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Taxonomic study of Collembola of West Virginia

George E. Lippert

Linda Butler

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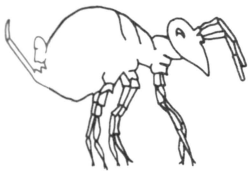
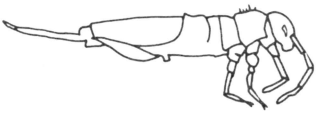
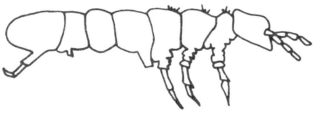
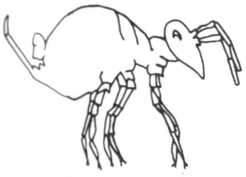
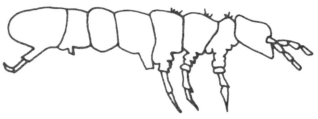
West Virginia University Agricultural Experiment Station

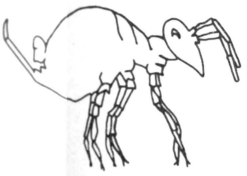


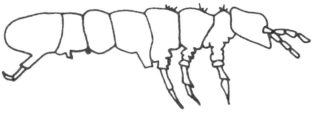


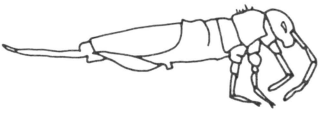












SUMMARY

Twenty-four genera, including 70 species plus two additional varieti Collembola of the Suborder Arthropleona, were collected from 10 counti West Virginia between 1969 and 1973. Several undescribed species were f but descriptions were not made pending further study. A key is presented t described species collected, but no attempt was made to prepare a key fo entire complement of species that probably occurs in West Virginia. Collem were sampled from a wide variety of habitats, but most frequently from mo For each Collembola species or variety, county where collected, habitat, substrate are given.

THE AUTHORS

George Lippert was a Graduate Assistant in Entomology at the time o study and this bulletin is a portion of his thesis which was submitted in p fullfillment of the requirements for the M. S. degree; Linda Butler is Entomol

ACKNOWLEDGMENTS

The authors wish to thank Dr. P. F. Bellinger who very kindly consente verify any material that was sent him. Additionally, he provided some unpub ed keys. As a result, all but a few of the specimens used in making up the were verified by Dr. Bellinger. However, any errors in the key are not in any attributable to him.

Several slides loaned by Dr. D. L. Wray were appreciated.

West Virginia University
Agricultural Experiment Station
College of Agriculture and Forestry
Dale W. Zinn, Director
Morgantown

Taxonomic Study of Collembola of West Virginia

George Lippert and Linda Butler

Collembola are still poorly known and many new species are described yearly. The exact status of many described species is uncertain. One of the greatest difficulties in Collembola identification is the lack of comprehensive keys to species. Available keys are out-of-date for the most part, or limited to specific genera. Many recently described species are not found in any key.

Early workers in this country include MacGillivray (1891) and Schott (1896), both of whom described many new collembolan species. The first monograph to be published was that of Guthrie (1903) on Collembola of Minnesota. Folsom (1913, 1916, 1917) produced several monographs on Collembola of North America, terminating in several papers which even today are invaluable.

Additional monographs included those of James (1933) on Collembola of Toronto, Canada; Mills (1934) on Collembola of Iowa; and Coleman (1941) who described many species for California.

Maynard's 1951 monograph on Collembola of New York State is well illustrated and places more emphasis on the Symphypleona than other monographs.

The most recent keys are those of Christiansen, Snider, Scott, and Richards. Christiansen has produced monographs on several genera in North America, including *Entomobrya* (1958), *Sinella* (1960a), *Tomocerus* (1960b), and *Pseudosinella* (1960a). Scott's pictorial key to the Collembola (1961) has been invaluable. Wray has published descriptions of many new species from various parts of North America and also an excellent key to the genera of Hypogastrurinae (1963). Snider (1967) produced a key to Collembola of Michigan and Richards (1968) published a well-illustrated key to genera of world Sminthuridae.

Many criteria including color are used in Collembola keys. Color is perhaps one of the worst. Species of *Entomobrya* exhibit a wide range of color (Maynard, 1951). Other problems include the presence of ecomorphs, seasonal variants, and age. Many young individuals, particularly in the Entomobryoidea, cannot be identified with certainty.

Many so-called species of Collembola are probably in reality more than one species. Evidence for this is seen in the on-going work of Christiansen and

Bellinger (1973-74) in which they prefer to treat certain species as complexes species until further work is done with them. They have shown synonomy wi several established species and have described, or are in the process of describi many new species. Many of these problems, as they relate to material collect for this study, will be discussed further in the key.

During this study, 24 genera and 70 species, plus two additional varieti and several probable new species, were collected from 195 separate samples fr 10 counties of West Virginia. While a wide variety of habitats were extracted f Collembola, the most common were mosses. A key to identified taxa is prese ed, but no attempt was made to describe new species. County, habitat, a substrate are given for each species or variety.

The key contains only genera, species, and varieties collected during th study. Thus it is not unlikely that collections from similar habitats will inclu new species or species not found in this key. However, the key has the value allowing placement of the specimen into the proper family or genus. Identifica tion should not be accepted as final without consulting a description of th species in a source such as Salmon (1964).

Key to the Collembola of West Virginia Along with Areas and Habitats

1. Body globular, with the first four anterior abdominal segments fused dorsally (Figure 1). Furcula well developed

SYMPHYPLEONA
(not included in this key)

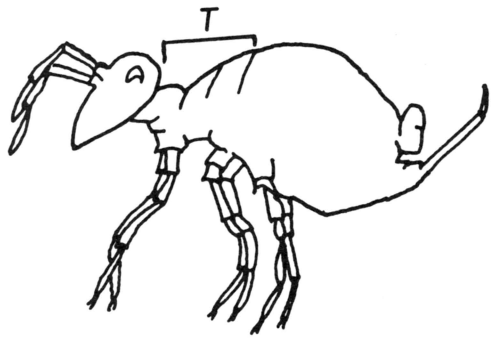


FIGURE 1. Symphypleona collembolan showing fusion of first four anterior abdominal segments; T, thorax.

1A. Body elongate, with the first four anterior abdominal segments not fused dorsally (Figure 2). Furcula well developed, reduced, or absent

ARTHROPLEONA. 2

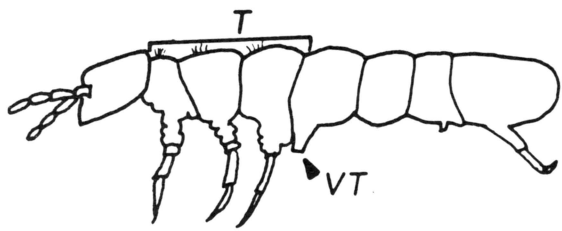


FIGURE 2. First four abdominal segments not fused; first thoracic segment dorsally distinct and with dorsal setae; abdominal segments IV through VI fused; furcula not reaching ventral tube; T, thorax; VT, ventral tube.

2. First thoracic segment dorsally distinct and with dorsal setae (Figure 2). Integument usually tuberculate, never with scales

PODUROIDEA. 3

2A. First thoracic segment not distinct dorsally and without dorsal setae (Figure 3). Integument usually not tuberculate, sometimes with scales

ENTOMOBRYOIDEA. 14

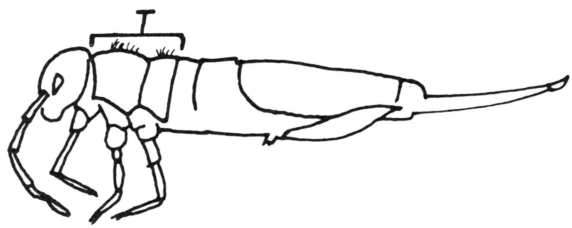


FIGURE 3. First thoracic segment not dorsally distinct and without dorsal setae; T, thorax.

3. Dens always present and conspicuously bowed, with the tips convergin (Figure 4), and with distal rings of tubercles

PODURIDA
Podura **(Genus**

FIGURE 4. Dens bowed with the tips converging.

3A. Dens sometimes reduced or absent, not conspicuously bowed and th tips not converging; always without distal rings or tubercles. Note that som *Isotoma* may have the dens somewhat converging

. . . .

4. With pseudocelli at base of antennae (Figure 5). Body white or yellow ish

ONYCHIURIDAE. . . . .

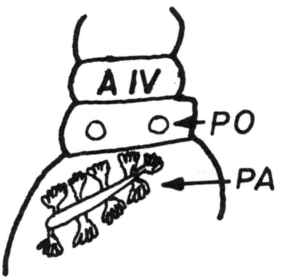


FIGURE 5. Base of antenna with compound postantennal organ (PA) and pseudocelli (PO); AIV, fourth antennae segment.

4A. Without pseudocelli at base of antennae. Body with dark pigment (some genera unpigmented, but none were collected in this study)

HYPOGASTRURIDAE. . . .

5. Chewing mouthparts with a well-developed molar plate (Figure 6)

HYPOGASTRURINAE. . . .

FIGURE 6. Mandible with a well-developed molar plate (MP).

5A. Chewing mouthparts without a well-developed molar plate. Mouthparts often project forward in a buccal cone

NEANURINAE. 7

6. Eyes 8 per side. Postantennal organ present (Figure 5). Furcula well-developed. Unguiculus present or absent

Hypogastrura **(Genus 2)**

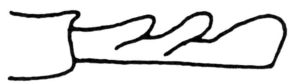
6A. Eyes 5 per side. Postantennal organ absent. Unguiculus absent. Furcula often reduced

Xenylla **(Genus 3)**

7. Mucro trilamellate (Figure 7)

Odontella **(Genus 6)**

FIGURE 7. Trilamellate mucro.



7A. Mucro not trilamellate, variously reduced or even absent

. 8

8. With anal spines (Figure 8)

Friesea **(Genus 7)**

FIGURE 8. Abdomen VI with anal spines.

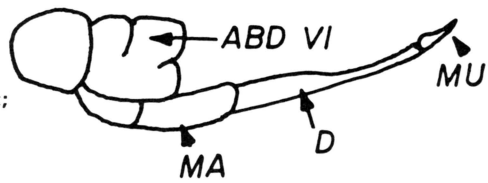
8A. Without anal spines

. 9

9. Furcula present, with all three segments distinct (Figure 9)

. 10

FIGURE 9. Furcula with manubrian (MA), dens (D), and mucro (MU) distinct; ABDVI, sixth abdominal segment.



9A. Furcula absent or reduced. Mucro always absent

. 11

10. Eyes 8 per side.

Pseudachorutes **(Genus 5)**

10A. Eyes 5 per side.

Microgastrura **(Genus 8)**

11. Last abdominal segment bilobed (Figure 10). Body usually with conspicuous tubercles. Usually rather large, stout species

. 12

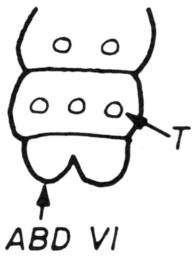


FIGURE 10. Last abdominal segment (ABDVI) bilobed; abdomen with tubercles (T).

11A. Last abdominal segment not bilobed. Body without tubercles. Usually rather small species

Anurida **(Genus 4)**

12. Postantennal organ present, of 50 or more tubercles

Morulina **(Genus 10)**

12A. Postantennal organ absent

Neanura **(Genus 9)**

13. Unguiculus well-developed (Figure 11)

Onychiurus **(Genus 12)**

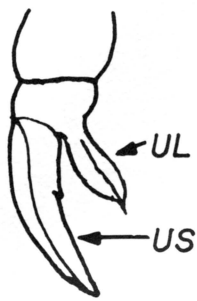


FIGURE 11. Well-developed unguiculus (UL); US, unguis.

13A. Unguiculus extremely reduced or absent

Tullbergia **(Genus 11)**

14. Body with or without scales. Postantennal organ absent

Entomobryidae. 24

14A. Body without scales. Postantennal organ present [Note that juvenile *Tomocerus* **(Genus 23)** (Entomobryidae) will also key here as well as *Isotomiella minor* **(Genus 20)**]

Isotomidae **15**

15. Anal spines present (Figure 8)

. . . . .**16**

15A. Anal spines absent

. . . . .**17**

16. Furcula not reaching ventral tube (Figure 2)

Tetracanthella **(Genus 17)**

16A. Furcula reaching to ventral tube

"Spinisotoma" **(Genus 18)**
(an ecomorph of *Isotoma*)

17. Abdominal segment IV through VI fused (Figure 2), with no clear non-sectaceous bands separating these segments, though folds may be present

Folsomia **(Genus 19)**

17A. Abdominal segments IV through VI not fused; segments IV and V always separated by a non-setaceous band or suture

. . . . .**18**

18. Head conspicuously wide, greater in width than the second thoracic segment. Antennae shorter than head

Metisotoma **(Genus 14)**

18A. Head subequal to, or narrower than the second thoracic segment. Antennae longer than head

. . . . .**19**

19. Postantennal organ, eyes, and pigment absent. Antennae IV with conspicuous rods (Figure 12)

Isotomiella **(Genus 20)**

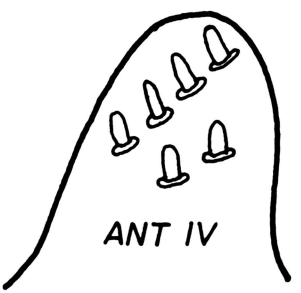


FIGURE 12. Antenna IV with rods.

19A. Postantennal organ present. Eyes and pigment present or absent. Antennae IV without conspicuous rods

. 20

20. Ventral manubrial setae 10 or more, usually more than 14. Sometimes with bothriotricha (Figure 13)

. 21

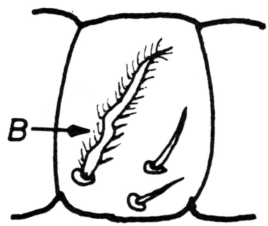


FIGURE 13. Bothriotricha (B) and simple setae.

20A. Ventral manubrial setae 9 or fewer, usually 6 or fewer. Never with bothriotricha

. 23

21. Some abdominal segments with bothriotricha

Isotomurus **(Genus 13)**

21A. No abdominal bothriotricha

. 22

22. Dens with dorsal spines (Figure 14)

Semicerura **(Genus 16)**

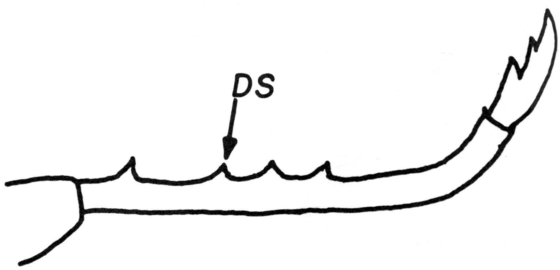


FIGURE 14. Dens with dorsal spines (DS).

22A. Dens without dorsal spines

Isotoma **(Genus 21)**

23. Postantennal organ divided into four quadrants (Figure 15)

Micrisotoma **(Genus 22)**

FIGURE 15. Postantennal organ divided into four quadrants.

23A. Postantennal organ not divided into four quadrants

Proisotoma **(Genus 15)**

24. Antenna four-segmented. Abdomen III shorter than IV. Dens sometimes with spines. Body with or without scales

. . . . .**25**

24A. Antenna five- or six-segmented. Abdomen III and IV subequal in length. Dens never with spines. Body without scales

Orchesella **(Genus 28)**

25. Body with hairs, but no scales

. . . . .**26**

25A. Body with hairs and scales (Note that scales are often lost in handling, but are usually retained at least on the dens.)

. . . . .**27**

26. Tibiotarsus with two rows of smooth setae on inner surface (Figure 16). Use low magnification, as these are minutely serrate at high magnification. Antenna without an apical retractile papilla

Entomobryoides **(Genus 25)**

FIGURE 16. Two rows of smooth setae on inner surface of tibiotarsus.

26A. Tibiotarsus without two rows of smooth setae on inner surface. Antenna with an apical retractile papilla

Entomobrya **(Genus 24)**

27. Dens with spines (Figure 14)

Tomocerus **(Genus 23)**

27A. Dens without spines

. . . . .**28**

28. Unguis with large paramedial teeth in some species (Figure 17). Ey reduced or absent

Pseudosinella (Genus 2

FIGURE 17. Unguis with a large paramedial tooth (PT).

28A. Unguis without large paramedial teeth. Eyes seldom reduced, neve absent

Lepidocyrtus (Genus 27

GENUS 1 *Podura* Linnaeus

Only *Podura aquatica* Linnaeus was collected. It is unmistakable by the nature of the dens.

Randolph Co, Gaudineer Knob; Pendleton Co., Spruce Knob. *Sphagnum* sp. moss.

GENUS 2 *Hypogastrura* Bourlet

Christiansen and Bellinger recognize four subgenera of *Hypogastrura* all encountered in this investigation, but this genus requires further study. Many species are probably species complexes.

1. Unguiculus very minute or absent

Subgenus *Schoettella*

ununguiculta Tullberg

This is the only member of the subgenus collected and is unmistakable because of the absence of an unguiculus.

Ohio Co., Oglebay Park. Pine litter and dry outer bark of pine tree.

1A. Unguiculus very evident

. 2

2. Posterior lobe of postantennal organ surrounding the accessory boss. Sometimes with cephalic spines

Subgenus *Mitchellania* Wray

Bellinger states that the specimens collected may be *H. horrida* but is uncertain because they do not exactly fit the description of that species. This will be studied further. It is the only member of the subgenus collected, and is unmistakable because of the accessory boss.

Preston Co., Cathedral State Park; Randolph Co., Gaudineer Knob. Agaric fungi and *Hypnum* sp. moss.

2A. Without cephalic spines

. 3

3. Mucro with high lateral flaps (Figure 18). In ventral view, the mucro resembles a half peanut shell. Length of dorsal setae conspicuously variable, some being quite long. Most species with long anal spines

Subgenus *Ceratophysella*. 4

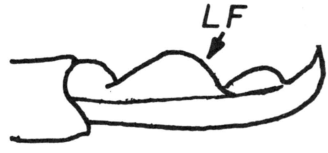


FIGURE 18. Mucro with high lateral flaps (LF).

3A. High lateral flaps on the mucro absent (Figure 19). Body setae genera ly short and uniform. Anal spines usually short

Subgenus *Hypogastrura* Bourlet. . . .

FIGURE 19. Mucro without high lateral flaps.

4. With clavate tenent hairs

boletivora Packar

4A. Without clavate tenent hairs

denticulata Bagnal

This species might best be treated as a complex of species yet to be deter mined. Evidence for this is in the wide range of habitats in which they occur and much morphological variability. *Hypogastrura armata* and *pseudarmata*, two firmly entrenched, though probably erroneous species, fall here.

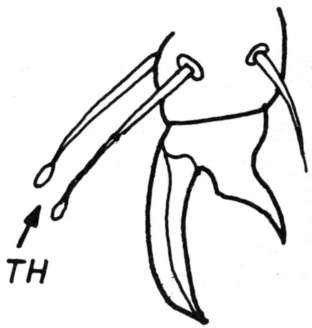
Grant Co., North Fork Mountain; Marshall Co., Viola; Ohio Co., Oglebay Park; Preston Co., Terra Alta; Randolph Co., Gaudineer Knob; Ritchie Co., North Bend State Park; and Tucker Co., Dolly Sods. Mosses *Hypnum imponens*, *Thuidum* sp. *Dicranum* sp., *Sphagnum* sp., *Leucobryum glaucum;* fungi *Tremella* sp., *Hygrophorus* sp., *Daedalia unicolor*; liverworts *Trichocolea* sp. and *Bazzania triloba;* hemlock litter; mixed litter; moss-lichen mixtures.

5. With 2-3 long clavate tenent hairs (Figure 20)

macgillivrayi Folsom

Randolph Co., Gaudineer Knob; Ohio Co., Oglebay Park. Rotten red spruce wood and leaf litter.

FIGURE 20. Clavate tenent hairs (TH).



5A. With only 1 tenent hair, clavate or not

. 6

6. Anal spines minute, not easily seen at low magnification. Dens conspicuously papillate

.....9

6A. Anal spines large, easily seen at low magnification. Dens not conspicuously papillate

.....7

7. With some serrate setae

.....8

7A. Without serrate setae

gigas Maynard

This species may show some slightly clavate body setae. Not all setae are pointed as Maynard (1951) states. This characteristic is associated more with the *packardi* complex, but *packardi* has serrate setae.

Preston Co., Terra Alta. *Fissidens* sp. moss.

8. With stout capitate hairs

packardi Folsom

Ohio Co., Oglebay Park. Agaric fungi.

8A. Without stout capitate hairs

packardi var. *dentata* Folsom

Ohio Co., Oglebay Park. Agaric fungi.

9. Dens with many thornlike subapical papillae (Figure 21)

nivicola Fitch

The subapical papillae appear like multi-tuberculate conical projections which are much higher than the other tubercles of the dens. Without proper orientation this may be hard to see.

Randolph Co., Gaudineer Knob; Preston Co., Cathedral State Park. Moss including *Hypnum imponens;* rotted hemlock wood.

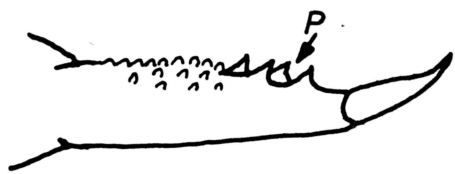


FIGURE 21. Dens with thorn-like papillae (P).

9A. Dens without thornlike subapical papillae

manubrialis Tullberg

Randolph Co., Gaudineer Knob; Preston Co., Cathedral State Park. Rotted hemlock wood; *Catherinia-Hypnum* moss mixes.

GENUS 3 *Xenylla* Tullberg

This genus is distinguished from *Hypogastrura* by the presence of five eye per side and the lack of a postantennal organ and unguiculus. The furcula ma also be reduced. Only one species collected, *Xenylla humicola* Tullberg.

Preston Co., Cathedral State Park and Terra Alta; Tucker Co., Dolly Sod Fungus *Daedalia unicolor*, lichen *Cladonia* sp., liverwort *Trichocolea* sp., an moss *Thuidium* sp.

GENUS 4 *Anurida* Laboulbene

This genus is also subject to some controversy. Bellinger states that *pygma* may represent a species complex. Some authors consider *Micranurida* as a separate genus.

1. Maxillae untoothed

Subgenus *Micranurida*

One species collected, *Anurida pygmaea* Börner, which is white with eye absent.

Monongalia Co., Blacksville; Ritchie Co., North Bend State Park; Tucke Co., Dolly Sods. Moss *Hypnum imponens,* powdered wood from ant nest.

1A. Maxillae toothed

Subgenus *Anurida*

One species collected, *Anurida* "C. G. *granaria"* Nicolet, which is white with eyes absent.

Grant Co., Dolly Sods; Preston Co., Terra Alta. Moss.

GENUS 5 *Pseudachorutes* Tullberg

Christiansen and Bellinger (personal communication) have tentatively identified several new species of *Pseudachorutes*, but have not published the descriptions. The following established species were collected:

1. Body with heavy blunt hairs dorsally

. . . . 2

1A. Body with short curving setae dorsally

subcrassoides Mills

Grant Co., North Fork Mountain. Liverwort *Marsupella emarginata.*

2. Postantennal organ oval, with 19-28 tubercles. Retractile knob at apex of Ant. IV absent

saxatilis MacNamara

Pendleton Co., Spruce Knob. Moss *Sphagnum* sp.

2A. Postantennal organ round, with 12-15 tubercles. Retractile knob of Ant. IV present.

aureofasciatus Harvey

Marshall Co., Majorsville; Preston Co., Terra Alta and Cathedral State Park; Tucker Co., Dolly Sods. Agaric fungi; soil lichens; moss *Hypnum imponens;* liverwort *Trichocolea* sp.; and hemlock litter.

GENUS 6 *Odontella* Schaeffer

The one species collected, *Odontella cornifer* Mills, possesses a characteristic trilamellate mucro and conspicuously tapering antennae.

Monongalia Co., Morgantown; Randolph Co., Gaudineer Knob; Ritchie Co., North Bend State Park; Tucker Co., Dolly Sods. Soil lichens, shelf fungi, soil, and *Bazzania* liverwort.

GENUS 7 *Friesea* Dalla Torre

One species was collected, *Friesea claviseta* Axelson

Ohio Co., Oglebay Park; Monongalia Co., Triune. Rotted wood.

GENUS 8 *Microgastrura* Stach

One species was collected, *Microgastrura minutissima* Mills.

Marshall Co., Majorsville; Monongalia Co., Morgantown. Shelf fungi and moss.

GENUS 9 *Neanura* MacGillivray

Neanura also requires intensive study. Bellinger and Christiansen have tentatively identified many new species, as yet unpublished. Established species which were collected include the following:

1. Body white. Eyes two per side

pseudoquadrioculata Stach

Bellinger (personal communication) assigns this name for North American species which other authors call *N. barberi.* Possibly it is a complex of species.

Tucker Co., Dolly Sods. *Sphagnum* sp. and *Ceratodon purpureum* mosses and *Trichocolea* sp. liverwort.

1A. Body bluish

. 2

2. Eyes three per side. Without serrate setae

muscorum Templeton

Ohio Co., Oglebay Park; Randolph Co., Dolly Sods; Tucker Co., Dolly Sods. Decayed red pine wood, wood of hemlock and hardwoods. Mixed mosses, including *Mnium* sp., *Hypnum* sp., and *Hypnum molluscum.*

2A. Eyes four or five per side. With serrate setae

serrata Folsom

This species has previously been recorded only from the West Coast.

Monongalia Co., Coopers Rock State Forest. Moss *Hypnum imponens.*

GENUS 10 *Morulina* Börner

One species of this genus, formerly considered in the genus *Neanura*, w collected: *Morulina gigantea* Tullberg.

Ohio Co., Oglebay Park. Edge of lawn.

GENUS 11 *Tullbergia* Lubbock

The two species collected are much narrower and more elongate than m species of *Onychiurus* with which they might be confused. The reduced or abs unguiculus will separate them.

1. Unguiculus bristle-like

granulata Mi

Tucker Co., Dolly Sods. *Polytrichum* moss.

1A. Unguiculus absent

clavata Mi

Grant Co., North Fork Mountain; Marshall Co., Viola; Tucker Co., Dol Sods. Moss *Hypnum* sp., *Hypnum molluscum*, and *Dicranum* sp.; rotted wo and red pine litter.

GENUS 12 *Onychiurus* Gervais

This is a large genus. Some well-established species such as *Onychiur fimetarius* are now considered to be species complexes, and North Americ material previously identified as *O. fimetarius* is, according to Bellinger (perso communication), probably *O. justi.* All species lacking anal spines are here assigned to this last species.

The numbers of pseudocelli at the antennal base are important in identifica tion, but may be hard to find, especially in young specimens.

1. Postantennal organ of simple vesicles

....1

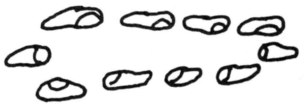
1A. Postantennal organ of compound vesicles

....5

2. Postantennal vesicles subparallel (Figure 22)

....3

FIGURE 22. Postantennal vesicles subparallel.



2A. Postantennal organs at right angles to the organ

parvicornis Mills

Tucker Co., Dolly Sods; Marshall Co., Cameron. In lichen-moss mixtures and in *Hypnum* sp. moss.

3. One pseudocellus on antennal base

.....4

3A. Two to three pseudocelli on antennal base (Figure 5)

subtenuis Folsom

Grant Co., North Fork Mountain; Marshall Co., Cameron; Preston Co., Terra Alta and Cathedral State Park; Randolph Co., Gaudineer Knob; Ritchie Co., North Bend State Park; Tucker Co., Dolly Sods. Agaric fungi, rotted hemlock, red pine litter; mosses *Sphagnum* sp., *Polytrichum* sp., *Dicranum* sp., *Dicranum scoparium, Dicranum flagellare, Hypnum* sp., *Hypnum molluscum, Ceratodon purpureus;* lichens on soil.

4. Unguiculus with distinct basal lamellae

similis Folsom

Ohio Co., Oglebay Park. Turf.

4A. Unguiculus without distinct basal lamellae

sibricus Tullberg

Grant Co., North Fork Mountain; Marshall Co., Viola; Ohio Co., Oglebay Park; Randolph Co., Gaudineer Knob; Tucker Co., Dolly Sods. Lichens, *Cladonia* sp., *Parmelia* sp., *Bazzania triloba,* and *Marsupella emarginata;* various mosses including *Sphagnum* sp.; moss-lichen mixes; turf.

5. Anal spines absent

justi Denis

Grant Co., North Fork Mountain and Smoke Hole; Marshall Co., Majorsville and Cameron; Ohio Co., Valley Grove, Oglebay Park; Pendleton Co., Spruce Knob; Preston Co., Terra Alta and Cathedral State Park; Randolph Co., Gaudineer Knob; Ritchie Co., North Bend State Park. Fungus *Craterellus cantherellus;* mosses, including *Polytrichum* sp., *Sphagnum* sp., *Dicranum* sp., *Mnium* sp., *Camptothecium* sp.; liverworts *Marsupella emarginata, Bazzania triloba;* leaf litter; rotted hemlock and red pine wood.

5A. Anal spines present

ramosus Folsom

Preston Co., Terra Alta; Tucker Co., Dolly Sods; Randolph Co., Gaudineer Knob. Hemlock litter; mosses *Hypnum molluscum, Hypnum* sp.; moss-lichen mixes.

GENUS 13 *Isotomurus* Börner

This genus contains many undescribed species and can be confused wi *Isotoma* if the bothriotricha are missing. Bellinger (personal communicatio states that in *Isotomurus* the setae are ciliate on all sides, whereas in *Isotoma* th setae are smooth or unilaterally ciliate. Also any *Isotoma*-like species with small ventral mucronal tooth is *Isotomurus*. Only one probable species w collected, *Isotomurus tricolor* (?) Packard.

Preston Co., Terra Alta; Randolph Co., Gaudineer Knob; Tucker Co., Dol Sods. Mosses including *Entodon* sp.; liverwort *Bazzania triloba;* lichen *Cladon* sp.

GENUS 14 *Metisotoma* Maynard

Metisotoma is readily distinguished by the large head and deep purple-blu color. Only one species collected, *Metisotoma grandiceps* Reuter.

Grant Co., Smoke Hole; Ohio Co., Oglebay Park; Pendleton Co., Spruc Knob; Preston Co., Cranesville Swamp and Terra Alta; Randolph Co., Gaudinee Knob; Tucker Co., Dolly Sods. Mosses including *Sphagnum* sp., *Polytrichum* sp. *Mnium* sp., *Dicranum* sp., *Dicranum flagellare, Thuidium* sp., *Entodon* sp. *Hypnum* sp., *Hypnum imponens, Ceratodon purpureum;* liverworts *Bazzani triloba, Marsupella emarginata;* lichens *Parmelia* sp., *Cladonia* sp.; rotted re spruce wood.

GENUS 15 *Proisotoma* Börner

Bellinger (personal communication) refers to *Proisotoma* as a "wastebaske genus" and states that at least one of the West Virginia specimens represents a new genus.

1. Dens with a lateral subapical bladder (Figure 23)

bulbosa Folsom

Tucker Co., Dolly Sods. Lichen *Cladonia* sp.; moss *Polytrichum* sp.; under dead yellow birch bark.

FIGURE 23. Dens with a lateral subapical bladder (B).

1A. Dens without a lateral subapical bladder

. . . . 2

2. Body segments without deep intersegmental constrictions. Dark blue

minuta Tullberg

Randolph Co., Gaudineer Knob; Tucker Co., Dolly Sods. Mosses *Sphagnum* sp., *Dicranum scoparium, Polytrichum* sp., *Hypnum* sp.; liverwort *Conocephallum* sp.; under dead yellow birch bark.

2A. Body segments with deep intersegmental constrictions. Grayish or bluish

antiqua Folsom

Ohio Co., Oglebay Park. Hemlock litter.

GENUS 16 *Semicerura* Maynard

One species was collected, *Semicerura bishopi* Maynard. The dorsal spines on the dens are unique for Isotomidae in this collection.

Tucker Co., Dolly Sods. Moss *Polytrichum* sp. and yellow birch bark.

GENUS 17 *Tetracanthella* Schott

One species collected, *Tetracanthella ethalae* Wray.

Monongalia Co., Blacksville. Powdered wood from carpenter ant nest.

GENUS 18 *Spinisotoma* Stach

One species, *Spinosotoma dispersa* Wray, was collected. *S. dispersa* and *Tetracanthella ethalae* were the only isotomids collected with anal spines. In *Spinisotoma* the furcula reaches the ventral tube. It does not in *Tetracanthella*. It is quite probable that *Spinisotoma* is in reality an ecomorph of *Isotoma.*

Preston Co., Terra Alta. *Sphagnum* sp.

GENUS 19 *Folsomia* Willem

This genus also contains many undescribed species. Eye number is used as a major criterion in most keys, and it is often necessary to clear specimens for proper identification.

1. Eyes absent

.....2

1A. Eyes present

.....3

2. Dens twice as long as manubrium and bearing serrate setae

nivalis Packard

Preston Co., Cranesville Swamp; Tucker Co., Dolly Sods. Moss-lichen mixes; dead red spruce wood.

2A. Dens subequal to manubrium and without serrate setae

hodgei Maynard

Grant Co., Dolly Sods. Moss.

3. Eyes 8 per side. Body with clavate tenent hairs.

prima M

Ohio Co., Oglebay Park; Tucker Co., Dolly Sods; Preston Co., Terra Al Mosses including *Polytrichum* sp., *Fissidens* sp., *Hypnum* sp.; lichen-m mixtures; *Cladonia* sp. lichen.

3A. Eyes 4 per side. With many anterior manubrial setae

highlandia Wi

Ohio Co., Oglebay Park. *Xyllaria* sp. fungi.

GENUS 20 *Isotomiella* Bagnall

This is the only isotomid genus collected with no pigment, no eyes, and postantennal organ. One species, *Isotomiella minor* Schaeffer, was collected.

Tucker Co., Dolly Sods. Moss; *Cladonia* sp. lichen.

GENUS 21 *Isotoma* Bourlet

Though many members of this large genus are well established, many a not. Some species which are strongly entrenched in the literature seem to sho variation, and it is impossible to identify them with certainty. *Isotoma olivac* probably represents a complex of several species. The separation of *Isotom arborea* var. *nigra* and *I. nigrifrons* is uncertain. Much of this problem seems stem from immature individuals and from ecomorphs.

In some cases the use of color as a criterion causes problems. As Bellinge (personal communication) has pointed out, many species show very clos gradation of one color into another. One species, *Isotoma monochaeta,* has no been previously recorded in North America. Also see comments under *Isoto murus.*

1. Tenent hairs present

. . . .2

1A. Tenent hairs absent

. . . .5

2. Genital and anal segments ankylosed

. . . .3

2A. Genital and anal segments not ankylosed

. . . .4

3. With one tenent hair

monochaeta Kos

Grant Co., Dolly Sods and Smoke Hole; Marshall Co., Viola; Monongalia Co., Blacksville; Ohio Co., Oglebay Park; Preston Co., Terra Alta and Cranesville Swamp; Ritchie Co., North Bend State Park; Tucker Co., Dolly Sods. Rotted

wood or under bark of black cherry, elm, red spruce, yellow birch, and white pine; mosses including *Sphagnum* sp., *Mnium* sp., *Dicranum* sp., *Dicranum scoparium, D. flagellare, Rhodobryum roseum, Hypnum* spp., *Hypnum molluscum, Leucobryum glaucum*; lichens, including *Cladonia* sp., in moss-lichen mixes.

3A. With three tenent hairs

sensibilis Tullberg

Tenent hairs of *sensibilis* may break off causing the specimen to be mistaken for *I. monochaeta.*

Ohio Co., Viola; Preston Co., Terra Alta; Tucker Co., Dolly Sods. Pine litter; *Polyporous versicolor* fungi; liverwort *Umbillicaria* sp.; mosses including *Dicranum* sp., *Polytrichum* sp., *Hypnum molluscum; Parmelia* sp. lichen.

4. Eyes equal in size

cinerea Nicolet

Randolph Co., Gaudineer Knob; Tucker Co., Dolly Sods.
Mosses *Catherinia* sp., *Hypnum* sp., *Polytrichum* sp.

4A. Eyes unequal in size

arborea Linnaeus

Ohio Co., Oglebay Park; Tucker Co., Dolly Sods. Black cherry wood and bark, yellow birch bark, *Polytrichum* sp. moss.

5. Eyes absent

tariva Wray

Pendleton Co., Spruce Knob; Preston Co., Cranesville Swamp. *Sphagnum* sp. moss and under bark of red spruce.

5A. Eyes present

. 6

6. Eyes four, on black spots. Blackish-purple pigment in the form of fine mottling

notabilis Schaeffer

Preston Co., Terra Alta. Tucker Co., Dolly Sods; Hemlock litter; *Sphagnum* sp. moss.

6A. Eyes three or eight per side

. 7

7. Eyes three per side. Body white

andrei Mills

Grant Co., North Fork Mt.; Monongalia Co., Blacksville. Powdered wood from carpenter ant nest; liverwort *Marsupella emarginata.*

7A. Eyes eight per side. Body color variable

...

8. Mucro with three teeth

...

8A. Mucro with four teeth

.....

9. Unguis with two strong inner teeth and two outer teeth

viridis Bou

Marshall Co., Viola; Monongalia Co., Cassville; Ohio Co., Oglebay P Tucker Co., Dolly Sods. Roadside gravel near lawn, leaf litter, moss, alf sweeping.

9A. Unguis without teeth

trispinata MacGilliv

Preston Co., Cranesville Swamp, Cathedral State Park; Ritchie Co., No Bend State Park. Under red spruce bark, moss, and in red pine litter.

10. Mucro complexly lamellate (Figure 24)

.....

FIGURE 24. Mucro complexly lamellate.

10A. Mucro not complexly lamellate

.....11

11. Antennae II, III and IV unequal in length.

gellida Folsom

Tucker Co., Dolly Sods. In red pine litter.

11A. Antennae II, III and IV subequal in length

subaequalis Folsom

Pendleton Co., Spruce Knob; Preston Co., Cranesville Swamp. In *Sphagnum* and red spruce bark.

12. Apical tooth of mucro minute

viridis catena MacGillivray

Ohio Co., Oglebay Park. In red pine litter.

12A. Apical tooth of mucro not minute

.....13

13. Body white

albella Packard

Monongalia Co., Blacksville and Triune. Loose bark of locust tree and dead leaves.

13A. Body not white

.....14

14. The ground color at least a dirty yellowish. With varying amounts of blue or purple pigment on the body

olivacea Tullberg

Preston Co., Terra Alta and Cathedral State Park; Randolph Co., Gaudineer Knob; Tucker Co., Dolly Sods. Hemlock and red pine litter; lichen-moss mixes; fungus *Polyporus versicolor;* mosses *Sphagnum* sp. *Polytrichum* sp.

14A. Ground color whitish, bluish, or purplish; always some blue or purple present on the body

nigrifrons Folsom

Marshall Co., Viola and Cameron; Ohio Co., Oglebay Park; Randolph Co., Gaudineer Knob; Tucker Co., Dolly Sods. Hemlock and red pine litter; rotted hardwood; under white pine bark; mosses including *Polytrichum* sp., *Dicranum scoparium, Hypnum* sp.

GENUS 22 *Micrisotoma* Bellinger

This genus is characterized by the form of the postantennal organ. One species was collected, *Micrisotoma achromata* Bellinger.

Ohio Co., Oglebay Park. In gravel at roadside near lawn.

GENUS 23 *Tomocerus* Nicolet

Tomocerus are fairly easily recognized because of the dental spines. Young specimens, however, are almost undeterminable because of retarded development of the dental spines.

1. With a conspicuous lamella connecting teeth of the mucro (Figure 25)

lamelliferous Mills

Ohio Co., Oglebay Park; Randolph Co., Gaudineer Knob; Ritchie Co., North

FIGURE 25. Conspicuous lamella (L) connecting teeth of the mucro.

Bend State Park; Tucker Co., Dolly Sods. Hemlock litter; mosses, includi
Dicranum scoparium, Hypnum sp.

1A. Without a conspicuous lamella connecting the teeth of the mucro
....

2. Larger dental spines limited to the beginning and end of the row
flavescens Tullbe

Grant Co., Smoke Hole; Marshall Co., Viola and Burch Run Lake; Mon
galia Co., Morgantown; Ohio Co., Oglebay Park and Bear Rock Lakes; Pendleto
Co., Spruce Knob; Preston Co., Cathedral State Park; Randolph Co., Gaudine
Knob; Tucker Co., Dolly Sods. Various mosses including *Polytrichum* sp
Mnium sp., mixes of *Rhodobryum roseum* and *Thuidium delicatulum; Hypnu*
spp., *Hypnum imponens, Dicranum flagellare, Leucobryum glaucum, Ceratodo*
purpureum; liverworts *Bazzania triloba, Conocephallum* sp; red pine an
hemlock litter; various fungi including *Tremella* sp., *Boletus* sp.; various agaric
Xyllaria sp., and shelf fungi. In rotted hardwoods; tent caterpillar nests; unde
yellow birch bark; in lichen-moss mixes; and in *Cladonia* sp. lichen.

2A. Larger dental spines not limited to the start and end of the row
bidentatus Folsom

Ohio Co., Oglebay Park; Preston Co., Terra Alta; Randolph Co., Gaudineer
Knob; Tucker Co., Dolly Sods. Mosses, including *Hypnum imponens* and
Sphagnum sp.; *Bazzania triloba* liverwort; hemlock litter.

GENUS 24 *Entomobrya* Rondani

Color has been relied on to a large extent in distinguishing species of *Entomobrya.* Maynard (1951) has shown that color is variable, and Christiansen (1958) reworked the genus using the shape and position of setae of the male genital plate as the major taxonomic criterion. However, orientation of the specimen to see the genital setae properly can be a problem and females or immatures are often undeterminable. Only one species, *Entomobrya atrocincta* Schott, was identified with certainty. This species is distinctive since the only purple pigmentation is on the thorax.

Tucker Co., Dolly Sods. Agaric fungi.

GENUS 25 *Entomobryoides* Maynard

Entomobryoides is distinguished from *Entomobrya* by the presence of two rows of smooth setae on the tibiotarsus. The setae should be examined under medium power (ca. 400X) because they appear minutely serrate at high power. The only species collected was *Entomobryoides dissimilis* Moniez which is very large and densely covered with ciliate setae, much more so than any *Entomobrya.*

Preston Co., Terra Alta. In *Hypnum imponens* moss.

GENUS 26 *Pseudosinella* Schaeffer

There is some doubt as to whether *Pseudosinella* should be separated from *Lepidocyrtus*. The only species identified was *Pseudosinella argentea* Bourlet.

Preston Co., Terra Alta. *Hypnum imponens* moss.

GENUS 27 *Lepidocyrtus* Bourlet

One species, *L. cyaneus*, shows considerable variation. At Bellinger's suggestion, we are assuming blue species without scales on the antennal base to be *cyaneus*, but further study is needed.

1. With blue pigment on eyes and antennae only

lanuginosus Gmelin

Ohio Co., Olgebay Park; Tucker Co., Dolly Sods. Moss including *Dicranum flagellare*; in hemlock litter.

1A. With more extensive blue

.....**2**

2. With scales all over the appendages

paradoxus Uzel

Tucker Co., Dolly Sods. In *Hypnum* sp. moss.

2A. Without scales all over the appendages

.....**3**

3. Without scales at the base of the antennae

cyaneus Tullberg

Grant Co., Smoke Hole; Marshall Co., Viola; Monongalia Co., Morgantown; Ohio Co., Oglebay Park; Pendleton Co., Spruce Knob; Preston Co., Terra Alta, Cathedral State Park, Cranesville; Randolph Co., Gaudineer Knob; Ritchie Co., North Bend State Park; Tucker Co., Dolly Sods. Mosses including *Polytrichum* sp., *Sphagnum* sp., *Dicranum* sp., *Hypnum imponens, Hypnum molluscum, Thuidium* sp., *Catherinia-Hypnum* mixes, *Rhodobryum roseum-Thuidium delicatulum* mixes, *Leucobryum glaucum, Ceratodon purpureum;* fungi, including *Xyllaria* sp. and shelf fungi, lichen and moss-lichen mixes including *Cladonia-Parmelia* spp.; under pine, elm, and birch bark; hemlock litter.

3A. With scales at the base of the antennae

.....**4**

4. Abdomen IV with a midorsal band of purple pigment

unifasciatus James

Preston Co., Dolly Sods; Randolph Co., Gaudineer Knob. Mosses *Hypnum imponens, Pogonotum* sp.

4A. Abdomen IV without a midorsal band of purple pigment

lignorum Fabricus

Marshall Co., Viola and Cameron; Preston Co., Cranesville and Terra Al
Ritchie Co., North Bend State Park. Moss, including *Camptothecium* sp., p
pine, and hemlock litter.

GENUS 28 *Orchesella* Templeton

Keys for this genus rely heavily on color, which may vary with age an
habitat of the specimen. *Orchesella* is characterized by having a five- or si
segmented antenna, but in young individuals one of these segments may be lo
In general, abdomen III and IV of *Orchesella* are subequal while in *Lepidocyrt*
abdomen IV is very much shorter than III, and in *Entomobrya* abdomen IV i
much shorter than III.

1. With transverse bands of purple pigment

hexfasciata Harve

Marshall Co., Viola; Ohio Co., Oglebay Park; Pendleton Co., Spruce Knob
Preston Co., Terra Alta and Cranesville Swamp; Randolph Co., Dolly Sod
Tucker Co., Dolly Sods. Occurs in a wide variety of habitats. Liverwort
Bazzania triloba and *Trichocolea* sp.; mosses including *Polytrichum* sp.
Sphagnum sp., *Dicranum* sp., *Dicranum flagellare, Dicranum scoparium*
Hypnum sp., *Hypnum imponens, Thuidium* sp., *Mnium* sp., *Hylocomnium* sp.
Leucobryum glaucum, Ceratodon purpureum; lichens and lichen-moss mixe
including *Parmelia* sp.; rotted red spruce wood; hemlock litter and wood.

1A. Without transverse bands of purple pigment

. . . . 2

2. With longitudinal stripes on body

ainslei Folsom

Grant Co., Smoke Hole and North Fork Mountain; Randolph Co.,
Gaudineer Knob; Tucker Co., Dolly Sods. Mosses including *Dicranum* sp.,
Mnium sp., *Ceratodon purpureum, Polytrichum* sp., *Hypnum* sp.; liverwort
Bazzania triloba and *Trichocolea* sp.; lichens including *Parmellia* sp., *Umbillicaria*
sp.

2A. Without longitudinal stripes on body. Head, prothorax, and meso-
throax yellow. With varying amounts of purple pigment on body

folsomi Maynard

Ohio Co., Oglebay Park

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