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and
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ABSTRACT

Higgins, Robert P., and Reinhardt Møbjerg Kristensen. Kinorhyncha from Disko Island, West Greenland. *Smithsonian Contributions to Zoology*, number 458, 56 pages, 167 figures, 7 tables, 1 map, 1988.—Seven new species, two representing the genus *Pycnophyes* and five species of *Echinoderes*, are described from the Arctic waters of West Greenland. Keys to the adults of both genera are included. To determine the diversity and relative abundance of the kinorhynch fauna, samples of subtidal sediment were collected along the long axes of Disko Bay and Disko Fjord at depths of 6.5 m to 300 m. One species was found at only a single locality; others were more widely distributed and most abundant in the more protected confines of the fjord or deeper water of the bay. No kinorhynchs were found in sediments directly affected by glacial meltwater. Accounts of the first five of six stages in the life history of one of the two species of *Pycnophyes* are included in the description of that species.

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Contents

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Introduction

A paucity of information exists on the meiofauna from Arctic regions in contrast to more numerous publications treating microscopic invertebrates from tropical oceans. The presence of the phylum kinorhyncha in the Arctic meiofauna has been noted in six instances. The first kinorhynch reported from the Arctic (70°N) was *Echinoderes arcticus* (Steiner, 1919); unfortunately, this species from the White Sea, near Murmansk, was based on a juvenile specimen and has not been found again. The second kinorhynch described from the Arctic (75°N) was *E. arlis* Higgins, 1966b, which was found between depths of 419 and 747 m in the Chukchi Sea off Point Barrow Alaska.

The presence of kinorhynchs (otherwise unidentified) in Arctic sediments has been noted in four other studies, all of them dealing with quantitative ecology of subtidal meiofauna (Beaufort Sea: Carey and Montagna, 1982; Laptev Sea: Sheremetevskij, 1977; Norwegian Sea: Thiel, 1971; Norwegian Sea and Greenland Sea: Dinet, 1977). Carey and Montagna (1982) reported kinorhynch abundance at 0.1 · 10 cm^{-2}, comprising 0.2 percent of the total meiofauna; Sheremetevskij (1977) found kinorhynchs at a concentration of 0.62 · 10 cm^{-2}, or 0.3 percent of the total meiofauna; Thiel (1971:104) listed kinorhynch abundance at about 1.5 · 10 cm^{-2}, or 0.14 percent of the total meiofauna collected; and Dinet's (1977) data placed kinorhynchs at 1–8 · 10 cm^{-2}, or 0.3–1.7 percent of the total meiofauna.

In contrast with the dearth of information pertaining to the meiobenthos, the study of Greenlandic subtidal macrobenthos has a lengthy history, dating from the publications of Otto Fabricius' *Fauna Groenlandica* in 1780. Much interest in subtidal macrobenthic communities within the coastal waters of Greenland has been directed toward the commercially important populations of deep-sea prawns (Horsted and Smidt, 1956). The first studies of meiofauna from the coasts of Greenland were initiated in 1978 (Kristensen and Niilonen, 1982; Kristensen and Nørrevang, 1982; Kristensen and Higgins, 1984). Although very little quantitative data were published by these authors, they have been impressed with the relatively high abundance of meiobenthos found in the sediments along the western coast of Greenland.

The present study focuses on a particular component of the subtidal meiofauna, the Kinorhyncha, from Disko Island, West Greenland (Map 1). As in most other studies of Greenlandic meiobenthos, the site of this study was determined by the proximity of the Danish Arctic Station.

Methods.—The specimens upon which this study is based were taken from 10 samples of mud to sandy-mud from depths between 6.5 m and 300 m on the south and southwestern coasts of Disko Island. Certain sites required sampling with a 0.1 m^2 Van Veen grab, but most samples were taken with a meiobenthic dredge designed to collect the surface few centimeters of sediment. Insofar as possible, each sample taken by the dredge consisted of about 10 liters, which probably represents a 4 m^2 minimum sample-surface area, assuming that the 25 cm wide dredge blade removed only the upper centimeter of sediment. Though by no means a quantitative procedure, samples taken in this manner probably provide a reasonable approximation of the relative abundance of kinorhynchs and their species diversity at a given station.

Samples of sediment were taken so as to effect a transect along the long axes of Disko Fjord, a relatively protected area between a glacier at its eastern limits and a moraine barrier at its seaward limits, and another in Disko Bay, from Skansen near the southeastern coast of Disko Island to the open sea off the southwestern coast. The eastern limits of both transects were under the greatest influence of meltwater from extensive

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glaciers; the western limits were the least influenced.

Wherever possible, stations were established within areas locally known as "shrimp fields": areas of high benthic productivity characterized by well-oxygenated, stable, brown, diatom-enriched, muddy sediment. Other stations, such as those near Skansen, the Bay of Iterla (RH 1536) and Igpik (RH 1537), were established to include areas of muddy sand and well-sorted sand habitats similar to those sampled in previous studies (Kristensen and Nørrevang, 1982).

Specimens mentioned in this paper are deposited either in the National Museum of Natural History, Smithsonian Institution, under the catalog numbers of the former United States National Museum (USNM), or in the Zoological Museum of Copenhagen, Denmark under the senior author's reference numbers (RH).

MEASUREMENTS AND ABBREVIATIONS.—Laboratory procedures followed the protocol described by Higgins (1983:4–7). Measurements are given in micrometers (μm); ratios (e.g., SW/TL) are expressed in percent of the total length measured on the midline, from the anterior margin of segment 3 (first trunk segment) to the posterior margin of segment 13, exclusive of spines. Maximum sternal width is measured at the anteroventral margin of the widest pair of sternal plates as first encountered in measuring each segment from anterior to posterior. Standard width (or sternal width at segment 12) is measured at the anteroventral margin of the 12th sternal plates. All spines (except terminal ones) are numbered by segment. In this publication two sets of abbreviations are used.

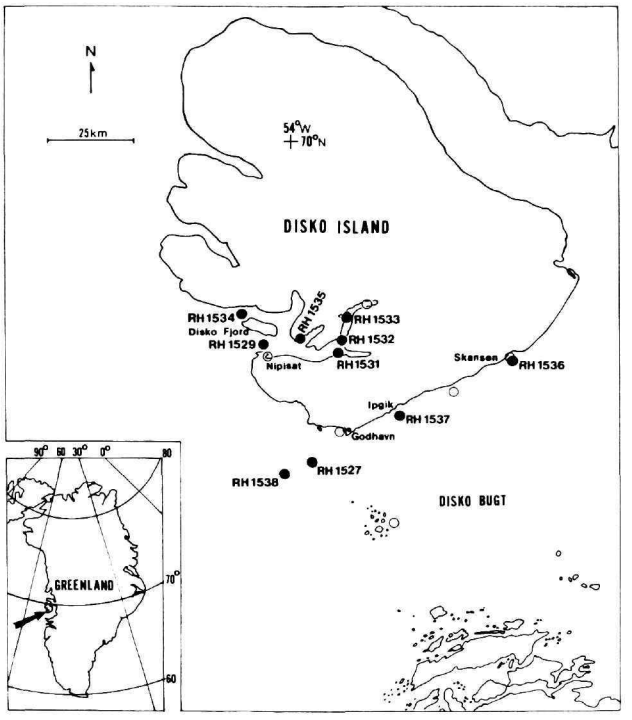
Abbreviations used in the text and tables are as follows:

D	middorsal spine
Dm	mean length of middorsal spines
L	lateral spine
L-(n)*	lateral spine modified as an adhesive tube
LA	lateral accessory spine
LD	laterodorsal spine
Lm	mean length of lateral spines
LTAS	lateral terminal accessory spine
LTS	lateral terminal spine
MSW	maximum sternal width
MTS	midterminal spine
P	penile spine
SD	subdorsal spine
SL	segment length
SW	standard width
TL	trunk length

Abbreviations used on the illustrations are as follows:

AS	lateral terminal accessory spine
AT	adhesive tube
CS	cuticular scar
D	dorsal
DS	middorsal spine
GP	gonopore
LD	lateral duct
LS	lateral spine
MP	micropapilla
MS	muscle scar
MT	midventral thickening
MX	middorsal papilla
MY	developing middorsal (spinose) process
MZ	middorsal (spinose) process
OP	oval patch
PA	pachycyclus
PE	penile spines 1–3
PF	pectinate fringe
PH	penile hairs
PL	placids
PO	pore
PS	perforation sites
S	segments 1–13
SE	seta
SP	sensory papilla
SS	sensory spot (flosculus)
TP	trichoscalid plate
TS	lateral terminal spine
V	ventral

LOCALITIES.—Ten sampling sites (Map 1) along the south and southwest coasts of Disko Island provided the material for this study. All collections were made by R.P. Higgins and



MAP 1.—Study sites, Disko Island, Greenland, showing the location of the 15 sampling stations (open circles indicate unnumbered stations where no kinorhynchs were found; solid circles with numbers indicate stations where kinorhynchs were found; area of larger map located on inset by arrow).

R.M. Kristensen. The locality data for material examined are referred to by the senior author's reference numbers (RH); these and collection data follow.

RH 1527 28 Aug 1981; from mud, 200-250 m depth, about 2 km northeast of Yderst Parry Skaer, Disko Bay, West Greenland (69°08.6′N, 53°50.0′W); Van Veen grab.

RH 1529 3 Sep 1981; from sandy mud, 200 m depth, 4 km northeast of Nipissat Loran Station, Disko Fjord, Disko Island, West Greenland (69°27.8′N, 54°9.0′W); meiobenthic dredge and Van Veen grab.

RH 1531 4 Sep 1981; from sandy mud, 6.5 m depth, Qivitut Bay, Disko Fjord, Disko Island, West Greenland (69°27.0′N, 53°35.7′W); Van Veen grab.

RH 1532 4 Sep 1981; from sandy mud, 140 m depth, 3 km west of Akuliaruseq, Disko Fjord, Disko Island, West Greenland (69°28.1′N, 53°35.7′W); meiobenthic dredge.

RH 1533 4 Sep 1981; from brown mud, 120 m depth; 1 km east of Qarusuit, Kuanerssuit Suvdluat, Disko Fjord, Disko Island, West Greenland (69°32.5′N, 53°33.0′W); meiobenthic dredge.

RH 1534 4 Sep 1981; from brown mud, 200 m depth; between Kuanit and Qeqertaq Alangua, Disko Fjord, Disko Island, West Greenland (69°33.2′N, 54°17.0′W); meiobenthic dredge.

RH 1535 4 Sep 1981; from brown mud with rocks and pebbles covered with the calcium carbonate encrusting algae *Lithothamnium corallina*, 9 m depth; anchorage at Diskofjord (settlement), Disko Fjord, Disko Island, West Greenland (69°29.1′N, 53°57.0′W); Van Veen grab.

RH 1536 12 Sep 1981; from brown mud, 100 m depth, about 3 km east of Skansen, Disko Island, West Greenland (69°26.5′N, 52°32.0′W); meiobenthic dredge.

RH 1537 12 Sep 1981; from brown mud, 225 m depth, Igpik, about 14 km northeast of Godhavn, Disko Island, West Greenland (69°17.7′N, 53°13.0′W); meiobenthic dredge.

RH 1538 15 Sep 1981; from sandy mud, 300 m depth, about 8 km west-southwest of Yderste Parry Skaer, Disko Bay, West Greenland (69°07.2′N, 54°04.0′W); meiobenthic dredge.

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Order CYCLORHAGIDA Zelinka, 1896

Family ECHINODERIDAE Bütschli, 1876

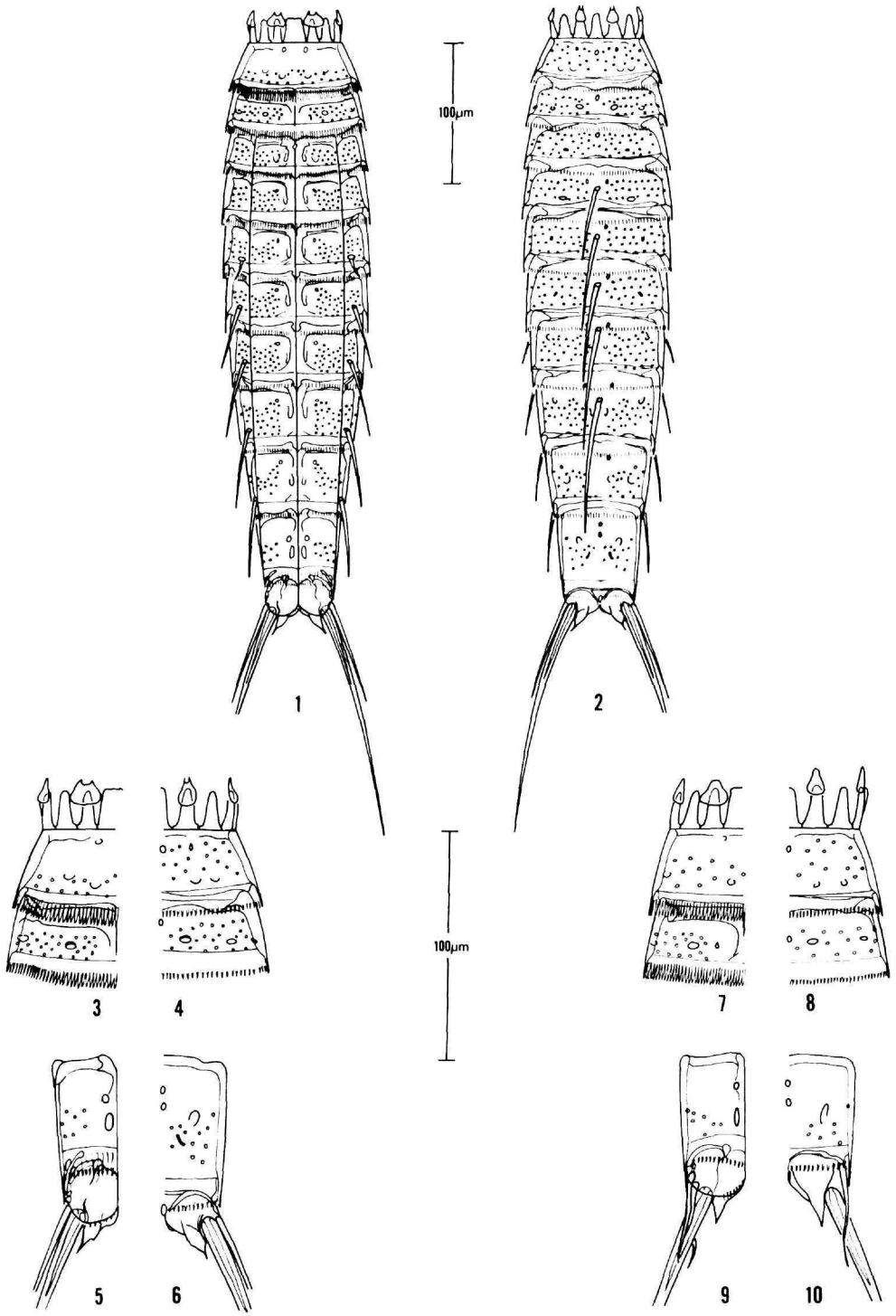
Genus *Echinoderes* Claparède, 1863

Key to Adults of *Echinoderes*

1. Middorsal spines present 2
   Middorsal spines absent 37
2. Middorsal spines on segments 6–10 3
   Middorsal spines absent on one or more segments 6–10 26
3. Lateral spines on segment 7 4
   Lateral spines absent on segment 7 43
4. Lateral spines on segment 6 . . . . . ***E. agigens*** Băcescu, 1968
   Lateral spines absent on segment 6 5
5. Lateral accessory spines dorsally adjacent to lateral spine on segment 10 6
   Lateral accessory spines absent on segment 10 7
6. Middorsal spines very short, 6–13 μm, Dm/TL 2.5–3.0 percent; sensory spots anterior to prominent ventral muscle scars on segment 12 . ***E. gerardi*** Higgins, 1978
   Middorsal spines slightly longer, 15–20 μm; Dm/TL 4.0–5.6 percent; sensory spots lateral to prominent ventral muscle scars on segment 12 . . . . . ***E. dujardinii*** Claparède, 1863
7. Lateral spines (adhesive tubes) on segment 4 8
   Lateral spines (adhesive tubes) absent on segment 4 18

8. Lateral spines (or setae if male) on segment 12 9
   Lateral spines (or setae if male) absent on segment 12 . . . . . *E. brevicaudatus* Higgins, 1977a
9. Terminal ventral plates rounded, extending beyond tergal furcae; most ventral plates with single row of perforation sites (hair origins) . . . . . *E. krishnaswamyi* Higgins, 1985
   Terminal ventral plates not rounded, not extending beyond tergal furcae; ventral plates with more than single row of perforation sites (hair origins) 10
10. Ventral midline of segment 4 strongly cuticularized; terminal tergal plate divided at midline . . . . . *E. nybakkeni* Higgins, 1986
    Ventral midline of segment 4 not strongly cuticularized; terminal tergal plate not divided at midline 11
11. Middorsal spine on segment 10 twice length of that on segment 9 12
    Middorsal spine on segment 10 equal to or only slightly longer than that on segment 9 13
12. MSW/TL about 29 percent; setae present near lateral spines on segment 12 of male . . . . . *E. ferrugineus* Zelinka, 1928
    MSW/TL about 22 percent; setae not present near lateral spines on segment 12 of male . . . . . *E. worthingi* Southern, 1914
13. Lateral terminal spines with serrulate lateral margins . . . . *E. pilosus* Lang, 1949
    Lateral terminal spines without serrulate lateral margins 14
14. LTS/TL greater than 41 percent; setae absent near lateral spines on segment 12 . 15
    LTS/TL less than 37 percent; setae near lateral spines on segment 12 . . . . . *E. pacificus* Schmidt, 1974
15. Terminal ventral plates truncate, slightly fringed; perforation sites absent . . . . . *E. imperforatus* Higgins, 1983
    Terminal ventral plates caudate; perforation sites present 16
16. Mesial half of terminal ventral pachycycli strongly diverging posteriorly, meeting at midline forming broad median notich; tergal furcae with interrupted mesial margins . . . . . *E. ehlersi* Zelinka 1913
    Mesial half of terminal ventral pachycycli with only slight posterior divergence, not forming broad median notch; tergal furcae evenly tapered, pointed 17
17. LTS/TL greater than 55 percent (SW/TL 17.5–20.0 percent) . . . . . *E. sublicarum* Higgins, 1977b
    LTS/TL less than 55 percent (SW/TL 19–28 percent) . . *E. kozloffi* Higgins, 1977a
18. Lateral spines or setae on segment 12 19
    Lateral spines or setae absent on segment 12 20
19. Round pore or cuticular scar replacing lateral spine on segment 4; female and male with short lateral spine on segment 12 . . . . . *E. bookhouti* Higgins, 1964b
    Round pore or cuticular scar not at site of missing lateral spine on segment 4; female with short lateral spine, male with seta appendages on segment 12 . . . . . *E. truncatus* Higgins, 1983
20. Lateral spines on segments 7–11 21
    Lateral spines on segments 7, 10, and 11 only 25
21. Round pore or cuticular scar replacing lateral spine on segment 4 22
    Round pore or cuticular scar not at site of missing lateral spine on segment 4 . . . . . *E. remanei* (Blake, 1930)
22. Pectinate fringe on ventral plates of segment 3 uniform in length 23
    Pectinate fringe on ventral plates of segment 3 shorter on either side of midline . . . . . *E. tubilak,* new species
23. LTS/TL generally less than 30 percent (especially in females) . . . . . *E. aquilonius,* new species
    LTS/TL generally more than 30 percent 24

24. Combined length of ventral plates of segments 12 and 13 more than sternal width of segment 12 . . . . . ***E. pennaki*** Higgins, 1960
Combined length of ventral plates of segments 12 and 13 less than sternal width of segment 12 . . . . . ***E. angustus,*** new species
25. Lateral spines on segment 10 dorsally displaced, not in line with other lateral spines . . . . . ***E. tchefouensis*** Lou, 1934
Lateral spines on segment 10 not dorsally displaced, in line with other lateral spines . . . . . ***E. eximus,*** new species
26. Middorsal spines on 2 segments only 27
Middorsal spines on 3 or 4 segments 28
27. Middorsal spines on segments 6 and 8 only . . . . . ***E. bispinosus*** Higgins, 1982
Middorsal spines on segments 6 and 9 only . . . . . ***E. citrinus*** Zelinka, 1928
28. Middorsal spines on 4 segments (6–9) only . . . . . ***E. setiger*** Zelinka, 1928
Middorsal spines on 3 segments only 29
29. Middorsal spines on segments 6, 8, and 10 only 30
Middorsal spines on segments 6, 7, and 10 only . . . . . ***E. druxi*** d'Hondt, 1973
30. Lateral spines on segment 7 31
Lateral spines absent on segment 7 . . . . . ***E. arlis*** Higgins, 1966b
31. Lateral terminal spines shorter than segment 12 . . . ***E. abbreviatus*** Higgins, 1983
Lateral terminal spines longer than segment 12 32
32. Lateral accessory spines dorsally adjacent to lateral spine on segment 10 33
Lateral accessory spines absent on segment 10 . . . ***E. bermudensis*** Higgins, 1982
33. Subdorsal spines on segment 4 34
Subdorsal spines absent on segment 4 35
34. Lateral accessory spines on segments 8–10 . . . ***E. newcaldoniensis*** Higgins, 1967
Lateral accessory spines on segment 10 only . . . . . ***E. peterseni,*** new species
35. Subdorsal muscle scars on segment 4 36
Subdorsal muscle scars absent on segment 4 . . . . . ***E. riedli*** Higgins, 1966a
36. Middorsal spine on segment 10 extending beyond margin of segment 12 (lateral terminal spines long and flexible, 62 percent of trunk length) . . . . . ***E. kristenseni*** Higgins, 1985
Middorsal spine on segment 10 not extending beyond margin of segment 12 (lateral terminal spines long, slightly flexible, 42–62 percent of trunk length) . . . . . ***E. wallaceae*** Higgins, 1983
37. Lateral spines (adhesive tubes) on segment 4; females with lateral terminal accessory spines 38
Lateral spines (adhesive tubes) absent on segment 4; females without lateral terminal accessory spines 39
38. Lateral accessory spine on segment 10 . . . . . ***E. horni*** Higgins, 1983
Lateral accessory spine absent on segment 10 . ***E. andamensis*** Higgins and Rao, 1979
39. Lateral spines on segment 11 . . . . . ***E. caribiensis*** Kirsteuer, 1964
Lateral spines absent on segment 11 or replaced by minute seta 40
40. Lateral terminal spines long, more than 50 percent of trunk length . . . . . ***E. maxwelli*** Omer-Cooper, 1957
Lateral terminal spines short, less than 30 percent of trunk length 41
41. Lateral spines on segments 7 and 10 distinct, at least 30 μm long . . . . . ***E. bengalensis*** (Timm, 1958)
Lateral spines on segments 7 and 10 absent or present as minute setae 42
42. Anterior trunk segments swollen . . . . . ***E. capitatus*** (Zelinka, 1928)
Anterior trunk segments not swollen . . . . . ***E. coulli*** Higgins, 1977
43. Lateral terminal spines nearly equal to trunk length . . ***E. levanderi*** Karling, 1954
Lateral terminal spines nearly equal to half the trunk length . . . . . ***E. elongatus*** (Nyholm, 1947)



FIGURES 1–10.—*Echinoderes angustus*, new species. Holotypic female (USNM 233200): 1, 2, neck and trunk segments, ventral and dorsal views; 3, 4, segments 2–4, lateral half, ventral and dorsal views; 5, 6, segments 12–13, lateral half, ventral and dorsal views. Allotypic male (USNM 233201): 7, 8, segments 2–4, lateral half, ventral and dorsal views; 9, 10, segments 12–13, lateral half, ventral and dorsal views.

Echinoderes angustus, new species

FIGURES 1–16

DIAGNOSIS.—Middorsal spines on segments 6–10 increasing uniformly in length posteriorly; lateral spines on segments 7–11, round to oval cuticular scars (pores?) in L-4 (adhesive tube) and SD-4 spine positions; lateral terminal spines moderately long, 140–198 μm, 29.4–54.6 percent of trunk length; nearly complete midventral cuticularization present on segment 4; pectinate fringe on posteroventral margin of segment 3 fine, uniform in size; perforation sites on ventral surface of segment 3 in 2 poorly defined rows, adjacent to posterior margin; turgal furcae long, curving away from midline.

DESCRIPTION.—Adults (Figures 1–16) trunk length 320–475 μm; MSW-8 (*maximum sternal width of segment 8*), 62–77 μm, 15.1–21.2 percent of trunk length; SW (*standard width*) at segment 12, 48–60 μm, 12.2–21.2 percent of trunk length.

Segment 2 consisting of 16 placids, 16–20 μm long, $\bar{x}$ 22 (*mean of 22 measurements*) = 18.7±1.1 μm); midventral placid truncate, wider (~16 μm) than others (~8 μm); ventral trichoscalid plates (of head segment) overlapping alternate placids, broadly expanded at posterior margins; dorsal trichoscalid plates uniformly narrow (Figures 3, 4, 7, 8).

Segment 3, 33–44 μm long, $\bar{x}$ 22 = 38.4±2.6 μm; middorsal cuticular scar near anterior margin, subdorsal cuticular scars slightly anterior to middorsal cuticular scar; ventral surface with small crescentic muscle scars on both sides of ventral midline, additional crescentic muscle scars more laterally; perforation sites (hair origins) widely scattered over dorsal surface, ventral perforation sites in two rows near posterior margin; pectinate fringe fine, uniform in width (~1 μm wide) and length (~10 μm), along posterior margins of both dorsal and ventral surfaces.

Segment 4, 32–40 μm long, $\bar{x}$ 22 = 35.6±2.5 μm; middorsal cuticular scar near anterior margin, subdorsal cuticular scars on both sides, slightly posterior middorsal cuticular scar, smaller cuticular scars lateral to subdorsal scars; round to oval cuticular scars (pores?) at presumptive site of missing lateral spines (adhesive tubes), slightly mesial to projected tergosternal articulation zone of adjacent posterior segment; additional cuticular scars more laterally situated; perforation sites in 3 rows on both dorsal and ventral surfaces; pectinate fringe as in segment 3, but slightly less prominent; pachycyclus well developed, cuticularization extending along ventral midline, partially divided along ventral midline.

Segment 5, 34–42 μm long, $\bar{x}$ 22 = 38.9±2.2 μm; middorsal cuticular scar less prominent than that on segment 4, subdorsal cuticular scars also less prominent and lying slightly more posterolaterally; crescentic muscle scars lateral to mesial cuticularization of ventral plates; perforation sites in 4 poorly defined rows on dorsal surface, in better defined 3-row pattern on ventral plates; pectinate fringe as in segment 4.

Segment 6, 35–50 μm long, $\bar{x}$ 22 = 42.3±3.2 μm; middorsal spine 38–58 μm long, $\bar{x}$ 21 = 48.6±5.7 μm; subdorsal cuticular scars on each side of dorsal midline, slightly anterior to middorsal spine; larger, more prominent, slightly oval scars posterolateral to middorsal spine; small cuticular scars lateral to mesial cuticularization of ventral plates, near anterior margins; perforation sites in 3 poorly defined rows dorsally, in 3 or 4 rows ventrally; pectinate fringe as in segments 4 and 5.

Segment 7, 37–52 μm long, $\bar{x}$ 22 = 45.3±3.9 μm; middorsal spine 42–72 μm long, $\bar{x}$ 22 = 60.5±8.3 μm; lateral spines, possibly adhesive tubes, 8–24 μm long, $\bar{x}$ 15 = 16.1±4.3 μm, near lateroventral margins of tergal plate; small subdorsal cuticular scars anterior to middorsal spine as in segment 6, but more prominent; posterolateral cuticular scars absent; small muscle(?) scars near lateral limits, ventral scars as in segment 6; perforation sites on dorsal surface in 4 rows, in less-defined rows on ventral plates but with slightly V-shaped pattern (Figure 1); pectinate fringe as in segment 6.

Segment 8, 40–58 μm long, $\bar{x}$ 22 = 49.2±3.7 μm; MSW 62–77 μm, $\bar{x}$ 22 = 68.1±3.2 μm; MSW/TL 15.1–21.2 percent, $\bar{x}$ 22 = 18.2±1.5 percent; middorsal spine 56–89 μm long, $\bar{x}$ 21 = 71.3 +–8.8 μm; lateral spines 40–50 μm long, $\bar{x}$ 21 = 44.4±3.7 μm; perforation sites in 4 rows on ventral plates, pattern similar to that in segment 7; all other characters similar to those in segment 7.

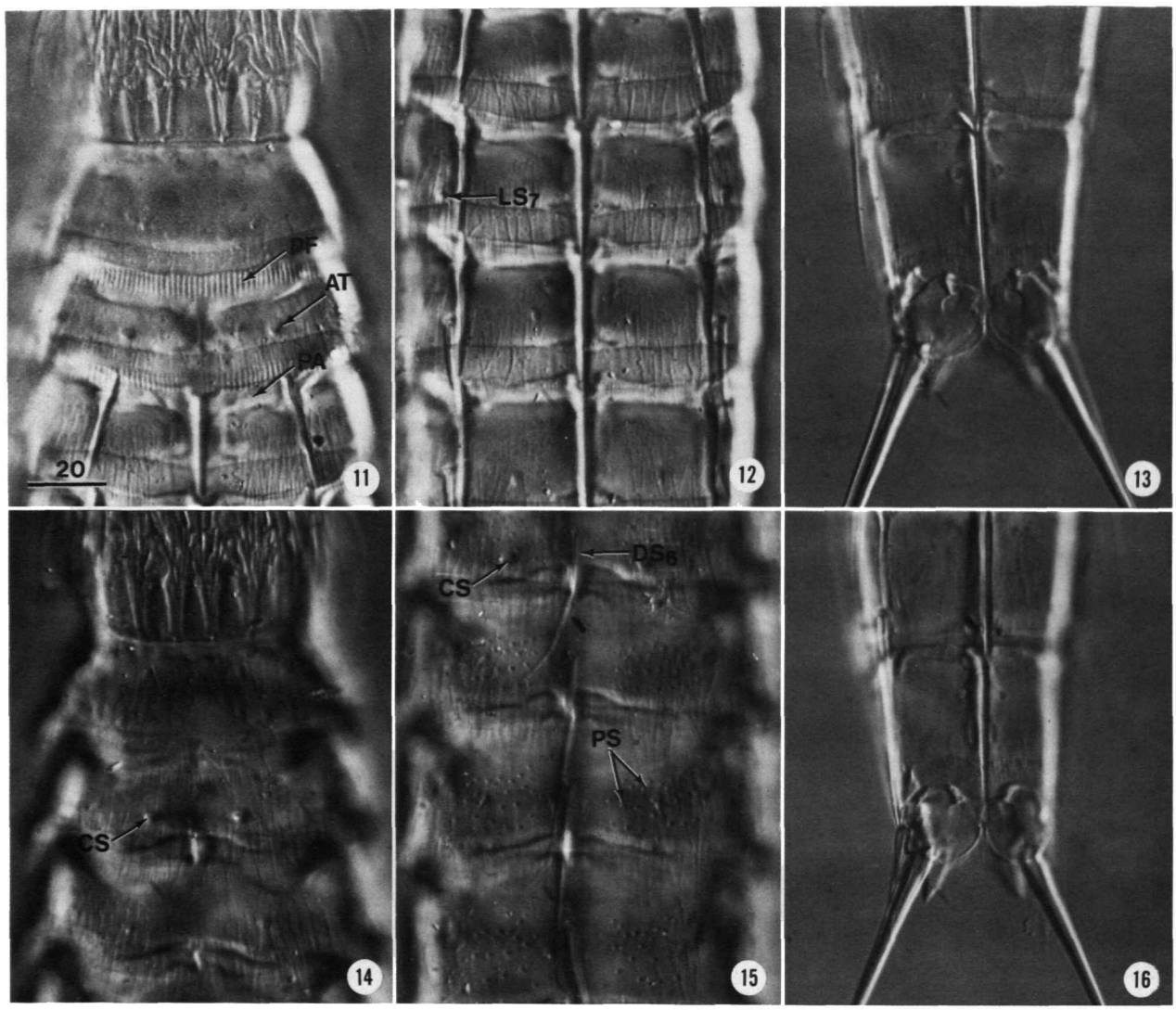
Segment 9, 48–64 μm long, $\bar{x}$ 22 = 50.6±5.6 μm; middorsal spine 62–94 μm long, $\bar{x}$ 20 = 79.7±8.3 μm; lateral spines 41–60 μm long, $\bar{x}$ 20 = 49.6±4.2 μm; dorsolateral muscle scars larger than on segment 8; perforation sites in 5 rows; all other characters similar to those in segment 8.

Segment 10, 50–70 μm long, $\bar{x}$ 22 = 55.6±4.1 μm; middorsal spine 74–106 μm, $\bar{x}$ 22 = 89.3±8.7 μm; lateral spines, 44–60 μm long, $\bar{x}$ 21 = 52.5±4.7 μm; subdorsal muscle scars(?) near midline, posterior to middorsal spine; all other characters similar to those in segment 9.

Segment 11, 50–60 μm long, $\bar{x}$ 22 = 54.7±2.4 μm; middorsal spine absent; lateral spines 36–56 μm long, $\bar{x}$ 22 = 46.4±6.2 μm; dorsolateral muscle scars more prominent than in segment 10; perforation sites less numerous, 3 or 4 poorly defined rows on dorsal surface, 2 or 3 rows on ventral plates; all other characters similar to those on segment 10.

Segment 12, 44–58 μm long, $\bar{x}$ 22 = 50.5±3.7 μm; SW 48–60 μm, $\bar{x}$ 22 = 53.3±3.0 μm; SW/TL 12.2–21.2 percent, $\bar{x}$ 22 = 14.3 ±1.5 percent; lateral spines absent; 2 middorsal cuticular scars near anterior margin, prominent dorsolateral muscle scars slightly posterior to level of posteriormost middorsal cuticular scar; additional smaller muscle scars more posteromesial to larger muscle scars (Figure 6); small cuticular scars near anteromesial margin of ventral plates; more prominent, longitudinally oval muscle scars slightly posterior to smaller cuticular scars; perforation sites fewer and not in well-defined rows on dorsal or ventral plates; pectinate fringe barely visible.

Segment 13, 24–34 μm long, $\bar{x}$ 22 = 28.6±2.5 μm; tergal furcae lanceolate to weakly cuspidate with mesial margin slightly interrupted (Figures 5, 6, 9, 10); ventral plates with rounded posterior margins slightly fringed; lateral terminal



FIGURES 11–16.—*Echinoderes angustus*, new species. Holotypic female (USNM 233200): 11, segments 2–5, ventral view; 12, segments 6–9, ventral view; 13, segments 12–13, ventral view; 14, segments 2–5, dorsal view; 15, segments 6–9, dorsal view. Allotypic male (USNM 233201): 16, segments 12–13 ventral view. (Interference-contrast photographs all with same scale (in μm) as shown in Figure 11.)

spines 140–198 μm long, $\bar{x}$ 22 = 172.7±15.3 μm; LTS/TL 29.4–54.6 percent, $\bar{x}$ 22 = 46.4±6.5 percent; lateral terminal accessory spines of females 48–88 μm long, $\bar{x}$ 10 = 71.0±10.5 μm; LTAS/TL 13.7–21.7 percent, $\bar{x}$ 9 = 19.8±2.4 percent; LTAS/LTS 26.9–53.3 percent, $\bar{x}$ 6 = 40.3±8.6 percent; penile spines of male: P-1 30–41 μm long, $\bar{x}$ 10 = 37.0±3.3 μm; P-2 20–22 μm long, $\bar{x}$ 7 = 20.6±1.5 um; P-3 30–36 μm long, $\bar{x}$ 9 = 33.0±2.1 μm.

In addition to the lack of lateral accessory spines and the presence of 3 pairs of penile spines, males differ from females in having a slightly longer trunk length, slightly longer middorsal spines, and slightly shorter lateral spines.

Morphometric data for adult specimens are shown in Table 1.

HOLOTYPE.—Adult female, TL 410 μm (Figures 1–6, 11–15), Disko Island, sta RH 1535 (see 'Localities'), USNM 233200.

ALLOTYPE.—Adult male, TL 375 μm (Figures 7–10,16), other data as for holotype, USNM 233201.

PARATYPES.—Two females and 3 males, TL 355–415 μm, other data as for holotype, USNM 233202; 2 females, TL 355–370 μm, Disko Island, sta RH 1527, USNM 233203; 3 females and 4 males, TL 320–400 μm, Disko Island, sta RH 1531, USNM 233204; 1 male, TL 475 μm, Disko Island, sta

TABLE 1.—Measurements (μm) and indices (%) for *Echinoderes angustus* adults (see text for explanation of abbreviations).

Character	Sex	Sample size	Range	Mean	Standard deviation	Standard error	Coefficient of variability
TL	m	11	325–475	381.8	41.5	12.5	10.9
	f	11	320–415	369.6	31.3	9.4	8.5
	mf	22	320–475	375.7	36.4	7.8	9.7
SW	m	11	48–58	52.6	2.6	0.8	5.0
	f	11	48–60	54.0	3.2	1.0	6.0
	mf	22	48–60	53.3	3.0	0.6	5.5
SW/TL	m	11	12.2–16.0	13.8	1.3	0.4	9.3
	f	11	12.5–21.2	14.7	1.7	0.5	11.4
	mf	22	12.2–21.2	14.3	1.5	0.3	10.5
MSW-8	m	11	62–77	67.6	4.2	1.3	6.3
	f	11	66–70	68.6	1.6	0.5	2.3
	mf	22	62–77	68.1	3.2	0.7	4.6
MSW/TL	m	11	15.1–20.0	17.8	1.4	0.4	7.8
	f	11	16.2–21.2	18.6	1.6	0.5	8.8
	mf	22	15.1–21.2	18.2	1.5	0.3	8.5
Dm	m	10	56.8–83.6	67.7	8.5	2.7	12.6
	f	9	62.4–76.8	71.9	4.0	1.3	5.6
	mf	19	56.8–83.6	69.7	6.9	1.6	10.0
Dm/TL	m	10	14.6–20.0	17.7	2.0	0.6	11.2
	f	9	16.0–22.2	19.3	2.1	0.7	10.9
	mf	19	14.6–22.2	18.2	1.8	0.4	10.0
D-6	m	11	38–58	48.2	6.7	2.0	14.0
	f	10	38–52	49.1	4.7	1.5	9.5
	mf	21	38–58	48.6	5.7	1.3	11.8
D-7	m	11	42–71	57.2	9.2	2.8	16.1
	f	11	50–72	63.7	6.0	1.8	9.4
	mf	22	42–72	60.5	8.3	1.8	13.7
D-8	m	11	56–89	69.1	10.1	3.0	14.6
	f	10	60–82	73.7	6.9	2.2	9.4
	mf	21	56–89	71.3	8.8	1.9	12.4
D-9	m	10	62–94	76.7	10.6	3.4	13.9
	f	10	78–90	82.6	3.8	1.2	4.6
	mf	20	62–94	79.7	8.3	1.9	10.5
D-10	m	11	74–106	85.9	9.9	3.0	11.5
	f	11	80–100	92.6	6.0	1.8	6.5
	mf	22	74–106	89.3	8.7	1.9	9.7
Lm	m	9	36.6–48.5	41.3	3.4	1.1	8.1
	f	5	43.6–46.0	45.0	1.1	0.5	2.5
	mf	14	36.6–48.5	42.7	3.2	0.9	7.5
Lm/TL	m	9	8.6–12.6	10.8	1.4	0.5	13.2
	f	5	10.6–11.9	11.6	0.9	0.4	7.9
	mf	14	8.6–12.6	11.1	1.3	0.3	11.6
L-7	m	9	8–24	16.6	5.1	1.7	30.9
	f	6	10–18	15.3	2.7	1.1	17.8
	mf	15	8–24	16.1	4.3	1.1	26.5

TABLE 1.—Continued.

Character	Sex	Sample size	Range	Mean	Standard deviation	Standard error	Coefficient of variability
L-8	m	11	40–46	41.8	1.7	0.5	4.1
	f	10	44–50	46.9	3.3	1.1	7.1
	mf	21	40–50	44.4	3.7	0.8	8.4
L-9	m	10	41–52	46.7	3.5	1.1	7.6
	f	10	50–60	52.6	2.1	0.7	4.0
	mf	20	41–60	49.6	4.2	0.9	8.4
L-10	m	11	44–56	49.6	3.8	1.1	7.6
	f	10	56–60	55.7	3.4	1.1	6.1
	mf	21	44–60	52.5	4.7	1.0	9.0
L-11	m	11	36–44	41.0	2.5	0.8	6.2
	f	11	46–56	51.8	3.0	0.9	5.8
	mf	22	36–56	46.4	6.2	1.3	13.3
LTS	m	11	140–198	173.5	18.8	5.7	10.8
	f	11	140–180	172.0	11.6	3.5	6.8
	mf	22	140–198	172.7	15.3	3.3	8.8
LTS/TL	m	11	29.4–53.6	46.1	7.9	2.4	17.1
	f	11	39.4–54.6	46.8	5.1	1.5	11.0
	mf	22	29.4–54.6	46.4	6.5	1.4	14.0
LTAS	f	10	48–88	71.0	10.5	3.3	14.7
LTAS/TL	f	9	13.7–21.7	19.8	2.4	0.8	12.0
LTAS/LTS	f	6	26.9–53.3	40.3	8.6	3.5	21.4
P-1	m	10	30–41	37.0	3.3	1.1	9.0
P-2	m	7	20–22	20.6	1.5	0.6	7.4
P-3	m	9	30–36	33.0	2.1	0.7	6.4
SL-2	m	11	18–20	19.0	0.9	0.3	4.7
	f	11	16–20	18.6	1.3	0.4	7.0
	mf	22	16–20	18.7	1.1	0.2	6.0
SL-3	m	11	36–44	39.1	2.4	0.7	6.2
	f	11	33–40	37.7	2.6	0.8	6.9
	mf	22	33–44	38.4	2.6	0.6	6.6
SL-4	m	11	32–40	36.5	2.6	0.8	7.1
	f	11	32–40	34.7	2.2	0.7	6.5
	mf	22	32–40	35.6	2.5	0.5	7.1
SL-5	m	11	34–42	38.6	2.2	0.7	5.7
	f	11	36–42	39.1	2.3	0.7	5.9
	mf	22	34–42	38.9	2.2	0.5	5.7
SL-6	m	11	35–46	42.1	3.0	0.9	7.1
	f	11	38–50	42.6	3.5	1.0	8.1
	mf	22	35–50	42.3	3.2	0.7	7.5
SL-7	m	11	37–52	45.2	4.0	1.2	8.9
	f	11	41–52	45.4	3.9	1.2	8.6
	mf	22	37–52	45.3	3.9	0.8	8.5

TABLE 1.—Continued.

Character	Sex	Sample size	Range	Mean	Standard deviation	Standard error	Coefficient of variability
SL-8	m	11	40–58	49.0	4.4	1.3	8.9
	f	11	45–54	49.4	3.0	0.9	6.1
	mf	22	40–58	49.2	3.7	0.8	7.4
SL-9	m	11	48–64	53.0	4.3	1.3	8.1
	f	11	48–56	51.9	2.2	0.7	4.3
	mf	22	48–64	50.6	5.6	1.2	11.1
SL-10	m	11	50–70	56.4	5.4	1.6	9.5
	f	11	52–60	54.9	2.4	0.7	4.4
	mf	22	50–70	55.6	4.1	0.9	7.4
SL-11	m	11	50–60	54.6	2.7	0.8	4.9
	f	11	52–58	54.9	2.1	0.6	3.8
	mf	22	50–60	54.7	2.4	0.5	4.3
SL-12	m	11	46–58	51.8	3.4	1.0	6.6
	f	11	44–54	49.1	3.5	1.1	7.1
	mf	22	44–58	50.5	3.7	0.8	7.2
SL-13	m	11	24–28	27.0	1.3	0.4	5.0
	f	11	26–34	30.3	2.3	0.7	7.6
	mf	22	24–34	28.6	2.5	0.5	8.7

RH 1533, USNM 233205; 1 male, TL 420 µm, Disko Island, sta 1536, USNM 233206; 1 female, TL 350 µm, Disko Island, sta 1537, USNM 233207; 1 female, TL 340 µm, Disko Island, sta 1538, USNM 233208. Other paratypes have been deposited in the Zoological Museum, Copenhagen.

REMARKS.—*Echinoderes angustus* is one of 6 species having middorsal spines on segments 6–10 and lateral spines on segments 7–11 (but lacking on 12) in members of both sexes. A seventh species, *Echinoderes truncatus*, will be included in the discussion of these species because, although the female also has lateral spines on segment 12, they are replaced by small setae in the male.

One of the species in this group, *E. brevicaudatus*, has lateral spines (adhesive tubes) on segment 4, but differs strikingly by having short lateral terminal spines and a different pectinate fringe pattern. In *E. brevicaudatus*, the pectinate fringe pattern on the ventral plates of segment 4 consists of wide elements that curve mesially until near the midline where their length is reduced by one-half; on segments 9 and 10, the pectinate fringe consists of wide elements near the lateral margin and others about one-third as long mesially. The variation in the width of the elements of pectinate fringe in *E. tubilak* is reminiscent of that on segment 4 of *E. brevicaudatus* in that there are distinctively narrower elements near the midline. However, in *E. tubilak* this occurs on segment 3 and the extent of the narrower fringe elements is much greater.

Echinoderes remanei and *E. truncatus* lack lateral spines (adhesive tubes) on segment 4 or any indication of a cuticular scar or pore in its place. *Echinoderes aquilonius* differs from *E. angustus* by its clearly shorter lateral terminal spines, broader segment 12, and differences in perforation site patterns on the ventral surface of segment 3.

Echinoderes pennaki has distinctly lanceolate tergal furcae in addition to a segment 12 that is about as broad as long (as contrasted with the much longer-than-broad segment 12 of *E. angustus*); other differences are to be found in such characters as trichoscalid plates, perforation sites, and cuticular scar patterns.

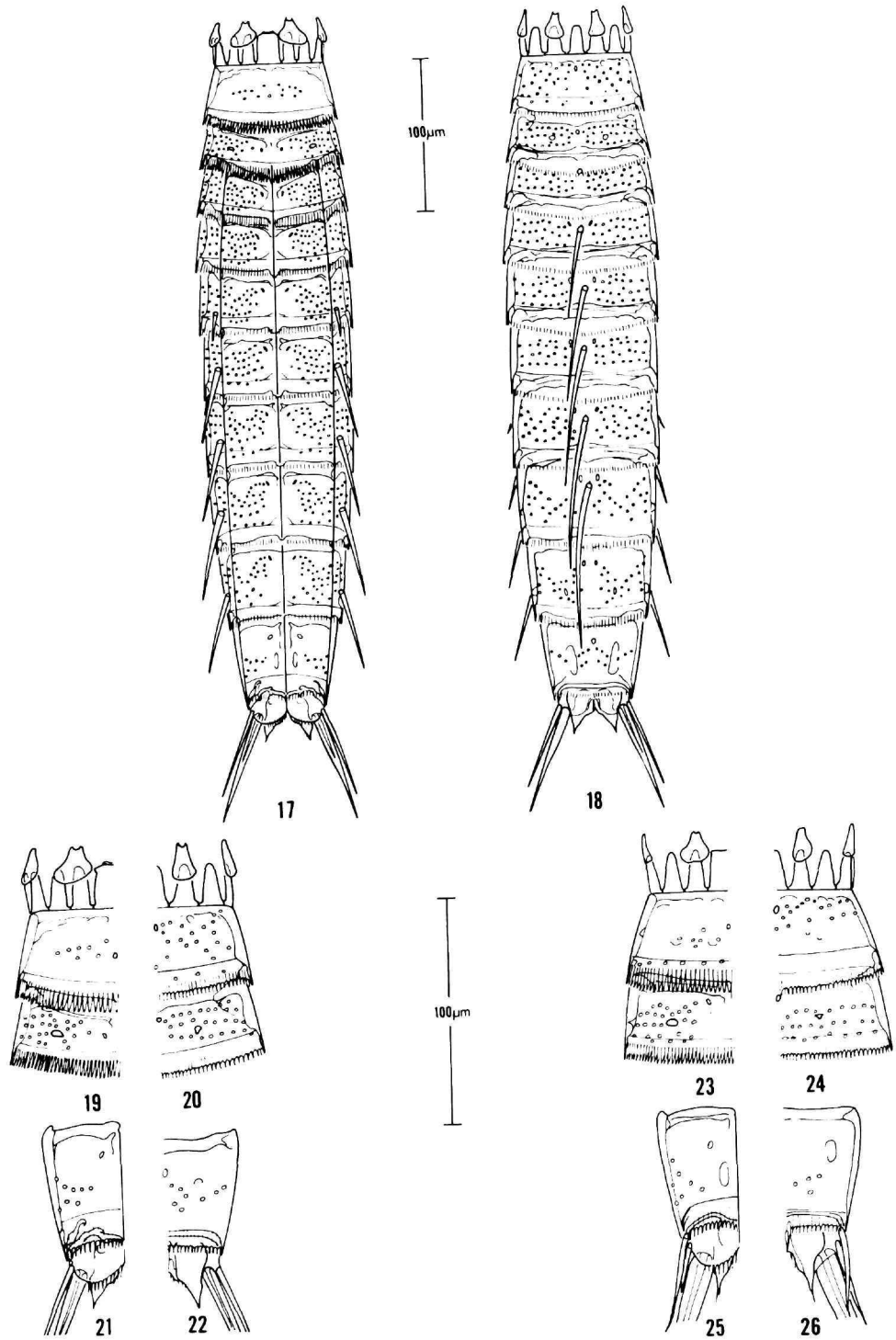
Echinoderes angustus differs from all other species in this genus in having an almost completely developed midventral suture on segment 4.

ETYMOLOGY.—The name of this species is from the Latin *angustus* (slender).

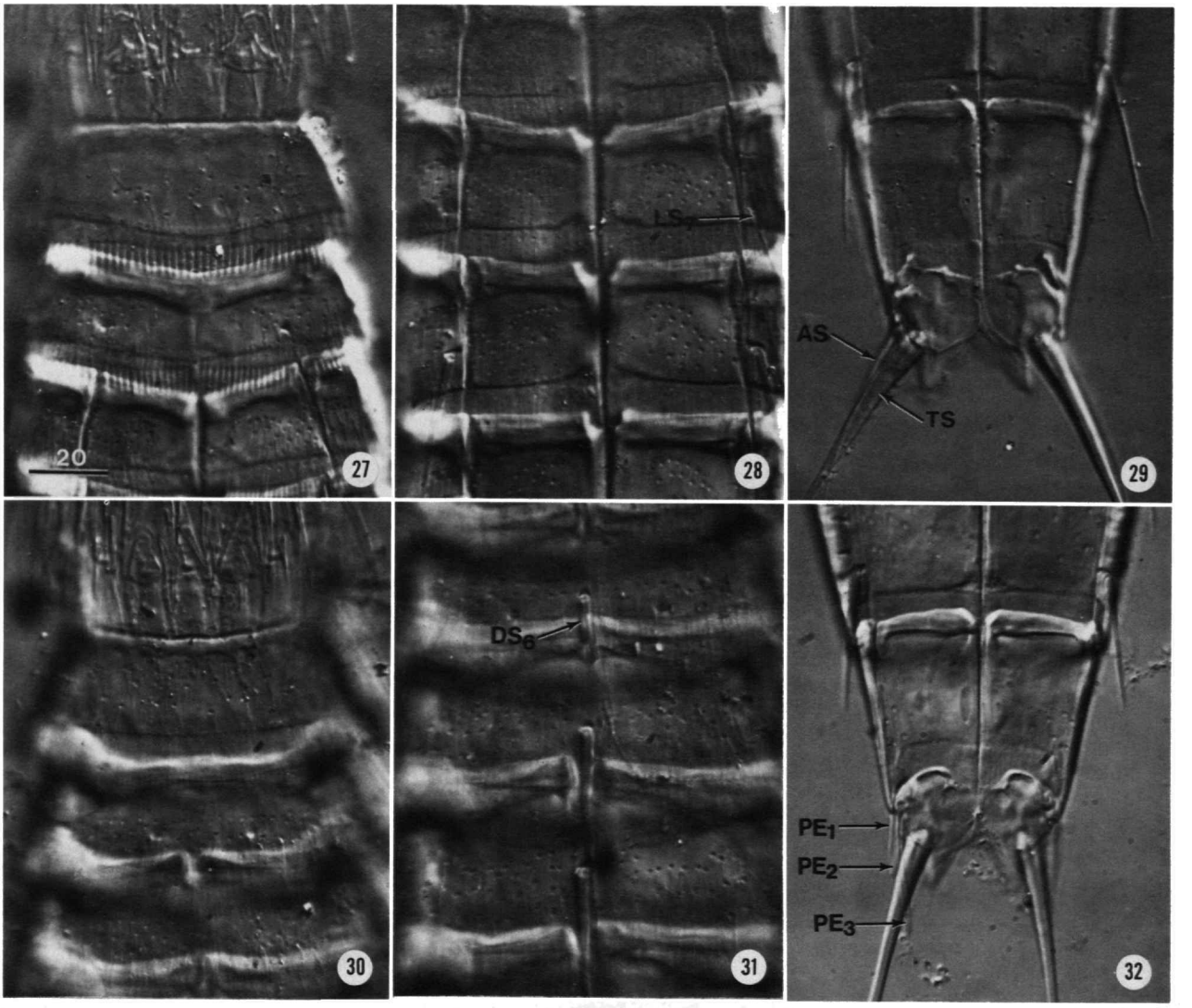
Echinoderes aquilonius, new species

FIGURES 17–32

DIAGNOSIS.—Middorsal spines on segments 6–10 increasing uniformly in length posteriorly; lateral spines on segments 7–11, round to oval cuticular scars (pores?) in L-4 (adhesive tube) and SD-4 spine positions; lateral terminal spines moderately long, 62–149 µm, 14.0–36.2 percent of trunk length; well-developed pectinate fringe on posteroventral margin of segment 3 uniform in size; perforation sites on ventral surface of segment 3 clustered in poorly defined transverse or longitudinal band on or near midline; tergal furcal long, straight.



FIGURES 17–26.—*Echinoderes aquilonius*, new species. Holotypic female (USNM 233209): 17, 18, neck and trunk segments, ventral and dorsal views; 19, 20, segments 2–4, lateral half, ventral and dorsal views; 21, 22, segments 12–13, lateral half, ventral and dorsal views. Allotypic male (USNM 233210): 23, 24, segments 2–4, lateral half, ventral and dorsal views; 25, 26, segments 12–13, lateral half, ventral and dorsal views.



FIGURES 27–32.—*Echinoderes aquilonius*, new species. Holotypic female (USNM 233209): 27, segments 2–5, ventral view; 28, segments 6–9, ventral view; 29, segments 12–13, ventral view; 30, segments 2–5, dorsal view; 31, segments 6–9, dorsal view. Allotypic male (USNM 233210): 32, segments 12–13, lateral half, ventral and dorsal views.

DESCRIPTION.—Adult (Figures 17–32) trunk length, 363–465 um; MSW-8, 63–82 µm, 14.2–21.4 percent of trunk length; SW 46–64 um, 12.1–16.8 percent of trunk length.

Segment 2 with 16 placids, ~15–20 µm long, $\bar{x}$ 39 = 18.4± 1.1 µm; midventral placid wider (~20 µm) than others (~12 µm); ventral trichoscalid plates of head segment, overlapping alternate placids, expanded at posterior margins; dorsal trichoscalid plates much narrower (Figures 19, 20, 23, 24).

Segment 3, 36–44 µm long, $\bar{x}$ 39 = 41.4±1.8 µm; middorsal cuticular scar near anterior margin; perforation sites distributed more or less evenly on dorsal surface, centrally clustered on ventral surface; only slight indication of pectinate fringe at posterodorsal margin, well developed, and uniform in size (~10 µm long, 2 µm wide) ventrally.

Segment 4, 36–44 µm long, $\bar{x}$ 39 = 40.2±1.6 µm; middorsal cuticular scar near anterior margin, subdorsal cuticular scars posterolaterall oval to round cuticular scars (pores?) ventrolaterally at presumptive sites of wanting lateral spines (adhesive tubes), in line with lateroventral articulation zones of adjacent posterior segment; dorsal perforation sites arranged in 3 rows, ventral perforation sites in 3 or 4 rows, diminishing in number near midline; pectinate fringe of dorsal margin similar to that of segment 3, less pronounced on ventral margin than on segment 3; pachycyclus well developed, cuticularization extending posteriorly for short distance along ventral midline; small muscle scars on either side of midventral cuticularization.

Segment 5, 42–50 μm long, $\bar{x}$ 39 = 44.8±2.7 μm; middorsal cuticular scar near anterior margin; dorsal perforation sites and pectinate fringe similar to that on segment 4; ventral perforation sites more numerous than on segment 4, and clustered nearer to midline; small muscle(?) scars on either side of midline as in segment 4; pectinate fringe fine, less distinct than on segment 4.

Segment 6, 42–54 μm long, $\bar{x}$ 39 = 48.5±3.2 μm; middorsal spine, 50–70 μm long, $\bar{x}$ 39 = 58.5±4.5 μm; dorsal and ventral perforation sites and pectinate fringe similar to those on segment 5; cuticular scars (possibly muscle scars) on sides of middorsal spine, muscle scars(?) on sides of ventral midline slightly more lateral than on segment 5.

Segment 7, 46–60 μm long, $\bar{x}$ 39 = 52.6±3.4 μm; middorsal spine, 60–82 μm long, $\bar{x}$ 37 = 69.9±7.2 μm, slightly longer than that on segment 6; paired cuticular scars on sides of, and slightly anterior to, middorsal spine; muscle scars on sides of ventral midline as in segment 6; lateral spines (adhesive tube), 16–24 μm long, $\bar{x}$ 33 = 20.0±1.7 μm, near ventrolateral margin of tergal plate, near tergosternal articulation.

Segment 8, 51–68 μm long, $\bar{x}$ 39 = 56.4±9.2 μm; MSW 63–82 μm, $\bar{x}$ 39 = 74.5±3.5 μm; MSW/TL 14.2–21.4 percent, $\bar{x}$ 39 = 17.4±1.3 percent; middorsal spine, 70–98 μm long, $\bar{x}$ 37 = 81.6±7.8 μm, slightly longer than that on segment 6; lateral spines, 42–54 μm long, $\bar{x}$ 39 = 46.7±3.1 μm, twice length of lateral spine on segment 7; segment otherwise similar to segment 7.

Segment 9, 53–72 μm long, $\bar{x}$ 39 = 61.0±3.8 μm; middorsal spine, 82–110 μm long, $\bar{x}$ 38 = 94.5±6.5 μm, slightly longer than that on segment 8; lateral spines, 48–56 μm long, $\bar{x}$ 39 = 52.6±2.2 μm slightly longer than that on segment 8; segment otherwise similar to segment 8.

Segment 10, 56–74 μm long, $\bar{x}$ 39 = 63.8±3.3 μm; middorsal spine, 88–114 μm long, $\bar{x}$ 38 = 102.5±6.6 μm, slightly longer than that on segment 9; lateral spines, 44–62 μm long, $\bar{x}$ 39 = 53.1±4.2 μm, slightly longer than those on segment 9; perforation sites pattern slightly modified from that of segment 9; segment otherwise similar to segment 9.

Segment 11, 54–70 μm long, $\bar{x}$ 39 = 61.5±3.0 μm; middorsal spine absent; lateral spines 32–56, μm long, $\bar{x}$ 39 = 44.5±7.0 μm; slightly shorter than those on segment 10; fewer perforation sites on dorsal and ventral surfaces, pattern similar to that of segment 10; subdorsal cuticular scars in same positions as in segment 10, additional scars situated posteriorly (Figure 18); segment otherwise similar to segment 10.

Segment 12, 54–64 μm long, $\bar{x}$ 39 = 56.6±2.5 μm; SW 46–64 μm, $\bar{x}$ 39 = 59.0±3.6 μm; SW/TL 12.1–16.8 percent, $\bar{x}$ 39 = 13.7±1.1 percent; lateral spines absent; perforation sites on dorsal and ventral surfaces few, clustered centrally in tergal and sternal plates; single median cuticular scar near anterior margin of tergal plate, similar scar on both sides of ventral midline near anteromesial margin of each sternal plate; large, oval muscle scars subdorsally about middle of tergal plate; paired, moderate, oval muscle scars (on either side of ventral midline) near midmesial margin of each sternal plate; pectinate fringe poorly developed dorsally and ventrally.

Segment 13, 22–36 μm long, $\bar{x}$ 39 = 29.9±2.8 μm; tergal furcae tapering evenly to point, sternal plates with rounded posterior margins; pectinate fringe poorly developed as in segment 12; lateral terminal spines 62–149 μm long, $\bar{x}$ 38 = 103.1±31.0 μm; LTS/TL 14.0–36.2 percent, $\bar{x}$ 38 = 23.5±7.8 percent; lateral terminal accessory spines of female 43–60 μm long, $\bar{x}$ 19 = 54.7±5.2 μm; LTAS/TL 9.3–16.5 percent, $\bar{x}$ 19 = 12.7±1.8 percent; LTAS/LTS, 51.1–88.2 percent, $\bar{x}$ 19 = 75.0± 10.6 percent; penile spines of male: P-1 32–40 μm long, $\bar{x}$ 18 = 38.7±8.1 μm; P-2 20–22 μm long, $\bar{x}$ 17 = 20.1±0.5 μm; P-3 28–43 μm long, $\bar{x}$ 14 = 32.5±4.2 μm.

In addition to the lack of lateral accessory spines and the presence of three pairs of penile spine, males differ from females in having a slightly longer trunk length, slightly longer middorsal and lateral spines, and longer lateral terminal spines (males: LTS 110–149 μm long, $\bar{x}$ 19 = 132.4±10.3 μm; LTS/TL 25.5–36.2 percent, $\bar{x}$ 19 = 31.0±3.2 percent; females: LTS 62–90 μm long, $\bar{x}$ 19 = 73.8±7.7 μm; LTS/TL 14.0–20.0 percent, $\bar{x}$ 19 = 17.1±1.7 percent.

Morphometric data for adult specimens are shown in Table 2.

HOLOTYPE.—Adult female, TL 440 μm (Figures 17–22, 27–31), Disko Island, sta RH 1529, USNM 233209.

ALLOTYPE.—Adult male, TL 430 μm (Figures 23–26, 32), other data as for holotype, USNM 233210.

PARATYPES.—Five females and 5 males, TL 430–455 μm, other data as for holotype, USNM 233211; 2 females, TL 445–450 μm, Disko Island, sta RH 1533, USNM 233212; 2 females and 8 males, TL 425–465 μm, Disko Island, sta RH 1534, USNM 233213; 4 females and 2 males, TL 443–465 μm, Disko Island, sta RH 1537, USNM 233214; 4 females and 3 males, TL 363–385 μm, Disko Island, sta RH 1538, USNM 233215. Other paratypes have been deposited in the Zoological Museum, Copenhagen.

REMARKS.—*Echinoderes aquilonius*, like *E. angustus*, is one of six species having middorsal spines on segments 6–10 and lateral spines on segments 7–11. For reasons pointed out in "Remarks" following the description of *E. angustus*, *Echinoderes truncatus* is discussed with these seven species.

One of this group of species, *E. brevicaudatus*, has lateral spines (adhesive tubes) on segment 4; although the former species has very short lateral terminal spines, as in *E. aquilonius*, it has a strikingly different condition of the pectinate fringe on the anterior trunk segments, as mentioned previously. *Echinoderes remanei* (and *E. truncatus*) have no circular or oval cuticular scars (pores?) at the site of the lateral spines (adhesive tubes) on segment 4.

Of the 3 species, in addition to *E. aquilonius*, with cuticular scars in the place of lateral spines (adhesive tubes) on segment 4, *E. tubilak* differs by having a prominent pectinate fringe (except for 5 elements mesially) on the ventral surface of segment 3; *E. pennaki* has much longer lateral terminal spines;

TABLE 2.—Measurements (μm) and indices (%) for *Echinoderes aquilonius* adults (see text for explanation of abbreviations).

Character	Sex	Sample size	Range	Mean	Standard deviation	Standard error	Coefficient of variability
TL	m	20	370–465	429.4	24.2	5.4	5.6
	f	19	363–465	433.0	33.8	7.8	7.8
	mf	39	363–465	431.3	28.9	4.6	6.7
SW	m	20	46–62	57.4	3.7	0.8	6.4
	f	19	56–64	60.6	2.7	0.6	4.4
	mf	39	46–64	59.0	3.6	0.6	6.1
SW/TL	m	20	12.1–15.6	13.4	0.9	0.2	6.4
	f	19	12.1–16.8	14.1	1.3	0.3	8.9
	mf	39	12.1–16.8	13.7	1.1	0.2	8.1
MSW-8	m	20	63–82	74.1	3.4	0.8	4.6
	f	19	64–78	75.0	3.5	0.8	4.7
	mf	39	63–82	74.5	3.5	0.6	4.6
MSL/TL	m	20	16.1–18.0	17.1	1.3	0.3	7.6
	f	19	14.2–21.4	17.4	1.6	0.4	9.4
	mf	39	14.2–21.4	17.4	1.3	0.2	7.4
Dm	m	17	75.6–87.8	80.6	2.7	0.7	3.3
	f	15	73.2–91.2	83.9	5.3	1.4	6.3
	mf	32	73.2–91.2	82.2	4.4	0.8	5.3
Dm/TL	m	17	17.3–22.3	18.7	1.4	0.4	7.7
	f	15	16.2–23.1	19.2	1.9	0.5	9.9
	mf	32	16.2–23.1	19.0	1.7	0.3	8.8
D-6	m	20	52–70	59.2	5.0	1.1	8.4
	f	19	50–64	57.3	4.4	1.0	7.7
	mf	39	50–70	58.5	4.5	0.7	7.7
D-7	m	19	63–80	71.2	5.8	1.3	8.2
	f	18	60–82	71.1	6.9	1.6	9.8
	mf	37	60–82	69.9	7.2	1.2	10.2
D-8	m	18	70–90	79.6	4.2	1.0	5.3
	f	19	70–98	83.4	9.8	2.3	11.8
	mf	37	70–98	81.6	7.8	1.3	9.6
D-9	m	20	82–101	92.3	5.1	1.2	5.6
	f	18	86–110	96.8	7.1	1.7	7.4
	mf	38	82–110	94.5	6.5	1.1	6.9
D-10	m	20	88–110	99.9	6.0	1.3	6.0
	f	18	90–114	105.3	6.2	1.5	5.9
	mf	38	88–114	102.5	6.6	1.1	6.5
Lm	m	18	37.0–42.8	41.2	2.2	0.5	5.3
	f	15	41.4–48.0	45.8	2.0	0.5	4.3
	mf	33	37.0–48.0	43.3	3.1	0.5	7.1
Lm/TL	m	18	8.6–12.2	9.6	1.0	0.2	10.0
	f	15	9.2–12.6	10.6	0.9	0.2	8.4
	mf	33	8.6–12.6	10.0	1.0	0.2	10.3
L-7*	m	18	16–22	19.9	1.6	0.4	7.9
	f	15	16–24	20.3	1.8	0.5	8.8
	mf	33	16–24	20.0	1.7	0.3	8.3

TABLE 2.—Continued.

Character	Sex	Sample size	Range	Mean	Standard deviation	Standard error	Coefficient of variability
L-8	m	20	42–50	45.5	2.5	0.6	5.5
	f	19	44–54	48.0	3.0	0.7	6.2
	mf	39	42–54	46.7	3.1	0.5	6.5
L-9	m	20	48–56	51.7	2.1	0.5	4.0
	f	19	50–56	53.6	2.0	0.5	3.8
	mf	39	48–56	52.6	2.2	0.4	4.3
L-10	m	20	44–60	50.7	3.6	0.8	7.0
	f	19	50–62	55.6	3.3	0.8	6.0
	mf	39	44–62	53.1	4.2	0.7	7.9
L-11	m	20	32–48	38.9	4.0	0.9	10.4
	f	19	43–56	50.2	3.7	0.8	7.3
	mf	39	32–56	44.5	7.0	1.1	15.8
LTS	m	19	110–149	132.4	10.3	2.4	7.8
	f	19	62–90	73.8	7.7	1.8	10.4
	mf	38	62–149	103.1	31.0	5.0	30.1
LTS/TL	m	19	25.5–36.2	31.0	3.2	0.7	10.2
	f	19	14.0–20.0	17.1	1.7	0.4	10.1
	mf	38	14.0–36.2	24.0	7.5	1.2	31.2
LTAS	f	19	43–60	54.7	5.2	1.2	9.5
LTAS/TL	f	19	9.3–16.5	12.7	1.8	0.4	14.1
LTAS/LTS	f	19	51.1–88.2	75.0	10.6	2.4	14.2
P-1	m	18	32–40	38.7	8.1	1.9	20.9
P-2	m	17	20–22	20.1	0.5	0.1	2.4
P-3	m	14	28–43	32.5	4.2	1.1	12.9
SL-2	m	20	15–20	18.2	1.2	0.3	6.8
	f	19	16–20	18.6	1.0	0.2	5.2
	mf	39	15–20	18.4	1.1	0.2	6.1
SL-3	m	20	40–44	41.5	1.3	0.3	3.1
	f	19	36–44	41.4	2.2	0.5	5.4
	mf	39	36–44	41.4	1.8	0.3	4.3
SL-4	m	20	38–42	40.2	1.3	0.3	3.2
	f	19	36–44	40.3	1.9	0.4	4.7
	mf	39	36–44	40.2	1.6	0.3	3.9
SL-5	m	20	42–50	44.6	2.5	0.6	5.6
	f	19	42–50	45.0	2.9	0.7	6.5
	mf	39	42–50	44.8	2.7	0.4	5.9
SL-6	m	20	42–52	48.2	3.2	0.7	6.7
	f	19	44–54	49.0	3.2	0.7	6.6
	mf	39	42–54	48.5	3.2	0.5	6.6
SL-7	m	20	46–58	52.3	3.2	0.7	6.1
	f	19	46–60	52.8	3.6	0.8	6.8
	mf	39	46–60	52.6	3.4	0.5	6.4

TABLE 2.—Continued.

Character	Sex	Sample size	Range	Mean	Standard deviation	Standard error	Coefficient of variability
SL-8	m	20	51–62	57.1	3.8	0.8	6.6
	f	19	52–68	55.7	12.7	2.9	22.8
	mf	39	51–68	56.4	9.2	1.5	16.2
SL-9	m	20	53–64	59.8	3.4	0.8	5.7
	f	19	54–72	59.0	13.4	3.1	22.6
	mf	39	53–72	61.0	3.8	0.6	6.2
SL-10	m	20	56–68	63.1	3.2	0.7	5.0
	f	19	62–74	64.7	3.4	0.8	5.3
	mf	39	56–74	63.8	3.3	0.5	5.1
SL-11	m	20	54–64	60.1	2.6	0.6	4.4
	f	19	60–70	62.9	2.6	0.6	4.2
	mf	39	54–70	61.5	3.0	0.5	4.8
SL-12	m	20	54–60	56.3	2.1	0.5	3.8
	f	19	54–64	56.9	2.9	0.7	5.0
	mf	39	54–64	56.6	2.5	0.4	4.4
SL-13	m	20	22–36	28.5	3.1	0.7	11.0
	f	19	30–34	31.4	1.2	0.3	3.9
	mf	39	22–36	29.9	2.8	0.5	9.4

whereas the male of E. truncatus has only a seta on the ventrolateral margins of the dorsal plate of segment 12; the female is distinctive because of the presence of a spine in this position.

Except for the absence of middorsal spine 10 and the presence of lateral spines (adhesive tubes) on segment 4 in *E. setiger*, this species has many characters closely resembling those of *E. aquilonius*.

ETYMOLOGY.—The name of this species is from the Latin *aquilonius* (northern).

Echinoderes eximus, new species

FIGURES 33–48

DIAGNOSIS.—Middorsal spines on segments 6–10 long, increasing uniformly in length posteriorly; lateral spines on segments 7, 10, 11, round to oval cuticular scar (or pore?) in L-4 (adhesive tube) position; lateral terminal spines proportionately long, 141–180 μm, 42.9–75.1 percent of trunk length; strong midventral cuticularization on segment 4; well developed, pectinate fringe on posteroventral margin of on segments 3 and 4, uniform in size; perforation sites on ventral surface of segment 3 in 3 or 4 poorly defined rows; tergal furcae short and stubby.

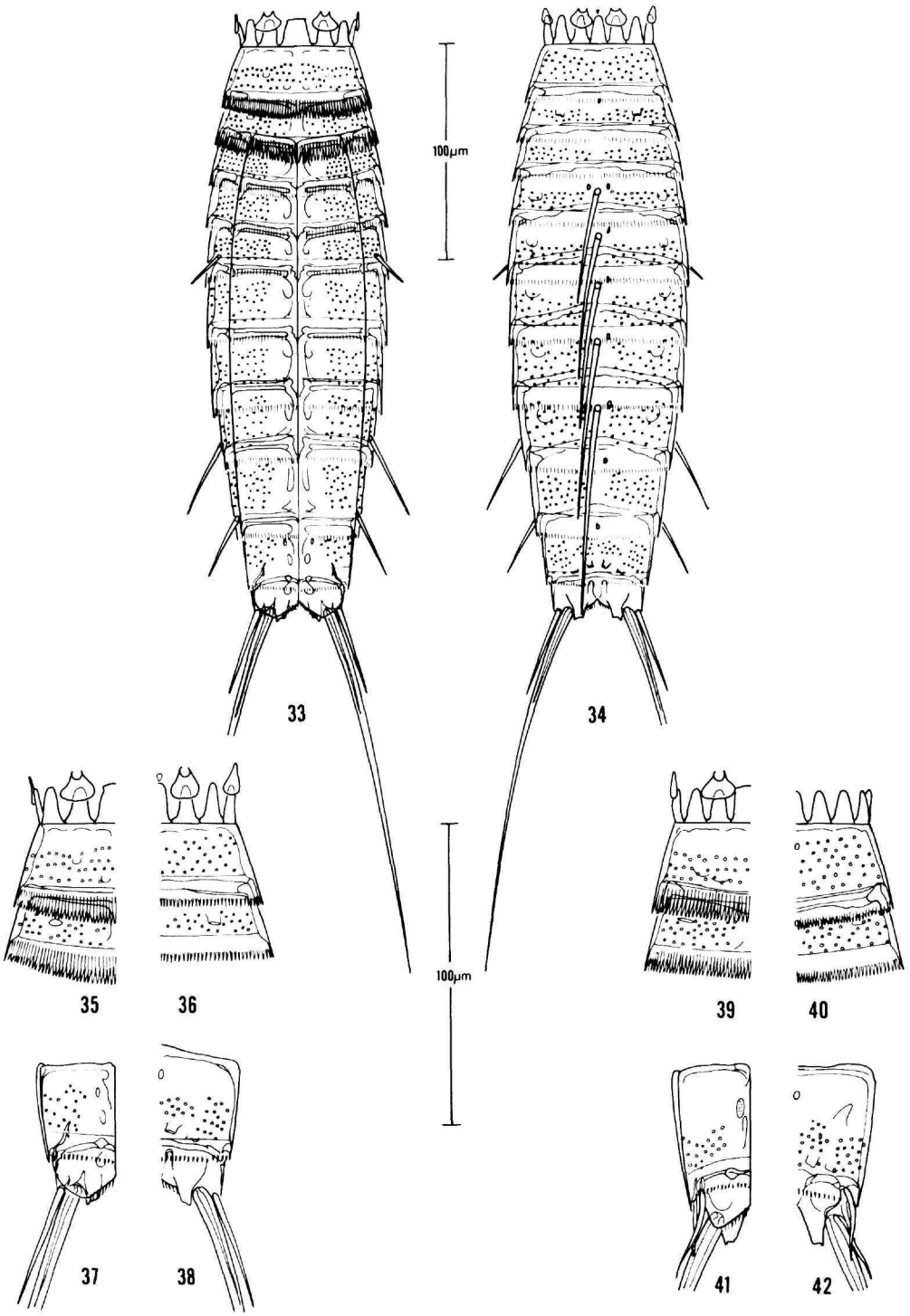
DESCRIPTION.—Adult (Figures 33–48) trunk length 213–343 μm; MSW-8 44–60 μm, 14.1–25.3 percent of trunk length; SW 42–54 μm, 13.8–23.4 percent of trunk length.

Segment 2 with 16 placids, 12–14 μm long, $\bar{x}$ 25 = 13.0±0.8 um, midventral placid truncate and wider (~11 μm) than others (~6 μm); ventral trichoscalid plates (of head segment) overlapping alternate placids, broadly expanded at posterior margins, dorsal trichoscalid plates similar, only slightly smaller (Figures 35, 36, 39, 40).

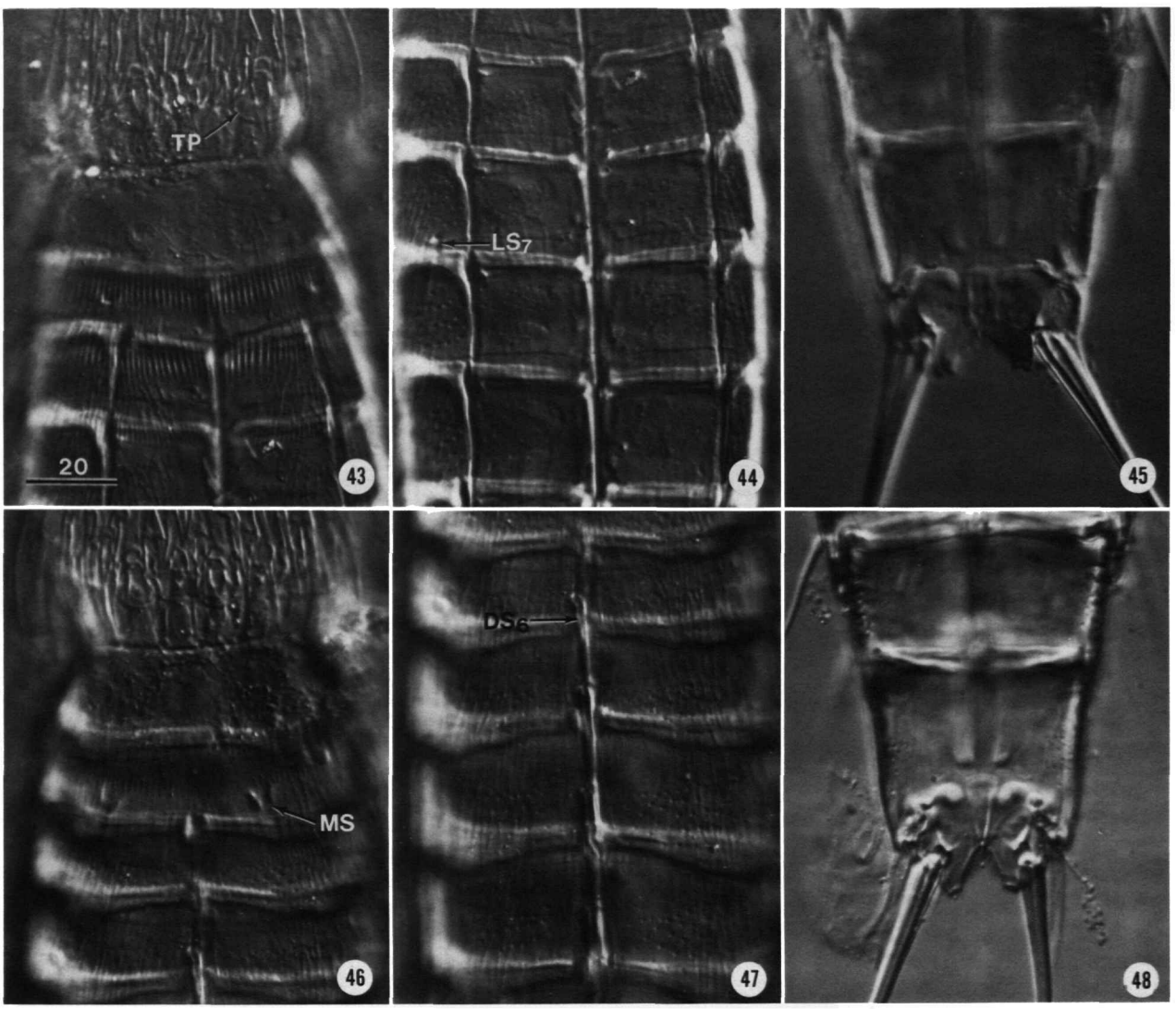
Segment 3, 26–34 μm long, $\bar{x}$ 25 = 29.9±2.2 μm; no cuticular scars evident on dorsal surface, poorly formed crescentic subdorsal (muscle?) scars near posterior margin, two others more anterolaterally situated; perforation sites evenly distributed on dorsal surface arranged more or less in three rows, occupying posterior two-thirds of segment on ventral surface; pectinate fringe on ventral margin well developed, uniform in size (~1–2 μm wide, ~10 μm long), much finer on posterior dorsal margin.

Segment 4, 25–33 μm long, $\bar{x}$ 25 = 29.2±2.0 μm; minute, oval middorsal cuticular scar near anterior margin; nearly truncated cuticular (muscle?) scars subdorsally in SD-4 position; round to oval cuticular scars (pores?) ventrolaterally at presumptive sites of missing lateral spines (adhesive tubes), slightly more anteriorly displaced than in most species; perforation sites in 2 or 3 poorly defined rows dorsally and ventrally; pectinate fringe similar to that on segment 3; pachycyclus well developed, cuticularization extending two-thirds length of the segment along ventral midline.

Segment 5, 28–34 μm long, $\bar{x}$ 25 = 31.1±1.4 μm; middorsal and other cuticular scars absent; perforation sites in 3 poorly defined rows dorsally, 4 rows ventrally; pectinate fringe fine on both dorsal and ventral plates.



FIGURES 33–42.—*Echinoderes eximus*, new species. Holotypic female (USNM 233216): 33, 34, neck and trunk segments, ventral and dorsal views; 35, 36, segments 2–4, lateral half, ventral and dorsal views; 37, 38, segments 12–13, lateral half, ventral and dorsal views. Allotypic male (USNM 233217): 39, 40, segments 2–4, lateral half, ventral and dorsal views; 41, segments 12–13, lateral half, ventral and dorsal views.



FIGURES 43–48.—*Echinoderes eximus*, new species. Holotypic female (USNM 233216): 43, segments 2–5, ventral view; 44, segments 6–9, ventral view; 45, segments 12–13, ventral view; 46, segments 2–5, dorsal view; 47, segments 6–9, dorsal view. Allotypic male (USNM 233217): 48, segments 12–13, ventral view. (Interference-contrast photographs all with same scale (in μm) as shown in Figure 43.)

Segment 6, 29–37 μm long, $\bar{x}$ 25 = 33.6±2.1 μm; middorsal spine 44–70 μm long, $\bar{x}$ 24 = 54.5±5.3 μm; subdorsal cuticular scars on sides of dorsal midline, slightly anterior to middorsal spine; larger crescentic (muscle?) scars more posterolateral to middorsal spine; no cuticular scars apparent on ventral plates; perforation sites in 3 or 4 rows on both dorsal and ventral plates; pectinate fringe as in segment 5.

Segment 7, 28–42 μm long, $\bar{x}$ 25 = 37.4±3.2 μm; middorsal spine 54–78 μm long, $\bar{x}$ 24 = 67.0±5.9 μm; lateral spines, possibly adhesive tubes, 18–22 μm long, $\bar{x}$ 24 = 19.5±1.1 μm; segment otherwise similar to segment 6.

Segment 8, 31–44 μm long, $\bar{x}$ 25 = 39.4±3.2 μm; MSW 44–60 μm, $\bar{x}$ 25 = 54.6±2.9 μm, MSW/TL 14.1–25.3 percent, $\bar{x}$ 25 = 18.8±2.6 percent; middorsal spine 64–86 μm long, $\bar{x}$ 25 = 73.9±5.5 um; lateral spines absent; perforation sites more widely separated, but otherwise similar to those of segment 7.

Segment 9, 33–56 μm long, $\bar{x}$ 25 = 43.0±4.0 μm; middorsal spine 68–96 μm long, $\bar{x}$ 25 = 85.1±6.6 μm; lateral spines absent; otherwise similar to previous segment.

Segment 10, 36–51 μm long, $\bar{x}$ 25 = 45.3±3.6 μm; middorsal spine, 85–107 μm long, $\bar{x}$ 24 = 94.7±5.6 μm, extending to terminal margin of segment 13; lateral spines, 32–43 μm long, $\bar{x}$ 23 = 37.1±2.9 μm, prominent, twice length of lateral spines on segment 7; segment otherwise similar to previous segment.

TABLE 3.—Measurements (μm) and indices (%) for *Echinoderes eximus* adults (see text for explanation of abbreviations).

Character	Sex	Sample size	Range	Mean	Standard deviation	Standard error	Coefficient of variability
TL	m	12	245–325	288.8	31.5	9.1	10.9
	f	13	213–343	299.3	40.7	11.3	13.6
	mf	25	213–343	294.3	36.2	7.3	12.3
SW	m	12	42–52	47.3	3.2	0.9	6.7
	f	13	45–54	50.3	3.3	0.9	6.5
	mf	25	42–54	48.8	3.5	0.7	7.2
SW/TL	m	12	13.8–19.6	16.5	1.7	0.5	10.1
	f	13	13.9–23.4	17.2	2.9	0.8	16.8
	mf	25	13.8–23.4	16.8	2.4	0.5	14.0
MSW-8	m	12	44–56	53.4	3.1	0.9	5.8
	f	13	52–60	55.7	2.2	0.6	3.9
	mf	25	44–60	54.6	2.9	0.6	5.2
MSW/TL	m	12	14.1–22.4	18.7	2.5	0.7	13.2
	f	13	15.7–25.3	18.9	2.7	0.8	14.4
	mf	25	14.1–25.3	18.8	2.6	0.5	13.6
Dm	m	11	70.4–75.6	72.6	1.6	0.5	2.2
	f	12	70.0–83.6	78.2	4.5	1.3	5.7
	mf	23	70.0–83.6	75.5	4.4	0.9	5.8
Dm/TL	m	11	22.1–30.2	25.6	2.9	0.9	11.4
	f	12	21.5–36.9	26.1	4.0	1.2	15.5
	mf	23	21.5–36.9	25.9	3.5	0.7	13.4
D-6	m	11	48–56	52.2	2.4	0.7	4.7
	f	13	44–70	56.5	6.2	1.7	11.0
	mf	24	44–70	54.5	5.3	1.1	9.6
D-7	m	11	54–72	65.0	4.7	1.4	7.3
	f	13	54–78	68.8	6.4	1.8	9.2
	mf	24	54–78	67.0	5.9	1.2	8.8
D-8	m	12	64–75	71.3	3.3	0.9	4.6
	f	13	65–86	76.2	6.2	1.7	8.1
	mf	25	64–86	73.9	5.5	1.1	7.5
D-9	m	12	80–88	83.1	2.5	0.7	3.1
	f	13	68–96	86.9	8.5	2.4	9.8
	mf	25	68–96	85.1	6.6	1.3	7.7
D-10	m	12	85–98	90.3	3.5	1.0	3.9
	f	12	94–107	99.1	3.3	1.0	3.4
	mf	24	85–107	94.7	5.6	1.1	5.9
Lm	m	11	26.3–30.7	28.0	1.4	0.4	4.8
	f	11	27.3–31.3	29.8	1.3	0.4	4.5
	mf	22	26.3–31.3	28.9	1.6	0.3	5.5
Lm/TL	m	11	8.5–11.1	9.7	0.9	0.3	9.4
	f	11	8.1–13.4	10.2	1.6	0.5	15.8
	mf	22	8.1–13.4	10.0	1.3	0.3	12.8
L-7	m	11	18–22	19.6	1.4	0.4	7.0
	f	13	18–20	19.4	1.0	0.3	5.0
	mf	24	18–22	19.5	1.1	0.2	5.9

TABLE 3.—Continued.

Character	Sex	Sample size	Range	Mean	Standard deviation	Standard error	Coefficient of variability
L-10	m	12	33–41	36.1	2.3	0.7	6.3
	f	11	32–43	38.3	3.3	1.0	8.5
	mf	23	32–43	37.1	2.9	0.6	7.9
L-11	m	12	25–30	28.1	1.7	0.5	6.0
	f	13	30–34	31.5	1.3	0.4	4.2
	mf	25	25–34	29.8	2.3	0.5	7.6
LTS	m	12	141–163	153.5	6.7	1.9	4.4
	f	13	144–180	165.0	10.9	3.0	6.6
	mf	25	141–180	159.5	10.7	2.1	6.7
LTS/TL	m	12	45.6–62.7	53.4	6.4	1.9	12.0
	f	13	42.9–75.1	56.2	9.6	2.7	17.0
	mf	25	42.9–75.1	55.0	8.1	1.6	14.8
LTAS	f	13	28–43	38.2	4.3	1.2	11.2
LTAS/TL	f	13	9.4–20.1	13.1	3.0	0.8	22.7
LTAS/LTS	f	13	15.5–26.8	23.2	2.8	0.8	12.0
P-1	m	9	28–38	32.4	3.0	1.0	9.1
P-2	m	5	18–24	22.8	2.7	1.2	11.8
P-3	m	6	26–36	32.2	3.7	1.5	11.5
SL-2	m	12	12–14	12.8	0.8	0.2	5.9
	f	13	12–14	13.2	0.8	0.2	6.3
	mf	25	12–14	13.0	0.8	0.2	6.3
SL-3	m	12	26–32	28.8	1.9	0.5	6.5
	f	13	26–34	30.9	1.9	0.5	6.1
	mf	25	26–34	29.9	2.2	0.4	7.2
SL-4	m	12	26–30	28.8	1.9	0.5	6.5
	f	13	25–33	29.5	2.2	0.6	7.4
	mf	25	25–33	29.2	2.0	0.4	7.0
SL-5	m	12	29–33	31.4	1.1	0.3	3.5
	f	13	28–34	30.8	1.7	0.5	5.5
	mf	25	28–34	31.1	1.4	0.3	4.6
SL-6	m	12	30–35	32.9	1.6	0.5	4.9
	f	13	29–37	34.2	2.4	0.7	7.0
	mf	25	29–37	33.6	2.1	0.4	6.3
SL-7	m	12	28–40	36.6	3.3	1.0	9.1
	f	13	31–42	38.2	3.0	0.8	7.9
	mf	25	28–42	37.4	3.2	0.6	8.5
SL-8	m	12	34–42	39.1	2.4	0.7	6.0
	f	13	31–44	39.7	3.9	1.1	9.7
	mf	25	31–44	39.4	3.2	0.6	8.1
SL-9	m	12	40–45	42.7	1.8	0.5	4.2
	f	13	33–56	43.5	5.3	1.5	12.1
	mf	25	33–56	43.0	4.0	0.8	9.3

TABLE 3.—Continued.

Character	Sex	Sample size	Range	Mean	Standard deviation	Standard error	Coefficient of variability
SL-10	m	12	40–50	44.8	2.6	0.8	5.8
	f	13	36–51	45.8	4.3	1.2	9.5
	mf	25	36–51	45.3	3.6	0.7	7.9
SL-11	m	12	40–44	40.7	1.2	0.4	3.0
	f	13	37–44	41.3	1.7	0.5	4.0
	mf	25	37–44	41.0	1.5	0.3	3.6
SL-12	m	12	42–46	44.1	1.9	0.6	4.4
	f	13	35–41	38.9	1.7	0.5	4.3
	mf	25	35–46	41.3	3.2	0.6	7.7
SL-13	m	12	18–29	20.7	2.9	0.9	14.2
	f	13	20–26	23.2	1.8	0.5	7.9
	mf	25	18–29	22.0	2.7	0.5	12.3

Segment 11, 37–44 μm long, $\bar{x}$ 25 = 41.0±1.5 μm; middorsal spine absent, lateral spines, 25–34 μm long, $\bar{x}$ 25 = 29.8±2.3 μm, slightly shorter than lateral spines on previous segment; dorsolateral cresentic muscle scars of previous segments absent, posteromesial muscle scars on ventral plates; segment otherwise similar to segment 10.

Segment 12, 35–46 μm long, $\bar{x}$ 25 = 41.3±3.2 μm; SW 42–54 μm, $\bar{x}$ 25 = 48.8±3.5 μm; SW/TL 13.8–23.4 percent, $\bar{x}$ 25 = 16.8±2.4 percent; lateral spines absent; middorsal cuticular scar near anterior margin; 4 prominent truncate muscle scars near posteromedian margin of dorsal plate; small, oval cuticular scars near anteromesial margins of ventral plates, larger cuticular scars more posteriorly situated; perforation sites fewer than in segment 11, partially set off subdorsally into 2 discrete areas; segment otherwise similar to segment 11.

Segment 13, 18–29 μm long, $\bar{x}$ 25 = 22.0±2.7 μm; tergal furcae short, not much longer than ventral plates, latter with slightly pointed posterolateral margin (Figures 37, 38, 41, 42); ventral plates with somewhat angular margin, both dorsal and ventral plates with slight pectinate fringe; prominent muscle scar situated anteromesially on ventral plate; no perforation sites present; lateral terminal spines 141–180 μm long, $\bar{x}$ 25 = 159.5±10.7 μm; LTS/TL 42.9–75.1 percent, $\bar{x}$ 25 = 55.0±8.1 percent; lateral terminal accessory spines of female 28–43 μm long, $\bar{x}$ 13 = 38.2±4.3 μm, LTAS/TL 9.4–20.1 percent, $\bar{x}$ 13 = 13.1±3.0 percent; LTAS/LTS 15.5–26.8 percent, $\bar{x}$ 13 = 23.2±2.8 percent; penile spines of male: P-1 28–38 μm long, $\bar{x}$ 9 = 32.4±3.0 μm; P-2 18–24 μm long, $\bar{x}$ 5 = 22.8±2.7 μm; P-3 26–36 μm long, $\bar{x}$ 6 = 32.2±3.7 μm.

In addition to the lack of lateral accessory spines and the presence of 3 pairs of penile spines, males differ from females in having slightly shorter and narrower trunks, slightly shorter middorsal and lateral spines, and slightly longer tergal furcae.

Morphometric data for adult specimens are shown in Table 3.

HOLOTYPE.—Adult female, TL 265 μm (Figures 33–38, 43–47), Disko Island, sta RH 1538, USNM 233216.

ALLOTYPE.—Adult male, TL 258 μm (Figures 39–42, 48), other data as for holotype, USNM 233217.

PARATYPES.—Two females and 3 males, TL 213–265 μm, other data as for holotype, USNM 233218; 5 females and 5 males, TL 285–335 μm, Disko Island, sta 1534, USNM 233219; 52 unmounted specimens, Disko Island, sta 1534, USNM 233220; 4 females and 2 males, TL 310–343 μm, Disko Island, sta 1537, USNM 233221.

REMARKS.—According to the literature, no other currently described species of *Echinoderes* has a spine formula similar to that of *E. eximus*. However, Higgins' current (unpublished) studies of *E. tchefouensis* from the type-locality at Yan Tai, People's Republic of China, indicate that this species has middorsal spines on segments 6–10 and lateral spines on segments 7, 10, and 11 as in *E. eximus*. Although study of the Chinese species is incomplete, it clearly differs from *E. eximus* in having no indications of cuticular scars or pores at the L-4 position; neither are these characters indicated at the SD-4 position.

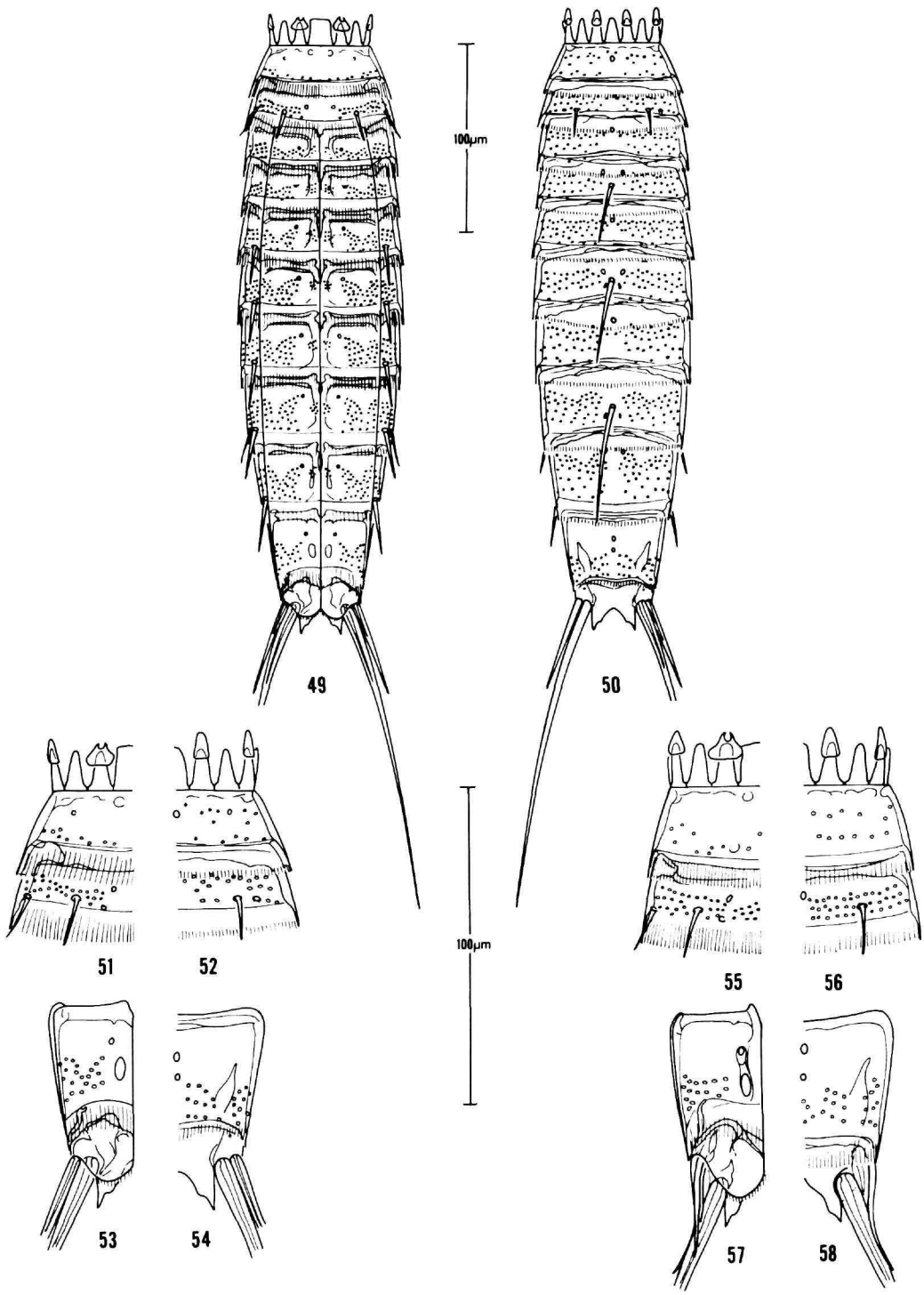
ETYMOLOGY.—The name of this species is from the Latin *eximus* (exceptional, uncommon).

Echinoderes peterseni, new species

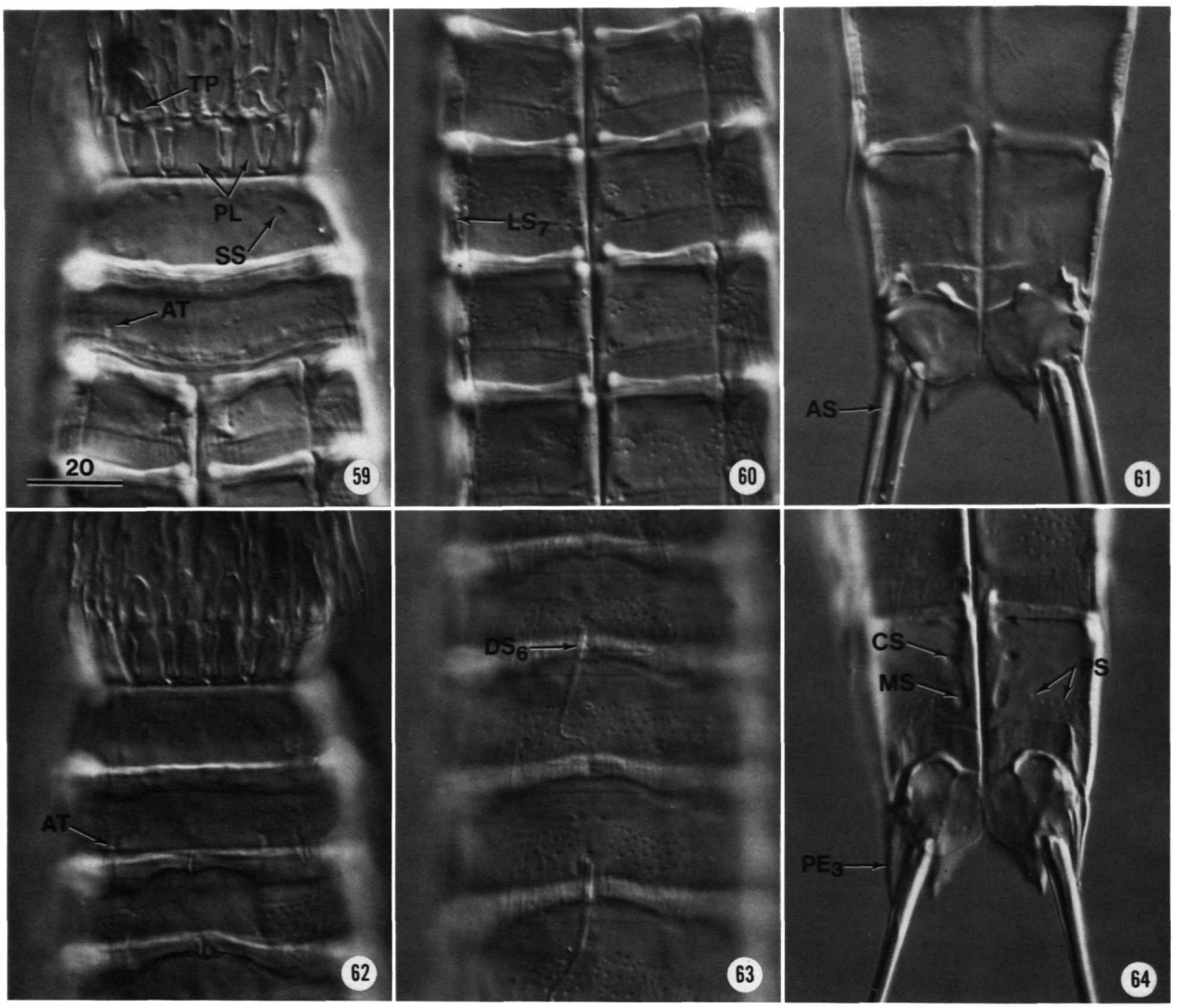
FIGURES 49–64

DIAGNOSIS.—Middorsal spines on segments 6, 8, and 10, moderately long, increasing uniformly in length posteriorly; subdorsal spines on segment 4; lateral spines on segments 4, 7–11; lateral accessory spines on segments 4 and 10; lateral terminal spines long, 150–172 μm, 48.6–68.8 percent of trunk length; no midventral cuticularization on segment 4; pectinate fringe poorly developed on all segments.

DESCRIPTION.—Adult (Figures 49–64) trunk length 250–325



FIGURES 49–58.—*Echinoderes peterseni*, new species. Holotypic female (USNM 233222): 49, 50, neck and trunk segments, ventral and dorsal views; 51, 52, segments 2–4, lateral half, ventral and dorsal views; 53, 54, segments 12–13, lateral half, ventral and dorsal views. Allotypic male (USNM 233223): 55, 56, segments 2–4, lateral half, ventral and dorsal views; 57, 58, segments 12–13, lateral half, ventral and dorsal views.



FIGURES 59–64.—*Echinoderes peterseni*, new species. Holotypic female (USNM 233222): 59, segments 2–5, ventral view; 60, segments 6–9, ventral view; 61, segments 12–13, ventral view; 62, segments 2–5, dorsal view; 63, segments 6–9, dorsal view. Allotypic male (USNM 233223): 64, segments 12–13, ventral view. (Interference-contrast photographs all with same scale (in μm) as shown in Figure 59.)

μm; MSW-7, 54–60 μm, 16.9–22.4 percent of trunk length; SW 48–56 μm, 15.3–20.0 percent of trunk length.

Segment 2 with 16 placids, 14–15 μm long, $\bar{x}$ 16 = 14.2± 0.4 μm, midventral placid truncate, wider (~14 μm) than others (~8 μm); ventral trichoscalid plates (of head segment) broadly expanded posteriorly, overlapping alternate placids, dorsal ones nearly uniform in width (Figures 51, 52, 55, 56).

Segment 3, 30–32 μm long, $\bar{x}$ 16 = 31.4±1.0 μm; midventral cuticular scar near anterior margin, cuticular scars on sides of ventral midline near anterior margin; perforation sites in 2 poorly defined rows dorsally (one near anterior and the other along posterior margin); pectinate fringe poorly developed.

Segment 4, 28–32 μm long, $\bar{x}$ 16 = 29.5±1.2 μm; cuticular scars lateral to subdorsal spines, small scars on sides of ventral midline near anterior margin, 2 additional scars more posterior and slightly more lateral; lateral spines (adhesive tubes), 14–18 μm long, $\bar{x}$ 16 = 15.3±1.5 μm, slightly mesial to projected tergosternal junction of adjacent posterior segment; lateral accessory spines of female: 16–20 μm long, $\bar{x}$ 7 = 17.3±1.5 μm, dorsolateral to lateral spines; subdorsal spines (adhesive tubes) 12–14 μm long, $\bar{x}$ 9 = 14.7±1.7 μm; perforation sites arranged in 3 rows dorsally and ventrally; pachycyclus well developed, no midventral cuticularization; pectinate fringe uniformly fine, not easily seen.

Segment 5, 28–36 μm long, $\bar{x}$ 16 = 30.8±1.9 μm; middorsal cuticular scar near anterior margin, ventral cuticular scar near center of each ventral plate; perforation sites in 4 or 5 poorly organized rows dorsally, 3 rows ventrally; pectinate fringe as in segment 4.

Segment 6, 28–36 μm long, $\bar{x}$ 16 = 31.8±2.0 μm; middorsal spine 30–44 μm long, $\bar{x}$ 15 = 39.2±4.0 μm; subdorsal cuticular scars anterior to middorsal spine, ventral cuticular scars near center on each ventral plate; additional small clusters of perforation sites forming V-shaped pattern on ventral plates, clusters of small perforation sites near mesial margin of each ventral plate; segment 7 otherwise similar to segment 5.

Segment 7, 28–36 μm long, $\bar{x}$ 16 = 32.8±2.6 μm; MSW 54–60 μm, $\bar{x}$ 16 = 57.0±1.7 μm; MSW/TL 16.9–22.4 percent, $\bar{x}$ 16 = 18.6±1.2 percent; middorsal spine absent; middorsal cuticular scar near anterior margin; ventral cuticular scars slightly more anterior than on segment 6; lateral spines (adhesive tubes), 14–24 μm long, $\bar{x}$ 16 = 19.3±2.2 μm; segment otherwise similar to segment 6.

Segment 8, 30–41 μm long, $\bar{x}$ 16 = 36.1±3.2 μm; middorsal spine 45–60 μm long, $\bar{x}$ 16 = 52.8±4.0 μm; lateral spines 20–26 μm long, $\bar{x}$ 16 = 22.4±1.8 μm; ventral plates similar to those of segment 7, dorsal plate similar to that of segment 6 except for additional horizontally narrow cuticular scars near anterior margin and oval cuticular scars posterior to middorsal spine.

Segment 9, 34–44 μm long, $\bar{x}$ 16 = 38.9±2.9 μm; middorsal spine absent; lateral spines 23–36 μm long, $\bar{x}$ 16 = 26.6±2.9 μm; middorsal cuticular scar near anterior margin, median cuticular scars on ventral plates slightly more mesially situated than on previous segments; horizontally narrow cuticular scars and oval cuticular scars posterior to middorsal spine of previous segment absent; perforation sites poorly organized into 4 or 5 rows on both dorsal and ventral plates, clusters of small perforation sites near mesial margins of ventral plates; pectinate fringe poorly defined as in previous segments.

Segment 10, 36–46 μm long, $\bar{x}$ 16 = 42.1±2.6 μm; middorsal spine, 60–70 μm long, $\bar{x}$ 16 = 66.1±3.5 μm, extending to posterior edge of segment 11; lateral spines, 22–36 μm long, $\bar{x}$ 16 = 27.7±3.0 μm; lateral accessory spine, probably an adhesive tube, 18–24 μm long, $\bar{x}$ 13 = 21.4±1.5 μm; subdorsal cuticular scars posterior to middorsal spine, anterior cuticular scars of segments 6, 8 absent; segment otherwise similar to segment 9.

Segment 11, 40–44 μm long, $\bar{x}$ 16 = 42.5±1.2 μm; middorsal spine absent; lateral spines 26–38 μm long, $\bar{x}$ 16 = 28.9±2.7 μm; lateral accessory spines absent; subdorsal cuticular scars near anterior margin only; segment otherwise similar to segment 10.

Segment 12, 36–44 μm long, $\bar{x}$ 16 = 40.3±2.4 μm; SW 48–56 μm, $\bar{x}$ 16 = 50.9±2.1 μm; SW/TL 15.3–20.0 percent, $\bar{x}$ 16 = 16.7±1.2 percent; middorsal and lateral spines absent; 2 middorsal cuticular scars slightly anterior to middle of segment; cuticular scars on ventral plates as in previous segment; additional nearly lanceolate dorsolateral muscle scars prominent; additional large, prominent oval muscle scars mesially at midlength on ventral plates; perforation sites diminished on both dorsal and ventral plates; ventral margin of each ventral plate slightly recurved; segment otherwise similar to segment 11.

Segment 13, 21–28 μm long, $\bar{x}$ 16 = 26.3±2.0 μm; tergal furcae pointed, mesial margin interrupted (Figures 53, 54, 57, 58); ventral plates with rounded margins, both dorsal and ventral plates with very slight pectinate fringe; no perforation sites present; lateral terminal spines 150–172 μm long, $\bar{x}$ 15 = 161.6±5.3 μm; LTS/TL 48.6–68.8 percent, $\bar{x}$ 15 = 53.2±4.6 percent; lateral terminal accessory spines of female 48–56 μm long, $\bar{x}$ 10 = 52.2±2.4 μm; LTAS/TL 16.1–20.0 percent, $\bar{x}$ 10 = 17.1±1.1 percent; LTAS/LTS 29.0–34.1 percent, $\bar{x}$ 10 = 31.8±1.6 percent; penile spines of male: P-1 35–40 μm long, $\bar{x}$ 6 = 37.3±1.8 μm; P-2 20–22 μm long, $\bar{x}$ 5 = 21.2±1.1 μm; P-3 26–34 μm long, $\bar{x}$ 6 = 32.7±1.0 μm.

In addition to the lack of lateral accessory spines and the presence of 3 pairs of penile spines, males differ from females in having slightly shorter lateral terminal spines, but otherwise are very similar in morphometry.

Morphometric data for adult specimens are shown in Table 4.

HOLOTYPE.—Adult female, TL 310 μm (Figures 49–54, 59–63), Disko Island, sta RH 1535, USNM 233222.

ALLOTYPE.—Adult male, TL 310 μm (Figures 55–58, 64), other data as for holotype, USNM 233223.

PARATYPES.—Eight females and 4 males, TL 250–325 μm, other data as for holotype, USNM 233224; 35 unmounted specimens, data as for holotype, USNM 233225. Other paratypes have been deposited in the Zoological Museum, Copenhagen.

REMARKS.—Seven species of *Echinoderes* have middorsal spines only on segments 6, 8, and 10; in addition to *E. peterseni*, these include: *E. bermudensis*, *E. canariensis*, *E. kristenseni*, *E. newcaledoniensis*, *E. riedli*, and *E. wallaceae*. All seven have lateral spines (adhesive tubes) on segment 4; all except *E. bermudensis* and *E. canariensis* have lateral accessory spines on segment 10. Only one of these, *E. newcaledoniensis*, has subdorsal spines on segment 4 and accessory lateral spines on segments 4 and 10. However, *E. newcaledoniensis* also has subdorsal spines on segment 10 in addition to accessory lateral spines on segments 8, 9, and 11. Although the presence of accessory lateral spines on segment 10 is found in groups of species having middorsal spines on segments 6–10, only the group of species having middorsal spines on segments 6, 8, and 10 have additional accessory lateral spines.

In addition to the differences in subdorsal spines on segment 10 and accessory lateral spines on segments 8, 9, and 11 noted, *E. newcaledoniensis*, differs from *E. peterseni* in having shorter lateral accessory spines in the female; longer, more evenly tapered tergal furcae; long, narrow trichoscalid plates both dorsally and ventrally; narrower pachycycli; a middorsal spine on segment 10 which is twice the length of that on segment 8; moreover, it exhibits differences in the number and position

TABLE 4.—Measurements (μm) and indices (%) for *Echinoderes peterseni* adults (see text for explanation of abbreviations).

Character	Sex	Sample size	Range	Mean	Standard deviation	Standard error	Coefficient of variability
TL	m	6	300–310	305.5	3.4	1.4	1.1
	f	10	250–325	306.0	22.1	7.0	7.2
	mf	16	250–325	305.8	17.2	4.3	5.6
SW	m	6	48–52	49.7	1.5	0.6	3.0
	f	10	48–56	51.7	2.1	0.7	4.1
	mf	16	48–56	50.9	2.1	0.5	4.2
SW/TL	m	6	15.5–16.7	16.2	0.5	0.2	3.0
	f	10	15.3–20.0	17.0	1.4	0.4	8.2
	mf	16	15.3–20.0	16.7	1.2	0.3	7.0
MSW-7	m	6	54–60	57.5	2.0	0.8	3.4
	f	10	55–60	56.7	1.5	0.5	2.6
	mf	16	54–60	57.0	1.7	0.4	2.9
MSW/TL	m	6	18.0–19.3	18.6	0.5	0.2	2.9
	f	10	16.9–22.4	18.6	1.5	0.5	8.3
	mf	16	16.9–22.4	18.6	1.2	0.3	6.6
Dm	m	5	50.0–57.3	53.7	3.5	1.6	6.5
	f	10	46.7–56.0	52.4	3.0	0.9	5.7
	mf	15	46.7–57.3	52.8	3.1	0.8	5.9
Dm/TL	m	5	16.3–19.1	17.5	1.2	0.5	6.9
	f	10	15.0–22.1	17.1	2.0	0.6	11.7
	mf	15	15.0–22.1	17.2	1.7	0.5	10.1
D-6	m	5	36–44	40.8	3.0	1.4	7.4
	f	10	30–44	38.4	4.3	1.4	11.2
	mf	15	30–44	39.2	4.0	1.0	10.2
D-8	m	6	50–60	54.2	3.9	1.7	7.2
	f	10	45–56	52.1	4.1	1.3	7.9
	mf	16	45–60	52.8	4.0	1.0	7.6
D-10	m	6	60–70	65.2	5.0	2.0	7.7
	f	10	64–70	66.6	2.3	0.7	3.5
	mf	16	60–70	66.1	3.5	0.9	5.3
Lm	m	4	23.0–26.3	24.3	1.6	0.8	6.6
	f	10	22.0–24.2	22.9	0.7	0.2	3.1
	mf	14	22.0–26.3	23.3	1.2	0.3	5.0
Lm/TL	m	4	7.4–8.7	7.9	0.6	0.3	7.5
	f	10	6.9–9.0	7.5	0.6	0.2	8.3
	mf	14	6.9–9.0	7.6	0.6	0.2	8.2
L-4*	m	6	14–18	15.8	1.6	0.7	10.1
	f	10	14–18	15.0	1.4	0.5	9.4
	mf	16	14–18	15.3	1.5	0.4	9.8
L-7*	m	6	14–24	19.3	3.3	1.3	16.9
	f	10	18–22	19.2	1.4	0.4	7.3
	mf	16	14–24	19.3	2.2	0.5	11.3
L-8	m	6	20–26	22.8	2.2	0.9	9.8
	f	10	20–24	22.2	1.5	0.5	6.7
	mf	16	20–26	22.4	1.8	0.4	7.8

TABLE 4.—Continued.

Character	Sex	Sample size	Range	Mean	Standard deviation	Standard error	Coefficient of variability
L-9	m	6	25–36	27.8	4.1	1.7	14.8
	f	10	23–28	25.8	1.6	0.5	6.0
	mf	16	23–36	26.6	2.9	0.7	10.7
L-10	m	6	26–36	28.5	3.9	1.6	13.6
	f	10	22–30	27.2	2.4	0.8	8.8
	mf	16	22–36	27.7	3.0	0.8	10.8
L-11	m	6	27–38	29.5	4.2	1.7	14.2
	f	10	26–30	28.5	1.5	0.5	5.3
	mf	16	26–38	28.9	2.7	0.7	9.5
LA-4	m	3	16–20	18.0	2.0	1.2	11.1
	f	7	16–20	17.3	1.5	0.6	8.7
	mf	10	16–20	17.5	1.6	0.5	9.0
LA-10	m	4	20–24	22.0	1.6	0.8	7.4
	f	9	18–22	21.1	1.5	0.5	6.9
	mf	13	18–24	21.4	1.5	0.4	7.0
SD-4	m	5	14–18	15.6	1.7	0.8	10.7
	f	9	12–14	14.7	1.7	0.6	11.8
	mf	14	12–18	15.0	1.7	0.5	11.4
LTS	m	5	150–162	158.4	5.0	2.2	3.1
	f	10	158–172	164.0	5.0	1.6	3.0
	mf	15	150–172	161.6	5.3	1.4	3.3
LTS/TL	m	5	49.1–54.0	51.8	1.8	0.8	3.4
	f	10	48.6–68.8	53.9	5.5	1.7	10.2
	mf	15	48.6–68.8	53.2	4.6	1.2	8.7
LTAS	f	10	48–56	52.2	2.4	0.8	4.6
LTAS/TL	f	10	16.1–20.0	17.1	1.1	0.4	6.5
LTAS/LTS	f	10	29.0–34.1	31.8	1.6	0.5	4.9
P-1	m	6	35–40	37.3	1.8	1.2	8.0
P-2	m	5	20–22	21.2	1.1	1.3	14.5
P-3	m	6	26–34	32.7	1.0	1.2	9.3
SL-2	m	6	14–14	14.0	0.0	0.0	0.0
	f	10	14–15	14.3	4.8	0.2	3.4
	mf	16	14–15	14.2	0.4	0.1	2.8
SL-3	m	6	30–32	31.0	1.1	0.5	3.5
	f	10	30–32	31.6	0.8	0.2	2.7
	mf	16	30–32	31.4	1.0	0.2	3.1
SL-4	m	6	28–31	29.3	1.2	0.5	4.1
	f	10	28–32	29.6	1.3	0.4	4.3
	mf	16	28–32	29.5	1.2	0.3	4.1
SL-5	m	6	29–36	31.3	2.5	1.0	8.0
	f	10	28–32	30.5	1.6	0.5	5.2
	mf	16	28–36	30.8	1.9	0.5	6.3

TABLE 4.—Continued.

Character	Sex	Sample size	Range	Mean	Standard deviation	Standard error	Coefficient of variability
SL-6	m	6	31–36	31.8	2.3	1.0	7.3
	f	10	28–34	31.8	2.0	0.6	6.3
	mf	16	28–36	31.8	2.0	0.5	6.4
SL-7	m	6	28–36	31.6	2.9	1.2	9.3
	f	10	28–36	33.4	2.3	0.7	6.8
	mf	16	28–36	32.8	2.6	0.7	7.9
SL-8	m	6	32–40	35.7	2.7	1.1	7.5
	f	10	30–41	36.3	3.6	1.1	9.8
	mf	16	30–41	36.1	3.2	0.8	8.8
SL-9	m	6	37–41	39.0	1.6	0.6	4.0
	f	10	34–44	38.9	3.6	1.1	9.3
	mf	16	34–44	38.9	2.9	0.7	7.5
SL-10	m	6	39–46	41.8	2.4	1.0	5.7
	f	10	36–46	42.2	2.8	0.9	6.6
	mf	16	36–46	42.1	2.6	0.6	6.1
SL-11	m	6	41–44	42.3	1.0	0.4	2.4
	f	10	40–44	42.6	1.4	0.4	3.2
	mf	16	40–44	42.5	1.2	0.3	2.9
SL-12	m	6	42–44	42.7	0.8	0.3	1.9
	f	10	36–40	38.8	1.8	0.6	4.5
	mf	16	36–44	40.3	2.4	0.6	6.0
SL-13	m	6	21–28	25.0	2.7	1.1	10.7
	f	10	26–28	27.0	0.9	0.3	3.5
	mf	16	21–28	26.3	2.0	0.5	7.6

of cuticular markings, including the pattern of perforation sites.

ETYMOLOGY.—This species in named in honor of Dr. G. Høpner Petersen, Chairman of the Board of Directors of the Danish Arctic Station.

Echinoderes tubilak, new species

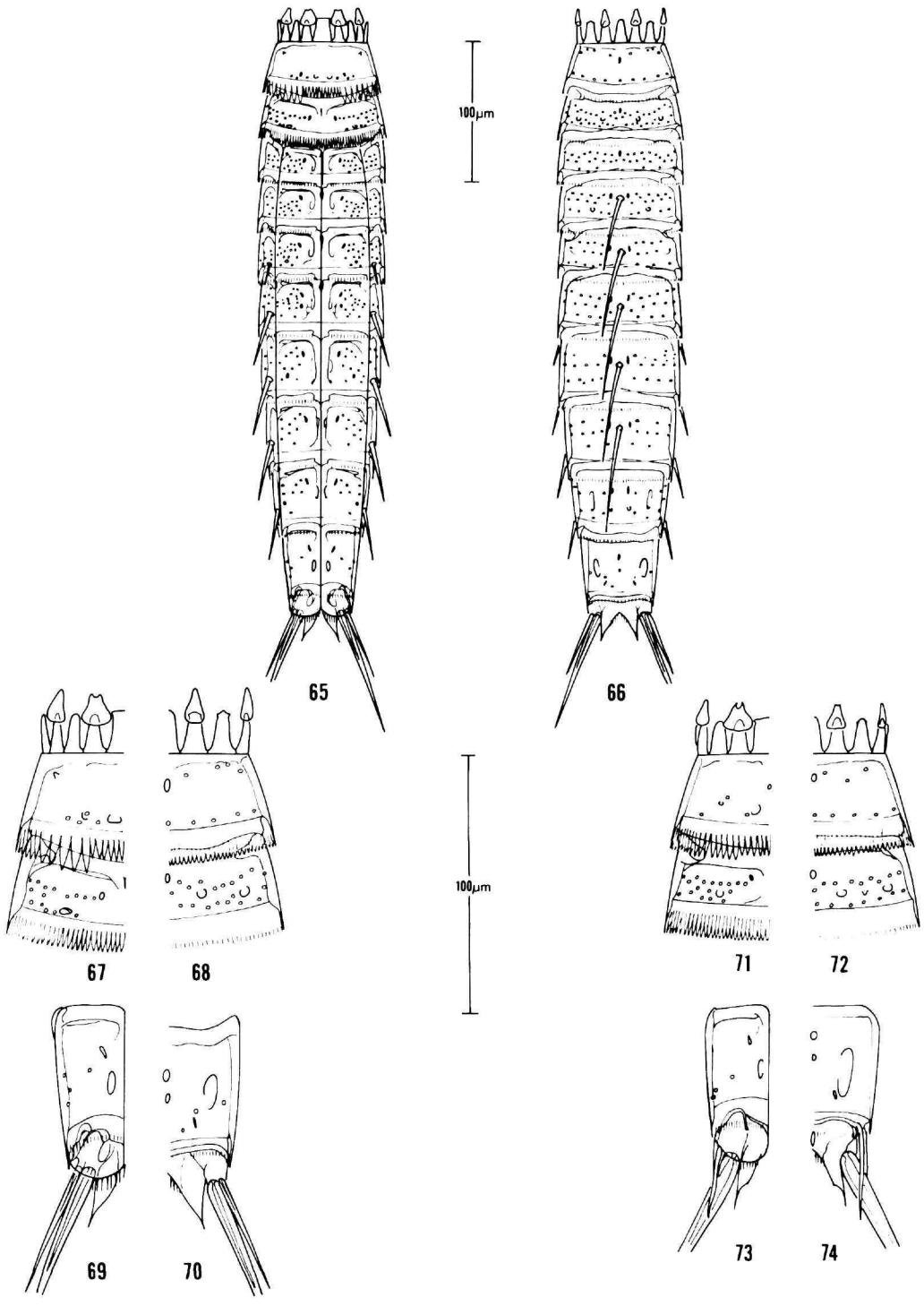
FIGURES 65–80

DIAGNOSIS.—Middorsal spines on segments 6–10, increasing uniformly in length posteriorly; lateral spines on segments 7–11, round to oval cuticular scars (pores?) in L-4 (adhesive tubes) and SD-4 positions; lateral terminal spines short to moderate, 64–160 μm long, 17.0–41.6 percent of trunk length; slight indication of sutured ventral midline near pachycyclus of segment 4; pectinate fringe well developed on ventral surface of segments 3 and 4; pectinate fringe on segment 3 with median area of distinct fringe and lateral areas of wider fringe elements; segment 4 with uniformly distinct fringe; perforation sites sparsely distributed over both dorsal and ventral surfaces.

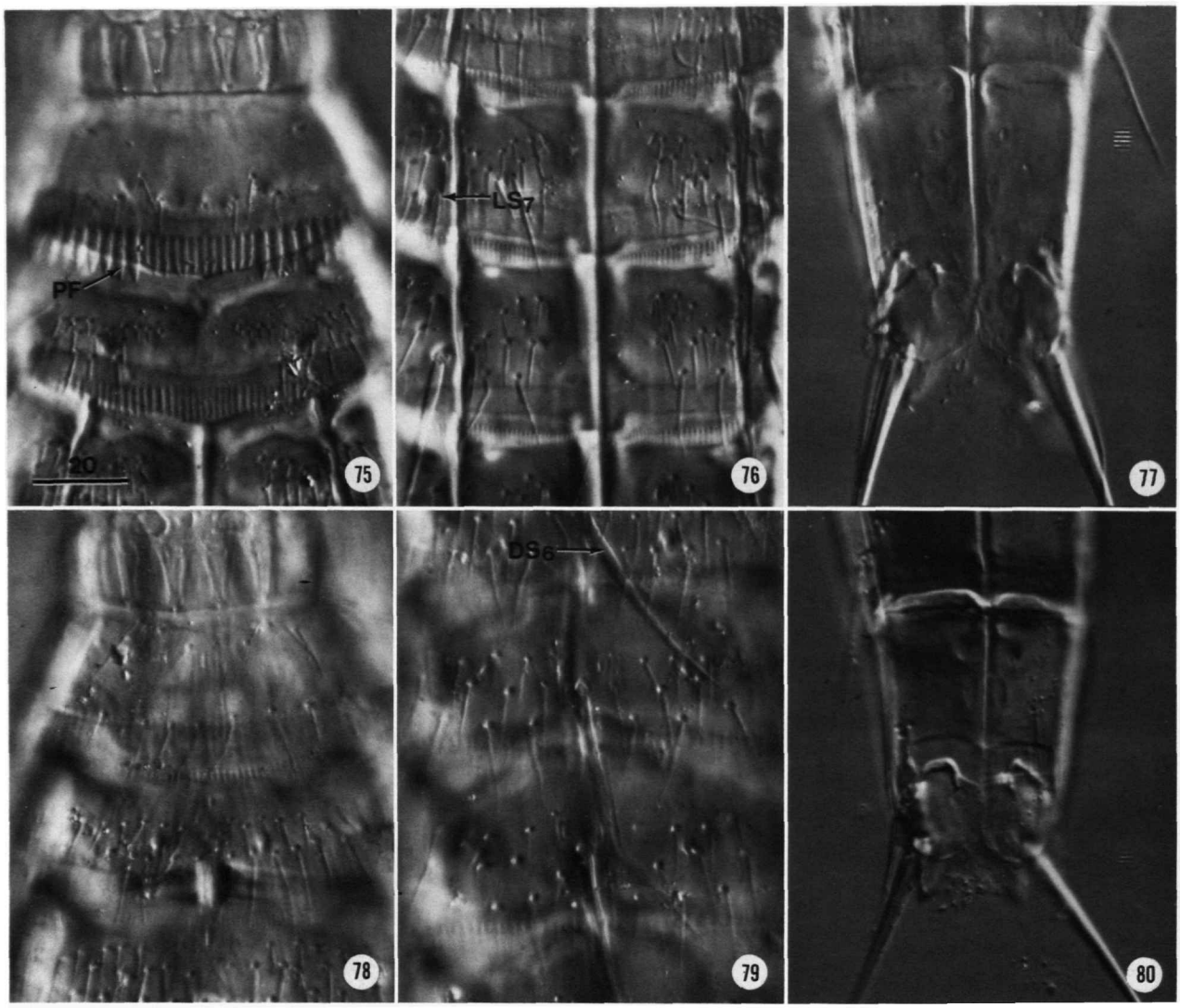
DESCRIPTION.—Adult (Figures 65–80) trunk length 333–415 μm; MSW-8, 58–68 μm, 14.6–19.8 percent of trunk length; SW 44–56 μm, 10.9–15.6 percent of trunk length.

Segment 2 consisting of 16 placids, 14–18 μm long, $\bar{x}$ 53 = 16.4±0.8 μm; midventral placid truncate, anterior margin slightly expanded laterally, wider (~14 μm) than others (~8 μm); ventral trichoscalid plates (of head segment) overlapping alternate placids, broadly expanded posteriorly; dorsal trichoscalid plates narrow (Figures 67, 68, 71, 72).

Segment 3, 31–42 μm long, $\bar{x}$ 54 = 39.0±2.1 μm; middorsal cuticular scar near anterior margin, narrowly oval in vertical axis; round cuticular scars on sides of ventral midline near posterior margin of segment, smaller cuticular scars situated more laterally; small, angular muscle(?) scars near anterolateral margins of ventral surface; few perforation sites scattered along anterior margin of dorsal surface, single row near posterior margin; few posteromedial perforation sites on ventral surface; pectinate fringe of median one-third of ventral surface uniform in width (~2 μm) and length (~9 μm), contrasting distinctly with wider (~4 μm), longer (~13 μm) uniform-sized fringe



FIGURES 65–74.—*Echinoderes tubilak*, new species. Holotypic female (USNM 233226): 65, 66, neck and trunk segments, ventral and dorsal views; 67, 68, segments 2–4, lateral half, ventral and dorsal views; 69, 70, segments 12–13, lateral half, ventral and dorsal views. Allotypic male (USNM 233227): 71, 72, segments 2–4, lateral half, ventral and dorsal views; 73, 74, segments 12–13, lateral half, ventral and dorsal views.



FIGURES 75–80.—*Echinoderes tubilak*, new species. Holotypic female (USNM 233226): 75, segments 2–5, ventral view; 76, segments 6–9, ventral view; 77, segments 12–13, ventral view; 78, segments 2–5, dorsal view; 79, segments 6–9, dorsal view. Allotypic male (USNM 233227): 80, segments 12–13, ventral view. (Interference-contrast photographs all with same scale (in μm) as shown in Figure 75.)

laterally (but not continuing dorsally); pectinate fringe slightly diminished in size in females, fringe barely visible on dorsal margin in either sex.

Segment 4, 18–39 μm long, $\bar{x}$ 54 = 34.9±2.9 μm; narrowly elongate middorsal scar similar to that on previous segment; subdorsal and additional lateral round cuticular scars near posterior margin; narrowly elongate cuticular scars on sides of ventral midline, additional oval to round cuticular scars (pores?) at presumptive sites of missing lateral spines (adhesive tubes), near posterior margin; perforation sites in 2 poorly organized 2 rows dorsally, 2 or 3 rows ventrally; pectinate fringe barely visible on dorsal margin; pachycyclus well developed, cuticularization extending posteriorly for short distance along midventral line, slight fissure indicated within midventral cuticularization.

Segment 5, 34–46 μm long, $\bar{x}$ 54 = 39.4±2.8 μm; narrowly elongate middorsal cuticular scar near anterior margin, similar cuticular scars centered on each ventral plate; 3 rows of perforation sites on both dorsal and ventral surfaces; pectinate fringe barely visible on both dorsal and ventral surfaces.

Segment 6, 35–50 μm long, $\bar{x}$ 54 = 42.3±3.6 μm; middorsal spine 44–60 μm long, $\bar{x}$ 52 = 49.4±3.7 μm; subdorsal, narrowly elongate cuticular scars at sides of middorsal spine; additional circular cuticular scars situated posterolateral to middorsal

spines; segment otherwise similar to segment 5.

Segment 7, 40–53 μm long, $\bar{x}$ 54 = 46.9±4.9 μm; middorsal spine 50–66 μm long, $\bar{x}$ 52 = 59.9±3.5 μm; lateral spines, probably adhesive tubes, 8–26 μm long, $\bar{x}$ 27 = 17.0±3.2 μm, near lateroventral margins of tergal plate; subdorsal pair of narrowly elongate cuticular scars flanking middorsal spine, no other cuticular scars noted; similar anteromedian cuticular scars on ventral plates, additional round cuticular scars laterally, near posterior margins of ventral plates; perforation sites organized into 3 rows dorsally, 3 or 4 less organized rows ventrally; segment otherwise similar to segment 6.

Segment 8, 44–60 μm long, $\bar{x}$ 54 = 52.0±4.1 μm; MSW 58–68 μm, $\bar{x}$ 53 = 63.7±2.4 μm, MSW/TL 14.6–19.8 percent, $\bar{x}$ 53 = 16.6±1.1 percent; middorsal spine 54–71 μm long, $\bar{x}$ 52 = 63.2±3.7 μm; lateral spines 36–48 μm long, $\bar{x}$ 54 = 41.2±2.3 μm; as compared with segment 7, ventral plates with additional perforation sites, and round cuticular scars directly posterior and closer to narrowly oval cuticular scars; otherwise similar to segment 7.

Segment 9, 48–62 μm long, $\bar{x}$ 54 = 55.9±4.0 μm; middorsal spine 60–78 μm long, $\bar{x}$ 53 = 65.5±4.0 μm; lateral spines 42–50 μm long, $\bar{x}$ 54 = 44.0±2.2 μm; ventral plates with fewer perforation sites than on segment 8; round cuticular scars of previous segment now more oval than those on segment 8 and positioned posterolaterally as on segment 7; segment otherwise similar to segment 8.

Segment 10, 52–66 μm long, $\bar{x}$ 54 = 58.4±3.2 μm; middorsal spine 58–76 μm long, $\bar{x}$ 51 = 64.5±4.0 μm; lateral spines 38–50 μm long, $\bar{x}$ 53 = 44.0±2.5 μm; round cuticular scars of previous segment absent; segment otherwise similar to segment 9.

Segment 11, 51–60 μm long, $\bar{x}$ 54 = 54.4±2.2 μm; middorsal spine absent; lateral spines 30–48 μm long, $\bar{x}$ 51 = 37.2±4.7 μm; narrowly elongate subdorsal cuticular scars in same position as those on segment 10, 2 circular cuticular scars situated more posteriorly than those on segment 10; prominent, narrowly elongate muscle scars positioned laterally; as in segment 9, circular cuticular scars near posterolateral margins of ventral plates but with slightly fewer perforation sites; segment otherwise similar to segment 10.

Segment 12, 46–55 μm long, $\bar{x}$ 54 = 49.8±6.5 μm; SW 44–56 μm, $\bar{x}$ 53 = 49.4±3.4 μm; SW/TL 10.9–15.6 percent, $\bar{x}$ 53 = 12.8±1.2 percent; lateral spines absent; narrowly elongate middorsal scar near anterior margin, second such scar posteriorly adjacent; narrowly elongate muscle scars as in segment 11; additional narrowly elongate cuticular scars posteromesial to muscle scars; ventral plates with prominent oval muscle scars posterior to narrowly elongate cuticular scars near anteromesial margins; perforation sites few; pectinate fringe barely visible.

Segment 13, 20–38 μm long, $\bar{x}$ 54 = 27.7±3.9 μm; tergal furcae evenly lanceolate (Figures 69, 70, 73, 74); ventral plates with rounded posterior margins, moderately fringed; lateral terminal spines 64–160 μm long, $\bar{x}$ 54 117.4±31.7 μm; LTS/TL 17.0–41.6 percent, $\bar{x}$ 54 = 30.7±8.1 percent; lateral terminal accessory spine of females 42–66 μm long, $\bar{x}$ 26 = 56.0±5.8 μm; LTAS/TL 10.5–17.8 percent, $\bar{x}$ 26 = 14.8±2.1 percent; LTAS/LTS 52.5–83.9 percent, $\bar{x}$ 26 = 65.8±7.2 percent; penile spines of male: P-1 28–40 μm long, $\bar{x}$ 21 = 31.9±3.0 μm; P-2 16–22 μm long, $\bar{x}$ 15 = 18.8±1.7 μm; P-3 30–36 μm long, $\bar{x}$ 12 = 32.0±2.3 μm.

In addition to the lack of lateral accessory spines and the presence of 3 pairs of penile spines, males differ from females in having a slightly narrower standard width (relatively narrower posteriorly), slightly shorter lateral spines, and much shorter lateral terminal spines (an average of 22.8 percent of the trunk length as contrasted with an average of 38.0 percent of the trunk length in females).

Morphometric data for adult specimens are shown in Table 5.

HOLOTYPE.—Adult female, TL 415 μm (Figures 65–70, 75–79), Disko Island, sta RH 1529, USNM 233226.

ALLOTYPE.—Adult male, TL 395 μm (Figures 71–74, 80), other data as for Holotype, USNM 233227.

PARATYPES.—Eleven females and 16 males, TL 360–415 μm, other data as for holotype, USNM 233228; 1 female and 1 male, TL 385–395 μm, Disko Island, sta RH 1532, USNM 233229; 3 females and 4 males, TL 365–385 μm, Disko Island, sta RH 1533, USNM 233230; 115 unmounted specimens, Disko Island, sta RH 1535, USNM 233231; 3 females, TL 400–415 μm, Disko Island, sta RH 1536, USNM 233232; 4 males, TL 398–410 μm, Disko Island, sta RH 1537, USNM 233233; 6 females and 1 male, TL 333–350 μm long, Disko Island, sta RH 1538, USNM 233234.

REMARKS.—*Echinoderes tubilak* is one of 6 species having middorsal spines on segments 6–10 and lateral spines on segments 7–11 as noted in the discussions of *E. angustus* and *E. aquilonius*. This new species is distinguished most clearly from these other two new species by the unique pattern of pectinate fringe on the ventral surface of segment 3, a pattern reminiscent of the pectinate fringe on the ventral surface of segment 4 in *E. brevicaudatus*.

Echinoderes tubilak appears to be closely related to *E. aquilonius*. Both species have relatively short lateral terminal spines and share many other features. *Echinoderes aquilonius* has a prominent, but uniform, pectinate fringe on the ventral surface of segment 3 and more perforation sites, which also occur in a different pattern. Although both species share narrowly elongate cuticular scars, especially on the ventral plates, other cuticular and morphometric features differ.

The 3 species, *E. angustatus*, *E. aquilonius*, and *E. tubilak* from Disko Bay, having relatively short lateral terminal spines, appear to have a close relationship with *Echinoderes remanei*, which inhabits the northeastern coast of the United States (Higgins, 1964a). This latter species lacks the round to oval cuticular scars in the L-4 and SD-4 positions, but has a prominent pectinate fringe on the ventral surface of segment 3, and is similar to all these, especially to *E. aquilonius*, in many other features. Collections of species of the genus *Echinoderes* between Disko Island and Maine may provide

TABLE 5.—Measurements (μm) and indices (%) for *Echinoderes tubilak* adults (see text for explanation of abbreviations).

Character	Sex	Sample size	Range	Mean	Standard deviation	Standard error	Coefficient of variability
TL	m	28	350–410	386.7	17.2	3.3	4.5
	f	26	333–415	380.6	27.2	5.3	7.1
	mf	54	333–415	383.8	22.6	3.1	5.6
SW	m	27	44–50	46.9	1.6	0.3	3.5
	f	26	48–56	52.1	2.5	0.5	4.8
	mf	53	44–56	49.4	3.4	0.5	6.8
SW/TL	m	27	10.9–14.2	12.1	0.8	0.2	6.9
	f	26	12.6–15.6	13.6	1.0	0.2	7.2
	mf	53	10.9–15.6	12.8	1.2	0.2	9.0
MSW-8	m	27	58–66	62.9	2.4	0.5	3.8
	f	26	60–68	64.5	2.2	0.4	3.4
	mf	53	58–68	63.7	2.4	0.3	3.8
MSW/TL	m	27	14.6–18.2	16.3	0.9	0.2	5.7
	f	26	15.2–19.8	16.9	1.2	0.2	7.0
	mf	53	14.6–19.8	16.6	1.1	0.2	6.6
Dm	m	28	57.0–63.2	59.7	1.9	0.4	3.1
	f	20	58.0–68.0	61.8	2.7	0.6	4.4
	mf	48	57.0–68.0	60.5	2.5	0.4	4.1
Dm/TL	m	28	14.1–16.8	15.4	0.9	0.2	5.9
	f	20	14.7–17.1	16.0	1.2	0.3	7.7
	mf	48	14.1–17.1	15.6	1.0	0.2	6.7
D-6	m	28	44–60	48.8	3.8	0.7	7.9
	f	24	44–58	50.2	3.9	0.8	7.8
	mf	52	44–60	49.4	3.7	0.5	7.6
D-7*	m	28	52–64	58.6	3.0	0.6	5.1
	f	24	50–66	61.4	3.5	0.7	5.7
	mf	52	50–66	59.9	3.5	0.5	5.8
D-8	m	28	56–68	61.9	2.6	0.5	4.2
	f	24	54–71	65.0	4.3	0.9	6.6
	mf	52	54–71	63.2	3.7	0.5	5.8
D-9	m	28	60–78	65.6	4.3	0.8	6.6
	f	25	60–74	65.3	3.7	0.7	5.6
	mf	53	60–78	65.5	4.0	0.6	6.1
D-10	m	28	60–70	63.5	3.6	0.7	5.7
	f	23	58–76	65.7	4.1	0.9	6.3
	mf	51	58–76	64.5	4.0	0.6	6.2
Lm	m	11	27.4–43.0	35.4	3.6	1.1	10.3
	f	15	36.4–41.6	38.2	1.5	0.4	3.9
	mf	26	27.4–43.0	37.0	2.9	0.6	7.9
Lm/TL	m	11	7.1–10.8	9.1	0.9	0.3	9.7
	f	15	9.1–11.4	9.9	0.7	0.2	7.0
	mf	26	7.1–11.4	9.6	0.9	0.2	9.0
L-7	m	12	8–20	15.8	3.0	0.9	19.1
	f	15	14–26	17.8	3.2	0.8	17.7
	mf	27	8–26	17.0	3.2	0.6	18.5

TABLE 5.—Continued.

Character	Sex	Sample size	Range	Mean	Standard deviation	Standard error	Coefficient of variability
L-8	m	28	36–44	40.7	2.3	0.4	5.7
	f	26	40–48	41.7	2.2	0.4	5.2
	mf	54	36–48	41.2	2.3	0.3	5.5
L-9	m	28	42–48	43.8	1.9	0.4	4.4
	f	26	42–50	44.3	2.5	0.5	5.7
	mf	54	42–50	44.0	2.2	0.3	5.1
L-10	m	27	38–48	43.1	2.3	0.5	5.4
	f	26	41–50	45.2	2.1	0.4	4.6
	mf	53	38–50	44.0	2.5	0.3	5.6
L-11	m	27	30–40	33.7	2.6	0.5	7.6
	f	24	33–48	41.3	3.0	0.6	7.2
	mf	51	30–48	37.2	4.7	0.7	12.6
LTS	m	28	124–160	147.0	6.6	1.3	4.5
	f	26	64–96	85.5	6.9	1.4	8.1
	mf	54	64–160	117.4	31.7	4.3	27.0
LTS/TL	m	28	31.3–41.6	38.0	2.4	0.5	6.3
	f	26	17.0–32.0	22.8	2.9	0.6	12.9
	mf	54	17.0–41.6	30.7	8.1	1.1	26.4
LTAS	f	26	42–66	56.0	5.8	1.1	10.3
LTAS/TL	f	26	10.5–17.8	14.8	2.1	0.4	14.0
LTAS/LTS	f	26	52.5–83.9	65.8	7.2	1.4	10.9
P-1	m	21	28–40	31.9	3.0	0.7	9.5
P-2	m	15	16–22	18.8	1.7	0.4	8.8
P-3	m	12	30–36	32.0	2.3	0.6	7.2
SL-2	m	28	14–18	16.4	0.9	0.2	5.3
	f	25	15–18	16.4	0.8	0.2	4.7
	mf	53	14–18	16.4	0.8	0.1	5.0
SL-3	m	28	33–41	39.1	1.6	0.3	4.0
	f	26	31–42	38.8	2.6	0.5	6.8
	mf	54	31–42	39.0	2.1	0.3	5.5
SL-4	m	28	32–38	35.4	1.4	0.3	4.0
	f	26	18–39	34.3	3.8	0.8	11.2
	mf	54	18–39	34.9	2.9	0.4	8.3
SL-5	m	28	34–46	40.0	2.7	0.5	6.8
	f	26	34–42	38.9	2.8	0.6	7.3
	mf	54	34–46	39.4	2.8	0.4	7.1
SL-6	m	28	35–48	43.6	3.4	0.6	7.7
	f	26	37–50	42.4	3.6	0.7	8.5
	mf	54	35–50	42.3	3.6	0.5	8.4
SL-7	m	28	42–52	48.5	3.5	0.7	7.3
	f	26	40–53	46.3	4.0	0.8	8.6
	mf	54	40–53	46.9	4.9	0.7	10.4

TABLE 5.—Continued.

Character	Sex	Sample size	Range	Mean	Standard deviation	Standard error	Coefficient of variability
SL-8	m	28	44–58	52.9	3.6	0.7	6.8
	f	26	45–60	51.1	4.4	0.9	8.6
	mf	54	44–60	52.0	4.1	0.6	7.8
SL-9	m	28	48–62	57.1	3.8	0.7	6.7
	f	26	49–62	54.7	3.9	0.8	7.1
	mf	54	48–62	55.9	4.0	0.5	7.2
SL-10	m	28	53–66	59.3	2.9	0.5	4.8
	f	26	52–64	57.5	3.3	0.6	5.7
	mf	54	52–66	58.4	3.2	0.4	5.4
SL-11	m	28	51–60	54.5	2.4	0.4	4.3
	f	26	52–58	54.4	2.1	0.4	3.8
	mf	54	51–60	54.4	2.2	0.3	4.1
SL-12	m	28	46–53	50.3	1.5	0.3	3.0
	f	26	46–55	51.0	2.1	0.4	4.1
	mf	54	46–55	49.8	6.5	0.9	13.0
SL-13	m	28	20–35	26.1	3.9	0.7	14.8
	f	26	23–38	29.0	3.4	0.7	11.7
	mf	54	20–38	27.7	3.9	0.5	14.0

significant insight about speciation of this group, as well as significant information about zoogeography patterns.

ETYMOLOGY.—The name of this species is from the Greenlandic term for a mythical spirit.

Order HOMALORHAGIDA Zelinka, 1896

Family PYCNOPHYIDAE Zelinka, 1896

Genus *Pycnophyes* Zelinka, 1907

Key to Adults of *Pycnophyes*

1. Posterior margin of tergal plate 3 with middorsal process 2
   Posterior margin of tergal plate 3 even, without middorsal process 12
2. Middorsal process of tergal plate 3 rounded 3
   Middorsal process of tergal plate 3 spinose, pointed 4
3. Midsternal plate of segment 3 elongate, apex of plate twice width of base; length of plate two-thirds width of posterior margin of segment 3 . . . . ***P. communis*** Zelinka, 1908
   Midsternal plate of segment 3 short, apex of plate three times width of base;length of plate one-half width of posterior margin of segment 3 . . . . ***P. maximus*** Reimer, 1963
4. Patches of punctations near lateral margins of sternal plates 4–12 . . . . ***P. iniorhaptus*** Higgins, 1983
   No patches of punctations on sternal plates 4–12 5
5. Thin area of cuticle at anteromesial margin of episternal plates double or longitudinally divided 6
   Thin area of cuticle at anteromesial margin of episternal plates single or not present 8

6. Anteromesial thickenings of pachycycli ("Mittelwülste") of sternal plate 12 adjacent at ventral midline . . . . . ***P. calmani*** Southern, 1914
   Anteromesial thickenings of pachycycli ("Mittelwülste") of sternal plate 12 widely separated, not adjacent at ventral midline. 7
7. Sternal plate 12 with vertical cuticular striations near lateral margin . . . . . ***P. dentatus*** (Reinhard, 1881)
   Sternal plate 12 without vertical cuticular striations near lateral margin . . . . . ***P. flaveolatus*** Zelinka, 1928
8. Anterior margin of midsternal plate projecting well beyond anteromesial margins of episternal plates . . . . . ***P. carinatus*** Zelinka, 1928
   Anterior margin of midsternal plates even with, not projecting beyond, anteromesial margins of episternal plates 9
9. Single laterodorsal placid on each side of single middorsal placid . . . . . ***P. odhneri*** Lang, 1949
   Two laterodorsal placids on each side of midline, no middorsal placid 10
10. Prominent, pointed middorsal processes on segments 4–11; margin of tergal plate pointed middorsally 11
    Middorsal processes on segments 4–11 not prominent, very short, cordate; margin of tergal plate even, without middorsal point . . . . . ***P. frequens*** Blake, 1930
11. Midsternal plate of segment 3 with posterior margin twice width of anterior margin . . . . . ***P. chiliensis*** Lang, 1953
    Midsternal plate of segment 3 with posterior margin only slightly wider than anterior margin . . . . . ***P. cryopygus,*** new species
12. Anterior margin of tergal plate 3 scalloped (with middorsal and laterodorsal projections conforming to lateral margins of dorsal placids) 13
    Anterior margin of tergal plate 3 dentate, coronate, or even 14
13. Posterior margins of tergal plates 4 and 5 without middorsal processes . . . . . ***P. kielensis*** Zelinka, 1928
    Posterior margins of tergal plates 4 and 5 (4–11) with middorsal processes . . . . . ***P. ponticus*** (Reinhard, 1881)
14. Anterior margin of tergal plate 3 dentate-coronate with prominent middorsal projection and 3 lateral projections on each side (remaining margin denticulate) . . . . . ***P. rugosus*** Zelinka, 1928
    Anterior margin of tergal plate 3 even, evenly dentate, or sculptured 15
15. Thin area of cuticle at anteromesial margin of episternal plates double 16
    Thin area of cuticle at anteromesial margin of episternal plates single or otherwise undefined but never double 17
16. Anteromesial thickenings of pachycycli ("Mittelwülste") of sternal plates 10 and 11 prominent; lateral terminal spines thick, robust; anterior margin of tergal plate 3 denticulate . . . . . ***P. sanjuanensis*** Higgins, 1961b
    Anteromesial thickenings of pachycycli ("Muttelwulste") not prominent on any sternal plate; lateral terminal spines thin, not robust; anterior margin of tergal plate 3 smooth, without sculpturing . . . . . ***P. sculptus*** Lang, 1949
17. Lateral terminal spines nearly equal to combined length of segments 12 and 13 . 18
    Lateral terminal spines nearly equal to or longer than combined length of segments 11, 12, and 13 20
18. Anterior margin of tergal plate 3 strongly denticulate . ***P. zelinkaei*** Southern, 1914
    Anterior margin of tergal plate 3 even, unsculptured 19
19. Posterior margin of sternal plates of segment 12 even, not projecting posteriorly at midline . . . . . ***P. beaufortensis*** Higgins, 1964b
    Posterior margin of sternal plates of segment 12 concave, projecting posteriorly at midline . . . . . ***P. greenlandicus,*** new species
20. Middorsal processes rounded on tergal plates 4–11; anterior margin of tergal plate 3 strongly denticulate, almost pectinate . . . . . ***P. robustus*** Zelinka, 1928

Middorsal processes absent or pointed on tergal plates 4–11; anterior margin of tergal plate 3 even or slightly denticulate 21
21. Middorsal processes absent on tergal plates 4–11 22
Middorsal processes pointed on tergal plates 4–11 . . ***P. longicornis*** Higgins, 1983
22. Posterior margins of tergal plate 13 with lateral bulbous protrusions and slight median notch; 2 lateral setae on each side of segment 12 . . . . . ***P. emarginatus*** Higgins, 1983
Posterior margin of tergal plate 13 even or slightly roughened; single lateral seta on each side of segment 12 23
23. Sternal plates 11 and especially 12 with strong longitudinal cuticular ridges near lateral margins . . . . . ***P. corrugatus*** Higgins, 1983
Sternal plates 11 and 12 without longitudinal cuticular ridges near lateral margins . 24
24. Midsternal plate broad at apex, about one-half basal width; terminal segment often telescoped within penultimate segment . . . . . ***P. ecphantor*** Higgins, 1983
Midsternal plate very narrow at apex, one-fourth to one-third the basal width; terminal segment prominently broad, rounded and exposed . . . . . ***P. egyptensis*** Higgins, 1966a

Pycnophyes cryopygus, new species

FIGURES 81–133

DIAGNOSIS.—Trunk segments 4–11 nearly uniform in width, tapering at segments 12, 13; terminal margin truncate; lateral terminal spines 184–220 μm long, 19.8–26.9 percent of trunk length, middorsal spinose processes of segments 3–12 projecting beyond margins of tergal plates, becoming larger in posterior progression to segment 11, process on segment 12 extremely reduced; midsternal plate nearly uniform in width; sternal setae lateral to sensory spots on segments 5–8, mesial to sensory spots on segments 9–11.

DESCRIPTION.—Adults (Figures 81–114), trunk length 760–865 μm; MSW-7 190–220 μm, 22.7–26.6 percent of trunk length; SW 156–180 μm, 19.3–22.6 percent of trunk length; middorsal spinose processes on segments 3–12 projecting beyond margin of tergal plates, becoming larger in posterior progression to segment 11, process on segment 12 extremely reduced.

Segment 2 consisting of 4 dorsal, incised placids, and 2 ventral even placids, all ~30 μm wide.

Segment 3, 106–121 μm long, $\bar{x}$ 24 = 113.7±3.6 μm, with acute anterolateral processes; slight sculpturing near dorsal and ventral anterior margin, small middorsal spinose process on tergal posterior margin; pair of subdorsal triangular muscle scars anterior to midlength of tergal plate, oval muscle scars posterior to triangular scars, large dorsoventral muscle scars near lateral margins of tergal plate; sensory spots lateral to dorsoventral muscle scars; midsternal plate nearly rectangular, ~115 μm long, 50 μm wide at anterior margin, 75 μm wide at posterior margin with slight lateral expansion anterior to midlength; midsternal and episternal plates with slight evidence of thinner cuticle submarginally; episternal plates with sensory spots near anterior margins and positioned at anterior limits of dorsoventral muscle scars; second set of sensory spots near posteromesial limits of dorsoventral muscle scars.

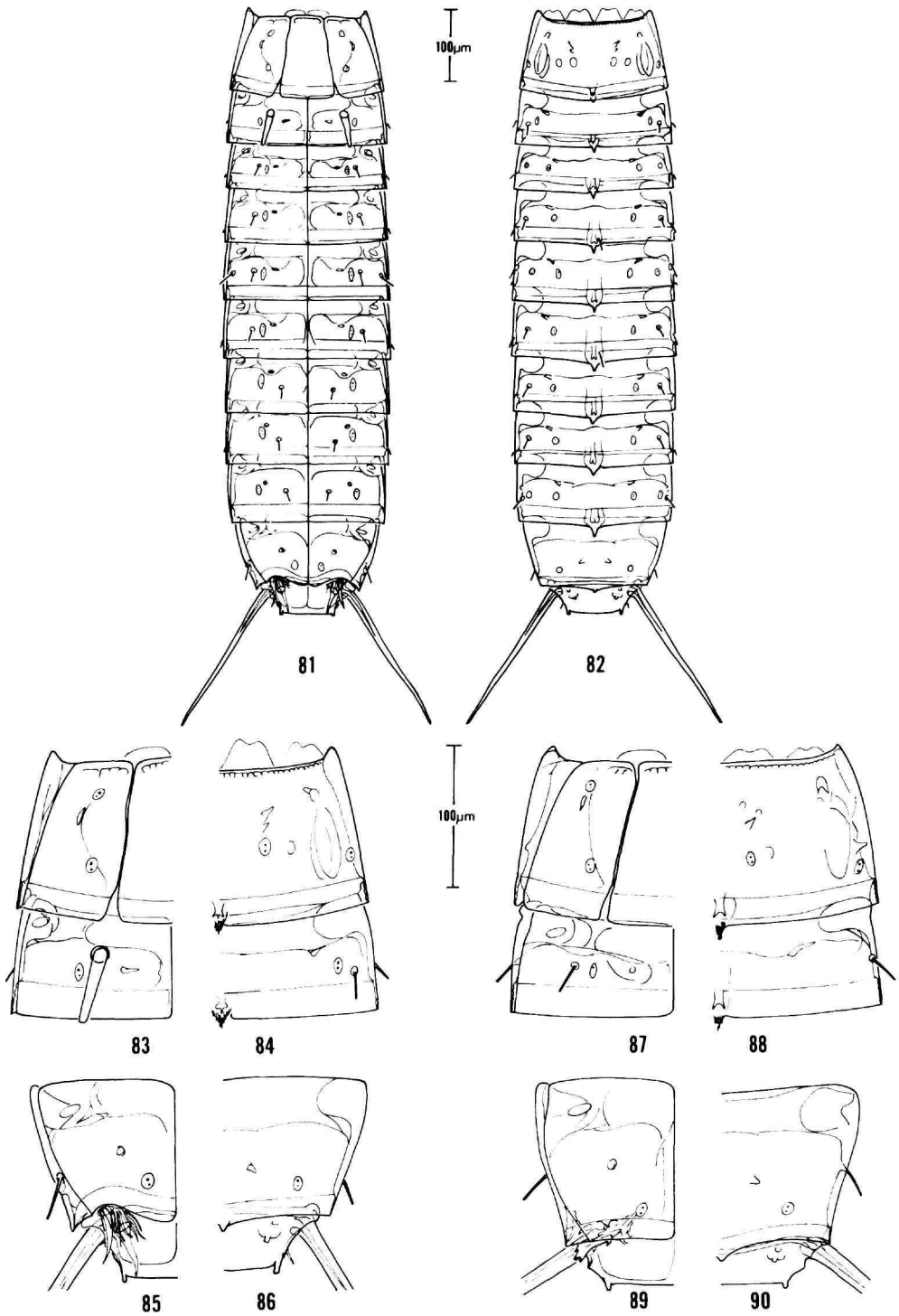
Segment 4, 74–84 μm long, $\bar{x}$ 2.4 = 74.5±2.7 μm; pachycycli of both tergal and sternal plates well developed; tergal plate with prominent, spinose middorsal process extending beyond posterior margin; angular dorsoventral muscle scars near anterolateral margins; sensory spots posterior and slightly lateral to angular muscle scars; single seta lateral to each sensory spot and another at tergosternal margin; sternal plates with narrow to oval, transversely oriented dorsoventral muscle scars near ventral midline; sensory spots lateral to muscle scars in females, prominent adhesive tubes, ~55 μm long, lateral to muscle scars in males; sensory spots posterolateral to adhesive tubes in males, setae lateral to sensory spots in females.

Segment 5, 70–79 μm long, $\bar{x}$ 24 = 74.5±2.7 μm; tergal plate as in previous segment except for stronger middorsal spinose process, slight mesial displacement of dorsoventral muscle scars and adjacent sensory spots, and replacement of dorsolateral setae with second, more laterally situated sensory spots; sternal plates of both sexes with median narrow, transversely oriented dorsoventral muscle scars (slightly more lateral than in previous segment), laterally adjacent sensory spots, and setae lateral to sensory spots.

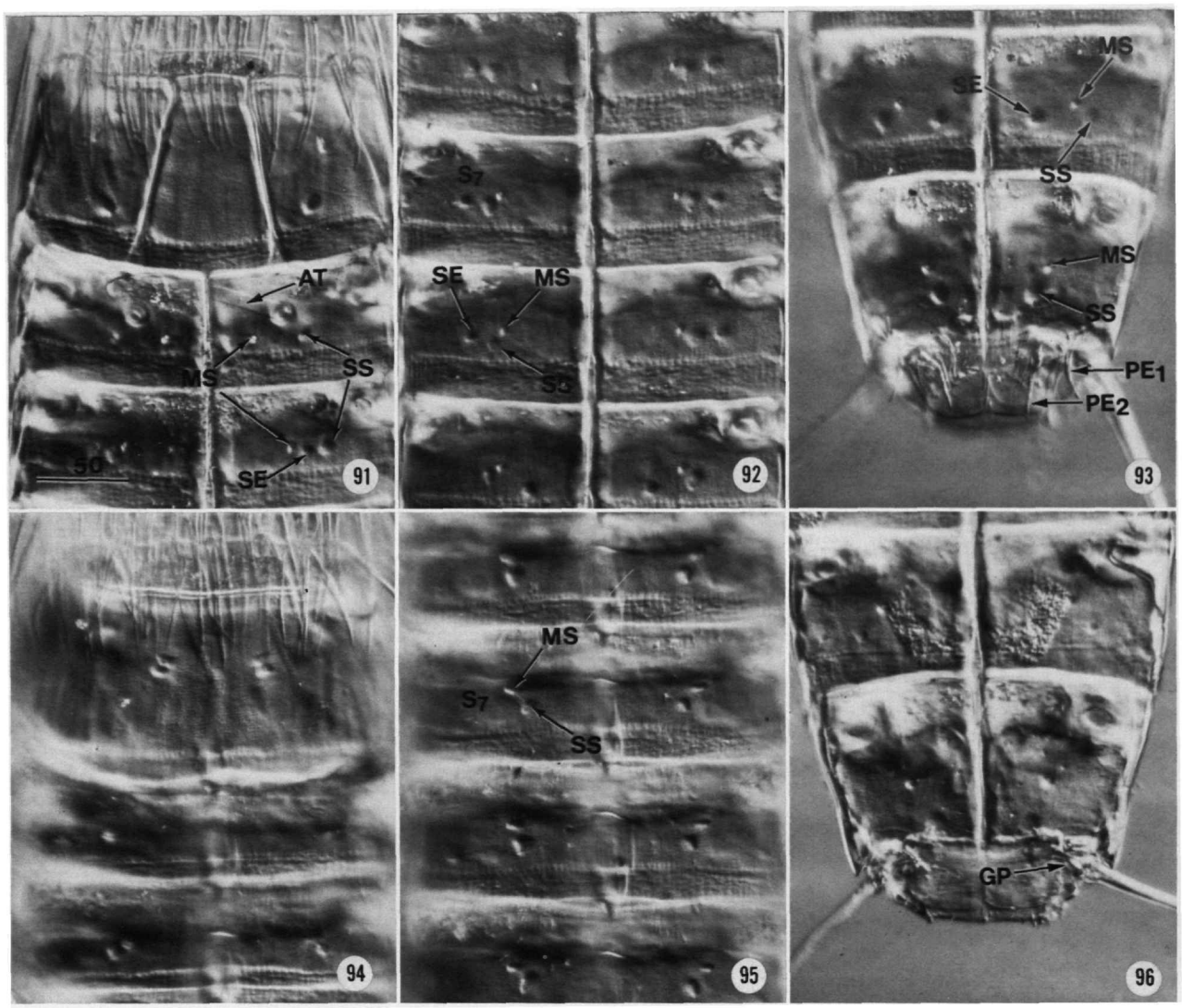
Segment 6, 74–82 μm long, $\bar{x}$ 24 = 77.8±2.5 μm; middorsal spinous process similar to that of previous segment, occasionally with one or more perispinal setae (Figure 82); dorsoventral muscle scars and adjacent sensory spots and setae at lateral margin as in segment 5, but dorsolateral setae replacing sensory spots; sternal plates similar to those of previous segments.

Segment 7, 74–86 μm long, $\bar{x}$ 24 = 80.2±2.9 μm; MSW 190–220 μm, $\bar{x}$ 24 = 205.8±1.0 μm; MSW/TL 22.7–26.6 percent, $\bar{x}$ 24 = 25.1±1.0 percent; tergal plate similar to that of segment 5; sternal plates similar to those of segment 6 with addition of pair of setae near lateral margins.

Segment 8, 78–90 μm long, $\bar{x}$ 24 = 81.6±2.9 μm; otherwise



FIGURES 81–90.—*Pycnophyes cryopygus*, new species. Holotypic male (USNM 233235): 81, 82, neck and trunk segments, ventral and dorsal views; 83, 84, segments 2–4, lateral half, ventral and dorsal views; 85, 86, segments 12–13, ventral and dorsal views. Allotypic female (USNM 233236): 87, 88, segments 2–4, ventral and dorsal views; 89, 90, segments 12–13, ventral and dorsal views.



FIGURES 91–96.—*Pycnophyes cryopygus*, new species. Holotypic male (USNM 233235): 91, segments 2–5, ventral view; 92, segments 6–9, ventral view; 93, segments 12–13, ventral view; 94, segments 2–5, dorsal view; 95, segments 6–9, dorsal view. Allotypic female (USNM 233236): 96, segments 12–13, ventral view. (Interference-contrast photographs all with same scale (in μm) as shown in Figure 91.)

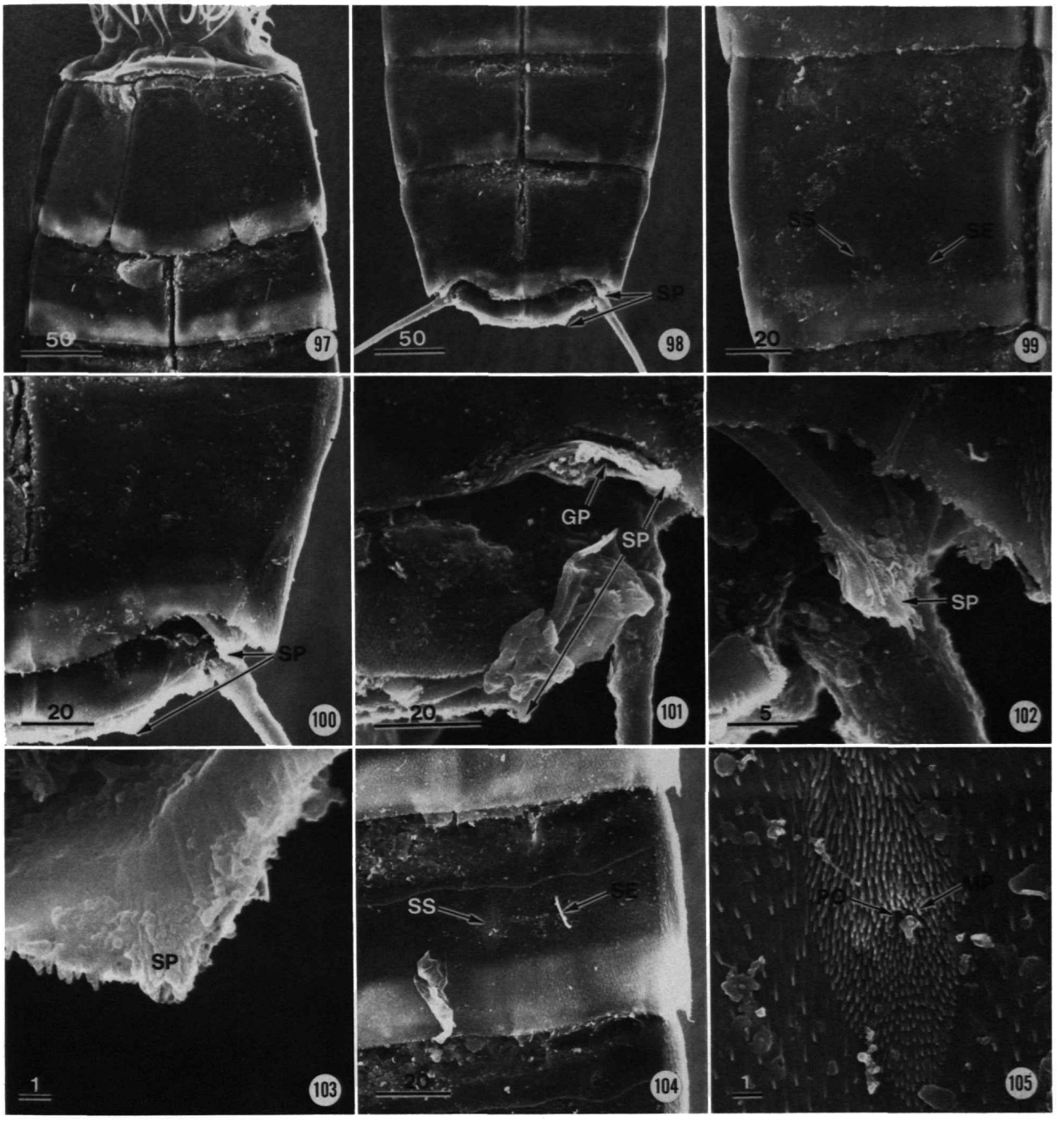
similar to segment 6.

Segment 9, 74–90 μm long, $\bar{x}$ 24 = 82.2±3.6 μm; tergal plate similar to that of previous segment; sternal plates with lateral setae mesial to sensory spot, otherwise similar to that of previous segment.

Segment 10, 80–94 μm long, $\bar{x}$ 24 = 87.0±4.4 μm; tergal plate similar to that of previous segment; sternal pachycycli with less extensive cuticularization, otherwise similar to those of previous segment.

Segment 11, 84–102 μm long, $\bar{x}$ 24 = 92.7±4.3 μm; tergal plate with 2 lateral sensory spots as in segments 5 and 7, setae near lateral margins displaced more dorsally than in previous segments; middorsal spinose process at maximum development; sternal plates with setae more mesial than in segment 10, otherwise similar.

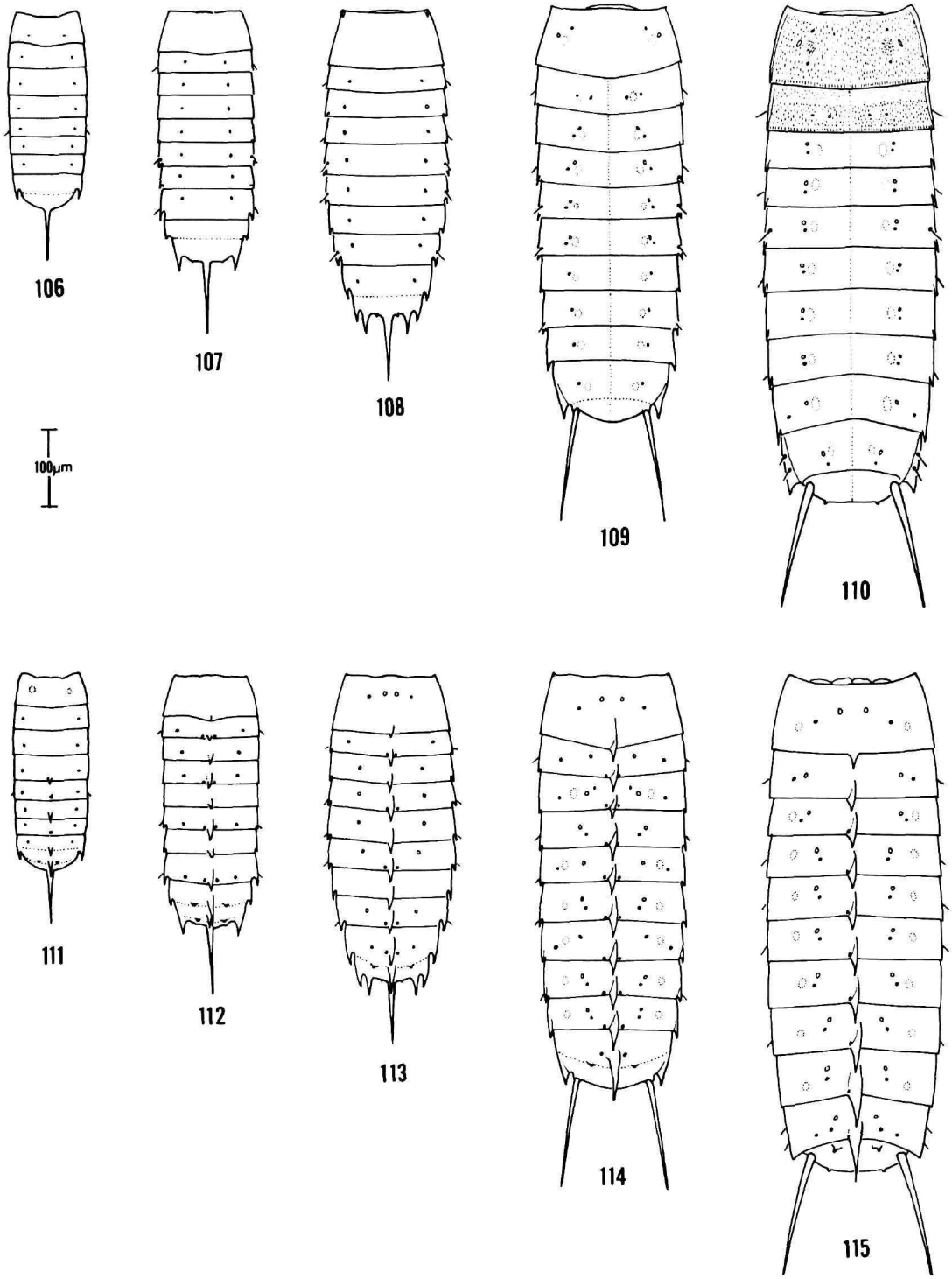
Segment 12, 86–110 μm long, $\bar{x}$ 24 = 100.6±5.6 μm, much wider at anterior than at posterior margin; SW 156–180 μm, $\bar{x}$ 24 = 169.0±7.4 μm; SW/TL 19.3–22.6 percent, $\bar{x}$ 24 = 20.6±0.8 percent; middorsal spinose process minute, forming only slight protuberance at posterior margin; dorsoventral muscle scars



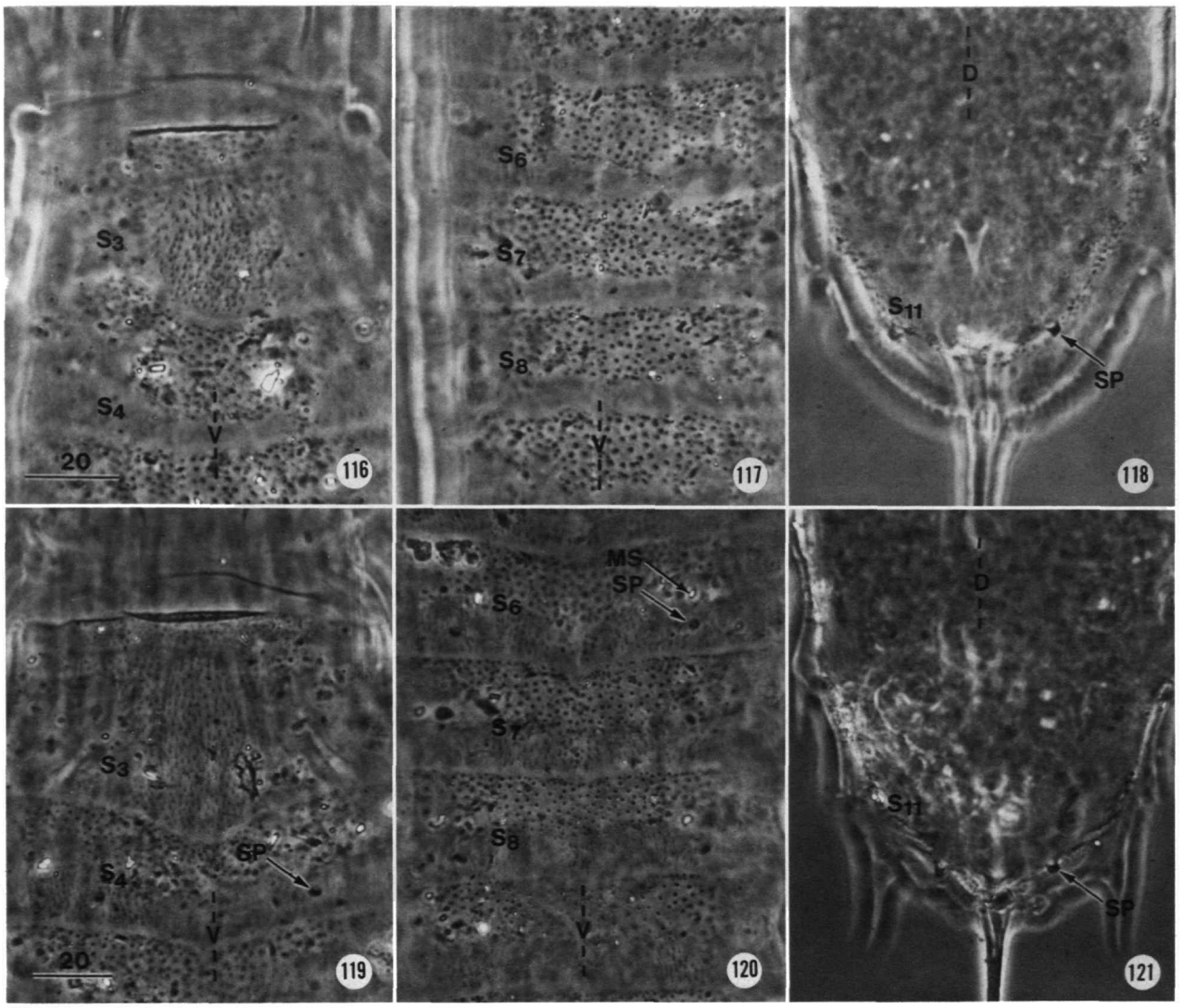
FIGURES 97–105.—*Pycnophyes cryopygus*, new species, female, ventral view: 97, segments 2–4; 98, segments 11–13; 99, segment 11, lateral half; 100, segments 12–13; 101, same as 100, magnified; 102, sensory papilla on segment 12; 103, sensory papilla on segment 13; 104, segment 5, lateral half; 105, same sensory spot as on 104, magnified. (SEM photographs, each to scale (in μm) indicated.)

closer to dorsal midline than in segment 12, and single sensory spot nearer posterior margin; lateral setae near tergal-sternal junction; sternal plates with dorsoventral muscle scars closer to ventral midline than in segment 12, sensory spots situated posteromesially, posterior margin concave.

Segment 13, 48–56 μm long, $\bar{x}$ 24 = 52.8±2.1 μm; lateral



FIGURES 106–115.—*Pycnophyes cryopygus*, new species, juvenile stages 1–5. Ventral views: 106, J-1; 107, J-2; 108, J-3; 109, J-4; 110, J-5. Dorsal views: 111, J-1; 112, J-2; 113, J-3, 114, J-4; 115, J-5.



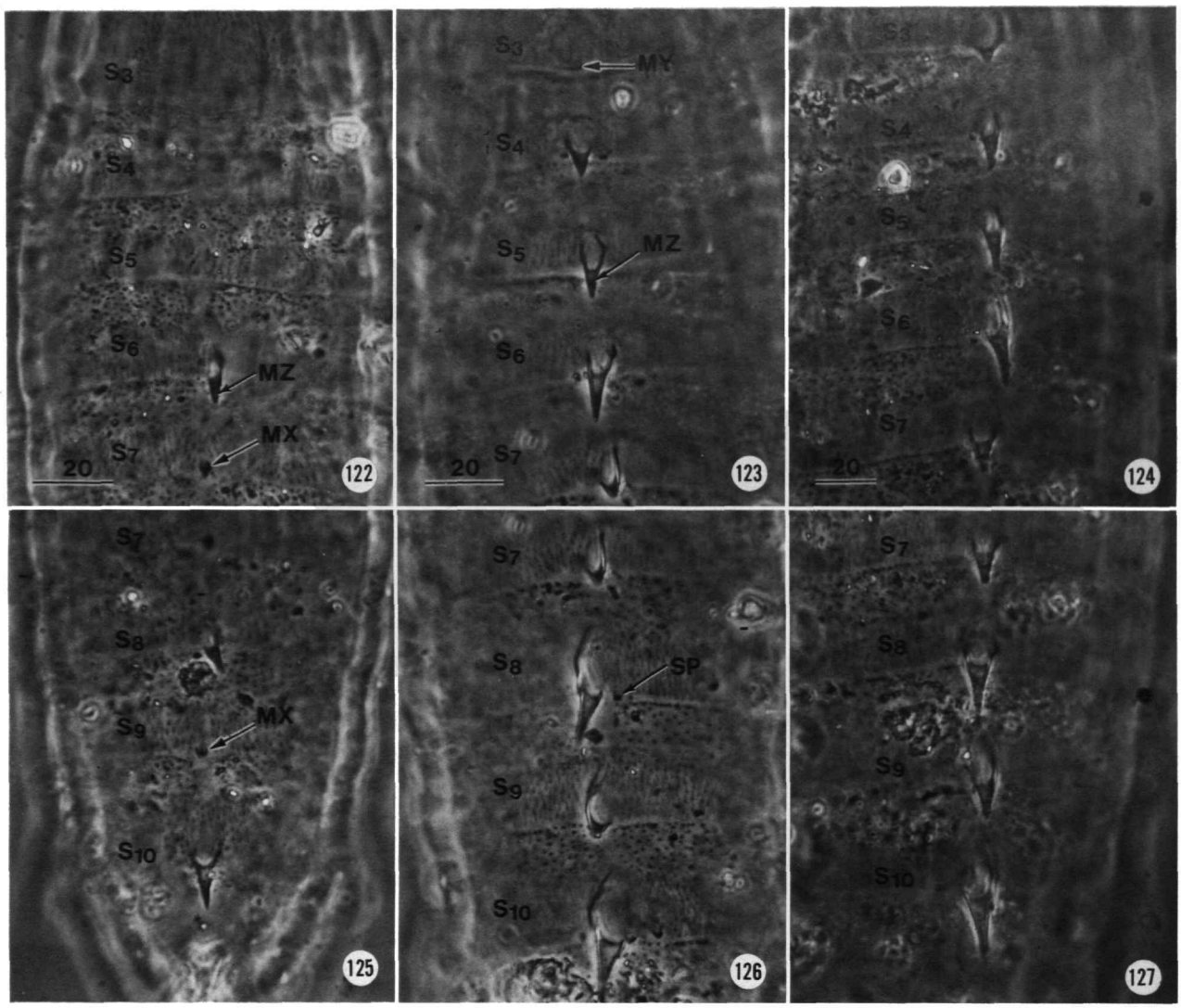
FIGURES 116–121.—*Pycnophyes cryopygus*, new species. J-1 stage: 116, segments 2–4, ventral view; 117, segments 6–8, ventral view; 118, segments 9–13, dorsal view. J-2 stage: 119, segments 2–3, ventral view; 120, segments 6–8, ventralview; 121, segments 9–13, dorsal view. (Phase-contrast photographs, Figures 116–118, to scale (in μm) as shown in Figure 116; Figures 119–121 to scale (in μm) as in Figure 119.)

terminal spines 184–220 μm long, $\bar{x}$ 23 = 197.1±10.8 μm, relatively thin (~12 μm at base); tergal plates with prominent cuticular scars near anterolateral margins, and sensory papillae at posterolateral margins (Figures 85, 86, 89, 90); combined sternal plates slightly smaller than tergal plate, margins generally conforming to those of tergal plate.

In addition to sexually dimorphic characters noted for segment 4, males differ from females in having 2 pairs of penile spines, ~35–40 μm long, at anterolateral margins of sternal plates of segment 13; anteriormost penile spine (P-1) associated with penile hairs on intersegmental tissue between segments 12 and 13, second penile spine (P-2) more posterior, associated with anterolateral margin of segment 13. Each pair of penile spines positioned within recurved posterior margin of segment 12; female gonopores in anterolateral regions of segment 13, appearing as slit-like openings in protruding intersegmental tissue; sensory papillae at lateral margins of gonopores.

Morphometric data for adult specimens are shown in Table 6.

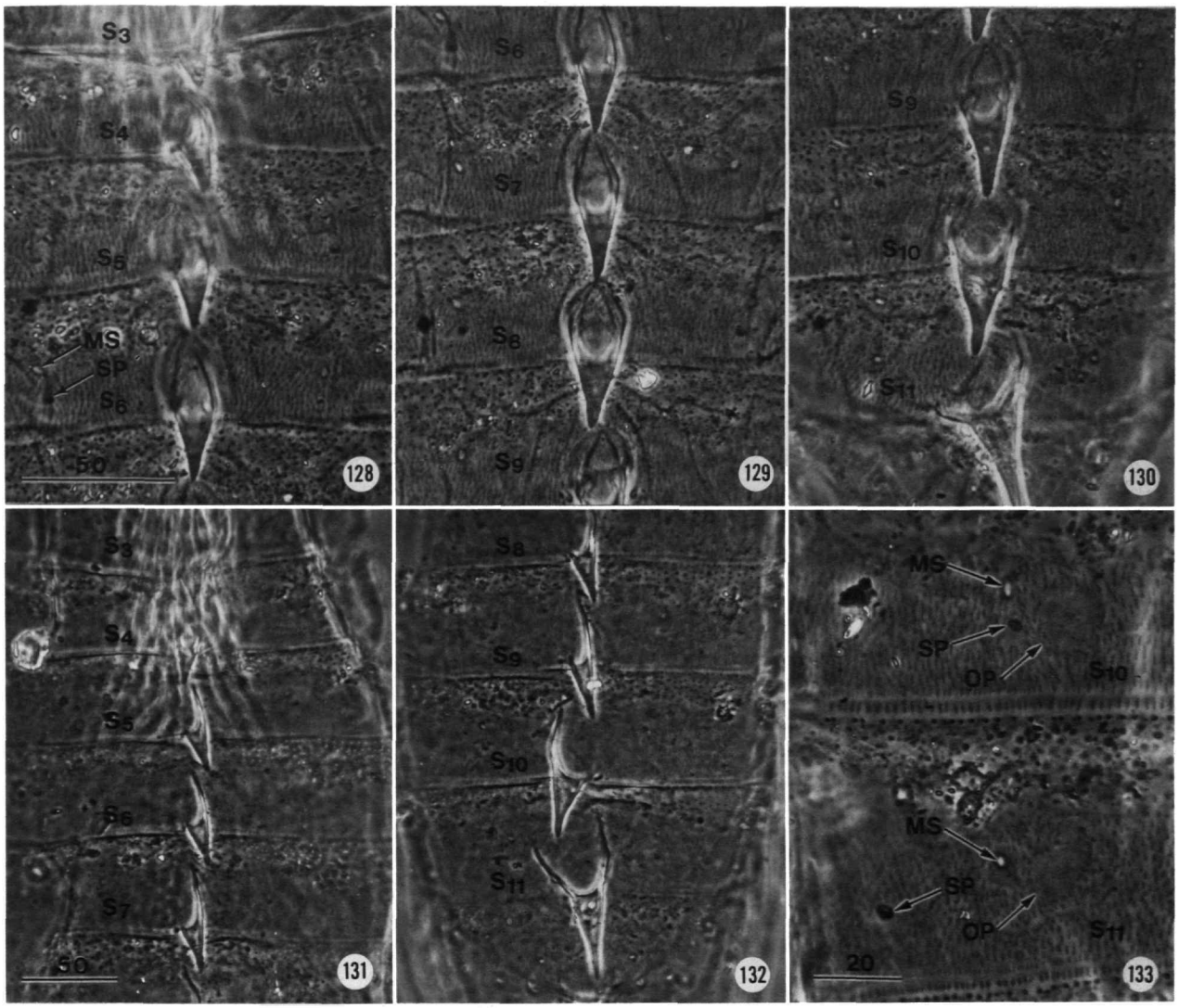
JUVENILE STAGES.—A series of 11 juvenile stages representing the first 5 of the normal 6 stages in the juvenile life history



FIGURES 122–127.—*Pycnophyes cryopygus*, new species, dorsal view. Segments 3–7: 122, J-1; 123, J-2, 124, J-3. Segments 7–11: 125, J-1; 126, J-2; 127, J-3. (Phase-contrast photographs, Figures 122 and 125 to scale (in μm) as shown in Figure 122; Figures 123 and 126 to scale (in μm) as shown in Figure 123; Figures 124 and 127 to scale (in μm as shown in Figure 124.))

of *Pycnophyes* were found in the type-locality of *P. cryopygus* and could be assigned, with reasonable assurance, to this species. All except one (mounted laterally) could be assigned to a specific stage (J-1–J-5, Figures 100–127). (Note: Sensory spots and/or setae tend to develop on either side of spinose processes laterally and middorsally; in the case of middorsal spinose processes, sensory spots or setae may develop on both sides or just one side; this also may be the case with the lateral processes at the tergosternal junction. If a seta develops on the ventral side of this junction, it is referred to as a ventrally displaced lateral seta; if it develops on the dorsal side of this junction it is referred to as a dorsally displaced lateral seta; if the position of the base of the seta cannot be determined it is referred to merely as a lateral seta.)

J-1 (first of three "Centrophyes" stages, juvenile stages originally assigned to the larval genus *Centrophyes* Zelinka, 1928), (Figures 106, 111, 116–118, 122, 125), TL 262–270 μm long; SW ~62–80 μm (estimated because tergosternal articulation zones are not apparent in early juvenile stages); SW/TL ~23.6–29.6 percent; MSW-4 ~82–95 μm; MSW/TL ~31.2–35.1 percent; MTS (midterminal spine) 72–90 μm long; MTS/TL 27.4–33.3 percent.



FIGURES 128–133.—*Pycnophyes cryopygus*, new species. J-4, dorsal view: 128, segments 3–6; 129, segments 6–9; 130, segments 9–11. J-5, dorsal view: 131, segments 3–7; 132, segments 8–11. J-5, ventral view: 133, segments 10–11, lateral half. (Phase-contrast photographs, Figures 128–130 to scale (in μm) as shown in Figure 128; Figures 131, 132 to scale (in μm) as shown in Figure 131; Figure 133 scale in μm.)

In ventral aspect second segment represented by poorly developed single median placid situated in concave margin of undivided ventral cuticle (possibly single sternal plate), tergosternal junctions appear not to be established (Figure 106); segments 3–9 each with laterally situated small oval thin areas of cuticle, assumed to be dorsoventral muscle scars; segments 10, 11 (including 12, 13) distinguished by weakly developed transverse line; lateral setae on segment 7. Terminal segment with midterminal spine only.

Cephalic extremity in dorsal aspect situated in concave margin of segment 3, exhibiting slight bulge possibly indicating 2 subdorsal anlagen of placids of segment 2; oval patches, ~5–7 μm, apparently areas of nonporous cuticle, near lateral margins of segment 3; segments 4–9 with laterally situated dorsoventral muscle scars; segment 7 with lateral setae near presumptive tergal margins; segments 6, 8, 10, and 11 with middorsal spinous processes extending posteriorly from tergal plate margins; segments 7 and 9 with middorsal papillae (Figures 122, 125: MX), anlagen of middorsal spinous processes, appearing similar to sensory papillae; posterior margin of segment 10 with subdorsal sensory papillae.

J-2 (Figures 107, 112, 119–121, 123, 126), TL 315–345 μm;

TABLE 6.—Measurements (μm) and indices (%) for *Pycnophyes cryopygus* adults (see text for explanation of abbreviations).

Character	Sex	Sample size	Range	Mean	Standard deviation	Standard error	Coefficient of variability
TL	m	16	760–845	806.3	30.2	7.6	3.7
	f	8	825–865	842.5	16.5	5.8	2.0
	mf	24	760–865	818.3	31.3	6.4	3.8
SW	m	16	156–174	165.5	4.8	1.2	2.9
	f	8	160–180	176.0	6.9	2.4	3.9
	mf	24	156–180	169.0	7.4	1.5	4.4
SW/TL	m	16	19.3–22.6	20.5	0.8	0.2	3.9
	f	8	19.3–21.8	20.8	0.8	0.3	3.6
	mf	24	19.3–22.6	20.6	0.8	0.2	3.8
MSW-7	m	16	190–220	202.0	6.9	1.7	3.4
	f	8	194–220	213.3	8.0	2.8	3.8
	mf	24	190–220	205.8	1.0	1.8	4.4
MSW/TL	m	16	22.7–26.6	25.1	1.0	0.3	4.1
	f	8	23.5–26.1	25.3	0.8	0.3	3.3
	mf	24	22.7–26.6	25.1	1.0	0.2	3.9
LTS	m	15	184–220	197.9	9.3	2.4	4.7
	f	8	170–210	195.5	13.6	4.8	7.0
	mf	23	184–220	197.1	10.8	2.2	5.5
LTS/TL	m	15	22.4–26.9	24.5	1.7	0.4	6.8
	f	8	19.8–25.4	23.2	1.8	0.6	7.7
	mf	23	19.8–26.9	24.1	1.8	0.4	7.5
SL-3	m	16	106–118	112.8	3.5	0.9	3.1
	f	8	112–121	115.6	3.2	1.1	2.8
	mf	24	106–121	113.7	3.6	0.7	3.2
SL-4	m	16	74–84	78.3	2.9	0.7	3.7
	f	8	76–84	81.0	2.5	0.9	3.0
	mf	24	74–84	74.5	2.7	0.6	3.7

SW ~80–90 μm; SW/TL ~24.2–25.3 percent; MSW-4 ~115–128 μm; MSW/TL ~34.8–38.0 percent; MTS 88–95 μm long; MTS/TL 34.8–38.0 percent.

Similar in ventral aspect to J-1 stage; additional segments (segments 12, 13) established by weak transverse line; segments (3)4–10 with dorsoventral muscle scars (presumed present on segment 3 but not seen in specimens); segment 8 with ventrally displaced lateral setae, segments 4 and 10 with lateral setae; terminal segment with posterolateral margins projecting well beyond margin and bearing midterminal spine.

Similar in dorsal aspect to J-1 stage, especially segment 2; anterior margin of trunk truncate; additional segments as noted above; slight indication of middorsal spinous process on segment 3, better developed process on segments 4–12 (Figure 112), processes on segments 7, 9, and 12 smaller than those on segments 8, 10 and 11; process on segment 11 twice as long as any preceding process; perispinal sensory papillae on segments 4, 6, 8, and 10; subdorsal sensory papillae at margins of segment 11 and 12; terminal segment with prominent spinose processes at lateral margins and midterminal spine; dorsoventral muscle scars present on dorsal surface of segments (3)4–6, 8, 10, apparently missing on segments 3(?), 7, and 9.

J-3 (Figures 108, 113, 124, 127), TL 395 μm; SW ~75 μm; SW/TL ~18.9 percent; MSW-4 ~145 μm; MSW/TL ~36.7 percent; MTS 90 μm long; MTS/TL 22.7 percent.

Similar in ventral aspect to J-1 stage, terminal region more strongly tapered, segment 13 not delineated, but more apparent; segment 2 represented by single midventral placid set off from segment 3; segment 3 as in J-2 stage; dorsoventral muscle scars present on segments 4–11; ventrally displaced lateral setae on segments 7, 8, and 10 in addition to lateral setae on segments 4 and 6; segment 13 with posterolateral margins projecting well beyond terminal margin; sensory papillae on terminal margin, lateral to midterminal spine.

Similar in dorsal aspect to J-2 stage, with modifications

TABLE 6.—Continued.

Character	Sex	Sample size	Range	Mean	Standard deviation	Standard error	Coefficient of variability
SL-5	m	16	70–78	73.9	2.6	0.7	3.5
	f	8	72–79	75.8	2.7	0.9	3.5
	mf	24	70–79	74.5	2.7	0.6	3.7
SL-6	m	16	74–81	76.9	2.3	0.6	3.0
	f	8	76–82	79.5	1.9	0.7	2.3
	mf	24	74–82	77.8	2.5	0.5	3.2
SL-7	m	16	74–82	79.2	2.7	0.7	3.4
	f	8	80–86	82.3	2.3	0.8	2.8
	mf	24	74–86	80.2	2.9	0.6	3.7
SL-8	m	16	78–90	81.6	2.9	0.7	3.6
	f	8	81–88	85.3	3.0	1.1	3.5
	mf	24	78–90	81.6	2.9	0.7	3.6
SL-9	m	16	74–85	80.6	2.6	0.7	3.2
	f	8	81–90	85.5	3.0	1.1	3.5
	mf	24	74–90	82.2	3.6	0.7	4.3
SL-10	m	16	80–91	84.9	3.4	0.8	4.0
	f	8	86–94	91.3	2.9	1.0	3.1
	mf	24	80–94	87.0	4.4	0.9	5.1
SL-11	m	16	84–96	90.7	3.3	0.8	3.6
	f	8	92–102	96.6	3.2	1.1	3.3
	mf	24	84–102	92.7	4.3	0.9	4.6
SL-12	m	16	86–110	98.6	5.7	1.4	5.8
	f	8	102–108	104.6	1.8	0.6	1.7
	mf	24	86–110	100.6	5.6	1.1	5.5
SL-13	m	16	50–56	53.1	1.8	0.5	3.5
	f	8	48–56	52.2	2.4	0.9	4.6
	mf	24	48–56	52.8	2.1	0.4	3.9

noted in ventral aspect; middorsal processes, increasing in size in posterior progression, on segments 3–12, perispinal sensory papillae on segments 4, 6, 8, 10, and 11; similar sensory papillae lateral to dorsoventral muscle scars on segment 3 and subdorsally on posterior margins of segments 11 and 13; dorsoventral muscle scars subdorsally near anterior margin of segment 3, near lateral margins on segment 4, and dorsolateral to subdorsal on segments 5–8, 10, 11 as in J-2 stage (apparently none on segment 9).

J-4 (first of 3 "Hyalophyes" stages, originally assigned to the larval genus *Hyalophyes* Zelinka, 1928; see also Figures 109, 114, 128–130), TL 535–550 μm; SW ~140–160 μm; SW/TL ~26.1–29.0 percent; MSW-4 ~195–210 μm, MSW/TL ~36.4–38.1 percent; without midterminal spine; lateral terminal spines present; LTS 140–145 um long; LTS/TL 25.6–27.1 percent.

Trunk in ventral aspect more rectangular, successive segments only slightly narrower beginning with segment 4; midventral suture indicated on segments 4–13; dorsoventral muscle scars near lateral margins of segment 3, near midline on segment 4, slightly more lateral, nearly medial on sternal plates of segments 5–12; oval patches, ~10–12 μm, posteromesially adjacent to dorsoventral muscle scars on segment 3, laterally adjacent to dorsoventral muscle scars on segment 4, and mesially adjacent to dorsoventral muscle scars on segments 5–12; sensory papillae anteromesially adjacent to dorsoventral muscle scars on segment 3, laterally adjacent to oval patches of nonporous cuticle on segment 4, and posterolaterally adjacent to dorsoventral muscle scars on segments 5–8; lateral setae as in J-3 stage; lateral terminal spines present, posterior margin of terminal segment (segment 13) evenly rounded.

Prominent middorsal spinous processes on segments 3–12; perispinal sensory papillae on segments 4–12; dorsoventral muscle scars subdorsally on segment 3, slightly more laterally on segments 4–11; oval patches laterally adjacent to dorsoventral muscle scars on segments 5, and 7–11 (absent on segments

3, 4, 6, 12, 13); sensory papillae posterolateral to dorsoventral muscle scars on segments 3 and 4, laterally adjacent to oval patches on segments 5, 7, and 9, posteromesial to dorsoventral muscle scars on segments 6, 8, 10, and 11; sensory papillae medially at posterior margin of segment 12.

J-5 (Figures 110, 115, 131–133), TL 655 μm; SW ~190 μm; SW/TL ~29.0 percent; MSW–7, ~225 μm; MSW/TL ~34.3 percent; LTS 175 μm; LTS/TL 26.7 percent.

Similar in ventral aspect to J-4 stage; dorsoventral muscle scars nearly identical to those of J-4 stage; oval patches slightly larger (~10–15 μm), in same position as J-4 stage; additional sensory papillae adjacent posteriorly to oval patch on segment 3, additional sensory papillae immediately posterior to dorsoventral muscle scars on segments 9, 10, and 12, near lateral margins of segment 11; lateral, near lateral terminal spines, on truncate terminal margin of segment 13; single ventrally displaced lateral setae on segment 7, double setae on segment 12, lateral setae on segments 4, 6, 8, and 10.

In dorsal aspect, 4 placids (of segment 2) visible adjacent to concave anterior margin of segment 3; oval patches of nonporous cuticle on segments 3, 5–11 (apparently missing on segments 4 and 12 as in J-4 stage); dorsoventral muscle scars as in J-4 stage, more lateral on segments 4 and 5, dorsoventral muscle scars on segment 12; perispinal sensory papillae on segments 5–12; sensory papillae posterolateral to dorsoventral muscle scars on segment 3, posterolaterally adjacent to dorsoventral muscle scars on segments 4 and 5, posterior to dorsoventral muscle scars on segments 6–12, and near anterolateral margin on segment 13.

HOLOTYPE.—Adult male, TL 845 μm (Figures 81–86, 91–95), Disko Island, sta RH 1529, USNM 233235.

ALLOTYPE.—Adult female, TL 865 μm (Figures 87–90, 96), other data as for holotype, USNM 233236.

PARATYPES.—Four females and 2 males, TL 820–855 μm, other data as for holotype, USNM 233237; 11 juveniles, TL 262–550 μm (Figures 106–127), other data as for holotype, USNM 233238; 40 unmounted specimens, data as for holotype, USNM 233239; 7 females and 3 males, TL 795–860 μm, Disko Island, sta RH 1534, USNM 233240; 1 male, TL 760 μm, Disko Island, sta RH 1535, USNM 233241; 4 females and 6 males, TL 765–855 μm, Disko Island, sta RH 1536, USNM 233242; 2 males and 2 females (SEM preparations) on stubs 75, 76, Disko Island, sta RH 1536, USNM 233243; 13 unmounted specimens, Disko Island, sta RH 1536, USNM 233244; 1 female and 2 males, TL 760–825 μm, Disko Island, sta RH 1538, USNM 233245; 2 juveniles, TL 245, 255 μm, Disko Island, sta RH 1538, USNM 233246. Other paratypes have been deposited in the Zoological Museum, Copenhagen.

REMARKS.—*Pycnophyes cryopygus* resembles only a few described species, all occurring in the North Atlantic, as might be expected. With respect to the prominent middorsal spinous processes, *P. cryopygus* is similar to *P. dentatus*. Segment 3 of latter also has a slightly sculptured anterior margin, which is similar to that of *P. cryopygus*. However, among the many differences, *P. cryopygus* has strongly incised dorsal placids (as contrasted with even margins in *P. dentatus*), the distinctive parallel longitudinal striations near the lateral margins of the sternal plates of segment 12 (in *P. dentatus*) are missing in *P. cryopygus*, and the rounded terminal margin and relatively thin, lateral terminal spines of *P. dentatus* contrast strikingly with the truncate terminal margin and long, robust lateral terminal spines of *P. cryopygus*.

The only species described from the northwest Atlantic, *P. frequens*, has much less prominent middorsal spinous processes, although these processes occur on the same segments as in *P. cryopygus*. The former species has a relatively long, narrow trunk (TL 730–810 μm; SW/TL ~16.8 percent; MSW/TL ~21.3 percent) contrasted with *P. cryopygus* (TL 760–865 μm; SW/TL ~20.6 percent; MSW/TL ~25.1 percent). Cuticular features, such as setae, and muscle scars, are considerably different, despite similarities in the truncate posterior margin and lateral terminal spines.

Insofar as known, there are normally 6 juvenile stages in the life history of the Kinorhyncha (Higgins, 1961a; 1968; 1974; 1977a; Higgins and Fleeger, 1980). The series of paratypic juveniles noted in the description of *P. cryopygus* represented only the first 5 of the 6 stages; all were found with the type-specimen (sta RH 1529). Collections from this locality had only a single specimen of the other species of *Pycnophyes*, the description of which follows these remarks. Therefore, it seems reasonable to assume that the juvenile series belong to the most abundant species. In most instances, juveniles of *P. cryopygus* can be differentiated from the second species, but the latter species is not represented by a sufficient number of specimens, or specimens in satisfactory condition for adequate study.

Several generalizations can be made based on this series of juvenile stages. First, there is a relatively uniform increase in the growth of the species from one stage to another. Cuticular characters such as dorsoventral muscle scars, lateral setae, sensory papillae, and the oval patches of nonporous cuticle appear to develop in a definite sequence, although some inconsistencies occur, perhaps a reflection of the limited number of specimens studied. As first noted by Zelinka (1928:345), a marked change occurs when the last of the 3 "Centrophyes" stages (Figures 108, 113) molts to form the first of 3 "Hyalophyes" stages (Figures 109, 114).

The sequence in the development of middorsal spinous process from the J-1 stage to the J-2 stage involves first the middorsal spinous processes on segments 6, 8, and 10 with sensory papillae-like structures as the anlagen of the processes on segments 7 and 9. Although these processes are considerably different from the middorsal spines of the Cyclorhagida, and persist only in the juvenile stages of many species of *Pycnophyes*, there is an obvious suggestion that middorsal spinous processes and their homologous middorsal spines must be considered carefully in adjudging plesiomorphic-apomorphic status in investigations of kinorhynch phylogeny.

The evidence presented by this series of juvenile development also suggests that juvenile clusters of micropapillae

(sensory papillae) may be relatively unaltered and remain as "sensory spots"; probably they are homologs of the flosculae of the Priapulida (van der Land, 1970:77) and the Loricifera (Kristensen, 1983:169; Higgins and Kristensen, 1986:34), and there is some suggestion that they may develop into setae or even spines. The final disposition of this hypothesis can be effected only through careful study of the ultrastructure of the life history stages of kinorhynchs.

The missing J-6 stage of *P. cryopygus* probably will exhibit many more characters similar to those of the adult, including the initial sutures defining the 3 ventral plates on the first trunk segment (segment 3). This latter condition is manifested in the adults of the genus *Paracentrophyes* in the neotenic family Neocentrophyidae (Higgins, 1983:44). Similarly, the midventral placid corrresponding to that of the juvenile *Pycnophyes* remains as such in the latter family, but changes into 2 bilaterally situated placids in the adult *Pycnophyes*.

ETYMOLOGY.—The name of this species is from the Greek *kryos* (icy, cold) plus *pyge* (rump), given in recognition of the common condition experienced in Arctic research.

Pycnophyes greenlandicus, new species

FIGURES 134–167

DIAGNOSIS.—Trunk segments 4–11 nearly uniform in width, tapering at segments 12, 13; terminal tergal margin truncate; lateral terminal spines 126–255 μm long, 14.8–22.7 percent of trunk length; subcuticular middorsal spinose processes nearly uniform in size on segments 3–11 only, barely protruding beyond posterior margins of segments 3–8, otherwise even with margins; midsternal plate trapezoidal; sternal setae lateral to sensory spots on segments 4 and 5, mesial to sensory spots on segments 6–11.

DESCRIPTION.—Adults (Figures 134–167), trunk length 855–1035 μm; MSW-7 186–225 μm, 17.8–25.8 percent of trunk length; SW 160–184 μm, 15.9–20.4 percent of trunk length; middorsal spinose processes subcuticular, on segments 3–11 uniform in size, barely protruding beyond margins of tergal plates 3–8, otherwise even with margins.

Segment 2 consisting of 4 dorsal, incised placids, and 2 ventral even placids, all ~35–45 μm wide.

Segment 3, 106–120 μm long, $\bar{x}$ 30 = 113.3±4.1 μm; with angular anterolateral processes; anterior margin without sculpturing, small slightly protruding subcuticular middorsal process at posterior tergal margin; pair of subdorsal triangular muscle scars near anterior margin of tergal plate, smaller scars adjacent posteriorly, large, elongate dorsoventral muscle scars near anterolateral margins; midsternal plate trapezoidal, ~90 μm long, ~40 μm wide at anterior margin, ~75 μm wide at posterior margin; slight evidence of thinner cuticle submarginally on midsternal plate, two adjacent areas of thinner cuticle submarginally on each episternal plate; episternal plates with sensory spots between anterior margins and anterior limits of dorsoventral muscle scars; slight cuticular scar along midlateral edge of dorsoventral muscle scars; possible second set of sensory spots near posteromesial margins of dorsoventral muscle scars.

Segment 4, 80–91 μm long, $\bar{x}$ 30 = 86.0±3.2 μm; pachycycli of both tergal and sternal plates well developed; tergal plate with subcuticular spinous process similar to that on segment 3; sensory spots near midlateral margins; small, oval dorsoventral muscle scars mesial to sensory spots; smaller, circular cuticular scars mesial to oval dorsoventral muscle scars; sternal plates with small, mesial, oval dorsoventral muscle scar and smaller posteromesial cuticular scar; sensory spots slightly lateral to midregion of sternal plates with laterally adjacent setae in females and anteromesially adjacent, prominent adhesive tubes, ~50 μm long, in males; lateral setae projecting from lateral margin.

Segment 5, 75–94 μm long, $\bar{x}$ 30 = 85.9±4.0 μm; tergal plate with subcuticular spinose process, muscle scars and cuticular scars closely resembling those of previous segment; sensory spot posteriorly displaced between cuticular scars; setae lateral to sensory spots and flanked laterally by additional sensory spots; sternal plates with small, circular cuticular scars near strongly cuticularized mesial margin, additional scars near anteromedial margin of each plate; sensory spots posterior to anteromedial scars, setae lateral to latter.

Segment 6, 80–98 μm long, $\bar{x}$ 30 = 93.0±4.2 μm; tergal plate as in previous segment, anterolateral dorsoventral muscle scars slightly elongated at posterior margin of pachycyclus; lateral sensory spots slightly more anterior than on previous segment, near posterior limits of pachycyclus; sternal plate with additional cuticular scars posteromesial to anteromedial scars, setae mesial to sensory spots and at lateral margins.

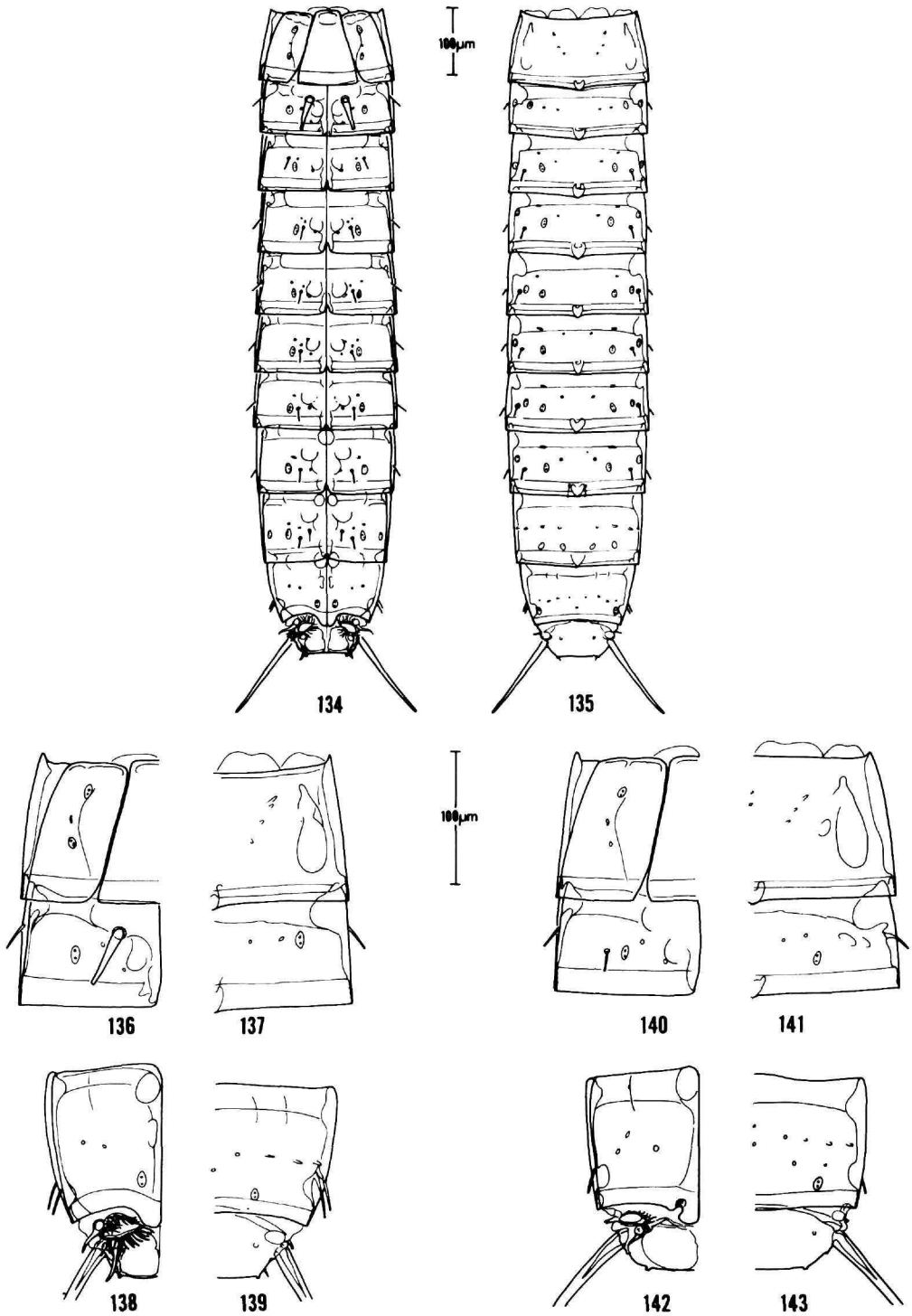
Segment 7, 84–100 μm long, $\bar{x}$ 30 = 93.0±4.2 μm; MSW 186–225 μm, $\bar{x}$ 30 = 198.5±8.1 μm; MSW/TL 17.8–25.8 percent, $\bar{x}$ 30 = 21.0±1.6 percent; mesial sensory spots as in previous segment, later sensory spots now nearly adjacent to mesial sensory spots, mesially adjacent to setae; single cuticular scar anterior to mesial sensory spots; subcuticular spinose process slightly smaller than that in previous segment; sternal plates similar to those of previous segment, anteriormost cuticular scars slightly more lateral to sensory spots, setae at lateral margins of sternal plates.

Segment 8, 90–102 μm long, $\bar{x}$ 30 = 95.9±4.0 μm; tergal and sternal plates similar to those of segment 7.

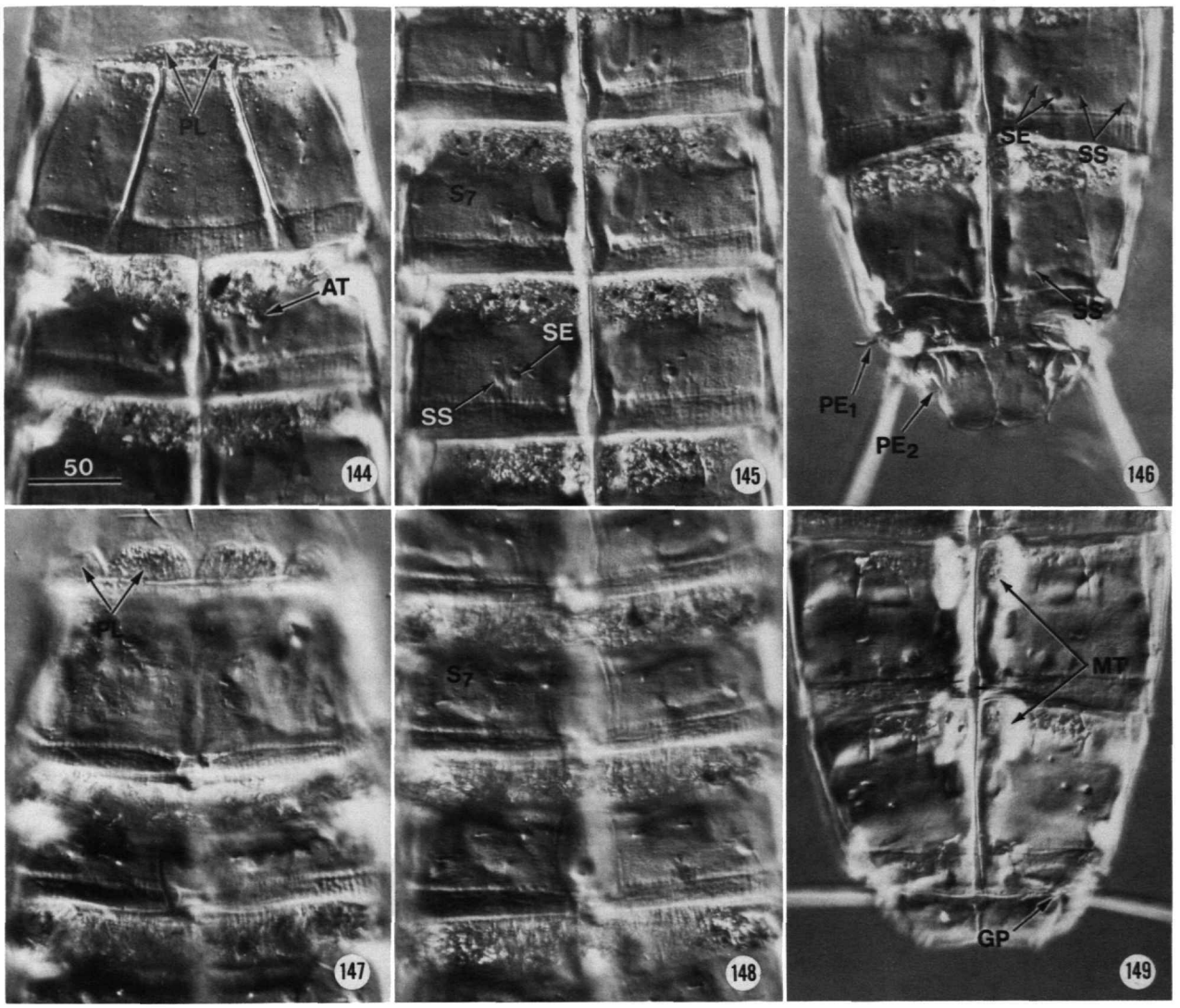
Segment 9, 85–104 μm long, $\bar{x}$ 30 = 97.7±4.1 μm; tergal and sternal plates similar to those of segment 7.

Segment 10, 93–110 μm long, $\bar{x}$ 30 = 100.7±16.1 μm; subcuticular middorsal spinose process slightly larger than those on previous segment, with perispinal setae, segment otherwise similar to segment 8; sternal plates similar to those of segments 8, 9.

Segment 11, 96–112 μm long, $\bar{x}$ 30 = 101.1±18.9 μm; subcuticular middorsal spinose process less prominent than on previous segment; transverse row of 4 cuticular scars laterally on dorsal plate; sensory spots subdorsally, additional



FIGURES 134–143.—*Pycnophyes greenlandicus*, new species. Holotypic male (USNM 233247): 134, 135, neck and trunk segments, ventral and dorsal views; 136, 137, segments 2–4, lateral half, ventral and dorsal views; 138, 139, segments 12–13, ventral and dorsal views. Allotypic female (USNM 233248): 140, 141, segments 2–4, ventral and dorsal views; 142, 143, segments 12–13, ventral and dorsal views.

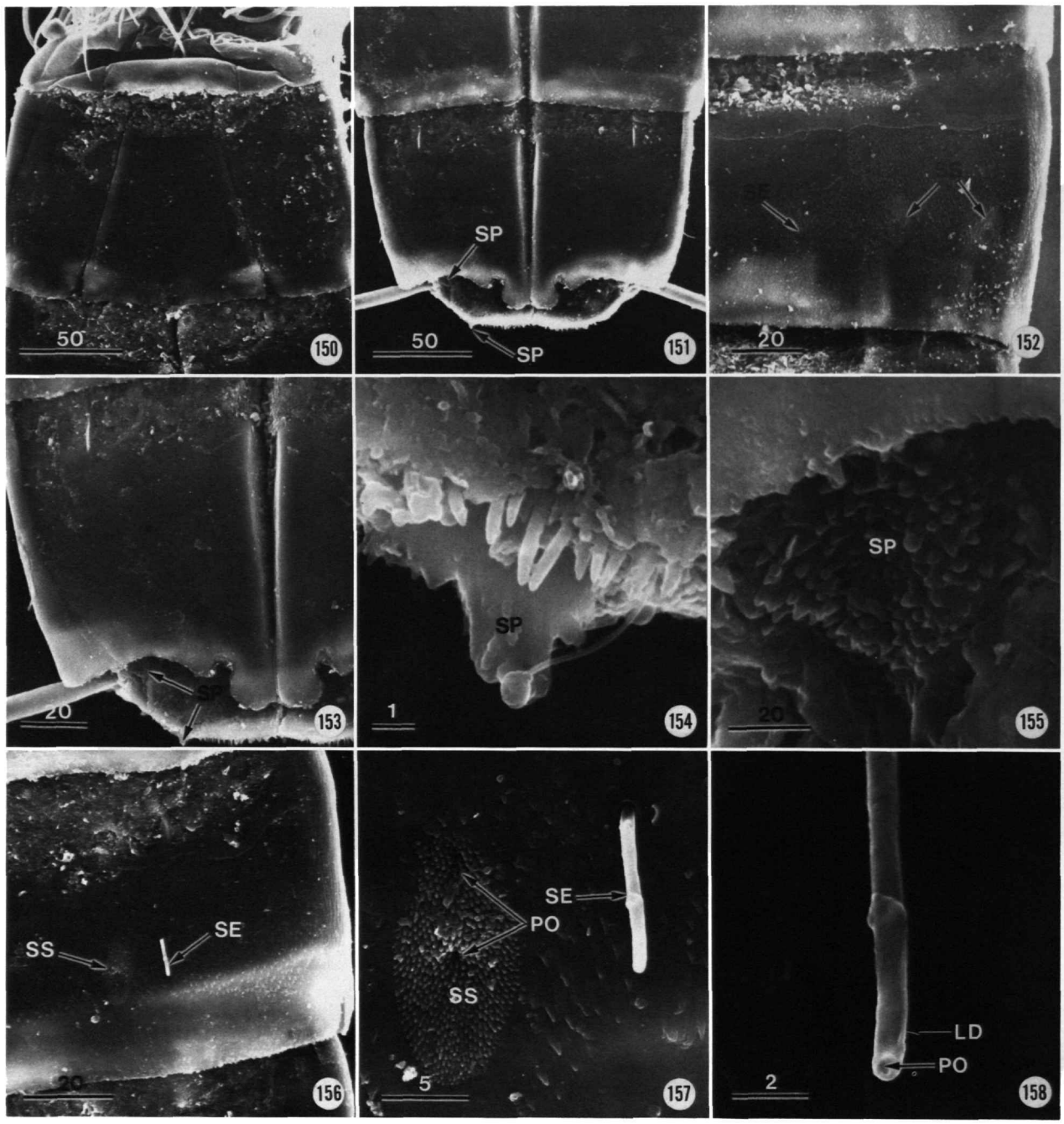


FIGURES 144–149.—*Pycnophyes greenlandicus*, new species. Holotypic male (USNM 233247): 144, segments 2–5, ventral view; 145, segments 6–8, ventral view; 146, segments 11–13, ventral view; 147, segments 2–5, dorsal view; 148, segments 7–8, dorsal view. Allotypic female (USNM 233248): 149, segments 12–13, ventral view. (Interference-contrast photographs all with same scale (in μm) as shown in Figure 144.)

sensory spots more laterally, at margin of arthrocorium; setae absent; sternal plates with pair of setae mesially, pair of sensory spots laterally.

Segment 12, 92–108 μm long, $\bar{x}$ 30 = 98.9±4.9 μm, much wider at anterior margin than at posterior margin; SW 160–184 um, $\bar{x}$ 30 = 170.5±5.6 μm; SW/TL 15.9–20.4 percent, $\bar{x}$ 30 = 18.1±1.0 percent; subcuticular middorsal spinose process absent, replaced by small middorsal cuticular scar; transverse row of 4 cuticular scars as in previous segment; sensory spots near posterior lateral margin; sternal plates with 2 median cuticular scars; small thickenings of mesial margin resembling "Mittelwülste"; sensory spots posteromesially; pair of setae on each lateral margin in male, single setae on each lateral margin in female; posterior margins of sternal plates strongly concave, accommodating genital fields of segment 13; posterior margins of sternal plates of female deeply incised mesially, leaving margin adjacent to posteromesial sensory spot.

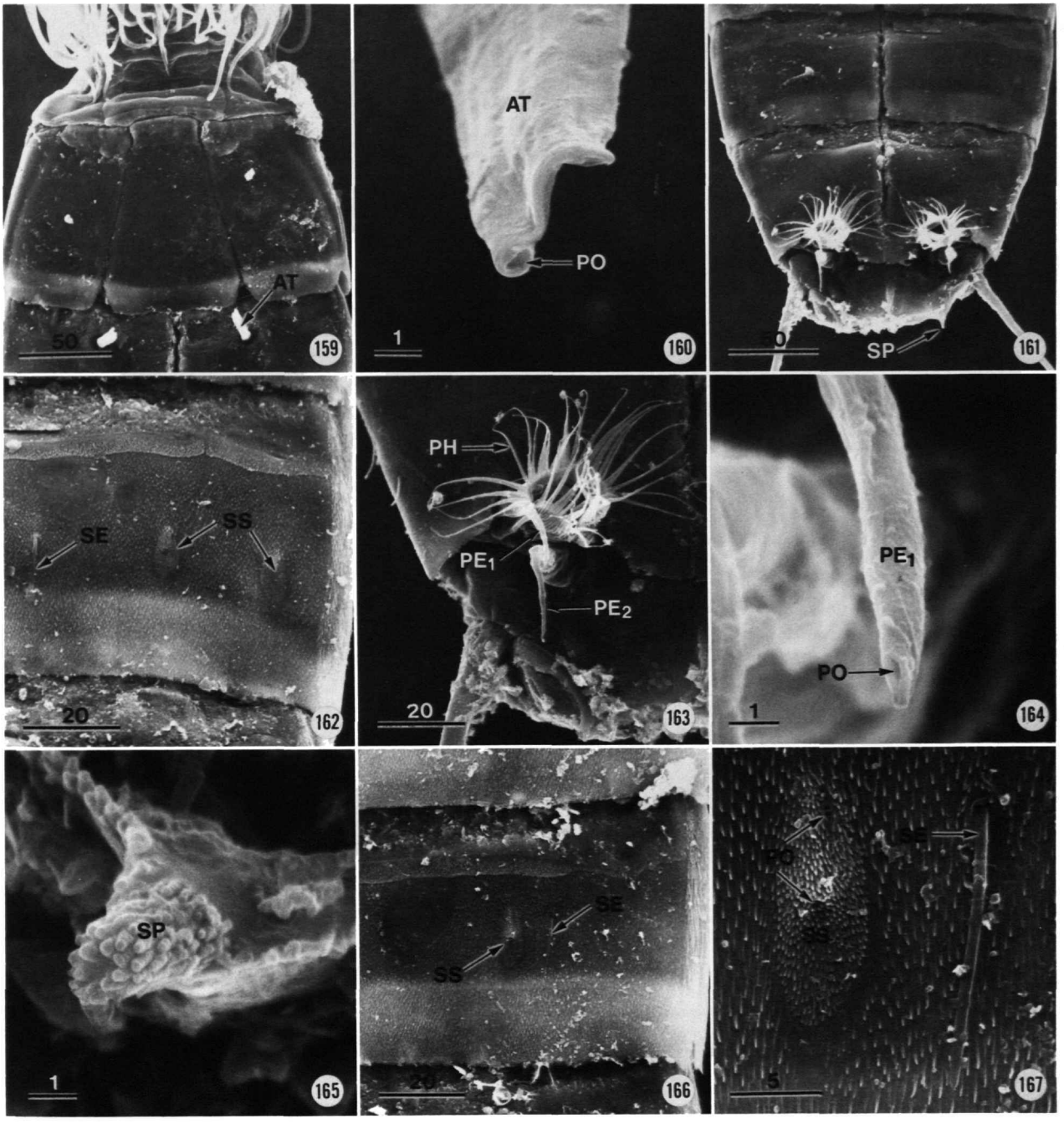
Segment 13, 40–58 μm long, $\bar{x}$ 30 = 47.0±4.8 μm; lateral terminal spines 126–255 μm long, $\bar{x}$ 29 = 176.5±24.4 μm; tergal plates with prominent cuticular scars, probably associated with sensory papillae at posterolateral margins; combined



FIGURES 150–158.—*Pycnophyes greenlandicus*, new species, female, ventral view: 150, segments 2–3; 151, segments 12–13; 152, segment 11, lateral half; 153, same as 151, magnified; 154, sensory papilla at posterior margin of segment 13; 155, sensory papilla at anterior margin of segent 13; 156, segment 5, lateral half; 157, sensory spot and seta on segment 5; 158, seta on segment 5. (SEM photographs, each to scale (in μm) indicated.)

sternal plates slightly smaller than tergal plate, margins generally conforming to those of tergal plate.

In addition to sexually dimorphic characters noted for segments 4 and 12, males differ from females in having two pairs of penile spines, ~38–42 μm long, at anterolateral margins of sternal plates of segment 13; anteriormost penile



FIGURES 159–167.—*Pycnophyes greenlandicus*, new species, male, USNM 233255, ventral view: 159, segments 2–3; 160, adhesive tube; 161, segments 11–13; 162, segment 11, lateral half; 163, segments 12–13, lateral half; 164, penile spine; 165, sensory papilla at posterior margin on segment 13; 166, segment 5, lateral half; 167, same sensory spot and seta as in 166, magnified. (SEM photographs each to scale (in μm) indicated.)

spine (P-1) associated with penile hairs on intersegmental area between segments 12 and 13, second penile spine (P-2) more posterior, associated with anterolateral margin of segment 13; each pair of penile spines positioned within recurved posterior margin of segment 12; female gonopores also anterolateral in segment 13, appearing as slit-like openings in protruding

TABLE 7.—Measurements (μm) and indices (%) for *Pycnophyes greenlandicus* adults (see text for explanation of abbreviations).

Character	Sex	Sample size	Range	Mean	Standard deviation	Standard error	Coefficient of variability
TL	m	5	935–995	974.0	23.8	10.7	2.5
	f	25	855–1035	937.6	47.9	9.6	5.1
	mf	30	855–1035	941.2	49.0	8.9	5.2
SW	m	5	160–184	170.4	9.6	4.3	5.7
	f	25	160–178	170.8	4.9	1.0	2.9
	mf	30	160–184	170.5	5.6	1.0	3.3
SW/TL	m	5	16.3–18.5	17.4	0.8	0.4	4.5
	f	25	15.9–20.4	18.2	1.1	0.2	5.8
	mf	30	15.9–20.4	18.1	1.0	0.2	5.8
MSW-7	m	5	190–206	195.6	6.2	2.8	3.2
	f	25	186–225	199.1	8.4	1.7	4.2
	mf	30	186–225	198.5	8.1	1.5	4.1
MSW/TL	m	5	19.2–20.8	20.0	0.6	0.3	3.1
	f	25	17.8–25.8	21.2	1.6	0.3	7.7
	mf	30	17.8–25.8	21.0	1.6	0.3	7.4
LTS	m	5	180–214	193.6	14.1	6.3	7.2
	f	24	126–255	172.9	24.7	5.1	14.3
	mf	29	126–255	176.5	24.4	4.5	13.8
LTS/TL	m	5	18.1–22.0	19.8	1.5	0.7	7.4
	f	24	14.8–27.7	18.5	3.1	0.6	17.0
	mf	29	14.8–27.7	18.7	2.9	0.6	15.7
SL-3	m	5	106–116	110.8	4.2	1.9	3.7
	f	25	106–120	113.8	4.0	0.8	3.5
	mf	30	106–120	113.3	4.1	0.8	3.6
SL-4	m	5	82–91	86.4	3.4	1.5	3.9
	f	25	80–90	85.9	3.2	0.6	3.7
	mf	30	80–91	86.0	3.2	0.6	3.7

intersegmental area; sensory papillae at lateral and posterior margins of gonopores (Figures 142, 151, 153, 155).

Morphometric data for adult specimens are shown in Table 7.

HOLOTYPE.—Adult male, TL 980 μm (Figures 134–139, 144–148), Disko Island, sta RH 1534, USNM 233247.

ALLOTYPE.— Adult female, TL 950 μm (Figures 140–143, 149), other data as for holotype, USNM 233248.

PARATYPES.—Five females and 1 male, TL 935–1035 μm, other data as for holotype, USNM 233249; 13 juveniles, TL 280–585 μm, other data as for holotype, USNM 233250; 30 unmounted specimens, same data as for holotype, USNM 233251; 1 female, TL 940 μm, Disko Island, sta RH 1529, USNM 233252; 2 females and 1 male, TL 855–970 μm, Disko Island, sta RH 1532, USNM 233253; 11 females and 1 male, TL 855–995 μm, Disko Island, sta RH 1536, USNM 233254; 2 females and 1 male (SEM preparations) on stubs 75 and 76, USNM 233255: 23 unmounted specimens, Disko Island, sta RH 1536, USNM 233256; 4 females, TL 860–915 μm, Disko Island, sta RH 1538, USNM 233256. Other paratypes have been deposited in the Zoological Museum, Copenhagen.

REMARKS.—*Pycnophyes greenlandicus*, reaching a trunk length of 1035 μm, is the largest kinorhynch known. Like *P. cryopygus*, it resembles only a few other species; one of the most similar species is *P. sanjuanensis*. The latter species also is long, reaching 826 μm in length. In general, *P. greenlandicus* has a narrower trunk length (MSW/TL 17.8–25.8 percent) than *P. sanjuanensis* (MSW/TL ~24 percent). The trunk differs slightly in the more tapered posterior segments of the new species. However, both have double, thin cuticular areas at the anterior margins of the episternal plates, but the anterior margin of the tergal plate of this segment is strongly sculptured (denticulate) in *P. sanjuanensis* and even (smooth) in *P. greenlandicus*. The midventral thickenings of *P. sanjuanensis* are kidney-shaped, whereas those of the new species are round to oval.

TABLE 7.—Continued.

Character	Sex	Sample size	Range	Mean	Standard deviation	Standard error	Coefficient of variability
SL-5	m	5	84–88	85.6	1.7	0.8	2.0
	f	25	75–94	85.9	4.3	0.9	5.0
	mf	30	75–94	85.9	4.0	0.7	4.6
SL-6	m	5	86–93	89.8	2.5	1.1	2.8
	f	25	80–98	90.1	4.5	0.9	5.0
	mf	30	80–98	93.0	4.2	0.8	4.6
SL-7	m	5	90–97	92.6	2.9	1.3	3.1
	f	25	84–100	93.1	4.5	0.9	4.9
	mf	30	84–100	93.0	4.2	0.8	4.6
SL-8	m	5	92–98	96.0	2.5	1.1	2.6
	f	25	90–102	96.2	4.3	0.9	4.4
	mf	30	90–102	95.9	4.0	0.7	4.2
SL-9	m	5	97–104	98.8	3.1	1.4	3.2
	f	25	85–104	97.4	4.3	0.9	4.4
	mf	30	85–104	97.7	4.1	0.8	4.2
SL-10	m	5	100–110	104.8	3.6	1.6	3.5
	f	25	93–107	103.4	4.6	0.9	4.5
	mf	30	93–110	100.7	16.1	2.9	15.9
SL-11	m	5	99–110	106.0	6.2	2.8	5.9
	f	25	96–112	103.9	4.6	0.9	4.4
	mf	30	96–112	101.1	18.9	3.5	18.7
SL-12	m	5	98–108	100.0	4.5	2.0	4.5
	f	25	92–106	98.6	5.1	1.0	5.1
	mf	30	92–108	98.9	4.9	0.9	5.0
SL-13	m	5	48–56	52.0	3.2	1.4	6.1
	f	25	40–58	46.0	4.5	0.9	9.7
	mf	30	40–58	47.0	4.8	0.9	10.2

Pycnophyes maximus, a European species described from the Baltic Sea, is also a large kinorhynch, reaching 900 μm in length. In general shape, it also is strikingly similar to *P. greenlandicus* but, unfortunately, was not described in sufficient detail to make detailed comparisons possible. It differs from the new species, however, in having rounded middorsal processes on tergal plates 3–8 and, based on the illustration of the species (Reimer, 1963: fig 3), the midventral thickenings on segments 11 and 12 are more elongate to oval.

Another kinorhynch with strong similarities to *P. greenlandicus* is *Pycnophyes frequens*, a species inhabiting the northeastern coast of the United States as far north as Maine and probably further. *P. frequens* reaches 775 μm in length and has many similar morphometric characters but is readily distinguished by having only a single, mesial, thin cuticular area on each episternal plate, elongate to oval to slightly kidney-shape midventral thickenings on sternal plates 11 and 12, and dorsal plates with even margins.

The two sympatric species of *Pycnophyes* in Greenland waters are easily separated on the basis of their relative shapes and lengths of lateral terminal spines (Figures 81, 82, 134, 135). In ventral view, specimens can be distinguished by the presence of nearly round midventral thickenings at the anterior margins of segments 11 and 12 in *P. greenlandicus*; in dorsal view, *P. greenlandicus* has only subcuticular spinous processes which do not project beyond the tergal margins; these processes are more lanceolate and project beyond the tergal margins in *P. cryopygus*.

Although a series of juvenile stages thought to belong to *P. greenlandicus* were found in the same samples as the holotype, the specimens did not reveal sufficient nor consistent enough details to make possible their assignment to a specific stage of the life history; hence, they have not been included in the description of this species.

ETYMOLOGY.—The name of this species is derived from its place of discovery, Greenland.

Ecological Notes

Physiographically, Disko Bay is classified as a low-Arctic ecosytem, composed of a mixture of polar and nonpolar water. Disko Fjord, on the other hand, is a high-Arctic ecosystem because it is isolated from nonpolar water by an offshore barrier created by a glacier near Qeqertaq Island.

In Disko Bay, well-sorted sandy sediments contained abundant meiofauna, mostly harpacticoid copepods, nematodes, and amphipods, but no kinorhynchs. However, the sample of muddy sand at 100 m near Skansen (RH 1536) contained 62 kinorhynchs, represented by *Pycnophyes cryopygus* (37 percent) and *P. greenlandicus* (56 percent) as well as by *Echinoderes tubilak* (5 percent) and *E. angustus* (1.6 percent). Further west along the south coast of Disko Island, in a slightly more muddy sediment at 225 m (one of the "shrimp fields"), kinorhynchs were represented only by members of the genus *Echinoderes*; 4 of the 5 species from the region, all but *E. peterseni*, were found at this station. Further west, at Engelskmandens Havn (west of Godhavn), the muddy sand was anoxic and no kinorhynchs were found. A single, relatively small sample of muddy sediment taken in the open bay at 200–250 m (RH 1527) produced only a few specimens each of *E. angustus* (3 specimens) and *E. eximus* (4 specimens). At the southernmost station (RH 1538), another "shrimp field," the muddy sediment contained 34 specimens representing 6 of the 7 species, the greatest diversity noted from any one sample.

The sediments strongly influenced by the glacial melt-water at the Bay of Nipisat, near the western limits of Disko Fjord, and at Kuanerssuit Suvdluat near the eastern limits, produced no kinorhynchs. However, they were found at all other stations within the fjord. The station (RH 1533) only 10 km west of the upper limits of the fjord (Kuanerssuit Suvdluat) yielded 125 specimens, more than any other station included in this study. The dominant species was *Echinoderes tubilak* (98 percent); 2 other species, *E. angustus* and *E. aquilonius*, were represented by only 1 or 2 specimens. *Echinoderes tubilak*, which was so abundant at station RH 1533, was only sparsely represented in the muddy sediments of station RH 1532, 2 km to the southwest; 3 living adult specimens of *P. tubilak* were found along with 70 dead ones and 3 living specimens of *Pycnophyes greenlandicus*. The next station, at Qivitut Bay (RH 1531), was characterized by muddy sand with pebbles at a depth of 6.5 m; here, only 9 specimens of *E. angustus* were found.

Station RH 1535, at the village of Diskofjord, was also in shallow water (9 m) and, as at the previous station, the muddy sand was mixed with pebbles and larger stones covered with the algae *Lithothamnium corallina*. *Echinoderes peterseni*, which was found at no other station, was represented by 43 specimens (81 percent). In addition, this sample contained 9 specimens (17 percent) of *E. angustus* and a single specimen (2 percent) of *P. cryopygus*. Samples from stations RH 1529 (200 m) at the southwestern limits of the fjord, and RH 1534 (200 m) at the northwestern limits of the fjord, both contained relatively large numbers of kinorhynchs. Of the 118 specimens from the former station (RH 1529), 61 specimens (52 percent) were *Pycnophyes cryopygus*, but *P. greenlandicus* was represented by only a single specimen (<1 percent); *E. tubilak*, represented by 36 specimens (36 percent) was the second most abundant species. The only other species present was *E. aquilonius*; only 14 specimens (12 percent) were found at this station. At station RH 1534, 135 kinorhynchs were found near the northwestern limits of the fjord's entrance. Of these, the most abundant species was *E. eximus*, which was represented by 62 specimens (46 percent). Fifty-three specimens (30 percent) were *P. greenlandicus* and 10 (7 percent) were *P. cryopygus*; the relative abundance of these two species was reversed at station RH 1529. *Echinoderes aquilonius*, represented by 10 specimens (8 percent), was the only other species collected at this station.

From these data, *Echinoderes eximus* appears to be a deep-water, high-salinity species. *Echinoderes tubilak* seems to be tolerant of lower salinities, but may be restricted to shallower depths (<35 m?). *Echinoderes peterseni* was the only species found at a single locality; possibly it is associated with the encrusting algae, *Lithothamnium corallina*. *Echinoderes angustus*, occurring in 7 of 10 stations where kinorhynchs were found, appears to be the most eurytopic species, followed by *E. tubilak*, which occurred at 6 of the 10 stations.

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