 11, Pygidial sternum, sternal view; 12, Anal plate, lateral view. Scales: a, Figs. 5–7; b, Figs. 4, 8, 9; c, Figs. 1–3, 10–12.

2). Relative lengths of setae: $p = 10$, $p' = (44-47)$, $p'' = 24$, $r = 41(-44)$. Setae p''' absent. Tergal seta p $1.5\times$ longer than tergal branch t ; branch t fusiform, widest in distal half, $1.6(-1.7)\times$ as long as its greatest diameter, $0.9\times$ length of sternal branch s ; branch s $1.4(-1.5)\times$ as long as its greatest diameter and with anterodistal corner slightly more truncated than posterior corner. Seta q as tergal-anterior seta of fourth segment, length equal to s . Relative lengths of flagella (with base segments included) and of base segments alone: $F_1 = 100$, $bs_1 = 9(-10)$; $F_2 = (42-44)$, $bs_2 = (5-7)$; $F_3 = 77(-78)$, $bs_3 = f(8-9)$. Flagellum F_2 thinner than F_1 and F_3 ; F_1 $5.5(-5.6)\times$ as long as t , F_2 and F_3 $(2.1-2.2)$ and $(3.8-3.9)\times$ as long as s , respectively. Distal calyces subhemispherical, glabrous, distal part of flagella axes widened only between calyx and first lamella. Globulus g $1.3\times$ longer than wide, with very short stalk under a thick basal part and approximately eight slightly bent bracts, capsule longer than wide, diameter of g $0.6(-0.7)\times$ greatest diameter of branch t . Antennae glabrous.

Trunk.—Setae of collum segment appearing simple, cylindrical, annulate, blunt. Sublateral setae $3.2\times$ length of submedian setae; process with V-shaped cleft anteriorly (Fig. 3) and with minutely granulated surface; appendages subglobular, caps hemispherical.

Setae on tergites as on head, somewhat longer posteriorly. On trunk 4+4 setae on tergite 1, 6+? on II, 6+6 on III-V, 4+2 on VI. Submedian posterior setae on VI tapering, about as long as their interdistance and $4.2(-4.8)\times$ as long as pygidial seta a_1 (Fig. 4). Tergites glabrous.

Bothriotricha.—Relative lengths of bothriotricha: $T_1 = 100$, $T_2 = (102-106)$, $T_3 = (100-119)$, $T_4 = (107-114)$, $T_5 = (106-117)$; axes simple, very thin in $T_1 - T_4$; T_1 , T_2 and T_4 (Fig. 6) similar to each other with short, oblique, simple pubescent hairs proximally and longer, erect, branched hairs distally, there partly arranged in whorls. Bothriotrix T_3 similar but with thicker axis and

branched hairs on distal three-fourths (Fig. 5). Bothriotrix T_5 thin with short oblique pubescence of simple hairs.

Genital papillae (paratype).—Genital papillae glabrous, $1.5\times$ as long as their greatest diameter, inner margin straight, outer evenly curved in distal two-thirds; seta $0.3\times$ length of papilla (Fig. 7).

Legs.—Setae on coxa and trochanter of leg 9 simple, cylindrical, annulate, blunt (Fig. 8); more anteriorly these setae furcate with a rudimentary glabrous secondary branch. Tarsus of leg 9 tapering, $(2.7-3.0)\times$ as long as its greatest diameter; proximal seta tapering, pointed, with distinct oblique pubescence, $0.2\times$ length of tarsus and $1.2(-1.4)\times$ length of distal seta, which is cylindrical, striate, and blunt (Fig. 9). Cuticle of tarsus minutely granular.

Pygidial tergum.—Posterior margin straight, but with low lobes behind insertion points of setae $a_1 = 10$, $a_2 = 38(-40)$, $a_3 = (80-82)(-87)$, $st = 6$. Setae dissimilar: a_1 and st short, cylindrical, straight, annulate, converging; a_2 and a_3 long, tapering, glabrous except most distally, somewhat curved inwards. Distance $a_1 - a_1$ $2.2(-2.4)\times$ the length of a_1 ; distance $a_1 - a_2$ about $5\times$ the distance $a_2 - a_3$; distance $st - st$ $5(-5.3)\times$ the length of st and $1.4(-1.5)\times$ the distance $a_1 - a_1$. Cuticle glabrous.

Pygidial sternum.—Posterior margin between b_1 setae with broad indentation and median lobe with shallow posteromedian incision (Fig. 11). Relative lengths of setae ($a_1 = 10$): $b_1 = 40(-42)$, $b_2 = (25-30)$, $b_3 = 9$. Seta b_1 thin, cylindrical, striate distally; b_2 similar but tapering, curving inward; b_3 cylindrical, blunt, annulate. Length of b_1 setae $0.7(-0.8)\times$ their interdistance; b_2 $(1.3-1.5)\times$ the distance $b_1 - b_2$; b_3 $0.2\times$ the distance $b_3 - b_3$.

Anal plate (Figs. 11, 12) narrowest anteriorly, $1.1\times$ longer than broad, with convex lateral margins; posterior margin with a median shallow indentation between rounded lateral corners; two sublateral, straight, blunt, striate, slightly divergent ap-

pendages protruding from sternal side of posterolateral corners; length of appendages (0.7)–0.8× length of plate.

Type specimens (N = 3).—Holotype female 9 and two paratypes (male 9, female 9), North Carolina, Haywood County, Great Smoky Mountains National Park, Cataloochee, 150 m south of Palmer Branch at Caldwell Fork, 39436N, 3107E, elevation 861–923 m, old-growth hemlock forest, 4 June 1996, sample reference number 9610-6, F. Coyle, R. Edwards, J. Stiles, R. Wright, collectors.

Derivation of name.—This species is named for the general type locality, the Cataloochee Mountains, in the southeastern part of GSMNP.

Diagnosis.—*Allopaupopus* (*A.*) *cataloocheensis* has many characters in common with *A.* (*A.*) *cantralli* Remy from Tennessee (Remy 1958) and South Carolina (Scheller 1988). The two species can be separated by the length of the temporal organs (longer than their distance apart in *A. cataloocheensis*, shorer than their distance apart in *A. cantralli*), the length of the pistil of the temporal organ (longer in *A. cataloocheensis*), and the dimensions of the antennal branches (in *A. cataloocheensis* the tergal branch 1.5–1.6× the length of its greatest diameter, the sternal branch 1.4–1.5× the length of its greatest diameter; in *A. cantralli*, the ratios 3–3.25 and 2.5 for tergal and sternal branches, respectively). In *A. cataloocheensis*, the pubescence of bothriotrix T_3 is branched (simple in *A. cantralli*), and the distal margin of the anal plate is indented, not evenly convex. The new species also resembles *A.* (*A.*) *humilis* Remy from Bulgaria and Greece, especially in antennal and pygidial characteristics. The species can be separated by the shape of the antennal globulus (proportionately long in *A. cataloocheensis*, not short as in *A. humilis*) and the anal plate (broadest posteriorly in *A. cataloocheensis*, with a narrow posterior lengthening in *A. humilis*). The new species may also have a distant relationship with *A.* (*A.*) *frigoriatiens* Scheller from northeastern

Siberia (Scheller 1986) as indicated by similarities in the shape of the sternal antennal branch and the chaetotaxy of the pygidium.

Allopaupopus (*Allopaupopus*) *hilteneae*

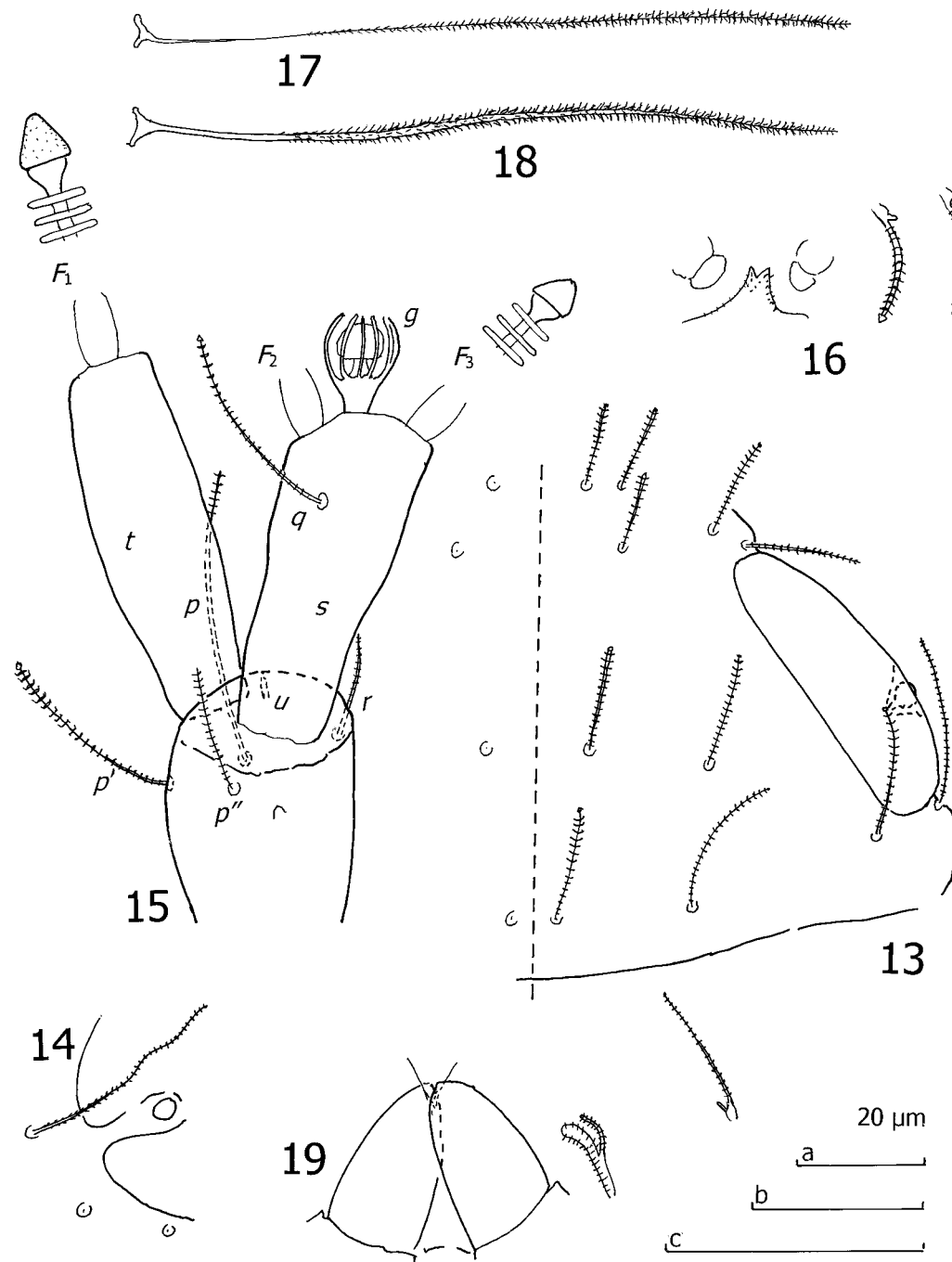
Scheller, new species

Figs 13–25

Length.—(0.72–)0.98 mm.

Head.—Tergal setae striate-annulate; submedium setae blunt, lateral setae tapering, pointed (Fig. 13). Relative lengths of setae, first row: $a_1 = 10$, $a_2 = (10–)11$; second row: $a_1 = 10(–)12$, $a_2 = 12$, $a_3 = 14$; third row: $a_1 = 12$, $a_2 = (12–)14$; fourth row: $a_1 = (12–)14$, $a_2 = (16–)22$, $a_3 = ?(25)$, $a_4 = 17$; lateral group setae: $I_1 = ?25$, $I_2 = (22–)26$, $I_3 = 19(–)22$. Ratio a_1/a_1 in first row 0.8, second row 0.5(–)0.6, third row 0.9(–)1.0, fourth row (2.5–)2.6. Temporal organs in tergal view small, length (0.7–)0.8 of their shortest distance apart; in posterior half a distinct lateral, subglobular, slightly protruding pistil (Figs. 13, 14), diameter 4 μm . Head cuticle glabrous.

Antennae.—Fourth segment (Fig. 15) with five setae: p , p' , p'' and u subcylindrical, blunt, striate-annulate, r tapering, striate. Seta p''' a rudimentary knob. Relative lengths of setae: $p = 100$, $p' = 60(–)83$, $p'' = (38–)40(–)42$, $r = (29–)32$, $u = 12(–)13$. Tergal seta p 0.9× length of tergal branch t . Tergal branch t somewhat fusiform, (2.9–)3.3× longer than its greatest diameter and (0.9–)1.1× length of sternal branch s ; length of branch s (2.3–)2.4× its greatest diameter. Anterodistal corner of s only slightly more truncated than posterior corner. Seta q cylindrical, striate-annulate, 0.6(–)0.7× length of s . Relative lengths of flagella (with base segments included) and of base segments alone: $F_1 = 100$, $bs_1 = 7$; $F_2 = (86–)89$, $bs_2 = 7$; $F_3 = (83–)84$, $bs_3 = 7$. Flagellum, F_1 2.4(–)2.6× as long as t , F_2 and F_3 (2.1–)2.3× as long as s . Distal calyces large, conical, distal part of flagella axes widened only between calyx and first lamella. Globulus g (1.2–)1.3× longer than



Figs. 13–19. *Allopauropus (A.) hilteneae*, holotype male. 13, Head, median and right part, tergal view; 14, Temporal organ, posterior part, lateral view; 15, Left antenna, sternal view; 16, Collum segment, median and left part, sternal view; 17, Bothriotrix T_1 ; 18, Bothriotrix T_3 ; 19, Genital papillae and setae on coxa and trochanter of leg 2, anterior view. Scales: a, Figs. 17–19; b, Figs. 13, 14, 16; c, Fig. 15.

wide, about 10 bracts, capsule wider than long with flattened bottom; diameter of g $0.7\times$ greatest diameter of t . Antennae glabrous.

Trunk.—Submedian and sublateral setae of collum segment subequal in length, furcate; inner branch of setae cylindrical, blunt, striate-annulate; outer branch rudimentary, glabrous (Fig. 16). Sternite process with V-shaped incision anteriorly, appendages barrel-shaped with subhemispherical capsules. Process pubescent, appendages glabrous.

Setae on anterior tergites as on head, gradually lengthening and tapering posteriorly. Tergite I with 4+4 setae, tergites II–IV with 6+6 setae each, tergite VI with 4+2 setae; setae not counted on tergite V. Submedian posterior setae on tergite VI tapering, length $0.4\times$ their interdistance and $0.6(-0.7)\times$ length of pygidial setae a_1 . Tergites glabrous.

Bothriotricha.—Relative lengths of bothriotricha: $T_1 = 100$, $T_2 = 105(-110)$, $T_3 = (89-)$ 100, $T_4 = 111(-118)$, $T_5 = 119(-123)$. Axes simple, very thin in T_1 , T_2 , T_4 and T_5 (Fig. 17); axis of T_3 thicker, tapering, pointed (Fig. 18). Pubescence hairs short, straight, simple, oblique on proximal halves, erect distally.

Genital papillae.—Glabrous, $1.7\times$ length of their greatest diameter, inner and outer margins similarly and evenly curved (Fig. 19); length of seta $0.4\times$ length of papilla.

Legs.—Setae on coxa and trochanter of leg 9 furcate, branches blunt, striate, those of coxal seta and main branch of trochanteral seta somewhat clavate; secondary branch of trochanteral seta thin, cylindrical (Figs. 20, 21); secondary branches of setae on coxae and trochanters of more anterior legs reduced or rudimentary (Fig. 19). Tarsus of leg 9 tapering, $3.6\times$ length of its greatest diameter (Fig. 22); proximal seta tapering, pointed, strongly turned outwards, distal half indistinctly striate; length $0.4\times$ length of tarsus and $2.5\times$ length of distal

seta, which is subcylindrical, striate, blunt. Cuticle of tarsus glabrous.

Pygidial tergum.—Posterior margin straight (Fig. 24). Relative lengths of setae; $a_1 = 10$, $a_2 = 6(-8)$, $a_3 = 16(-18)$, $st = (4-)$ 5; all setae directed posteriorly, somewhat curved inwards, thin, tapering; st setae converging, with short but distinct oblique pubescence; a_1 and a_3 with very short pubescence distally, a_2 glabrous. Seta a_2 inserted anterior to a_1 and outside a_3 . Distance $a_1 - a_1$ $(1.2-)$ $1.4\times$ length of a_1 ; distance $a_1 - a_2$ $(1.2-)$ $1.5\times$ length of distance $a_2 - a_3$; distance $st - st$ $(1.6-)$ $1.8\times$ length of st and $0.7\times$ length of distance $a_1 - a_1$. Cuticle glabrous.

Pygidial sternum.—Posterior margin between b_1 setae a large, broad, rounded lobe (Fig. 23). Relative lengths of setae ($a_1 = 10$): $b_1 = 17(-18)$, $b_2 = (5-)$ 6, $b_3 = 3$. Seta b_1 thin, cylindrical, striate distally; b_2 similar but tapering; b_3 subcylindrical, blunt, annulate. Seta b_2 curved inwards. Seta b_1 $1.6(-1.8)\times$ their interdistance; b_2 as long as distance $b_1 - b_2$; b_3 one-quarter of distance $b_3 - b_3$.

Anal plate narrowest anteriorly, $1.3\times$ longer than broad, with convex lateral margins; posterior margin with a median V-shaped incision between two thick, cylindrical, blunt, diverging appendages (Figs. 24, 25); length of appendages $0.6\times$ length of plate. Anal plate with distinct oblique pubescence on both sides, longest on the appendages.

Type specimens (N = 3).—Holotype male 9 and two paratypes (male 9, female 9), North Carolina, Swain County, Great Smoky Mountains National Park, Balsam Mountain Road, 0.8 km south of Palmer Creek trailhead, 3537.445N, 8310.761W, deciduous forest with *Acer rubrum*, *Halesia carolina*, *Fagus grandifolia*, *Hamamelis virginiana*, 24 September 2002, U. Scheller, E. Bernard, I. Stocks, collectors.

Other specimens (N = 4).—One female 9, two juveniles 6, one juvenile 5, same data as type specimens.

Derivation of name.—This species is

dedicated to Jeanie Hilten, Executive Director of Discover Life in America, who generously gave valuable time and assistance to this study.

Diagnosis.—*Allopauropus* (*A.*) *hiltenae* is closest to *A.* (*A.*) *racovitzai* Remy from Romania (Remy 1939). The two species have distinct similarities in the antennae and the pygidium, especially in the unusual arrangement of setae a_1 , a_2 and a_3 . In the new species seta a_2 is placed anterior to a_1 and anteriolaterally of a_3 . In most other species, seta a_2 is inserted posterior to a_1 and between a_1 and a_3 . There also are striking resemblances between the two species in the shape of seta st and the anal plate. However, the two species can be separated as follows: dimensions of antennal branches t and s (2.9–3.3 and 2.3–2.4 \times longer than wide, respectively, in *A. hiltenae*, 5 and 3 \times longer than wide in *A. racovitzai*); shape of antennal globulus g (proximal third subconical in *A. hiltenae*, subcylindrical in *A. racovitzai*); shape of posterior half of anal plate (V-shaped incision between the appendages in *A. hiltenae*, U-shaped incision in *A. racovitzai*).

Allopauropus* (*Decapauropus*) *bernardi

Scheller, new species

Figs. 26–33

Length.—(0.45–)0.48 mm.

Head (holotype only).—Median and submedian tergal setae subcylindrical, annulate, lateral seta in second row and lateral group setae tapering, pointed, annulate (Fig. 26). Relative lengths of setae, first row: $a_1 = 10$, $a_2 = 12$; second row: $a_1 = 10$, $a_2 = 13$, $a_3 = 12$; third row: $a_1 = 10$, $a_2 = 12$; fourth row: $a_1 = a_2 = 17$, $a_3 = 12$, $a_4 = 15$; lateral group setae: $I_1 = I_2 = I_3 = 17$. The ratio $a_1/a_1 - a_1$ 0.7 in first and second rows, 1.0 in third and fourth rows. Temporal organs broadest anteriorly, their length 2.1 \times their shortest distance apart; laterally, pistil claviform, one-fourth length of temporal organ. Head cuticle glabrous.

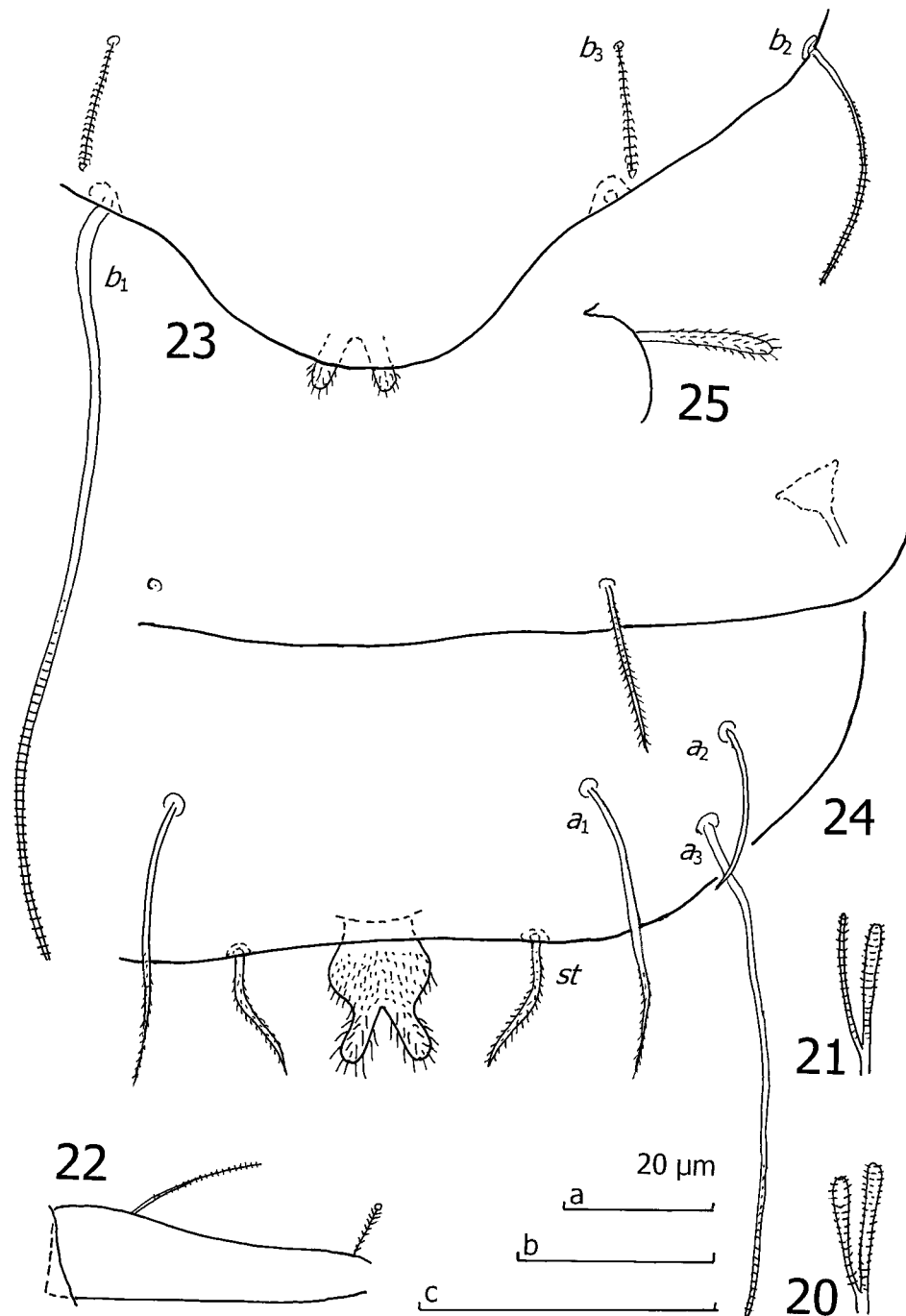
Antennae.—Fourth segment with four

cylindrical, striate-annulate setae, p'' thinnest of the four (Fig. 27). Relative lengths of setae: $p = 100$, $p' = (36\text{--})47$, $p'' = (29\text{--})35$ (–36), $r = (35\text{--})41$. Setae p''' and u absent. Tergal seta p (1.4–)1.5 \times length of tergal branch t . Branch t fusiform, 1.7(–2.0) \times longer than its greatest diameter, 0.9 \times length of sternal branch s ; branch s 1.4(–1.8) \times longer than its greatest diameter and with its anterodistal corner distinctly truncated. Seta q cylindrical, striate, 1.1(–1.2) \times longer than branch s . Relative lengths of flagella (with base segments included) and of base segments alone: $F_1 = 100$, $bs_1 = (9\text{--})10$; $F_2 = (38\text{--})41$, $bs_2 = 7$; $F_3 = (90\text{--})93$ (–96), $bs_3 = (9\text{--})10$. Flagellum F_1 (4.6–)5.5 \times longer than branch t , flagella F_2 and F_3 2.1(–2.3) and (3.9–)5.2 \times longer than branch s , respectively. Distal calyces subconical, glabrous, distal part of flagella axes not widened. Globulus g 1.2 \times longer than wide, with thin stalk, nine bracts, and spherical capsule; diameter of g slightly less than greatest diameter of branch t . Antennae glabrous.

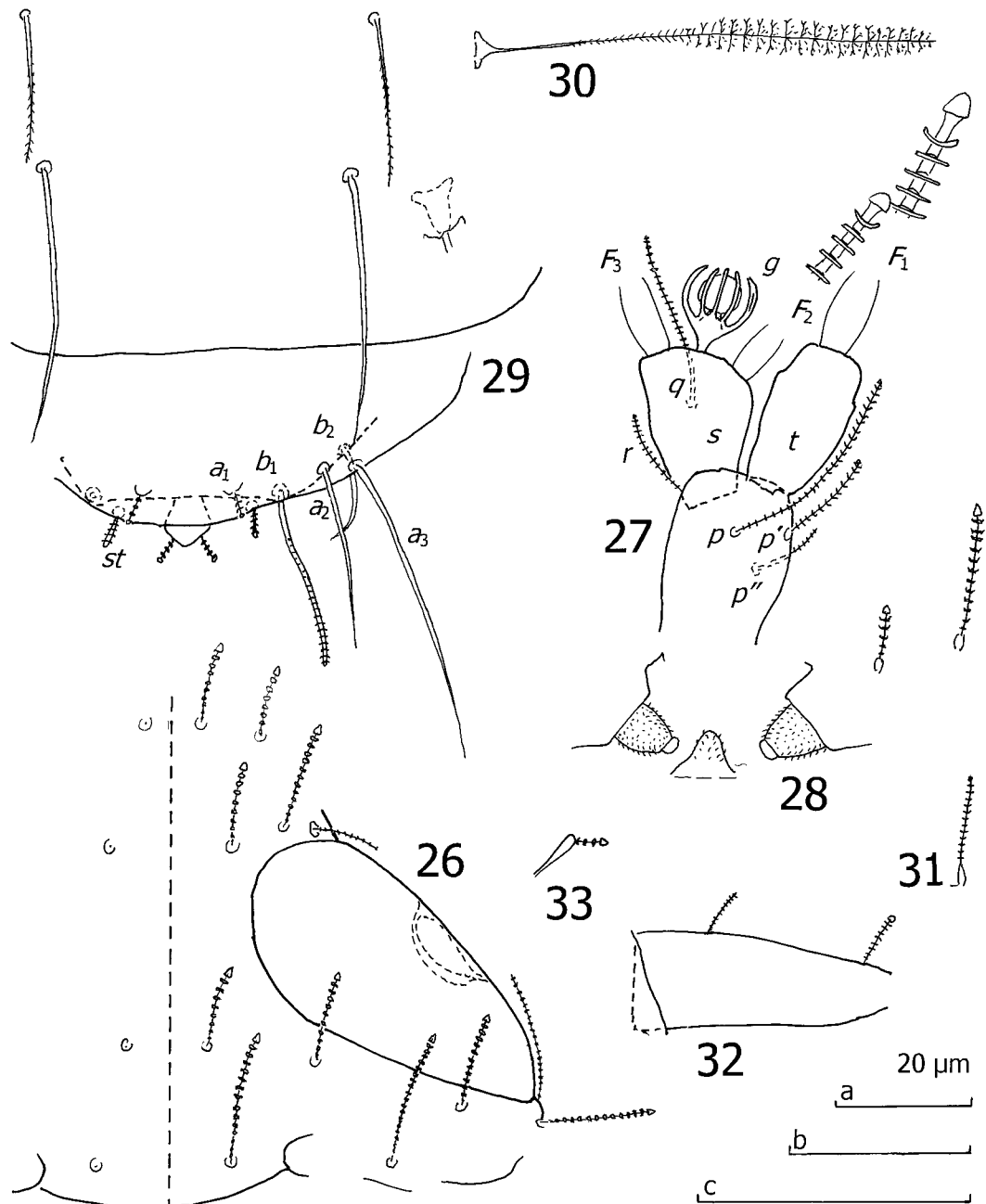
Trunk.—Setae of collum segment furcate (Fig. 28); main branch cylindrical, blunt, annulate, secondary branch rudimentary, minute. Sublateral setae twice length of submedian setae; process triangular, with short pubescence, apical incision indistinct; appendages subconical with subspherical, slightly flattened caps and short pubescence.

Setae on tergites similar to those of head, distinctly longer on tergite VI than on anterior tergites; 4+4 setae on tergite I, 4+6 on II, 6+6 on III–IV, 6'4 on V, 4+2 on VI. Submedian posterior setae on VI tapering, pointed, about as long as their interdistance (Fig. 29) and seven times length of pygidial setae a_1 . Tergites glabrous.

Bothriotricha.—Relative lengths of bothriotricha: $T_1 = 100$, $T_2 = 103$, $T_3 = (110\text{--})113$, $T_4 = (105\text{--})108$ (–115), $T_5 = (140\text{--})143$ (–155). Axes simple, thin. Pubescence increasing in length distally, especially on $T_1 - T_4$, consisting of short, simple hairs on T_5 and on proximal thirds of T_1



Figs. 20–25. *Allopauropus (A.) hilteneae* Scheller, new species, holotype male. 20, Seta on coxa of leg 9; 21, Seta on trochanter of leg 9; 22, Tarsus of leg 9; 23, Pygidial sternum, posterior part, sternal view; 24, Posteromedian and right part of tergite VI and median and right part of pygidial tergum; 25, Anal plate, lateral view. Scales: a, Figs. 20–22; b, Figs. 23, 25; c, Fig. 24.



Figs. 26–33. *Allopauropus (D.) bernardi*, holotype female. 26, Head, median and right part, tergal view; 27, Left antenna, sternal view; 28, Collum segment, median and left part, sternal view; 29, Tergite VI, median part, and pygidial tergum, median and right part, tergal view; 30, Bothriotrix T_3 ; 31, Seta on trochanter of leg 9; 32, Tarsus of leg 9; 33, Anal plate, lateral view. Scales: a, Fig. 30; b, Figs. 29, 31, 32; c, Figs. 26–28, 33.

– T_4 ; more apically on $T_1 - T_4$ pubescence longer, ramose, and arranged in whorls (Fig. 30).

Legs.—Setae on coxa and trochanter of all legs simple, annulate-striate (Fig. 31). Tarsus of leg 9 distinctly tapering, length $2.6(-2.7) \times$ its greatest diameter (Fig. 32). Setae cylindrical, blunt, striate, length of each $0.2 \times$ length of tarsus. Cuticle of tarsus glabrous.

Pygidial tergum.—Posterior margin rounded or with low rounded bulge between setae st (Fig. 29). Relative lengths of setae: $a_1 = 10$, $a_2 = (45-)$ 48, $a_3 = (86-)$ 88(–109), $st = (8-)$ 10; setae somewhat divergent. Setae a_1 and st straight, subcylindrical, striate, a_2 and a_3 curving inwards, tapering, pointed, glabrous. Distance $a_1 - a_1$ $2.5 \times$ length of a_1 ; distance $a_1 - a_2$ as long as distance $a_1 - a_1$ and somewhat longer than distance $a_2 - a_3$; distance $st - st$ $3.6(-3.7) \times$ length of st and $1.5(-1.6) \times$ the distance $a_1 - a_1$. Cuticle glabrous.

Pygidial sternum.—Posterior margin between setae b_1 with broad indentation (Fig. 29). Relative lengths of setae ($a_1 = 10$): $b_1 = 48(-50)$, $b_2 = 13$. Setae b_1 cylindrical, blunt, striate; b_2 tapering, pointed, curved inwards, glabrous. Length of b_1 setae $1.1(-1.3) \times$ their interdistance; length of b_2 $1.1 \times$ the distance $b_1 - b_2$.

Anal plate narrowest anteriorly, as broad as long, pentagonal, margins straight (Fig. 29); protruding from the two posterolateral sides, two diverging, cylindrical, annulate, blunt appendages (Fig. 33) slightly longer than half of the length of the plate.

Type specimens ($N = 3$).—Holotype female 9, North Carolina, Swain County, Ravensford area just north of Cherokee, 669163.662N, 722206.802E, upland forest, Tullgren sample, 22 Aug 2001, Pennie J. Long, Tracy Goodrich, collectors; two paratype females 9, North Carolina, Swain County, Ravensford area just north of Cherokee, 668466.193N, 720318.752E, flood plain forest, Tullgren sample, 30 October 2001, Ernest C. Bernard, Tracy Goodrich, collectors.

Other specimens ($n = 240$).—Same locality as above (Ravensford), Tullgren samples, upland forest, 669200.106N, 722181.572E, three females 9, one subadult female 8, two juveniles 6, 30 October 2001, Bernard and Goodrich, collectors, and 62 females 9, 57 males 9, one subadult female 8, 68 juveniles 6, three juveniles 5, 40 juveniles 3, 28 Dec 2001, Ernest C. Bernard, Adriean Mayor, collectors; same locality (Ravensford), Tullgren sample, upland forest, 669132.193N, 722188.803E, one female 9, one juvenile 6, one juvenile 3, 28 December 2001, Ernest C. Bernard, Adriean Mayor, collectors.

Derivation of name.—Dedicated to Professor Dr. Ernest C. Bernard, The University of Tennessee, Knoxville, who initiated this study and gave valuable support during its performance.

Diagnosis.—*Allopaupopus* (*D.*) *bernardi* is close to *A. (D.) marshalli* Scheller, 1984 from Canada (British Columbia) and *A. (D.) causeyae* Starling, 1943 from North Carolina. It is distinguished from *A. marshalli* by the shape of the antennal globulus g (subspherical, not longish) and pygidial seta st (subcylindrical, annulate, not very short, clavate). Moreover, pygidial seta a_2 is $4-5 \times$ longer than a_3 (only somewhat longer than a_3 in *A. marshalli*) and the shape of the anal plate is different (pentagonal in *A. bernardi*, linguiform in *A. marshalli*). Unfortunately, the description of *A. causeyae* is in parts erroneous (see Remy 1958), but the new species differs in the following respects: the proximal seta on the tarsus of the last pair of legs is one-fifth the length of the tarsus, whereas in *A. causeyae* this seta is one-third the length of the tarsus; in *A. bernardi* the length of the submedian posterior setae on tergite VI is equal to their distance apart, not two-thirds of that distance as in *A. causeyae*; pygidial setae b_2 are directed posteriorly and curved inwards on *A. bernardi*, not diverging and straight as on *A. causeyae*; and the anal plate of *A. bernardi* is pentagonal, not trapezoidal as in *A. causeyae*.

Allopauropus (Decapauropus)
chauliosetus Scheller, new species
Figs. 34–42

Length.—0.65 mm.

Head.—Tergal setae (Fig. 34) cylindrical, annulate; median and submedian setae blunt, annulate; lateral seta in third row and lateral group setae tapering. Relative lengths of setae, first row: $a_1 = a_2 = 10$; second row: $a_1 = 6$, $a_2 = 17$, $a_3 = 16$; third row: $a_1 = 7$, $a_2 = 8$; fourth row: a_1 , a_3 , a_4 unknown (setae broken off), $a_2 = 10$; lateral group setae: I_1 broken off, $I_2 = I_3 = 13$. Ratio of seta a_1 length to distance $a_1 - a_1 - 1.7$ in first row, 0.4 in second row, 0.7 in third row, undetermined in fourth row. Temporal organs broad in tergal view, length $1.7\times$ their shortest distance apart; small pore in posterior part of level of I_1 . Head cuticle glabrous.

Antennae.—Fourth segment with four cylindrical, annulate setae, seta r thinnest of the four. Relative lengths of setae: $p = 100$, $p' = 57$, $p'' = 46$, $r = 43$ (Fig. 35). Seta p''' absent. Tergal seta p $1.3\times$ length of tergal branch t . Branch t fusiform, length $3.1\times$ its greatest diameter and $1.6\times$ length of sternal branch s ; length of branch s $1.7\times$ its greatest diameter, anterodistal corner truncated. Seta q similar to tergal-anterior setae of fourth segment, length $1.6\times$ that of seta s . Relative lengths of flagella (with base segments included) and of base segments alone: $F_1 = 100$, $bs_1 = 7$; $F_2 = 37$, $bs_2 = 4$; $F_3 = 76$, $bs_3 = 7$. Flagellum F_1 $3.5\times$ longer than branch t , F_2 and F_3 2.1 and $4.2\times$ longer than branch s , respectively. Distal calyces subhemispherical, glabrous, distal part of flagellar axes fusiform. Globulus g short-stalked, $1.1\times$ longer than wide, approximately eight bracts, capsule with flattened bottom. Diameter of globulus g $0.6\times$ greatest diameter of branch t . Antennae glabrous.

Trunk.—Sublateral seta on collum segment $2.5\times$ longer than submedian setae. Sternite process and appendages not observed.

Setae on tergite I as on head, longer and pointed more posteriorly; $4+(?)2$ setae on tergite I, $4+4$ setae on tergite VI, undetermined on tergites II–V. Submedian posterior setae on tergite VI tapering, pointed, with oblique pubescence, length $1.5\times$ their interdistance. Posterior tergites distinctly pubescent, but pubescence sparse on tergite VI (Fig. 40).

Bothriotricha.—Relative lengths of bothriotricha: $T_1 = 100$, $T_2 = 131$, posterior bothriotricha lost. Axes simple, thin; pubescence very short, hairs erect on distal half (Fig. 36).

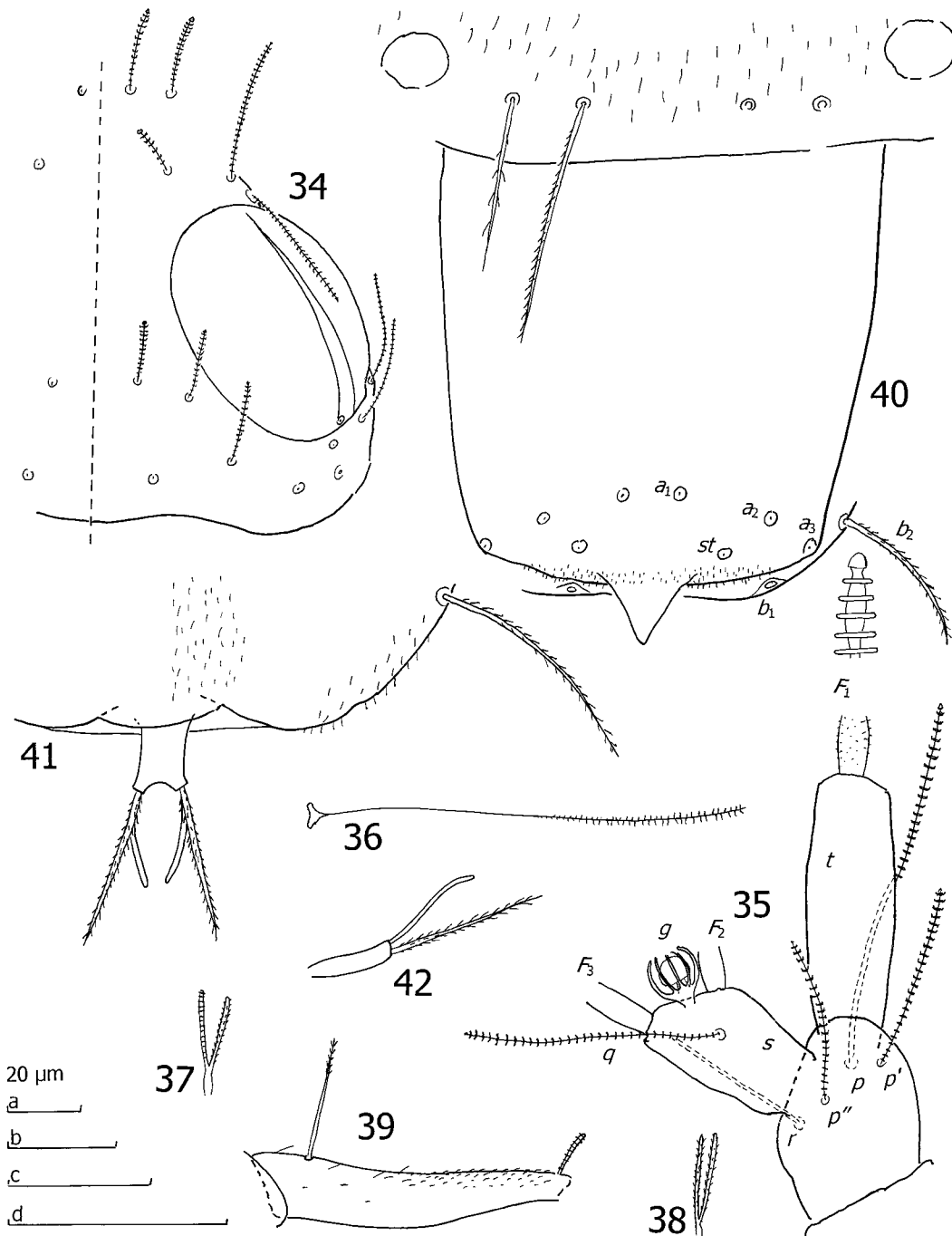
Legs.—Setae on coxae and trochanters of legs 8 and 9 furcate (Figs. 37, 38), branches similar but not identical, cylindrical, striate; more anteriorly these setae simple, straight, cylindrical, blunt. Tarsus of leg 9 (Fig. 39) slightly bow-shaped, slender, tapering, length $5.1\times$ its greatest diameter; proximal tarsal seta straight, perpendicular to tarsus, tapering, pointed, with oblique pubescence on distal third, length $0.4\times$ length of tarsus and $2.4\times$ length of distal seta, which is subcylindrical, clavate, blunt, and striate. Cuticle of tarsus with distinct pubescence on dorsal side, pubescence sparse on proximal half. Seta on tibia projecting perpendicularly to the dorsal surface of tibia.

Pygidium.—Length and width of pygidium equal, and with distinct posterolateral corners at seta a_3 (Fig. 40).

Pygidial tergum.—Posterior margin somewhat rounded but with large posteromedian triangular lobe projecting backwards just below insertion points of st setae (Fig. 40). All setae lost. Distance $a_1 - a_2$ $1.7\times$ distance $a_1 - a_1$ and twice the distance $a_2 - a_3$; distance $st - st$ $2.5\times$ that of $a_1 - a_1$. Posterior margin with short, erect pubescence, triangular lobe glabrous.

Pygidial sternum.—Posterior margin between b_1 setal bases almost straight; b_1 setae lost. Seta b_2 $22\ \mu\text{m}$ long, curved inwards, directed posterolaterally, tapering, pointed, with distinct oblique pubescence, length $0.4\times$ distance $b_1 - b_2$.

Anal plate (Figs. 41, 42) broadest ante-



Figs. 34–42. *Allopauropus (D.) chaulioetus*, holotype female. 34, Head, median and right part, tergal view; 35, Right antenna, sternal view; 36, Bothriotrix T_1 ; 37, Seta on coxa of leg 9; 38, Seta on trochanter of leg 9; 39, Tarsus of leg 9; 40, Posterior part of tergite VI and pygidium, tergal view (pubescence partially indicated); 41, Pygidial sternum, posterior part, sternal view (pubescence partially indicated); 42, Anal plate, lateral view. Scales: a, Figs. 37, 38; b, Figs. 36, 39; c, Figs. 34, 40; d, Figs. 35, 41, 42.

riorly, $1.6\times$ longer than broad, with concave lateral margins; distinct posterolateral corners separated by median shallow indentation; posterolateral corners cut squarely, each provided with two appendages extending backwards. Sternal appendages longest, $1.3\times$ longer than plate, somewhat diverging, straight, tapering distally, pointed, with distinct oblique pubescence; tergal appendages shorter, $1.2\times$ longer than plate, directed posteriorly, curved inwards, cylindrical, blunt, glabrous.

Type specimen.—Holotype female 9, Tennessee, Sevier County, Great Smoky Mountains National Park, Twin Creeks Natural Resources Center, under rotted wood on lower part of mowed lawn, 16 September 2002, Ulf Scheller, collector.

Derivation of name.—From Greek *chaulios* = outstanding, prominent (proximal seta on the tarsus).

Diagnosis.—The antennae and posterior part of the pygidial tergum, including the anal plate, have characters that suggest *A. (D.) chaulioisetus* is close to *A. (D.) aegyptiacus* Remy (Remy 1950) and *A. (D.) excavatus* Scheller (Scheller 1970). The former species has been found in several subtropical-tropical sites, even from Florida (Remy 1958), but the latter is known only from Sri Lanka. The new species is distinguished from *A. aegyptiacus* by the following characters: ratio of length of antennal globulus *g* to length of sternal antennal branch *s* (0.3 in *A. chaulioisetus*, 0.6 in *A. aegyptiacus*); appearance of bothriotrix T_3 (no distal endswelling in *A. chaulioisetus*, distal endswelling in *A. aegyptiacus*); pubescence on bothriotrix T_5 (short hairs in *A. chaulioisetus*, very strong, straight hairs in *A. aegyptiacus*); and proximal seta on tarsus 9 (straight and prominent in *A. chaulioisetus*, somewhat curved and oblique in *A. aegyptiacus*). The new species is distinguished from *A. excavatus* by the following characters: appearance of T_3 (no distal endswelling in *A. chaulioisetus*, with distinct endswelling in *A. excavatus*); relative lengths of the setae on the tarsus of the last

pair of legs (proximal seta $2.4\times$ longer than distal seta in *A. chaulioisetus*, 1.4 – $1.5\times$ in *A. excavatus*); shape of the posterior part of the pygidial tergum (triangular in *A. chaulioisetus*, semicircular in *A. excavatus*); shape of the anal plate (posterolateral corners cut quarterly in *A. chaulioisetus*, tapering in *A. excavatus*).

Allopauropus (Decapauropus) parkeri

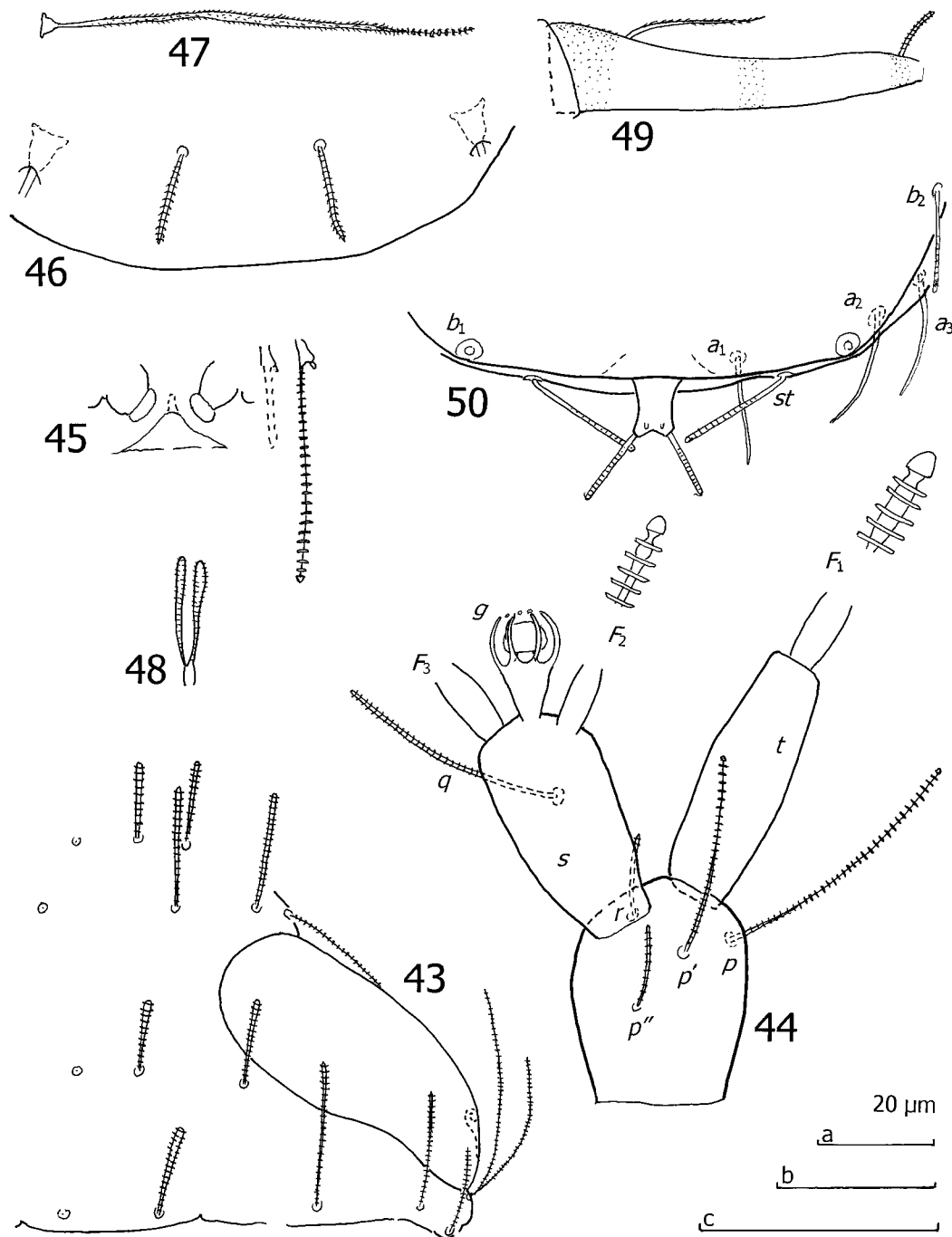
Scheller, new species

Figs. 43–50

Length.— 0.74 (– 0.94) mm.

Head.—Tergal setae thin, subcylindrical, blunt, striate (Fig. 43). Relative lengths of setae (holotype only), first row: $a_1 = 10$, $a_2 = 11$; second row: $a_1 = a_2 = 15$, $a_3 = 16$; third row: $a_1 = 9$, $a_2 = 11$; fourth row: $a_1 = 11$, $a_2 = 18$, $a_3 = 15$, $a_4 = 12$; lateral group setae: $I_1 = 27$, $I_2 = I_3 = 20$. Ratio of a_1 to distance $a_1 - a_1$ 1.2 in first row, 0.9 in second and fourth rows, 1.1 in third row. Temporal organs large, length in tergal view (1.6 –) $1.7\times$ their shortest distance apart; posterior part with small aperture. Head cuticle glabrous.

Antennae. Fourth segment (Fig. 44) with four cylindrical, striate-annulate setae, *r* thinnest. Relative lengths of setae: $p = 100$, $p' = (64$ –) 68 , p'' and $r = 25$. Seta p''' absent. Tergal seta *p* $1.1\times$ length of tergal branch *t*; branch *t* fusiform, widest in the middle, (2.9 –) $3.1\times$ longer than its greatest diameter, length similar to that of sternal branch *s*; branch *s* $2.2\times$ longer than its greatest diameter, anterodistal corner truncated. Seta *q* cylindrical striate, $0.9\times$ length of branch *s*. Relative lengths of flagella (with base segments included) and of base segments alone: $F_1 = 100$, $bs_1 = 10$; $F_2 = 83$ (– 89), $bs_2 = (8$ –) 9 ; $F_3 = (95$ –) 97 , $bs_3 = 10$. Flagellum F_1 3.1 (– 3.3) \times length of *t*, F_2 and F_3 3.0 (– 3.3) and $3.3\times$ length of *s*, respectively. Distal calyces subhemispherical, glabrous, distal part of flagella axes weakly widened. Length of globulus *g* (1.3 –) $1.5\times$ its width and with distinct stalk, seven bracts, capsule with flattened bottom; di-



Figs. 43–50. *Allopauropus (D.) parkeri*, holotype female. 43, Head, median and right part, tergal view; 44, Right antenna, sternal view; 45, Collum segment, median and left part, sternal view; 46, Tergite VI, posterior part; 47, Bothriotrix T_3 ; 48, Seta on trochanter of leg 9; 49, Tarsus of leg 9 (pubescence partially indicated); 50, Pygidium, posterior and left part, sternal view. Scales: a, Figs. 47–49; b, Figs. 43, 46; c, Figs. 44, 45, 50.

iameter of g (1.0–)1.1 \times greatest diameter of branch t . Antennae glabrous.

Trunk.—Setae of collum segment furcate (Fig. 45); inner branch subcylindrical, annulate, blunt, outer branch rudimentary, blunt, glabrous. Sublateral setae twice length of submedian setae. Sternite process broadly triangular, narrow anteriorly; appendages barrel-shaped with subhemispherical caps; process and appendages glabrous.

Setae on tergites subcylindrical, blunt, striate (Fig. 46), becoming longer posteriorly; 4+4 setae on tergite I, 6+6 on II–IV, 4+4 on V, and 4+2 on VI. Submedian posterior setae on tergite VI cylindrical, length 0.7 \times their interdistance and (1.3–)1.8 \times length of pygidial seta a_1 . Tergites glabrous.

Bothriotricha.—Relative lengths of bothriotricha (one paratype only): $T_1 = 100$, $T_3 = (90)$, $T_4 = (98)$, $T_5 = (152)$; T_2 length not determined. Axes very thin in T_1 , T_2 and T_4 , with short, simple, pubescence oblique proximally, erect distally. Bothriotrix T_3 (Fig. 47) with thicker axis, thickest in the middle, tapering proximally and distally, most distal part annulate, pubescence oblique.

Legs.—Setae on coxa and trochanter of leg 9 furcate (Fig. 48), main branch weakly clavate, secondary branch cylindrical, both with short, oblique pubescence. On more anterior legs secondary branch rudimentary, blunt, primary branch distinctly clavate, pubescent. Setae on coxa more clavate and shorter than setae on trochanter. Tarsus of leg 9 (Fig. 49) tapering, 4.3 \times longer than wide. Proximal seta tapering, pointed, with distinct oblique pubescence, length 0.3(–)0.4 \times that of tarsus and 1.6(–)2.3 \times longer than distal seta, which is cylindrical, blunt, striate. Cuticle of tarsus with minute pubescence.

Pygidial tergum.—Posterior margin evenly rounded. Relative lengths of setae: $a_1 = st = 10$, $a_2 = a_3 = (11–)12$; all setae short (Fig. 50); a_1 and st straight, cylindrical, blunt, a_1 slightly divergent, striate, st convergent, glabrous; a_2 and a_3 tapering, curved inwards, convergent, glabrous. Dis-

tance $a_1 - a_1$ (1.4–)1.5 \times length of a_1 ; distance $a_1 - a_2$ about twice the length of distance $a_2 - a_3$; distance $st - st$ 2.0(–)2.1 \times length of st and 1.5 \times the distance $a_1 - a_1$. Cuticle glabrous.

Pygidial sternum.—Posterior margin between b_1 almost straight (Fig. 50). Relative lengths of setae ($a_1 = 10$): $b_1 = (35–)41$, $b_2 = 10(–)13$. Setae b_1 and b_2 thin, cylindrical, striate distally; b_2 almost straight, slightly curved inwards. Length of seta b_1 about equal to $b_1 - b_1$ interdistance; length of b_2 0.6 \times distance $b_1 - b_2$.

Anal plate (Fig. 50) broadest anteriorly, length 1.1 \times its width, with concave lateral margins; posterior margin with shallow median indentation between obliquely truncated lateral corners, each with a cylindrical, blunt, striate appendage; appendages diverging, about as long as plate. Two minute appendages protruding downwards from sternal side of base of posterolateral corners.

Type specimens (N = 3).—Holotype female 9, North Carolina, Swain County, Balsam Mountain Road, 4 km from south entrance, 3537.445N, 8310.761W, west-facing slope, deciduous forest with *Acer rubrum*, *Halesia carolina*, *Fagus grandifolia*, *Hamamelis virginiana*, 24 September 2002, U. Scheller, E. Bernard, I. Stocks, collectors; two paratype females 9, Tennessee, Sevier County, Indian Gap, *F. grandifolia*, *Rubus* sp., *Dryopteris* sp., above Appalachian Trail, 17 Sep 2002, U. Scheller, I. Stocks, collectors.

Derivation of name.—Dedicated to Dr. Charles R. Parker, United States Geological Survey, Biological Resources Division, for kind collecting help.

Diagnosis.—There are superficial similarities in the shapes of the antennae, bothriotricha and pygidium with several species. Among American species, *A. (D.) parkeri* may be close to *A. (D.) jasperensis* Remy described from Arkansas (Remy 1959) but the anal plates are different (broadest anteriorly and without small submedian sternal appendages in *A. parkeri*, narrowest ante-

riorly and with two small submedian sternal appendages in *A. jasperensis*). The antennal globulus *g* in *A. parkeri* is long-stalked, not short-stalked as in *A. jasperensis*.

Allopauropus (Decapauropus) porterensis

Scheller, new species

Figs. 51–61

Length.—(0.50–)0.53 mm.

Head.—Median and submedian tergal setae striate and variably clavate (Fig. 51), lateral seta in fourth row cylindrical, lateral seta in second row and lateral group setae thin, tapering, pointed. Relative lengths of setae, first row $a_1 = 10$, $a_2 = (9-)$ 11; second row: $a_1 = (10-)$ 13, $a_2 = (18-)$ 19, $a_3 = (14-)$ 18; third row: $a_1 = (10-)$ 11(–12), $a_2 = (12-)$ 14; fourth row: $a_1 = (12-)$ 15, $a_2 = (16-)$ 17, $a_3 = (15-)$ 16, $a_4 = 14(–16)$; lateral group setae: $I_1 = 29$, $I_2 = 20$, $I_3 = 16$. Ratio of seta a_1 length to the distance $a_1 - a_1$ in first row (0.9–)1.0, second row (0.6–)0.7, third row 0.9(–1.0), fourth row 0.8(–1.0). Temporal organs broad in tergal view, their length $1.2\times$ their shortest distance apart; small pore in posterior part of level of I_1 . Head cuticle glabrous.

Antennae.—Fourth segment (Fig. 52) with four cylindrical striate-annulate setae, seta *r* the thinnest with distinct striation. Relative lengths of setae: $p = 100$, $p' = (64-)$ 73, $p'' = 32$, $r = 27(–28)$. Seta p''' absent. Tergal seta *p* $1.3(–1.4)\times$ length of tergal branch *t*. Branch *t* fusiform, length (3.0–)3.3 \times its greatest diameter and as long as sternal branch *s*; branch *s* length $2.0(–2.1)\times$ its greatest diameter, distal corners subequally truncated. Seta *q* similar to setae *p* and p' , almost as long as branch *s*. Relative lengths of flagella (with base segments included) and of base segments alone: $F_1 = 100$, $bs_1 = 9(–10)$; $F_2 = ?(76-80)$, $bs_2 = 8$; $F_3 = (81-)$ 84, $bs_3 = 10$. Flagellum F_1 $3.1(–3.4)\times$ length of branch, *t*, F_2 and F_3 $?(2.6-2.7)$ and $2.6(–2.9)\times$ length of branch *s*, respectively. Distal calyces subconical to subhemispherical, glabrous, distal part of flagella axes not or slightly

widened. Width of globulus *g* $1.4(–1.5)\times$ its length with thick basal part, approximately eight slightly curved bracts and spherical capsule. Diameter of *g* $1.2\times$ greatest diameter of branch *t*. Antennae glabrous.

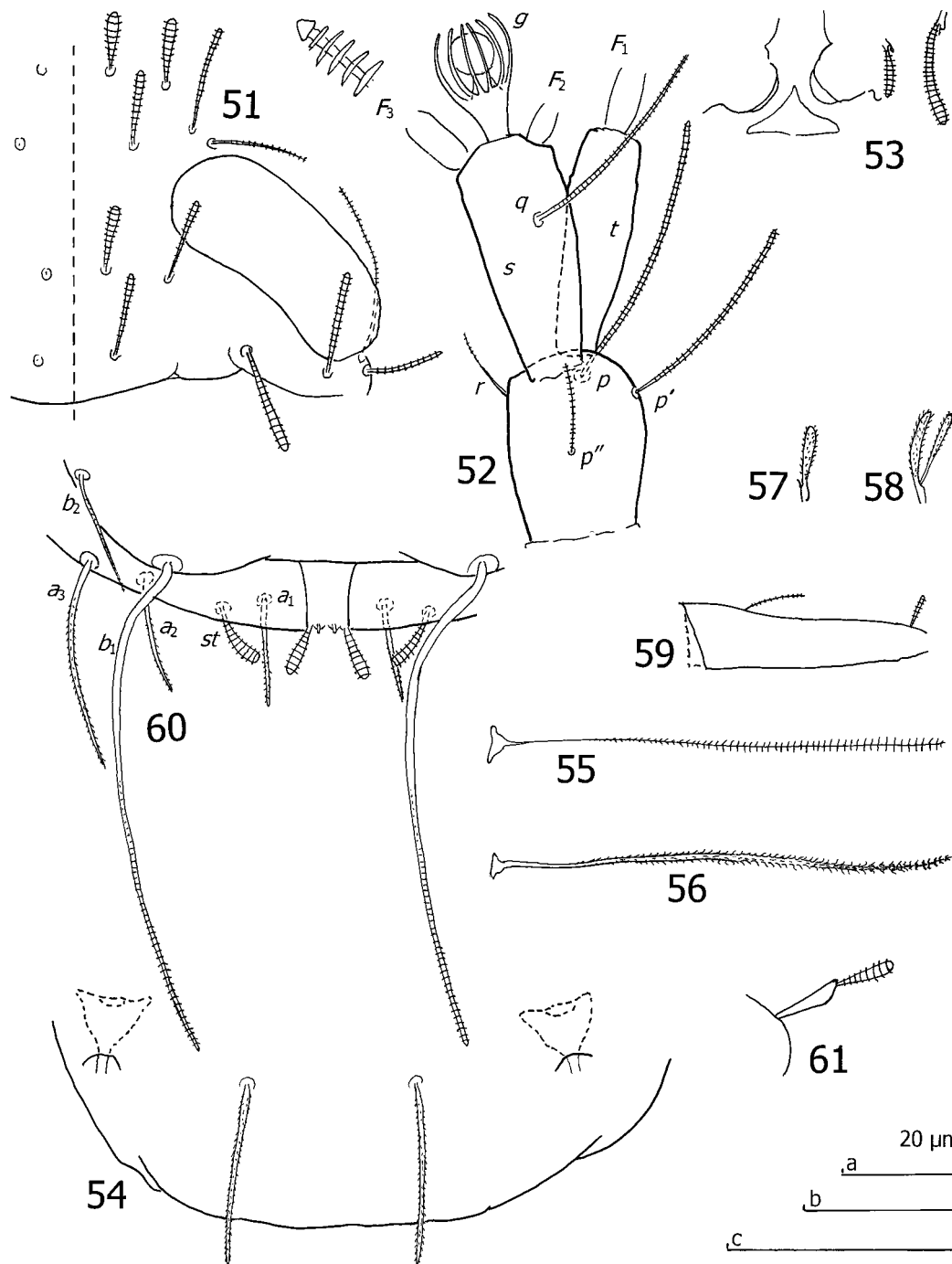
Trunk.—Setae of collum segment furcate (Fig. 53); main branch cylindrical, blunt, striate; secondary branch rudimentary, glabrous. Sublateral setae twice the length of submedian setae; process triangular, narrow anteriorly, with minute apical incision; appendages subcylindrical with flattened caps; process and appendages glabrous.

Setae on tergites as on head, gradually lengthening posteriorly; 4+4 setae on tergite I, 6+6 on II–IV, 6+4 on V, 4+2 on VI. Submedian posterior setae on tergite VI (Fig. 54) subcylindrical, with minute pubescence, about as long as their interdistance and $(1.4-)$ 1.6 \times length of pygidial setae a_1 . Tergites glabrous.

Bothriotricha.—Relative lengths of bothriotricha: $T_1 = 100$, $T_2 = (118-)$ 131, $T_3 = (90-)$ 100(–110), $T_4 = (122-)$ 132, $T_5 = (183-)$ 206(–210). Axes simple, very thin in all but T_3 ; pubescence of simple erect hairs, distinct on T_1 and T_2 , very short on T_4 and T_5 (Fig. 55). Bothriotrix T_3 (Fig. 56) with thicker axis, coarse and oblique pubescence on proximal three-fourths, annulate most distally.

Legs.—Setae on coxa and trochanter of leg 9 furcate, branches weakly clavate to subcylindrical (Fig. 58); more anteriorly these setae with rudimentary glabrous secondary branch (Fig. 57). Tarsus of leg 9 tapering, length (3.5–)3.8 \times its greatest diameter (Fig. 59). Proximal seta tapering, pointed, striate, $0.3\times$ length of tarsus, $(1.8-)$ 2.0 \times length of subclavate, blunt, striate distal seta. Cuticle of tarsus glabrous.

Pygidial tergum.—Posterior margin rounded. Relative lengths of setae: $a_1 = 10$, $a_2 = (9-)$ 10, $a_3 = (17-)$ 19, $st = 6$; setae of very different appearance (Fig. 60). Seta a_1 straight, slightly tapering, with minute pubescence; a_2 and a_3 cylindrical, tapering, pubescent, curved inwards; *st* striate, cla-



Figs. 51–61. *Allopauropus (D.) porterenis*, holotype female. 51, Head, median and right part, tergal view; 52, Right antenna, sternal view; 53, Collum segment, median and left part, sternal view; 54, Tergite VI, posterior part; 55, Bothriotrix T₁C; 56, Bothriotrix T₃; 57, Seta on coxa of leg 8; 58, Seta on trochanter of leg 9; 59, Tarsus of leg 9; 60, Pygidium, posterior and left part, sternal view; 61, Anal plate, lateral view. Scales: Figs. 56–58; b, Figs. 53, 55, 59; c, Figs. 51, 52, 54, 60, 61.

vate, curved inwards, converging. Distance $a_1 - a_1$ equal to length of a_1 ; distance $a_1 - a_2$ almost twice distance $a_2 - a_3$; distance $st - st$ (2.4–)3× length of st and 1.4(–1.7)× distance $a_1 - a_1$. Cuticle glabrous.

Pygidial sternum.—Posterior margin between b_1 setae with broad indentation (Fig. 60). Relative lengths of setae ($a_1 = 10$): $b_1 = (38–)44$, $b_2 = (9–)11$. Seta b_1 gradually tapering, striate distally; b_2 similar, curved inwards, with oblique pubescence. Seta b_1 length (1.4–)1.6× distance $b_1 - b_1$; b_2 length (1.0–)1.1× distance $b_1 - b_2$.

Anal plate (Fig. 60) broadest anteriorly, 1.8× longer than broad, with concave lateral margins and distinct lateral corners separated by a median V-shaped indentation, four appendages protruding from posterosternal margin: two appendages sublateral, straight, clavate, striate, diverging, about as long as plate (Fig. 61); two appendages submedian, very short, glabrous.

Type specimens (n = 3).—Holotype female 9 and two paratype females 9, Tennessee, Sevier, County, Great Smoky Mountains National Park, Porter's Flat, 3950200N, 283000E, elevation 738 m, hardwood cove forest, 18–19 June 1996, sample reference number 9617-2, F. Coyle, collector.

Derivation of name.—A Latinized adjective of the name Porter's Flat, the type locality.

Diagnosis.—*Allopauropus* (*D.*) *porterensis* is clearly distinguished from all other members of the subgenus *Decapauropus* by a combination of the following characters: anterior and posterior corners of antennal branch s with subsimilar truncations; globulus g proportionally large and with bracts only slightly bent; bothriotrix T_3 with very short pubescence; anal plate with truncated posterior corners and two long and two short posterior appendages. *Allopauropus porterensis* has some characters in common with other species, but their distributions are scattered around the world and do not give any clues to possible relationships.

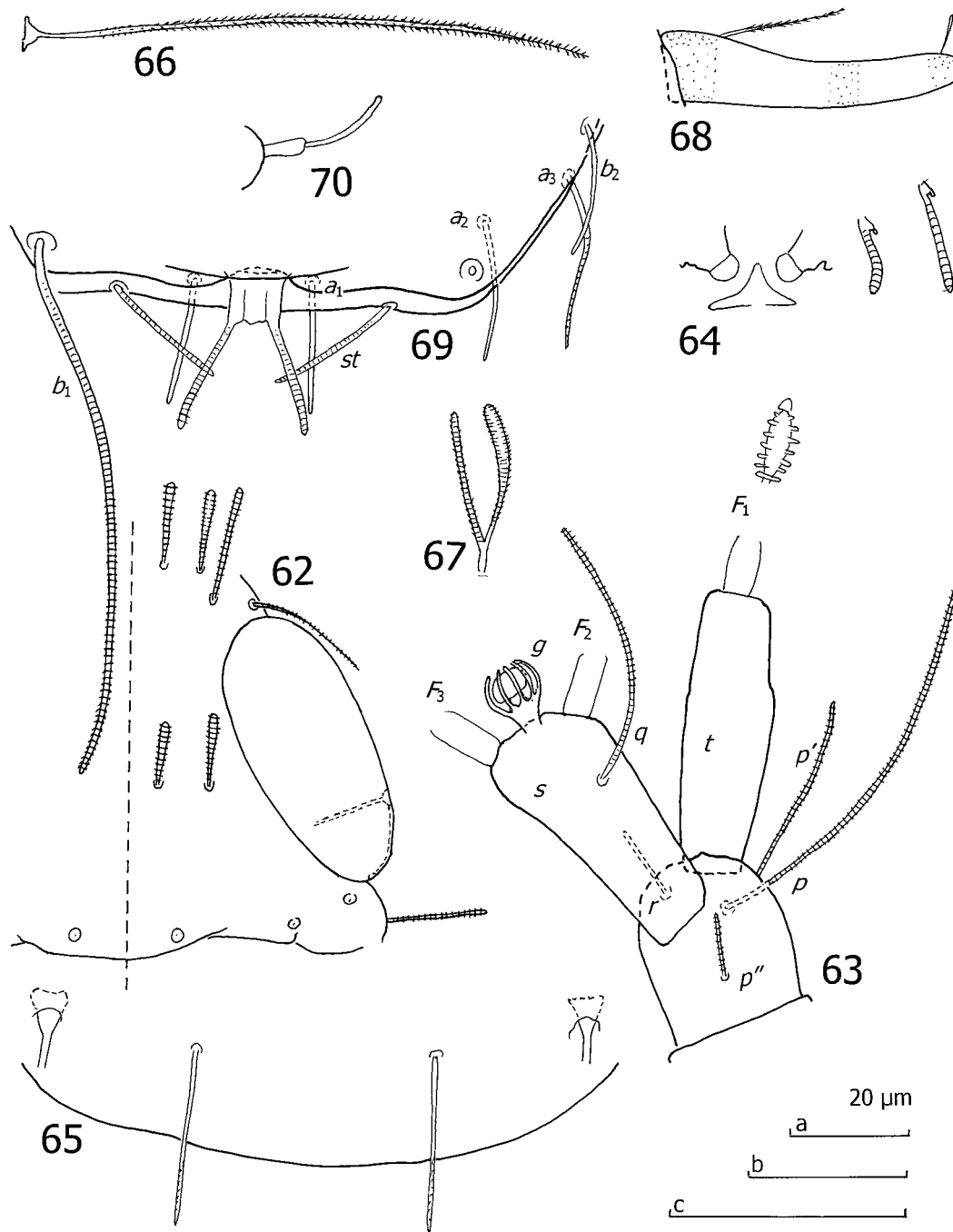
Allopauropus (*Decapauropus*)
purchasensis Scheller, new species
Figs. 62–70

Length.—(0.61)0.72 mm.

Head.—Median and submedian tergal setae moderately clavate, striate (Fig. 62). Relative lengths of setae, first row: $a_1 = 10$, $a_2 = 9(11)$; second row: $a_1 = ?(16)$, $a_2 = 15(18)$, $a_3 = 16(19)$; third row: $a_1 = a_2 = 9(13)$; fourth row: $a_1 = ?(15)$, $a_2 = a_3 = ?(25)$, $a_4 = 13$; lateral group setae not studied. Ratio of seta a_1 length to the distance $a_1 - a_1$ in first row 1.3, second row ?(0.9), third row 1.1(1.3), fourth row ?(1.0). Length of temporal organs 1.6× their shortest distance apart; in posterior part of a small inner tube crossing perpendicularly from surface in direction of inner median part of head. Head cuticle glabrous.

Antennae.—Fourth segment (Fig. 63) with four cylindrical, striate setae, seta r the thinnest. Relative lengths of setae: $p = 100$, $p' = (60)64$, $p'' = 29(24)$, $r = (23)24$. Seta p'' absent. Tergal seta p equal in length to tergal branch t . Branch t fusiform, widest in the middle, length (3.2)3.5× its greatest diameter, 1.1× length of sternal branch s . Length of branch s 2.2(2.3)× its greatest diameter, anteriodistal corner slightly more truncated than posterodistal corner. Seta q cylindrical, striate, (1.0)1.1× length of branch s . Relative lengths of flagella (with base segments included) and of base segments alone (holotype only): $F_1 = 100$, $bs_1 = 7$; $F_2 = 81$, $bs_2 = 8$; $F_3 = 83$, $bs_3 = 7$. Flagellum F_1 2.9× length of branch t , F_2 and F_3 2.6 and 2.7× length of branch s , respectively. Distal calyces very small, subhemispherical, glabrous; distal part of flagella axes widened, most distinctly on F_1 . Globulus g 1.2(1.3)× longer than wide, with distinct stalk and ten bracts, capsule with flattened bottom; diameter of g 0.7(0.8)× greatest diameter of branch t . Antennae glabrous.

Trunk.—Setae of collum segment (Fig. 64) furcate; inner branch subcylindrical, striate, blunt, outer branch rudimentary,



Figs. 62–70. *Allopaupopus (D.) purchasensis*, holotype female. 62, Head, median and right part, tergal view; 63, Right antenna, sternal view; 64, Collum segment, median and left part, sternal view; 65, Tergite VI, posterior part; 66, Bothriotrix T_3 ; 67, Seta on coxa of leg 9; 68, Tarsus of leg 9 (pubescence partially indicated); 69, Pygidium, posterior and left part, sternal view; 70, Anal plate, lateral view. Scales: a, Figs. 64, 66, 68; b, Figs. 62, 67, 70; c, Figs. 63, 65, 69.

blunt, glabrous. Sublateral setae $(1.3)1.6\times$ length of submedian setae. Sternite process triangular, narrow anteriorly; appendages subconical, with subhemispherical caps; process and appendages glabrous.

Setae on anterior tergites similar to setae on head, becoming longer and cylindrical posteriorly, 4+4 setae on tergite I, 6+6 on II–V, 4+2 on VI. Submedian posterior setae on tergite VI cylindrical, length $(0.6)0.7\times$ their interdistance and $(1.1)1.2\times$ length of pygidial seta a_1 (Fig. 65). Tergites glabrous.

Bothriotricha.—Relative lengths of bothriotricha: $T_1 = 100$, $T_2 = 98(102)$, $T_3 = 90(98)$, $T_4 = 102(109)$, $T_5 = 161(162)$. Axes simple, very thin in T_1 and T_2 , somewhat thicker in T_4 and T_5 , thickest in T_3 . Bothriotrix T_3 tapering distally (Fig. 66), covered with short, simple, oblique pubescence. Pubescence on other bothriotricha except T_3 very short, all hairs simple.

Legs.—Setae on coxa and trochanter of leg 9 furcate (Fig. 67), main branch moderately clavate, secondary branch cylindrical, both with short oblique pubescence. On more anterior legs, secondary branch rudimentary, blunt; coxal setae more clavate than setae on trochanter. Tarsus of leg 9 arcuate (Fig. 68), tapering, length $3.9(4.2)\times$ its greatest diameter. Proximal seta almost straight, tapering, pointed, with distinct oblique pubescence; setal length $(0.3)0.4\times$ that tarsus, $(3.0)3.1\times$ length of subcylindrical, blunt, striate distal seta. Cuticle of tarsus with minute pubescence.

Pygidial tergum.—Posterior margin almost straight, low bulge between *st* setae. Relative lengths of setae: $a_1 = 10$, $a_2 = (9)11$, $a_3 = 14(15)$, *st* = 9. Seta a_1 and *st* straight, cylindrical, blunt; a_1 and a_3 somewhat curved inwards, tapering, a_1 and a_2 glabrous, a_3 striate distally, *st* striate, converging (Fig. 69). Distance $a_1 - a_1$ equal to length of seta a_1 ; distance $a_1 - a_2$ $2.1\times$ distance $a_2 - a_3$; distance *st* - *st* $(2.0)2.1\times$ length of *st* and $(2.0)2.3\times$ distance $a_1 - a_1$. Cuticle glabrous.

Pygidial sternum.—Posterior margin between b_1 setae almost straight, low bulge

below anal plate (Fig. 69). Relative lengths of setae ($a_1 = 10$): $b_1 = (41)42$, $b_2 = 10$; these setae cylindrical, b_1 striate, b_2 glabrous. Seta b_2 curved inwards. Seta b_1 about as long as their interdistance; b_2 $0.7\times$ distance $b_1 - b_2$.

Anal plate nearly square, with straight lateral margins (Fig. 69); posterior margin almost straight; each posterior corner with long, cylindrical, blunt, striate appendage protruding posteriorly and diverging outwards; appendage length $2.2\times$ length of plate (Fig. 70).

Type specimens (N = 2).—Holotype female 9 and one paratype female 9, North Carolina, Haywood County, Great Smoky Mountains National Park, Purchase Knob, 3940.013N, 7031.3292E, elevation 1420 m, deciduous forest, 20 September 2002, U. Scheller, R. Lowe, collectors.

Other specimens (N = 10).—Same data as holotype, two juveniles 5, two juveniles 3; Tennessee, Sevier County, Great Smoky Mountains National Park, Twin Creeks Natural Resources Center, under rotted wood 5 m from stream, east side of Twin Creek near footbridge to collecting plot, deciduous forest with hemlock (*Tsuga canadensis*), *Rhododendron* sp., moss and Christmas ferns, 16 Sep 2002, one female 9, U. Scheller; collector; North Carolina, Swain County, Great Smoky Mountains National Park, Balsam Mountain Road, 0.8 km south of Palmer Creek trailhead, 3537.445N, 8310.761W, deciduous forest with *Acer rubrum*, *Halesia carolina*, *Fagus grandifolia*, *Hamamelis virginiana*, 24 Sep 2002, one female 9, U. Scheller, E. Bernard, I. Stocks, collectors; Tennessee, Sevier County, Great Smoky Mountains National Park, 350 m east of Road Prong trailhead at Appalachian Trail, steep slope at hog enclosure, under rotted log, 3536.707N, 8328.033W, 17 September 2002, one female 9, U. Scheller, I. Stocks, collectors; Tennessee, Sevier County, Great Smoky Mountains National Park, Porter's Creek trail, 200 paces from bridge over Porter's Creek, 3950800N, 283000E, elevation 738 m, 24–25 August 1996, two females 9,

one juvenile 6, F. Coyle, M. Aiken, R. Edwards, R. Wright, collectors.

Derivation of name.—A Latinization of the name Purchase (Knob), type locality for this new species.

Diagnosis.—*Allopaupopus (D.) purchasensis* is close to *A. (D.) jasperensis* Remy from Arkansas (Remy 1959). These species are separated by shape of the antennal globulus *g* (base conical, as long as bracts, in *A. purchasensis*, but very short, one-third the length of the bracts in *A. jasperensis*); shape of the distal part of bothriotrix T_3 (pointed in *A. purchasensis* n.sp., blunt in *A. jasperensis*); ratio of setal lengths on the tarsus of the last pair of legs (length of proximal seta/length of distal seta 2.4-3.1 in *A. purchasensis*, 3.5 in *A. jasperensis*); shape of the anal plate (posterior margin straight or slightly convex in *A. purchasensis*, with median incision in *A. jasperensis*).

Allopaupopus purchasensis also may be closely related to two species described in this paper, *A. (D.) porterensis* and *A. (D.) parkeri*, but the latter two species have a pair of small additional appendages on the most posterior part of the anal plate.

Allopaupopus (Decapauropus) stocksii

Scheller, new species

Figs. 71-79

Length.—0.68 mm.

Head.—Most tergal setae not available for study. Those setae seen (Fig. 71) striate, length of a_1 of first row 10 μm , moderately clavate; a_2 in second row 14 μm long, subcylindrical; a_3 in second row 12 μm long, tapering; a_3 in fourth row 15 μm long, subcylindrical; lateral group setae not studied. Length of temporal organs 1.8 \times as long as their shortest distance apart; aperture in posterior part. Head cuticle glabrous.

Antennae.—Fourth segment (Fig. 72) with six cylindrical striate setae, setae p''' thinnest. Relative lengths of setae: $p = 100$, $p' = 80$, $p'' = 24$, $p''' = 29$, $r = 28$, $u = 4$. Length of tergal seta p 1.2 \times that of tergal

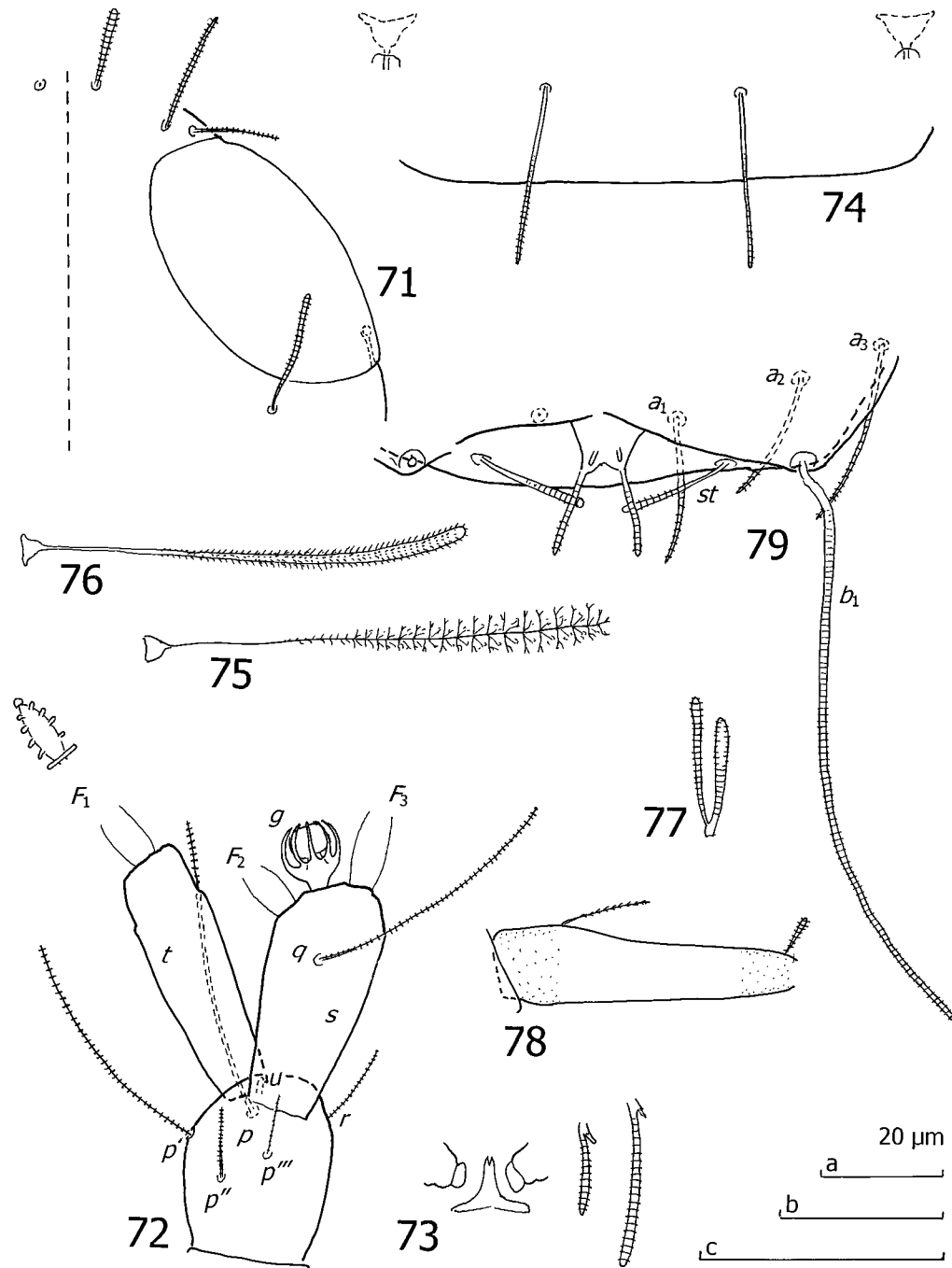
branch t . Branch t fusiform, length 6.5 \times its greatest diameter and 1.1 \times longer than sternal branch s . Length of branch s 2.1 \times its greatest diameter; anterodistal corner truncate. Seta q cylindrical and striate, 1.2 \times longer than branch s . Length of flagellum not measured. Flagellum F_1 with very small, subhemispherical, glabrous calyces and with distal part of flagella axis fusiform. Globulus g 1.2 \times longer than wide, stalk short but distinct, about 10 bracts, capsule with flattened bottom; diameter of g 0.8 \times greatest diameter of branch t . Antennae glabrous.

Trunk.—Seta of collum segment furcate (Fig. 73); inner branch subcylindrical, striate, blunt, outer branch rudimentary, glabrous. Sublateral setal length 1.9 \times that of submedian setae. Sternite process narrow anteriorly and with distal incision; appendages subcylindrical, with subhemispherical caps; process and appendages glabrous.

Setae on anterior tergites subcylindrical, blunt, striate, becoming longer posteriorly; 4+4 setae on tergite I, number of setae on other tergites not determined. Submedian posterior setae on tergite VI (Fig. 74) slightly tapering, striate distally, length 0.9 \times their interdistance and 1.2 \times length of pygidial setae a_1 . Tergites glabrous.

Bothriotricha.—Relative lengths of bothriotricha: $T_1 = 100$, $T_2 = ?$, $T_3 = 96$, $T_4 = 116$, $T_5 = 203$. Axes simple, very thin except on T_3 , which has a thicker, distally blunt axis (Fig. 76). Pubescence on proximal part of T_1 , T_2 and T_4 short, simple, oblique; more apically the hairs long, branched, whorled (Fig. 75); T_5 and proximal part of T_3 with short pubescence of simple, oblique hairs.

Legs.—Setae on coxa and trochanter of leg 9 furcate (Fig. 77), branches slightly clavate and striate, secondary branch longer than primary branch. On more anterior legs secondary branch rudimentary; coxal setae on legs 3-8 more clavate than on leg 9. Tarsus of leg 9 tapering (Fig. 78), 3.8 \times longer than its greatest diameter. Proximal seta almost straight, tapering, pointed, with



Figs. 71-79. *Allopaupopus (D.) stocksii*, holotype female. 71, Head, median and right part, tergal view; 72, Left antenna, sternal view; 73, Collum segment, median and left part, sternal view; 74, Tergite VI, posterior part; 75, Bothriotrix T₁; 76, Bothriotrix T₃; 77, Seta on trochanter of leg 9; 78, Tarsus of leg 9 (pubescence partially indicated); 79, Pygidium, posteromedian and left part, sternal view. Scales: a, Figs. 75-78; b, Figs. 71, 73; c, Figs. 72, 74, 79.

short oblique pubescence; length $0.3\times$ length of tarsus and $2.1\times$ as long as distal seta, which is subcylindrical, blunt, striate. Cuticle of tarsus with minute pubescence.

Pygidial tergum.—Posterior margin almost straight, low bulge between *st* setae. Relative lengths of setae: $a_1 = 10$, $a_2 = 9$, $a_3 = 13$, $st = 9$; all of these setae striate distally; a_1 , a_2 , and a_3 thin, tapering, pointed, curved inwards, a_1 directed posteriorly, a_1 and a_2 converging (Fig. 79). Setae *st* straight, subcylindrical, blunt, strongly converging. Distance $a_1 - a_1$ $0.9\times$ length of seta a_1 ; distance $a_1 - a_2$ equal to distance $a_2 - a_3$; distance $st - st$ $2.1\times$ greater than length of *st* and $1.9\times$ greater than distance $a_1 - a_1$. Cuticle glabrous.

Pygidial sternum.—Posterior margin between b_1 with a broadly V-shaped indentation (Fig. 79). Relative lengths of setae ($a_1 = 10$): $b_1 = 42$, b_2 not measured. Setae b_1 and b_2 cylindrical, striate. Length of b_1 setae $1.6\times$ their interdistance.

Anal plate broadest anteriorly, as long as broad, with concave lateral margins; distinct posterolateral corners separated by a medial broadly V-shaped indentation (Fig. 79). Each posterolateral corner with a straight, diverging, cylindrical, blunt, striate appendage nearly $1.8\times$ longer than the plate; two additional short, slightly diverging, blunt, glabrous appendages protruding postero-ventrally from posterosternal part of plate.

Type specimen.—Holotype female 9, Tennessee, Sevier County, Great Smoky Mountains National Park, Appalachian Trail, 350 m east of Road Prong trailhead, 3536.707N, 8328.033W, steep slope at hog enclosure, under rotted log, 17 September 2002, U. Scheller, I. Stocks, collectors.

Derivation of name.—Dedicated to Mr. Ian Stocks for his kind collecting help.

Diagnosis.—*Allopaupopus* (*D.*) *stocksi* belongs to a group of species with subquadrate anal plates and long posterior appendages, and seems to be closest to *A. (D.) bohnsacki* Remy from Tennessee (Remy 1957) and *A. (D.) micronatus* Remy from

California (Remy 1958). Both species also have been collected in GSMNP. *Allopaupopus stocksi* is easily distinguished from *A. bohnsacki* by the shape of the anal plate (two short posterosternal appendages in *A. stocksi*, no such appendages in *A. bohnsacki*). *Allopaupopus stocksi* and *A. mucronatus* are clearly distinguished by the shape of the anal plate (broadly V-shaped posteromedian margin in *A. stocksi*, posteromedian projection in *A. mucronatus*) and the distal portion of bothriotrix T_3 (blunt in *A. stocksi*, pointed in *A. mucronatus* Remy).

Allopauros stocksi also is close to three species described in this paper: *A. (D.) parkeri*, *A. (D.) porterensis*, and *A. (D.) purchasensis*, but is distinguished from them by the shape of the bothriotricha (T_3 with blunt distal end, T_1 , T_2 , and T_4 with long, branched pubescence in *A. stocksi*; T_3 with pointee end, and T_1 , T_2 , and T_4 with short, simple pubescence in the other three species). Antennal and anal plate shapes also differ among these species.

Allopaupopus (Decapauropus) virgulatus

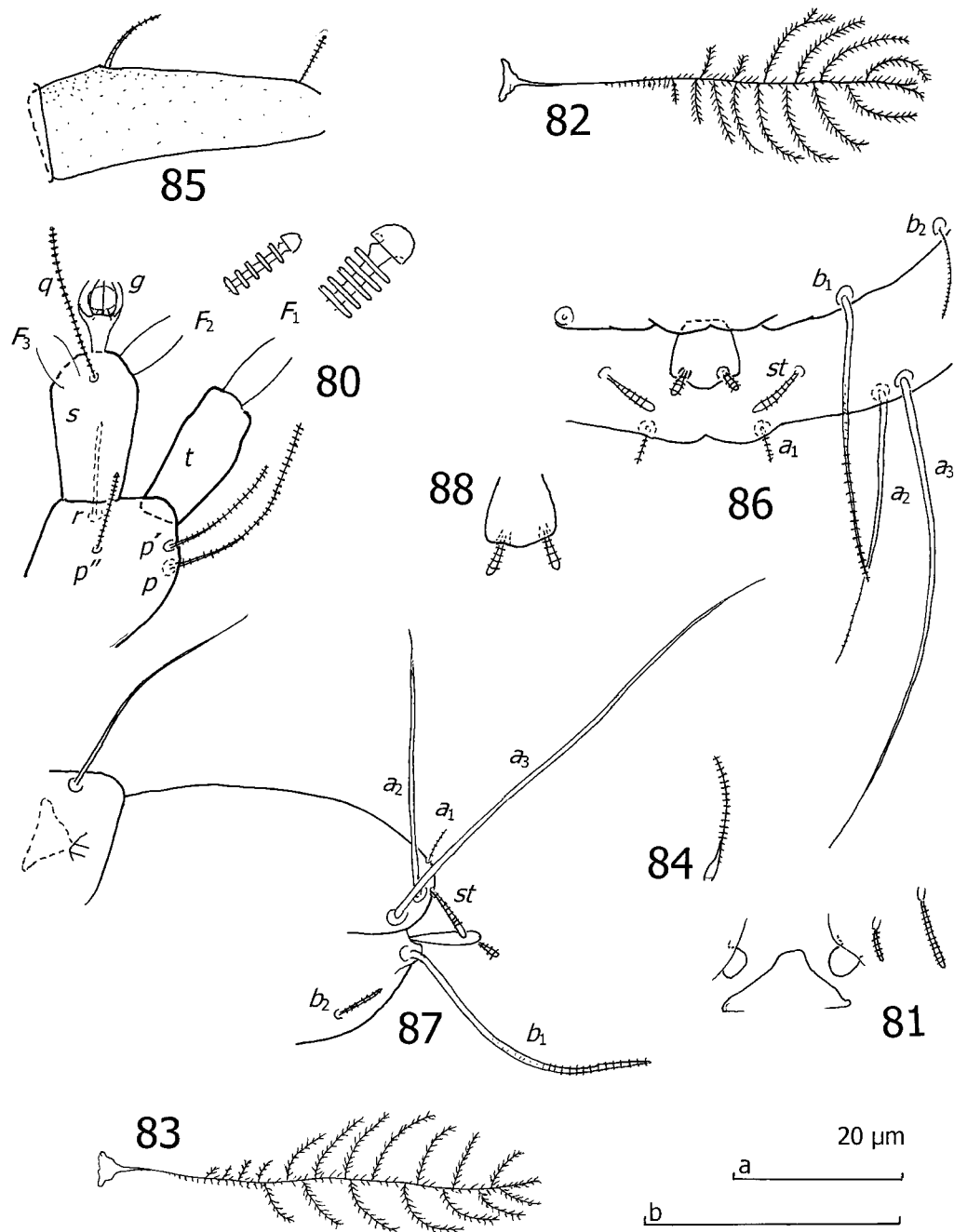
Scheller, new species

Figs. 80–88

Length.—0.41 mm.

Head.—Setae thin, especially a_3 of second row. Relative lengths of setae, first row: $a_1 = a_2 = 10$; second row: $a_1 = 13$, $a_2 = 16$, $a_3 = 10$; third row: $a_1 = ?$, $a_2 = ?$; fourth row: $a_1 = 10$, $a_2 = 17$, $a_3 = ?$, $a_4 = 14$; lateral group setae $I_1 = 24$, $I_2 = 17$, $I_3 = 16$. Ratio of seta a_1 length of the distance $a_1 - a_1$ and temporal organs not studied. Temporal organ with long, distinct pistil in lateral part of the organ. Head cuticle glabrous.

Antennae.—Third segment with four setae. Fourth segment (Fig. 80) with four cylindrical, blunt, striate-annulate setae, seta *r* thinnest. Relative lengths of setae: $p = 100$, $p' = 59$, $p'' = 35$, $r = 47$. Setae p''' and *u* absent. Length of tergal seta *p* $1.5\times$ length of tergal branch *t*. Branch *t* subcylindrical, $2.2\times$ longer than its greatest diameter and



Figs. 80–88. *Allopauropus (D.) virgulatus*, holotype female. 80, Right antenna, sternal view; 81, Collum segment, median and left part, sternal view; 82, Bothriotrix T_1 ; 83, Bothriotrix T_3 ; 84, Seta on trochanter of leg 9; 85, Tarsus of leg 9; 86, Pygidium, posteromedian and left part, sternal view; 87, Pygidium and posterior part of tergite VI, lateral view; 88, Anal plate, tergal view. Scales: a, Figs. 81–83; b, Figs. 80, 84–88.

equal to sternal branch s . Length of branch s $1.6\times$ its greatest diameter, anterodistal and posterodistal corners similarly truncated. Seta q similar to setae p and p' , $1.2\times$ length of branch s . Flagellum F_2 longer than F_3 . Relative lengths of flagella (with base segments included) and of base segments alone: $F_1 = 100$, $bs_1 = 11$; $F_2 = 76$, $bs_2 = 10$; $F_3 = 72$, $bs_3 = 8$. Flagella F_2 and F_3 of same thickness, thinner than F_1 . Flagellum F_1 $4.5\times$ length of branch t , F_2 and F_3 3.5 and $3.3\times$ length of branch s , respectively. Distal calyces hemispherical to subhemispherical, glabrous, distal part of flagella axes widened only between calyx and first lamella. Width of globulus g $1.6\times$ its length, stalk long and thick, approximately eight slightly bent bracts, capsule spherical. Antennae glabrous.

Trunk.—Setae of collum segment appearing simple, cylindrical, blunt, striate (Fig. 81). Sublateral seta length $1.8\times$ submedian seta length; processes blunt-ended, glabrous; appendages concealed, caps subhemispherical.

Setae on tergites not studied.

Bothriotricha.—Relative lengths of bothriotricha: $T_1 = 100$, $T_2 = 106$, $T_3 = 104$, $T_4 = 124$, $T_5 = 166$. Axes thin, all but T_5 polymorose with branches in one plane (Figs. 82, 83); main axes and branches covered with a distinct pubescence of somewhat oblique simple hairs; primary branches sometimes secondarily branched most distally. Approximate number of branches: T_1 14, T_2 16, T_3 18, T_4 15. Bothriotrix T_5 with simple, straight axis and short pubescence of simple, straight, oblique hairs.

Legs.—Setae on coxa and trochanter of leg 9 simple, cylindrical, striate (Fig. 85). Tarsus of leg 9 tapering, length $3.1\times$ its greatest diameter. Setae striate, proximal seta tapering, pointed, distal seta subcylindrical, blunt. Length of proximal seta $0.2\times$ length of tarsus and $1.4\times$ as long as distal seta. Cuticle of tarsus minutely pubescent.

Pygidial tergum.—Posterior margin rounded (Fig. 86) with two low lobes be-

hind insertion points of a_1 setae. Relative lengths of setae: $a_1 = 10$, $a_2 = 73$, $a_3 = 130$, $st = 30$. Setae of very different appearance: a_1 and st short, blunt, striate, a_1 diverging, st widening distally, curved inwards, converging and directed downwards; setae a_2 and a_3 long, tapering, pointed, glabrous, curved inwards, a_2 directed upwards (Fig. 87). Distance $a_1 - a_1$ $3.0\times$ greater than length of seta a_1 ; distance $a_1 - a_2$ $2.5\times$ greater than distance $a_2 - a_3$; distance $st - st$ $3.0\times$ greater than length of seta st and $1.7\times$ greater than distance $a_1 - a_1$. Cuticle glabrous.

Pygidial sternum.—Posterior margin between b_1 setae with broad, low median bulge having an indistinct median indentation (Fig. 86). Relative lengths of setae ($a_1 = 10$): $b_1 = 75$, $b_2 = 27$. Seta b_1 thin, cylindrical, striate distally; b_2 similar to b_1 , tapering, curved inwards. Length of b_1 setae equal to their interdistance; length of seta b_2 $0.8\times$ distance $b_1 - b_2$.

Anal plate narrowest anteriorly, as long as broad, with convex lateral margins; posterior margin with low triangular lobe between two submedian appendages protruding from posterosternal margin; appendage length nearly $0.4\times$ length of plate; appendages straight, blunt, striate, somewhat diverging and directed obliquely downwards (Figs. 86–88).

Type specimen.—Holotype female 9, North Carolina, Swain County, Ravensford, 669165.926N, 722197.989E, upland forest, Tullgren sample, 22 August 2001, P. L. Jennings, T. Goodrich, collectors.

Other material.—Two juv. 3, same data as holotype.

Derivation of name.—From Latin *virgula* = little twig, branch (bothriotricha $T_1 - T_4$).

Diagnosis.—*Allopauropus* (*D.*) *virgulus* is well distinguished by the many-branched bothriotricha in combination with the shape of the antennal globulus and the anal plate, and the characters of the collum segment. It resembles the central Amazonian *A. (D. brachypodus* Scheller and *A.*

(*D.*) *anomoios* Scheller (Scheller 1994, 1997, respectively) and *A. (D.) ramosus* Scheller from Sierra Leone (Scheller 1995), especially in the shape of the bothriotricha and the anal plate. However, these species are all easily separated from *A. virgulatus* in having a distal end-swelling on bothriotrix T_3 and furcate distal setae on the tarsi of at least the last pair of legs.

Allopaupopus (Desmopaupopus)

Scheller, new subgenus

Starling described *Pauropus dukensis* from the Duke Forest at Duke University in North Carolina (Starling 1943). A few more specimens collected by K.K. Bohnsack in the AEC Controlled Area, Oak Ridge, Tennessee, were studied by Remy (1957). Remy noted that seta b_3 was absent from the pygidial sternum, but that setae d_1 and d_2 were present on the pygidial tergum in the subadult stage. In these respects *P. dukensis* resembled *Scleropauropus squameus* Remy from Ivory Coast (Remy 1948). Soon after, when reporting some specimens of *Pauropus dukensis* from Tennessee (Remy 1958), Remy speculated that the species might belong to the subgenus *Scleropauropoides* in *Scleropauropus*. However, when Remy reported the species from Jasper, Arkansas (Remy 1959), he still placed the species in *Pauropus*. The collection of several specimens of *P. dukensis* from GSMNP allows for a new appraisal of the placement of this species.

The combination *Pauropus dukensis* is dubious. In its general appearance (antennae, tergites, legs, pygidium) it resembles *Pauropus* spp., but only the anterodistal part of the sternal antennal branch is distinctly truncated as in *Allopaupopus*, while the anterodistal and posterodistal corners are equally truncated in *Pauropus*. Moreover, the sclerotization of the tergites is so weak that it cannot justifiably be placed in *Scleropauropodinae*. The occurrence of the setae d_1 and d_2 in the subadult stage is the only character it has in common with *Scler-*

opauropoides; but this character state also applies in *Allopaupopus*. Remy's hesitation as to the placement of this taxon was understandable because its pygidial chaetotaxy could also be found in *Pauropodinae*, e.g., in the subgenera *Decapauropus* and *Perissopauropus* in *Allopaupopus*. Study of the GSMNP material and a comparison with characters of the genera *Pauropus*, *Allopaupopus*, and *Scleropauropus* demonstrate the need for a new combination. *Pauropus dukensis* is moved to *Allopaupopus* in *Pauropodinae* and a new subgenus for it, *Desmopaupopus*, is created.

Derivation of name.—From Greek *desmos* = (uniting) band (binds together some subgenera in *Allopaupopus*).

Diagnosis.—A subgenus in *Allopaupopus* with the following combination of characters: pygidial sternum with setae b_1 and b_2 ; pygidial tergum in the subadult stage (eight pairs of legs) with both d_1 and d_2 ; anterodistal corner of sternal antennal branch more truncated than posterodistal corner; temporal organ with anteriorly directed vesicular organ.

Type species.—*Allopaupopus (Desmopaupopus) dukensis* (Starling 1943).

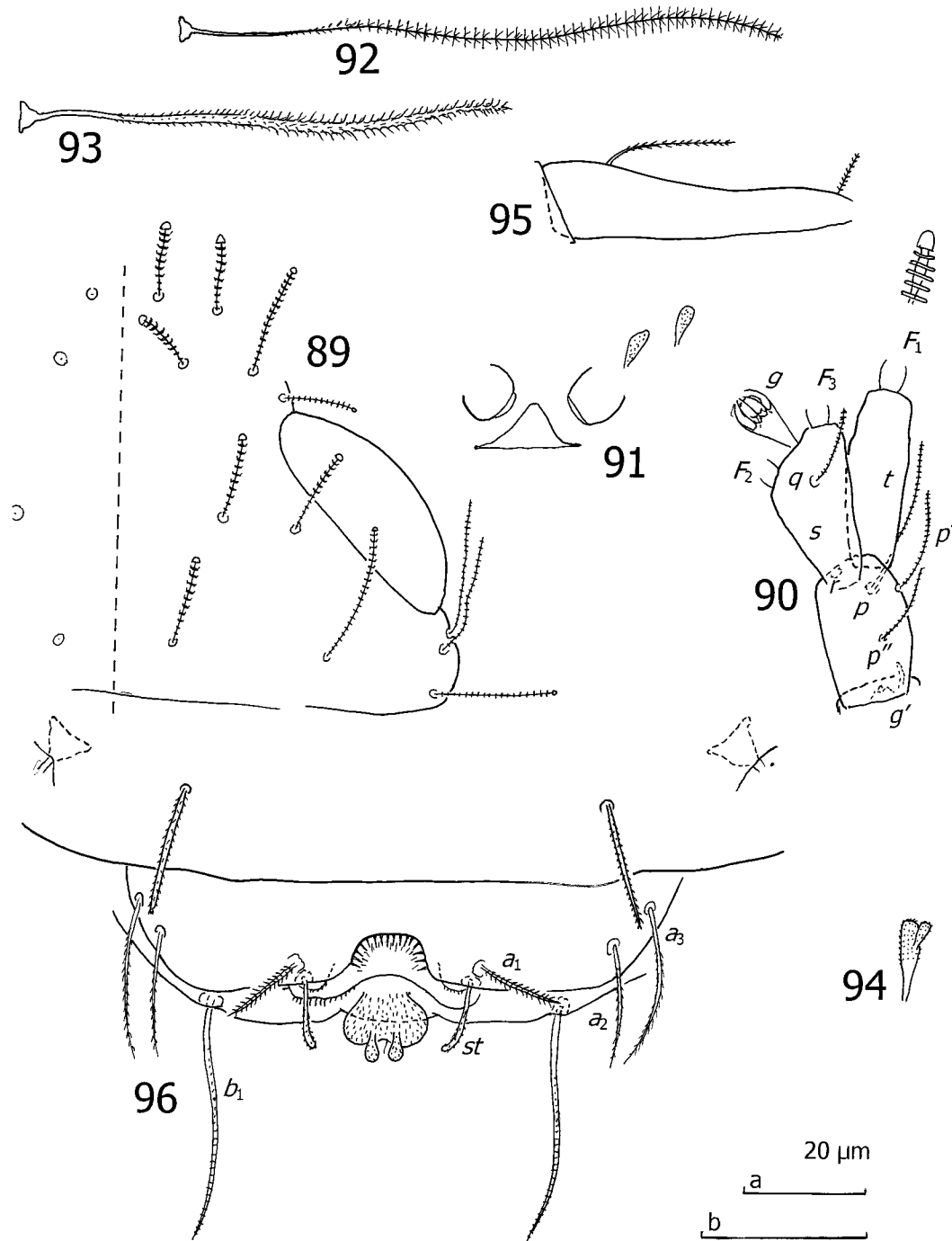
Stylopaupopus (Stylopaupopus) sulcatoides Scheller, new species

Figs. 89–96

Length.—0.75 mm.

Head.—Tergal setae annulate; median and submedian setae weakly clavate, lateral and sublateral setae cylindrical, blunt; lateral-group setae tapering (Fig. 89). Relative lengths of setae, first row: $a_1 = a_2 = 10$; second row: $a_1 = 9$, $a_2 = 16$, $a_3 = 10$; third row: $a_1 = 12$, $a_2 = 13$; fourth row: $a_1 = 12$, $a_2 = 19$, $a_3 = ?$, $a_4 = 17$; $I_1 = I_3 = 17$, $I_2 = 19$. Ratio of seta a_1 to the distance $a_1 - a_1$ in first row 1.1, in second row 0.5, in third row 0.4, in fourth row 0.8. Temporal organs mainly lateral, their length in tergal view $0.8\times$ their shortest distance apart. Head cuticle glabrous.

Antennae.—Third segment with three se-



Figs. 89–96. *Stylopaupopus (S.) sulcatoides*, holotype female. 89, Head, median and right part, tergal view; 90, Right antenna, sternal view; 91, Collum segment, median and left part, sternal view; 92, Bothriotrix T₁; 93, Bothriotrix T₃; 94, Seta on trochanter of leg 9; 95, Tarsus of leg 9; 96, Pygidium and posterior part of tergite VI. Scales: a, Figs. 91–93, 95; b, Figs. 89, 90, 94, 96.

tae and rudimentary seta g' on distal part of tergal side (Fig. 90). Fourth segment with four cylindrical, striate setae, seta r thinnest. Relative lengths of setae: $p = 100$, $p' = 65$, p'' about 50; length of r not determined. Setae p'' and u absent. Tergal seta p as long as length of tergal branch t . Branch t fusiform, length $2.5\times$ its greatest diameter and equal to sternal branch s . Length of branch s $1.9\times$ its greatest diameter, posterodistal corner distinctly truncate. Seta q similar to tergal-anterior setae of fourth segment, approximately half the length of branch s . Relative lengths of flagella (with base segments included) and of base segments alone: $F_1 = 100$, $bs_1 = 6$, $F_2 = 97$, $bs_2 = ?$, $F_3 = 48$, $bs_3 = ?$. Flagellum F_2 thinner than F_1 and F_3 ; length of F_1 $3.3\times$ that of t , F_2 and F_3 3.1 and $1.6\times$ as long as s , respectively. Distal calyces of F_1 longer than wide, glabrous; other calyces not studied. Globulus g twice the length of its greatest diameter; with about 11 bracts; capsule subspherical. Diameter of g $0.8\times$ greatest diameter of branch t . Antennae glabrous.

Trunk.—Setae of collum segment leaf-shaped, blunt, shortly pubescent, probably furcate with secondary branch rudimentary; both setae of the same length (Fig. 91). Sternite process triangular with blunt anterior end without incision; appendages barrel-shaped with very low caps. Process and appendages glabrous.

Setae on tergites only partly studied. Tergite VI with $4+2$ setae which are almost cylindrical with oblique pubescence; length of posterior setae $0.3\times$ their interdistance and almost $1.5\times$ length of pygidial setae a_1 (Fig. 96). Tergites glabrous.

Bothriotricha.—Relative lengths: $T_1 = 100$, $T_2 = 92$, $T_3 = 81$, $T_4 = 112$, $T_5 = 129$. Axes thin, simple, straight, thickest in T_3 ; pubescence consisting of simple straight hairs, oblique on T_3 (Fig. 93) and on most proximal parts of other bothriotricha, erect and arranged in whorls on other bothriotricha (Fig. 92).

Legs.—Setae on coxa and trochanter of legs 1–8 leaf-shaped, blunt, with very short

pubescence, secondary branch rudimentary; on leg 9 these setae furcate with secondary branch clavate; secondary branch with very short pubescence, length of branch less than half the length of seta (Fig. 94). Tarsus of leg 9 tapering, length $3.8\times$ its greatest diameter. Proximal seta tapering, pointed, with short oblique pubescence on distal two-thirds, setal length $0.4\times$ length of tarsus and $2.8\times$ length of cylindrical, blunt, striate, distal seta (Fig. 95). Cuticle of tarsus glabrous.

Pygidial tergum.—Posterior margin with broad cleft between a_1 setae (Fig. 96); with cleft, many short, stout, straight and erect pubescence hairs. Relative lengths of setae: $a_1 = 10$, $a_2 = 14$, $a_3 = 18$, $st = 8$. Tergal pygidial setae of very different appearance: a_1 , a_2 , and a_3 tapering and pointed; a_1 also distinctly diverging and slightly curved outwards; st cylindrical and blunt, somewhat converging, distal one-third curved inwards; a_2 and a_3 slightly curved inwards; a_1 striate and pubescent, other setae with very short pubescence. Distance $a_1 - a_1$ twice the length of a_1 , distance $a_1 - a_2$ $2.7\times$ distance $a_2 - a_3$; distance $st - st$ $2.2\times$ greater than length of st and $0.9\times$ distance $a_1 - a_1$. Cuticle mostly glabrous but with short pubescence below posteromedian cleft.

Pygidial sternum.—Posterior margin between b_1 setae almost straight but with small rounded lobe below anal plate (Fig. 96). Relative lengths of setae ($a_1 = 10$): $b_1 = 27$. Seta b_1 tapering, striate distally, length $0.7\times$ the distance $b_1 - b_1$.

Anal plate (Fig. 96) narrowest anteriorly, heart-shaped with posteromedian incision and rounded posterolateral corners; two short, clavate appendages, $0.5\times$ length of plate, extending backwards from posterior part of tergal side. Plate and appendages with very short, oblique pubescence.

Type specimen.—Holotype female 9, North Carolina, Swain County, Great Smoky Mountains National Park, Appalachian Trail, 350 m east of Road Prong trailhead, 3943300N, 278600E, elevation 1646 m, at hog enclosure, beech gap forest, in

litter, 10 June 1997, sample reference number 9721-1, F. Coyle, I. Stocks, M. Aiken, M. Davis.

Derivation of name.—From Latin *sulcatus* = with furrow, and Greek *-oides* = similar to, referring to the similarity to *S. sulcatus* Remy.

Diagnosis.—In the pygidial tergum and other characters *S. sulcatoidus* is very close to *S. sulcatus* Remy from California (Remy 1958). A posteromedian cleft occurs in both species and the properties of the anal plate and setae are generally similar. The new species is distinguished from the California species by the shape of the cleft (short and broad in *S. sulcatoidus*, long and V-shaped in *S. sulcatus*), the shape of pygidial seta *st* (cylindrical and blunt in *S. sulcatoidus*, lanceolate and pointed in *S. sulcatus*), the shape of the posterolateral corners of the anal plate (rounded, not pointed) and the antennal globulus *g* (in *S. sulcatoidus*, without constriction below the bracts and with its length 0.3× the length of the sternal antennal branch *s*; in *S. sulcatus*, *g* without constriction and half the length of *s*).

Stylopauropus (Stylopauropus)
divaricatus Scheller, new species
Figs. 97–105

Length.—0.82 mm.

Head.—Median and submedian setae clavate, densely pubescent (Fig. 97). Relative lengths of setae, first row: $a_1 = a_2 = 10$; second row: $a_1 = 10, a_2 = 13, a_3 = 11$; third row: $a_1 = a_2 = 10$; fourth row: $a_1 = 13, a_2 = a_4 = 12, a_3 = 14$; lateral group setae not studied. Ratio of a_1 setal length to $a_1 - a_1$ distance 1.0 in first and fourth rows, 0.5 in second row, 0.8 in third row. Temporal organs large, ovoid, length in tergal view 1.1× their shortest distance apart. Head cuticle glabrous.

Antennae.—Third segment (Fig. 99) with three setae and rudimentary *g'* on distal part of tergal side. Fourth segment (Fig. 98) with four cylindrical, striate setae, seta *r* thinnest. Relative lengths of setae: $p = 100,$

$p' = 56, p'' = 54, r = 30.$ Setae p''' and *u* absent. Length of tergal seta *p* 0.9× length of tergal branch *t*. Branch *t* fusiform, distal end angled obliquely, length 3.4× its greatest diameter and 0.9× length of sternal branch *s*. Length of branch *s* 2.3× its greatest diameter; posterodistal corner distinctly truncate. Seta *q* similar to tergal-anterior setae of fourth segment, length 0.9× length of branch *s*. Relative lengths of flagella (with base segments included) and of base segments alone: $F_1 = 100, bs_1 = 6; F_2 = 91, bs_2 = 8; F_3 = 47; bs_3 = 5.$ Flagellum F_2 distinctly thinner than F_1 and F_3 ; F_1 3.2× longer than branch *t*, F_2 and F_3 2.5 and 1.3× longer than branch *s*, respectively. Distal calyces subhemispherical, glabrous; distal part of flagella axes widened only between calyx and first two lamellae. Length of globulus *g* 2.2× its width; approximately 10 bracts; capsule subspherical. Diameter of *g* 1.1× greatest diameter of branch *t*. Antennae glabrous.

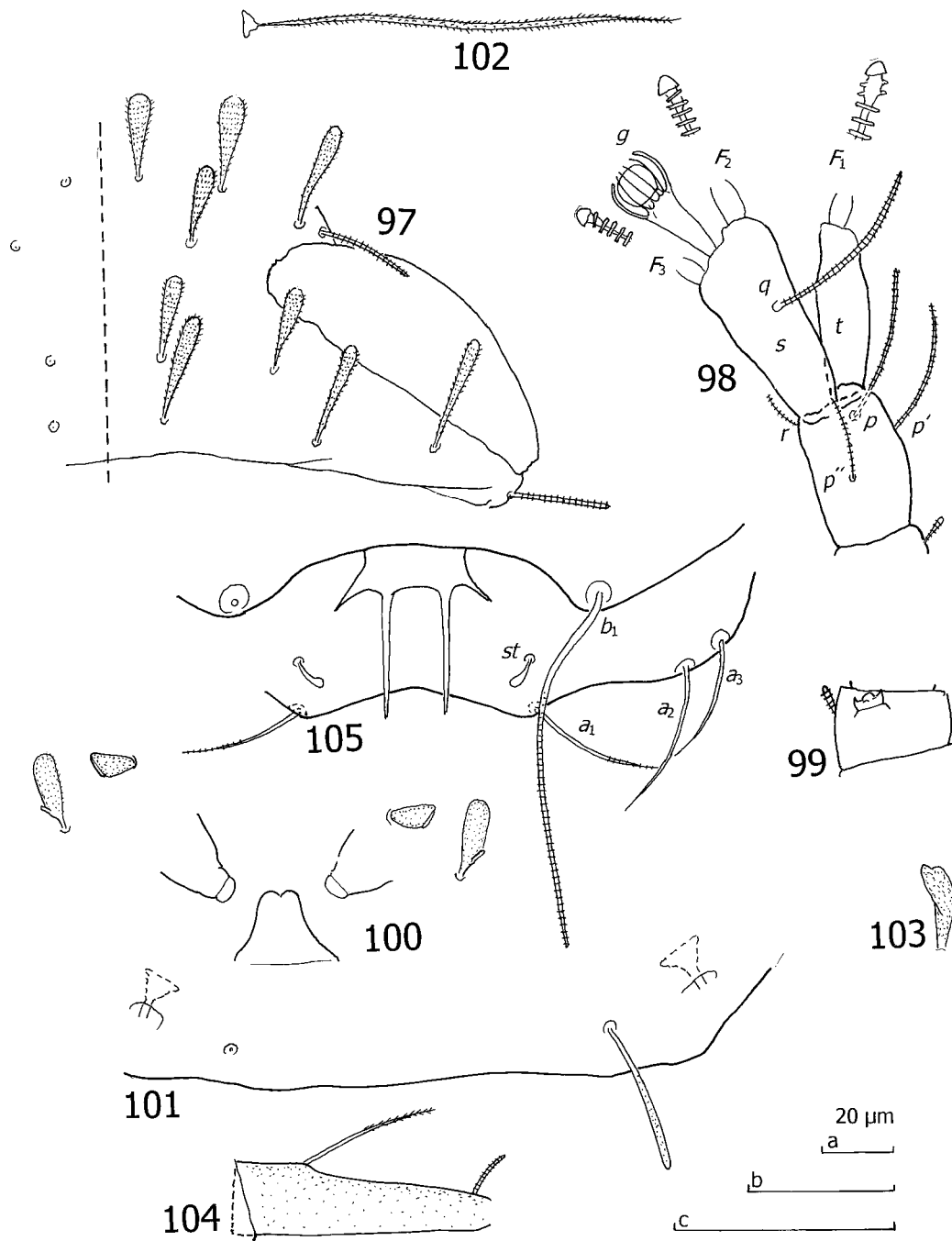
Trunk.—Setae of collum segment leaf-shaped, blunt, minutely pubescent, furcate, secondary branch rudimentary (Fig. 100). Length of sublateral setae 1.7× length of submedian setae; processes with broad anterior part with anteromedian incision; appendages conical with small rounded caps. Process and appendages glabrous.

Setae on tergites similar to head setae on anterior tergites, more posteriorly somewhat longer and less clavate. Tergite VI (Fig. 101) with 4+2 setae, posterior setae almost cylindrical, length 0.4× their interdistance and 1.8× length of pygidial setae a_1 . Tergites glabrous.

Bothriotricha.—Most broken or lost, length of $T_3 = 120, T_4 = 130$ mm, the former (Fig. 102) distinctly thicker than the latter, both with short pubescence of oblique hairs.

Genital papillae.—Glabrous, length 1.4× their greatest diameter, inner margin straight, outer margin evenly curved in distal third.

Legs.—Setae on coxa and trochanter leaf-shaped, blunt, very shortly pubescent,



Figs. 97–105. *Stylopaupopus (S.) divaricatus*, holotype male. 97, Head, median and right part, tergal view; 98, Right antenna, sternal view; 99, Right antenna, third segment, tergal view; 100, Collum segment, median and left part, sternal view; 101, Tergite VI, posterior part; 102, Bothriotrix T_3 ; 103, Seta on trochanter of leg 9; 104, Tarsus of leg 9; 105, Pygidium, posteromedian part, sternal view. Scales: a, Fig. 102; b, Figs. 103, 104; c, Figs. 97–101; d, Fig. 105.

secondary branch rudimentary (Fig. 103). Tarsus of leg 9 tapering (Fig. 104), length $3.4\times$ its greatest diameter. Proximal seta tapering, pointed, with short, oblique pubescence on distal half, length half that of tarsus and $2.6\times$ length of distal seta, which is cylindrical, blunt, and striate. Cuticle of tarsus minutely granular.

Pygidial tergum.—Posterior margin (Fig. 105) with broad indentation between a_1 setae. Relative lengths of setae: $a_1 = a_3 = 10$, $a_2 = 13$, $st = 3$. Setae of very different appearance: a_1 , a_2 and a_3 tapering and pointed; a_1 distinctly diverging and directed upwards, curved inwards, with minute pubescence only most apically; a_2 and a_3 converging, curved inwards and directed downwards; st short, clavate, glabrous, converging and curving inwards. Distance $a_1 - a_1$ $1.8\times$ greater than length of seta a_1 ; distance $a_1 - a_2$ $3.8\times$ greater than distance $a_2 - a_3$; distance $st - st$ $7.0\times$ greater than length of seta st and equal to distance $a_1 - a_1$. Cuticle glabrous.

Pygidial sternum.—Posterior margin between b_1 with broad rounded indentation (Fig. 105). Relative lengths of setae ($a_1 = 10$): $b_1 = 25$. Seta b_1 tapering, striate distally, as long as interdistance $b_1 - b_1$.

Anal plate (Fig. 105) about twice broader than long, lateral margins concave, posterior corners lengthened into tapering appendages slightly shorter than length of plate; posterior margin straight with two straight, tapering, submedian appendages directed posteriorly, about twice longer than plate.

Type specimen.—Holotype male 9, Tennessee, Sevier County, Great Smoky Mountains National Park, Porter's Flat, 3950200N, 283000E, elevation 738 m, soil in hardwood cove forest, 18–19 June 1996, sample reference number 9617-2, F. Coyle, collector.

Derivation of name.—From Latin *divaricatus* = spread apart (setae a_1 of the pygidial tergum).

Diagnosis.—*Stylopauropus* (*S.*) *divaricatus* is very similar to *S.* (*S.*) *gozenyamensis*

from Japan (Hagino 1994), especially in the head, antennae, collum segment, genital papillae, and anal plate. The species differ in form of head seta a_3 of the second row (cylindrical and striate in *S. divaricatus*, clavate and pubescent in *S. gozenyamensis*) and the dimensions of the tarsi of the last pair of legs (length $3.4\times$ maximum width in *S. divaricatus*, $4.7\text{--}5.3\times$ in *S. gozenyamensis*). Other distinguishing characters are the shape of the posterior margin of the pygidial tergum (broadly indented in *S. divaricatus*, with small median bulge in *S. gozenyamensis*), the surface of the setae of the pygidial tergum (almost glabrous in *S. divaricatus*, distinctly pubescent in *S. gozenyamensis*), and the shape of the anal plate (sides concave, posteromedian indentation with broad, flat bottom in *S. divaricatus*, sides convex, posteromedian indentation U-shaped in *S. gozenyamensis*).

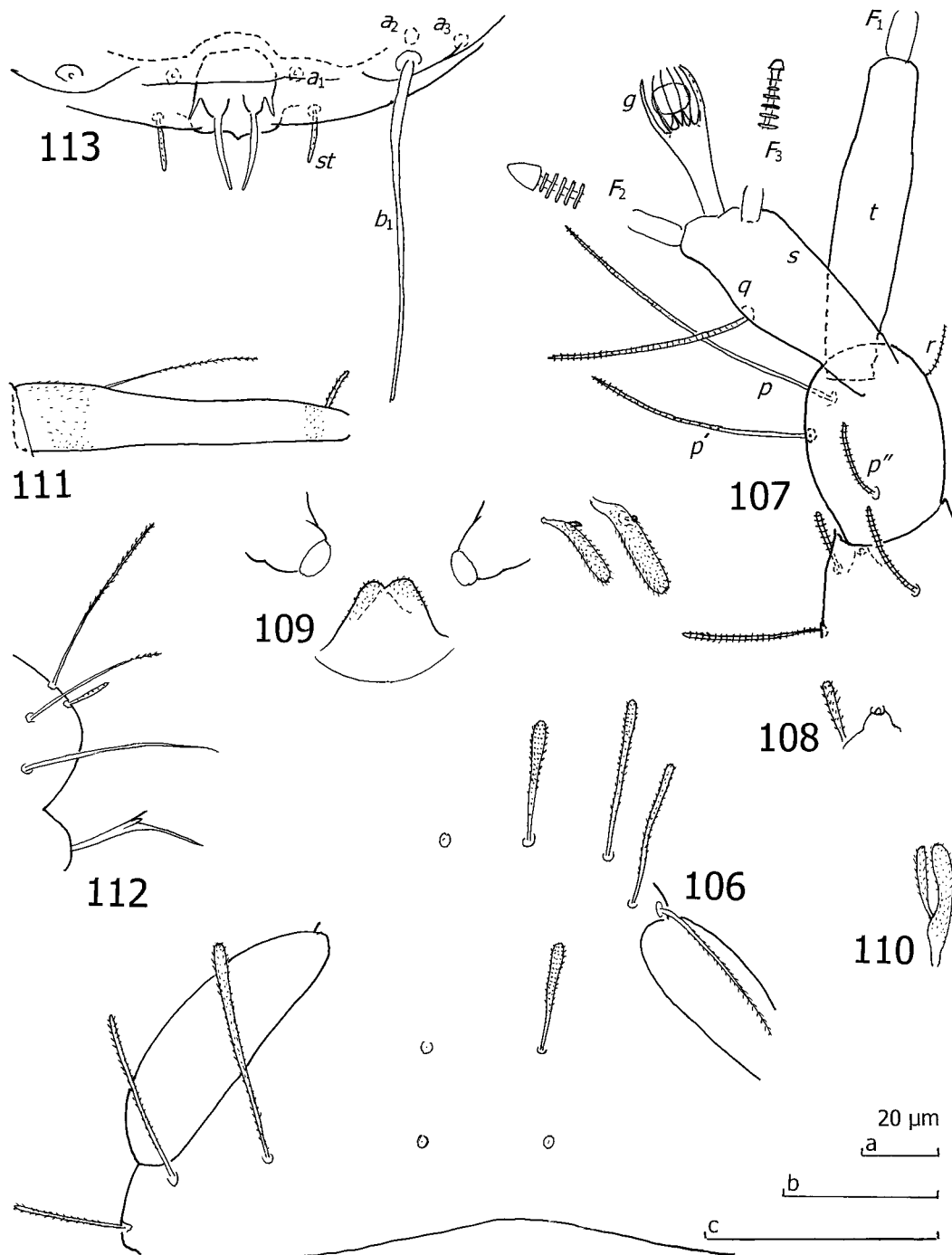
Stylopauropus (*Stylopauropus*) *quadruus*

Scheller, new species
Figs. 106–113

Length. — 0.87(–1.04) mm.

Head.—Median and submedian setae clavate, densely pubescent, lateral setae subcylindrical or pointed (Fig. 106). Relative lengths of seta, first row: $a_1 = 10$, $a_2 = 13$; second row: $a_1 = ?(9)$, $a_2 = 12(–15)$, $a_3 = (14\text{--})16$; third row: $a_1 = 9$, $a_2 = ?(13)$; fourth row: $a_1 = ?(13)$, $a_2 = 19$, $a_3 = 16(–17)$, $a_4 = 9$; lateral group (paratype only): $I_1 = 13$, $I_2 = 17$, $I_3 = 13$. Ratio of seta a_1 length to $a_1 - a_1$ distance 1.4 in first row, 1.0(–1.3) in third row, undetermined in second and fourth rows. Temporal organs in tergal view ovoid; their length $1.2\times$ their shortest interdistance. Head cuticle glabrous.

Antennae.—Third segment with three setae and rudimentary g' on distal part of tergal side (Figs. 107, 108). Fourth segment with four thin, cylindrical, striate setae (Fig. 107). Relative lengths of setae: $p = 100$, $p' = 71(–72)$, $p'' = 24(–33)$, $r = 19(–25)$. Setae p''' and u absent. Length of tergal seta



Figs. 106–113. *Stylopaupopus (S.) quadrius*, holotype female. 106, Head, setae only partly shown; 107, Left antenna, sternal view; 108, Rudimentary globulus on third antennal segment, tergal view; 109, Collum segment, median and left part, sternal view; 110, Seta on trochanter of leg 9; 111, Tarsus of leg 9 (pubescence partially indicated); 112, Pygidium, posteromedian part, sternal view; 113, Pygidium, posterior part, tergal view. Scales: a, Fig. 111; b, Figs. 109, 110; c, Figs. 106–108, 112, 113.

$p(0.9-)$ 1.0 \times length of tergal branch t . Branch t fusiform, length (4.8-) $4.9\times$ its greatest width and (1.2-) $1.3\times$ length of sternal branch s . Length of branch s (2.6-) $2.7\times$ its greatest width; posterodistal corner truncate. Seta q similar to tergal-anterior setae of fourth segment, length $0.9(-1.1)\times$ that of branch s . Relative lengths of flagella (with base segments included) and of base segments alone (holotype only): $F_1 = 100$, $bs_1 = 6$; $F_2 = 93$, $bs_2 = 7$; $F_3 = 53$, $bs_3 = 4$. Flagellum F_2 thinner than F_1 and F_3 ; F_1 $2.3\times$ longer than branch t ; F_2 and F_3 2.8 and $1.6\times$ length of branch s , respectively. Distal calyces of F_2 conical, those of F_3 hemispherical, both glabrous. Distal ends of flagella axes not widened. Width of globulus g $2.5\times$ its length; approximately 13 bracts; capsule subspherical. Diameter of g and branch t about equal. Antennae glabrous.

Trunk.—Setae of collum segment leaf-shaped, blunt, shortly pubescent, furcate, secondary branch rudimentary (Fig. 109). Sublateral setae $1.5\times$ longer than submedian setae; processes with broad anterior part with distinct anteromedian incision; appendages subconical with rounded caps. Anterior part of process distinctly pubescent, appendages almost glabrous. Setae on anterior tergites similar to head setae, more posteriorly somewhat longer and less clavate. Tergite VI with 4+4 setae, posterior setae almost cylindrical, similar to pygidial setae a_1 . Tergites glabrous.

Bothriotricha (paratype only).—Relative lengths: $T_1 = 100$, $T_2 = T_3 = 107$, $T_4 = 164$, $T_5 = 207$. Axes of bothriotricha T_1 and T_2 very thin, simple, straight; axes thicker in T_3 and T_4 , thickest in T_5 . Pubescence of simple straight hairs, oblique on T_3 and on most proximal parts of other bothriotricha, otherwise erect.

Legs.—Setae on coxa and trochanter of legs 1-8 leaf-shaped, blunt, shortly pubescent, with secondary branch rudimentary, blunt; on leg 9 coxal and trochanteral setae with clavate secondary branch, both branches pubescent (Fig. 110). Tarsus of leg

9 tapering, length $4.8\times$ its greatest width (Fig. 111). Proximal seta thin, tapering, pointed, with very short oblique pubescence on distal half, setal length $0.5\times$ tarsal length, $3.7\times$ length of distal seta, which is cylindrical, blunt, striate. Cuticle of tarsus with very faint pubescence.

Pygidial tergum.—Posterior margin rounded, below a_1 with small lobe possessing a minute median triangular tip (Fig. 113). Relative lengths of setae: $a_1 = 10$, $a_2 = 9$, $a_3 = 11$, $st = 3$. Setae of different appearance: a_1 , a_2 and a_3 tapering and pointed, with minute pubescence, somewhat curved; a_1 directed upwards, a_2 and a_3 diverging, all somewhat curved; st short, cylindrical, blunt, striate, almost straight. Distance $a_1 - a_1$ $0.7\times$ length of a_1 ; distance $a_1 - a_2$ $2.1\times$ distance $a_2 - a_3$; distance $st - st$ $2.9\times$ greater than st and $1.3\times$ distance $a_1 - a_1$. Cuticle glabrous.

Pygidial sternum.—Posterior margin between b_1 setae straight. Relative lengths of seta ($a_1 = 10$): $b_1 = 18$. Seta b_1 tapering, as long as $b_1 - b_1$ interdistance (Fig. 113).

Anal plate length and width equal, lateral margins convex, posterior corners lengthened into short, tapering, diverging appendages; posterior margin with two submedian subhemispherical lobes from which two appendages protrude backwards, directed posteriorly, as long as plate (Fig. 112), subcylindrical, tapering, glabrous, curved inwards moderately and converging.

Type specimens (N = 2).—Holotype female 9, Tennessee, Sevier County, Great Smoky Mountains National Park, Porter's Creek trail, 200 paces from bridge over Porter's Creek, 3950800N, 283000E, elevation 738 m, hardwood cove forest, 24-25 August 1996, sample reference number 9633-5, F. Coyle, R. Edwards, J. Stiles, R. Wright, collectors; one paratype male, Tennessee, Cocke County, Great Smoky Mountains National Park, Gabes Mountain trail, 500 m west of north trail head, deciduous forest, deep litter layer, 19 September 2002, U. Scheller, S. Stocks, collectors.

Other specimens (N = 2).—Same collec-

tion data as holotype, one female 9; Tennessee, Sevier County, Great Smoky Mountains National Park, Porter's Flat, hardwood cove forest, in soil, 3950200N, 283000E, elevation 738 m, one subadult female 8, 18–19 June 1996, sample reference number 9617-2, F. Coyle, R. Edwards, J. Stiles, R. Wright, collectors.

Derivation of name.—Latin *quadruus* = fourfold (posterior margin of anal plate).

Diagnosis.—Several species of the subgenus *Stylopaupopus* are similar in having anal plates with four posterior branches. Among them, *S. (S.) quadruus* may be closest to *S. (S.) boreus* Scheller from Alaska (Scheller 1986). In the new species the globulus bracts are long (short in *S. boreus*); seta p''' is absent (present in *S. boreus*); truncation of sternal branch s short, with globulus inserted near the distal end (in *S. boreus* truncation of branch s long, globulus inserted much below the distal end); pygidial seta st cylindrical (clavate in *S. boreus*); posterodistal corners of the anal plate pointed (blunt in *S. boreus*).

The new species also resembles a species described earlier from Tennessee (Morgan County), *S. (S.) fratuelis* Remy (Remy 1958), but in *S. fratuelis* tergal antennal branch t is proportionally shorter than *S. quadruus* and seta q is longer than sternal branch s (shorter than branch s in *S. quadruus*). Moreover, the posterior margin of the pygidial tergum is evenly rounded in *S. fratuelis* Remy, but has a posteromedian lobe in *S. quadruus*. Pygidial seta st is clavate in *S. fratuelis*, cylindrical in *S. quadruus*.

Some characteristics of the new species also point to relationships with *S. (S.) senticosus* Remy from Texas (Remy 1956) and *S. (S.) californianus* Remy from California (Remy 1958) and Alaska (Scheller 1986).

***Bracypaupopus andrewsensis* Scheller,**
new species
Figs. 114–124

Length.—(0.57–)0.58 mm.

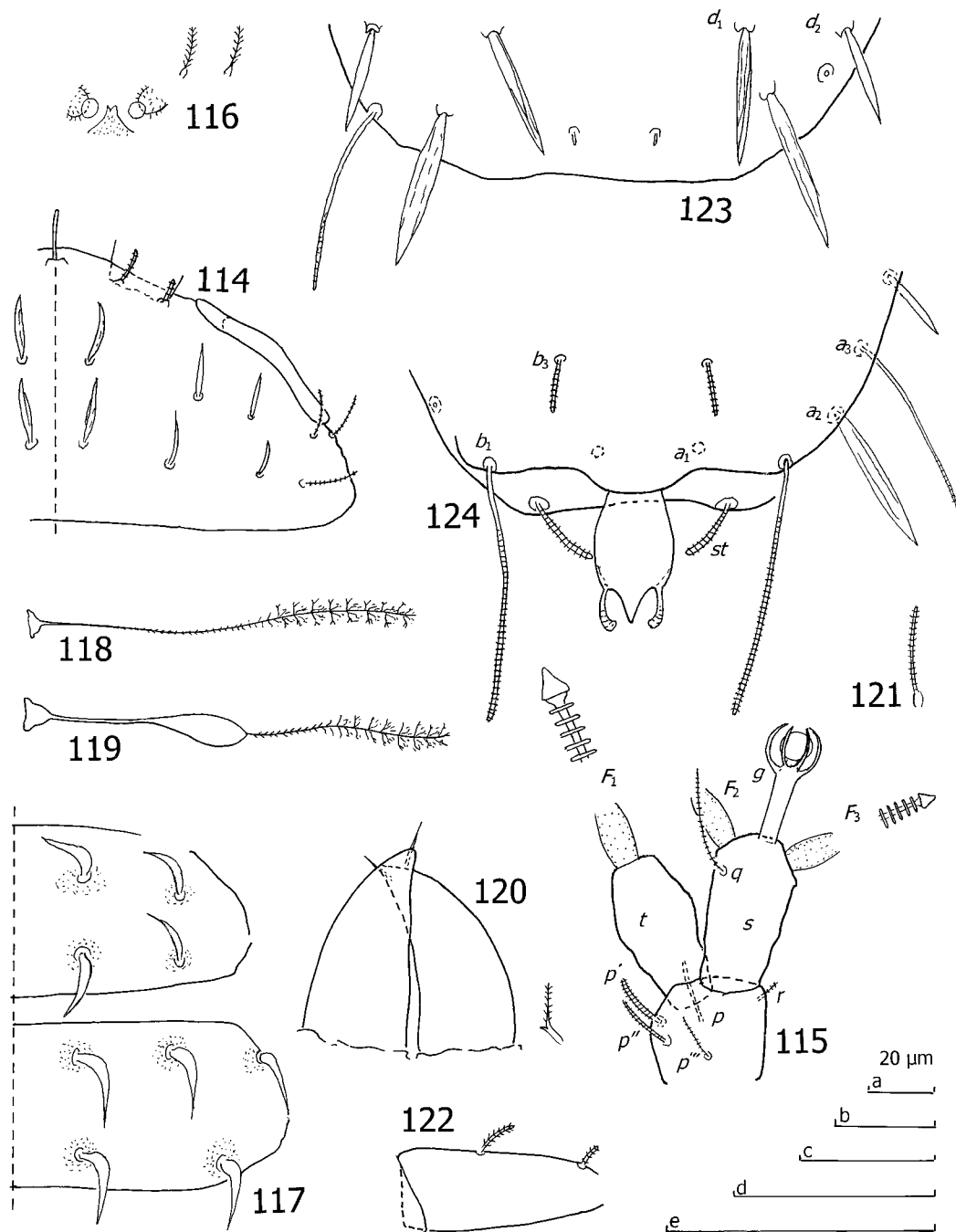
Head.—Tergal and lateral sides with 23

setae (Fig. 114). Anterior and sublateral setae cylindrical, blunt, striate; submedian and sublateral setae lanceolate, glabrous. Relative lengths of setae (holotype only), first row: $a_1 = 10$, $a_2 = 7$; second row: $a_1 = 15$, $a_2 = 13$, $a_3 = 9$, $a_4 = 10$; third row: $a_1 = 18$, $a_2 = 15$, $a_3 = 8$, $a_4 = 13$. Behind temporal organ and on lateral side at least one cylindrical seta. In first row length of seta a_1 $0.9\times$ distance $a_1 - a_1$, in second row length $1.4\times$ the interdistance. Temporal organs with anterior tube-like slightly uplifted appendage. Temporal organ nearly glabrous.

Antennae.—Fourth segment (Fig. 115) with five setae, all cylindrical, blunt, striate, seta p''' thinnest; relative lengths: $p = 100$, $p' = 92(-95)$, $p'' = (80-83)$, $p''' = (64-67)$, $r = 42(-44)$. Length of tergal seta p $0.4\times$ length of tergal branch t . Length of branch t $(1.8-1.9)\times$ width, almost as long as sternal branch s . Length of branch s $1.9\times$ width, anterodistal and posterodistal truncations equal. Seta q inserted on sternal side, very near anterodistal corner, cylindrical, annulate, length $0.7\times$ length of branch s . Relative lengths of flagella (base segments included) and base segments alone (holotype only): $F_1 = 100$, $bs_1 = 12$, $F_2 = 84$, $bs_2 = 10$, $F_3 = 71$, $bs_3 = 10$. Length of flagellum F_1 $3.3\times$ length of branch t , F_2 and F_3 2.6 and $2.3\times$ length of branch s , respectively; F_1 thickest, F_2 thinnest. Distal calyces conical, glabrous; flagella axes widened only between calyx and first lamella. Length of globulus g $2.4\times$ its greatest diameter, stalk cylindrical; length of g $0.7(-0.8)\times$ length of branch s , greatest diameter $0.6\times$ width of t ; six bracts and spherical capsule. Antennae glabrous.

Trunk.—Submedian and sublateral setae of collum segment similar, blunt, annulate, probably simple (Fig. 116). Sternite process triangular, with anterior incision and sparse pubescence. Sternite appendages subglobular with distinct but sparse erect pubescence; caps subglobular, glabrous.

Tergites entire, smooth, without sclerotization of the cuticle. Tergite I with 4+4 se-



Figs. 114–124. *Brachypauropus andrewsensis*. Figs. 114–118, 120–124, Holotype male; Fig. 119, Paratype male. 114, Head, median and right part, tergal view; 115, Left antenna, sternal view; 116, Collum segment, median and left part, sternal view; 117, Tergites I and II, right side; 118, Bothriotrix T₁; 119, Bothriotrix T₃; 120, Genital papillae, anterior view; 121, Seta on coxa of leg 8; 122, Tarsus of leg 8; 123, Pygidial tergum, posterior part; 124, Pygidium, posterior part, sternal view. Scales: a, Fig. 117; b, Fig. 118; c, Figs. 114, 119–120; d, Figs. 115–116, 121–122; e, Figs. 123–124.

tae, II–IV 6+6 each, V 6+4. Setae hook-like with flexure in proximal part, pointed, glabrous (Fig. 117).

Bothriotricha.—Axes simple, very thin, except T_3 with strong fusiform thickening just below the middle (Figs. 118, 119). Proximal half of T_3 glabrous, other bothriotricha with short simple oblique hairs proximally; distal half of all bothriotricha with long, erect, branched hairs arranged in whorls. All bothriotricha of similar length.

Genital papillae.—Subconical, inner side straight, outer side evenly curved, twice longer than wide; seta thin, length $0.2\times$ papilla length (Fig. 120). Seta on coxa of leg 2 furcate, main branch pointed, with distinct oblique pubescence; secondary branch rudimentary, pointed.

Legs.—All legs 5-segmented. Setae on coxa and trochanter of eighth leg simple, cylindrical, blunt, striate (Fig. 121). More anteriorly, coxal and trochanteral setae with rudimentary glabrous secondary branches. Tarsus of leg 8 short, tapering, length $2.5\times$ its greatest diameter (Fig. 122); setae subequal, short, slightly curved, cylindrical, blunt, striate; length of proximal seta $0.2\times$ length of tarsus and $1.6\times$ length of distal seta. Cuticle of tarsus glabrous.

Pygidial tergum.—Posterior margin between st setae almost straight; cuticle glabrous. Relative lengths of setae: $a_1 = 10$, $a_2 = 30(-32)$, $a_3 = (33-35)$, $st = 12(-13)$, $d_1 = 25$, $d_2 = 19$. Seta a_1 and a_2 straight; a_1 cylindrical, striate, posteriorly directed, a_2 lanceolate, glabrous, diverging; a_3 and st cylindrical, striate, curved inwards, a_3 diverging, st converging (Fig. 124). On juvenile 6 specimen, seta a_2 clavate. Distance $a_1 - a_1$ $1.5\times$ greater than length of seta a_1 , distance $a_1 - a_2$ twice that of distance $a_2 - a_3$; distance $st - st$ $2.8\times$ length of st , $2.3\times$ distance $a_1 - a_1$. Length of d_1 seta $0.4\times$ their interdistance, $2.5\times$ length of a_1 , $1.3\times$ length of d_2 .

Pygidial sternum.—Posterior margin between b_1 seta straight but with a posterior rounded lobe below anal plate (Fig. 124); cuticle glabrous. Relative lengths of setae

($a_1 = 10$): $b_1 = (45-48)$, $b_3 = (9-10)$; seta b_2 absent. Setae b_1 and b_3 cylindrical, blunt, striate. Length of b_1 setae $0.9\times$ their interdistance, length of b_3 setae $0.4\times$ their interdistance.

Anal plate length $1.7\times$ its greatest width, widening from its base outwards, lateral margins convex, terminating in a projection forming an almost equilateral triangle (Fig. 124). Two posteriorly directed appendages, clavate, curved inwards, protruding backwards from posterolateral corners; length of appendages $0.3\times$ length of plate.

Type specimens (N = 2).—Holotype male 8 and one paratype male 8, North Carolina, Swain County, Great Smoky Mountains National Park, Andrews Bald, 39354N, 2738E, elevation 1,753 m, grassy bald, 27 June 1996, sample reference number 9621, F. Coyle, R. Edwards, J. Stiles, R. Wright, collectors.

Other specimens.—Two juveniles 6, same data as type material.

Derivation of name.—A Latinization of the name Andrews (collecting site).

Diagnosis.—Nine species are now included in the genus, of which one, *B. lubbocki* Bagnall (Bagnall 1911) from Great Britain, is insufficiently described and doubtful. Six of the other species are European, as well, but two species are known from North America: *B. pearsei* Starling (Starling 1943) from North Carolina and *B. inopinabilis* Scheller 1986) from Alaska. The new species described above has only a weak relationship to the Alaskan species and may be closer to the species from North Carolina. However, it is difficult to decide how close the relationship is because Starling's description was based on immature specimens (juv. 6) and is poor in details of taxonomic value.

The best characters for distinguishing *B. andrewsensis* from *B. pearsei* are in the antennal flagellae (relative lengths $F1 > F2 > F3$ in *B. andrewsensis*, $F1 > F2 < F3$ in *B. pearsei*); stalk of the antennal globulus (much longer than the bracts in *B. andrewsensis*, about as long as the bracts in *B. pear-*

sei); pygidial seta b_3 (straight *B. andrewensis*, curled distally in *B. pearsei*); and in pubescence of the bothriotrix T_3 (long whorled and branched hairs on distal third in *B. andrewensis*, short, oblique pubescence in *B. pearsei*).

Biogeography

An unexpected outcome of the collecting of pauropods in GSMNP was the occurrence of many species new to science, indicating a very diverse fauna. The relationships of this fauna to others are unknown and will remain so until we have a more complete list of species than those 47 we have today, and a better knowledge of the species composition of the Nearctic as a whole. However, the diagnoses of the new species point to relationships in some directions.

1. Five species (*Allopaupopus cataloocheensis*, *A. bernardi*, *A. parkeri*, *A. purchasensis*, and *Brachypauropus andrewsenensis*) seem to have their closest relatives in species at present known only from eastern North America. They may well belong to a young element with more or less restricted ranges.

2. Many of the species occurring in the western U.S.A. may belong to a circum-Pacific element now distributed in California, Alaska and Japan (Hagino 1989, 1991a, 1991b, 1993, 1994; Hagino & Scheller 1985; Scheller 1981, 1985, 1986). This element is striking particularly for the subgenus *Donzelotauropus* in *Stylopauropus* and in general of *Brachypauropodidae*. They are most diversified around the North Pacific. From this study it seems probable that other genera also may be included. Two species, *Allopaupopus stocksii* and *Stylopauropus (S.) alleghenyensis*, show relationships to Californian species. Two more species also may be included, *S. (S.) divaricatus*, which resembles a Japanese species, and *S. (S.) quadrus*, closest to an Alaskan species.

3. The similarities between Nearctic and Wet Palaearctic biota have been proved in many groups of animals and plants. One

species reported here, *A. hiltanae*, belongs to this biota, as it shows striking resemblances to a species described from Romania. The general shape of the antennae is very similar, both species have a distinctive pygidial chaetotaxy not found elsewhere, and the anal plates are very similar.

4. Connections to tropical faunas are limited, but *Allopaupopus chaulioisetus* and *A. virgulatus* may have tropical relatives, the former to a species with wide tropical distribution, but also occurring in Florida, and the latter to species in Amazonas and Sierra Leone.

Acknowledgments

Financial support was received from Discover Life in America, which supported the visit of the first author in the GSMNP. We thank Charles R. Parker, Ian and Stephanie Stocks, and Rex Lowe for generous collecting help. Logistical assistance was provided by the University of Tennessee, Knoxville, and Great Smoky Mountains National Park, National Park Service.

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Associate Editor: Wayne N. Mathis

Appendix.—Pauropoda known from Great Smoky Mountains National Park, recorded before 1998 (pre-All-Taxa Biodiversity Inventory [ATBI]) and 1998 to present (during ATBI).¹

| Family, species ² | Pre-ATBI | ATBI |
|--|----------|------|
| Brachypauropodidae | | |
| <i>Brachypauropus andrewsensis</i> Scheller, antea | | x |
| <i>Deltopauropus macswaini</i> Remy, 1956 | x | x |
| Eurypauropodidae | | |
| <i>Eurypauropus spinosus</i> Ryder, 1879 | x | x |
| <i>E. unciger</i> Remy, 1956 | | x |
| Pauropodidae | | |
| <i>Allopauropus (Allopauropus) cantralli</i> Remy, 1958 | | x |
| <i>A. (A.) carolinensis</i> (Starling, 1943) | x | x |
| <i>A. (A.) cataloocheensis</i> Scheller, antea | | x |
| <i>A. (A.) hiltanae</i> Scheller, antea | | x |
| <i>A. (Decapauropus) aristatus</i> Remy, 1936 | | x |
| <i>A. (D.) barroisi</i> Remy, 1956 | | x |
| <i>A. (D.) bernardi</i> Scheller, antea | | x |
| <i>A. (D.) bohnsacki</i> Remy, 1957 | | x |
| <i>A. (D.) chaulisetis</i> Scheller, antea | | x |
| <i>A. (D.) cognatus</i> Remy, 1956 | | x |
| <i>A. (D.) cuenoti</i> (Remy, 1931) | | x |
| <i>A. (D.) distinctus</i> Bagnall, 1936 | | x |
| <i>A. (D.) gracilis</i> (Hansen, 1902) | | x |
| <i>A. (D.) intonsus</i> Remy, 1956 | | x |
| <i>A. (D.) jasperensis</i> Remy, 1959 | | x |
| <i>A. (D.) milloti</i> Remy, 1945 | | x |
| <i>A. (D.) mucronatus</i> Remy, 1958 | | x |
| <i>A. (D.) parkeri</i> Scheller, antea | | x |
| <i>A. (D.) parvus</i> Remy, 1958 | | x |
| <i>A. (D.) porterensis</i> Scheller, antea | | x |
| <i>A. (D.) pulcher</i> Remy, 1956 | | x |
| <i>A. (D.) purchasensis</i> Scheller, antea | | x |
| <i>A. (D.) quadrimaculatus</i> Scheller, 1985 | | x |
| <i>A. (D.) remigatus</i> Scheller, 1984 | | x |
| <i>A. (D.) stocksii</i> Scheller, antea | | x |
| <i>A. (D.) tenellus</i> Scheller, 1971 | | x |
| <i>A. (D.) virgulatus</i> Scheller, antea | | x |
| <i>A. (D.) vulgaris</i> (Hansen, 1902) | x | x |
| <i>A. (Desmopauropus</i> Scheller, n. subgen.) <i>dukensis</i> (Starling, 1943) | x | x |
| <i>Polypauropoides americanus</i> Scheller, 1988 | | x |
| <i>Stylopauropus (Donzelotauropus) fraternus</i> Scheller, 1985 | | x |
| <i>S. (D.) pocahontas</i> Scheller, 1985 | | x |
| <i>S. (D.) quadrisulcus</i> Remy, 1957 | x | x |
| <i>S. (D.) schusteri</i> Remy, 1959 | x | x |
| <i>S. (Stylopauropus) californianus</i> Remy, 1958 | | x |
| <i>S. (S.) divaricatus</i> Scheller, antea | | x |
| <i>S. (S.) dybasi</i> Remy, 1956 | | x |
| <i>S. (S.) pedunculatus</i> (Lubbock, 1867) | | x |
| <i>S. (S.) quadruus</i> Scheller, antea | | x |
| <i>S. (S.) sulcatoidus</i> Scheller, antea | | x |
| <i>S. (S.) sulcatus</i> Remy, 1958 | | x |

¹ List includes species described from the Ravensford area of GSMNP just north of Cherokee, North Carolina, transferred to the Eastern Band of Cherokee Indians in 2004 by an Act of Congress.

² *Allopauropus causeyae* Starling, 1943 has been reported from Greenbrier Cove (Remy 1958) but the identification is open to question. Two subadult females of *Polypauropus* sp. (Ravensford) and a single molting *Scleropauropus* sp. (Appalachian Trail) also have been collected, but material is insufficient for identification or description.