

New Ostracoda  
(Halocyprida: Thaumatocyprididae  
and Halocyprididae) from  
Anchialine Caves in the  
Bahamas, Palau, and Mexico

LOUIS S. KORNICKER  
and  
THOMAS M. ILIFFE

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## A B S T R A C T

Kornicker, Louis S., and Thomas M. Iliffe. New Ostracoda (Halocyprida: Thaumatoxypididae and Halocyprididae) from Anchialine Caves in the Bahamas, Palau, and Mexico. *Smithsonian Contributions to Zoology*, number 470, 47 pages, 22 figures, 8 tables, 1989.—Four new ostracode taxa are described from anchialine environments. *Danielopolina bahamensis*, a thaumatoxypid, is described from Eleuthera, the Bahamas, based on 13 specimens. *Danielopolina mexicana* is described from two specimens from the Yucatan Peninsula, Mexico. This brings the number of known *Danielopolina* species to five; a revised key to the genus is included. The description of *D. bahamensis* includes the first for a male of the genus.

Two new halocyprids are also described: *Deeveya jillae*, based on three specimens from Eleuthera, the Bahamas (bringing the number of known species of *Deeveya* to three); and a new subspecies, *Euconchoecia bifurcata pax*, based on 77 specimens from Koror Island, Palau.

Ontogeny is described for those taxa with sufficient specimens: *Danielopolina bahamensis* and *E. bifurcata pax*. *D. bahamensis* probably has five growth stages. *E. bifurcata pax* has seven. The first instar of each of these two species has five pairs of appendages (first and second antennae, mandible, maxilla, and fifth limb) in addition to a furca.

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# New Ostracoda (Halocyprida: Thaumatoxypididae and Halocyprididae) from Anchialine Caves in the Bahamas, Palau, and Mexico

*Louis S. Kornicker and Thomas M. Iliffe*

## Introduction

An anchialine cave is one containing salt or brackish pools without surface connection with the sea, and which fluctuate with the tide (Iliffe et al., 1984:311). Within such caves, a remarkable fauna has recently been discovered, including many new taxa (Iliffe et al., 1983, 1984; Hart et al., 1985). Knowledge of the ostracode suborder Halocypridina has been considerably enhanced by anchialine cave studies: the first troglobitic member of the suborder was described by Danielopol (1972, 1976) from a cave in Cuba; the second from a cave in Bermuda (Angel, 1983:531; Angel and Iliffe, 1987); the third from a cave in the Turks and Caicos Islands (Kornicker and Iliffe, 1985); the fourth from lava-tunnels in the Canary Islands (Hartmann, 1985; Wilkins et al., 1986) and the fifth from a "blue hole" in Andros Island, the Bahamas (Kornicker and Palmer, 1987). Here, three new anchialine species and one new anchialine subspecies are described from caves in the Bahamas, Palau, and the Yucatan Peninsula of Mexico.

**TERMINOLOGY AND ABBREVIATIONS.**—In the Halocypridina, the maxilla bears one endite on the precoxale and a bifurcate endite on the coxale. Herein, the endite of the

precoxale is termed endite I and the proximal and distal parts of the coxale endite are termed endites II and III, respectively. Furcal claws are numbered starting from the distal claw (claw 1).

For the seventh joint of the first antenna of the Thaumatoxypididae, the dorsal bristle is designated the a-bristle when present (absent on *Danielopolina orghidani* and *D. carolinae*), the medial ventral bristle is designated the b-bristle, and the lateral ventral bristle is designated the c-bristle (either the b- or c-bristle is absent on *Thaumatoxypis echinata*). For the eighth joint, the anterior bristle is designated the d-bristle, the stout lateral bristle at the midwidth of the joint is designated the e-bristle, and the bristle medial to the e-bristle is designated the f-bristle (absent on *T. echinata*).

In our discussion of *Deeveya jillae*, new species, we use a lettering system for bristles of joints 7 and 8 of the first antenna and for bristles of the endopodite of the 2nd antenna that Kornicker (in press) applies to *Spelaeocicia bermudensis*, slightly modified from its original application to *D. bransoni* by Kornicker and Palmer (1987:610). The designating letters and bristle positions are as follows. 1st antenna, 7th joint: a-, dorsal; b-, medial ventral; c-, lateral ventral. 1st antenna, 8th joint: d-, anterior; e-, stout lateral bristle near midwidth of joint; f-, medial, near midwidth of joint and with proximal part angled ventrally; g-, posterior, lateral to f-bristle and either slightly medial to or at same level as e-bristle. Endopodite of 2nd antenna, 1st joint: a- and b-, 2 dorsal bristles. Endopodite of 2nd antenna, 2nd joint: c-, d-, and e-, small bristles not found on all species; f- and g-, 2 long lateral and medial bristles, respectively. Endopodite of 2nd antenna, 3rd joint: h-, i-, j-, 3 long terminal bristles.

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Use of the terms hair, spine, and bristle follow Poulsen (1962:8).

In the figures, Arabic numerals indicate limbs 1–7, as well as individual joints of each limb (the location of the numeral indicating whether a limb or joint is indicated). Roman numerals I–III indicate the endites.

The following abbreviations are used: ant., antenna; as, auxiliary muscle attachment; B.O., Bellonci organ; C.O., copulatory organ; dist., distal; endop., endopodite; esoph., esophagus; exop., exopodite; mast. pad, masticatory pad; Md, mandible; Mx, maxilla; ms, adductor muscle attachments; P.I., pars incisiva; protop., protopodite; prox., proximal; u.p., unpaired process.

USNM specimen numbers indicate the United States National Museum collections of the National Museum of Natural History (NMNH), Smithsonian Institution.

**METHODS.**—Specimen and environmental data collection were made by Iliffe. Specimens were first preserved in alcohol, and then in glycerine for about a month prior to examination by Kornicker. In specimens of *Danielopolina bahamensis*, carapace reticulations tended to flake off while the body was being removed from the shell. Although reticulations were intact and clear at the time of illustration, none of our glycerine preserved specimens of *D. bahamensis* have retained visible surface reticulation.

Specimens were measured with an ocular micrometer through a microscope and are reported to the nearest 0.01 mm. Measurements are given as maximum length and height, each measured with specimen oriented in approximate living position, including or excluding processes as indicated. Drawings were made with a camera lucida; most appendages were drawn with the appendage mounted in glycerine and under a cover slip. Some appendages were examined at  $\times 100$  under oil immersion.

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the manuscript, and Elizabeth Harrison-Nelson (NMNH) for general assistance. This paper is Contribution Number 1108 of the Bermuda Biological Station for Research.

## Order HALOCYPRIDA Dana, 1853

### Suborder HALOCYPRIDINA Dana, 1853

**COMPOSITION.**—The Halocypridina includes two superfamilies: the Thaumatocypridoidea Müller, 1906; and Halocypridoidea Dana, 1853 (Kornicker and Sohn, 1976, fig. 2) (the ending -oidea rather than -acea is used herein for superfamilies, c.f., Kornicker and Sohn, 1976). The earliest known fossil Thaumatocypridoidea is from the Permian; the earliest known fossil Halocypridoidea is from the Cretaceous (Kornicker and Sohn, 1976:6).

### Superfamily THAUMATOCYPRIDOIDEA Müller, 1906

**COMPOSITION.**—Includes the single family Thaumatocyprididae Müller, 1906.

### Family THAUMATOCYPRIDIIDAE Müller, 1906

**COMPOSITION.**—This long ranging family (Permian to Holocene) includes five genera (Figure 1). Two are known only as fossils: *Thaumatomma* Kornicker and Sohn, 1976, from the Permian of Idhra Island, Greece; and *Pokornyopsis* Kozur, 1974, from the Upper and Lower Jurassic of southwestern and western Germany. Three are known only from the Holocene: *Thaumatocypris* Müller, 1906, from off Sumatra (1100 m) and Indonesia (2000 m); *Thaumatoconcha* Kornicker and Sohn, 1976, from the Atlantic, Pacific, and Indian Oceans at depths ranging from 150 to 4758 m; and *Danielopolina* Kornicker and Sohn, 1976 (see "Composition," below).

### *Danielopolina* Kornicker and Sohn, 1976

**TYPE SPECIES.**—*Danielopolina carolynae* Kornicker and Sohn, 1976.

**COMPOSITION.**—The genus includes five species: *D. carolynae* Kornicker and Sohn, 1976, from the mid-Atlantic (00°46'S, 29°24'–28°W) at a depth of 3459 m; *D. orchidani* (Danielopol, 1972), from a saline grotto in Cuba; *D. wilkensi* Hartmann, 1985, from a marine lava-tunnel in the Canary Islands; *D. bahamensis*, new species, from a marine cave in Eleuthera, the Bahamas; and *D. mexicana*, new species, from a marine cave in Yucatan, Mexico. Hence, the entire genus *Danielopolina* inhabits anchialine or deep sea environments.

**DIAGNOSES (EMENDED).**—The original diagnosis of *Danielopolina* by Kornicker and Sohn (1976:93) was based on two species. Now including three additional species (two described herein), the genus requires an emended diagnosis.

**Carapace:** Surface reticulate or with abundant small

straight or curved spines. Boundaries of reticulations formed of either closely spaced minute subround papillae or of ridges of continuous or discontinuous segments (Figures 2a,b, 3a,b).

**First Antenna:** 1st joint with 2 bristles (1 dorsal, 1 lateral); 7th joint with 2 ventral and 0 or 1 dorsal bristle; 8th joint with 3 bristles.

**Second Antenna:** Endopodite 3-jointed (but 2nd and 3rd joints of female endopodite fused): 1st joint with no ventral bristles and 0 or 2 dorsal bristles; 3rd joint dorsal and with sclerotized process on male.

**Sixth Limb:** Process on dorsal corner of 1st exopodial joint with 2 bristles (limb and process absent in some growth stages).

**Bellonci Organ:** Absent, except for *D. mexicana*.

**CORRECTION.**—The senior author would like to take this opportunity to correct Kornicker and Sohn (1976). The adult of *Danielopolina orchidani* bears 3 short claws, not 4 (as in Kornicker and Sohn, 1976:9, table 1). The number of claws indicated by Kornicker and Sohn (1976) in their table 13 is correct.

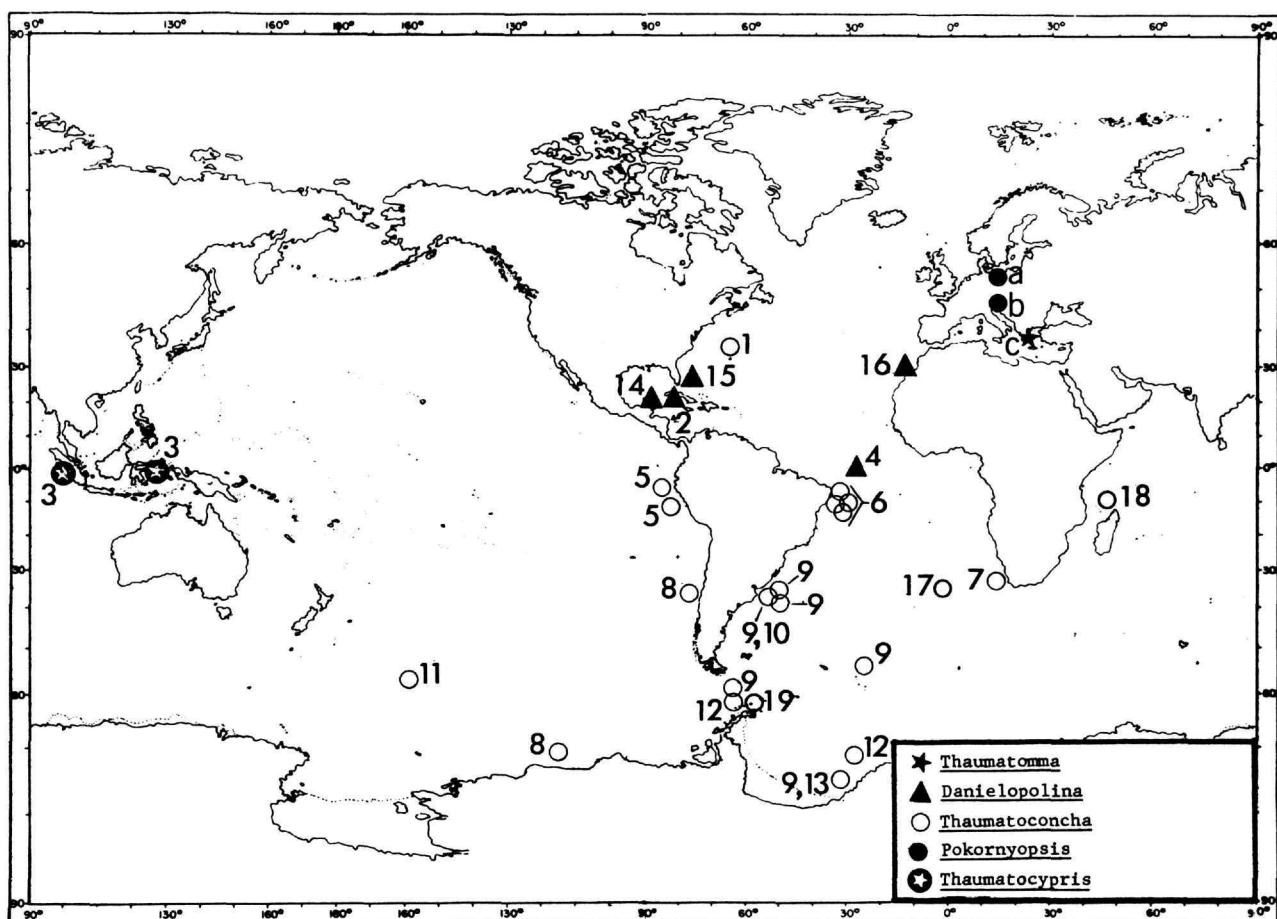


FIGURE 1.—Distribution of living and fossil species of the Thaumatoxypidae, fossil species identified by a letter, living species by a numeral: a = *Pokornyopsis bettenstaedti* (Bartenstein); b = *P. feifeli* (Treibel); c = *Thaumatomma piscifrons* Kornicker and Sohn; 1 = *Thaumatoconcha polythrix* Kornicker and Sohn; 2 = *Danielopolina orchidani* (Danielopol); 3 = *Thaumatoconcha echinata* Müller; 4 = *Danielopolina carolyneae* Kornicker and Sohn; 5 = *Thaumatoconcha elongata* Kornicker and Sohn; 6 = *T. tuberculata* Kornicker and Sohn; 7 = *T. hessleri* Kornicker and Sohn; 8 = *Thaumatoconcha* species indeterminate (Kornicker and Sohn, 1976); 9 = *T. radiata* Kornicker and Sohn; 10 = *T. caraionae* Kornicker and Sohn; 11 = *T. punctata* Kornicker and Sohn; 12 = *T. sandersi* Kornicker and Sohn; 13 = *Thaumatoconcha* species A (Kornicker and Sohn, 1976); 14 = *Danielopolina mexicana*, new species; 15 = *D. bahamensis*, new species; 16 = *D. wilkensi* Hartmann; 17 = *Thaumatoconcha* species (Kornicker, 1985); 18 = *T. porosa* Kornicker; 19 = *Thaumatoconcha* species (Hartmann, 1986). (Map adapted from Kornicker and Sohn, 1976, fig. 9.)

### Revised Key to the Species of *Danielopolina*

1. Carapace with surface spines . . . . . *D. mexicana*, new species
- Carapace without surface spines . . . . . 2
2. Carapace longer than 1.5 mm, including processes . . . . . *D. carolynae*
- Carapace shorter than 1.0 mm, including processes . . . . . 3
3. Each lamella of furca with 6 short fused claws . . . . . *D. wilkensi*
- Each lamella of furca with 3 short fused claws . . . . . 4
4. Each valve with single posterodorsal process; walls of surface reticulations formed by subround papillae; 2nd joint of 1st antenna with 2 bristles . . . . *D. orhidani*
- Each valve without single posterodorsal process; walls of surface reticulations formed by ridges; 2nd joint of 1st antenna without bristles . . . . . *D. bahamensis*, new species

#### *Danielopolina bahamensis* Kornicker and Iliffe, new species

FIGURES 1-6, 9

ETYMOLOGY.—From the type locality.

MATERIAL.—The Bahamas, Eleuthera, Hatchet Bay, Hatchet Bay Cave (Figure 1), 15 June 1986, collected by Thomas M. Iliffe with a 93 µm mesh plankton net from 0-3 m water depths. Holotype: USNM 193285, adult male on slide and in alcohol. Paratypes: USNM 193286 and 193287, each single adult females; USNM 193288, 10 juveniles (sex unknown).

DISTRIBUTION.—Known only from the Bahamas, Eleuthera, Hatchet Bay, Hatchet Bay Cave (Figure 1).

HABITAT.—Eleuthera, situated on the eastern margin of Great Bahama Bank, is a long, thin island composed of low hills of eolian limestone. Hatchet Bay Cave is located several km northwest of the settlement of Hatchet Bay and about 1 km inland from the west coast of Eleuthera.

Hatchet Bay Cave includes three levels: an entrance chamber floored with limestone breakdown contains inactive stalactites and stalagmites and is inhabited by a colony of bats; an extensive middle level, reached by ladder, contains dry passages and chambers of phreatic origin; the lowest level, also accessible by ladder, consists of a chamber half-filled with water (Figure 9). Maximum depth in the central depression of this anchialine pool was about 3 m. Surface water on 15 June 1986 had a salinity of 32‰, a temperature of 21.7°C and 6 ppm dissolved oxygen. No human-sized passages were observed to extend from this pool and no water currents were observed in it. Also collected from this pool were a possible new genus of calanoid copepod (Audun Fosshagen, pers. comm.); a macellicephalan polynoid polychaete identified by Marian H. Pettibone (in litt., 1986) as perhaps a young *Pelagomacellicephalia iliffei*, previously known only from the anchialine Conch Bar Cave, Turks and Caicos Islands (Pettibone, 1985); and the new ostracode species *Deeveya jilliae* described herein.

DESCRIPTION OF ADULT FEMALE (Figures 2, 3, Table 1).—Carapace subround in lateral view with straight dorsal margin in vicinity of hinge and also straight margin between

anterior and anteroventral processes; ventral and posterior margins as well as anterior margin dorsal to anterior process evenly rounded; valves broadest at about midlength and midheight, in vicinity of adductor muscle attachments. Short anterior and anteroventral processes with bases just lateral to valve edge; each process bearing fragile spine-bearing frill (Figures 2a, 3a,b) that easily breaks off at slight touch with dissecting needle leaving smaller firm protuberance (Figure 2c) similar to those on species of *Thaumatoconcha* (see Kornicker and Sohn, 1976, fig. 19). Paratype (USNM 193287) with fragile serrate posterodorsal frill (Figure 2a) that broke off when touched with dissecting needle (other specimens in collection without this frill).

ORNAMENTATION: Surface finely reticulate with reticulation walls formed of both continuous and discontinuous segments (Figures 2a,b, 3a,b).

MUSCLE ATTACHMENTS (Figures 2a,c, 3a,b): Adductor muscle attachments central in location; subround with greatest diameter trending towards posterior end of hinge; consisting of several wedge-shaped segments more or less radially arranged, but difficult to discern in detail. Crescent-shaped auxiliary muscle scar located anteroventral to adductor muscle attachment (Figures 2a, 3b).

CARAPACE SIZE: USNM 193286, left valve, length without anterior process 0.41 mm, height 0.37 mm. Paratype, USNM 193287, left valve/right valve: lengths without processes, 0.41/0.42 mm; height 0.37/0.36 mm.

FIRST ANTENNA (Figure 2c,d): Limb with 8 joints. 1st joint with 2 bare bristles (1 dorsal, 1 lateral near ventral margin). 2nd joint with distal medial spines. 3rd joint well defined from 4th by separation of sclerotized frame at ventral and dorsal margins, but without medial or lateral sutures. 3rd joint with proximal medial spines. 4th joint bare, dorsal edge longer than dorsal edge of 3rd joint but relationship reversed along ventral edge. 5th joint slightly smaller than 4th, with 1 long bare ventral bristle. 6th joint slightly smaller than 5th. 7th joint about same size as 6th, with 2 long bare ventral b- and c-bristles and 1 short dorsal a-bristle. 8th joint smaller than 7th, with 1 short d-bristle and 2 long bare e- and f-bristles.

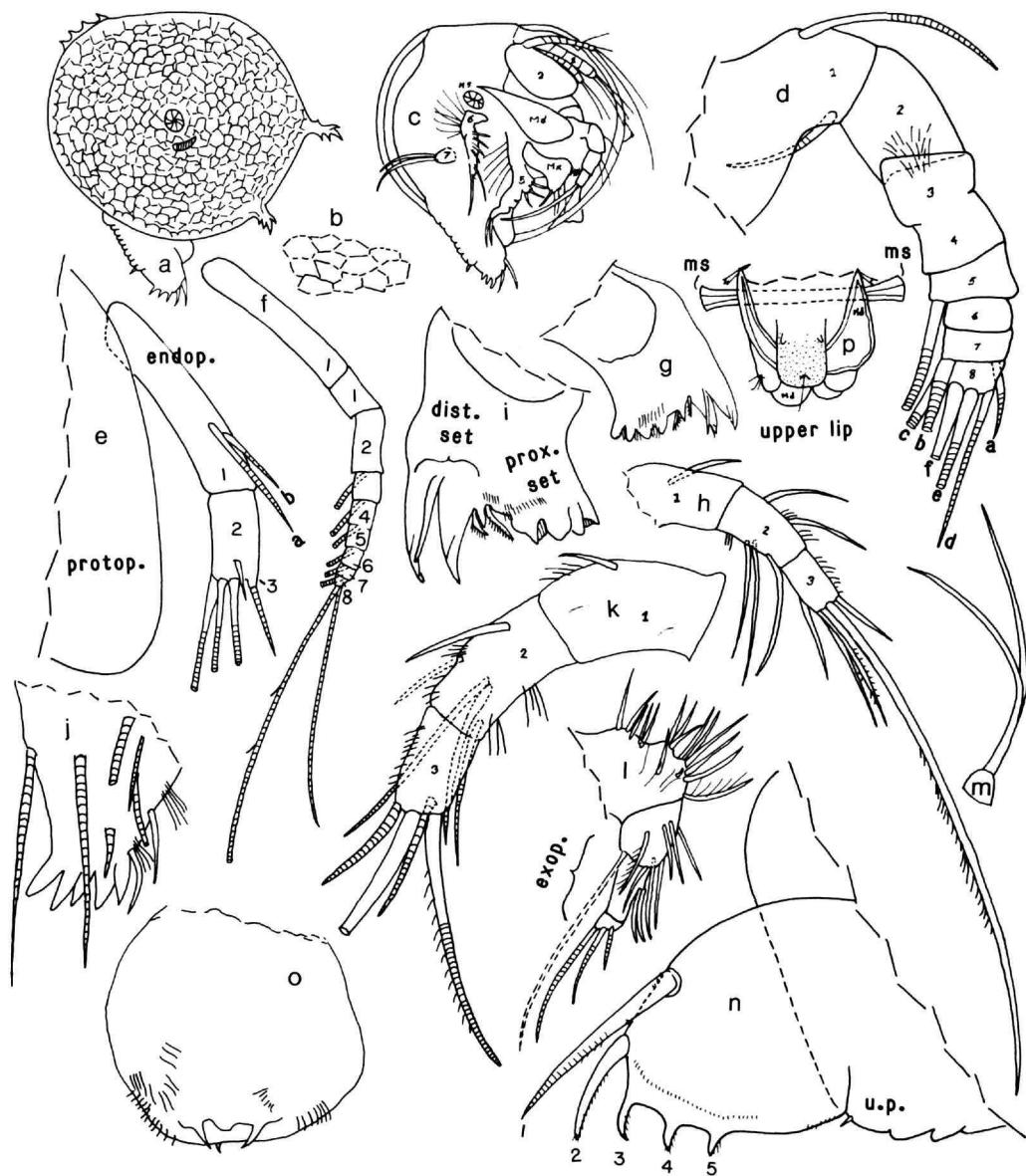


FIGURE 2.—*Danielopolina bahamensis*, new species, USNM 193287, paratype, adult female: *a*, complete specimen, right side, showing position of central adductor muscle and auxiliary muscle, attachments (length of right valve, excluding processes, 0.42 mm); *b*, detail of reticulations of right valve surface about half way between adductor muscle attachments and ventral margin ( $\times 2$  magnification of *a*); *c*, specimen, with right valve removed (not all appendage bristles shown); *d*, left 1st antenna, medial view (distal parts of some bristles not shown); *e*, endopodite and part of protopodite of right 2nd antenna, lateral view; *f*, exopodite of right 2nd antenna, lateral view; *g*, right mandibular coxale, lateral view; *h*, right mandibular endopodite, lateral view; *i*, coxale, left mandible, lateral view; *j*, basale, left mandible, lateral view; *k*, endopodite, left mandible, lateral view; *l*, left 5th limb; *m*, left 7th limb; *n*, left lamella of furca, lateral view; *o*, upper lip, posterior end at bottom; *p*, anterior view of body showing upper lip (stippled), anterior view of parts of mandibles, and adductor muscle. (Figure components not to same scale.)

**Second Antenna (Figure 2c,e,f):** Protopodite bare. Endopodite (Figure 2e): 1st joint elongate with 2 dorsal a- and b-bristles; 2nd joint with ventral and dorsal margins parallel, about  $\frac{1}{2}$  length of 1st joint, with 1 short lateral bristle and 3 long terminal bristles; 3rd joint small, fused to 2nd, with short

terminal bristle. Exopodite (Figure 2f) with 8 joints: 1st joint divided weakly into long proximal and short distal parts; bristles of joints 2–7 long, ringed and with minute, widely separated, marginal spines, and natatory hairs; 8th joint with 2 bristles (1 long, 1 medium), both with minute widely

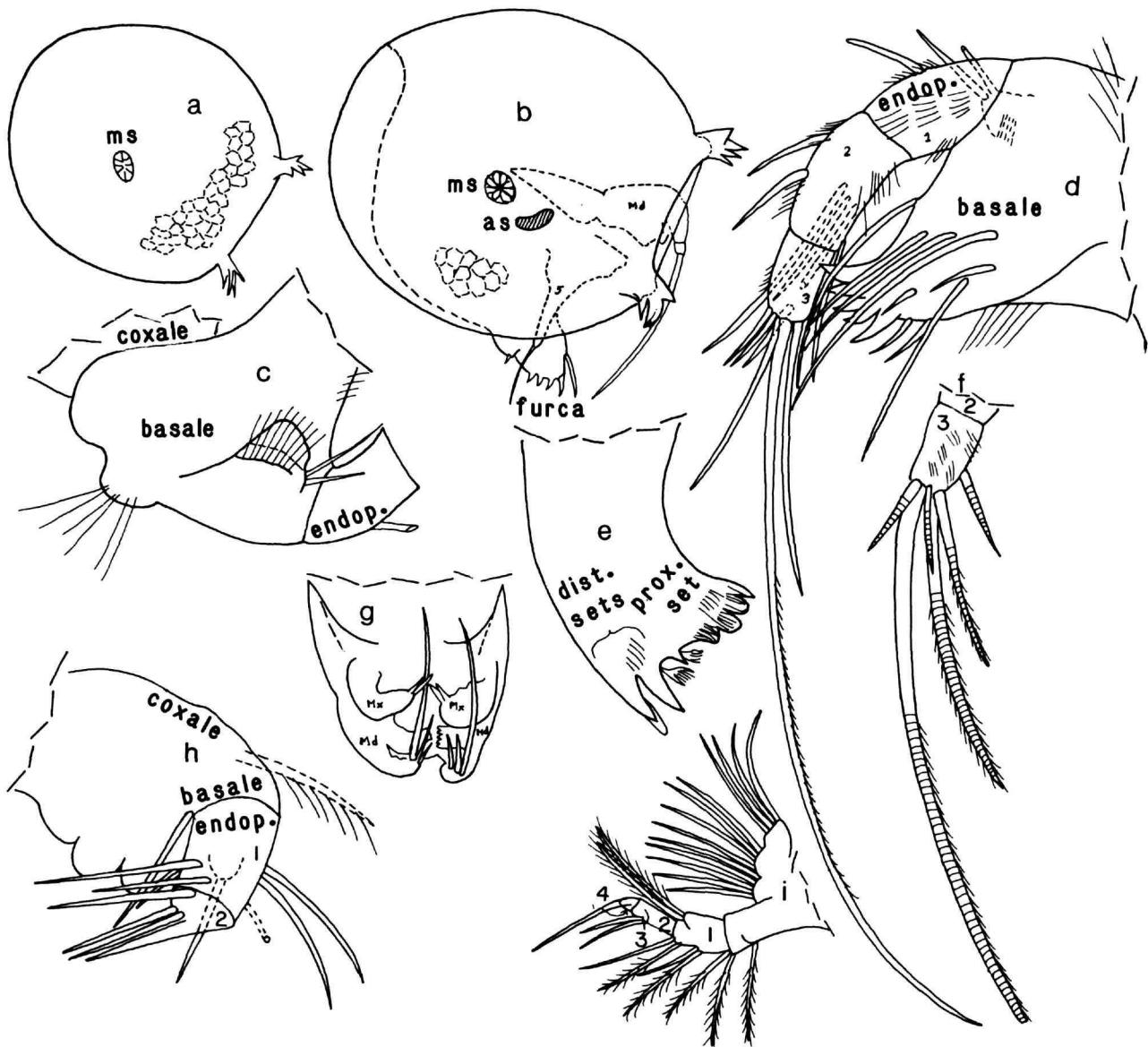


FIGURE 3.—*Danielopolina bahamensis*, new species, USNM 193286, paratype, adult female: *a*, complete specimen, right side, showing reticulations and position of central adductor muscle (length of carapace excluding processes 0.41 mm); *b*, same as *a*, showing central adductor muscle, auxiliary muscle attachments, and positions of right mandible, right 5th limb, and projecting furca; *c*, proximal right mandible showing spines and bristles of basale, medial view; *d*, basale and endopodite of left mandible, lateral view; *e*, tip of coxale of right mandible, medial view; *f*, tip of endopodite of right mandible, medial view; *g*, ventral view of body showing positions of maxillae and mandibles (most bristles not shown); *h*, maxilla (endites not shown); *i*, 6th limb. (Figure components not to same scale.)

separated marginal spines (illustrated on only 1 bristle, Figure 2f).

**Mandible** (Figures 2c,g-k,p, 3b-g): Coxale endite with proximal and distal sets of teeth separated by space (Figures 2g,i, 3e); proximal set comprising 4 broad cusps plus triangular tooth close to distal set of teeth; surface between cusps and medial and lateral surfaces just proximal to cusps with slender spines; 1 spinous bristle with base just proximal and another spinous bristle with base just distal to triangular tooth; distal set of teeth consisting of 2 flat teeth, each having at least 3 pointed cusps; 1 slender pointed bristle with base on lateral

side of flat teeth. Basale (Figures 2j, 3c,d): tooth of endite with 5 triangular cusps; posterior edge of endite with 1 proximal bristle and 1 distal blunt bristle; anterior margin of endite with 1 long bristle; lateral side of endite with 4 or 5 slender proximal bristles and 1 shorter distal ringed bristle; medial side with 2 proximal bristles on low spinous mound. Endopodite 3-jointed with 1st and 2nd joints about same length and 3rd joint shorter (Figures 2c,h,k, 3b-d,f,g); 1st joint with long lateral and dorsal spines and 1 dorsal bristle; 2nd joint spinous, with 1 distal ventral bristle, 2 or 3 medial bristles near ventral margin, and 2 dorsal bristles; 3rd joint spinous, with 6 bristles (1 long,

TABLE 1.—Comparison of selected characters of female *Danielopolina*. Specimens are adults, except for *D. mexicana* which is probably A-1. Information on *carolynae* comes from Kornicker and Sohn (1976), on *orghidani* from Danielopol (1972, 1976) and Kornicker and Sohn (1976), and on *wilkensi* from Hartmann (1985).

Character	<i>carolynae</i>	<i>orghidani</i>	<i>wilkensi</i>	<i>bahamensis</i>	<i>mexicana</i>
Carapace length (mm), excluding processes	1.85	0.52–0.59	0.63	0.41–0.42	0.82
Walls of reticulations (R=ridges, P=papillae, S=spiny)	P	P	R	R	S
Bristle count on:					
First Antenna					
2nd joint, ventral/dorsal	1/1	1/1	0/1	0/0	0/1
5th joint, ventral	2	1	1	1	1
7th joint, ventral/dorsal	2/0	2/0	2/1	2/1	2/1
Second Antenna					
Protopodite	1	0	0	0	1
Endopodite					
1st joint, ventral/dorsal	0/2	0/2	0/0	0/2	0/2
2nd joint, lateral/terminal	1/4	0/3	0/4	0/3	0/3
3rd joint	1	1	1	1	1
Exopodite					
1st joint/last joint	1/2	0/2	0/2	0/2	0/2
Mandible					
Basale, posterior margin	3	2	2	2	2
Endopodite, 1st joint, dorsal	1	1	0	1	1
Fifth limb, exopodite					
ventral 2nd joint, midventral/terminal	2/1	2/1	2/1	2/0	2/0
3rd joint	2	2	2	3	3
Sixth limb					
Protopodite	4	4	3	3	3
Exopodite					
1st joint	5	4	3	4	4
1st joint, dorsal process	2	2	2	2	2
2nd and 3rd joints, midventral/dorsal	3/1	1/1	2/0	2/0	2/0
3rd joint, terminal ventral	1	0	0	0	0
4th joint	2	2	2	1	2
Length of dorsal margin of 3rd joint of 1st antenna to length of dorsal margin of 4th joint (L, longer; S, shorter; =, same length)	L	S	S	S	=
No. of exopodial joints on second antenna	9	8	8	8	9
No. of furcal claws, long/short	2/6	2/3	2/6	2/3	2/5
Bellonci organ (– = absent, + = present)	–	–	–	–	+

terminal, lateral bristle about twice length of endopodite and with ventral spines, 2 medium length bristles, and 3 shorter bristles); 3rd joint of limbs of USNM 193287 (Figure 2h,k) with 4–5 bristles but limbs somewhat fragmented and bristles may have been torn away.

**Maxilla** (Figures 2c, 3g,h): Endite I with 10 bristles; endite II with about 7 bristles; endite III with 3 or more bristles; some bristles on each endite stout pectinate. Coxale with long stout dorsal plumose bristle. Basale with long slender ventral bristle. Endopodite (Figure 3h): 1st joint with 3 anterior (dorsal) bristles, 3 posterior (ventral) bristles, and 1 medial (or lateral) bristle; end joint with 1 anterior, stout, linear, sclerotized bristle without a visible suture at the base, and 3 slender, ringed bristles.

**Fifth Limb** (Figures 2c,l, 3b): Epipodite with bristles forming 3 groups, each with 4 plumose bristles. Protopodite and endopodite with about 15 bristles; distal endopodial joint with short tooth-like bristle. Exopodite 3-jointed: 1st joint with 1 very long terminal bristle near dorsal margin and 7 bristles closer to or on ventral margin; 2nd joint elongate with 2 midbristles on ventral margin; 3rd joint small with 3 bristles (middle bristle 63% and smallest bristle 31% length of longest bristle).

**Sixth Limb** (Figures 2c, 3i): Epipodite with bristles forming 3 groups (5 bristles in proximal group, 4 in each distal group). Protopodite with 3 ventral bristles (1 proximal, 2 terminal). Exopodite 4-jointed: 1st joint divided by weak suture into proximal part with 2 ventral bristles, and shorter distal part with 2 ventral bristles; small process with 2 long plumose bristles present on dorsal corner of terminal margin of 1st joint; 2nd and 3rd joints completely fused, with 2 ventral bristles just distal to midlength; 4th joint with 1 long terminal bristle.

**Seventh Limb** (Figure 2c,m): Small with 2 long bristles.

**Furca** (Figures 2a,c,n, 3b): Each lamella with 2 long anterior articulated claws followed by 3 short ventral nonarticulated claws; 1st anterior claw weakly ringed; posterior edges of all claws with faint spines; anterior claw edges with a few spines near tip; lateral surface of lamella with minute spines forming row, more and longer spines on medial surface (not shown on illustration); small unpaired process on posterior of body just proximal to lamellae.

**Bellonci Organ:** Absent.

**Lips:** Upper lip with 2 pointed processes oriented posteriorly (Figure 2o,p). Lower lip with 2 lateral triangular processes (1 on each side) oriented anteriorly; anterior apex rounded.

**Gut Content:** Brown unidentified particles.

**DESCRIPTION OF ADULT MALE** (Figures 4, 5a–f).—Carapace (Figure 4a,b) similar in shape and surface patterning to that of adult female but lacks posterodorsal frill in this specimen (USNM 193285; tip may have broken off).

**Carapace Size:** USNM 193285, holotype, left valve/right valve lengths including anterior process 0.43/0.42 mm, lengths without anterior process 0.40/0.40 mm, heights 0.35/0.33 mm.

**First Antenna** (Figure 4c): 1st joint with 2 bristles (1

ventral, 1 dorsal). 2nd joint with distal medial spines. 3rd joint spinous, separated from 4th joint by distinct suture; ventral margin longer and dorsal margin shorter than that of 4th joint. 4th joint with 2 long bare ventral bristles. 5th joint with 3 long ventral bristles (2 bare or with widely separated, minute, marginal spines, 1 with abundant, short, distal hairs). 6th joint bare. 7th joint with 2 long, bare, ventral b- and c-bristles and 1 short, bare, dorsal a-bristle. 8th joint with 2 long e- and f-bristles (bare or with widely spaced, minute, marginal spines) and 1 shorter bare d-bristle dorsal to others.

**Second Antenna** (Figure 4a,b,d,e): Protopodite bare. Endopodite: 1st joint elongate with 2 dorsal a- and b-bristles; 2nd joint short, broadening distally and with 5 bristles (2 long and 2 medium near ventral edge, 1 short near dorsal edge, with base on lateral side); 3rd joint small, with terminal sclerotized hook-like process with row of short spines along distal edge, and row of longer proximal spines. Exopodite similar to that of female, except natatory hairs on bristles appear more numerous. [Kornicker and Sohn (1976:50, fig. 33) interpreted the hook-like terminal process on the endopodite of *Thaumataconcha radiata* to be a modified 3rd joint; the process on thaumatocyprids is reinterpreted herein to be a modified bristle on a small 3rd joint.]

**Mandible** (Figure 4a,f,g): Similar to that of adult female (Figure 2g–k, 3c–f).

**Maxilla** (Figure 4h): Only 2 endites observed (aberrant?). Coxale with 1 spinous dorsal bristle. Basale obscured, no ventral bristle observed. Endopodite: 1st joint with 1 anterior and 2 posterior bristles. End joint: 1 limb similar to that of adult female, other with 3 terminal bristles, each with suture at base. (In the Thaumatocypridae, maxillae are usually similar between sexes; differences observed here may result from an aberrant maxilla on our single male specimen. Aberrant appendages are occasionally encountered in ostracodes.)

**Fifth Limb** (Figure 4a,i,j): Epipodite with 11 bristles forming 3 groups with 3 bristles in proximal group and 4 in middle and distal groups. Distributions of bristles of protopodite, endopodite, and exopodite similar to those of adult female. 3rd (end) joint: middle bristle 58% and smallest bristle 28% of longest bristle.

**Sixth Limb** (Figure 4a,k,l) and **Seventh Limb** (Figure 4a,m): Similar to those of adult female.

**Furca** (Figures 4a,b, 5a–c): Similar to that of adult female; small unpaired process proximate to lamellae larger than on adult female.

**Bellonci Organ:** Absent.

**Lips** (Figure 5d,e): Similar to those of adult female.

**Copulatory Organ** (Figure 5b,c,f): Single organ on left side of body; anterior part with long recurved process tapering to narrow tip; posterior styliform process with 3 faint hairs at tip.

**Gut Content:** Brown particulate matter similar to that in gut of adult female.

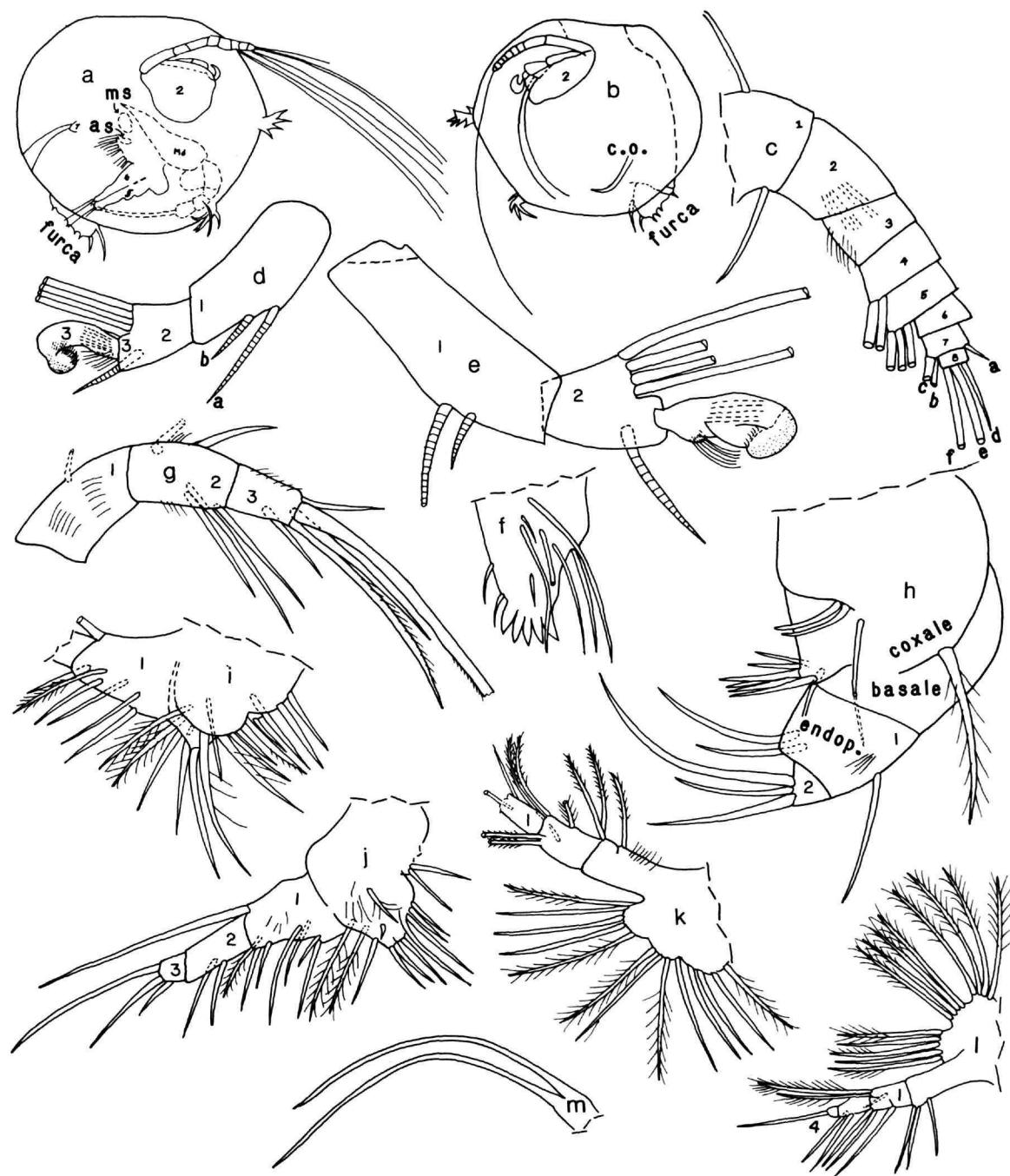


FIGURE 4.—*Danielopolina bahamensis*, new species, USNM 193285, holotype, adult male: a, complete specimen, right side, showing positions of 2nd antenna, mandible, 5th, 6th, and 7th limbs, and projecting furca (length of right valve excluding processes 0.38 mm); b, complete specimen, left side, showing 2nd antenna and tip of penis; c, right 1st antenna, lateral view; d, endopodite of left 2nd antenna, medial view; e, endopodite of right 2nd antenna, medial view; f, basale of right mandible, lateral view; g, endopodite of right mandible, lateral view; h, aberrant maxilla; i,j, right and left 5th limbs, respectively; k,l, right and left 6th limbs, respectively; m, right 7th limb. (Figure components not to same scale.)

**DESCRIPTION OF INSTAR I, SEX UNKNOWN** (Figure 5*g-l*).—Carapace similar to that of adult but reticulations not present (Figure 5*I*). The specimen studied was a whole-mount with the right valve folded back. A glass cover slip was placed over the specimen, which was studied at  $\times 100$  under oil immersion. Some of the appendages and parts were obscured (1st antenna, endopodite of 2nd antenna, coxale of mandible, endites of maxilla).

**Carapace Size:** USNM 193288C, length without anterior process 0.18 mm, height 0.15 mm.

**First Antenna** (Figure 5*g,l*): Joints 1–6 without bristles; suture between 3rd and 4th joints partially fused; 4th joint slightly longer than 3rd. 7th joint with long ventral bristle and faint short dorsal bristle. 8th joint with 2 bristles, 1 long, 1 short.

**Second Antenna** (Figure 5*h,l*): Protopodite bare, like adults. Endopodite (Figure 5*l*): 1st joint bare; fused 2nd and 3rd joints with 3 bristles (2 long, 1 short). Exopodite: 1st joint not divided; joints 2–7 each with long bare bristle; 8th joint with 2 bare bristles, 1 long, 1 short.

**Mandible** (Figure 5*i,l*): Coxale obscured in specimen. Basale with 1 anterior bristle, 2 short posterior bristles, and no lateral bristles; proximal medial bristles not observed but could be obscured. Endopodite: joints 1 and 2 bare; 3rd joint with 4 bristles (1 very long, 3 short).

**Maxilla** (Figure 5*i,l*): Similar to that of adult but with fewer bristles.

**Fifth Limb** (Figure 5*j,l*): Epipodite with 3 lobes, each with 2 or 3 bristles. Protopodite and endopodite with 5 or more bristles. Exopodite: 1st joint with 1 very long terminal bristle near dorsal margin and 1 ventral bristle; 3rd joint with 1 terminal bristle.

**Sixth and Seventh Limbs:** Absent.

**Furca** (Figure 5*k,l*): Each lamella with 2 long articulated anterior claws with only anterior of these articulated. Unpaired process on posterior of body proximal to lamellae well-developed.

**Bellonci Organ:** Absent.

**Lips:** Obscured, but in general similar to those of adult.

**Gut Content:** Unidentified amber colored material.

**DESCRIPTION OF INSTAR II, SEX UNKNOWN** (Figure 5*m-v*).—Carapace with shape similar to that of adult female, but lacking reticulations.

**Carapace Size:** USNM 193288E, length with anterior process 0.26 mm, length without anterior process 0.25 mm, height 0.21 mm.

**First Antenna** (Figure 5*m*): Joints 1–4 without bristles; 3rd joint slightly longer than 4th and fused to 4th except along dorsal edge. 5th joint with broad ventral bristle rounded at tip and just reaching to 7th joint (bristle may be broken, but is similar on both limbs of the single specimen examined). 6th joint without bristles. 7th joint with short dorsal bristle and long ventral bristle. 8th joint with 2 terminal bristles (1 short dorsal and 1 long ventral).

**Second Antenna** (Figure 5*n*): Protopodite similar to that

of adult. Endopodite: 1st joint elongate without bristles. 2nd and 3rd joints fused, with 1 short and 3 long bristles (2 broad, 1 slender). Exopodite: 1st joint not divided; 2nd–7th joints each with 1 long ringed bristle (no hairs observed on bristles); 8th joint with 1 long and 1 shorter ringed bristles (no hairs observed on bristles).

**Mandible** (Figure 5*o-r*): Coxale similar to that of adult. Basale: with 1 proximal medial bristle; tooth of endite with only 4 triangular cusps; lateral side with 1 long proximal bristle, 1 long slender anterior bristle and 2 short posterior bristles, and terminal teeth similar to those of adult. Endopodite: 1st joint without bristles; 2nd joint with 1 bristle; 3rd joint with 4 bristles (1 very long, 3 short).

**Maxilla:** Similar to that of adult female but with fewer bristles.

**Fifth Limb** (Figure 5*s*): Epipodite with at least 6 bristles. Protopodite and endopodite with 6 bristles. Exopodite 3-jointed: 1st joint with 1 very long terminal dorsal bristle and 2 bristles near ventral margin; 2nd joint with 1 indistinct bristle near ventral margin; end joint with 1 long bristle.

**Sixth and Seventh Limbs:** Absent.

**Furca** (Figure 5*t*): Each lamella with 2 long articulated anterior claws followed by small triangular protuberance. Unpaired process on posterior of body just proximal to lamellae well-developed.

**Bellonci Organ:** Absent.

**Lips** (Figure 5*u,v*): Similar to those of adult.

**Gut Content:** Brown unidentified particles.

**DESCRIPTION OF INSTAR III, SEX UNKNOWN** (Figure 6).—Carapace similar in shape and ornamentation to that of adult female (frill missing from anterior and anteroventral process of USNM 193288D) (Figure 6*a,b*).

**Carapace Size:** USNM 193288A, length with anterior process 0.30 mm, length without anterior process 0.28 mm, height 0.23 mm; USNM 193288B, length with anterior process 0.30 mm, length without anterior process 0.27 mm, height 0.23 mm; USNM 193288D, length without anterior process 0.30 mm, height 0.23 mm.

**First Antenna** (Figure 6*b-d*): 1st joint obscured but with dorsal bristle. Suture between 3rd and 4th joints obscured. 5th joint with long ventral bristle. 6th joint bare. 7th joint with short dorsal bristle and long ventral bristle. 8th joint with 2 long bristles.

**Second Antenna** (Figure 6*b,c,e,f*): Protopodite similar to that of adult. Exopodite similar to that of adult female except 1st joint not subdivided and natatory hairs not observed on bristles. Endopodite: 1st joint with 1 dorsal bristle; 2nd joint with 3 long terminal bristles (unlike adult female one of these bristles located near dorsal corner); 3rd joint small, fused to 2nd, with short terminal bristle.

**Mandible** (Figure 6*b,c,g*): Coxale and basale similar to those of adult female, except lateral side of basale with 3 proximal and 1 distal bristles. Endopodite: 1st joint with dorsal spines but no bristle; 2nd joint with spines and 2 short bristles;

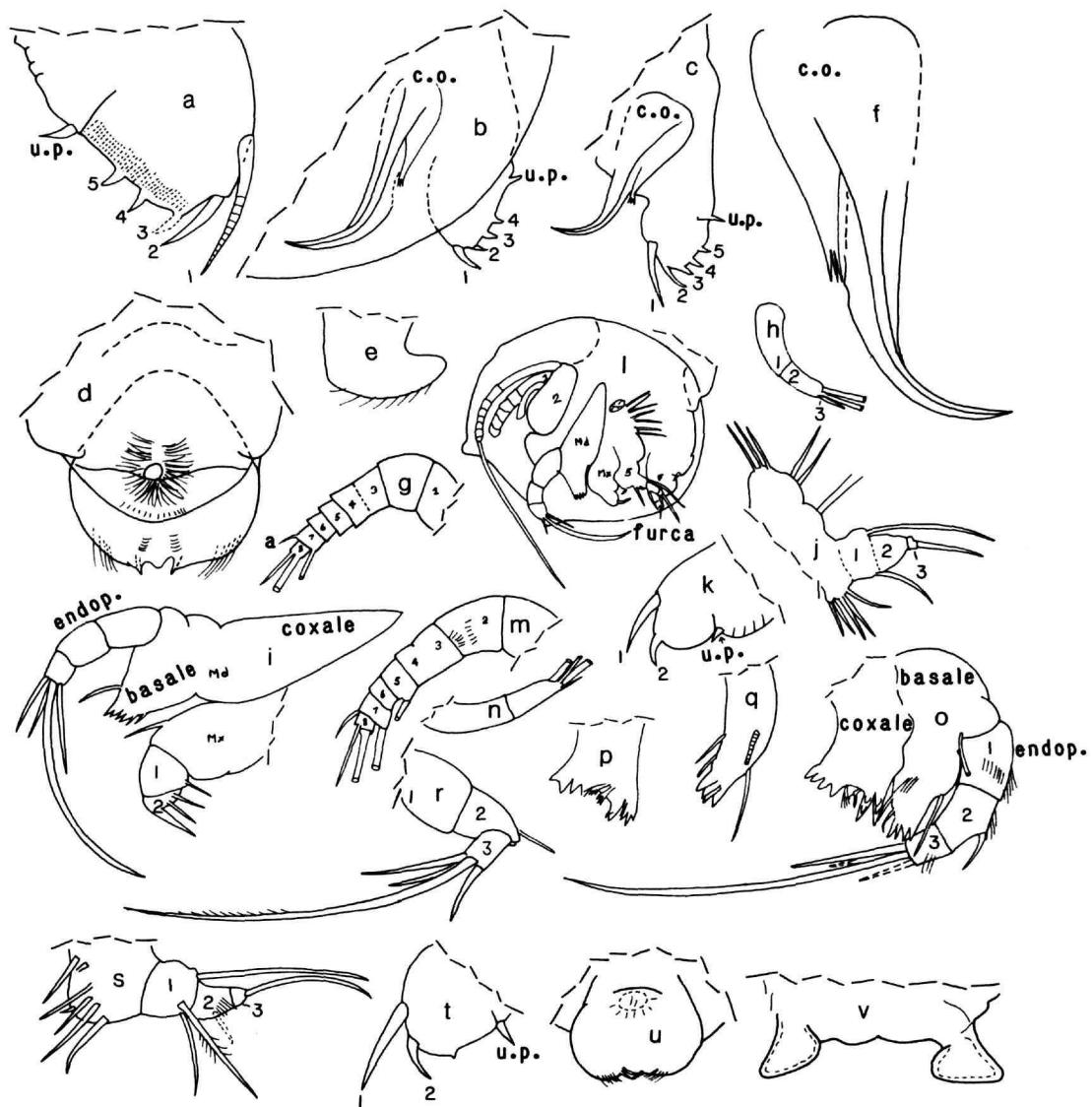


FIGURE 5.—*Danielopolina bahamensis*, new species (a-f, USNM 193285, holotype, adult male; g-l, USNM 193288C, paratype, instar I, sex unknown; m-v, USNM 193288E, paratype, instar II, sex unknown): a, right furcal lamella; b, left furcal lamella and copulatory organ as seen through left valve; c, same as b, shell removed; d, upper lip, posterior end at bottom; e, lower lip, anterior end at right; f, medial view of copulatory organ; g, left 1st antenna, lateral view; h, endopodite of left 2nd antenna, lateral view; i, left maxilla and mandible, lateral view; j, left 5th limb, lateral view; k, left lamella of furca; l, left view of juvenile specimen with left valve removed showing position of appendages (not all bristles shown); m, right 1st antenna, medial view; n, endopodite of left 2nd antenna, medial view; o, left mandible, medial view; p, coxale of right mandible, lateral view; q, basale of right mandible, lateral view; r, endopodite of right mandible (twisted); s, right 5th limb, medial view; t, left lamella of furca; u, upper lip, anterior view (outline of mouth as seen through lip is dashed); v, lower lip (flattened under cover slip, outer ends of triangular processes oriented anteriorly in natural position). (Figure components not to same scale.)

3rd joint with spines and 1 long and 3 short bristles.

*Maxilla* (Figure 6c): Similar to that of adult female but with fewer bristles.

*Fifth Limb* (Figure 6c,h): Epipodite with bristles forming 3 groups: 3 bristles in proximal and distal groups, and 4 bristles in middle group. Protopodite and endopodite each with about 8 bristles. Exopodite 3 jointed: 1st joint with 1 very long terminal bristle near dorsal margin, 1 distal medial bristle, and 1 distal ventral bristle; 2nd joint elongate with 1 ventral bristle; 3rd joint with 1 long and 2 short bristles.

*Sixth Limb* (Figure 6i): Epipodite not observed. No bristles observed on protopodite. Exopodite four-jointed: 1st joint with 2 terminal dorsal bristles; 2nd and 3rd joints fused and without bristles; 4th joint with short terminal bristle.

*Seventh Limb*: Absent.

*Furca* (Figure 6j,k): Each lamella with 2 long anterior claws separated from lamella by suture followed by 1 short ventral claw fused to lamella (left lamella of USNM 193288D with 2 short fused claws, Figure 6k); unpaired process on posterior of body just proximal to lamellae well-developed.

*Bellonci Organ*: Absent.

*Lips*: Similar to those of adult.

*Gut Content*: Brown unidentified particles.

#### COMPARISON WITH OTHER SPECIES OF *Danielopolina*

The surface reticulations of the new species *D. bahamensis* resemble those of *D. wilkensi* (Hartmann, 1985, fig. 1a) in having walls formed in part by continuous ridges and in part by intermittent ridges. In contrast, other species of *Danielopolina* (*D. orghidani* and *D. carolynae*) have walls of reticulations formed by closely spaced minute subround papillae (Kornicker and Sohn, 1976, figs. 71–76). The left valve of *D. wilkensi* bears a process at the posterodorsal corner that is absent on *D. bahamensis*. The appendages of *D. bahamensis* differ from those of *D. wilkensi*, most notably in having three instead of six small fused claws on each furcal lamella. The furca of *D. bahamensis* resembles that of *D. orghidani*, but the valves of the latter species, as well as those of *D. carolynae*, bear posterodorsal processes absent on valves of *D. bahamensis*. Selected characters of females of the five known species of *Danielopolina* are compared in Table 1.

#### SEXUAL DIMORPHISM

Carapace of adult male and female similar in shape and ornamentation. Length of left valve of unique male (excluding processes) 0.40 mm, lengths of left valves of 2 females 0.41 mm.

*First Antenna*: 3rd and 4th joints partially fused on female and separated by distinct suture in male. Ventral margin of 4th joint without bristles on female and with 2 long bristles on male. 5th joint with 1 bare bristle on female; and 3 bristles on male, longest with abundant distal hairs.

*Second Antenna*: Endopodite: 2nd joint with 4 bristles on female and 5 on male; ventral and dorsal margins of 2nd joint parallel on female, flaring on male. 3rd joint of female small, about  $\frac{1}{4}$  width of 2nd joint and bearing small terminal bristle; 3rd joint of male about  $\frac{1}{2}$  width of 2nd and bearing stout hook-like process bearing spines.

*Copulatory Organs*: Male with single copulatory organ having long curved anterior part with slender tip, and shorter styliform posterior part with 3 hairs at tip. Genital pore obscured on female.

*Posterior of Body*: Pointed process just posterior to furcal lamellae better developed on male than on female.

*Other Appendages*: Observed differences may be the result of variability within the species. The maxillae of male and female *D. bahamensis* differ, but this is attributed to the limb of our single male being aberrant. The epipodites of the 5th limbs of 1 male and 2 females examined have 11 bristles on the male and 12 on the female, but additional limbs should be studied to determine the constancy of the numbers; females of *D. carolynae* and *D. orghidani* have 14 epipodial bristles.

*Remarks*: Sexual dimorphism has not previously been reported in *Danielopolina*. The dimorphisms described here for *D. bahamensis* are similar to those observed by Kornicker and Sohn (1976:16, table 13) for species of *Thaumatoconcha*. An exception is that the 2nd endopodial joints of the 2nd antennae of male and female *Thaumatoconcha* have the same number of terminal bristles (4); that joint of *D. bahamensis* has 4 terminal bristles on the male and only 3 on the female. Also, the hook-like process on the 3rd joint of the 2nd antenna of the male *D. bahamensis* bears abundant long spines that are absent on this process on known males of *Thaumatoconcha*.

#### NUMBER OF GROWTH STAGES

The 10 juveniles in this collection include 3 growth stages, interpreted to be instar III (8 specimens), instar II (1 specimen), and instar I (1 specimen). Our conclusion that we lack the instar IV stage is based mostly on the absence of specimens with 2 short claws on the furcal lamellae. In the Thaumatocypriidae only the ontogeny of *Thaumatoconcha radiata* is fairly well known (Kornicker and Sohn, 1976:7); no comparative data exists on the ontogeny of *Danielopolina* species. Kornicker and Sohn (1976:40, table 1) have shown that each lamella of the furca of *T. radiata* increases the number of short furcal claws by 1 at each succeeding growth stage. Angel (1970:192) and Kornicker and Angel (1975: table 1) have shown that 3 species of *Bathyconchoecia* also add 1 claw on the furca in succeeding growth stages. The adult *D. bahamensis* bears 3 short furcal claws on each lamellae and the next younger growth stage in the present collection bears only 1 short furcal claw indicating it is probably an instar III.

Also, the growth factor of 1.46, obtained by dividing the length of the adult female by the length of next smaller instar, is much higher than the growth factor of 1.13 obtained for the

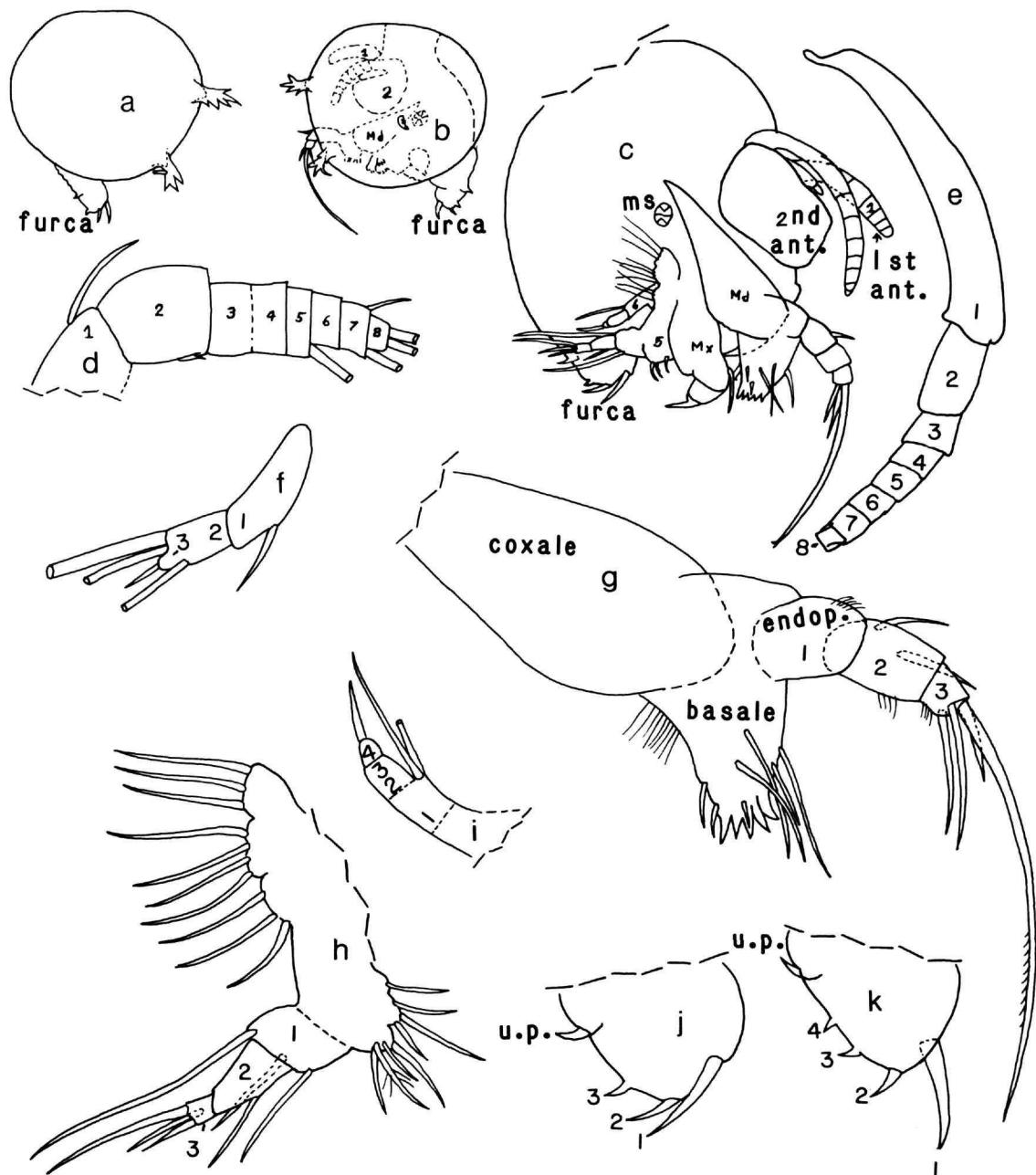


FIGURE 6.—*Danielopolina bahamensis*, new species, instar III, paratypes (a, USNM 193288A; b, USNM 193288B; c-k, USNM 193288D): a, complete specimen, right side, showing projecting furca (length of carapace excluding processes 0.28 mm); b, complete specimen, left side, showing position of appendages (length of carapace excluding processes 0.27 mm); c, body removed from carapace (length excluding processes 0.30 mm) showing positions of appendages (not all bristles of appendages shown); d, right 1st antenna, lateral view; e, exopodite of right 2nd antenna, lateral view; f, endopodite of right 2nd antenna, lateral view; g, right mandible, lateral view, tip of coxale not shown; h, right 5th limb, lateral view; i, right 6th limb, lateral view; j, k, right and left lamella of furca, respectively. (Figure components not to same scale.)

adult and A-1 females of *T. radiata* by Kornicker and Sohn (1976: table 2). But, as only a small number of specimens of *Danielopolina bahamensis* are available, this comparison may be unreliable. The large differences between the adults and next smallest stage in our collection in the number of bristles on the mandibular endopodite (Table 3), as well as on the 1st exopodial joints of the 5th and 6th limbs (Table 4) also suggest that an instar is missing from our sample.

Kornicker and Sohn (1976:8) concluded that *T. radiata* has 7 growth stages. In the present collection of *D. bahamensis* we cannot be certain that the single youngest specimen (USNM 1932886) is a 1st instar. That specimen is 0.18 mm in length. The 93 µm net with which our collection was made has sufficiently small openings to have captured specimens considerably smaller than 0.18 mm, if they had been in its path. Based on the first appearance of the 6th limb, we tentatively conclude that *D. bahamensis* has only 5 growth stages (instar I-adult). Limb 6 (bearing bristles) appears first on *T. radiata* in the 3rd instar. It seems reasonable to assume that it would appear in the same instar on *D. bahamensis*. The 7th limb appears first on *T. radiata* in the 4th instar but, unfortunately, that instar of *D. bahamensis* is not in our collection.

It seems probable that *D. orghidani*, which like *D. bahamensis* has only 3 short fused furcal claws on each lamella, also has but 5 growth stages. *D. wilkensi* and *D. carolynae*, which have 6 short fused furcal claws like *T. radiata*, have 7 growth stages (Kornicker and Sohn, 1976, table 1).

#### ONTOGENY

In both *D. bahamensis* and *T. radiata*, the 1st and 2nd antennae, mandible, maxilla, 5th limb, and furca are already present in the 1st instar, but the 6th and 7th limbs are not. The 6th limb appears in both species with just a few bristles, in the 3rd instar. The 7th limb appears on the 4th instar of *T. radiata* and probably of *D. bahamensis*, but that instar is not in our collection. The carapaces of all known stages of *D. bahamensis* are similar except for size; all probably have frill-like anterior and anteroventral processes, but these fragile frills have been broken off some of the specimens. All specimens of *D.*

*bahamensis* have anterior and anteroventral triangular processes underlying the frills.

Kornicker and Sohn (1976: table 5) listed the order of appearances of bristles on the 1st antenna of *T. radiata*. The total number of bristles on the 1st antenna of adult *D. bahamensis* (9 on female, 13 on male) is lower than that of adult *T. radiata* (13 or 14 on female, 15 on male). On *T. radiata* the number of bristles increases in each succeeding stage for the first 4 stages and then remains constant for the later stages (instars V, VI, and the adult). The number of bristles on the 1st antenna of *D. bahamensis* increases during the first 3 stages and additional bristles are present on the adult (the 4th stage is absent from our collection) (Table 2). In both species bristles appear on distal joints (5th, 7th, 8th) earlier than on proximal joints.

Kornicker and Sohn (1976, table 6) listed the order of appearance of bristles on the endopodite and exopodite of the 2nd antenna of *T. radiata*. The total number of bristles on the 2nd antenna endopodite of adult *D. bahamensis* (7 on female, 8 on male, including process) is lower than that of adult *T. radiata* (11 on female, 9 on male, including process). On both species bristles appear on the 2nd and 3rd joint before appearing on the 1st joint. The number of bristles on the end joint (9th joint) of the exopodite of the 2nd antenna of *T. radiata* increases from 1 on instar I to 3 on the adult; the number of bristles on the end joint (8th joint) of *D. bahamensis* remained the same (2 bristles) on all instars. The natatory hairs on the exopodial bristles are not always readily visible with the standard illumination used during this study; they appeared abundant on the adult male, less so on the adult female, and absent on the juveniles. On all instars the exopodial bristles were very long (except for 1 of the 2 bristles on the end joint) and probably are quite capable of serving as swim bristles despite absence of hairs.

The coxale of the mandible was obscured on instar I of *D. bahamensis* but was similar to that of the adult on instar II. The number of teeth on the basale increased from 4 on instar I to 5 on instar II and remained at that number in later instars. The anterior bristle as well as the 2 posterior bristles of the basale were present on all instars, but the number of lateral

TABLE 2.—Number of bristles on joints of first antenna of *Danielopolina bahamensis*, new species, and their timing of appearance (v = ventral; d = dorsal; l = lateral; nd = no data). Instar IV is not represented in our collections.

Instar	Joint number							
	1st l/d	2nd	3rd	4th v	5th v	6th	7th v/d	8th
I	0/0	0	0	0	0	0	1/1	2
II	0/0	0	0	0	0	0	1/1	2
III	0/0	0	0	0	0	0	1/1	2
IV	nd	nd	nd	nd	nd	nd	nd	nd
Adult ♀	1/1	0	0	0	1	0	2/1	3
Adult ♂	1/1	0	0	2	3	0	2/1	3

TABLE 3.—Number of bristles on 2nd antenna and mandible of *Danielopolina bahamensis*, new species. Instar IV is not represented in our collections (nd = no data).

Instar	2nd antenna			Mandible			
	Endopodial joints			Basale lateral	Endopodial joints		
	1st	2nd	3rd		1st	2nd	3rd
I	0	2	1	0	0	0	4
II	0	3	1	0-1	0	1	4
III	1	3	2	4	0	2	4
IV	nd	nd	nd	nd	nd	nd	nd
Adult ♀	2	4	1	5-6	1	5-6	5-6
Adult ♂	2	5	1 <sup>1</sup>	6	1	5	5

<sup>1</sup>Bristle is in form of a hooked process.

bristles increased from none on instar I to 5-6 on the adult (Table 4). The number of proximal medial bristles on the basale also increased from 0 on instar I to 2 on the adult. The bristles of the mandibular endopodite appeared first on distal joints (Table 3).

Unlike the anterior appendages on which bristles appeared on distal joints before appearing on proximal joints, bristles of the 5th and 6th limbs appeared on the 1st joint prior to appearance on the 2nd joint (Table 4). Instar IV, in which the 7th limb probably first appears, was absent from our collection. The limb bears 2 bristles in the adult. Each lamella of the furca of instar I bears only 2 anterior claws and the smaller (ventral) of these is fused to the lamella. On instar II both anterior claws are separated from the lamella by sutures, and a short ventral fused claw is represented by an anlage (minute triangular protuberance). Instar III bears 1 fused ventral claw. Instar IV, absent from our collection, probably has 2 fused ventral claws in instar IV since adults bear 3 fused ventral claws.

TABLE 4.—Number of bristles on exopodial joints of the 5th and 6th limbs of *Danielopolina bahamensis*, new species (- indicates that limb is absent in this stage; nd indicates "no data," instar IV being unrepresented in our collections). The 2nd and 3rd joints of the 6th limb are fused (see text).

Instar	Fifth limb joints			Sixth limb joints		
	1st	2nd	3rd	1st	2nd/3rd	4th
I	2	0	1	-	-	-
II	3	1	1	-	-	-
III	3	1	3	2	0	1
IV	nd	nd	nd	nd	nd	nd
Adult ♀	8	2	3	6	2	1
Adult ♂	8	2	3	6	2	1

#### *Danielopolina mexicana* Kornicker and Iliffe, new species

FIGURES 1, 7, 8

ETYMOLOGY.—From the type locality.

MATERIAL.—Mayan Blue Cave near Tulum, Quintana Roo, Yucatan Peninsula, Mexico, 7 Nov 1986, collected by Thomas M. Iliffe, with a plankton net near halocline at 16 m

depth. Holotype: USNM 193312, female of undetermined age (possibly A-1, instar VI), on slide and in alcohol. Paratype: USNM 193313, early juvenile in alcohol.

DISTRIBUTION.—Known only from Mayan Blue Cave, Yucatan Peninsula, Mexico.

HABITAT.—Mayan Blue Cave is a wholly underwater cave entered by a cenote situated approximately 5 km inland. Maximum depth was 19 m with fresh water overlying a halocline at 16 m. The surface temperature and salinity of the water in the cave were 25°C and 1‰, respectively. The salinity at which the ostracode was collected is unknown, but other caves in the same area have salinities beneath the halocline of 30-35‰. Other animals collected from Mayan Blue Cave include thermosbaenaceans, amphipods, copepods, mysids, shrimp, and cirolanid isopods; no other ostracodes were collected there.

REMARKS.—Previously described species of *Danielopolina* have 2 anterior claws on each lamella of the furca of the adult, followed by either 3 short ventral claws fused to the lamella, or 6 short ventral claws fused to the lamella followed by a short posteriorly oriented process. The furca of the holotype of *D. mexicana* bears 2 anterior claws on each lamella followed by 5 short ventral claws fused to the lamella. It lacks a short posteriorly oriented process. The furca of *D. mexicana* is therefore of a different type than previously described for *Danielopolina*. Hence, the number of fused claws useful for identifying age in other species of *Danielopolina* can not be used with certainty to estimate the age of *D. mexicana*. The holotype (USNM 193312) is estimated to be an A-1 female (instar VI) and the paratype (USNM 193313) is estimated to be an A-5 juvenile (instar II) based on the assumption that instars of *D. mexicana* and *Thaumatoconcha radiata* having the same number of fused claws are of the same age.

DESCRIPTION OF A-1? FEMALE (Figures 7b-e, 8).—Carapace subround in lateral view with straight dorsal margin in vicinity of hinge and also straight margin between anterior and anteroventral processes (Figure 7b,d,e); ventral and posterior margins as well as anterior margin dorsal to anterior process evenly rounded; valves with greatest width at about midlength and midheight, in vicinity of adductor muscle

attachments. Short anterior and anteroventral processes with bases just lateral to valve edge (Figure 7e); each process bearing fragile frill; triangular projections on frill bisected by narrow rod; frills easily broken off but with underlying firmer triangular process (shown as dashed lines in Figure 7b). Small frilled posterodorsal process present in same location on each valve. Edge of ventral margin of left valve with narrow shelf with perpendicular ribs (Figure 7c,e (bottom)); shelf along edge of right valve with crenulate inner edge and with 2 parallel ridges on valve inward from crenulate edge (Figure 7c (top)). Glandular openings not present on valve exterior.

**Ornamentation** (Figure 7b-e): Surface with abundant small straight or curved spines (not all shown in illustrations); spines longer and stouter in anteroventral part of valves. Reticulations present only on inner surfaces of anterior and anteroventral process, especially the latter (Figure 7e).

**Adductor Muscle Attachments:** Obscured by calcified shell.

**Carapace Size:** USNM 193312, length with anterior process 0.95 mm, length without anterior process 0.82 mm, height with processes 0.74 mm, height without processes 0.71 mm.

**First Antenna** (Figure 8a,p): 8-jointed: 1st joint with 2 bare bristles (dorsal bristle about same length as joint; ventral bristle lateral and near ventral margin, about length of limb, inserted on small process). 2nd joint with distal medial spines and distal dorsal bristle (spines not shown). 3rd joint defined

from 4th by minute suture at ventral margin but without lateral or medial sutures; ventral margin with minute spines forming rows; dorsal margin with minute spines forming row at distal end; dorsal edge of 3rd and 4th joints about same length; ventral edge of 3rd joint slightly longer than ventral edge of 4th. 5th joint shorter than 4th, with long terminal bristle on ventral margin (bristle with few minute widely separated spines along margins and terminal papilla). 6th joint slightly smaller than 5th, bare. 7th joint about same size as 6th, with 2 ventral bristles with minute widely separated marginal spines and terminal papillae (medial bristle about  $\frac{3}{4}$  length of lateral), and short dorsal bristle with few minute marginal spines. 8th joint small with 3 terminal bristles: dorsal bristle about  $\frac{1}{3}$  length of longest bristle, with distinct marginal spines; medial bristle about  $\frac{2}{3}$  length of longest bristle and with minute widely separated marginal spines and terminal papilla; long lateral bristle with widely separated minute marginal spines and terminal papilla. Pigmentation absent. Marginal spines and terminal papillae not shown on all bristles of illustrated limb (Figure 8a).

**Second Antenna** (Figure 8b,c,p): Protopodite with bristle on posterior edge and long hairs in vicinity of proximal ventral corner. Endopodite: 1st joint elongate with 2 dorsal bristles (distal bristle about  $\frac{2}{3}$  length of proximal); 2nd joint about  $\frac{2}{3}$  length of 1st, with 1 short lateral bristle near dorsal margin and 3 long terminal bristles; 3rd joint small, dorsal, fused to 2nd, with small terminal bristle. Exopodite with 9 joints: 1st joint divided into long proximal and short distal parts (suture developed only on medial surface); length of 2nd joint about same as combined lengths of joints 3 and 4; bristles of joints 2-8 long, ringed, and with natatory hairs; 9th joint with 2 bristles (1 short, 1 about  $\frac{1}{2}$  length of bristle of 8th joint, both with minute widely separated marginal spines); all joints with long lateral spines near inner margin.

**Mandible** (Figure 8d-h,p): Coxale endite with proximal and distal sets of teeth separated by space (Figure 8d,g); proximal set comprising 4 broad cusps plus triangular tooth close to distal set of teeth; surface between cusps and medial and lateral surfaces just proximal to cusps with slender spines; 2 spinous bristles with bases just proximal and lateral to triangular tooth; distal set of teeth consisting of 2 flat teeth (proximal with 7 cusps, distal with 4-5 cusps); 1 slender spinous bristle with base on lateral side of proximal flat tooth. Basale (Figure 8e,f,h): Endite with 5 triangular cusps (posterior cusp bare; 4 anterior cusps with marginal teeth except at tip); posterior edge of endite with 1 proximal bristle and 1 distal tubular bristle; anterior margin of endite with 1 long bristle; lateral side of endite with 5 proximal bristles (2 long and 1 short near posterior margin; 2 long near anterior margin) and 1 short distal bristle (Figure 8f); medial side with 2 spinous bristles on low spinous proximal mound (Figure 8h); long spines present at proximal posterior corner (Figure 8e,h,p). Endopodite 3-jointed with 1st and 2nd joints about same length, 3rd joint shorter and narrower (Figure 8e,h); 1st joint

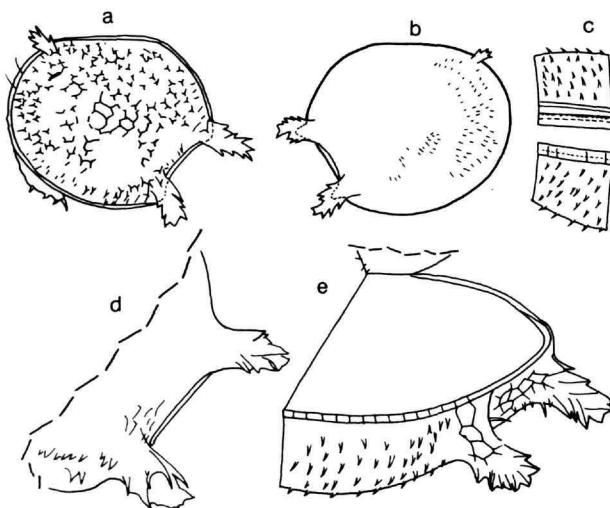


FIGURE 7.—*Danielopolina mexicana*, new species (a, USNM 193313, paratype, A-57, sex unknown; b-e, USNM 193312, holotype, A-1? female): a, complete specimen, right side, showing projecting furca (length without anterior process 0.40 mm); b, complete specimen, left side (length without anterior process 0.82 mm); c, ventral view of valves near midlength showing spines, anterior towards left; d, anteroventral part of right valve showing processes, lateral view; e, inside oblique view of left valve. (Figure components not to same scale.)

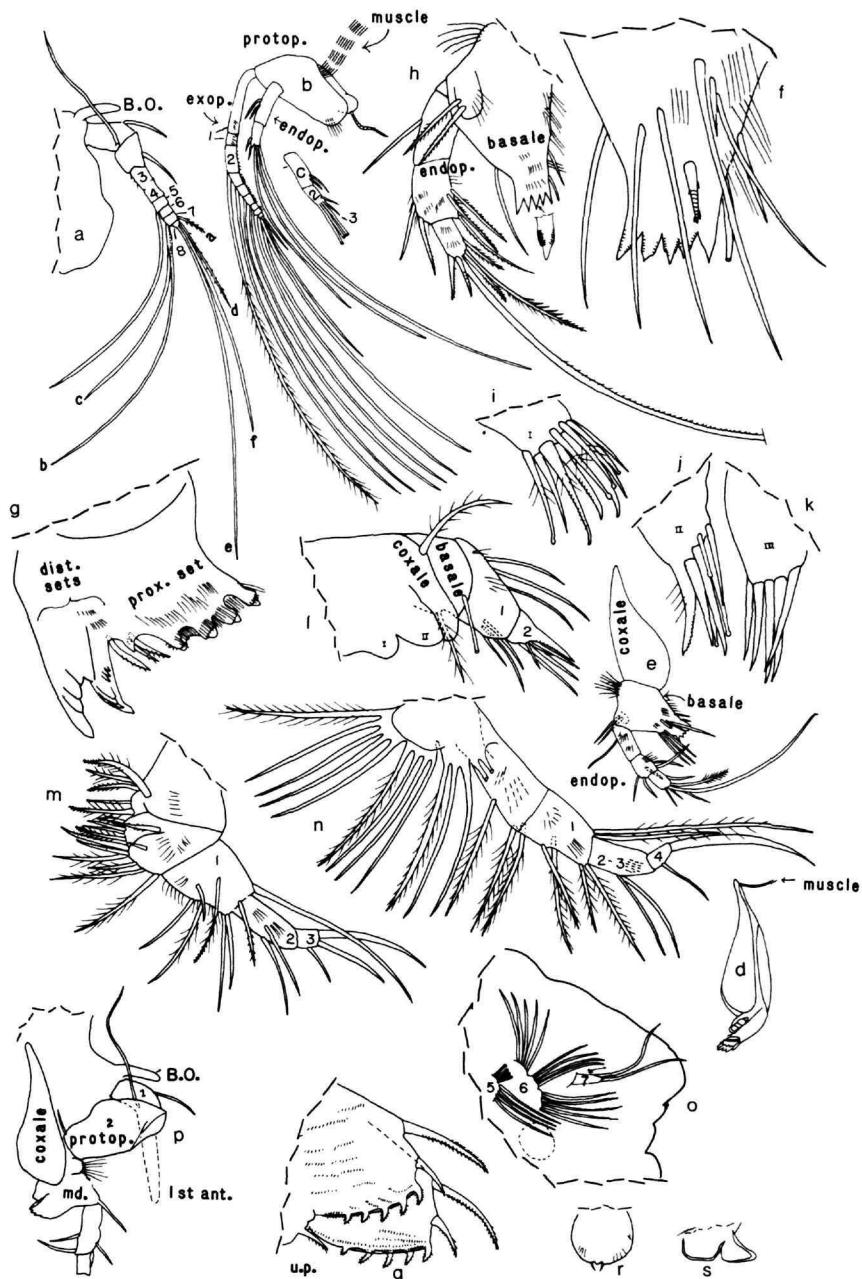


FIGURE 8.—*Danielopolina mexicana*, new species, USNM 193312, holotype, A-1? female: *a*, anterior of body showing Bellonci organ and right 1st antenna; *b*, right 2nd antenna, medial view; *c*, endopodite of left 2nd antenna, medial view; *d*, coxale, left mandible, medial view; *e*, left mandible, lateral view (distal end of coxale not shown); *f*, distal end of basale of left mandible, lateral view; *g*, distal end of coxale, right mandible, medial view; *h*, right mandible, medial view (with coxale not shown); *i,j,k*, maxillary endites I, II, III; *l*, maxilla, endite bristles not shown; *m*, right 5th limb, medial view; *n*, 6th limb; *o*, posterior of body showing positions of epipodites of 5th and 6th limbs (not all bristles shown), 7th limb, and central adductor muscle attachment area (dashed oval); *p*, anterior of body showing 1st joint of right 1st antenna (with 2 bristles) and outline of distal joints (dashed), protopode or right 2nd antenna, right mandible, and Bellonci organ; *q*, furcal lamellae (flattened under cover slip); *r*, upper lip, anterior or ventral view; *s*, lower lip from right side, anterior towards right. (Figure components not to same scale.)

with long medial spines and 1 dorsal bristle; 2nd joint spinous, with 1 subterminal ventral bristle, 2 medial bristles at midlength (1 or both near ventral margin), and 2 dorsal bristles; 3rd joint spinous, with 6 bristles (1 long terminal lateral bristle about twice length of endopodite and with ventral spines, 1 bristle about half length of longest bristle and with long marginal spines just distal to midlength, 1 spinous ventral bristle, and 3 spinous, short, terminal bristles (Figure 8*h*).

**Maxilla** (Figure 8*i-l*): Endite I (Figure 8*i*) with 10 bristles (4 pectinate unringed claw-like bristles with curved pointed tips and long proximal hairs, 2 spinous ringed bristles with pointed tips, and 4 spinous ringed bristles with minute bulbous tips, long proximal hairs and distal marginal spines); endite II (Figure 8*j*) with 7 bristles (3 pectinate unringed claw-like bristles, 1 spinous ringed bristle with pointed tip, and 1 short and 2 long ringed bristles with minute bulbous tips); endite III (Figure 8*k*) with about 5 bristles (region obscured). Coxale with long stout dorsal bristle with widely spaced long marginal hairs. Basale with 1 long ringed ventral bristle with long marginal hairs and 1 ringed medial bristle with minute bulbous tip. Endopodite (Figure 8*l*): 1st joint with 3 dorsal bristles, 3 distal bristles (1 on ventral margin with minute bulbous tip, 2 near ventral margin just proximal to ventral bristle and with pointed tips), and with few long hairs on or near dorsal margin; end joint with 1 anterior, stout, linear pectinate bristle without suture at base, and 5 spinous bristles (longest with rings only at tip, others entirely ringed).

**Fifth Limb** (Figure 8*m,o*): Epipodite with 13 plumose bristles forming 3 groups: dorsal group (not shown) with 5 bristles (proximal bristle shorter than others); medial group with 4 or 5 bristles; and ventral group with 3 or 4 bristles. Protopodite with 2 endites: proximal endite divided by suture into proximal lobe with 3 ventral bristles (1 medial with long marginal hairs; 1 proximal with long proximal hairs and short distal spines; 1 distal with distal third broad bearing short marginal spines) and distal lobe with 2 ventral bristles (proximal bristle bare tubular, distal bristle longer and with long proximal hairs, distal third broad bearing short spines); distal endite with 1 medial bristle (with few short marginal spines) with base some distance from ventral margin, and 4 ventral bristles (proximal bristle short with short marginal spines, following 2 bare, tubular bristles, distal bristle long with long proximal hairs and short distal spines); both endites with long proximal hairs. Endopodite with short tooth-like medial bristle near ventral margin and 6 bristles on ventral margin (2 stout claw-like pectinate, 1 tubular with long marginal hairs, 1 with long proximal hairs and short distal spines, and 2 with only long hairs). Exopodite 3-jointed: 1st joint with long surface hairs, 3 medial bristles (1 at joint midlength with long proximal hairs and short distal spines; 1 at joint midlength, short, tubular; 1 terminal with long proximal hairs and short distal spines), 4 ventral bristles (2 at midlength (proximal bristle bare, distal bristle with long proximal hairs) and 2 terminal, bare), and 1 long bare terminal dorsal bristle;

2nd joint with surface hairs and 2 bare midventral bristles; short 3rd joint with short bare ventral bristle and 2 long bare terminal claw-like bristles (middle bristle 64% and smallest bristle 37% of longest bristle). [See Poulsen, 1969:12, for interpretation of basale and endopodite.]

**Sixth Limb** (Figure 8*n,o*): Epipodite with 14 bristles forming 3 groups (5 bristles in proximal and distal groups, 4 bristles in middle group). Protopodite and endopodite fused, with 3 ventral bristles (1 proximal, 2 terminal, all with long marginal hairs). Exopodite 4-jointed: 1st joint with 4 ventral bristles (with long marginal hairs) forming 2 pairs (1 pair at midlength, other terminal) and 2 long bristles (with long marginal hairs) on minute process on distal dorsal corner; 2nd and 3rd joints fused, with 2 bare ventral bristles at midlength; end joint with short bare ventral bristle and long bare terminal bristle. Protopodite, endopodite, and exopodial joints 1–3 each with surface hairs.

**Seventh Limb** (Figure 8*o*): Small with 2 long bristles.

**Furca** (Figure 8*q*): Each lamella with 2 long articulated anterior claws followed by 5 short unarticulated ventral claws; claw 1 weakly ringed; posterior edges of claws with faint spine-like teeth; anterior edges of claws with distal hair-like spines; lateral and medial surfaces of each lamella with spinules forming rows (medial spinules longer); medial surface of each lamella with narrow transparent lamina extending slightly past edge; small unpaired process with marginal hairs on posterior of body just proximal to lamellae.

**Bellonci Organ** (Figure 8*a,p*): Transparent, flimsy, finger-like with rounded tip. Pigmentation absent in organ and region proximal to organ.

**Lips:** Upper lip with 2 pointed spine-like processes oriented posteriorly (Figure 8*r*). Lower lip with 2 lateral triangular processes (1 on each side) oriented anteriorly; anterior apex rounded (Figure 8*s*).

**Gut Content:** 2 pellets containing copepod appendages.

**DESCRIPTION OF A-5? JUVENILE, SEX UNKNOWN** (Figure 7*a*).—Carapace similar in shape to that of A-1? female described above and with similar processes (Figure 7*a*). This early juvenile (USNM 193313) was left intact in order to preserve the fragile ornamentation of the shell.

**Ornamentation** (Figure 7*a*): With surface spines. Differs from instar VI? in having reticulations on lateral surface of each valve; reticulations often incomplete and appearing as 3-pronged stars with rays of adjacent stars not meeting.

**Carapace Size:** USNM 193313, length including anterior process 0.49 mm, length without anterior process 0.40 mm, height including anteroventral and posterodorsal processes 0.37 mm, height without processes 0.34 mm.

**Furca** (Figure 7*a*): Each lamella with 2 anterior claws separated from lamella by suture, and 1 small fused ventral claw. Unpaired process on posterior of body just proximal to lamellae.

COMPARISON WITH OTHER SPECIES OF *Danielopolina*

*Danielopolina mexicana* differs from previously described species of the genus in having a carapace with abundant surface spines. Spines are also present on the carapace of *Thaumato-cypris echinata* Müller (1906, pl. II-4), but that species has much longer anterior and anteroventral processes.

## Superfamily HALOCYPRIDOIDEA Dana, 1853

COMPOSITION.—Includes the single family Halocyprididae Dana, 1853.

## Family HALOCYPRIDIDAE Dana, 1953

COMPOSITION.—The family includes five subfamilies: Archiconchoecinae Poulsen, 1969; Euconchoecinae Poulsen, 1969; Halocypridinae Dana, 1853; Conchoecinae Claus, 1891; and Deeveyinae Kornicker and Iliffe, 1985. A single fossil in

this family is known from the Cretaceous of Czechoslovakia (Pokorny, 1964).

## Subfamily DEEVEYINAE Kornicker and Iliffe, 1985

COMPOSITION.—The subfamily includes two genera: *Deeveya* Kornicker and Iliffe, 1985; and *Spelaeoecia* Angel and Iliffe, 1987.

*Deeveya* Kornicker and Iliffe, 1985

TYPE SPECIES.—*Deeveya spiralis* Kornicker and Iliffe, 1985.

COMPOSITION.—The genus includes three species, all from anchialine caves: *D. spiralis* Kornicker and Iliffe, 1985, from the Turks and Caicos Islands; *D. bransoni* Kornicker and Palmer, 1987, from South Andros Island, the Bahamas; and *D. jillae*, new species, from Eleuthera, the Bahamas, herein.

Key to the Species of *Deeveya*

1. Carapace viewed with transmitted light with coarse bright disks [Figure 10]; ventral bristle of 3rd endopodial joint of mandible with marginal hairs shorter than width of bristle . . . . . *D. jillae*, new species
- Carapace viewed with transmitted light lacking coarse bright disks; ventral bristle of 3rd endopodial joint of mandible with marginal hairs longer than width of bristle . . . . . 2
2. Ventral bristle of 3rd endopodial joint of mandible with long hairs at midlength; end joint of 5th limb with 4 bristles . . . . . *D. bransoni*
- Ventral bristle of 3rd endopodial joint of mandible with long hairs distally; end joint of 5th limb with 5 bristles . . . . . *D. spiralis*

*Deeveya jillae* Kornicker and Iliffe, new species

FIGURES 9-15

ETYMOLOGY.—The species is named for Jill Yager.

MATERIAL.—Bahama Islands, Eleuthera, Hatchet Bay, Hatchet Bay Cave, 15 June 1986, collected by Thomas M. Iliffe with a 93 µm mesh plankton net from 0–3 m water depths. Holotype: USNM 193298, juvenile (A-1) male, preserved on slide and in alcohol. Paratypes: USNM 193299 and USNM 193300, each is a single A-3 juvenile.

DISTRIBUTION.—Known only from the Bahamas, Eleuthera, Hatchet Bay, Hatchet Bay Cave.

HABITAT.—Same as that of *Danielopolina bahamensis* (Figure 9).

REMARKS.—In other species of *Deeveya*, the adult probably has 7 furcal claws, the A-1 instar has 6 furcal claws, the A-2 instar has 5 furcal claws, the A-3 instar has 4 furcal claws, and the A-4 instar has 3 furcal claws (Kornicker, Yager, Williams, in prep.). Because specimens of *D. jillae* on hand have either 6 or 4 furcal claws, they are identified tentatively as A-1 and A-3 instars, respectively.

DESCRIPTION OF A-1 MALE (Figures 10–13, 14a,b).—Carapace oval in lateral view except for straight dorsal margin and slightly concave anterior margin (Figures 10a, 11a). Right valve with small tubercle on dorsal margin near posterior end.

ORNAMENTATION (Figures 10, 11a–c).—Carapace when viewed with transmitted light shows coarse, bright disks (Figure 10b); disks not represented by depressions or bosses on valve surface which appears smooth; walls of reticulations within shell also visible in transmitted light (Figure 10b) at × 300 magnification, but not easily visible in low power photographs (Figure 10a); reticulations roughly 4–6 sided; at × 600 magnification minute bright bosses appear within some reticulations (not clearly resolved in Figure 10, but illustrated in Figure 11c); bosses appearing as projections along anterior and anteroventral shell edge. Valve margins with few long widely spaced bristles. Setal bristle at tip of posterodorsal tubercle of right valve. Broad infold along anterior, ventral and posterior shell margins, narrowest opposite anterior concavity of margin, widest at anteroventral corner. Narrow list present near inner margin of infold. Selvage along outer margin of infold with narrow lamellar prolongation with smooth outer edge. Unsym-

metric gland opening on tip of dorsal tubercle of right valve. Indistinct adductor muscle attachment scars forming a cluster near center of valve (Figure 11a).

**Carapace Size:** USNM 193298, length 1.07 mm, height with posterodorsal tubercle, 0.89 mm, height without tubercle 0.87 mm.

**First Antenna** (Figure 11d,e): Elongate with 8 joints. 1st joint with distal lateral spines extending to ventral margin where they are longer; distal end of lateral side of 1st joint overlapping proximal end of 2nd joint, especially at ventral margin. 2nd joint with mid-dorsal bristle bearing short marginal spines; distal end of 2nd joint overlapping proximal end of 3rd joint; distal half of 2nd joint bearing abundant short medial spines. 3rd joint elongate, with spinous ventral bristle distal to midlength, short spines along dorsal margin, and longer spines near ventral margin. 4th joint short with slender, dorsal, terminal bristle bearing few faint marginal spines. 5th joint slightly shorter than 4th, with long, ventral, terminal, filament-like bristle bearing few, short, widely spaced, distal spines and minute terminal papilla. 6th joint shorter than 5th, bare. 7th joint slightly longer than 4th joint, with 1 short, distal, lateral, spinous a-bristle near dorsal margin, and long b- and c-bristles (both with widely separated marginal spines) on small terminal ventral pedestal (both bristles longer than bristle of 5th joint; medial b-bristle shorter than lateral c-bristle, filament-like with terminal papilla; c-bristle with proximal rings, filament-like distally, with missing tip on both limbs of specimen). 8th joint with very long principal e-bristle and 3 shorter filament-like d-, f-, and g-bristles with terminal papilla, all bristles with widely spaced marginal spines (all spines not shown on Figure 11d).

**Second Antenna** (Figure 11f,g): Protopodite: lateral surface with long spines forming cluster just distal to middle, and shorter proximal spines near and along dorsal margin.

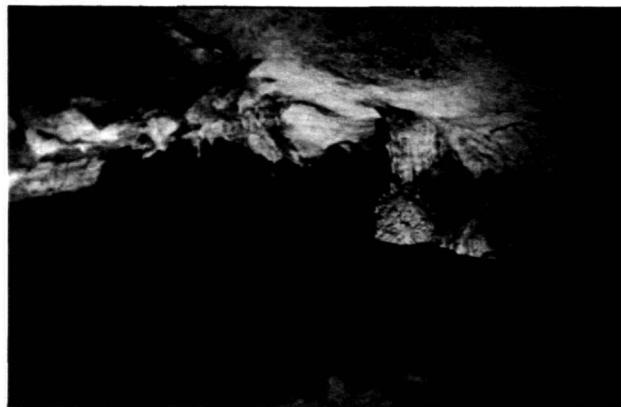


FIGURE 9.—Pool (at bottom) in Hatchet Bay Cave, Eleuthera, from which *Danielopolina bahamensis*, new species, and *Deeveya jillae*, new species, were collected.

Endopodite interpreted to be 3-jointed. 1st joint with distal a-and b-bristles on small protuberance (a-bristle about half length of b-bristle); 2nd joint forming right angle with 1st joint and with filament-like f- and g-bristles with widely separated marginal spines and terminal papillae; g-bristle stouter than f-bristle and with fairly strong annulations in proximal half; right limb 2nd joint has small process with concave tip on ventral margin near base of bristles (Figure 11f); left limb 2nd joint with similar process located between 2nd and 3rd joints but has pointed tip (Figure 11g). 3rd joint fused to 2nd, with long filament-like h-, i-, and j-bristles with widely spaced marginal spines and terminal papillae. Exopodite (not-illustrated) 9-jointed: 1st joint weakly divided into long

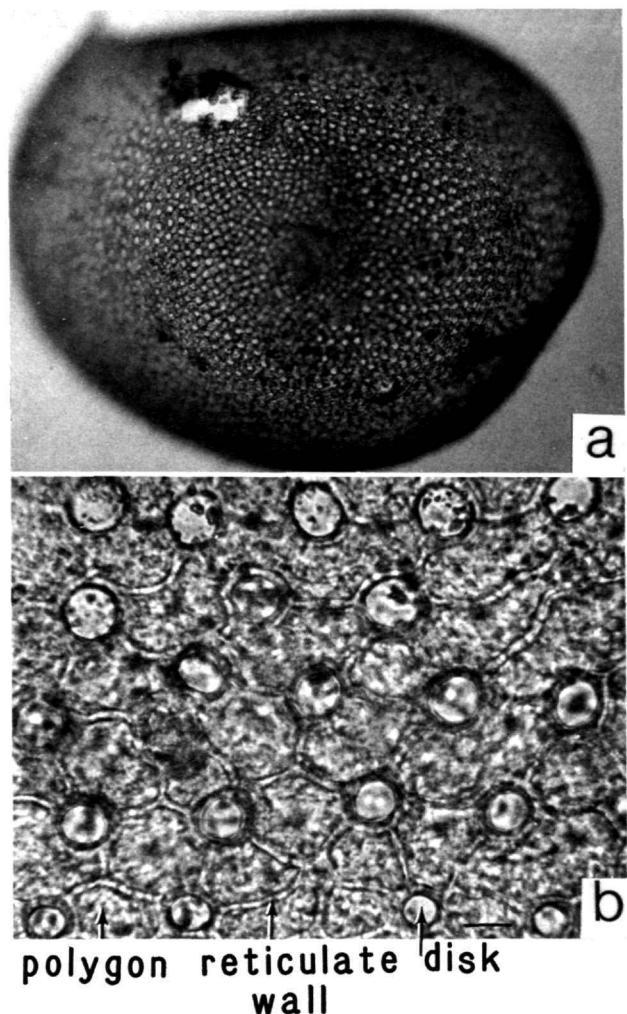


FIGURE 10.—*Deeveya jillae*, new species, USNM 193298, holotype, A-1 male: a, right valve from outside, transmitted light (length 1.07 mm); b, detail from a, transmitted light (scale bar represents 0.01 mm). Photographs by Dr. Robert P. Higgins.

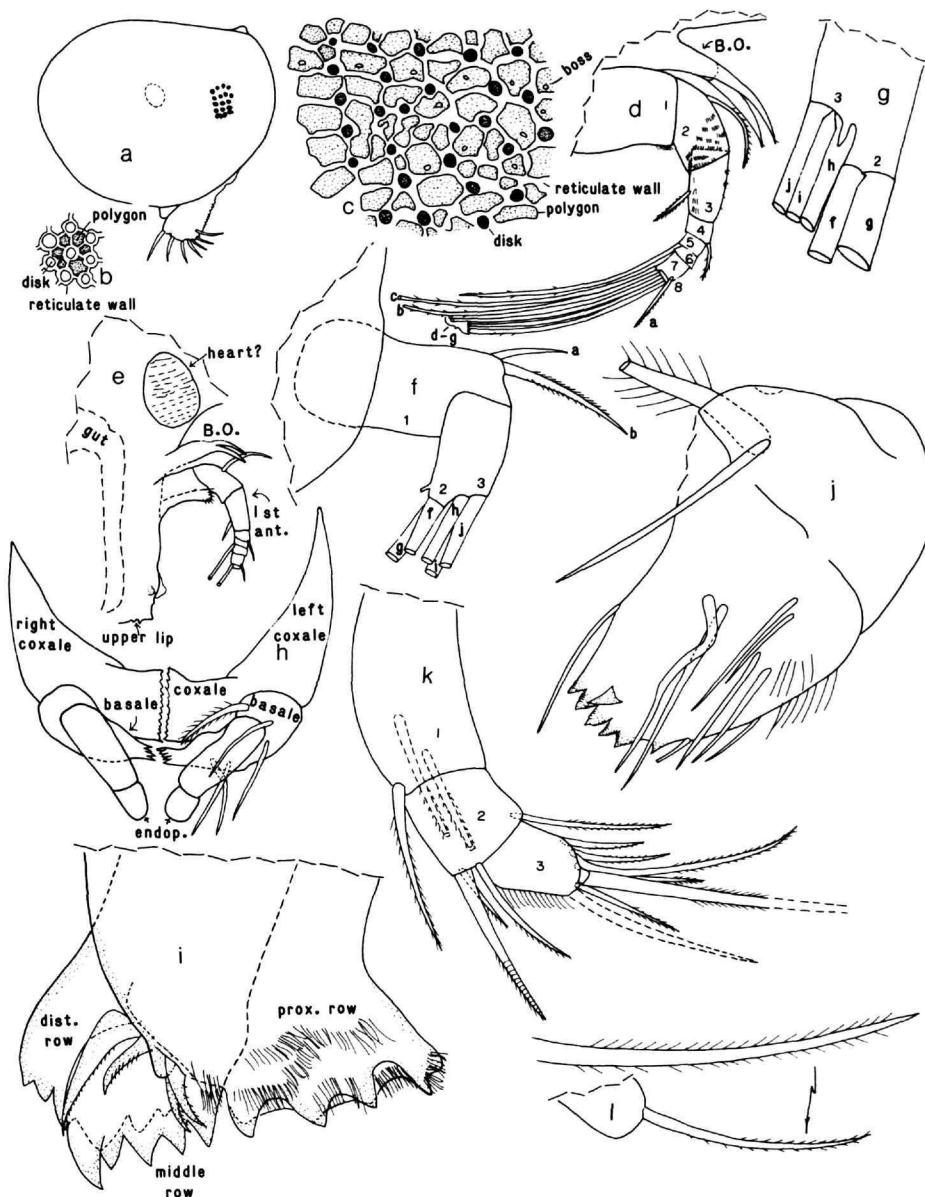


FIGURE 11.—*Deeveya jillae*, new species, USNM 193298, holotype, A-1 male: *a*, complete specimen, left side, showing central adductor muscle scar area (dashed oval), representative puncta in posterior part of left valve, and projecting furca (carapace length 1.07 mm); *b*, detail of sketch of shell showing round disks and reticulate substructure; *c*, detail (drawn with camera lucida, magnification higher than *b*) from *a*, showing round disks (dark stipple), reticulate walls (without pattern), polygonal areas (light stipple) within reticulate walls, and small round bosses (without pattern) within some polygonal areas; *d*, bifurcate Bellonci organ and medial view of left 1st antenna; *e*, anterior of body showing Bellonci organ, right 1st antenna (not all bristles shown), upper lip, outline of gut (dashed), and ellipsoid organ (heart?) dorsal to Bellonci organ; *f*, distal end of protopodite and endopodite of right 2nd antenna, lateral view; *g*, tip of endopodite of left 2nd antenna, lateral view; *h*, dorsal view of both mandibles showing proximity of teeth of coxale and basale; *i*, distal end of coxale, left mandible, posterior view; *j*, basale, left mandible, lateral view; *k*, left mandibular endopodite, lateral view; *l*, posterior bristle on 3rd left endopodial joint, left mandible, lateral view. (Figure components not to same scale.)

proximal and short distal parts; proximal part with minute spines near dorsal margin; distal part with short ringed bristle reaching just past distal end of 2nd joint; 2nd joint with long bristle with small widely spaced ventral spines and distal natatory hairs; joints 3–8 each with long bristle with natatory hairs; 9th joint with 4 bristles (2 spinous, short, about same length as combined joints 7–9; 1 fairly long with small spines and few distal natatory hairs, 1 long with only natatory hairs).

**Mandible** (Figures 11*h–l*, 12*a–d*): Coxale endite with teeth forming 3 rows (proximal, middle, distal). Proximal row consisting of 4 broad teeth; densely packed spines between teeth and at each end; medial and lateral spines and hairs proximal to teeth; pointed or rounded tooth (single or bifurcate) present between proximal and middle rows (about midway between posterior tooth of proximal row and anterior tooth of middle row), and adjacent to 2 stout spinous pointed bristles; 2 spinous bristles (posterior stouter) with bases just proximal and dorsal to bases of teeth forming middle row). Middle row with 5 teeth (posterior tooth longer than others) (Figures 11*i*, 12*a*). Distal row forming ventral edge of endite with 6–7 teeth (middle of these larger than others) (Figure 12*a*). Basale with 6 terminal cusps (5 anterior serrate proximally; 1 posterior cusp non-serrate, smaller than others and separated from them by gap) (Figures 11*j*, 12*b*). Anterior margin of endite with single ringed bristle; posterior margin with proximal hairs, 1 short proximal bristle and 1 short distal tubular bristle; lateral side with few long hairs, 6 slender distal bristles (2 longer than others and entwined as in *D. spiralis*, Figure 12*c*) and 1 short, stout, triangular tooth just proximal to terminal cusps; medial side of endite with few long hairs; proximal basale near insertion of endopodite with 3 bristles (1 stout and plumose, 1 slender with short marginal spines, 3rd bristle spinosity unknown; all 3 bristles shown on Figure 11*h*, but 1 bristle missing on dissected left mandible (Figure 11*j*) and 2 missing on dissected right mandible, Figure 12*b*). Endopodite 3-jointed with 1st joint about twice length of 2nd, and 2nd about same length as 3rd; 1st joint with 1 spinous anterior terminal bristle, 1 posterior bristle (missing on left limb of USNM 193298, Figure 11*k*) and 2 spinous, distal, medial bristles; 2nd joint with medial bristle near distal posterior corner, 3 terminal bristles at distal anterior corner and few medial hairs; 3rd joint hirsute medially and along anterior margin, with 4 distal medial bristles forming row, and 3 stout spinous terminal bristles (middle of these with smooth sharp tip, closely spaced posterior spines and more widely spaced anterior spines; posterior bristle with short marginal spines, Figure 11*l*).

**Maxilla** (Figure 12*e–h*): 3 well-developed endites: endite I with 2 proximal bristles with long proximal hairs and 8 terminal and subterminal bristles (Figure 12*e*); endite II with 2 proximal bristles with long proximal hairs and 8 terminal bristles (Figure 12*f*); endite III with 1 proximal bristle with long hairs and 6 terminal bristles (Figure 12*g*). Coxale with 1 stout, hirsute, terminal, dorsal bristle (Figure 12*h*). Basale with 1 slender ventral bristle with short spines and 1 slender terminal

bristle at midwidth of joint. Endopodite: 1st joint with 3–4 spinous bristles on or near anterior margin, and 4 bristles at distal posterior corner; 2nd joint with 2 stout claws, 3–4 slender bristles, and long hairs on anterior surface.

**Fifth Limb** (Figure 13*a,a'*): Epipodite with hirsute bristles forming 3 groups: dorsal group with 1 short and 4 long bristles; middle group with 6 long bristles; ventral group with 1 short and 4 long bristles. Protopodite and endopodite with 22–23 bristles including 2 pectinate claw-like bristles at ventral margin of knee (Figure 13*a'*). Exopodite 3-jointed: 1st joint with total of 10 bristles: 2 distal dorsal bristles (longest bare, other with long marginal hairs), 2 lateral bristles (distal of these plumose), 1 medial bristle near middle, 2 proximal ventral bristles, and 3 bristles on distal ventral corner. 2nd joint elongate with 3 bristles (1 dorsal, 2 ventral). 3rd joint short with 2 long claw-like bristles (longer pectinate) and 2 slender ringed bristles (bases of slender bristles medial to bases of claw-like bristles).

**Sixth Limb** (Figure 13*b*): Epipodite with hirsute bristles forming 3 groups: dorsal group with 1 short and 6 long bristles; middle group with 6 long bristles; ventral group with 5 long bristles. Protopodite with 2 joints: proximal joint with 3 bristles on or near ventral margin (proximal and 1 distal bristle with short marginal spines; other distal bristle plumose); distal joint with 3 bristles (1 plumose, 2 with short spines) on or near ventral margin. Exopodite 4-jointed: 1st joint with plumose lateral bristle, 5 plumose bristles on or near ventral margin, and process on dorsal distal corner with 4 bristles (longest bare, others plumose); 2nd joint with 2 bristles (bare or with short marginal spines) on or near ventral margin; 3rd joint separated from 2nd joint by suture; elongate with 2 bristles (1 ventral, 1 dorsal; either bare or with few short marginal spines); 4th joint small, with 2 stout claw-like bristles (longest pectinate) and 2 slender bristles (1 long, ventral; 1 short, medial).

**Seventh Limb** (Figure 13*c,d*): Limb with 3 poorly defined joints; terminal joint with 3 bristles (1 long, others about half length of long bristle).

**Furca** (Figures 11*a*, 13*e*): Each lamella with total of 6 claws followed by unpaired dorsal bristle; claws decreasing in length and width posteriorly along lamella; all claws bearing marginal spines; spines on claws 3–5 slightly longer; claws 5 and 6 with spines along both posterior and anterior margins, others with indistinct spines along posterior margin (lateral and medial row); tips of claws with minute terminal spine; stout triangular protuberance on each lamella following last claw, and small process laterally between claws 1 and 2. Unpaired dorsal bristle with marginal spines.

**Bellonci Organ** (Figure 11*d,e*): Well developed, bifurcate distally with each branch tapering to point with minute spine.

**Lips** (Figures 11*e*, 13*f–h*, 14*a,b*): Anterior face of lip at ventral corner with about 13 tooth-like processes (5–6 distinct processes forming row on each side of 2 smaller indistinct processes) (Figure 13*f*); 6 larger processes forming row on anterior face closer to ventral margin than previous row (Figure

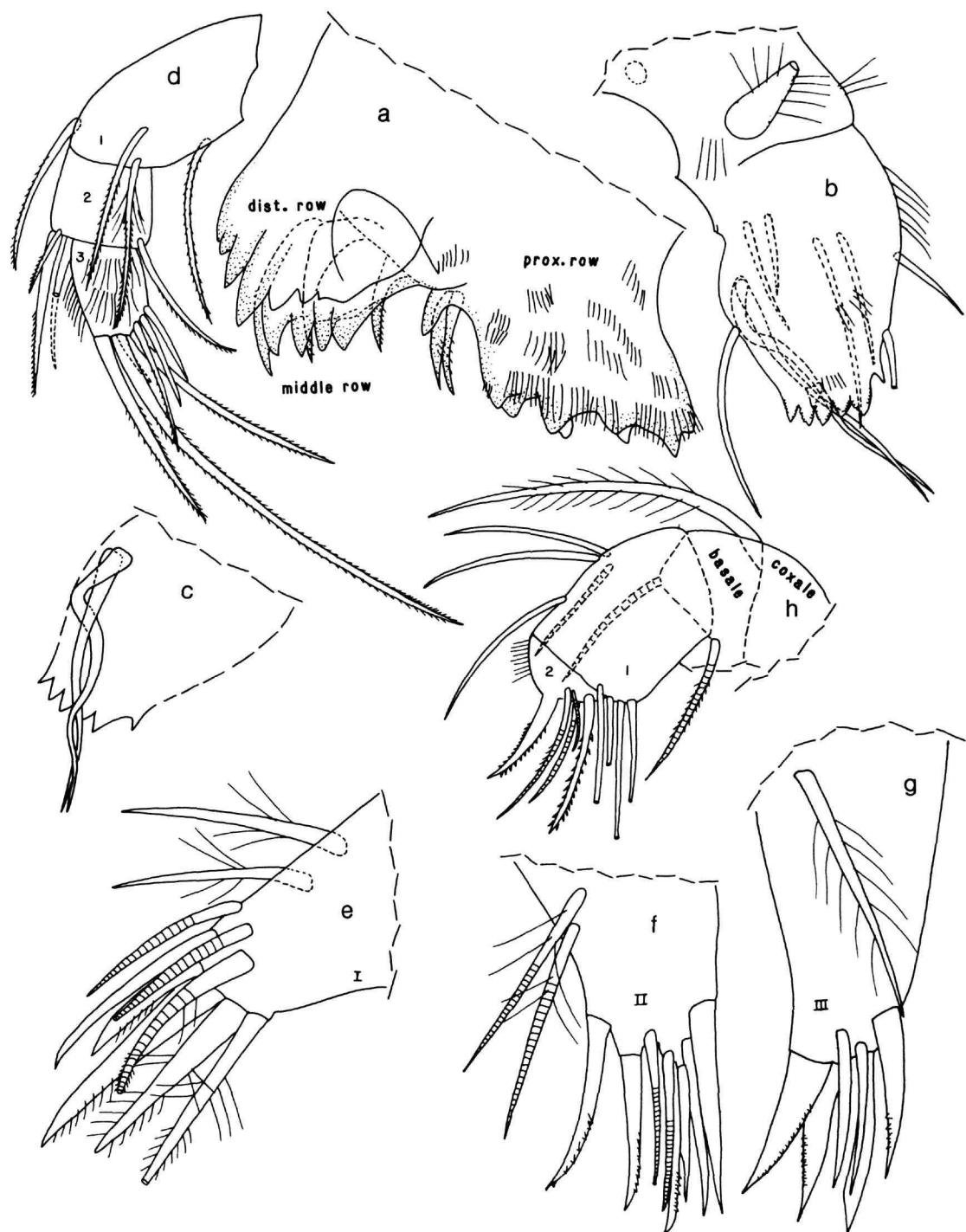


FIGURE 12.—*Deeveya jillae*, new species, USNM 193298, holotype, A-1 male: *a*, distal end of coxale, right mandible, anterior view; *b*, basale, right mandible, medial view; *c*, entwined lateral bristles on basale of right mandible; *d*, mandibular endopodite, medial view; *e,f,g*, right maxillary endites I, II, III; *h*, left maxilla, endites not shown. (Figure components not to same scale.)

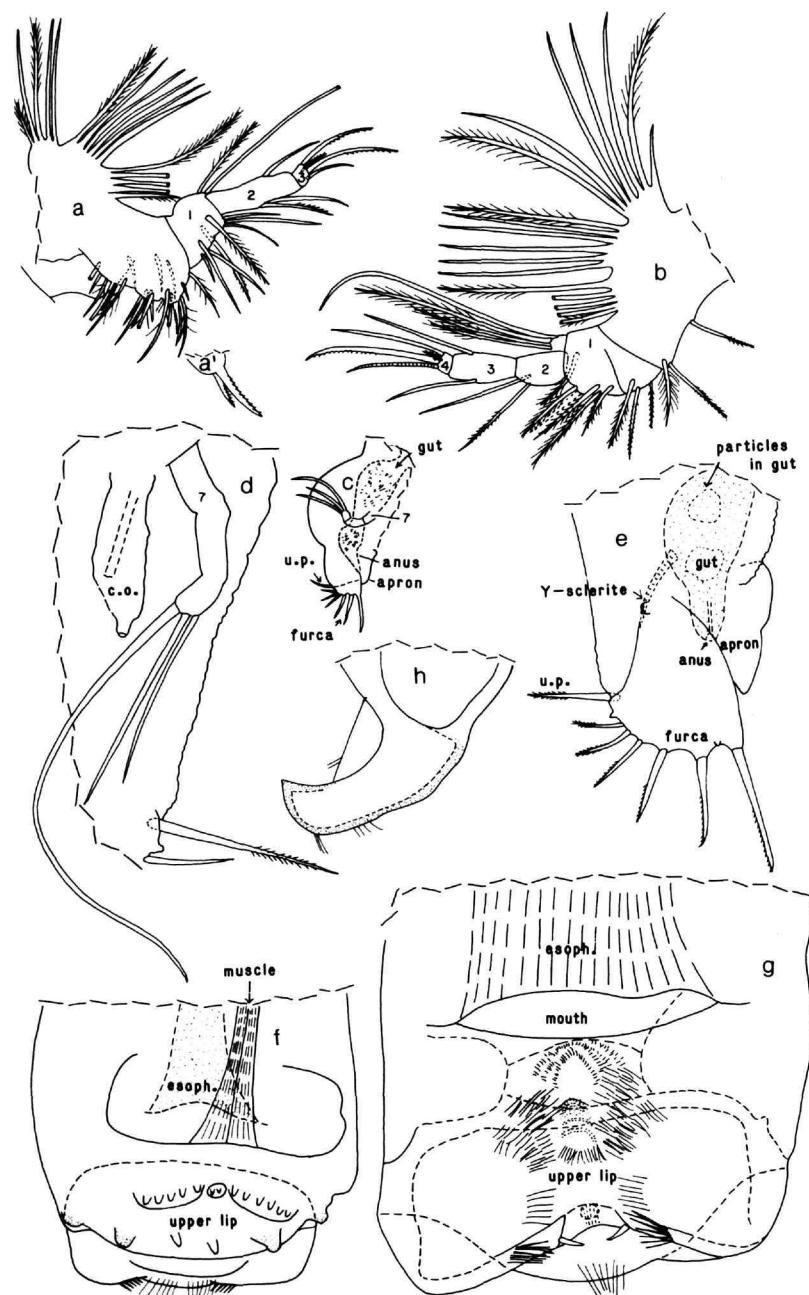


FIGURE 13.—*Deeveya jillae*, new species, USNM 193298, holotype, A-1 male: a, left 5th limb, lateral view; a', knee of endopodite of right 5th limb showing 2 claw-like bristles, lateral view; b, left 6th limb, medial view; c, posterior of body from right side showing right 7th limb, right lamella of furca, and gut leading to anus (dashed lines); d, posterior of body from left side showing left 7th limb, copulatory organ, unpaired bristle near furca, and short posterior claw of left lamella of furca; e, posterior of body showing unpaired bristle near furca, right lamella of furca, apron, posterior end of gut leading to anus (stippled, note food particles indicated by 2 dashed ovals), furcal sclerite (dashed), and small crescent shaped boss at rear ventral end of sclerite; f,g, anterior and posterior views, respectively, of upper lip, mouth, and gut (stippled in f, dashed in g); h, lower lip, lateral view, anterior towards left. (Figure components not to same scale.)

13f); posteroventral corner spinous (Figure 14a,b) with slight concavity at midwidth (when viewed posteriorly) having stout spine on each side followed by additional slender spines (Figure 13g); posterior face of lip ventral to mouth spinous (Figure 13f). Paragnathes triangular process on each side of mouth (Figure 13h); inner surface of paragnathes with long slender hairs.

*Copulatory Organ* (Figure 13d, only posterior branch shown): Weakly developed, with 2 branches; anterior branch slender with spine at tip; tip of posterior branch with minute rounded process.

*Posterior of Body* (Figure 13e): Evenly rounded, unsegmented.

*Apron* (Figure 13e): Curving shield anterior to both anus and proximal leading edge of furca.

*Anus* (Figure 13e): Between proximal anterior ends of furcal lamellae where they join.

*Gut and Gut Contents* (Figure 13e-g): Narrow in vicinity of mouth, broadening dorsal of central adductor muscle, narrowing in short segment proximal to a second broad area (not as broad as previous broad area), then narrowing towards anus. Anterior and posterior broad areas with brown unrecognized organic particles.

*Furcal Sclerites* (Figure 13e): A slender sclerite with pointed ventral tip present on each side of body proximal to furca and posterior to anus. A crescent shaped boss present lateral to ventral end of sclerite may be posterior edge of a process projecting slightly above surrounding surface (Figure 13e).

*Heart?* (Figure 11e): Ellipsoid organ just posterior and dorsal to Bellonci organ may be heart, but probably too big.

**DESCRIPTION OF A-3 JUVENILE** (Figures 14c-h, 15).—Carapace oval in lateral view except for almost straight dorsal and anteroventral margins. Right valve with small tubercle on dorsal margin near posterior end (Figure 14c,d).

*Ornamentation* (Figure 14c,d): Carapace viewed with transmitted light with coarse, bright disks; walls of reticulations within shell also visible in transmitted light. Valve margins with few long widely spaced bristles. Setal bristle at tip of posterodorsal tubercle of right valve (Figure 14d). Unsymmetric gland opening at tip of posterodorsal tubercle of right valve.

*Carapace Size:* USNM 193300, length 0.70 mm, height with posterodorsal tubercle 0.61 mm, height without tubercle 0.59 mm. USNM 193299, length 0.71 mm, height with posterodorsal tubercle 0.59 mm, height without tubercle 0.58 mm.

*First Antenna* (Figure 15a,k): 8-jointed: 1st joint spinous but without bristle. 2nd joint with short spinous dorsal bristle. 3rd joint elongate with spinous ventral bristle distal to midlength. 4th joint fused to 3rd (no suture separating joint observed on either side), with short terminal dorsal bristle. 5th and 6th joints short and without bristles. 7th joint with short dorsal a-bristle with base on lateral side, and long ventral terminal c-bristle (filament-like with widely separated marginal

spines and terminal papilla) with base on short pedestal; b-bristle absent. 8th joint small, with very long principal e-bristle (slightly longer than c-bristle of 7th joint), and filament-like d-, f-, and g-bristles (d- and f-bristles about half length of e-bristle and with widely separated marginal spines and terminal papillae, g-bristle short, about same length as combined joints 5-8, without spines or papillae).

*Second Antenna* (Figure 15b): Protopodite with few minute lateral spines near dorsal margin. Endopodite 3-jointed: 1st joint with 1 dorsal b-bristle; a-bristle absent. 2nd joint forming right angle with 1st joint, with 1 long g-bristle, more than twice length of protopodite, with fairly strong annulations in proximal half, widely spaced marginal spines and terminal papilla), and 1 very short bare lateral f-bristle. 3rd joint fused to 2nd, with 3 long filament-like h-, i-, and j-bristles about half length of g-bristle, with widely spaced marginal spines and terminal papilla. Exopodite (not-illustrated) 9-jointed: 1st joint not divided into proximal and distal parts, with short, terminal, medial bristle about  $\frac{3}{4}$  length of 2nd joint; bristle of 2nd joint long, with widely spaced, small, ventral spines and distal, natatory hairs; joints 3-8 each with long bristle with distal natatory hairs; 9th joint small with 2 bristles.

*Mandible* (Figure 15c-e): Coxale endite differs from that of A-1 male in having 7 small teeth in middle row (posterior tooth about same size as others) and in not having bristle near posterior end of row (Figure 15c). Basale with 6 terminal cusps (anterior and posterior cusps smaller than others and separated from them by space). Anterior margin of endite with single ringed bristle; posterior margin with proximal hairs, 1 short proximal bristle, and 1 short distal tubular bristle; lateral side with few long hairs, 3 slender bristles (not entwined) and 1 ventral tooth (Figure 15d); proximal anterior corner of basale with 2 long bristles (stouter of these hirsute). Endopodite 3-jointed: 1st joint with 1 spinous dorsal bristle; 2nd joint with 2 spinous dorsal bristles; 3rd joint with 1 distal medial bristle and 3 spinous terminal bristles (middle of these longer and with closely spaced posterior and more widely spaced anterior spines; posterior bristle with short marginal spines) (Figure 15e).

*Maxilla* (Figure 15f): 3 well developed endites: endite I with 7 spinous bristles (2 proximal, 5 terminal); endites II and III narrower and slightly longer than endite I, each with about 5-7 spinous terminal bristles. Coxale with 1 stout, hirsute, dorsal bristle. Basale with 2 long, stout, terminal bristles (1 ventral, 1 at midwidth). Endopodite: 1st joint with 2 spinous bristles on or near anterior margin, and 1 stout spinous bristle at distal posterior corner; 2nd joint with 2 stout pectinate claws and 4 slender bristles.

*Fifth Limb* (Figure 15g): Epipodite with hirsute bristles forming 3 groups: dorsal group with 1 short and 4 long bristles; middle group with 6 long bristles; ventral group with 4 long bristles. Protopodite and endopodite with about 11 bristles including pectinate claw-like bristle at ventral margin of knee and 1 small knife-like bristle (with proximal spines) just ventral

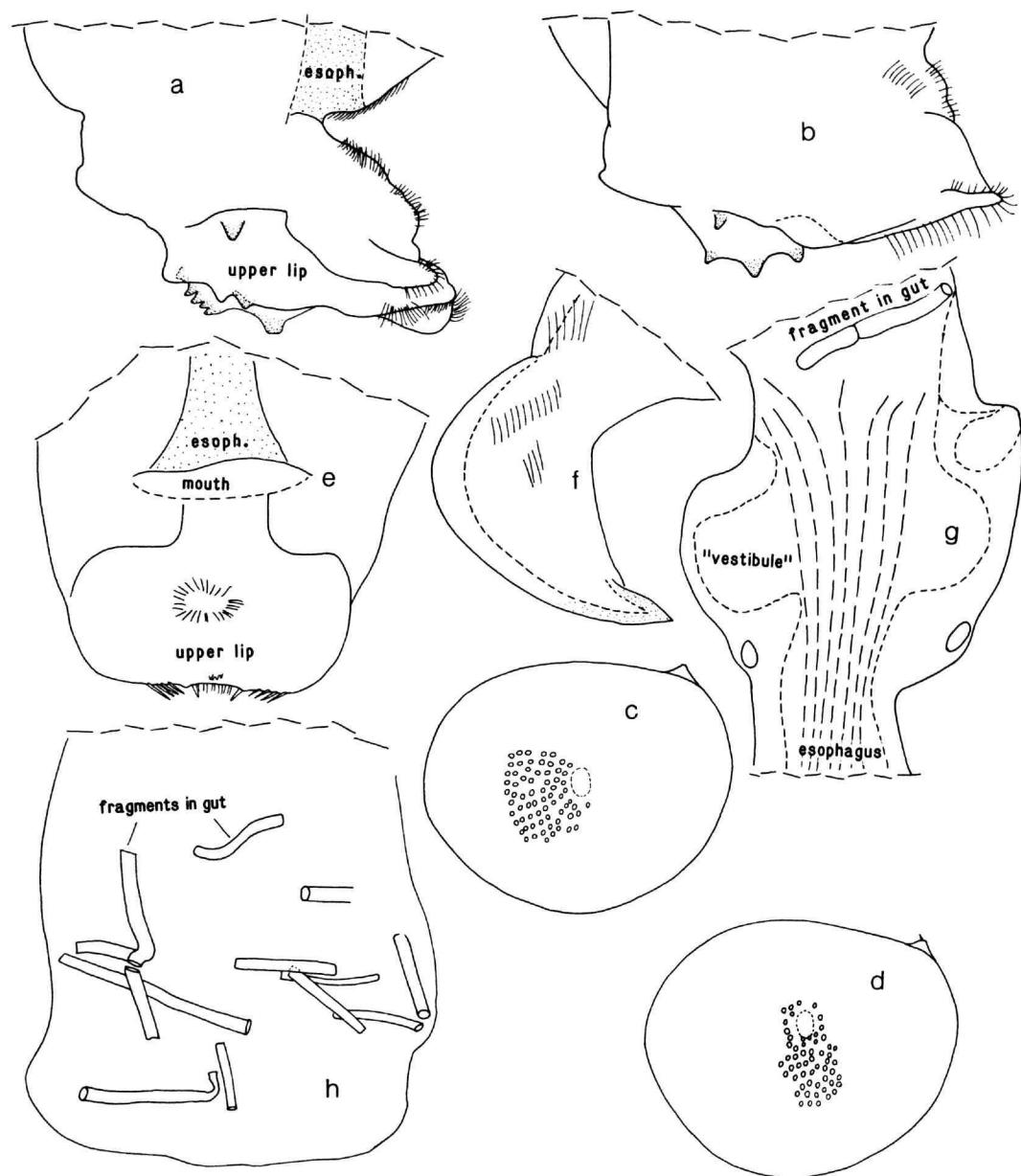


FIGURE 14.—*Deeveya jillae*, new species, (a,b, USNM 193298, holotype, A-1 male; c, USNM 193299, paratype, A-3, sex unknown; d-h, USNM 193300, paratype, A-3, sex unknown): a,b, upper lip from left side, anterior towards left (b oriented slightly differently than a); c, complete specimen from left side showing some disks anterior to central adductor muscle attachment area (dashed oval) (carapace length 0.71 mm); d, complete specimen from left side showing some disks in vicinity of central adductor muscle attachment area (dashed oval) and small bristle at tip of posterodorsal process of right valve (carapace length 0.70 mm); e, posterior view of upper lip showing mouth and gut; f, left lower lip, medial view, anterior towards right; g, anterior of gut showing "vestibule" at dorsal end of esophagus, and tubular food fragment; h, amber tubular food particles in anterior part of gut. (Figure components not to same scale.)

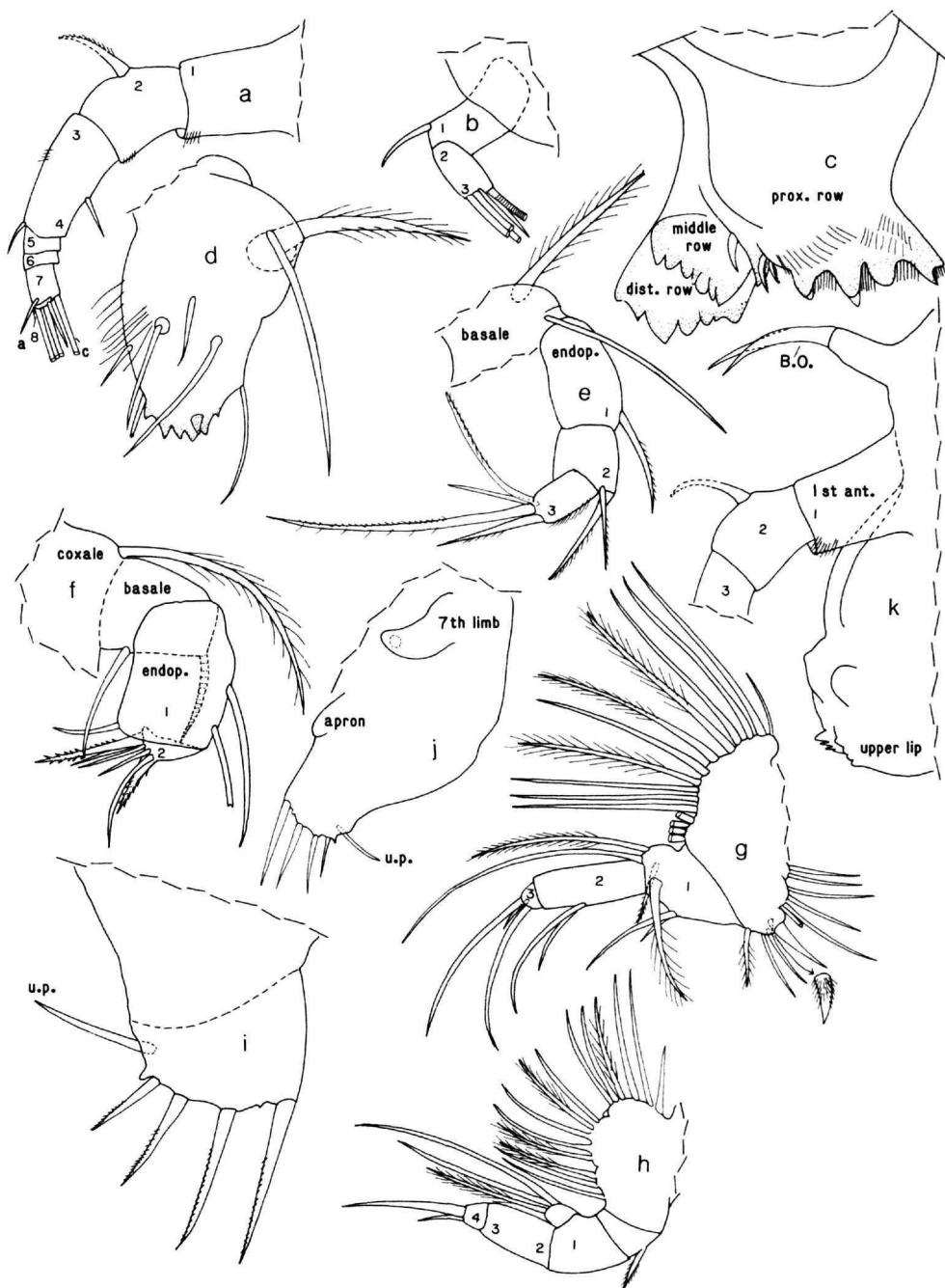


FIGURE 15.—*Deeveya jillae*, new species, USNM 193300, paratype, A-3 juvenile: *a*, left 1st antenna, lateral view; *b*, distal end of protopodite and endopodite of left 2nd antenna, lateral view; *c*, distal end of coxale of left mandible, anterior view; *d*, basale of right mandible, lateral view; *e*, dorsal part of basale and endopodite of right mandible, lateral view; *f*, maxilla with endites not shown; *g*, right 5th limb, lateral view; *h*, right 6th limb, lateral view; *i*, right lamella of furca and unpaired dorsal bristle; *j*, posterior of body showing left lamella of furca and unpaired dorsal bristle, lobe interpreted to be anlage of 7th limb, and small apron; *k*, anterior of body from left side showing Bellonci organ, proximal part of left 1st antenna, and upper lip. (Figure components not to same scale.)

to claw-like bristle. Exopodite 3-jointed: 1st joint with total of 6 bristles: 2 distal dorsal (longest bare, others with long marginal hairs), 1 distal plumose lateral bristle, 1 medial near midheight, and 2 subterminal ventral bristles. 2nd joint elongate with 2 ventral bristles. 3rd joint short with 2 long claw-like bristles and 1 slender ringed bristle with base medial to bases of claw-like bristles.

*Sixth Limb* (Figure 15h): Epipodite with faint hirsute bristles forming 3 groups: dorsal and middle groups each with about 5 bristles; ventral group obscure but with at least 3 bristles. Protopodite with 1 spinous ventral bristle. Exopodite 4-jointed: 1st joint with process on distal dorsal corner with 3 bristles (shortest plumose, others bare); 2nd and 3rd joints fused, bare; 4th joint small, with 1 stout claw-like bristle and 1 short bristle.

*Seventh Limb* (Figure 15j): Elongate lobe observed only on left side of posterodorsal part of body may be anlage of 7th limb (shape and presence on left side suggest it could also be a poorly developed anlage of a copulatory organ, but it is unlikely that a copulatory organ would be present on the A-3 instar).

*Furca* (Figure 15i,j): Each lamella with total of 4 claws followed by unpaired dorsal bristle; claws decreasing in length and width posteriorly along lamella; claws 1 and 2 with spines along posterior margins (medial and lateral row); claws 3 and 4 with spines along anterior and posterior margins; posterior spines of claw 3 slightly longer than spines on other claws; each lamella with stout triangular process following claw 4; small process present between claws 1 and 2.

*Bellonci Organ* (Figure 15k): Well developed, bifurcate distally, with each branch tapering to a point with a minute spine.

*Lips* (Figures 14e,f): Anterior face at ventral corner with small tooth-like processes (Figure 15k); posteroventral corner spinous with slight concavity at midwidth (when viewed posteriorly) having stout spine-like process at each side followed by additional slender spines (Figure 14e); posterior face of lip ventral to slit-like mouth spinous (Figure 14e). Paragnathes with triangular process on each side of mouth; inner surface of paragnath with hairs (Figure 14f).

*Copulatory Organ:* Absent, unless elongate lobe interpreted as anlage of 7th limb is actually anlage of copulatory organ (Figure 15j and discussion above).

*Posterior of Body* (Figure 15): Evenly rounded, unsegmented.

*Apron* (Figure 15j): Very small.

*Gut* (Figure 14e,g,h): Narrow in vicinity of mouth, forming vestibule at dorsal end of esophagus, narrowing before expanding into broad stomach, then narrowing to small anus. Anterior gut just after vestibule and posterior stomach with amber-colored fragments of a segmented tube from unidentified organism (Figure 14g,h).

#### COMPARISON WITH OTHER SPECIES OF *Deeveya*

The carapace of *D. jillae* differs from that of *D. spiralis* and *D. bransoni* in having distinct coarse, bright disks when viewed with transmitted light. The ventral bristle of the 3rd endopodial joint of the mandible of *D. jillae* bears short hairs; *D. spiralis* bears long hairs along the distal half of this bristle; *D. bransoni* bears long hairs at this bristle's midlength.

#### ONTOGENY

Carapaces of A-1 and A-3 instars are similar in shape and ornamentation (Figures 11a, 14c,d). All limbs except the 7th are present by the A-3 instar (the 7th limb is possibly represented by an anlage without bristles observed only on left side of USNM 193300, Figure 15j). The 6th limb of the A-3 instar (Figure 15h) has only a few exopodial bristles and probably was not present in prior stages. A poorly developed copulatory organ is present on the A-1 instar.

The number of bristles on the 5th and 7th joints of the 1st antennae each increased by 1 when comparing the A-3 and A-1 instars (Table 5). The exopodite of the 2nd antenna of the A-3 instar of *D. jillae* differs from that of the A-1 instar in not having the 1st joint divided into proximal and distal parts and in having 2 instead of 4 bristles on the 9th joint; the number of bristles on the 1st joint of the endopodite increased from 1 on the A-3 instar to 2 on the A-1 instar (Table 5). The number of teeth in the dorsal tooth-row of the distal set of teeth of the mandibular coxale decreased from 7 (small teeth) on the A-3 instar (Figure 15c) to 5 (larger teeth) on the A-1 instar (Figure 12a).

The two peculiar entwined lateral bristles on the mandibular basale of *D. spirula* (derivation of the specific name) are also entwined on the mandible of the A-1 instar *D. jillae* (bristles more weakly entwined on left mandible, Figure 11j, than on right, Figure 12c), but only one of the 3 bristles on the A-3 instar is in place of entwined bristles of the A-1 instar and that bristle is straight (Figure 15d).

The number of proximal bristles on the mandibular basale increased from 2 on the A-3 instar (Figure 15d) to 3 on the A-1 instar (Figure 11j); the increase in the number of lateral bristles on the basale as well as in the number of endopodial bristles are listed in Table 5. The number of epipodial bristles of the 5th limb is the same for the A-3 and A-1 instars, but the total number of bristles on the protopodite and endopodite increased from 11 to 22–23. The total number of exopodial bristles increased from 11 to 17 (Table 5, Figures 13a, 15g). On the 6th limb the number of protopodial bristles increased from 1 on the A-3 instar to 6 on the A-1 instar, and the total number of exopodial bristles increased from 5 to 18. The 2nd and 3rd joints are fused on the A-3 instar (Figure 15h) and separated by a suture on the A-1 instar (Figure 13b). The 7th limb on the A-3 instar is either absent or possibly represented by a lobe-like anlage without bristles (Figure 15j) and appears to be fully developed with 3 joints and 3 terminal bristles on

TABLE 5.—Comparison of selected characters of A-3 (sex unknown) and A-1 male of *Deeveya jillae*, new species.

Character	A-3	A-1
Carapace length (mm)	0.70–0.71	1.07
Bristle count on:		
First antenna		
1st joint, dorsal	0	0
1st joint, ventral	0	0
2nd joint, dorsal	1	1
3rd joint, ventral	1	1
4th joint, dorsal	1	1
5th joint, ventral	0	1
6th joint	0	0
7th joint, ventral	1	2
7th joint, dorsal	1	1
8th joint	4	4
Second antenna, endopodite		
1st joint	1	2
2nd joint	2	2
3rd joint	3	3
Mandible		
Basale, lateral	3	6
Endopodite		
1st joint	1	3
2nd joint	2	4
3rd joint	4	6.7
Fifth limb, exopodite		
1st joint	6	10
2nd joint	2	3
3rd joint	3	4
Sixth limb, exopodite		
1st joint	3	10
2nd joint	0	2
3rd joint	0	2
4th joint	2	4

the A-1 instar (Figure 13d). The furca bears 4 claws on each lamella on the A-3 instar (Figure 15i) and 6 on the A-1 instar (Figure 13e); each lamella on both instars bears a small process between the 1st and 2nd claws and a strong triangular process following the last claw; an unpaired dorsal bristle follows furcal claws on both instars. Lips appear similar on both instars, but the anterior face of the upper lip of the A-3 instar was obscured and not studied in detail. The copulatory organ was weakly developed on the A-1 instar (Figure 13d). The apron anterior to the furca is well developed on the A-1 instar and minute on the A-3 instar (Figures 13e, 15j).

#### Subfamily EUCONCHOECINAE Poulsen, 1969

**COMPOSITION.**—The subfamily includes 2 genera: *Euconchoecia* Müller, 1890; and *Bathyconchoecia* Deevey, 1968.

#### *Euconchoecia* Müller, 1890

**TYPE SPECIES.**—*Euconchoecia chierchiae* Müller, 1890, by monotypy.

**COMPOSITION.**—The genus is widespread and includes 7 species: *E. chierchiae* Müller, 1890, *E. aculeata* (Scott, 1894), *E. elongata* Müller, 1906, *E. maimai* Tseng, 1969, *E. shenghwai* Tseng, 1969, *E. pacifica* Chavtur, 1976, and *E. bifurcata* Chen and Lin, 1984.

#### *Euconchoecia bifurcata* Chen and Lin, 1984

**COMPOSITION.**—The species includes 2 subspecies: *E. bifurcata bifurcata*, from the East China Sea; and *E. bifurcata pax*, a new subspecies described herein.

#### *Euconchoecia bifurcata pax* Kornicker, new subspecies

Figures 16–22

**ETYMOLOGY.**—The subspecific name is from the Latin *pax* (peace).

**MATERIAL.**—Palau, Koror (Oreor), Ngermeuangel, Lake 2a Cave, 24 Feb 1985, collected by Thomas M. Iliffe with a 93 µm mesh plankton net from 10–24 m water depth using scuba. **Holotype:** USNM 193304, 1 adult male. **Paratypes:** USNM 193303, 1 ovigerous female; USNM 193305A, 3 adult males; USNM 193305V, 1 adult male; USNM 193305W, 1 adult male; USNM 193305X, 1 adult male; USNM 193305Y, 1 adult male; USNM 193306A, 1 instar VI male; USNM 193306, 9 adult females; USNM 193307, 1 instar I, sex unknown; USNM 193308A, 1 instar II, sex unknown; USNM 193308B, 1 instar III, sex unknown; USNM 193308C, 1 instar VI male; USNM 193308D, 1 instar VI female; USNM 193308E, 1 instar IV, sex unknown; USNM 193308F, 1 instar V male; USNM 193308G, 1 instar I, sex unknown; USNM 193308J, 1 instar I, sex unknown; USNM 193308K, 1 instar I, sex unknown; USNM 193308L, 1 instar I, sex unknown; USNM 193308M, 1 instar IV, sex unknown; USNM 193308N, 1 instar III, sex unknown; USNM 193308P, 1 instar II, sex unknown; USNM 193308X, 1 adult male; USNM 193308, 64 specimens, mostly juveniles but including 6 ovigerous females; USNM 193309A, 1 instar V male; USNM 193309B, 1 instar VI male.

**DISTRIBUTION.**—Known only from Palau, Koror (Oreor) Island, Ngermeuangel, Lake 2A Cave.

**HABITAT.**—The islands of Palau are situated in the Pacific Ocean at about 7°30'N, 134°30'E, approximately 800 km east of the Philippine island of Mindanao. The western half of Koror Island is composed of late Tertiary andesitic volcanics; the eastern half is capped by an uplifted and highly karstified coral reef platform.

Lake 2a (so designated by Dr. William H. Hamner in field notes of 11 Oct 1979, pers. comm.) is a marine lake located about 40 m inland from the eastern coast, and is roughly triangular in shape, 110 m long by 50 m wide and 15 m maximum depth. The entrance (4–5 m wide, 2.5 m high, at a depth of 8 m) to Lake 2a Cave is in the northwestern corner of the lake. A spacious chamber extends horizontally back over 160 m from the entrance to a silt plug at 36 m depth.

Sponge-draped stalactites hang from the ceiling and a thick layer of soft silt covers the floor. The only water movements noted were slight currents at the entrance and at the restriction in the deepest part of the cave. Salinity in the cave, at 10–24 m depths, was 31‰ and the water temperature was 29°C (sample taken between 10 and 24 m depth). The cave, with its direct connection to a marine lake, also contains epigean species.

**DESCRIPTION OF ADULT FEMALE** (Figures 16, 17).—Carapace elongate with straight dorsal margin and convex ventral margin in lateral view (Figure 16a–d). Each valve with posterodorsal spine (that of right valve much longer) and rostrum tapering to fine point (that of left valve longer). Posteroventral margin oblique. Valves thin; surface of valves with only a few long thread-like bristles. Each valve with unsymmetric gland opening just ventral to posterodorsal corner.

**Carapace Size, and Number of Eggs** (unless noted, length measurements include spines; egg number refers to eggs in marsupium): USNM 193303, length 1.26 mm, height 0.46 mm, height 36.2% of length, 1 egg. USNM 193306 (8 specimens): length 1.26 mm, length excluding posterior spine 1.22 mm, height 0.46 mm, height 36.4% of length (including spines), 1 egg; length 1.24 mm, 1 large unextruded egg; length 1.31 mm, height 0.44 mm, height 33.6% of length, 2 eggs; length 1.27 mm, 5 eggs; length 1.19 mm, 2 eggs; length 1.33 mm, height 0.48 mm, height 36.1% of length, 1 egg; length 1.26 mm, height 0.44 mm, height 34.9% of length, 2 eggs; length 1.26 mm, height 0.47 mm, height 37.3% of length, 1 large unextruded egg; USNM 193308, 6 ovigerous specimens: length 1.23 mm, 1 egg; length 1.18 mm, 1 egg; length 1.24 mm, height 0.47 mm, height 37.9% of length, 1 egg; length 1.17 mm, height 49 mm, height 41.9% of length, 5 eggs; length 1.25 mm, height 0.44 mm, height 35.2% of length, 2 eggs; length 1.18 mm, height 0.44 mm, height 37.3% of length, 1 egg. Mean length of 15 specimens, including spines = 1.24 mm; range = 1.17–1.33 mm. Mean height = 0.46 mm; range = 0.44–0.49 mm. Range of height as percent of length 33.6–41.9.

**First Antenna** (Figure 16e): 7-jointed, sutures separating 1st and 2nd, and 2nd and 3rd joints fairly well defined, others poorly defined or completely fused. Inferred 5th joint with about 25 long filaments (filaments represented by row of short lines not actual length of filaments in illustrated limb). Small 7th joint with 4 bristles (1 short, 1 medium, 2 long, about same length as filaments of 5th joint). Pigmentation absent.

**Second Antenna:** Protopodite bare. Exopodite with 9 joints (Figure 16f,g): 1st joint with or without short bristle reaching 3rd joint; joints 2–8 with long bristles with natatory hairs; 8th joint only slightly shorter than 7th; 9th joint small, with 2 bristles (ventral bristle narrower than bristles of joint 2–8, long, with natatory hairs; dorsal bristle short, slender). Endopodite (Figure 16f,h): 1st joint elongate with slender a- and b-bristles; 2nd joint with slender f-bristle and long stout g-bristle, both

with faint hairs; fused 3rd joint with 1 short slender bristle.

**Mandible** (Figure 17a–d): Coxale: toothed edge of pars incisiva with 12 smooth teeth (anterior 3 rounded, others triangular). Distal tooth list with 10 or 11 small square-tipped teeth followed by 2 larger teeth (anterior with rounded tip, posterior triangular); medial surface of list with about 10 minute papillae. Proximal tooth list narrow, with 2 triangular teeth followed by 2 or 3 smaller rounded or triangular teeth. Masticatory pad about same width as distal list, with minute stout spines on distal half, and 7 lancet-bristles forming vertical row (long spines near base of bristles); anterior edge of coxale (anterior to masticatory pad) with smooth knob-like process. Basale: distal edge with 6 triangular teeth (with 2–4 minute secondary teeth along edges) followed by short stout tubular process and stout pointed triangular tooth (with several indistinct pointed secondary teeth along posterior edge). Anterior margin of endite with pointed bristle about same length as width of distal edge of endite. Anterior margin of basale proximal to endite with 1 long bristle; lateral side of basale with 2 bristles with bases at about same level as lists of coxale (Figure 17c,d) and distal ventral tooth (tooth proximal to 2nd or 3rd tooth of edge of basale, and dentate along anterior margin). Proximal part of basale with 2 hirsute medial bristles (1 near dorsal margin, other inward from dorsal margin). Endopodite: 1st joint with medial hairs, 1 short dorsal bristle and 1 or 2 longer ventral bristles; 2nd joint with medial hairs, 2 dorsal bristles (lateral of these stout and spinous), and 1 or 2 ventral bristles; 3rd joint with medial and dorsal hairs and with 3 short medial bristles, 1 longer spinous lateral bristle on ventral corner, and 3 spinous terminal bristles (ventral of these about twice length of others).

**Maxilla** (Figure 17e,f): Precoxale endite with 7 bristles (2 tubular bare, 1 tubular with long spines, 4 regular pectinate, Figure 17e). Coxale endites (Figure 17f) each with 6 bristles (I with 2 tubular bare, 1 regular pectinate proximal, and 3 regular pectinate or bare, terminal (Figure 17f); III with 2 tubular bare, 1 regular slender with small spines, and 3 regular stout pectinate). Bristles of basale and 1st endopodial joint obscured. End joint with 6 bristles, some tubular, 1 stout pectinate.

**Fifth Limb** (Figure 17g, not all surface hairs and bristle armatures are shown): Epipodite with bristles forming 3 distinct groups: dorsal group with 1 short bristle (with short hairs) and 4 long hirsute bristles; middle and ventral groups each with 4 long hirsute bristles. Protopodite not jointed: endite I with 2 bristles (1 small tubular, 1 long spinous), endite II with 2 bristles (1 short tubular with short marginal spines and 1 longer spinous). Endopodite with 7 bristles (proximal and distal bristle longer than others and with long marginal spines, bristle next to proximal bristle long pectinate, bristle next to anterior bristle short with short marginal spines, remaining 3 bristles short, tubular, pectinate). Exopodite: 1st joint with 4 short ventral bristles with short marginal spines, 2 longer lateral bristles with long marginal hairs, and 1 very long bristle on

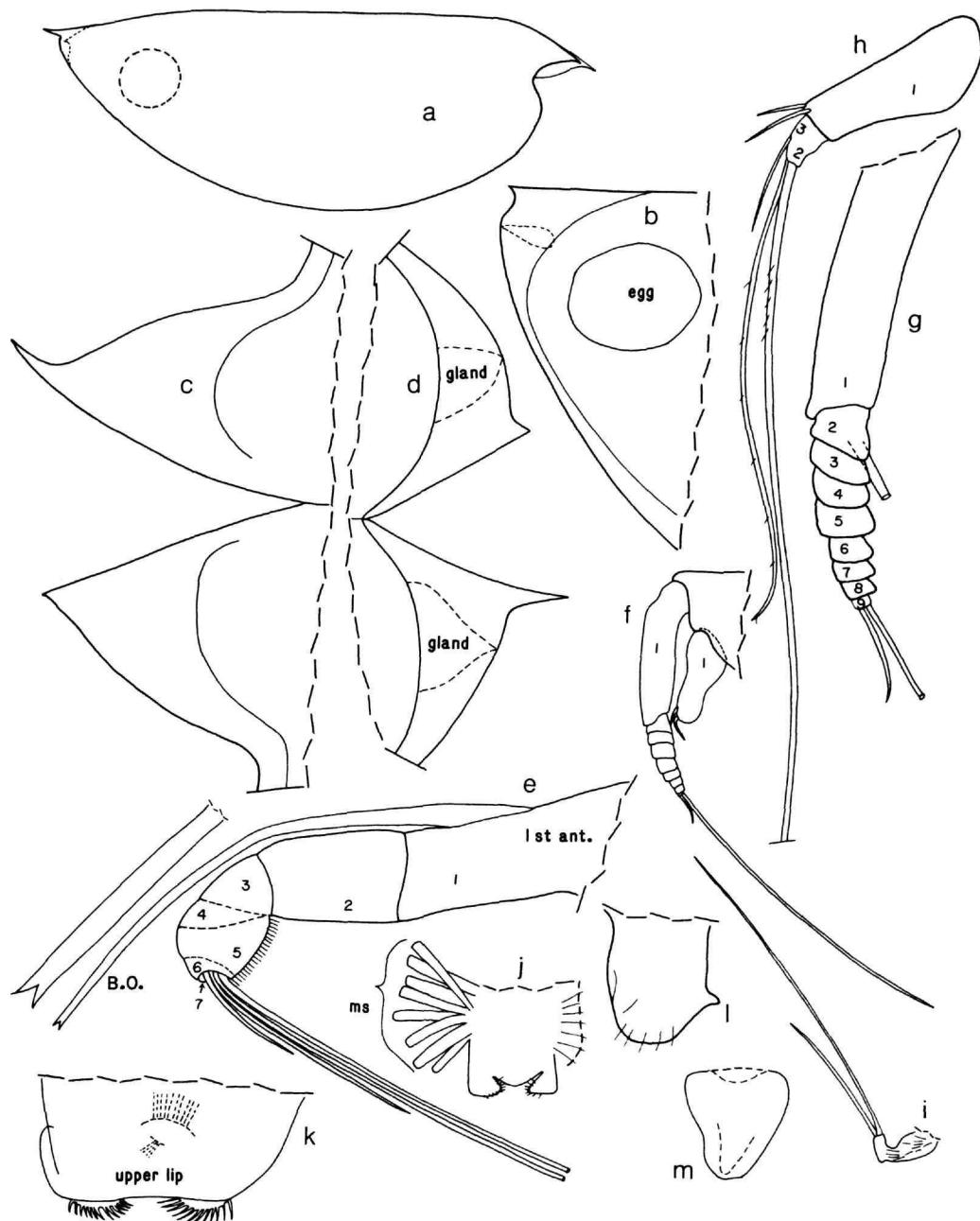


FIGURE 16.—*Euconchoecia bifurcata pax*, new subspecies, USNM 193303, paratype, ovigerous female: *a*, complete specimen showing single egg (dashed oval) in marsupium (length 1.26 mm, left valve shown as dashed line at posterior and thin line at anterior); *b*, posterodorsal end of inside of left valve showing positions of gland (dashed) and egg (circle); *c*, inside view of anterior of valves (under cover slip); *d*, inside view of posterior of valves (under cover, dashed lines indicate glands); *e*, left 1st antenna, and Bellonci organ with detail of tip, lateral view; *f*, left 2nd antenna (only 1st endopodial joint shown; not all bristles of exopodite shown); *g*, exopodite of left 2nd antenna (bristles of joints 3-8 not shown); *h*, endopodite of right 2nd antenna, medial view; *i*, right 7th limb; *j*, paragnaths of lower lip and central adductor muscles; *k*, posterior edge of upper lip from above; *l*, outline of upper lip from left, anterior towards left; *m*, upper lip, anterior or posterior view, ventral end towards bottom. (Figure components not to same scale.)



FIGURE 17.—*Euconchoecia bifurcata pax*, new subspecies, USNM 193303, paratype, ovigerous female: *a*, left mandible, medial view; *b*, coxale and basale of left mandible, medial view; *c*, basale of right mandible, lateral view; *d*, distal end of basale of right mandible, medial view; *e,f*, endites I, II, III of maxilla, as labelled; *g*, right 5th limb, medial view; *h*, right 6th limb, lateral view; *i*, right lamella of furca and anterior part of left lamella (lined); *j*, posterior of body showing left furcal lamella and unpaired bristle, left 7th limb, and unextruded egg (dashed oval); *k*, anterior of left lamella showing internal canals entering claws (dashed lines), and sclerotized parts (lined). (Figure components not to same scale.)

terminal dorsal corner; 2nd joint with 2 pectinate ventral bristles and 1 dorsal bristle with short hairs; end joint with 1 tubular ventral bristle and 2 stout pectinate terminal bristles (both with small beak-like recurved tip). Protopodite, endopodite and 1st exopodial joint with long medial hairs.

**Sixth Limb** (Figure 17*h*, not all surface hairs and bristle armature are shown): Epipodite with bristles forming 3 distinct groups: dorsal group with 1 short and 4 long hirsute bristles (large space between small and long dorsal bristle of only limb studied suggests dorsal group may be aberrant); middle group with 5 long hirsute bristles; ventral group with 5 long hirsute bristles. Protopodite fused to endopodite; endopodite with 2 short ventral bristles. Exopodite: 1st joint with 3 ventral bristles (1 with long hairs), 1 lateral bristle with long hairs, and 1 terminal dorsal bristle, with short hairs, extending past distal end of 2nd joint; 2nd joint with 1 distal ventral bristle with short hairs; 3rd joint with 2 distal bristles (1 ventral with short marginal hairs, 1 dorsal either bare or with few short hairs); 4th joint with 3 bristles (short ventral bristle either bare or with short fine hairs, long middle bristle pectinate distally along ventral margin and with recurved beak-like tip; dorsal bristle slightly longer than middle bristle, bare and with tapered tip). Protopodite, endopodite and 1st exopodial joint with surface hairs.

**Seventh Limb** (Figure 16*i*, 17*j*): Limb not jointed, but forming right-angle near terminus, with faint hairs and 2 unequal terminal bristles.

**Furca** (Figure 17*i-k*): Each lamella with 7 claws decreasing in length and width posteriorly; low rounded process between claws 1 and 2 may represent base of missing claw (see "Discussion of Furca," below); claws 1–4 with slender teeth forming lateral and medial row along posterior edge (not shown); claws 5 and 6 with indistinct posterior teeth (not shown); teeth not observed on claw 7; claws 1–4 with flat bent knife-like tip (not shown); claws 5–7 with straight spine-like tip; claw 1 with 1 or 2 minute proximal notches on posterior edge (not all shown); unpaired bristle (slightly smaller than claw 7 and with short hairs) present between lamellae following last claw (not shown on Figure 17*i*). Inner surfaces of lamellae hirsute. Claw 1 of left lamella of USNM 193303 slightly anterior to claw 1 of right lamella.

**Bellonci Organ** (Figure 16*e*): Elongate, extending past tip of 1st antenna, with bifurcate tip.

**Lips** (Figure 16*j-m*): In lateral view smoothly rounded and projecting anteriorly, with fine surface hairs (Figure 16*l*); posteroventral edge with 2 backward pointing combs of slender spines, 1 on each side of center; additional ventral spines (oriented both anteriorly and posteriorly) forming 2 rows at midwidth posterior to combs (Figure 16*k*). Paragnaths triangular with rounded distal margin, spinous (Figure 16*j*).

**DESCRIPTION OF ADULT MALE** (Figures 18, 19).—Carapace differs from that of female in being shorter and more elongate (height a lower percent of length), with more broadly rounded anteroventral and posteroventral margins, especially the latter

(Figure 18*a-e*). Anterodorsal and posterodorsal spines present but generally less developed than on female shell (spines seen best when valves flattened and viewed either ventrally or dorsally, Figures 18*d,e*, 19*f*). Carapace surface smooth. Position of glands as in female, just ventral to posterodorsal spines.

**Carapace Size** (all length measurements include spines): USNM 193304 (holotype), length 1.13 mm, height 0.54 mm, height 47.8% of length; USNM 193305A, length 1.08 mm, height 0.55 mm; USNM 193305V, length 1.11 mm, height 0.50 mm, height 45.0% of length; USNM 193305W, length 1.15 mm, height 0.49 mm, height 42.6% of length; USNM 193305X, length 1.17 mm, height 0.48 mm, height 41.0% of length; USNM 193305Y, length 1.16 mm, height 0.56 mm, height 48.3% of length. Mean length of 6 specimens = 1.13 mm; range = 1.08–1.17 mm. Mean height of 6 specimens = 0.52 mm; range = 0.48–0.56 mm. Range of height as percent of length = 41.0–50.9.

**First Antenna** (Figure 18*f*): Sutures separating 1st and 2nd, and 2nd and 3rd joints well defined; distal joints better defined than those of female but difficult to interpret. Inferred 5th joint with about 18 ventral filaments (about  $\frac{3}{4}$  length of stem) forming 2–3 rows, and long lateral hairs near dorsal margin. Inferred 6th joint with short bristle with long proximal and short distal hairs. End joint with 4 bristles: long lateral bristle about  $3\frac{1}{2}$  times length of sensory filament of 5th joint; ventral bristle about half length of longest bristle; 2 lateral bristles about half length of ventral bristle. Pigment absent.

**Second Antenna** (Figure 18*g-i*): Protopodite bare. Exopodite (Figure 18*g*): 1st joint with small bristle reaching distal end of 3rd joint; joints 2–8 with long natatory bristles; small 9th joint with 1 short bare dorsal bristle and longer ventral bristle (little over half length of bristle of 8th joint) with natatory hairs. Endopodite of left limb (Figure 18*i*): 1st joint with hairs along dorsal margin, and a-bristle about half length of b-bristle; 2nd joint elongate, broadest near middle and slight proximal concavity along ventral margin, with slender f-bristle and long stout g-bristle, both weakly ringed proximally, filament-like distally; g-bristle not noticeably widened and flattened distally, with few widely spaced marginal hairs and stout terminal papilla; f-bristle with few widely spaced marginal hairs, recurved tip, and terminal papilla; 3rd joint: short dorsal bristle weakly ringed (with terminal papilla) and straight or hook-shaped, with base on small lateral process; medial terminal bristle reaching past midlength of lateral terminal bristle, both filament-like, with small terminal papilla. Endopodite of right limb (Figure 18*h*): 1st joint similar to that of left limb; 2nd joint broader than that of female but with similar dorsal process and bristles (tip of f-bristle recurved as on female); 3rd joint forming v-shaped process: ventral branch of process terminating in broadly rounded tip with subterminal ridges; distal angle of v-shaped process with 3 filament-like bristles with terminal papilla; dorsal filament short, hook-shaped.

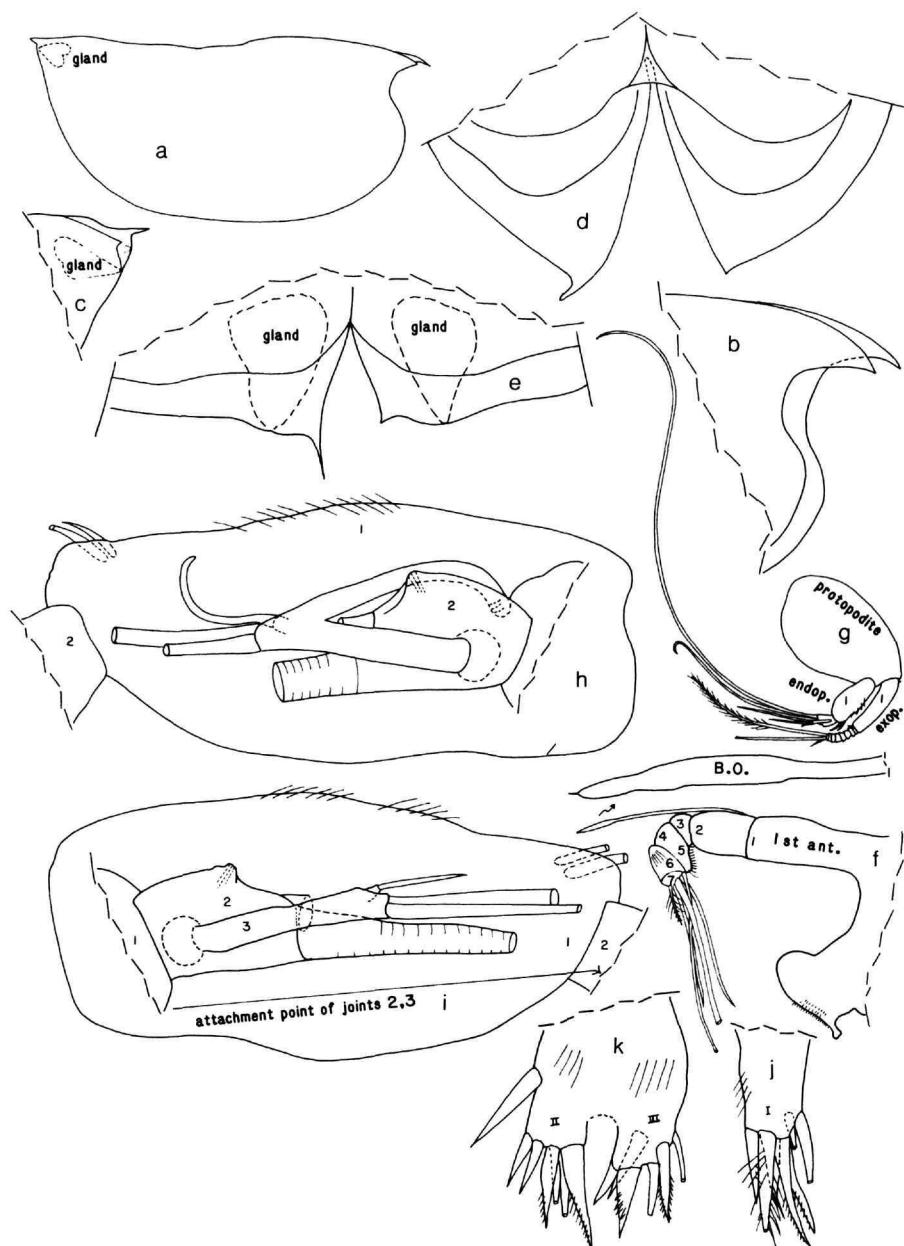


FIGURE 18.—*Euconchoecia bifurcata pax*, new subspecies, USNM 193304, holotype, adult male: *a*, complete specimen from right side, outline of posterodorsal gland of right valve dashed (length with spines 1.13 mm); *b*, anterior of valves from right side (body removed); *c*, posterodorsal corner of valve from left side, glands indicated by dashed lines; *d*, inside of anterior of valves flattened under cover slip; *e*, inside of posterior of valves flattened under cover slip, outline of glands dashed; *f*, anterior of body showing Bellonci organ (with detail of tip), left 1st antenna, and upper lip; *g*, left 2nd antenna, medial view; *h*, medial view of endopodite of right 2nd antenna (joints 2 and 3 placed within joint 1 on figure); *i*, medial view of endopodite of left 2nd antenna (joints 2 and 3 mounted within joint 1); *j, k*, endites I, II, III of maxilla, as labelled. (Figure components not to same scale.)

**Mandible** (Figure 19a): Coxale: distal edge of pars incisiva with 10 or 11 smooth low teeth. Distal tooth list with about 10 small teeth followed by 2 large teeth (posterior about twice length of anterior and pointed). Proximal tooth list with 4–5 small teeth. Masticatory pad with minute spines on distal half, 8 lancet-bristles, and long spines near bases of bristles. Basale similar to that of adult female. Endopodite: 1st joint with medial hairs near ventral margin, 1 short dorsal bristle, and 1 or 2 longer ventral bristles (right limb of USNM 193304 with 1, left limb with 2); 2nd joint with hairs on medial surface and distal dorsal margin, 2 dorsal bristles (lateral of these stout spinous), and 1 or 2 ventral bristles (right limb of USNM 193304 with 2, left limb with 1, other possibly broken off); 3rd joint similar to that of female.

**Maxilla** (Figures 18j,k, 19b): Endites (Figure 18j,k): endite I with 7 bristles (2 tubular bare, 1 tubular with long spines; 4 regular, pectinate); endite II with 7 bristles (2 tubular, bare; 1 stout, regular, proximal; 4 regular, terminal); endite III with 6 bristles (2 tubular, 4 regular). Coxale without dorsal bristle. Basale without bristles. Endopodite (Figure 19b): 1st joint: anterior margin with 3 bristles (proximal longer, pointed; middle tubular; distal with terminal papilla, all with faint hairs, almost bare); posterior margin with 2 long bristles (proximal tubular or with pointed tip; distal with pointed tip); inner side with 1 bristle almost on posterior margin (with terminal papilla), and few distal long hairs near anterior margin. End joint with anterior hairs and 6 bristles (anterior bristle stout, pectinate, fused to joint; posterior bristle almost completely fused to joint, long with weak marginal spines, either tubular or with pointed tip; shortest bristle with base on inner side and with terminal papilla; remaining 3 bristles terminal with pointed tips).

**Fifth Limb** (Figure 19c): Epipodite with bristles forming 3 groups: dorsal group with 1 short bristle and 4 long hirsute bristles; middle and ventral groups each with 4 long hirsute bristles. Protopodite not jointed: endite I with 2 bristles (1 small with terminal papilla, 1 long spinous, pointed), endite II with 2 bristles (1 short with short spines and pointed tip, 1 long with long spines and tubular (or broken) tip). Endopodite with 6 bristles (proximal bristle long pectinate, next bristle long slender, with long marginal hairs; distal bristle long with long marginal hairs, remaining 3 bristles short). Exopodite: 1st joint with 4 short ventral bristles, 2 longer lateral bristles with long marginal hairs, and 1 very long bristle on terminal dorsal corner; 2nd joint with 2 ventral bristles and 1 longer dorsal bristle; end joint with 1 short ventral bristle (with terminal papilla), 1 stout finely pectinate middle bristle with distal dorsal hairs and pointed tip, and 1 long finely pectinate dorsal bristle with tubular tip.

**Sixth Limb** (Figure 19d): Epipodite with bristles forming 3 groups: dorsal group with 1 short and 6 long hirsute bristles; middle group with 5 long hirsute bristles; ventral group with 5 long hirsute bristles. Protopodite fused to endopodite; endopodite with 2 short ventral bristles. Exopodite: 1st joint

with 5 bristles (3 near ventral margin, 1 lateral at joint midheight, and 1 terminal dorsal bristle shorter than 2nd joint); 2nd joint with 1 distal ventral bristle; 3rd joint with 2 distal bristles (1 ventral, 1 dorsal); 4th joint with 3 long hirsute bristles.

**Seventh Limb** (Figure 19d), **Furca** (Figure 19e), **Upper Lip** (Figure 18f), and **Paragnaths**: Similar to those of adult female.

**Bellonci Organ** (Figure 18f): Elongate, extending past tip of 1st antennae, broadening distally; USNM 193304, 193305W and 193305X with single pointed tip and terminal papilla; USNM 193305Y with bifurcate tip.

**Upper Lip** (Figure 19i): Similar to that of adult female.

**Copulatory Organ** (Figure 19d,f-h,j,k): Single, on left side, extending ventrally inside of extended 6th limb (Figure 19d); limb narrow near insertion of rod-shaped organ, then gradually broadening before narrowing to complex sclerotized tip (Figure 19d); rod-shaped organ penetrating canal (morphology of tip of organ obscure); canal curving anteriorly at tip to opening of vas deferens just proximal to tip (Figure 19f). Distal muscles of copulatory organ consisting of 5 lateral sets extending from anterior to dorsal margins (Figure 19g), and 5 mesial sets extending from anterior margin to canal (Figure 19h). Testis on left side of body (Figure 19k).

**Gut** (Figure 19i): Narrow esophagus followed by short bulbous section constricted anterior to main part of gut.

**DESCRIPTION OF INSTAR I, SEX UNKNOWN** (Figure 20).—Carapace almost globose, dorsal margin straight, ventral margin rounded (Figure 20a-f); posterodorsal corner of each valve without spine; tip of rostrum of left valve with spine pointing ventrally; a gland present on each valve on posterior margin near posterodorsal corner. Carapace of USNM 193308L more elongate than others.

**Carapace Size** (length measurements include spines): USNM 193307, length 0.29 mm; USNM 193308G, length 0.31 mm, height 0.23 mm; USNM 193308J, length 0.29 mm, height 0.22 mm; USNM 193308K, length 0.32 mm, height 0.21 mm; USNM 193308L, length 0.34 mm, height 0.20 mm. Average length 0.31 mm.

**First Antenna:** Obscure on all specimens; 1 bristle observed on USNM 193308J (Figure 20o), several indistinct bristles observed on USNM 193308L.

**Second Antenna** (Figure 20e,m,n,p,r): Protopodite pear-shaped. Exopodite with 8 joints (Figure 20r): 1st joint bare; joints 2–7 each with natatory bristle; 8th joint small with 2 unequal short bristles. Endopodite well developed with 2 joints but armature indistinct on all specimens examined, with at least 1 bristle.

**Mandible** (Figure 20e,m,n,s): Coxale obscure. Basale present but without bristles; teeth along ventral edge weakly developed. Exopodite 3-jointed: 1st joint without bristle; 2nd joint with stout terminal dorsal bristle with few marginal hairs; 3rd joint with 1 or 2 (usually 2) short ventral bristles and 2 stout terminal bristles.

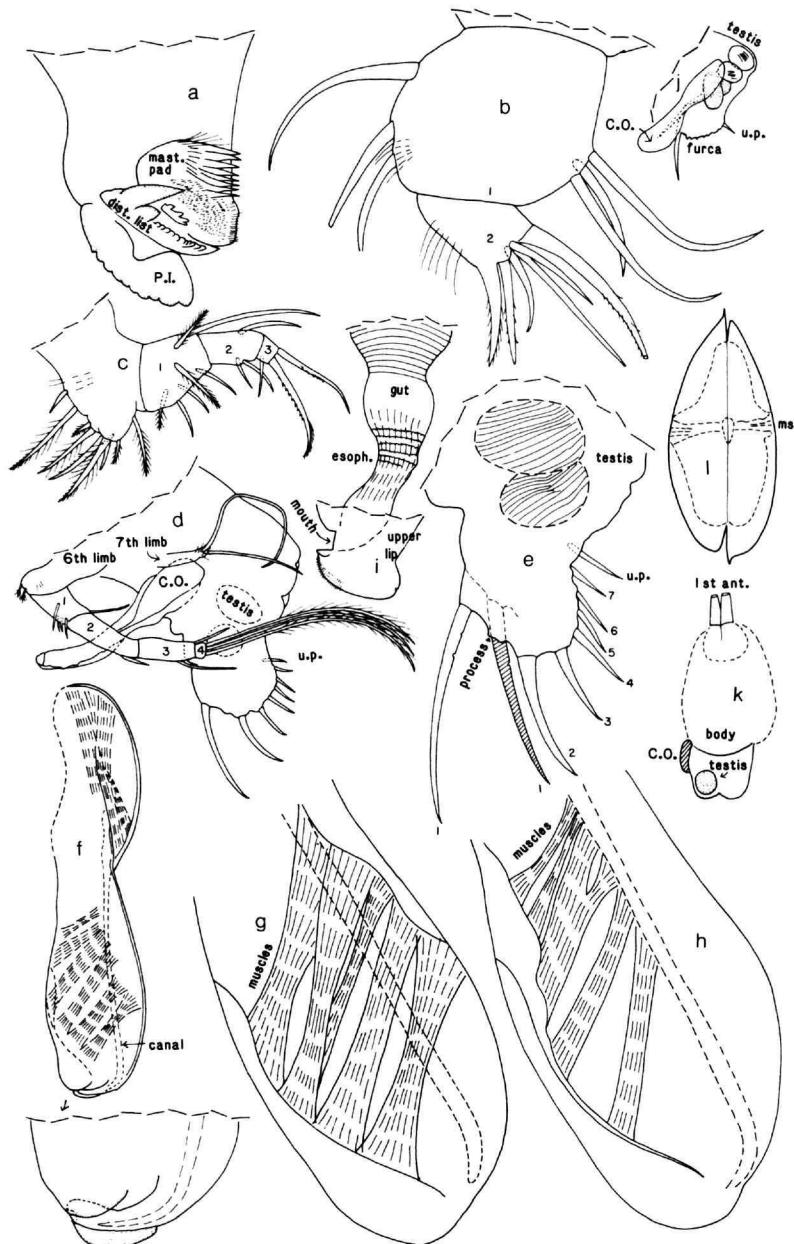


FIGURE 19.—*Euconchoecia bifurcata pax*, new subspecies, adult males (*a-i*, USNM 193304, holotype; *j,k*, USNM 193305W, paratype; *l*, 193305A, paratype): *a*, coxale endite of left mandible, medial view; *b*, endopodite of maxilla; *c*, left 5th limb, lateral view; *d*, posterior of body showing left 6th and 7th limbs (as numbered), left lamella of furca, copulatory organ, testis and vas deferens (dashed ovals); *e*, posterior of body showing left lamella of furca and claw 1 of right lamella (outlined), testis, and vas deferens (oval outlines); *f*, lateral view of copulatory organ (with detail of tip), anterior towards left; *g*, copulatory organ showing lateral layer of muscles; *h*, copulatory organ showing mesial layer of muscles; *i*, upper lip from right side with attached gut; *j*, posterior of body (length 1.15 mm) showing copulatory organ, testis and vas deferens, furca with claw 1 of left lamella, and unpaired bristle; *k*, dorsal view of body showing projecting 1st antennae (at top), copulatory organ (outlined), and testis (stippled); *l*, dorsal view of complete specimen (length, including spines, 1.08 mm) showing outline of body, central adductor muscle bundle, and heart (dashed oval at hinge midlength). (Figure components not to same scale.)

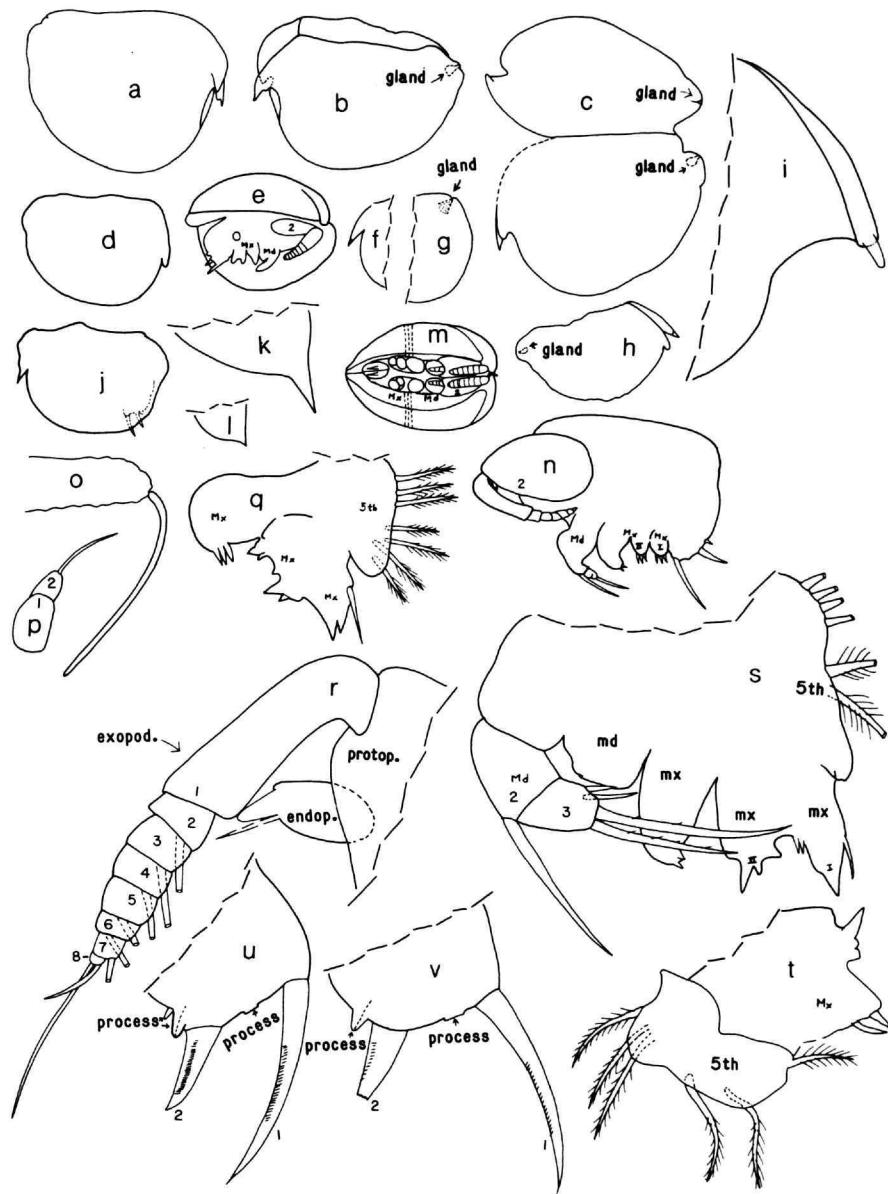


FIGURE 20.—*Euconchoecia bifurcata pax*, new subspecies, paratypes, instar I, sex unknown (a-c, USNM 193308G; d-g, 193308k; h-i, USNM 193308L; j-q, USNM 193308J; r-v, USNM 193307): a, b, complete specimen from right and left sides (length 0.31 mm); c, dorsal view of spread valves (not under cover slip); d, complete specimen from right side (length 0.32 mm); e, ventral view with left valve open to show appendages of right side (1st antenna, 5th limb, and Bellonci organ not shown) and oval representing central adductor muscles; f, g, anterior and posterior, respectively, of left valve (posteroventral gland stippled), lateral view; h, complete specimen (length 0.34 mm); i, inside view of anterior of left valve; j, complete specimen showing furca inside shell (length 0.29 mm); k, inside view of rostrum of left valve; l, outside view of rostrum of right valve; m, ventral view of complete specimen showing 2nd antennae, mandibles, maxillae, furca, and central adductor muscles (dashed lines); n, body viewed from left showing some appendages (1st antenna, 5th limb, and Bellonci organ not shown); o, right 1st antenna, lateral view; p, endopodite of right 2nd antenna, lateral view; q, maxilla and epipodite of 5th limb (as indicated); r, left 2nd antenna, lateral view; s, body showing mandible, maxilla, and epipodite of 5th limb; t, endites of right maxilla, and epipodite of right 5th limb; u, v, right and left lamellae of furca, respectively. (Figure components not to same scale.)

*Maxilla* (Figure 20e,m,n,q,s,t): Large with weak blunt bristles at tip of endopodite, and 2 well developed endites with blunt terminal bristles.

*Fifth Limb* (Figure 20s,t): Epipodite well developed with at least 7 hirsute bristles; protopodite, endopodite and exopodite comprising a small indistinct weakly developed lobe without bristles. [Epipodial bristles were not always visible on wholmounts; on specimens on which bristles were not seen on wholmounts they were clearly visible when specimens were dissected.]

*Sixth and Seventh Limbs*: Absent.

*Furca* (Figure 20u,v): Each lamella with 2 stout claws followed by process fused to lamella (process more strongly developed on some specimens); 2nd claw stouter than 1st; low process between claws 1 and 2. Single indistinct flat process following fused process observed on some specimens may represent unpaired bristle of later instars, otherwise unpaired bristle absent.

*Bellonci Organ*: Not observed. First antenna and Bellonci organ obscured on all specimens examined and it is possible that the organ is present.

**DESCRIPTION OF INSTAR II, SEX UNKNOWN** (Figure 21a-g).—Carapace resembling adult female but with less oblique posteroventral margin, elongate with long spine on tip of left rostrum extending past that of right rostrum (Figure 21a-c); posterodorsal corner of right valve with long spine, that of left with minute or no spine.

*Carapace Size*: USNM 193308A, length including spines 0.46 mm, height 0.22 mm, height 47.8% of length; USNM 193308P, specimen without carapace, length of body under coverslip 0.33 mm.

*First Antenna* (Figure 21d): Obscure on both specimens examined but tip with several long filaments and 1 short bristle.

*Second Antenna* (Figure 21e,g): Endopodite with 0 or 1 dorsal bristle on 1st joint and 2 bristles on 2nd joint (1 long and stout, other shorter and slender); 3rd joint with 1 short bristle on USNM 193308P (Figure 20g) and with minute spine-like bristle on USNM 193308A (Figure 21e). Exopodite with 8 joints: joint 1 without bristle; joints 2-7 each with natatory bristle; 8th joint small with 2 unequal short bristles and 1 longer bristle.

*Mandible, Maxilla, Fifth Limb*: Well developed. Maxilla endite I longer than endites II and III of coxale.

*Sixth and Seventh Limbs*: Absent.

*Furca* (Figure 21f): Each lamella with 3 claws followed by small node; claw 2 broader than claw 1; spines along posterior edge of claws 1 and 2, and hairs along posterior edge of claw 3; small flat tipped process between claws 1 and 2. Unpaired bristle following last claw.

*Bellonci Organ* (Figure 21d): Extending slightly past bent anterior end of 1st antennae, with bifurcate tip.

**DESCRIPTION OF INSTAR III, SEX UNKNOWN** (Figure 21h-k).—Spines of carapace similar to those of adult except none on posterodorsal corner of left valve (Figure 21h).

*Carapace Size* (length measurements include spines): USNM 193308B, length 0.62 mm, height 0.29 mm, height 46.7% of length; USNM 193308N, length 0.60 mm, height 0.26 mm.

*First Antenna* (Figure 21i): Well developed, with several long filaments on tip and inferred 5th joint.

*Second Antenna* (Figure 21j): Endopodite: 1st joint with 1 dorsal bristle; 2nd joint with long stout bristle and short slender bristle; 3rd joint with short bristle. Exopodite with 8 joints: 1st joint with short bristle not reaching 2nd joint; joints 2-7 each with natatory bristle; small 8th joint with 3 bristles (2 short, 1 medium length).

*Mandible, Maxilla, Fifth Limb*: Well developed type similar to that of adults, but not studied in detail.

*Sixth Limb*: Represented by anlage without bristles.

*Seventh Limb*: Absent.

*Furca* (Figure 21k): Each lamella with 4 claws; claw 2 about same width as claw 1; claw 4 followed by small node; small process between claws 1 and 2. Unpaired bristle following last claw.

*Bellonci Organ* (Figure 21l): Extending past distal end of 1st joint, with bifurcate tip.

**DESCRIPTION OF INSTAR IV, SEX UNKNOWN** (Figure 21l-p).—Carapace similar in shape and spinosity to that of adult female (Figure 21l-n).

*Carapace Size* (length measurements include spines): USNM 193308E, length 0.74 mm, height 0.34 mm, height 45.9% of length; USNM 193308M, length 0.74 mm, height 0.30 mm, height 40.5% of length.

*First Antenna*: Well developed with many filaments on inferred 5th joint.

*Second Antenna* (Figure 21o): Endopodite similar to that of instar II except for longer bristle on 3rd joint. Exopodite similar to that of instar II except 1st joint with short bristle just reaching 2nd joint, and 8th joint with 1 long and 2 short bristles.

*Mandible, Maxilla, Fifth Limb*: Well developed.

*Sixth Limb*: Epipodite well developed with hirsute bristles; endopodite with few bristles. Exopodite weakly developed but only slightly smaller than that of 5th limb; end joint with 2 bristles.

*Seventh Limb*: Absent.

*Furca* (Figure 21p): Each lamella with 5 claws followed by small node; claw 2 about same width as claw 1; small process between claws 1 and 2. Unpaired bristle following last claw.

*Bellonci Organ*: Extending past anterior end of 1st antenna, tip bifurcate.

**DESCRIPTION OF INSTAR V MALE** (Figure 21q-z).—Carapace similar in shape and spinosity to that of adult male (Figure 21q).

*Carapace Size* (length measurements include spines): USNM 193308F, length 0.97 mm; USNM 193309A, length 0.96 mm, height 0.39 mm, height 40.6% of length.

*First Antenna* (Figure 21r): Well developed.

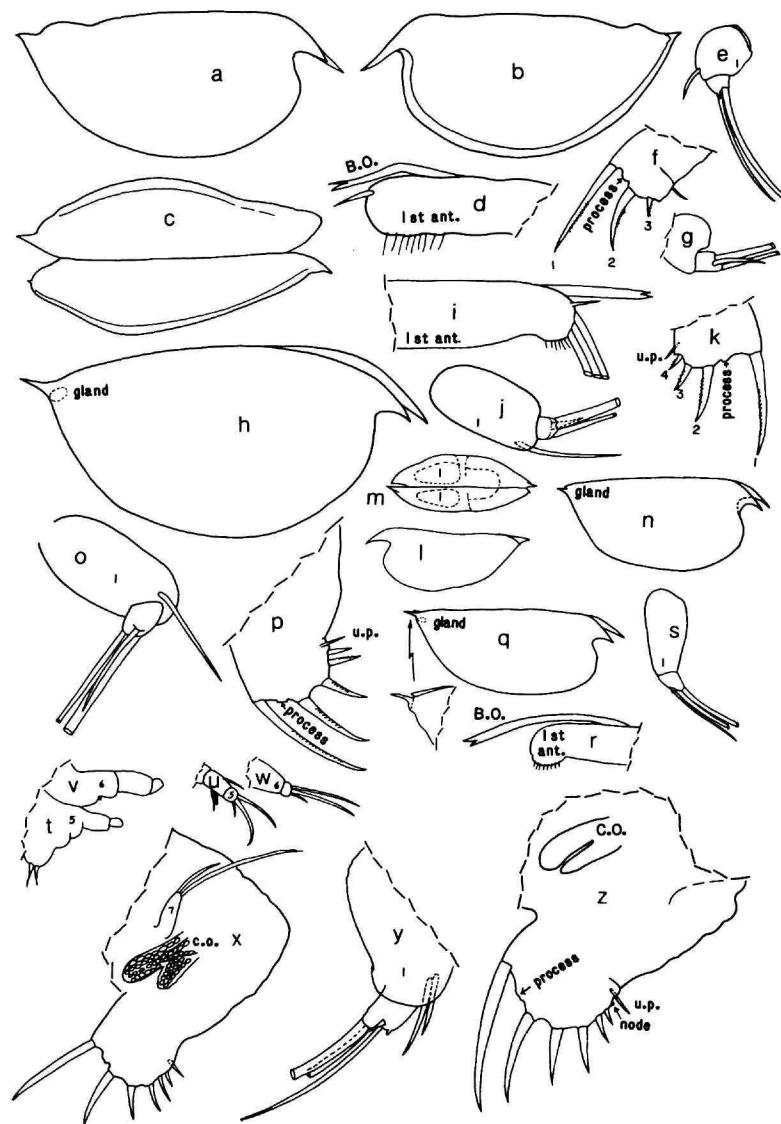


FIGURE 21.—*Euconchoecia bifurcata pax*, new subspecies, juvenile paratypes (a-f, USNM 193308A, instar II; g, USNM 193308P, instar II; h-k, USNM 193308B, instar III; l,m, USNM 193308M, instar IV; n-p, USNM 193308E, instar IV; q-x, USNM 193309A, instar V, male; y,z, USNM 193308F, instar V, male): a, complete specimen from right side (length 0.46 mm); b, complete specimen from left side; c, ventral view of partly opened specimen, anterior towards left; d, left 1st antenna and Bellonci organ; e, endopodite of right 2nd antenna, medial view; f, left lamella of furca and unpaired bristle; g, endopodite of left 2nd antenna, lateral view; h, complete specimen from right side (length 0.62 mm); i, right 1st antenna and Bellonci organ; j, endopodite or right 2nd antenna, medial view; k, right lamella of furca and unpaired bristle; l, complete specimen from left side (length 0.74 mm); m, dorsal view of complete specimen, anterior towards left (2 anterior dashed ovals represent protopodites of 2nd antennae); n, complete specimen from right side (length 0.74 mm); o, endopodite of right 2nd antenna, lateral view; p, left lamella of furca and unpaired bristle; q, complete specimen from right side with detail of posterior (length 0.96 mm); r, left 1st antenna and Bellonci organ; s, endopodite of left 2nd antenna, lateral view; t, left 5th limb (only 2 bristles shown), lateral view; u, tip of left 5th limb, lateral view; v, left 6th limb (no bristles shown), lateral view; w, tip of left 6th limb, lateral view; x, posterior of body from left side showing 7th limb (as indicated), left lamella of furca and unpaired bristle, and copulatory organ; y, endopodite of left 2nd antenna, medial view; z, posterior of body showing left lamella of furca and unpaired bristle, and copulatory organ. (Figure components not to same scale.)

**Second Antenna** (Figure 21s,y): Exopodite with 8 joints similar to those of instar IV; 1st joint with short bristle just reaching 2nd joint. Endopodite: 1st joint with 0–2 dorsal bristles; 2nd joint with 2 long bristles; 3rd joint with 1 short bristle, 1 minute dorsal papilla, and 1 indistinct pointed process longer than papilla (process not seen with certainty on all limbs examined); left and right endopodites similar in size.

**Mandible, Maxilla, Seventh Limb** (Figure 21x): Well developed.

**Fifth Limb** (Figure 21t,u): Well developed; 2nd exopodial joint with 2 ventral and 1 dorsal bristle; end joint with 3 bristles.

**Sixth Limb** (Figure 21v,w): Well developed; end joint with 3 bristles (2 long, 1 short).

**Furca** (Figure 21x,z): Each lamella with 6 claws; base of 2nd claw about same width or slightly wider than base of 1st claw; minute node following last claw; flat tipped process present between 1st and 2nd claws. Unpaired bristle following last claw.

**Bellonci Organ** (Figure 21r): Extending well past tip of 1st antenna, slightly widening near bifurcate tip.

**Copulatory Organ** (Figure 21x,z): USNM 193308F and 193309A with 2 lobes bearing globules; posterior lobe (rod-shaped organ) narrower than anterior lobe.

**DESCRIPTION OF INSTAR VI MALE** (Figure 22a-s).—Carapace similar in shape and spinosity to that of adult male.

**Carapace Size** (length measurements include spines): USNM 193306A, length 1.08 mm, height 0.39 mm, height 36.1% of length; USNM 193308C, length 1.07 mm, height 0.48 mm, height 44.9% of length; USNM 193309B, length about 1.05 mm. Mean length 1.07 mm.

**First Antenna** (Figure 22b,i,n): Well developed; inferred 5th joint with about 13 filaments.

**Second Antenna** (Figure 22c,d): Exopodite with 9 joints: 1st joint with short bristle extending to middle of 3rd joint; joints 2–8 each with natatory bristle; 9th joint small with 2 bristles (1 small, 1 about half length of bristle of 8th joint). Endopodite: 1st joint with 1 or 2 dorsal bristles; 2nd joint with 2 long bristles; 3rd joint with 1 long bristle, 1 small dorsal papilla, and 1 triangular pointed ventral process similar to that of instar V male but better defined. Left and right endopodite similar in size.

**Mandible, Maxilla, Seventh Limbs:** Well developed.

**Fifth and Sixth Limbs** (Figure 22j,k,p,q): 6th limb much larger than 5th limb. End joint of 6th limb with 3 long bristles (Figure 22q).

**Furca** (Figure 22g,h,l,r,s): Each lamella of USNM 193306A and 193308C with 7 claws; short process between 1st and 2nd claws (Figure 22h); no node following last claw. Unpaired bristle following last claw. USNM 193309B differs in having only 6 claws (Figure 22s).

**Bellonci Organ:** USNM 193308C with single pointed tip extending just past distal end of 1st antenna (Figure 22b). USNM 193306A with organ extending well past distal end of

1st antenna, broadening very slightly distally and with bifurcate tip (Figure 22i). USNM 193309B slender, not expanding distally; tip extending well past distal end of 1st joint, bifurcations not drawn out to slender points as in USNM 193306A (Figure 22n).

**Copulatory Organ:** Broad anterior lobe narrowing near midlength (Figure 22g,l,r); transverse muscles absent. Rod-shaped organ narrowing distally and with tubular tip curving posteriorly. Rod shaped organ of USNM 193306A with internal canal broadening near tip then continuing to form curved tubular tip (Figure 22m). Illustration of USNM 193309B with rod-shape organ lateral to broad anterior lobe (Figure 22r).

**DESCRIPTION OF INSTAR VI FEMALE** (Figure 22t-x).—Carapace similar in shape and spinosity to that of instar VI male.

**Carapace Size:** USNM 193308D length including spines 1.05 mm, height 0.41 mm, height 39.0% of length.

**First Antenna** (Figure 22u): Well developed.

**Second Antenna** (Figure 22v): Exopodite with 9 joints: 1st joint with small bristle not reaching 2nd joint; 9th joint small with 2 bristles (1 short, 1 about half length of bristle of 8th joint). Endopodite: 1st joint with short a-bristle and longer b-bristle; 2nd joint with slender f-bristle, stout g-bristle, and minute dorsal node near 3rd joint; 3rd joint with short slender bristle.

**Mandible, Maxilla, Seventh Limb:** Well developed.

**Fifth and Sixth Limbs** (Figure 22w): Relative differences in length less than for instar VI male. End joint of 6th limb with 2 long and 1 short bristle.

**Furca** (Figure 22x): Each lamella with 7 claws; low process between 1st and 2nd claws; node following last claw absent. Unpaired bristle following last claw.

**Bellonci Organ** (Figure 22u): Extending just past distal end of 1st endopodial joint; tip expanding just proximal to short bifurcate tip.

**Unextruded Eggs:** USNM 193308D with several small unextruded eggs.

#### COMPARISON BETWEEN SUBSPECIES OF *Euconchoecia bifurcata*

The carapaces of adult male and female *E. b. pax* are considerably shorter than those of *E. b. bifurcata* (Table 6). Also, the bifurcated tip of the Bellonci organ of the single known adult male *E. b. bifurcata* is formed by long branches, whereas, the tip of the organ of known adult males of *E. b. pax* is either bifurcate with minute branches, or is single and pointed. Generally, the Bellonci organ extends farther past the distal end of the 1st antenna of *E. b. pax* than of *E. b. bifurcata* (compare Chen and Lin, 1985, fig. 1:2,9, with Figures 16e, 18f, herein). The inferred 5th joint of the adult male 1st antenna may have fewer filaments on *E. b. pax* than on *E. b. bifurcata*, 18 compared to 25, but the variability of the number of

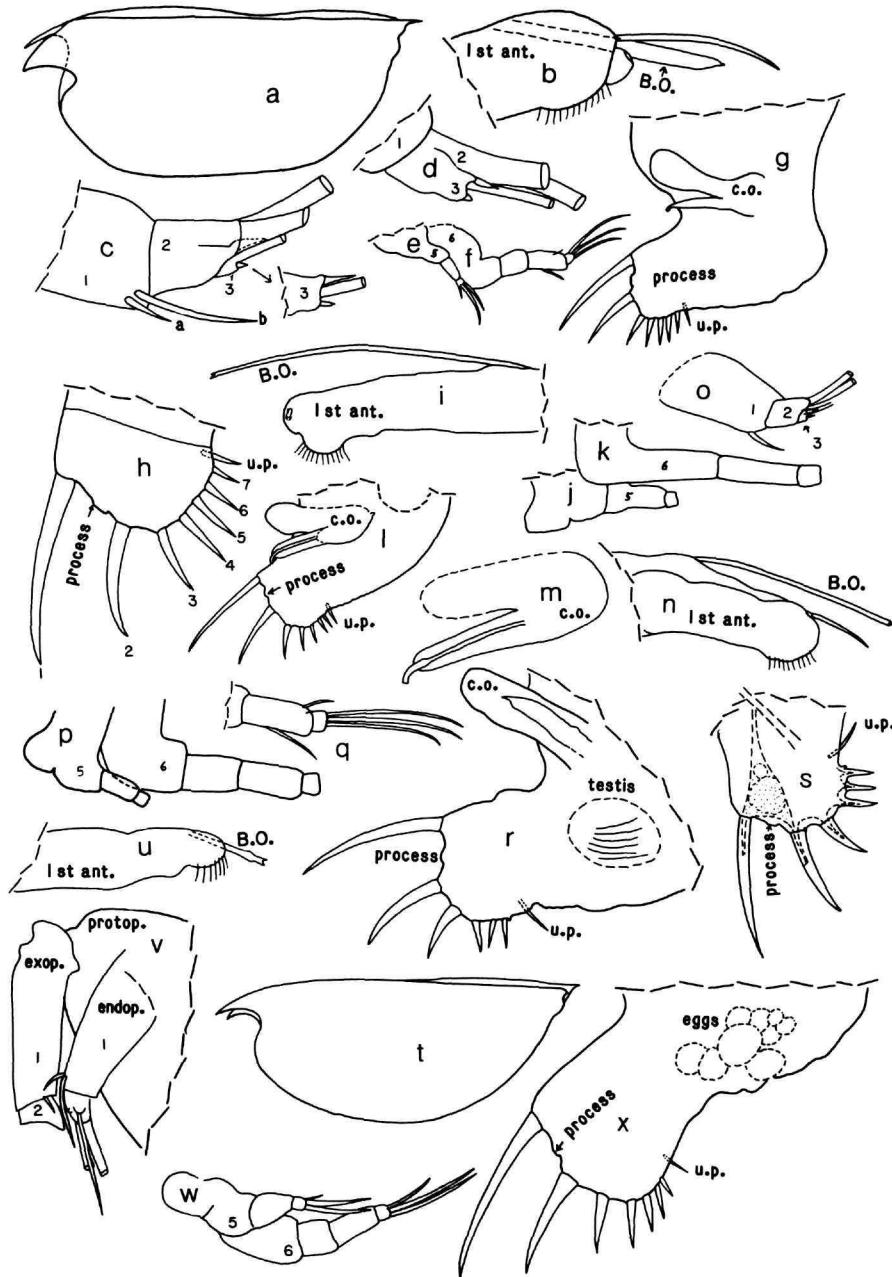


FIGURE 22.—*Euconchoecia bifurcata pax*, new subspecies, paratypes (*a–h*, USNM 193308C, instar VI male; *i–m*, USNM 193306A, instar VI male; *n–s*, USNM 193309B, instar VI male; *t–x*, USNM 193308D, instar VI female): *a*, complete specimen from left side (length 1.07 mm); *b*, tip of right 1st antenna and Bellonci organ; *c*, distal part of endopodite of left 2nd antenna, lateral view; *d*, tip of endopodite of right 2nd antenna, medial view; *e, f*, left 5th and 6th limbs (as indicated, not all bristles shown), lateral view; *g*, posterior of body showing left lamella of furca and unpaired bristle, and copulatory organ; *h*, left lamella of furca and unpaired bristle; *i*, left 1st antenna and Bellonci organ; *j, k*, 5th and 6th limbs (as indicated, bristles not shown); *l*, posterior of body showing left lamella of furca and unpaired bristle, and copulatory organ; *m*,

copulatory organ; *n*, right 1st antenna and Bellonci organ; *o*, endopodite of left 2nd antenna, lateral view; *p*, left 5th and 6th limbs (as indicated, bristles not shown), lateral view; *q*, tip of left 6th limb, lateral view; *r*, posterior of body showing left lamella of furca and unpaired bristle, copulatory organ, and testis; *s*, left lamella of furca showing internal structures, and unpaired bristle; *t*, complete specimen from left side (length 1.05 mm); *u*, right 5th limb (terminal bristle not shown) and Bellonci organ; *v*, right 2nd antenna, medial view; *w*, left 5th and 6th limbs (as indicated, not all bristles shown), lateral view; *x*, posterior of body showing left lamella of furca and unpaired bristle, and unextruded eggs (dashed ovals). (Figure components not to same scale.)

TABLE 6.—Comparison of carapaces of *Euconchoecia bifurcata bifurcata* and *E. bifurcata pax*, new subspecies.  
Data on *E. bifurcata bifurcata* from Chen and Lin, 1985:131–132.

Subspecies	Length (mm)		Height (mm)		(Height/length) × 100	
	Male	Female	Male	Female	Male	Female
<i>bifurcata</i>	1.47	1.72–1.86	0.58	0.56–0.60	40.0	32.0–33.0
<i>pax</i>	1.08–1.17	1.17–1.33	0.48–0.56	0.44–0.49	41.0–50.9	33.6–41.9

filaments is unknown, and it is difficult to accurately determine their number. The furca of *E. b. bifurcata* may have more claws than that of *E. b. pax* (see "Discussion of Furca," below).

#### ONTOGENY

The purpose of studying the ontogeny of *E. b. pax* was primarily to determine the order in which appendages were added, the number of instars in the species, and whether or not post-adult molting was indicated. The addition of bristles or claws was studied mainly on the 2nd antenna and furca.

The carapace of instar I is oval with a straight to slightly convex dorsal margin on USNM 193308G (Figure 20a), 193308J (Figure 20j), 193308K (Figure 20d), and more elongate on USNM 193308L (Figure 20h). On instar I the tip of the left rostrum bears a small spine and the tip of the right rostrum is usually bare but may have a minute spine; the posterodorsal corner of both valves are without spines. A posterodorsal gland is present on each valve of all instars. The carapace of instars II–VII have a long rostral spine on the right valve, a smaller rostral spine on the left valve, a long posterodorsal spine on the left valve, and a smaller posterodorsal spine on the right valve. The surface of valves of all instars is smooth without ornamentation. The preserved carapaces are uncalfed and tend to be distorted, especially the carapace of instar I.

The average growth factor of the shell, excluding the growth factor between the preadult (instar IV) and adult male, is 1.27. The mean growth factor was obtained by averaging the growth factors between instars for specified sex classes (Table 7). The growth factor between the instar IV and adult male, 1.06, is quite low. The growth factor between the instar VI and adult female is 1.18. It was not possible to differentiate sex of instars I–IV examined. Because of the small number of specimens used in determining carapace lengths, the growth factors must be considered approximations.

**First Antenna and Bellonci Organ:** The 1st antenna and Bellonci organ were obscured on the 5 specimens of instar I examined. On one specimen (USNM 193308J, Figure 20o) the 1st antenna appeared to have only 1 stout terminal filament but on another specimen (USNM 193308L) several filaments appeared to be present. The number of filaments on the 1st antenna increases in later instars. The Bellonci organ was not observed on instar I but could have been present. The organ is well developed on later instars.

**Second Antenna:** The protopodite, exopodite and endopodite are already well developed in instar I. The exopodite bears only 8 joints on instars I–V and 9 joints on later instars. The terminal eighth joint bears 2 bristles on instar I and 3 on instars II–V; instar VI and the adult bear 1 long bristle on the 8th joint and 2 short bristles on the 9th. The endopodites of instar I were obscure on specimens examined but has 2-joints and at least 1 fairly long bristle which appears to have its base on the 2nd joint on some specimens, but on one seemed to have the base on the 1st joint; also, a triangular flap may be present on the 2nd joint of some limbs. The 1st endopodial joint generally with no or 1 dorsal bristle on instar II, 1 bristle on instars III and IV, 1 or 2 on instar V, and 2 on later instars. The 2nd endopodial joint bears 2 bristles on instars II–VII. The 3rd endopodial joint bears 1 bristle on instars II–IV and female instars VI and VII (female instar V unknown, but probably also with 1 bristle), 1 bristle, 1 papilla, and 1 pointed process on male instars V and VI, 3 bristles, a lateral process, and small papilla on adult male left limb, and 3 bristles and v-shaped clasping process on adult male right limb.

**Mandible:** Already well developed on instar I but with weakly developed teeth on the basale, and bristles only on the endopodite. Additional bristles added in later instars.

**Maxilla:** Well developed in instar I, especially 2 endites which occupy relatively more space in instar I than in later instars.

TABLE 7.—Mean shell lengths and growth factors for male instars V, VI, and adult, and of unknown sex (u) of earlier instars of *Euconchoecia bifurcata pax*, new subspecies.

Age/sex	Mean length (mm)	Growth factor	Number of specimens
Adult/♂	1.13	1.06	5
VI/♂	1.07	1.10	3
V/♂	0.97	1.31	2
IV/u	0.74	1.21	2
III/u	0.61	1.33	2
II/u	0.46	1.48	1
I/u	0.31		5

**Fifth and Sixth Limbs:** Only epipodial bristles of the 5th limb were observed on instar I. The protopodite, exopodite and endopodite are represented by a short lobe. The epipodial bristles were not visible on whole mounts of some specimens but when the specimens were dissected the bristles and their long marginal hairs were clearly visible. The 5th limb is well developed in later instars. The 6th limb is absent in instars I and II and is represented in instar III as a small lobe without bristles and is termed here "anlage." The 6th limb is well developed in instar IV but is slightly smaller than the 5th limb. In later instars the 6th limb is longer than the 5th, especially in the adult male.

**Seventh Limb:** Appears first in instar V and is similar to that of the adult; elongate and bearing 2 bristles. No anlage without bristles was observed in earlier instars.

**Furca:** Instar I bears 2 claws on each lamella as well as a small process. The claws have a suture (indistinct on some) at their base and the process is without a suture. The process, which is more developed on some specimens and seems to have a central canal, probably represents the site of a 3rd claw appearing in the next instar. There is no single bristle posterior to the claws on the furca of instar I but an indistinct flat process may represent the bristle, which appears in the next and later instars. One additional claw is added in each juvenile instar so that instar VI bears 7 claws (rarely 6). The adult also bears 7 claws. A small process is present between claws 1 and 2 of all specimens examined; it may represent the base of a missing claw on the adult furca (see "Discussion of Furca," below).

**Copulatory Limb of Male:** A copulatory limb is present on male juvenile instars V-VI of the specimens studied. It was not observed on earlier instars but these could be females. The copulatory limb of instar V males consists of 2 lobes (anterior and posterior) having many globules (cells?) but little apparent internal structure. On instar VI males the posterior lobe (rod-shaped organ) has a curved tubular tip and an internal canal. On the adult, the rod-shaped organ is within the anterior lobe.

#### ORDER OF APPEARANCE OF APPENDAGES

Instar I of *E. b. pax* described herein differs from instar I of *E. elongata* (Tseng, 1975:104) in having a large maxilla and 5th limb epipodite. Tseng (1975:104) called the 1st growth stage "Metanauplius" but, being the 1st free living stage, it is equivalent to "Instar I" used herein. A maxilla and 5th limb of instar I of *Conchoecia magna* have been described by Claus (1894:6). It seems probable that *E. elongata* does have a maxilla, if not also a 5th limb. The maxilla is quite large in instar I of *E. b. pax* and *C. magna*, but the 5th limb could easily be overlooked. The 5th limb of the 1st instar of *C. magna* described by Claus (1894: 6) bears strong bristles on the protopodite absent on *E. b. pax* (possibly bristles on an endite of the maxilla was interpreted by Claus to be on the 5th limb).

Claus observed an anlage of the 6th limb on instar II of *C.*

*magna* but herein the anlage was not observed on *E. b. pax* until instar III, at which stage *C. magna* already had 1 bristle. A fairly well developed 6th limb with bristles is present on instar IV of *E. b. pax*, and the 7th limb with its 2 bristles appears on instar V. On *C. magna* the 7th limb was already present as an anlage without bristles on the 4th instar but apparently did not have bristles until the 6th instar (Claus, 1894:7, 8). On *E. elongata* an incomplete 7th limb (without bristles?) was present on the 4th instar and a complete 7th limb on the 5th instar (Tseng, 1975, table IV-4). On *C. magna*, *E. elongata*, and *E. b. pax* each lamella of the furca has 2 claws on the 1st instar, and an additional claw was added at each stage in instars II-VI. Another claw may be added in the adult. On *E. b. pax* a distinct bilobed copulatory organ is present on the male instar V (two 4th instars examined were without a copulatory organ, but they may have been females). On instar VI the anterior lobe of the copulatory organ already has the narrowing at midheight characteristic of the adult organ in species of the genus, and the posterior lobe (rod-shaped organ) has a tubular tip and may have an internal canal. In the adult male the rod-shaped organ is inserted within the posterior lobe.

The few ontogenetic studies on Halocypriidae (Claus, 1894; Tseng, 1975) suggest that in early instars appendages are added at different rates in different species, but this may in part be the result of observational error and difficulty in interpreting the state of development of the appendage when it is first noted in a description. When comparing at which stage appendages are added in different species it is probably better to use for first appearance an appendage with at least 1 bristle, because it is difficult to accurately determine when an anlage first appears, and it may vary slightly within a species. The 1st and 2nd antennae, the mandible, maxilla, 5th limb, and furca are already present in instar I of Halocypriidae. The 6th limb with bristles appears in instars III or IV, and the 7th limb with bristles probably appears in instar V, possibly as late as instar VI. In the Halocypriidae the number of furcal claws on each lamella may be a means to identify an instar of most species: 2 claws on instar I, 3 on instar II, 4 on instar III, 5 on instar IV, 6 on instar V, and 7 on instar VI. The number of claws may increase by one at each successive stage, so the presence or absence of certain appendages may help identify the stage; for example, the absence of a 6th limb with bristles indicates an instar no earlier than instar III, and a 7th limb with bristles probably occurs no earlier than instar V.

#### FURCA

Chen and Lin (1984, 1985) in their description of *E. bifurcata* stated that each lamella of the furca of the adult male and female bears 8 claws. All the adults in the present collection of the subspecies *E. b. pax* have only 7 claws on each lamella. There is, however, between the 1st and 2nd claws a small process that could be the base of a missing claw. In his description of the adult male *E. chierchiae* Müller, 1890, which

also has only 7 claws on each lamella of the furca, Skogsberg (1920:750; fig. 30) stated, "Between the first and second claw a rounded verruciform process seems always to be developed." Tseng (1975:53) in his description of the adult male and female of *E. elongata* Müller, 1906, stated that each lamella bears 8 claws and that the 2nd claw is easily lost in fixed specimens. None of the adults of *E. b. pax* have a claw attached to the process between the 1st and 2nd claws. All the instars examined, including the first, have the small process (without an attached claw) between the 1st and 2nd claws. In an attempt to provide independent evidence that a claw was present on the process prior to preservation of *E. b. pax* the venation in the vicinity of the claws was studied. A veinlet extends into each of the claws remaining on the furca but no veinlet is present in the vicinity of the process. The absence of the veinlet does not prove that the process never supported a claw, but does suggest that, if a claw had been present, it differed from the claws remaining on the furca. According to the illustrations by Tseng (1975, fig. IV-16:h,h') of the furca of the large adult female and male of *E. elongata* the 2nd furcal claws are considerably thinner than the 3rd, which is unusual in the halocyprids. In juvenile myodocopid ostracodes, specimens are sometimes encountered at a step in ecdysis with appendages of the next instar visible within the molting appendages. Thus, if the process between the 1st and 2nd claws of *E. b. pax* represents the base of a missing claw, the furca within the furca of a specimen about to molt should have the missing claw. Many of the juveniles in the collection were examined but, unfortunately, none were at the needed stage of ecdysis. Of interest is a new halocyprid genus and species (*Spelaeoecia bermudensis* Angel and Iliffe, 1987) having most of the 2nd claw missing on the many specimens in their collection. That phenomenon differs from that encountered in *E. b. pax* and *E. chierchiae* in that a stump of the 2nd claw remains making it quite clear that a complete claw had been present. Tseng (1975, table IV-8) listed the number of claws on the furca of each instar of *E. elongata* showing that instar I bears 2 claws and that 1 claw is added in each older juvenile instar, and an additional claw is added in the adult, which has 8 claws. This order would prevail for *E. b. pax* only if the process between claws 1 and 2 on juvenile instars I-VI does not represent the base of a missing claw, and if the process on the furcae of adults does represent the base of a missing claw. Because of the inability to demonstrate from the present collection that a claw had once been present, only the remaining claws are counted in describing the furca. If the process between claws 1 and 2 on juveniles represents the place of attachment of the claw that only appears on the adult, that claw is inserted between the sites of claws 1 and 2 of the juvenile, and not posterior to the last claw. Instars I-V have a small node following the last claw. The node probably marks the site of an additional claw appearing in the next instar. The node is absent on instar VI. This absence may support the possibility that on the adult the 2nd claw is inserted between the sites of

claws 1 and 2 of instar VI. Clearly, additional study is required to resolve how the claw is added in *Euconchoecia*.

POST-ADULT MOLTING.—Fenwick (1984:285), after reviewing previously reported data, concluded that the evidence for post adult molting among myodocopids is lacking. Tseng (1975, 1976) in a comprehensive field and laboratory study of the halocyprid *Euconchoecia elongata* described the last 2 of 8 stages as "small" and "large" adults, respectively: the growth rate for the small male to become a large male is 1.15, and for the small female to become a large female is 1.25. Clearly, post-adult molting is implied for *E. elongata*. The present collection of *E. bifurcata pax* provided the opportunity to compare its growth with *E. elongata*. As discussed herein, *E. b. pax* has only 7 growth stages, including only one adult stage. The furcae of most of the adults in the collection were examined for indications of ecdysis but none were found.

Because it seems likely that species in the same genus would either have, or not have, post-adult molting, and because post-adult molting has not been proven in other ostracode taxa, the publication of Tseng (1975) was examined to determine if the data could be interpreted differently. The length of the small adult of *E. elongata* was given by Tseng (1975:111) as 0.96–1.20 mm and the large adult as 1.20–1.58 mm (Tseng 1975:112). Thus, there is no separation of dimensions to show that 2 adult instars exist. Tseng (1975, table IV-5) listed the size frequency of small and large adults. When the length groupings are plotted against frequency no indication of 2 instars is apparent; the division of small and large adults appears arbitrary. However, the length range of 0.96–1.58 is certainly too broad to include only 1 stage; it seems probable that Tseng's (1975) small adult class included some juveniles. Possibly, the low growth ratio (1.17) between instars V and VI compared to the higher ratios (1.24–1.25) between each pair of younger instars (Tseng, 1975, table IV-9) indicates that some specimens of instar VI had been included in with the small adult class, but the difference in ratios could also be the result of sample error. If the smaller specimens in the small adult class are referred to instar VI and larger specimens are combined with the large adult class to form a single adult class, *E. elongata* would have a total of 7 instars, the same number as *E. b. pax*, and also as species of *Conchoecia* (Hillman, 1969:189).

#### BELLONCI ORGAN

Skogsberg (1920:750) described the male organ of *E. chierchiae* as "pointed distally (sometimes with 2 points)," and stated (Skogsberg, 1920: 752) that the female organ is of the same type as in the male. The descriptions of *E. bifurcata* by Chen and Lin (1984, 1985) were based on 1 adult male and 2 adult females. The bifurcate part of the Bellonci organ of the male which they illustrated (Chen and Lin, 1984, fig. 1:2) is formed of 2 long branches, whereas, that of the female (Chen and Lin, 1984, fig. 1:9) is formed of minute branches. Because

of the obvious variability in morphology of the tip of the Bellonci organ, the organs of 16 specimens of *E. b. pax* were examined (Table 8). The table shows that juveniles and adult females generally have short bifurcate tips, whereas most (3 of 4) adult males in this sample have a single pointed tip.

#### REPRODUCTION

Skogsberg (1920:574) discussed the sexual organs of the Conchoecinae, which appear similar to those observed in *E. b. pax*. The male *E. b. pax* has paired testis and a vas deferens (possibly paired), all on the left side of the body (Figure 19d). The copulatory organ is unpaired and includes a large penis and a smaller rod-shaped organ which is permanently inserted within the penis in the adult, but is posterior to the penis in juveniles (instars A-1 and A-2). The copulatory organ is on the left side of the body. In female Conchoecinae a single seminal receptacle is on the right side of the body anterior to the furca, and the ovaries are paired and connect with paired oviducts that merge into a single tube having its exit on the left side of the body just anterior to the furca (Skogsberg, 1920:574).

TABLE 8.—Morphology of the tip of the Bellonci organ of selected specimens of *Euconchoecia bifurcata pax*, new subspecies (u = sex unknown).

Age/sex	No. single	No. bifurcate
Instar II/u	0	2
Instar III/u	0	2
Instar IV/u	0	1
Instar V/♂	0	1
Instar VI/♂	0	1
Instar VI/♀	0	1
Adult/♂	3	1
Adult/♀	1	3

These were not identified on the few females of *E. b. pax* studied herein.

Tseng (1975:91) stated that the oviduct of *Euconchoecia elongata* opens at the center of a broad depression in the posterodorsal corner of the body, and he discussed in considerable detail the emission of the eggs through that opening (Tseng, 1975:54). Unfortunately, Tseng's publication (1975) lacks documentation and his interpretation, although possible, is difficult to accept without it.

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