

Ostracoda (Halocyprididae)  
from Anchialine Caves  
in the Bahamas

LOUIS S. KORNIKER,  
JILL YAGER,  
and  
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## ABSTRACT

Kornicker, Louis S., Jill Yager, and Dennis Williams. Ostracoda (Halocyprididae) from Anchialine Caves in the Bahamas. *Smithsonian Contributions to Zoology*, number 495, 51 pages, 30 figures, 4 tables, 1990.— Six new Halocyprididae from 4 anchialine caves in the Bahamas are described and illustrated: *Spelaeoecia styx* from South Andros Island, *S. sagax* from Grand Bahama Island, *S. capax* from Long Island, *Deeveya styx* from Abaco Island and Grand Bahama Island, *D. hirpex* from Abaco Island, and *D. medix* from Grand Bahama Island. Adult males, previously unknown in the genus *Deeveya*, are described for *D. styx* and *D. medix*. Keys are presented to the genera of Deeveyinae, and to the species of *Spelaeoecia* and *Deeveya*.

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# Ostracoda (Halocyprididae) from Anchialine Caves in the Bahamas

Louis S. Kornicker, Jill Yager,  
and Dennis Williams

## Introduction

Danielopol (1972) described from a marine cave in Cuba the first troglobitic ostracode in the suborder Halocypridina, a suborder previously known from the open ocean, where most members are planktonic. Since then, the number of known troglobitic anchialine species in that suborder has increased rapidly to 15, including the six new species from the Bahamas described herein. Three of the new species are in the genus *Deeveya* (Halocyprididae), which appears to be endemic to the Bahamas (including the Turks and Caicos Islands), and brings the number of its known species to six. The remaining three new species from the Bahamas are in the genus *Spelaeoecia* (Halocyprididae), a genus known previously only from Bermuda, and brings the number of known species to four. One of the five known troglobitic species of a more widely distributed genus in this suborder, *Danielopolina* (Thaumato-cyprididae), is from the Bahamas (Eleuthera Island), but none were in the present collections. The world distribution of troglobitic anchialine ostracodes in the suborder Halocypridina is shown in Table 1. Also presented herein are brief supplementary descriptions of *Deeveya spiralis*, *D. bransoni*, and *D. jillae* based on a restudy of the type specimens. The locations of Bahamian islands having caves from which troglobitic Halocypridina have been collected are shown in Figure 1 (only those islands having troglobitic ostracodes are named in the figure).

ABBREVIATIONS.—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 in the figures: a.m. = adductor muscle; ant. = antenna; B.O. = Bellonci organ; bas = basale; c.o. = copulatory organ; cox = coxale; end = endopodite; epip = epipodite; esop = esophagous; ex = exopodite; g.p. = glandular process; gen = genitalia; i.m. = inner margin of infold; l.p. = lamellar prolongation of list of selvage; mnd = mandible; mx = maxilla; precox = precoxale; u.p. = unpaired process.

USNM catalog numbers apply to collections in the National Museum of Natural History (NMNH), Smithsonian Institution (SI).

METHODS.—Specimen and environmental data collection were made by Yager and Williams. All specimens were fixed in formalin and then changed to 70% ethyl alcohol, and were placed in glycerin prior to examination.

Specimens were measured with an ocular micrometer and are reported to the nearest 0.01 mm. Measurements are maximum length and height; each specimen was measured oriented with the straight hinge of the dorsal margin up, including or excluding processes as indicated. Drawings were made with a camera lucida; some appendages were drawn with the appendage mounted in glycerine and under a cover slip.

ACKNOWLEDGMENTS.—Jill Yager and Dennis Williams collected the samples; Jill Yager described the habitats; Louis S. Kornicker is the author of the new taxa. Field notes on El Dorado Cave were compiled by members of Project Andros 1986: Michael Madden, Parker Turner, Roger Werner, and Dennis Williams.

We thank the following people for their help: Jack R. Schroeder (SI) for inking camera lucida drawings of carapaces and appendages and the shell length-height graph; Martin V. Angel (National Institute of Oceanography, Wormley, Godalming, Surrey, England) and Thomas E. Bowman (SI) for reviewing the manuscript, Elizabeth Harrison-Nelson (SI) for general assistance, and Don Fisher (SI) for final editing and preparation of the manuscript for publication. Field studies

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Review Chairman: C.W. Hart, National Museum of Natural History, Smithsonian Institution. Reviewers: Martin V. Angel, Institute of Oceanographic Sciences, England; Thomas E. Bowman, National Museum of Natural History, Smithsonian Institution.

TABLE 1.—World distribution of anchialine ostracodes in the suborder Halocypridina (Halocyprididae (H), Thaumatoocyprididae (T))

West Indies	
Little Bahama Bank	
Abaco Island (Dan's Cave)	
	<i>Deeveya styrax</i> , new species (H)
	<i>Deeveya hirpex</i> , new species (H)
Grand Bahama Island, Sweeting's Cay (Sagittarius Cave)	
	<i>Deeveya styrax</i> , new species (H)
	<i>Deeveya medix</i> , new species (H)
	<i>Spelaeoecia sagax</i> , new species (H)
Great Bahama Bank	
Eleuthera Island (Hatchet Bay Cave)	
	<i>Danielopolina bahamensis</i> Kornicker and Iliffe, 1989a (T)
	<i>Deeveya jillae</i> Kornicker and Iliffe, 1989a (H)
Long Island (Alfonso Dean Blue Hole)	
	<i>Spelaeoecia capax</i> , new species (H)
South Andros Island (The Bluff: Evelyn Green's and Stargate Blue Holes)	
	<i>Deeveya bransoni</i> Kornicker and Palmer, 1987 (H)
South Andros Island (El Dorado Cave)	
	<i>Spelaeoecia styx</i> , new species (H)
Turks and Caicos Islands, Caicos Islands	
Providenciales Island (The Hole)	
	<i>Deeveya spiralis</i> Kornicker and Iliffe, 1985 (H)
Cuba	
Matanzas (Grotto)	
	<i>Danielopolina orghidani</i> (Danielopol, 1972) (T)
Mexico, Yucatan Peninsula	
Quintana Roo near Tulum (Mayan Blue Cave)	
	<i>Danielopolina mexicana</i> Kornicker and Iliffe, 1989a (T)
Bermuda	
Crystal Cave, Fern Sink Cave, Green Bay Cave, Jane's Cave, Roadside Cave, Tucker's Town Cave, Walsingham Sink Cave, Wonderland Cave	
	<i>Spelaeoecia bermudensis</i> Angel and Iliffe, 1987 (H)
Canary Islands	
Lanzarote (marine lava tube)	
	<i>Danielopolina wilkensi</i> Hartmann, 1985 (T)
Galapagos Islands	
Santa Cruz (deep grieta east of Tortugas Bay; Grieta de Caleta la Torta)	
	<i>Danielopolina styx</i> Kornicker and Iliffe, 1989c (T)
Palau, Koror (Oreor) Island	
Ngermeuangel (Lake 2a Cave)	
	<i>Euconchoecia bifurcata pax</i> Kornicker in Kornicker and Iliffe, 1989a (H). (Subspecies probably troglolithic rather than troglitic.)

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## Habitats

ALFONSO DEAN BLUE HOLE (Hard Bargain Settlement, Long Island, Great Bahama Bank).—Although the entrance to this cave system is a small hole about 2 m in diameter, the cave widens into a classic bell-shaped room. The salinity increases with depth from about 9‰ at the surface, 20‰ at 13 m, and 30‰ at depths over 17 m. Tidal fluctuation is evident. The ostracodes were collected at a depth of about 13 m in the weakly photic or twilight zone of the cave. Dissolved oxygen content of water at that depth was recorded at less than 1 mg/l. The cave is inhabited by the ostracode *Spelaeoecia capax*, new species. Other animals in the cave include thermosbaenaceans, copepods, shrimp, and a free-swimming polychaete.

DAN'S CAVE (Abaco Island, Little Bahama Bank).—Located about 3 km from the sea, this cave is a typical Bahamian limestone cave with a distinct lens of fresh water overriding deeper saline water (Yager, 1987a:318). Tidal fluctuation is evident. The ostracodes were collected in the aphotic zone beneath the density interface in marine water of about 33‰. The oxygen content of this water is less than 1 mg/l. The cave fauna includes 2 new species of ostracodes, *Deeveya styrax* and *D. hirpex*, and a diverse group of crustaceans that appears to be common to anchialine environments: remipedes, thermosbaenaceans, cirrolanid isopods, shrimp, and nebaliceans. The only vertebrate observed in this cave is the Bahamian blind cave fish, *Lucifuga speleotes* Cohen.

EL DORADO CAVE (South Andros Island, Great Bahama Bank).—The cave is northwest of Congo Town and is one of a series of inland cave openings along an extensive north-south slumping fracture or fault. The openings are basically parallel to the eastern coast of the island and about 1 or 2 km inland. El Dorado Cave is located along the trail between Rat Bat Cave to the north and Swimming Hole (used by local children) to the south. El Dorado is a deep vertical fissure that extends to a depth of about 91 m. The water chemistry is typical of most anchialine caves in the Bahamas in which salinity increases with depth and dissolved oxygen decreases (Yager, 1987a:318). Tidal fluctuation is evident. The salinity was measured at 13‰ at the surface, 24‰ at 20 m, and 36‰ at 33 m. The dissolved oxygen was measured at 5.5 mg/l at the surface. A distinct layer of hydrogen sulfide was indicated when a white bacterial cloud was encountered at a depth of 10–20 m. At this depth the dissolved oxygen was less than 0.05 mg/l. At 30 m the dissolved oxygen was 0.1 mg/l. The ostracode *Spelaeoecia styx*, new species, was collected in this cave. In addition to the ostracodes, the thermosbaenacean *Tulumella bahamensis* Yager, 1987b, as well as unidentified copepods were collected. Gliding bacteria of the *Beggiatoa-Thiothrix* group were observed in the water column at 30 m depth.

SAGITTARIUS CAVE (Sweeting's Cay, Grand Bahama Island, Little Bahama Bank).—This cave is one of the Zodiac Caverns, a complex system of submerged caves beneath Sweeting's Cay,



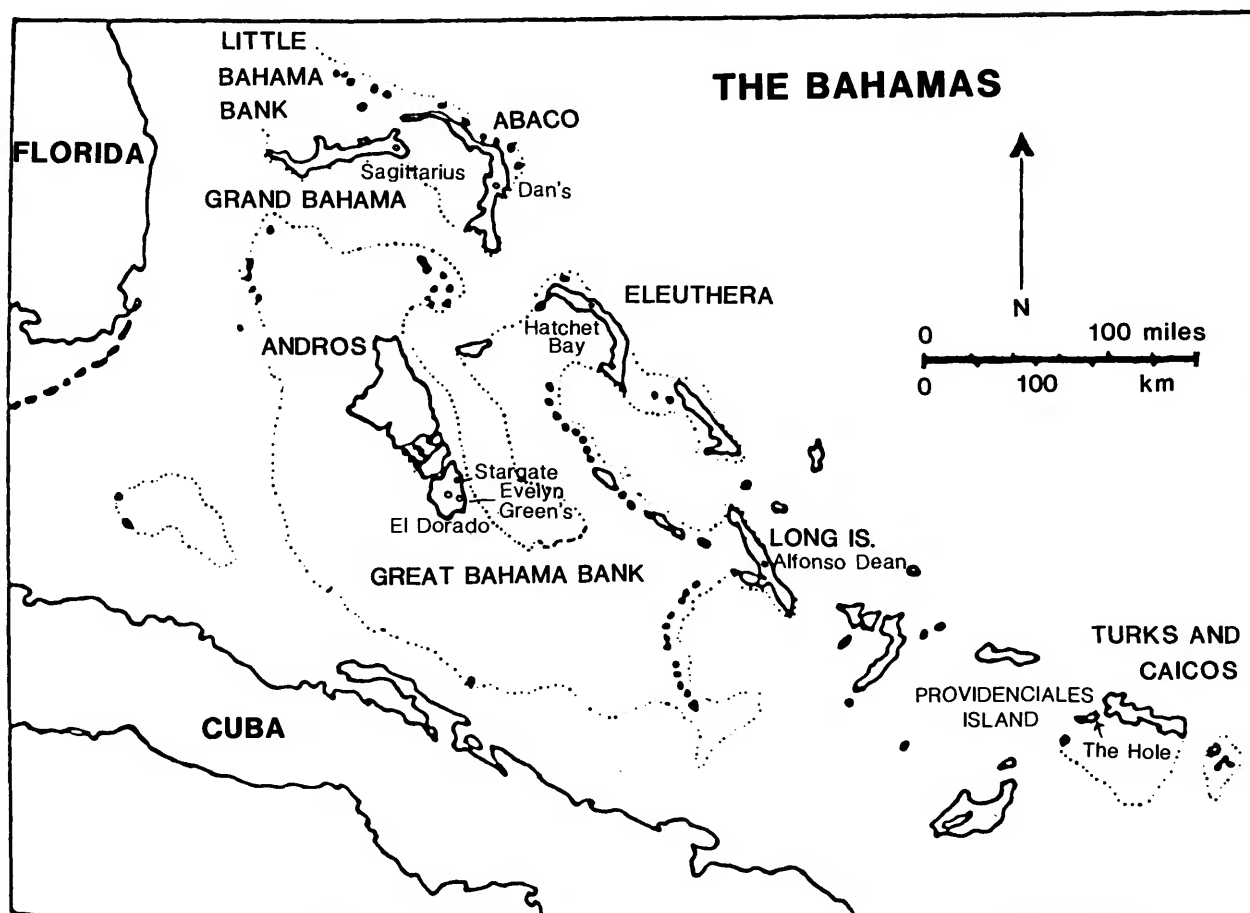


FIGURE 1.—Location map of Bahaman islands having caves from which troglotic Halocypridina have been collected (only those islands having caves with halocyprids are named; cave names are in upper and lower case letters).

a small island at the eastern end of Grand Bahama Island. The cave entrance is in a shallow saline lake behind the government dock and school. Tidal fluctuation is evident. Cunliffe (1985, table 1) listed the fauna and flora of the lake and cave including 2 ostracode genera, *Deeveyne* (= *Deeveya*) and *Speleocia* (= *Spelaeocia*). Three new species, *D. styrax*, *D. medix*, and *S. sagax*, are referred to those genera herein. A detailed study of the physical characteristics of the cave is now in progress by two of us (Yager and Williams), and preliminary results indicate that the cave is marine with a salinity of 35‰, and although the lake is well oxygenated at 5 or 6 mg/l, the oxygen content of the cave water is variable and much lower, reaching less than 1 mg/l at a depth of 16 m. The troglotic cave inhabitants include the Bahamian blind cave fish, 6 species of remipedes, 2 species of thermosbaenaceans, 2 species of amphipods, a stygiomysid, a cirrolanid isopod, and unidentified copepods.

#### Suborder HALOCYPRIDINA Dana, 1853

**COMPOSITION.**—This suborder comprises the superfamilies Halocypridoidea Dana, 1853, and Thaumacypridoidea Müller, 1906. Both superfamilies have been reported previously in anchialine caves in the Bahama Islands (including Turks and Caicos Islands) (Kornicker and Iliffe, 1985:476; Kornicker and Palmer, 1987:610; Kornicker and Iliffe, 1989a). Only the Halocypridoidea are represented in the collections reported upon herein.

**DISTRIBUTION.**—Species of Halocypridoidea that have been collected in caves, including those reported herein, are listed in Table 1. With the exception of *Euconchoecia bifurcata* pax Kornicker in Kornicker and Iliffe, 1989a, from Palau, which is probably troglolytic, species listed have been interpreted to be troglotic. Troglotic species of Thaumacypridoidea are more widespread than those of Halocypridoidea, which are

known only from the Bahamas and Bermuda (Table 1).

### Superfamily HALOCYPRIDOIDEA Dana, 1853

COMPOSITION.—This superfamily contains only the family Halocyprididae Dana, 1853.

### Family HALOCYPRIDIDAE Dana, 1853

COMPOSITION.—The family comprises the subfamilies Halocypridinae Dana, 1853, Conchoecinae Claus, 1891, Archiconchoecinae Poulsen, 1969, Euconchoecinae Poulsen, 1969, and Deeveyinae Kornicker and Iliffe, 1985. Only the Deeveyinae are represented in the collections reported upon herein.

### Subfamily DEEVEYINAE Kornicker and Iliffe, 1985

COMPOSITION.—The subfamily comprises the genera *Deeveya* Kornicker and Iliffe, 1985, and *Spelaeoecia* Angel and Iliffe, 1987.

DISTRIBUTION.—Members of this subfamily have been reported from Bermuda and the Bahama Islands (including Turks and Caicos Islands) (Table 1).

TERMINOLOGY.—The lettering of bristles of the 1st and 2nd antennae is that used by Kornicker and Palmer (1987:610–611) for *Deeveya*, and Kornicker (1989:314) for *Spelaeoecia*, and is based on the lettering system used by Skogsberg (1920:188, 575) for other taxa. The terminology used for the 6th limb is that mentioned by Angel and Iliffe (1987:551) as "segmentation that should be reconsidered": the exopodite is interpreted

to have 3 joints, and the joint considered to be the 1st exopodial joint in prior terminology is interpreted to be the basale, and the process (bearing 4–5 bristles) previously considered to be part of the 1st exopodial joint is interpreted to be the endopodite.

DISCUSSION.—The carapaces of species of *Spelaeoecia* differ from those of *Deeveya* in having a well-defined rostrum. The males of *Spelaeoecia* differ from males of *Deeveya* in 2 important characters: (1) the endopodite of the 2nd antenna bears a clasper on *Spelaeoecia* that is absent on *Deeveya*; (2) the posterior branch of the copulatory organ of *Spelaeoecia* has a narrow hirsute tip but is broadly rounded on *Deeveya*. Additional differences in the genera are listed in Table 2.

TABLE 2.—Comparison of selected characters of adult *Spelaeoecia* and *Deeveya*.

Character	<i>Spelaeoecia</i>	<i>Deeveya</i>
Carapace rostrum	present	absent
1st antenna, bristles of 3rd joint	0–1	1
2nd antenna, clasper on male endopodite	present	absent
Mandible, small proximal bristle on basale	present	absent
Mandible, 2 lateral basale bristles entwined	no	yes
Mandible, bristles of 1st endopodial joint	3–4	6–7
5th limb, bristles of 3rd exopodial joint	3	4–5
6th limb, bristles of endopodite	4–5	4
6th limb, bristles of 1st exopodial joint	2–4	4–6
6th limb, bristles of 3rd exopodial joint	3	4–5
Furca, number of claws per lamella	7–8	7
Unpaired bristle	1, 2, bifid	1
Male copulatory organ, tip of posterior process (P = pointed) (B = blunt)	P	B

### Key to the Genera of Deeveyinae

- Carapace with well-developed rostrum . . . . . *Spelaeoecia*  
 Carapace without well-developed rostrum . . . . . *Deeveya*

### *Spelaeoecia* Angel and Iliffe, 1987

*Spelaeoecia* Angel and Iliffe, 1987:543, 545.

TYPE SPECIES.—*Spelaeoecia bermudensis* Angel and Iliffe, 1987:545–549.

COMPOSITION (Table 1).—The genus comprises four species from marine caves: *S. bermudensis* from Bermuda, and three new species from the Bahamas (*S. capax* from Long Island, *S. sagax* from Grand Bahama Island, and *S. styx* from South Andros Island).

EMENDED DIAGNOSIS.—Intended to supplement characteristics mentioned by Angel and Iliffe (1987:543). 1st antenna: 1st

and 6th segments without bristles, 7th segment with 3 bristles, 8th segment with 4 bristles. 2nd antenna: 1st exopodial joint with 1 long bristle; adult male endopodite with straight claspers. 6th limb: single joint of endopodite with 4 or 5 bristles (*S. bermudensis* with 4, *S. sagax* and *S. styx* with 5). Adult furca with 7 or 8 claws on each lamella (7 on adult male and female *S. styx*, 8 on adult males and females of *S. bermudensis* and *S. sagax*). Copulatory organ of male with 2 branches; posterior branch with long styliform process with hirsute tip. Selected morphological characters of species of *Spelaeoecia* are compared in Table 3.

TABLE 3.—Distribution of bristles and claws on species of *Spelaeoecia*. (A = Anterior, C = Clasper, D = Dorsal, L = Lateral, M = Medial, na = not applicable, nd = no data, P = Posterior, T = Terminal, V = Ventral, ? = number uncertain, numbers not followed by letter indicate bristles in several localities.) Table does not include *S. capax*, of which only the carapace is known.

Character	<i>sagax</i>		<i>styx</i>		<i>bermudensis</i>	
	male	female	male	female	male	female
Length (mm)	1.63–1.73	1.73–1.77	0.98	0.82	1.37	1.58–1.64
1st Antenna						
1st joint	0	0	0	0	0	0
2nd joint	1D	1D	1D	1D	1D	1D
3rd joint	0	0	0	0	1V	1V
4th joint	1D	1D	1D	1D	1V,1D	1V,1D
5th joint	1V	1V	1–2V	1V	1V	1D
6th joint	0	0	0	0	0	0
7th joint	2V,1D	2V,1D	2V,1D	2V,1D	2V,1D	2V,1D
8th joint	4T	4T	4T	4T	4T	4T
2nd Antenna						
Endopodite						
1st joint	2D	2D	2D	2D	2D	2D
2nd joint	2 long	2 long	2 long	2 long	2 long	2 long
3rd joint	3 long,C	3 long	3 long,C	3 long	3 long,C	3 long
Exopodite						
9th joint	nd	nd	4T	4T	4T	4T
Mandible						
Basale						
Proximal	5	4	5	5	5	5
Endite	1A,2P,6L	1A,2P,6L	1A,2P,6L	nd	1A,2P,6L	1A,2P,6L
Endopodite						
1st joint	1D,1V,1–2M	1D,1V,1–2M	1D,2V	1D,1V,1M	1D,1V,1M	1D,1V,1M
2nd joint	1V,2D	1V,3D	1V,2–3D	1V,3D	1V,3D	1V,3D
3rd joint	4M,3T	4M,3T	4M,3T	4M,3T	4M,3T	4M,3T
Maxilla						
Endite I	12	nd	10	nd	11	nd
Endite II	12	nd	9	nd	10	nd
Endite III	6	nd	5	nd	7	nd
Coxale	1D	nd	1D	1D	1D	1D
Basale	1V	nd	1V	1V	1V	nd
Endopodite						
1st joint	9–12	nd	9	10	13	12
2nd joint	7T	nd	7T	7T	7T	nd
5th Limb						
Epipodite	16	16	15	14	15	15
Protopodite						
Gland	present	absent	present	absent	present	absent
Endite I	3V	3V	3V	nd	3V	?
Endite II	1M,3V	1M,3V	1M,3V	nd	1M,3V	?
Basale	1M,7V	1M,7V	1M,7V	nd	2M,7V	?
Endopodite	1M,9	1M,9	1M,9	nd	1M,8	?
Exopodite						
1st joint	2D,10	2D,9	2D,8–9	nd	2D,10	2D,?
2nd joint	1D,4V	1D,4V	1D,3V	1D,3V	1D,4V	1D,4V
3rd joint	3T	3T	3T	3T	3T	3T
6th Limb						
Epipodite	18	17	17	16	17	18
Precoxale	3	4	3–4	4	4	?
Coxale	5–6	4	4	5	5	?
Basale	1L,5V	1L,6V	1L,6V	1L,6V	1L,6V	?
Endopodite	5T	5T	5T	5T	4T	4T
Exopodite						
1st joint	3–4V	3V	2–3V	2–3V	4V	4V
2nd joint	1D,2V	1D,2V	1D,2V	1D,2V	1D,2V	1D,2V
3rd joint	3T	3T	3T	3T	3T	3T
7th Limb	3T	3T	3T	3T	3T	3T
Furca	8	8	7	7	8	8
Unpaired						
bristle	1	1	2	bifid	bifid	bifid
Bellonci organ	bifid	bifid	bifid	bifid	bifid	bifid
Genitalia						
Female spine	na	1	na	1	na	1
Male	bifid	na	bifid	na	bifid	na

Key to the Species of *Spelaeoecia*

1. Adult carapace longer than 2.25 mm . . . . . *S. capax*, new species  
 Adult carapace shorter than 1.90 mm . . . . . 2
2. Posterodorsal gland of right valve on protuberance, carapace shorter than 1.10 mm,  
 adult furca with 7 claws on each lamella, 1st antenna without ventral bristle on 3rd  
 joint . . . . . *S. styx*, new species  
 Posterodorsal gland of right valve not on protuberance; carapace longer than 1.35  
 mm; adult furca with 8 claws on each lamella, 1st antenna with or without ventral  
 bristle on 3rd joint . . . . . 3
3. 1st antenna with ventral bristles on 3rd and 4th joints . . . . . *S. bermudensis*  
 1st antenna without ventral bristles on 3rd and 4th joints . . . . . *S. sagax*, new species

*Spelaeoecia styx* Kornicker, new species

FIGURES 2-8

ETYMOLOGY.—From the Latin and Greek *Stryx* (river in the nether world).

MATERIAL.—El Dorado Cave, South Andros Island, Great Bahama Bank: USNM 193440, 1 adult male, appendages on 1 slide, carapace in alcohol (paratype); USNM 193441, 1 undissected adult male in alcohol (holotype); USNM 193442, 1 adult female, appendages on slide, carapace in alcohol (paratype).

DISTRIBUTION.—Known only from El Dorado Cave, South Andros Island.

DESCRIPTION OF ADULT MALE (Figures 2-6).—Carapace uncalcified, flexible, elongate, dorsal margin straight, ventral margin convex but fairly straight at midlength, anteroventral and posteroventral margins evenly rounded (Figure 2*a,d,g*); anterior incisur dorsal to midheight (Figure 2*a,f*); anterior of valve viewed from inside with edge of valve forming triangular rostrum (Figure 2*g*); edge of valve with slight sinuosity between anterior tip of rostrum and incisur (Figure 2*g*); anterior outer part of valve overreaching triangular rostrum to form broadly rounded extension of rostrum (Figure 2*g*). Posterodorsal corner of right valve with gland-bearing protuberance (Figure 2*d,e,g,i*).

*Ornamentation*: Surface with few long single bristles; small bristle at tip of protuberance in posterodorsal corner of right valve (Figure 2*e,g,i*). Surface appearing smooth, but at high resolution ( $\times 40$  objective,  $\times 15$  ocular, transmitted light) indistinct oblique striations observed on parts of valves (Figure 2*h*) (striations probably more distinct on living specimens). Edge of valve with 1 or 2 (usually 1) minute bristles between each pair of glandular tubes (Figure 2*j*).

*Infold* (Figure 2*g*): Broad infold except along hinge, narrower just posterior to inner end of incisur (Figure 2*g*); narrow list at about midwidth of infold extending from just ventral to incisur to posteroventral corner of valve; a 2nd list forming sclerotized bar just posterior to posterior hinge juncture, then extending ventrally as narrow ridge intersecting valve edge at posteroventral corner (Figure 2*g*).

*Glands*: Posterodorsal corner of right valve with protuber-

ance bearing along dorsal edge 5 or 6 minute glandular openings forming row just anterior to minute V-shaped indentation (detail in Figure 2*g*); small bristle at posterior corner of indentation. Left valve with minute glandular protuberance about halfway between posterior hinge juncture and posterodorsal corner of valve (Figure 2*c*). Outer edge of infold with minute tube-like glandular openings between point just ventral to incisur and posterior hinge juncture (USNM 193440 with about 18 tubes on each valve, mostly along anteroventral and ventral margins (Figure 2*j*), none observed along anterior edge of rostrum, and very few along posterior margin of valve).

*Selvage* (Figure 2*g,j*): Narrow bare lamellar prolongation extending from point just ventral to incisur to posterodorsal corner of each valve, not observed along either edge of rostrum or straight edge of valve between posterior hinge juncture and posterodorsal corner (on right valve prolongation not present dorsal to apex of glandular protuberance).

*Hingement*: Each valve with narrow sclerotized ridges forming bar between posterior juncture of hinge and posterodorsal corner of valve that may serve as locking structures when valves are closed (exact configuration of ridges difficult to resolve with light microscopes) (Figure 2*g*).

*Central Adductor Muscle Attachments* (Figure 2*a,b,g*): Difficult to determine exact number on specimens in collection, 3 of the scars on right valve of USNM 193440 shown in Figure 2*g*.

*Carapace Size*: USNM 193440, length 0.98 mm, height 0.55 mm; USNM 193441, length 0.98 mm, height 0.46 mm.

*First Antenna* (Figures 2*b, 3a,b*): With 8 joints but 3rd and 4th joints partly fused, boundary indicated by ventral and dorsal marginal indentations: 1st joint with terminal ventral lobe with numerous short spines; 2nd joint with short, indistinct, diaphanous, dorsal bristle, and distal medial spinules; 3rd joint bare, longer than 4th; 4th joint with short dorsal bristle with indistinct short marginal spines. 5th joint slightly shorter than 4th, with 1 or 2 long ventral unringed filaments. 6th joint shorter than 5th, bare. 7th joint about same length as combined 5th and 6th joints, with short spinous dorsal a-bristle, ventral b-bristle about  $\frac{2}{3}$  length of c-bristle, and long ventral c-bristle. 8th joint small with 4 terminal bristles (anterior



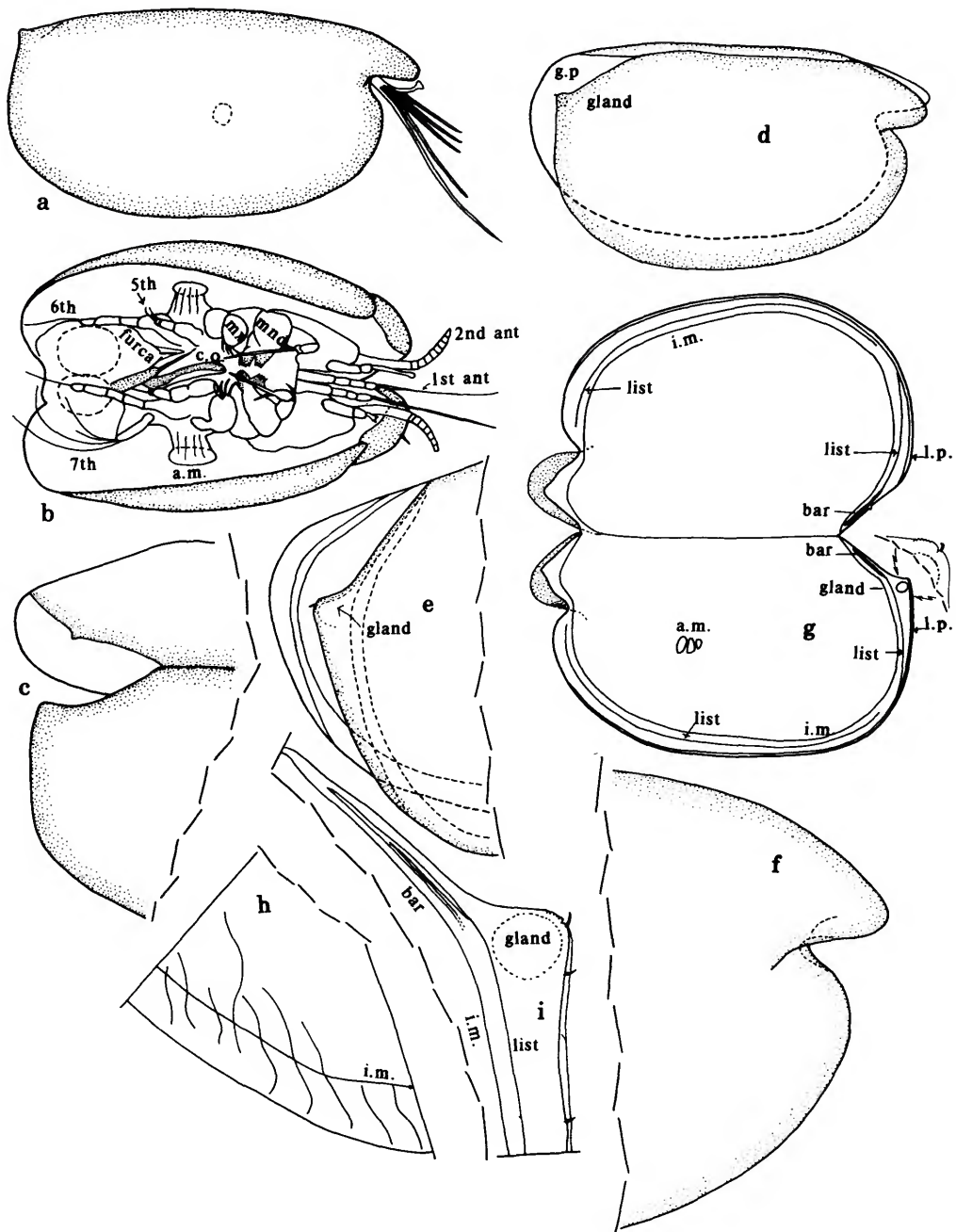


FIGURE 2.—*Spelaeoecia styx* Kornicker, new species, holotype, USNM 193441, adult male, length 0.98 mm: *a*, complete specimen from right side showing endopodite of right 2nd antenna projecting from incisor; *b*, ventral view of complete specimen with valves open (neither right 7th limb nor all sutures and bristles of other limbs shown); *c*, oblique dorsal view of posterior end of joined valves showing minute glandular protuberance of left valve. Paratype, USNM 193440, adult male, length 0.98 mm: *d*, joined valves from right side showing gland and protuberance of right valve; *e*, posterior end of joined valves from right side showing gland of right valve and infold (list and inner margin indicated) of both valves; *f*, anterior of right valve from outside; *g*, inside view of valves lying flat; *h*, posteroventral edge of left valve showing lineations present on outer surface of valve, and inner margin of infold; *i*, inside view of posterodorsal corner of right valve; *j*, inside view of valve margin near midlength of right valve showing 3 tube-like glandular openings along valve edge.



medial d-bristle about twice length of a-bristle; long lateral e-bristle about same length as c-bristle, stout with indistinct rings and few widely spaced minute marginal spines; medial, f-bristle narrow, about  $\frac{2}{3}$  length of e-bristle and oriented obliquely ventrally; and long, stout, g-bristle lateral to f-bristle and ventral to e-bristle, about  $\frac{3}{4}$  length of e-bristle). The b- to g-bristles with terminal papillae. (The diaphanous bristle on the dorsal margin of the 2nd joint could be easily overlooked; it appears spine-like with the  $\times 10$  and  $\times 20$  objectives, but is bristle-like with the  $\times 40$  and  $\times 100$  objectives using ordinary transmitted light).

*Second Antenna* (Figures 2b, 3c-g): Protopodite with small medial spines forming rows near ventral margin (Figure 3c). Endopodite 3-jointed (Figure 3e-g): 1st joint elongate, with a slender spinous a- and b-bristle; 2nd joint with 2 terminal bare f- and g-bristles with parallel sides and minute papilla at tip (g-bristle medial, stouter and longer than f-bristle and weakly ringed proximally), 1 minute lateral peg near base of f-bristle, and 1 slender, dorsal, spinous c-bristle; 3rd joint with equilength h-, i-, and j-bristles, all about half length of g-bristle, bare with parallel sides; clasper elongate, straight, with small sclerotized process at terminal dorsal edge and 2 small terminal spines, clasper of right limb more than twice length that of left. Exopodite with 9 joints (Figure 3d): 1st joint divided into long proximal and short distal parts (well-developed separation of parts evident along sclerotized ventral edge of joint but not along dorsal edge) with few spines near midlength, and long bristle with natatory hairs and ventral spines reaching well past 9th joint; bristle of 2nd joint with ventral spines (stouter than those on bristle of 1st joint) and natatory hairs; bristle of joints 3-7 with only natatory hairs; bristle of 8th joint with dorsal spines and natatory hairs; 9th joint with 4 terminal bristles (dorsal bristle about same length as combined lengths of joints 6-9 and with few indistinct spines; adjacent bristle about  $2\frac{1}{2}$  times longer and with dorsal spines; following bristle about 4 times longer and with dorsal spines; ventral bristle very long, with dorsal spines and natatory hairs); all long bristles of exopodite with 3 long proximal segments followed by closely spaced rings.

*Mandible* (Figures 2b, 4a-e): Coxale endite with proximal and distal sets of teeth separated by gap (Figure 4a-c): proximal set comprising 4 broad cusps plus small distal posterior triangular tooth; surface between cusps and just proximal to cusps with slender spines; 1 minute indistinct spinous bristle on corner just anterior to anterior cusp; 1 minute indistinct spinous bristle just posterior to posterior cusp; 3 spinous bristles adjacent to triangular tooth (exact number of bristles difficult to resolve, could be only 2); distal set of teeth comprising 2 flat teeth, each with 7 cusps; 1 stout curved spinous process and 1 minute bristle proximal to flat teeth. Basale (Figure 4d,e): distal edge with 5 terminal triangular cusps, 1 sharper triangular anterior cusp, and 1 small posterior cusp; lateral surface near distal edge with sharp tooth near midwidth; lateral surface distal to midlength with 2 minute and

4 longer bristles; anterior margin with 1 long bristle distal to midlength; posterior margin hirsute, with 2 distal bristles (proximal ringed in proximal  $\frac{3}{4}$  and with unringed pointed tip, distal tubular); proximal medial surface with transparent plumose bristle on hirsute protuberance, and 1 short bristle near endopodite; 2 transparent plumose bristles on or close to dorsal margin; lateral surface near insertion of endopodite with 1 long bare bristle. Endopodite (Figure 4d,e): 1st joint with 3 bristles (1 dorsal, 1 long and 1 short on or near ventral margin); 2nd joint widening distally, with 2 or 3 terminal dorsal bristles (1 stout, unringed, claw-like, with marginal spines, 1 short, ringed, bare, medial, 0 or 1 short, ringed, bare, lateral), and 1 long, ringed, terminal, ventral bristle; 3rd joint with 2 long stout claw-like spinous terminal bristles, 4 short ringed bristles forming medial row along terminal edge, and 1 longer ringed bristle on terminal lateral edge; anterior margin and medial surface of 3rd joint hirsute.

*Maxilla* (Figures 2b, 4f): Endite I with 10 bristles (3 tubular); endite II with 2 proximal and about 7 terminal bristles; endite III with 1 proximal and about 4 terminal bristles; some bristles on each endite stout, pectinate. Coxale and basale fused; coxale with long stout dorsal plumose bristle; basale with 1 long ventral bristle. Endopodite: 1st joint with 5 anterior bristles (4 at midlength, 1 distal), 2 distal posterior bristles, 2 lateral and 2 medial bristles; end joint with 2 stout claws and 5 slender ringed bristles (rings not shown).

*Fifth Limb* (Figures 2b, 5a-d): Epipodite with plumose bristles in 3 groups of 4, 6, and 5 (Figure 5d). Protopodite with lateral glandular process (Figure 5b,c), lateral spines, and 2 ventral endites: endite I with 3 bristles with long barbs; endite II with 1 proximal medial bristle and 3 ventral bristles (1 with long spines, 2 bare or with short spines). Basale with medial hairs and spinules, 1 long lateral anterior bristle with long spines, 1 proximal medial bristle, and 6 ventral bristles (2 tending to be claw-like, 1 with long proximal spines, 3 ringed, either bare or with short marginal spines). Endopodite with 1 proximal medial bristle (bare or with few short spines) and 9 additional bristles (1 short tooth-like medial, subventral bristle, 1 short lateral subventral bristle, 2 claw-like unringed ventral bristles, 3 ringed ventral bristles (either bare or with short spines, and 2 anterior long bristles with long spines); few indistinct minute spines near base of tooth-like bristle (not shown on illustration). Exopodite (Figure 5a,b): 1st joint: dorsal margin with 1 long subterminal bristle, and 1 plumose bristle with base on or near dorsal margin and proximal to subterminal bristle; ventral margin with weak suture at about midlength dividing joint into 2 parts: proximal part with 3 slender ventral bristles (bare or with short spines), 1 long plumose lateral bristle near ventral margin, and 1 short medial distal bristle near ventral margin (with short marginal spines); distal part with 1 or 2 subterminal ventral bristles and 2 distal plumose lateral bristles. 2nd joint: dorsal margin with 1 distal bristle; ventral margin with 3 slender bristles near midlength. 3rd joint with 2 stout, claw-like, unringed bristles, and 1 slender

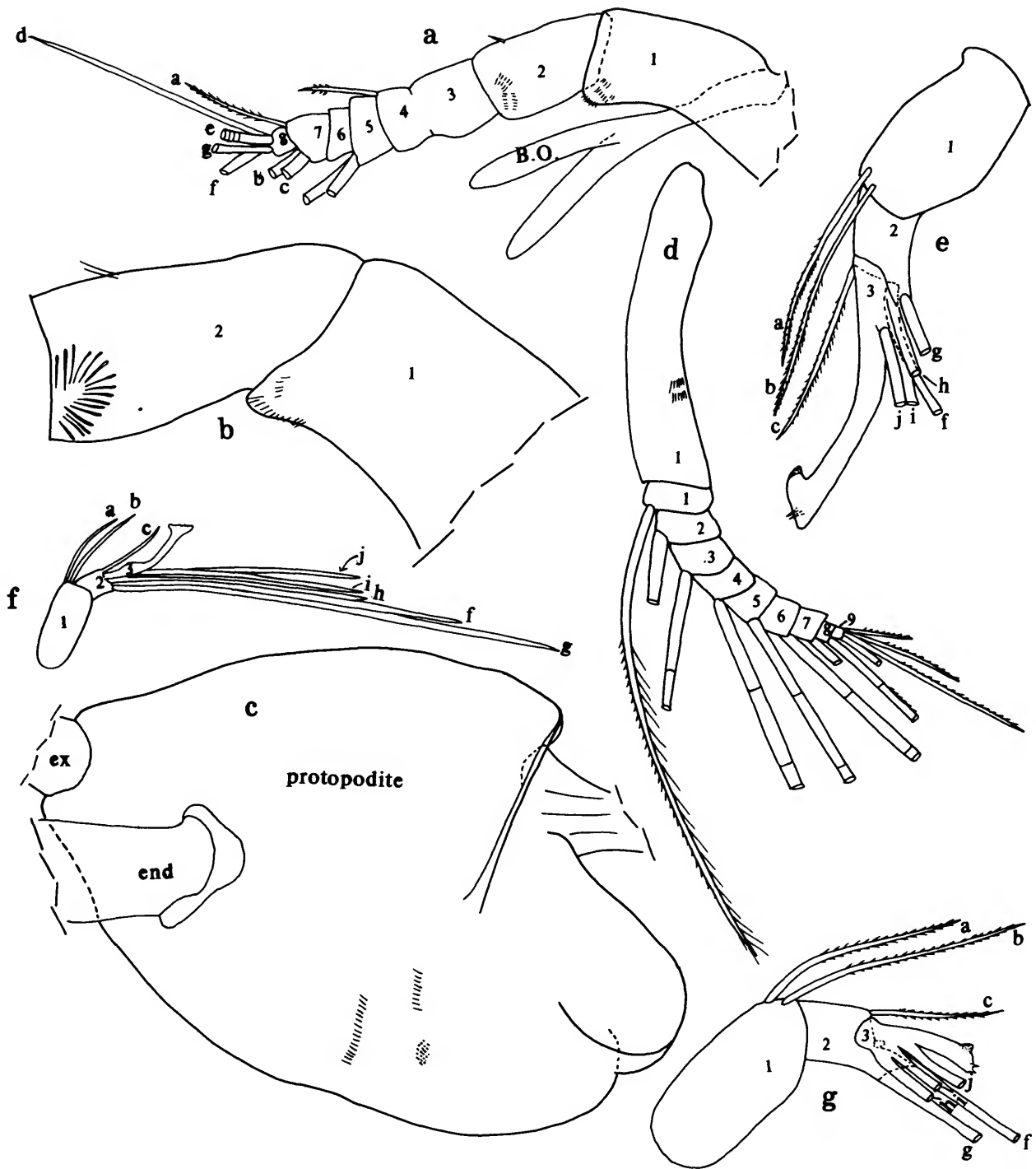


FIGURE 3.—*Spelaeocia styx* Kormicker, new species, paratype, USNM 193440, adult male, length 0.98 mm: *a*, left 1st antenna and Bellonci organ, lateral view; *b*, joints 1 and 2 of right 1st antenna, medial view; *c*, protopodite and proximal parts of endopodite and exopodite of right 2nd antenna, medial view; *d*, right exopodite of 2nd antenna, medial and lateral views; *e*, *f*, endopodite of right 2nd antenna, medial and lateral views; *g*, endopodite of left 2nd antenna, medial view.

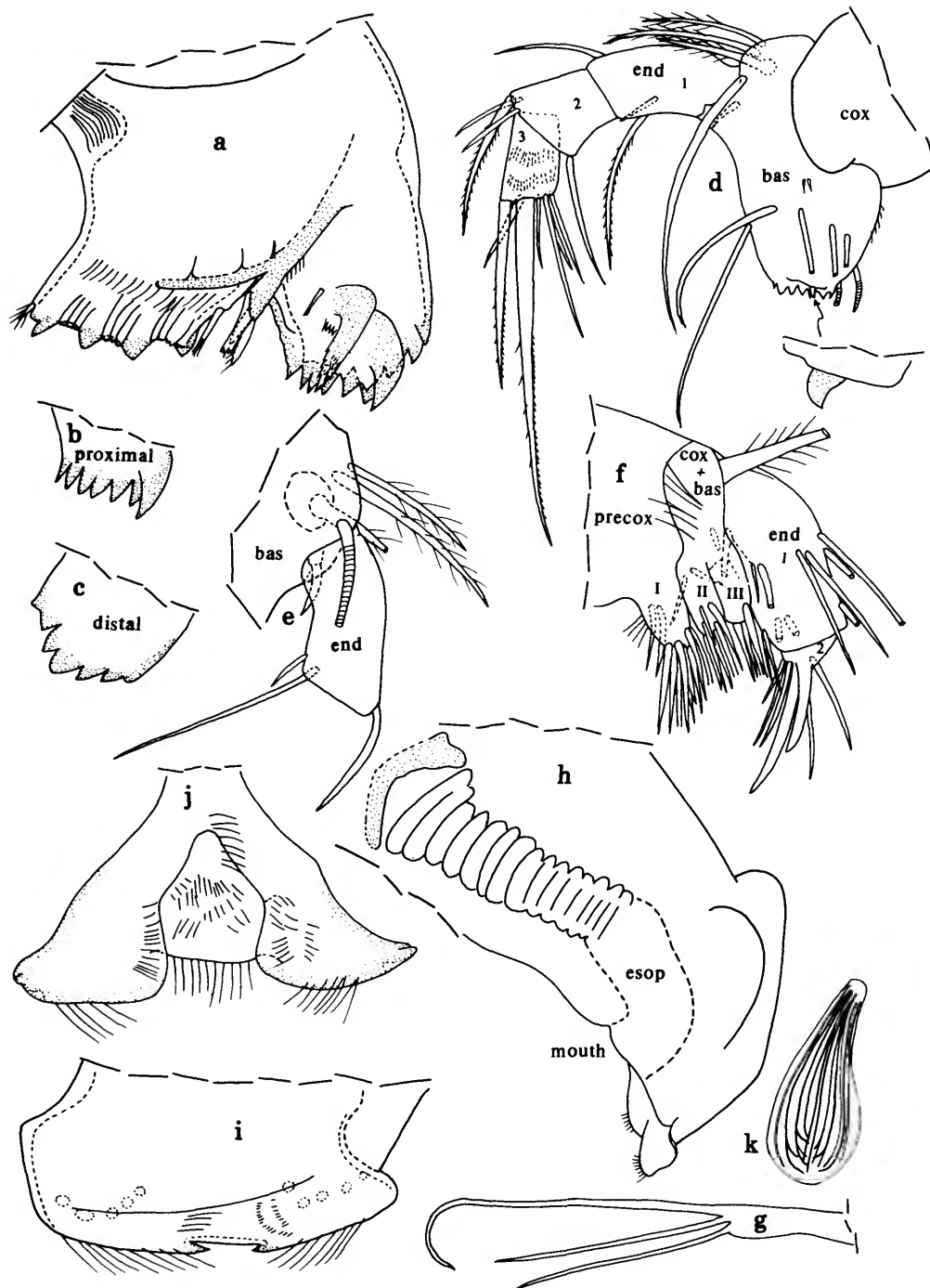


FIGURE 4.—*Spelaeoecia styx* Kornicker, new species, paratype, USNM 193440, adult male, length 0.98 mm: *a*, coxale endite of right mandible, medial view; *b, c*, proximal and distal flat teeth of distal set of teeth of coxale endite of mandible shown in *a*; *d*, left mandible (bristles of coxale not shown), lateral view; *e*, dorsal bristles of basale and 1st endopodial joint of right mandible, lateral view; *f*, maxilla; *g*, right 7th limb, lateral view; *h*, anterior of body from right side showing upper lip and esophagus; *i*, posterior edge of upper lip, ventral or dorsal view; *j*, lower lip under cover slip, anterior or posterior view; *k*, sperm cluster inside of body.

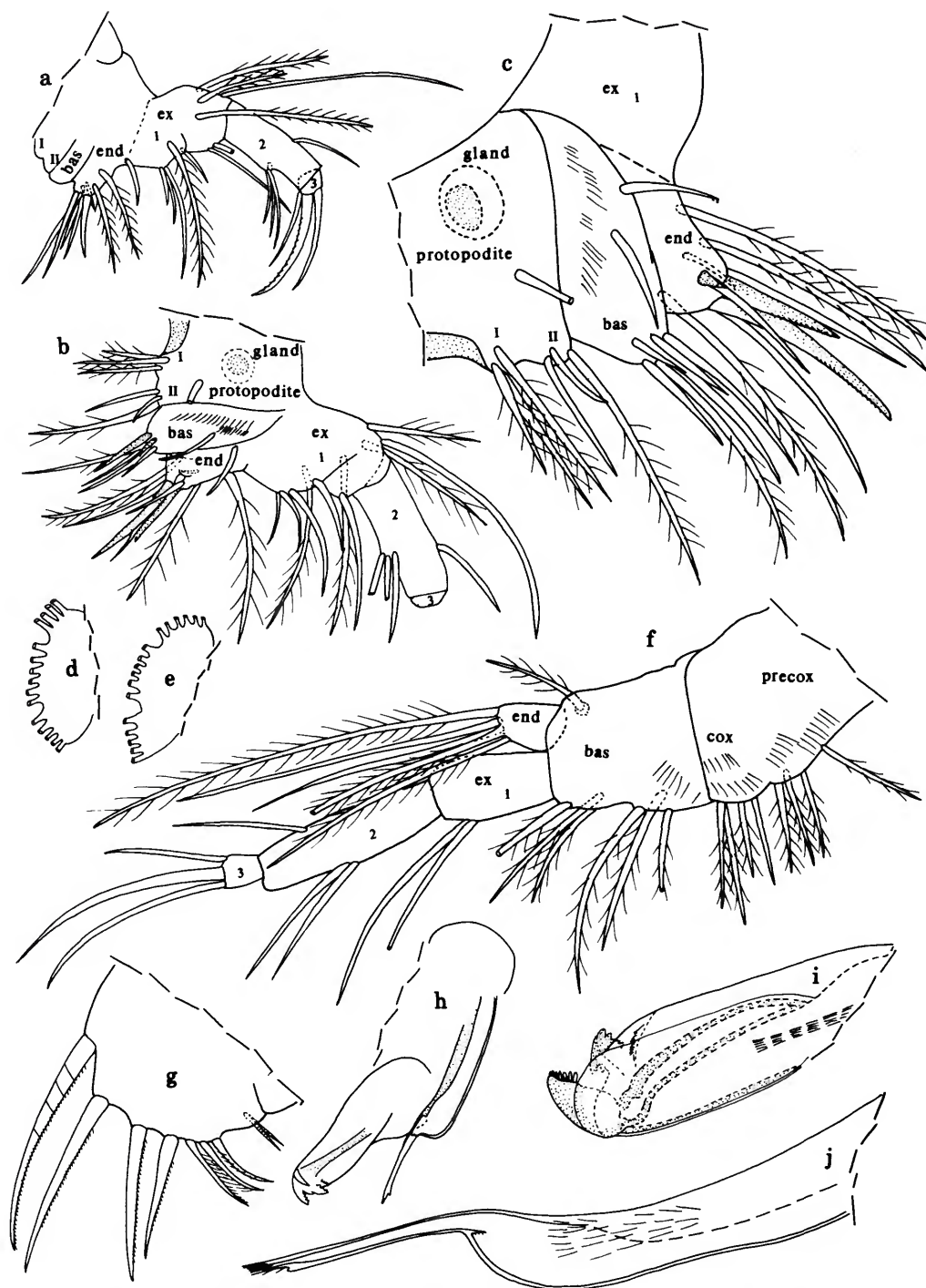


FIGURE 5.—*Spelaeoecia styx* Kornicker, new species, paratype, USNM 193440, adult male, length 0.98 mm: *a*, left 5th limb (not all bristles shown), lateral view; *b*, right fifth limb (bristles of 3rd endopodial joint not shown), medial view; *c*, proximal part of right fifth limb, medial view; *d,e*, epipodites of right 5th and 6th limbs (only proximal parts of epipodial bristles shown), lateral view; *f*, left 6th limb, medial view; *g*, left lamella of furca, lateral view; *h*, copulatory organ, lateral view; *i*, anterior branch of copulatory organ, medial view; *j*, posterior branch of copulatory organ, lateral view.



ringed ventral bristle; all bristles of 3rd joint bare. (Poulsen's (1969:12) interpretation of the protopodite, basale, and endopodite is followed in the above description of the 5th limb.)

**Sixth Limb** (Figures 2b, 5e,f): Epipodite with plumose bristles in 3 groups of 6, 6, and 5 (Figure 5e). Protopodite separated from basale by indistinct suture and divided ventrally by incision into 2 shallow lobes interpreted to be precoxale and coxale (Figure 5f): precoxale with 3 or 4 plumose bristles; coxale with 4 bristles (3 plumose, 1 bare). Basale with 7 plumose bristles (6 on or near ventral margin, 1 near distodorsal corner). Endopodite well developed, with 5 long bristles (3 plumose, 2 bare). Exopodite 3-jointed: 1st joint with 2 or 3 long bare ventral bristles; 2nd joint with 3 bare bristles (2 ventral, 1 dorsal); 3rd joint with 3 bristles (dorsal and middle bristles claw-like (middle claw may have minute spines distally on ventral edge, but their presence could not be resolved with certainty); dorsal and ventral bristles bare). Protopodite and 1st exopodial joint with medial hairs. (Terminology of segments is that suggested by Angel and Iliffe, 1987:551.)

**Seventh Limb** (Figures 2b, 4g): Elongate with 3 long terminal bristles.

**Furca** (Figures 2b, 5g): Each lamella with 7 claws, all with marginal spines, and basal sutures; claw 1 with 4 weakly developed sutures in proximal half; posterior end of furca with 2 closely spaced bristles in place of "unpaired" bristle. Apron anterior to furca short, just reaching proximal anterior edge of furca.

**Bellonci Organ** (Figure 3a): Elongate, bifurcating just distal to midlength, with rounded tips.

**Lips**: Upper lip projecting posteriorly, spinous, with inward pointing spine on each side of medial line (Figure 4h,i). Lower lip with triangular process on each side of mouth (Figure 4j).

**Copulatory Organ** (Figure 5h-j): Consisting of 2 parts on left side of body. Posterior rod-shaped organ with very long styliform process with hirsute tip (Figure 5j). Anterior part broad with 2 or 3 toothed prongs at tip (Figure 5i).

**Sperm Clusters** (Figures 4k, 6): USNM 193440 with about 17 pear-shaped sperm clusters near copulatory limbs, each cluster containing abundant thread-like filaments. (Müller (1894, pl. 38: fig. 32) illustrated similar clusters in a testis of *Conchoecia agassizii*.)

**Gut Content**: Gut of USNM 193440 with abundant thread-like filaments.

**DESCRIPTION OF ADULT FEMALE** (Figures 7, 8).—Shell decalcified and flexible, similar to that of adult male (Figure 7a).

**Size**: USNM 193442, length 0.82 mm, height 0.53 mm (because of film-like condition of decalcified shell, height dimension probably greater than when animal was alive).

**First Antenna** (Figure 7b): Both limbs with only 1 ventral filament on 5th joint; limb otherwise similar to that of adult male.

**Second Antenna** (Figure 7c-g): Protopodite bare. Endopodite

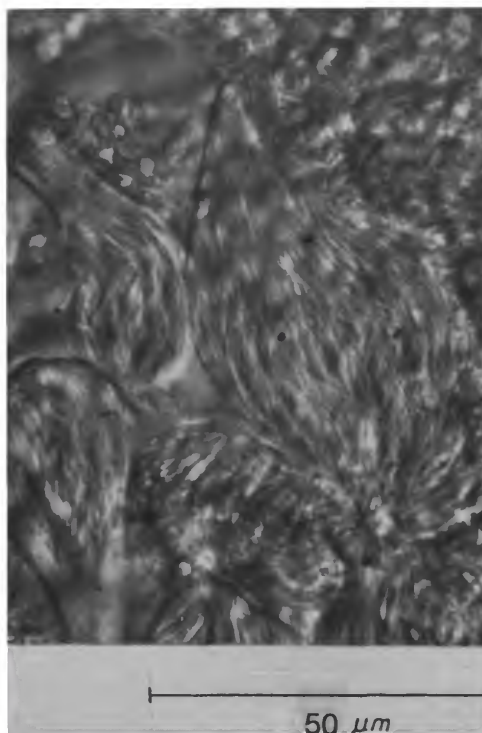


FIGURE 6.—*Spelaeoecia styx* Kornicker, new species, paratype, USNM 193440, adult male, length 0.98 mm: sperm clusters near copulatory limbs; note thread-like filaments within each cluster.

dite 3-jointed but 2nd and 3rd joints fused (Figure 7c-e); 1st joint with a slender a- and b-bristle; 2nd joint with stout f-bristle and shorter and more slender g-bristle (each with minute terminal papilla), and minute lateral peg near base of f-bristle (Figure 7e); 3rd joint with h-, i-, and j-bristles, each with terminal papilla; h-bristle with indistinct, minute, widely separated spines. Exopodite (Figure 7f,g): no spines observed on 1st joint, otherwise similar to that of adult male (as on adult male bristles of joints 1 and 2 with ventral spines in middle part, and bristle of 8th joint and 4 bristles of 9th joint with dorsal spines, and 1st joint divided into long proximal and short distal segments).

**Mandible** (Figure 7h,i): Similar to that of adult male.

**Maxilla** (Figure 7j,k): Not examined in detail but appearing similar to that of adult male.

**Fifth Limb**: Epipodite with bristles forming 3 groups, each with 4, 6, and 4 plumose bristles (Figure 7l). Protopodite without glandular process. Bristles of exopodial joints 2 and 3 similar to those of adult male. Bristles of protopodite and 1st exopodial joint not examined in detail but appearing similar to those of adult male.

**Sixth Limb** (Figure 7m,p): Epipodite with bristles forming 3 groups with 7 (6 long, 1 short and proximal), 5, and 4 or 5



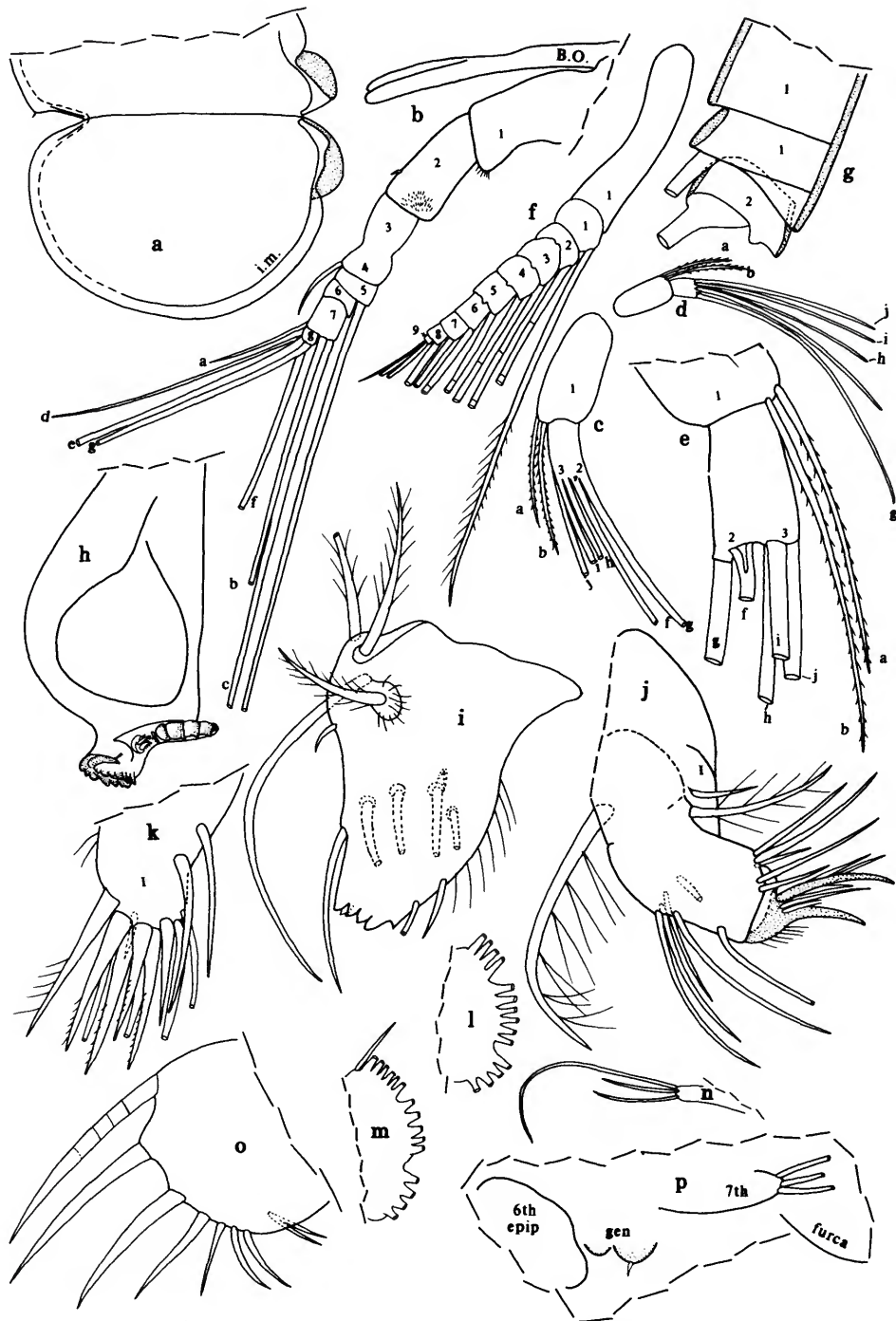


FIGURE 7.—*Spelaeoecia styx* Kornicker, new species, paratype, USNM 193442, adult female, length 0.82 mm: a, inside view of flattened valves; b, left 1st antenna and Bellonci organ, lateral view; c, endopodite of left 2nd antenna, lateral view; d, e, endopodite of right 2nd antenna, lateral view; f, exopodite of right 2nd antenna, medial view; g, joints 1 and 2 of exopodite of left 2nd antenna, medial view; h, distal end of coxale of left mandible (not under cover slip), medial view; i, basale of right mandible, medial view; j, maxilla (endites not shown); k, endite I of maxilla; l, m, epipodites of left 5th and 6th limbs, lateral view; n, right 7th limb, lateral view; o, left furcal lamella, lateral view; p, posterior part of left side of body (epipodial bristles of 6th joint not shown), lateral view.

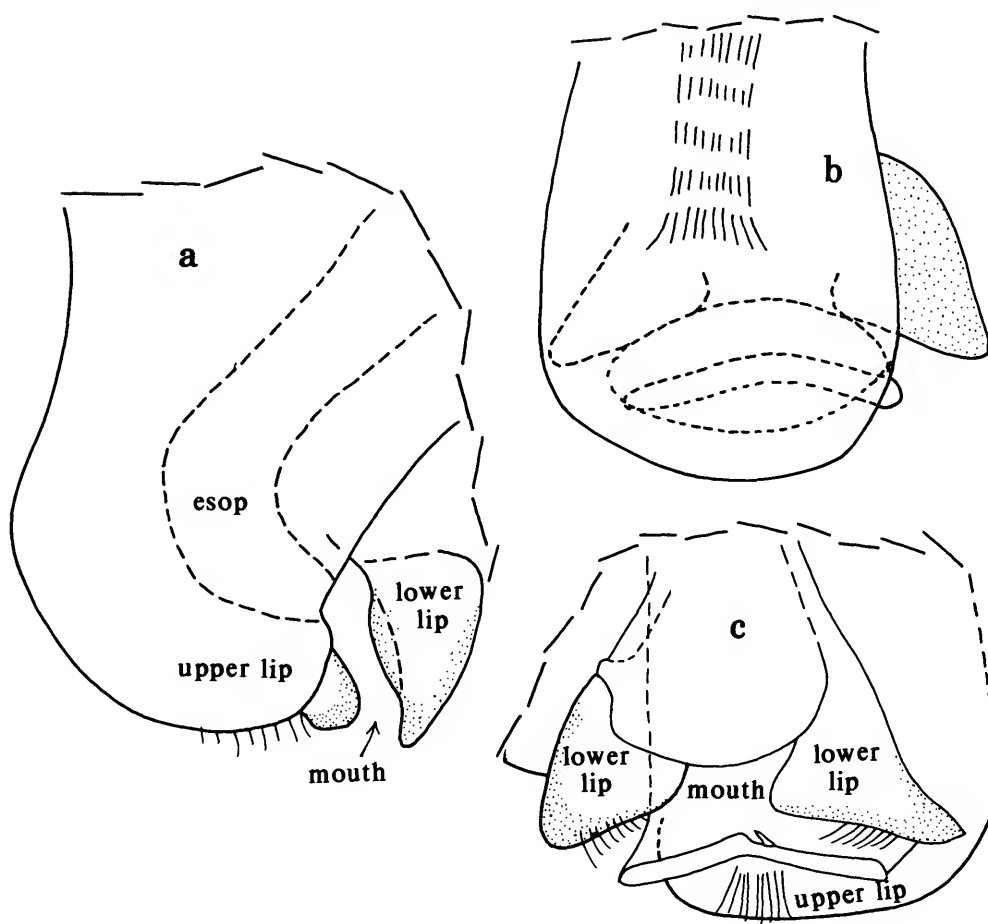


FIGURE 8.—*Spelaeoecia styx* Kornicker, new species, paratype, USNM 193442, adult female, length 0.82 mm, anterior of body showing lips, mouth and esophagus: a, lateral view from left side; b, anterior view, slightly oblique, left part of lower lip stippled, right part shown as dashed triangle; c, posterior view, slightly oblique.

plumose bristles (Figure 7m). Protopodite with 4 plumose bristles on precoxale and 5 on coxale. Remaining parts of limb similar to those of adult male.

**Seventh Limb** (Figure 7n,p): Similar to that of adult male.

**Furca** (Figure 7o): Similar to that of adult male except "unpaired" bristle bifurcate (not 2 separate bristles as on adult male).

**Bellonci Organ** (Figure 7b): Similar to that of adult male: tapering towards midlength then broadening and bifurcating, with broadly rounded tips and bare surface. Under oil immersion lens ( $\times 100$ ), suggestion of suture at midlength where organ narrowest.

**Lips** (Figure 8): Similar to those of adult male.

**Genitalia:** Small process bearing terminal spine present on left side of body between epipodite of 6th limb and proximal end of 7th limb in vicinity of receptaculum seminis, which was not visible (Figure 7p).

**Gut Content:** Gut gorged with many crustacean-like claws, but not otherwise identified. (The contents of the gut suggest that the species is either a carnivore or scavenger.)

**Maturity and Sex of Specimen:** Not known with certainty. Two oval masses containing globules, both inside the posterior part of the body, could be eggs. The furca of the specimen bears 7 claws on each lamella, the same number as on the adult male, which indicates the specimen is either the adult or A-1 stage. The absence of a copulatory limb, as well as the lack of a convex dorsal margin on the endopodite of the 2nd antenna, both present on the A-1 male *S. bermudensis* described by Kornicker and Iliffe (1989b), indicate that the specimen is not male. The carapace of the specimen is shorter than those of the 2 adult males in the collection (0.82 mm for specimen, 0.98 mm for 2 adult males). The specimen bears a small spined process on the left side of the body between the epipodial appendage of the 6th limb and the 7th limb (Figure 7p); a similar process was

found on the adult female *S. bermudensis* described by Kornicker and Iliffe (1989b), as well as on the adult female of *S. sagax*, new species, described herein. Because of the spined process, it is tentatively concluded that the specimen is an adult female.

**COMPARISONS.**—The carapace of *S. styx* differs from that of *S. bermudensis* in being smaller and in having the gland in the posterodorsal corner of the right valve on a small projecting process. The 1st antenna differs in not having ventral bristles on the 3rd and 4th joints; also, the dorsal bristle on the 2nd joint of *styx* differs from that of *bermudensis* in being diaphanous and shorter. The furca of *styx* differs from that of *bermudensis* in not having claw 2 on a stout protuberance. Known specimens of *bermudensis* have claw 2 of the furca broken off near its base, whereas all 3 specimens of *S. styx* in the present collection have claw 2 unbroken. Additional differences are listed in Table 3.

### *Spelaeocia sagax* Kornicker, new species

FIGURES 9–13

**ETYMOLOGY.**—From the Latin *sagax* (wise).

**MATERIAL.**—Sagittarius Cave, Sweeting's Cay, Grand Bahama Island, Little Bahama Bank. 25 Jul 1984: USNM 193448, 1 adult female in alcohol; USNM 193450A,B, 2 A-2 instars in alcohol; USNM 193450C, 16 specimens in alcohol (7 adult females, 6 adult males, 3 A-1 instars). 14 Dec 1984: USNM 193390, 16 specimens in alcohol. 8 Jun 1987 (from dark zone in salt water): USNM 193443, 1 adult male, appendages on 1 slide, some appendages and carapace in alcohol; USNM 193444, 1 adult female, appendages on 1 slide, some appendages and carapace in alcohol; USNM 193445A,B, 2 adult females in alcohol; USNM 193445D, 1 adult male in alcohol; USNM 193446 (holotype), 1 adult male in alcohol. 12 Sep 1987: USNM 193447A,B, 1 A-1 female and 1 adult female, both in alcohol. 17 Dec 1987: USNM 193690, 6 adult males plus 6 specimens in alcohol. All except holotype are paratypes.

**DISTRIBUTION.**—Known only from Sagittarius Cave.

**DESCRIPTION OF ADULT MALE** (Figures 9–11).—Carapace uncalcified, elongate; dorsal margin straight, ventral margin broadly convex; anterior incisure just dorsal to midheight (Figure 9a,c); in dorsal view carapace broadest near midlength (Figure 9d). Anterior of valve viewed from inside with edge of valve sinuate (Figure 9f); anterior outer part of valve broadly overreaching edge of valve and with rounded tip (Figure 9f); in lateral view posterodorsal corner of left valve more rounded than that of right (Figure 9g,h).

**Ornamentation.** Surface with few long single bristles; small dorsal bristle at posterodorsal corner of right valve near glands (Figure 9g). Surface with thin, slightly oblique striations (Figure 9e).

**Infold.** Broad except along hinge, narrower just posterior to inner end of incisure (Figure 9c,f); narrow list distal to

midwidth of infold extending from anteroventral corner of valve to point on ventral infold posterior to valve midlength (Figure 9c); 2nd list forming narrow bar posterior to posterior juncture of hinge, then extending ventrally as narrow ridge intersecting posterior edge of valve at midheight (Figure 9c,g,h).

**Glands:** Posterodorsal corner of right valve with about 5 minute glandular openings forming row on dorsal edge just anterior to minute V-shaped indentation and small bristle (Figure 9c,e,g). Outer edge of infold from point just ventral to incisure to posteroventral corner with about 20 minute broad tube-like glandular openings, mostly along anteroventral margin and anterior  $\frac{3}{4}$  of ventral margin; narrow pores in place of broad tubes along posterior  $\frac{1}{4}$  of ventral margin and posteroventral margin; 1 or 2 minute bristles generally between each pair of tube-like glandular openings and pores; bristles but no tubes or pores observed along posterior margin of valve dorsal to intersection of valve edge and ventral end of 2nd list (Figure 9g,h).

**Carapace Size:** USNM 193443, length 1.73 mm, height 0.83 mm. USNM 193445D, length 1.69 mm, height 0.77 mm; USNM 193446, length 1.67 mm, height 0.77 mm. USNM 193450C, 2 specimens, length 1.67 mm, height 0.78 mm; length 1.63 mm, height 0.75 mm.

**First Antenna** (Figure 10a): With 8 distinct joints. 1st joint with terminal ventral lobe with short spinules. 2nd joint with short distinct dorsal bristle with indistinct rings and minute distal spinules; medial surface with distal spinules. 3rd joint bare, separated from shorter 4th joint by distinct suture. 4th joint with bare dorsal bristle. 5th joint shorter than 4th, with dorsal spinules and long ventral filament with terminal papilla. 6th joint slightly shorter than 5th, with dorsal spinules. 7th joint longer than 5th, with short, ringed a-bristle with minute, widely separated, marginal spines, and long medial and ventral b-bristle, and longer ventral c-bristle (c-bristle with base ventral and lateral to b-bristle, both with minute, widely separated, marginal spines and terminal papilla). 8th joint small with narrow d-bristle about half length of stouter ringed e-bristle; e-bristle about same length as c-bristle, and f- and g-bristles about  $\frac{3}{4}$  length of e-bristle; all bristles with terminal papilla and minute, widely separated, marginal spines (those of e-bristle longer and stouter).

**Second Antenna** (Figures 9c,d, 10b,c): Protopodite bare (Figure 9c). Endopodite 3-jointed (Figure 10b,c): 1st joint elongate with a slender spinous a- and b-bristle (1 missing on right limb of USNM 193443, Figure 10c); 2nd joint with small lateral e-bristle near base of f-bristle (e-bristle not observed on left limb of USNM 193443, Figure 10b), and a terminal f- and g-bristle, each with terminal papilla (g-bristle medial to f-bristle, stouter and longer than f-bristle and weakly ringed proximally); 3rd joint with equilateral h-, i-, and j-bristles, all about half length of g-bristle, each with parallel sides and terminal papilla; clasper elongate, straight, with tip sclerotized on dorsal edge and 2 minute terminal spines; clasper of

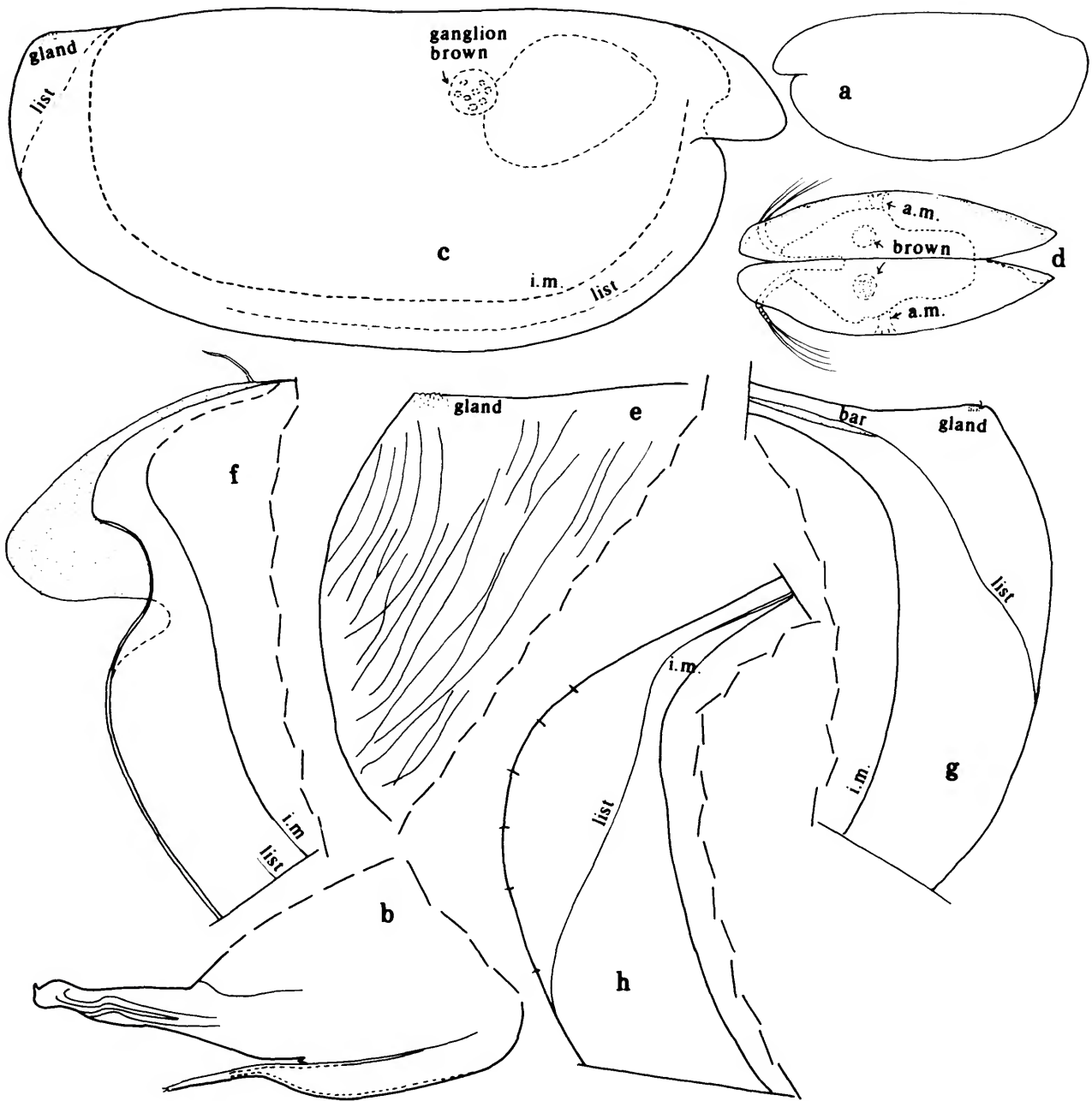


FIGURE 9.—*Spelaeoecia sagax* Kornicker, new species, holotype, USNM 193445D, adult male, length 1.69 mm: a, complete specimen from left side; b, copulatory organ as seen through left valve. Paratype, USNM 193443, adult male, length 1.73 mm: c, complete specimen from right side, dashed triangle in upper right outlines protopodite of right 2nd antenna; d, dorsal view of complete specimen showing protruding exopodites of the 2nd antennae, brown ganglia, and dashed outline of body; e, lineations on outer surface of posterior of right valve; f, inside view of anterior of right valve; g, inside view of posterior of right valve; h, inside view of posterior of left valve.





FIGURE 10.—*Spelaeoecia sagax* Kornicker, new species, paratype, USNM 193443, adult male, length 1.73 mm: *a*, anterior of body from left side showing 1st antenna (only proximal part shown of some bristles), Bellonci organ, anterior process at midheight, and basale of mandible; *b, c*, endopodites of left and right 2nd antennae, medial views; *d*, coxale endite of left mandible, medial posterior view; *e*, basale and endopodite of right mandible, lateral view; *f*, detail of basale in *e*; *g*, left 7th limb, lateral view; *h*, anterior of body from left side showing anterior process and upper lip; *i*, ventral view of anterior of body and upper lip; *j*, posterior view of mouth area (right lower lip not shown); *k*, anterior branch of copulatory organ, anterior to left; *l*, posterior branch of copulatory organ, anterior to right.



right limb more than twice length clasper of left limb. Exopodite with 9 joints; 1st joint divided into long proximal and short distal segments, with long terminal bristle (reaching well past 9th joint) with natatory hairs and ventral spines; bristle of 2nd joint with ventral spines and natatory hairs; bristles of joints 3–7 with only natatory hairs; bristles of 8th and 9th joints obscure on specimen examined.

**Mandible** (Figure 10a,d-f): Coxale endite similar to that of adult female described herein (Figure 10d) (right limb of USNM 193443 with only 1 bristle adjacent to tooth in space between proximal and distal sets of teeth; left limb with 2 as on adult female described herein (Figure 10d)). Basale (Figure 10a,e,f): teeth of distal edge and the 2 bristles of posterior margin similar to that of adult female described herein; lateral surface with stout tooth near midwidth of distal edge, and 6 bristles (3 reaching past distal edge, 2 shorter, 1 minute); anterior margin with 1 long bristle distal to midlength; proximal medial surface with plumose bristle on hirsute protuberance, 1 short bristle near endopodite; 2 plumose bristles on or near dorsal margin; lateral surface near insertion of endopodite with long bare bristle. Endopodite (Figure 10e): 1st joint with proximal concavity on ventral margin, and 3–4 bristles (1 long, stout, dorsal; 1–2 long and 1 short, usually on or near ventral margin, but long bristles may be medial and some distance from ventral margin). 2nd joint widening distally, with 2 terminal dorsal bristles (1 stout, unringed, claw-like, with marginal spines, 1 short, ringed, bare, medial), and 1 long, ringed, terminal, ventral bristle. 3rd joint with 2 long, stout, claw-like, spinous, terminal bristles (spines closely spaced on ventral margin, widely spaced on dorsal margin), 4 short ringed bristles forming medial row along terminal edge, and 1 longer ringed bristle on terminal lateral edge; medial surface and anterior margin of joint hirsute.

**Maxilla** (Figure 11a-c): Endites I and II each with 2 proximal and 10 terminal bristles; endite III with 1 proximal and 5 terminal bristles (3 claw-like). Coxale and basale fused; coxale with long stout plumose dorsal bristle; basale with 1 long ventral bristle and 1 long bristle at midwidth. Endopodite: 1st joint with 9–12 bristles; end joint with 2 stout claw-like bristles and 5 slender ringed bristles.

**Fifth Limb** (Figure 11d-f): Epipodite with bristles forming 3 groups (ventral group with 5 bristles, middle group with 6 bristles, dorsal group with 5 bristles (4 long, 1 short dorsal)). Protopodite with lateral glandular process, medial spines and hairs, and 2 ventral endites: endite I with 2 bristles with long spines and none or 1 tubular bristle with short spines; endite II with 1 proximal medial bristle with short spines and 3 ventral bristles (1 with long spines, 2 tubular and bare or with short spines (Figure 11d)). Basale (Figure 11f) with medial hairs and spines, 1 long lateral anterior bristle with long spines and 1 ventral endite with 1 proximal medial bristle with short marginal spines (pad of minute spines proximal to bristle), and 6 ventral bristles (2 claw-like, pectinate, 3 tubular either bare or with short spines, 1 with long spines). Endopodite with 1

proximal medial bristle with short spines, and 9 additional bristles (1 short tooth-like medial, subventral, 1 short lateral subventral, 2 claw-like unringed ventral, 1 long ventral with pointed tip, 2 tubular ventral either bare or with short spines, and 2 anterior, long with long spines (Figure 11e)). Exopodite (Figure 11d): 1st joint: dorsal margin with 1 long subterminal bristle and 1 plumose bristle; ventral margin divided into broad proximal and more slender distal parts: proximal part with 3 slender ventral bristles (bare or with short spines), 1 long plumose lateral bristle near ventral margin, and 1 fairly long medial bristle (with short spines) near ventral margin; distal part with 3 subterminal ventral bristles (bare or with short spines) and 2 distal lateral plumose bristles near midwidth of joint. 2nd exopodial joint: dorsal margin with 1 distal bristle; ventral margin with 4 slender bristles near midlength. 3rd joint with 2 stout claw-like, unringed bristles (both with ventral spines), and 1 slender, ringed, bare, ventral bristle.

**Sixth Limb** (Figure 11g): Epipodite with bristles forming 3 groups (dorsal group with 7 bristles (6 long, 1 short dorsal), middle group with 6 long, ventral group with 5 long). Protopodite separated from basale by indistinct suture and divided ventrally by small indentation into 2 parts interpreted to be precoxale and coxale: precoxale with 3 bristles (2 with long spinules, 1 with short spinules); coxale with 5–6 spinous bristles. Basale with 6 plumose bristles (5 on or near ventral margin, 1 distal, lateral, and near dorsal margin). Endopodite well developed, with 5 long bristles (3 plumose, 2 bare). Exopodite 3-jointed: 1st joint with 3 or 4 bare ventral bristles; 2nd joint with 3 bare bristles (2 ventral, 1 dorsal); 3rd joint with 3 bristles (dorsal and middle bristle claw-like; middle claw with indistinct minute ventral spines). Protopodite and basale with long medial hairs.

**Seventh Limb** (Figure 10g): Elongate with 3 terminal bristles (1 about twice length of others); indistinct marginal hairs visible at high magnification ( $\times 100$  objective,  $\times 15$  ocular).

**Furca** (Figure 11h): Each lamella with 8 claws with minute marginal teeth; claw 1 with 3 or 4 proximal transverse sutures; internal gland proximal to claw 2 leading to minute pore anterior to base of claw 2; single or bifid unpaired bristle at posterior end of furca. Apron anterior to furca short.

**Bellonci Organ** (Figure 10a): Elongate, with suture near midlength, bifurcating at about  $2/3$  length, each branch with rounded tip not reaching 3rd joint of 1st antenna.

**Lips** (Figure 10h-j): 2 small triangular processes (1 on each side) proximally on anterior margin (Figure 10h,i). Upper and lower lips similar to those of *S. styx*.

**Copulatory Organ** (Figures 9b, 10k,l): Posterior rod-shaped branch long slender styliform process with hirsute tip. Anterior branch broad with terminal sclerotized tooth-like process without marginal teeth.

DESCRIPTION OF ADULT FEMALE (Figures 12, 13a-c).—Carapace similar to that of adult male (Figure 12a-c).

**Carapace Size:** USNM 193444, length 1.77 mm, height

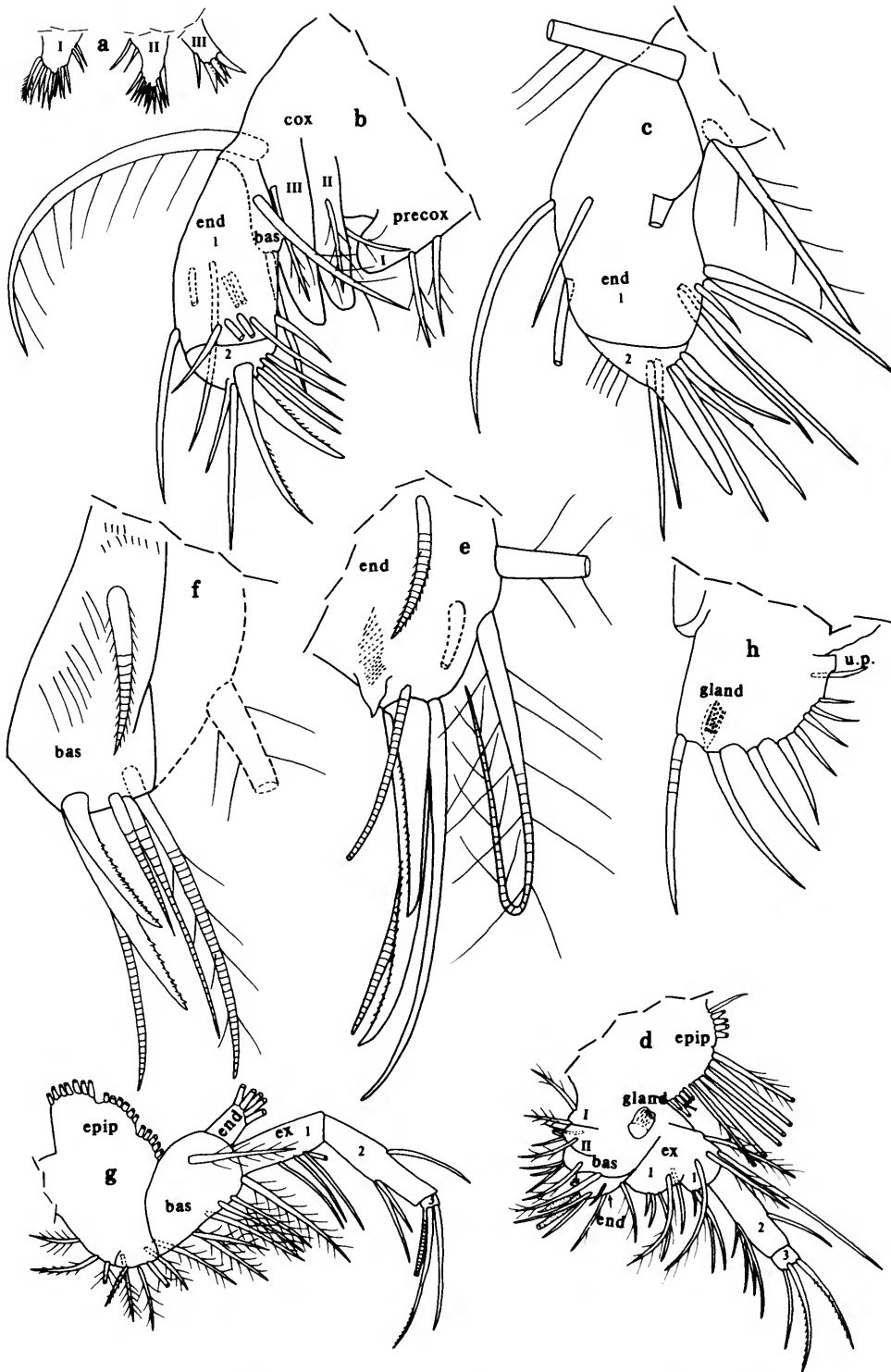


FIGURE 11.—*Spelaeoecia sagax* Kornicker, new species, paratype, USNM 193443, adult male, length 1.73 mm: a, endites of maxilla; b, c, maxillae; d, left 5th limb, lateral view (not all basale bristles shown); e, endopodite of right 5th limb, medial view; f, basale of right 5th limb, medial view; g, left 6th limb, lateral view; h, left lamella of furca, lateral view.

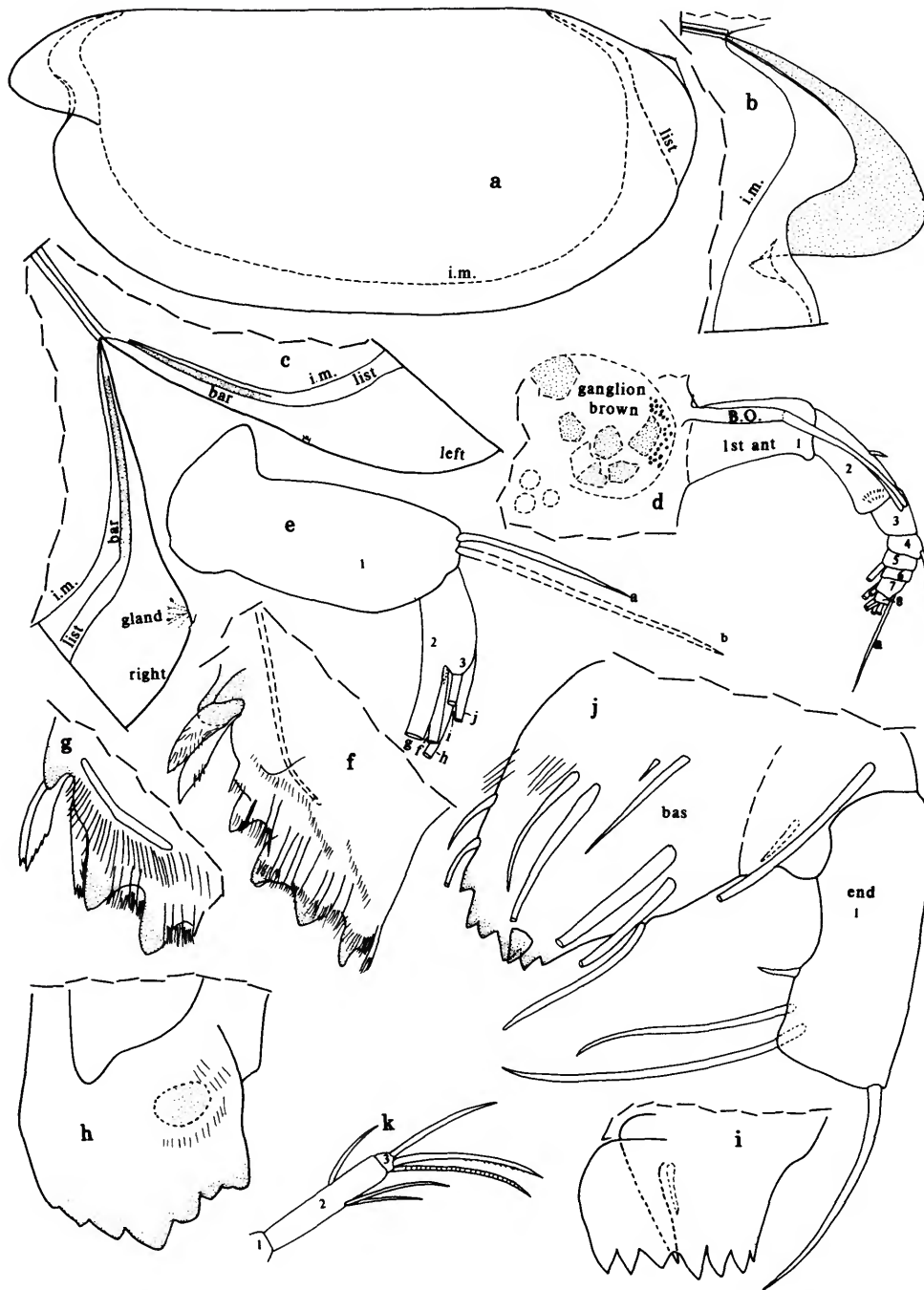


FIGURE 12.—*Spelaeoecia sagax* Kornicker, new species, paratype, USNM 193444, adult female, length 1.77 mm: a, complete specimen from left side; b, inside view of rostrum and incisor of left valve and small part of attached right valve at anterior juncture of hinge; c, inside view of posterior of flattened valves (bar stippled); d, anterodorsal part of body from right side (only proximal parts shown of some bristles of left 1st antenna); e, endopodite of left 2nd antenna, medial view (only proximal part shown of bristles of 2nd and 3rd joints); f, proximal tooth of coxale endite of right mandible, lateral view; g, posterior end of part of proximal tooth of coxale endite of left mandible, medial view; h, i, distal and proximal teeth of distal set of flat teeth of coxale endite of right mandible, lateral views; j, distal end of basale, and 1st endopodial joint of right mandible, lateral view; k, 2nd and 3rd exopodial joints of 5th limb.



0.80 mm. USNM 193445A,B, 2 specimens, length 1.76 mm, height 0.79 mm; length 1.75 mm, height 0.88 mm. USNM 193447B, length 1.73 mm, height 0.88 mm. USNM 193448, length 1.75 mm, height 0.84 mm.

*First Antenna* (Figure 12d): Similar to that of adult male.

*Second Antenna*: Protopodite and exopodite similar to those of adult male. Endopodite 3-jointed (Figure 12e): 1st joint elongate with a slender spinous a- and b-bristle; 2nd and 3rd joints fused; 2nd joint with 2 terminal f- and g-bristles, each with terminal papilla (g-bristle longer and stouter than f-bristle and weakly ringed proximally), 1 minute lateral bristle or peg near base of f-bristle; 3rd joint with equilength h-, i-, and j-bristles, all shorter than g-bristle.

*Mandible*: Coxale endite with proximal and distal sets of teeth separated by space (Figure 12f-i): proximal set comprising 4 broad cusps with anterior and posterior bristle and numerous spine bundles and individual spines (Figure 12f,g); stout tooth and 2 spinous bristles in space between sets of teeth; distal set of teeth comprising 2 flat teeth, each with 7 cusps (Figure 12h,i); 1 stout curved spinous process and 1 minute bristle proximal to flat teeth. Basale (Figure 12j): distal edge with 5 terminal triangular cusps, 1 sharper triangular anterior cusp, and 1 small posterior cusp; lateral surface near distal edge with sharp tooth near midwidth; lateral surface near midlength with 6 bristles (3 reaching past distal edge, 2 shorter, 1 minute); anterior margin with 1 long bristle distal to midlength; posterior margin hirsute, with 2 distal bristles (proximal with pointed tip, distal tubular); proximal medial surface with plumose bristle on hirsute protuberance, and 1 short bristle near endopodite; 1 plumose bristle near dorsal margin, and 1 long lateral bristle near insertion of endopodite. Endopodite (Figure 12j): 1st joint with proximal concavity on ventral margin, 1 terminal dorsal bristle, 1 short ventral bristle distal to midlength, and 1 or 2 long distal medial bristles near ventral margin (1 of the long bristles may be at joint midwidth); 2nd joint widening distally, with 3 terminal dorsal bristles (1 stout, unringed, claw-like, spinous, 1 short medial, 1 short lateral), and 1 long, ringed, terminal, ventral bristle; 3rd joint with 2 long stout claw-like spinous terminal bristles, 4 short ringed bristles forming medial row along terminal edge, and 1 longer ringed bristle on terminal lateral edge; anterior margin and medial surface of 3rd joint hirsute.

*Maxilla*: Similar to that of adult male.

*Fifth Limb*: Similar in size and armature to that of adult male. Epipodite: dorsal group with 5 bristles (1 short dorsal, 4 long); middle group with 6 long bristles; ventral group with 5 long bristles. Protopodite with medial spines and hairs, and 2 ventral endites: endite I with 3 bristles (2 long with long spines, 1 short bare); endite II with 1 proximal medial bristle with short spines and 3 ventral bristles (1 with long spines, 2 with short spines). Basale: with medial hairs and spines, 1 long lateral anterior bristle with long spines, and 1 ventral endite with 1 proximal medial bristle with short spines, and 6 ventral bristles (2 claw-like pectinate, 3 ringed either bare or with short

spines, 1 with long spines). Endopodite with 1 proximal medial bristle with short spines, and 9 additional bristles (1 short, tooth-like, medial, subventral (pad of minute spines proximal to bristle), 1 short lateral subventral; 2 claw-like unringed pectinate ventral, 3 ringed ventral either bare or with short spines, 2 anterior long with long spines). Exopodite (Figure 12k): 1st joint: dorsal margin with 1 long terminal bristle and 1 plumose bristle with base just distal to midlength of margin; ventral margin divided into broad proximal and more slender distal parts: proximal part with few minute distal medial spines, 2 slender ventral bristles (bare or with short spines), 1 long plumose lateral bristle near ventral margin, and 1 fairly long medial bristle (with short spines) near ventral margin; distal part with 3 subterminal ventral or subventral bristles (bare or with short spines) and 2 distal lateral plumose bristles. 2nd exopodial joint: dorsal margin with 1 distal bare bristle; ventral margin with 4 bare bristles near midlength. 3rd exopodial joint with 2 stout claw-like unringed bristles, and 1 slender, ringed, bare, ventral bristle.

*Sixth Limb*: Limb similar in size to that of adult male. Epipodite (Figure 13b): bristles of dorsal group fragmented but with at least 6 bristles; middle group with 6 long bristles, ventral group with 5 long bristles. Protopodite hirsute, proximal and distal parts (separated by distinct suture on 1 side) interpreted to be precoxale and coxale: precoxale with 4 bristles with long spines (3 ventral, 1 anterior that could be interpreted to be on distal part); coxale with 4 bristles (with long marginal hairs or spines) on or near ventral margin (anterior of hairy bristles could be interpreted to be on basale). Basale with indistinct spines and 7 plumose bristles (6 on or near ventral margin, 1 distal, lateral, and near dorsal margin). Endopodite well developed, with 5 long bristles (3 plumose, 2 bare); Exopodite 3-jointed: 1st joint with distal spines and 3 bare ventral bristles; 2nd joint with 3 bare bristles (2 ventral, 1 dorsal); 3rd joint with 3 bristles (dorsal and middle bristle claw-like; middle claw with indistinct ventral spines).

*Seventh Limb* (Figure 13b), *Furca and Apron* (Figure 13a,c), *Lips*: Similar to those of adult male.

*Bellonci Organ* (Figure 12d): Longer than that of male, reaching 3rd joint of 1st antenna.

*Genitalia* (Figure 13b): Small process bearing terminal spine present on left side of body near receptaculum seminis (receptaculum seminis not seen) between epipodite of 6th limb and proximal end of 7th limb.

*Ganglion* (Figure 12d): Dark brown ganglion present in head region proximal to 1st antenna. (Ganglion is term used by Müller (1894, pl. 3: fig. 17).)

*Gut Content*: Gut of USNM 193444 with tubular fragments similar to those in the female gut and also unidentified brown particles.

DESCRIPTION OF A-2 INSTAR (SEX UNKNOWN) (Figure 13d-f).—Carapace similar in shape to that of adult (Figure 13d).

*Infold*: Except for absence of anteroventral and ventral list,

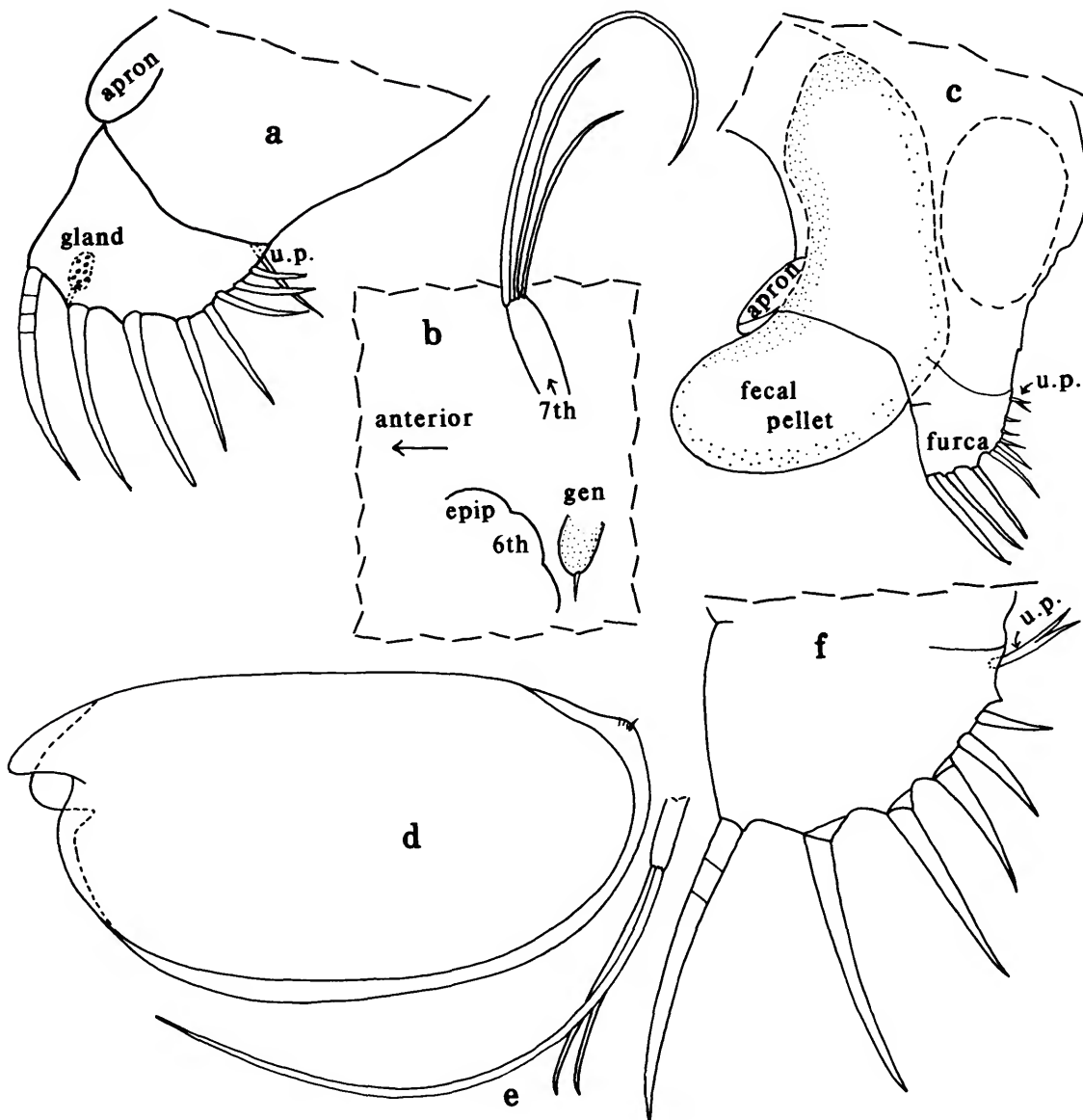


FIGURE 13.—*Spelaeoecia sagax* Kornicker, new species, paratype, USNM 193444, adult female, length 1.77 mm: a, left lamella of furca, lateral view; b, part of posterior of body (bristles of epipodite of 6th limb not shown). Paratype, USNM 193448, adult female, length 1.75 mm: c, posterior of body showing large fecal pellet protruding from anus. Paratype, USNM 193450A, A-2 instar, length 1.04 mm: d, complete specimen from left side; e, left 7th limb, lateral view; f, left lamella of furca, lateral view.

infold similar to that of adult.

**Glands:** Right valve with posterodorsal gland as on adult. Short tube-like glandular openings along ventral margin similar to those of adult.

**Carapace Size:** USNM 193450A, length 1.04 mm, height 0.53 mm; USNM 193450B, length 1.05 mm, height 0.44 mm.

**First Antenna:** Distribution of bristles similar to those of adult.

**Second Antenna:** Protopodite and endopodite similar to those of adult female, but presence of small bristle (or peg) at base of f-bristle as on endopodite of adult female not determined. Exopodite similar to that of adult but number of



bristles on 9th joint not determined.

**Mandible:** Endopodite: 1st joint with 1 terminal dorsal bristle and 1 distal medial bristle near midwidth of joint, and possibly other bristles; 2nd and 3rd joints with bristles as on adult. Coxale and basale not examined in detail but general morphology similar to that of adult.

**Maxilla:** Not examined in detail but similar type as on adult.

**Fifth and Sixth Limbs:** End joint of exopodite with 3 bristles as on adult. 6th limb longer than 5th. Remaining parts of appendages not examined in detail but general morphology similar to that of adult.

**Seventh Limb** (Figure 13e): Well developed, similar to that of adult.

**Furca** (Figure 13f): Each lamella with 6 claws; small triangular process following claw 6. Unpaired bristle bifid on USNM 193450A, single on USNM 193450B.

**Bellonci Organ:** Bifurcating as on adult; rounded tips not reaching 3rd joint of 1st antenna.

DESCRIPTION OF A-1 FEMALE.—Except for absence of anteroventral and ventral list, carapace similar to that of adult female.

**Carapace Size:** USNM 193447A, length 1.38 mm, height 0.68 mm.

**First Antenna:** Similar to that of adult female.

**Second Antenna:** Protopodite and exopodite similar to those of adult female. Endopodite with same number and distribution of a-, b-, f-, i-, and j-bristles (presence of small bristle (or peg) lateral to f-bristle as on adult female not determined).

**Mandible:** Bristles of 2nd and 3rd endopodial joint similar to those of adult female. Remaining joints not examined in detail.

**Maxilla:** Not examined in detail but of similar type to that of adult female.

**Fifth limb:** Bristles of 2nd and 3rd exopodial joints similar to those of adult female. Remaining joints not examined in detail.

**Sixth Limb:** Bristles of endopodite and 2nd and 3rd exopodial joints similar to those of adult female. Remaining joints not examined in detail.

**Seventh Limb:** Similar to that of adult female.

**Furca:** Each lamella with 7 claws; left but not right lamella of USNM 193447A with small process with rounded tip following claw 7. Unpaired bristle single or bifid.

**Bellonci Organ:** Bifurcate as on adult female, but relative length not determined (organ folded on specimen examined).

**Genitalia:** Spine-bearing process like that on left side of adult female absent.

VARIABILITY OF UNPAIRED BRISTLE OF FURCA.—The distribution of bifid and single unpaired bristles on 12 specimens of *S. sagax* is 4 single and 8 bifid.

Specimen	Single	Bifid
Adult female (USNM 193444)	+	
Adult female (USNM 193445B)		+
Adult female (USNM 193445A)		+
Adult female (USNM 193447B)		+
Adult female (USNM 193448)		+
Adult male (USNM 193443)	+	
Adult male (USNM 193445D)	+	
Adult male (USNM 193446)		+
A-1 female (USNM 193447A)		+
A-1 instar (USNM 193450C)		+
A-2 instar (USNM 193450A)		+
A-2 instar (USNM 193450B)	+	

COMPARISONS.—The 1st antenna of *S. sagax* differs from that of *S. bermudensis* in having a shorter dorsal bristle on the 2nd joint and no ventral bristles on the 3rd and 4th joints. The short dorsal bristle on the 2nd joint of the 1st antenna of *S. sagax* is well defined, not diaphanous as on *S. styx*. The basale of the mandible of *S. sagax* differs from that of *S. styx* in having 1 instead of 2 minute lateral bristles. The posterodorsal shell gland of *S. sagax* is not on a process projecting well above the dorsal shell edge as on *S. styx*. The carapace of *S. sagax* is much larger than that of *S. styx* (male *S. sagax* length 1.63–1.73 mm, male *S. styx* length 0.98 mm). The adult *S. sagax* bears 8 furcal claws compared to 7 on *S. styx*. The 2nd furcal claw is unbroken on both *S. sagax* and *S. styx*, but is broken on known specimens of *S. bermudensis*. The tip of the anterior lobe of the copulatory organ of the male *S. sagax* is without the numerous teeth on that of *S. styx* and without the large foot-like process on the organ of *S. bermudensis* (Kornicker, 1989). The unpaired bristle posterior to the furca of both *S. bermudensis* and *S. styx* is bifid, whereas *S. sagax* has either simple or bifid bristles, but the latter about twice as often.

DISCUSSION OF VENTRAL APRON.—Angel and Iliffe (1987:617) designated a curving shield anterior to both the anus and leading edge of the furca as the "apron." Apparently when fecal pellets are extruded from the anus the apron is pushed away from the furca (Figure 13a,c). The apron protects the anus when a fecal pellet is not being extruded, and probably helps prevent feces from fouling appendages anterior to the apron. The apron is present on all known species of the genera *Spelaeoecia* and *Deeveya*.

#### *Spelaeoecia capax* Kornicker, new species

FIGURE 14

ETYMOLOGY.—From the Latin *capax* (spacious) in reference to large size of the species.

MATERIAL.—Alfonso Dean Blue Hole, Long Island, Great Bahama Bank, 3 Aug 1985, USNM 193449, 1 carapace (holotype).

DISTRIBUTION.—Known only from Alfonso Dean Blue Hole.

REMARKS.—The senior author received 2 specimens of which the smaller was lost along with the body, but not the

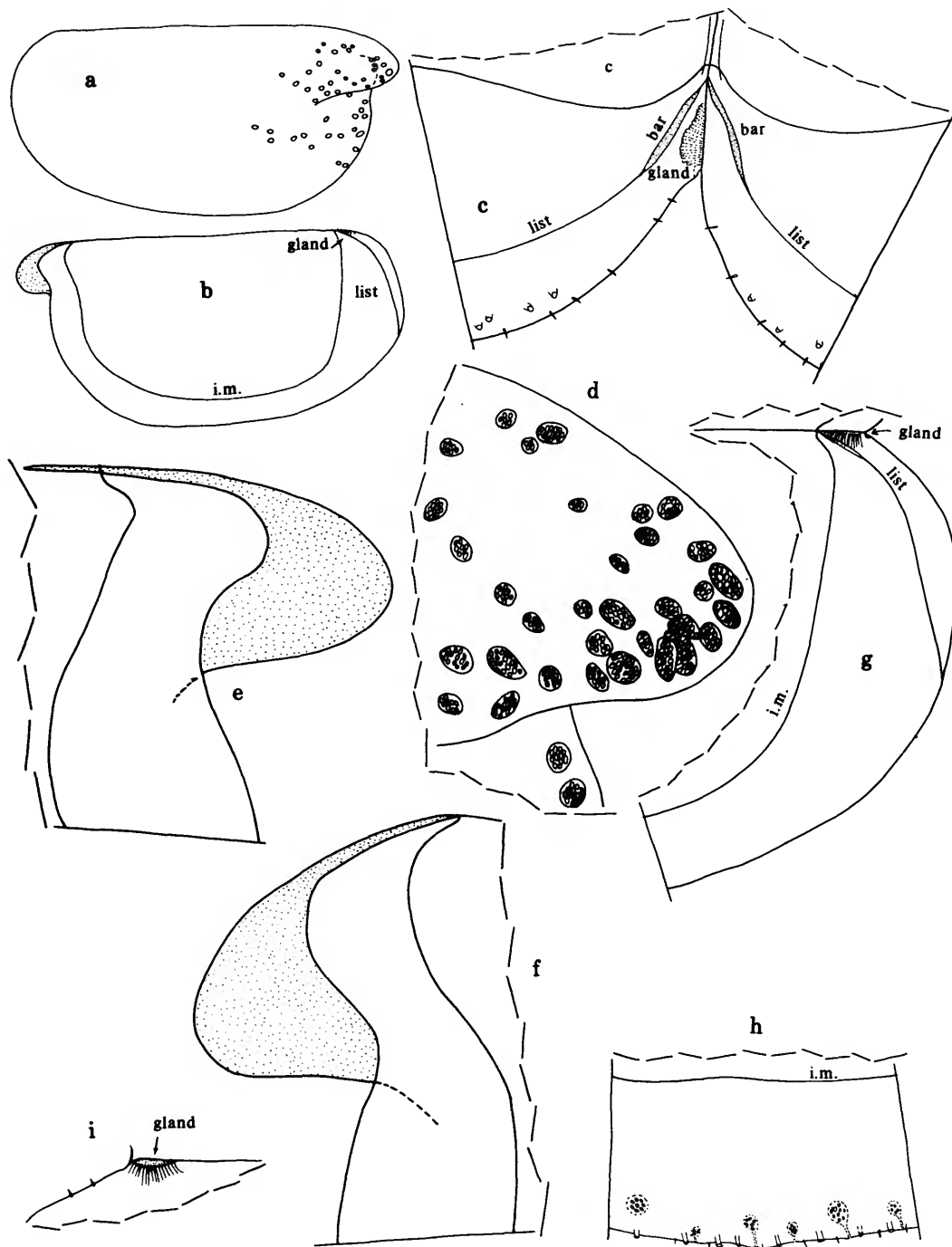


FIGURE 14.—*Spelaeoecia capax* Kornicker, new species, holotype, USNM 193449, sex unknown, length 2.49 mm: a, complete specimen from right side showing glands (not all marginal glands shown); b, inside view of right valve; c, inside view of posterior part of flattened valves; d, outside view of rostrum of right valve showing glands; e, inside view of anterior of left valve, outside surface of shell stippled; f, inside view of rostrum of left valve, outer surface of shell stippled; g, inside view of inside of posterior of right valve with small part of left valve attached; h, inside view of part of ventral margin of right valve showing marginal glands and ducts leading to pores; i, outside view of posterodorsal gland of right valve.

carapace, of the other. Additional specimens are not available, nor are additional collections planned by the junior authors. Therefore, the carapace of the specimen is described herein. Because the morphology of the carapace clearly shows it to belong to an undescribed species, and because the locality where it lives is confined, and so additional specimens should eventually be collected, the species is named rather than left in open nomenclature. Before the specimens were lost they were identified as a species of *Spelaeoecia*.

**DESCRIPTION** (Figure 14).—Carapace uncalcified, flexible, elongate; dorsal margin straight, ventral margin broadly convex; anterior incisur dorsal to midheight (Figure 14a,b). Anterior of valve viewed from inside with edge of valve slightly sinuate (Figure 14e,f); anterior outer part of rostrum broadly overreaching edge of valve and with rounded tip (Figure 14e,f); in lateral view posterodorsal corner of each valve evenly rounded (Figure 14a-c).

**Ornamentation:** Surface with fairly long bristles forming row just within valve edge, and minute bristles along valve edge. Surface with thin, slightly oblique striations.

**Infold:** Broad infold especially along shell posterior. Narrow posterior list forming narrow bar posterior to posterior juncture of hinge, then extending ventrally as narrow ridge intersecting valve edge at posteroventral corner (Figure 14b,c,g). (Anteroventral and ventral list present on previously described species of the genus not present, but that list tends to be less well developed or absent in juveniles, and possibly explains its absence in *S. capax*.)

**Glands:** Posteroventral corner of right valve with numerous minute glandular openings, many more than on previously described species of *Spelaeoecia*, but exact number could not be determined because of their small size (Figure 14c,g,i). Distinct amber cell clusters in anterior part of shell and along margins, each cluster with duct leading to small external pore (Figure 14a,d,h) (ducts leading from marginal clusters to valve edge

easily visible (Figure 14h), but more difficult to see away from valve edge).

**Carapace Size:** USNM 193449, length 2.49 mm, height 1.27 mm.

**COMPARISONS.**—The carapace of *S. capax* is much larger than those of known species (maximum length in mm: *S. capax* 2.49, *S. bermudensis* 1.64; *S. styx* 0.98; *S. sagax* 1.77). The posterior infold is much broader in *S. capax* than in other species. The large glandular clusters in the anterior part of each valve of *S. capax* are not present on previously described species. The gland at the posterodorsal corner of the right valve of *S. capax* has many more pores than in other species.

**Deeveya Kornicker and Iliffe, 1985**

*Deeveya* Kornicker and Iliffe, 1985:476.

**TYPE SPECIES.**—*Deeveya spiralis* Kornicker and Iliffe, 1985:476.

**COMPOSITION** (Table 1).—Including the 3 new species described herein, the genus comprises 6 species from marine caves in the Bahamas (including the Turks and Caicos Islands): *D. spiralis* from the Turks and Caicos Islands, *D. bransoni* from South Andros Island, *D. jillae* from Eleuthera Island, *D. styrax* from Abaco Island and Grand Bahama Island, *D. hirpex* from Abaco Island, and *D. medix* from Grand Bahama Island.

**EMENDED DIAGNOSIS.**—Intended to supplement characteristics mentioned by Kornicker and Iliffe (1985:476). 1st antenna: 1st and 6th joints without bristles. 2nd antenna (male): endopodite without clasper (similar to that of female); 1st exopodial joint with short bristle. 6th limb: single joint of endopodite with 4 bristles. Adult furca with 7 claws on each lamella. Copulatory organ of male with 2 branches; posterior branch with blunt rounded tip. Selected characters of species of *Deeveya* are compared in Table 4.

**Key to the Species of *Deeveya***

1. Adult carapace longer than 2.5 mm . . . . . 2  
    Adult carapace shorter than 2.5 mm . . . . . 3
2. Anterior margin of carapace with unbranched bristles; width of distal end of 3rd joint of 1st antenna about 1/4 length of dorsal margin of joint; terminal joint of 5th limb with 4 bristles . . . . . *D. styrax*, new species  
    Anterior margin of carapace with bifurcate bristles; width of distal end of 3rd joint of 1st antenna more than 1/3 length of dorsal margin of joint; terminal joint of 5th limb with 5 bristles . . . . . *D. spiralis*
3. Adult carapace longer than 2 mm . . . . . *D. hirpex*, new species  
    Adult carapace shorter than 2 mm . . . . . 4
4. Carapace when viewed with transmitted light with disks at intersections of reticule not wider than reticulations [Figure 29b] . . . . . *D. bransoni*  
    Carapace when viewed with transmitted light with disks at intersections of reticule much wider than reticulations [Figure 29d,f] . . . . . 5
5. Width of distal end of 3rd joint of 1st antenna 31% length of dorsal margin of joint; estimated length of adult carapace less than 1.5 mm . . . . . *D. jillae*  
    Width of distal end of 3rd joint of 1st antenna 38% length of dorsal margin of joint; length of adult carapace more than 1.5 mm . . . . . *D. medix*, new species

TABLE 4.—Distribution of bristles and claws on species of *Deeveya*. (A = Anterior, D = Dorsal, L = Lateral, M = Medial, na = not applicable, nd = no data, P = Posterior, T = Terminal, V = Ventral, numbers not followed by letter indicate bristles in several localities).

Character	<i>spiralis</i>	<i>styrax</i>		<i>bransoni</i>	<i>medix</i>		<i>hirpex</i>	<i>jillae</i>
	female	male	female	female	male	female	female	A-1 male
Length (mm)	2.67-2.87	3.12-3.19	3.00-3.06	1.68	1.67-1.73	1.67-1.75	2.36	1.07
1st Antenna								
1st joint	0	0	0	0	0	0	0	0
2nd joint	1D	1D	1D	1D	1D	1D	1D	1D
3rd joint	1V	1V	1V	1V	1V	1V	1V	1V
4th joint	1D	1D	1D	1D	1D	1D	1D	1D
5th joint	1V	1V	1V	1V	1V	1V	1V	1V
6th joint	0	0	0	0	0	0	0	0
7th joint	2V,1D	2V,1D	2V,1D	2V,1D	2V,1D	2V,1D	2V,1D	2V,1D
8th joint	4T	4T	4T	4T	4T	4T	4T	4T
2nd Antenna								
Endopodite								
1st joint	2D	2D	2D	2D	2D	2D	2D	2D
2nd joint	2 long	2 long	2 long	2 long	2 long	2 long	2 long	2 long
3rd joint	3 long	3 long	3 long	3 long	3 long	3 long	3 long	3 long
Exopodite								
9th joint	4T	4T	4T	4T	4T	4T	4T	4T
Mandible								
Basale								
Proximal	4	4	4	4	4	nd	4	3*
Endite	1A, 2P, 6L	1A, 2P, 6L	1A, 2P, 6L	1A, 2P, 6L	1A, 2P, 6L	nd	1A, 2P, 5-6L	1A, 2P, 6L
Endopodite								
1st joint	1D, 1V, 5M	1D, 1V, 5M	1D, 1V, 5M	1D, 1V, 4M	1D, 1V, 4M	nd	1D, 1V, 4M	1D, 1V, 2M
2nd joint	1V, 3D	1V, 3D	1V, 3D	1V, 3D	1V, 3D	nd	1V, 3D	1V, 3D
3rd joint	5M, 3T	4M, 3T	4M, 3T	4M, 3T	4M, 3T	nd	4M, 3T	4M, 3T
Maxilla								
Endite I	nd	13	nd	10	13	nd	12	10
Endite II	nd	13	nd	9	13	nd	11	9
Endite III	nd	7	nd	6	7	nd	6	7
Coxale	1D	1D	nd	1D	1D	nd	1D	1D
Basale	1V, 1L	1V, 1L	nd	1V, 1L	1V, 1L	nd	1V, 1L	1V, 1L
Endopodite								
1st joint	9	12	nd	10-11	10	nd	10-11	8-9
2nd joint	8T	9T	nd	7T	8T	nd	7T	5-6T
5th Limb								
Epipodite	15	15-16	16	16	16	nd	17	15
Protopodite								
Gland	absent	present	absent	absent	present	absent	absent	absent
Endite I	3V	3V	3V	3V	3V	nd	3V	3V
Endite II	1M, 4V	1M, 4-5V	1M, 6V	1M, 4V	1M, 5V	nd	1M, 4-5V	1M, 3V
Basale	1M, 8V	1M, 9V	1M, 7V	1M, 7V	1M, 10V	nd	1M, 8V	1M, 7V
Endopodite	1M, 10	1M, 9	1M, 9	1M, 9	1M, 9	nd	1M, 9	1M, 7
Exopodite								
1st joint	2D, 11	2D, 13	2D, 13	2D, 10	2D, 12	nd	2D, 11	2D, 8
2nd joint	1D, 4V	1D, 4V	1D, 4V	1D, 3V	1D, 4V	1D, 4V	1D, 3V	1D, 2V
3rd joint	5T	4T	4T	4T	4T	4T	4T	4T
6th Limb								
Epipodite	18	14	17	18	16	nd	17	18
Precoxale	4	4	4	4	4	4	4	3
Coxale	4	4	4	4	4	4	4	3
Basale	1L, 6V	1L, 6V	1L, 6V	1L, 5-6V	1L, 6V	1L, 5V	1L, 6V	1L, 5V
Endopodite	4T	4T	4T	4T	4T	4T	4T	4T
Exopodite								
1st joint	4V	6V	6V	4V	6V	6V	4V	2V
2nd joint	1D, 2V	1D, 2V	1D, 2V	1D, 2V	1D, 2V	1D, 2V	1D, 2V	1D, 1V
3rd joint	4-5T	4T	4T	4T	4T	4T	4T	4T
7th Limb	3T	3T	3T	3T	3T	3T	3T	3T
Furca	7	7	7	7	7	7	7	6
Unpaired bristle	1	1	1	1	1	1	1	1
Bellonci organ	bifid	bifid	bifid	bifid	bifid	bifid	bifid	bifid
Genitalia								
Female spine	3	na	2	na	1	na	1	na
Male organ	bifid	bifid	bifid	bifid	bifid	bifid	bifid	bifid

\*a 4th bristle may have broken off during dissection.



*Deeveya styra* Kornicker, new speciesFIGURES 15-21, 22*d*, 29*c*, 30

**ETYMOLOGY.**—From the Greek *styra* (spike at the butt end of a spear).

**MATERIAL.**—Dan's Cave, Abaco Island, Little Bahama Bank: 9 Jun 1984: USNM 193451, 1 adult male, appendages on slide, dry right valve on slide, left valve and some appendages in alcohol (holotype); USNM 193452, 1 adult female in alcohol. 15 Jun 1984: USNM 193605, 2 adults (unopened) in alcohol. 24 Dec 1984: USNM 193485, 1 adult female in alcohol; USNM 193586, 1 adult male in alcohol. 25 Jul 1985: USNM 193482, 1 adult female in alcohol. Sagittarius Cave, Sweeting's Cay, Grand Bahama Island: 25 Jul 1984: USNM 193591, 1 adult, sex undetermined, length 3.25 mm, height with tubercle 2.32 mm. 8 Jun 1987: USNM 193587, 1 adult female in alcohol. 12 Sep 1987: USNM 193588, 1 adult male in alcohol; USNM 193589, 1 adult female in alcohol (unopened).

**DISTRIBUTION.**—Dan's Cave, Abaco Island (type locality), and Sagittarius Cave, Sweeting's Cay, Grand Bahama Island, both islands on Little Bahama Bank.

**DESCRIPTION OF ADULT MALE** (Figures 15-19).—Carapace oval in lateral view except for straight dorsal margin and slightly concave anterior margin (Figure 17*a*). Right valve with small tubercle on dorsal margin near posterior end.

**Ornamentation** (Figures 15, 16): Carapace of USNM 193588 with internal reticulations similar to those of female described herein. Carapace of USNM 193451 (preserved in lactic acid) when viewed with transmitted light without reticulations but with indistinct internal striations perpendicular to valve margins (Figure 17*b*). SEM micrographs of carapace of USNM 193451 show surface with minute bosses at middle of slight protuberance bounded by quadrate depressed valleys appearing dark in micrograph (Figure 15*e,f*). Pores in shallow rimmed depression sparsely distributed on valve surface (Figure 16*a,b*).

**Bristles** (Figures 15*e*, 16*a*, 17*b,c*): Bristles of unequal length along valve margins and more sparsely distributed elsewhere. (Bristles along anterior margin single, not bifurcate as on *D. spiralis*, and without 2-4 very long posterior bristles also on that species.)

**Infold** (Figure 17*d*): Broad infold along anterior, ventral, and posterior margins, narrowest opposite anterior concavity of margin. Narrow list present along anterior, ventral, and posterior infolds; list bearing lamellar prolongation with smooth outer edge (Figure 17*d*). Selvage along outer margin with lamellar prolongation with smooth edge.

**Glands:** Glandular opening at tip of dorsal tubercle of right valve anterior to minute setose bristle (Figures 16*c,d*, 17*a*).

**Central Adductor Muscle Attachments** (Figures 15*a-c*, 19*d*): 11-12 individual attachments arranged in ellipse with long axis oblique to dorsal margin; 3 additional scars forming row anterior and ventral to ellipse (Figure 15*a,b*).

**Carapace Size:** USNM 193451, length 3.12 mm, height including tubercle of right valve 2.20 mm. USNM 193586, length 3.19 mm, height including tubercle of right valve 2.19 mm. USNM 193588, right valve, length 3.01 mm, height including tubercle 2.16 mm, height excluding tubercle 2.11 mm.

**First Antenna** (Figure 17*e-g*): Elongate with 8 joints. 1st joint with terminal ventral spinulose lobe overlapping proximal ventral corner of 2nd joint. 2nd joint with dorsal midbristle with indistinct marginal spines; distal half of joint with short medial spines. 3rd joint elongate with ventral bristle distal to joint midlength. 4th joint short with slender terminal dorsal bristle. 5th joint shorter than 4th, with long terminal ventral bristle with short proximal ringed part and slightly broader unringed distal part with minute widely spaced marginal spines and terminal papilla. 6th joint shorter than 5th, bare. 7th joint about same length as 4th, with short ringed lateral a-bristle near distal dorsal corner, and b- and c-bristles on terminal ventral pedistal (medial b-bristle less than  $\frac{2}{3}$  length of lateral c-bristle, with short ringed proximal part and unringed filament-like distal part with widely spaced minute marginal spines and terminal papilla; c-bristle about twice length of stem, ringed in proximal  $\frac{2}{3}$  and with widely spaced minute marginal spines (spines stouter than both those of b-bristle and bristle of 5th joint) and terminal papilla). 8th joint with terminal d-, e-, f-, and g-bristles (d-bristle with short ringed proximal part and slightly broader distal part with indistinct minute marginal spines and blunt tip with terminal papilla reaching tip of bristle of 5th joint; e-bristle about same length as c-bristle, distinctly ringed in proximal half, with widely spaced minute marginal spines (spines much stouter than those of d-bristle, similar to those of c-bristle) and terminal papilla; f-bristle at slight ventral angle, about same length as d-bristle, about  $\frac{1}{3}$  length of e-bristle, with short ringed proximal part and slightly broader unringed filament-like distal part with terminal papilla; g-bristle more than half length of e-bristle, with short ringed proximal part and unringed filament-like distal part with widely spaced indistinct marginal spines and terminal papilla).

**Second Antenna** (Figure 17*h*): Lateral and medial surfaces of protopodite with minute spines along proximal dorsal margin; longer distal lateral spines forming transverse rows at midwidth. Endopodite (Figure 17*h*): 1st joint with medial transverse suture or sclerite just proximal to joint midlength, with a-bristle about  $\frac{3}{4}$  length of b-bristle. 2nd joint forming angle with 1st joint, with f-bristle about  $\frac{2}{3}$  length of g-bristle, with short proximal ringed part and unringed slightly broader filament-like distal part, and minute widely spaced marginal spines and terminal papilla; g-bristle about twice length of protopodite, with distinct rings in proximal  $\frac{2}{3}$ , and widely spaced minute marginal spines (stouter than spines of f-bristle) and terminal papilla; minute medial peg near insertion of 3rd joint. 3rd joint separated from 2nd by distinct suture, with h-, i-, and j-bristles about half length of g-bristle; each with short ringed proximal part and unringed slightly broader filament-

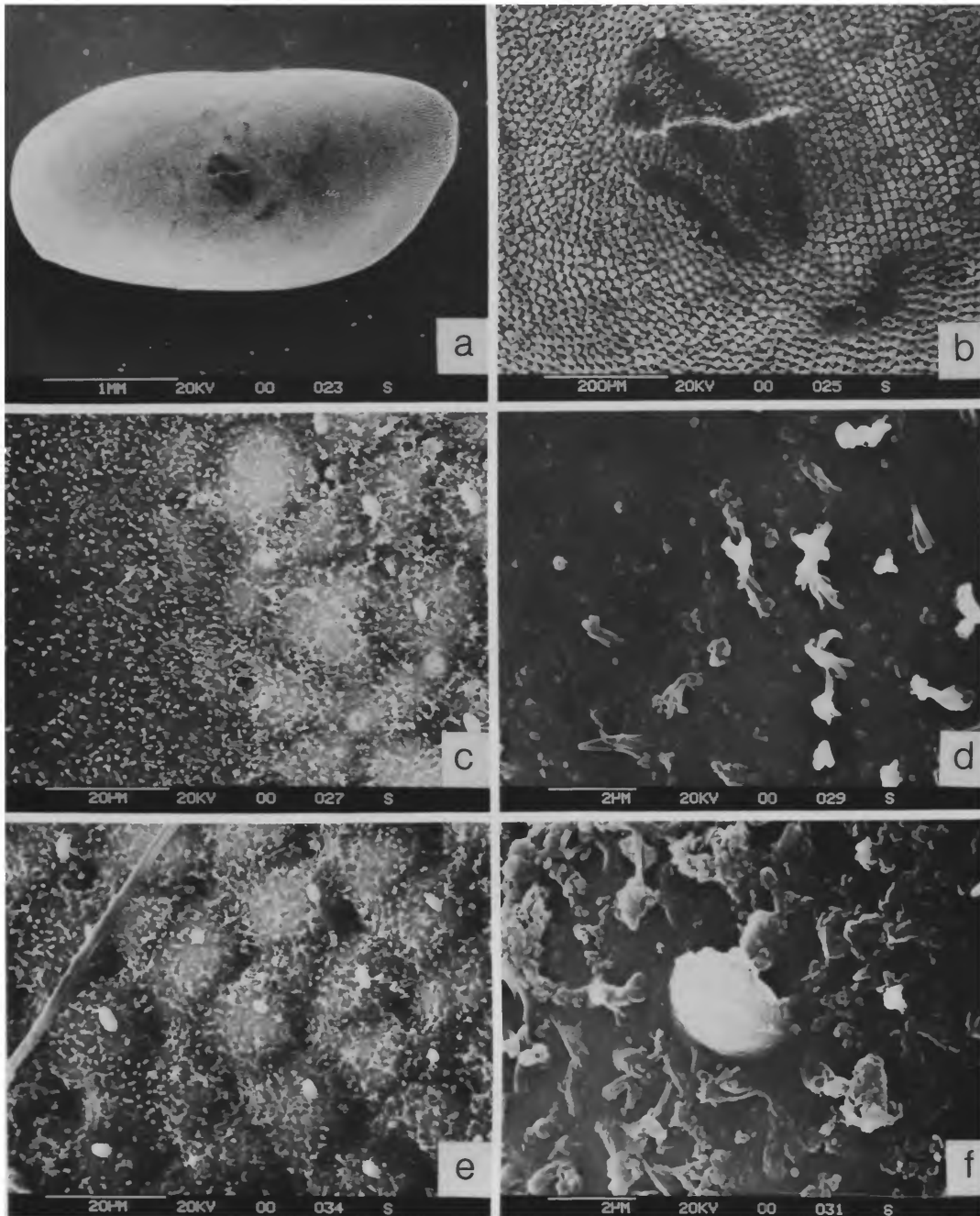


FIGURE 15.—*Deevya styrax* Kornicker, new species, holotype, USNM 193451, adult male, length 3.12 mm: *a*, outside view of right valve, anterior to right (valve distorted during drying resulting in upper edge of valve being curled inwards and not visible in illustration); *b*, detail of muscle attachment area in *a* (horizontal white line through attachments is artifact); *c*, detail of surface along right edge of central adductor muscle attachments in *b* (slightly darker area in left half of micrograph is on muscle attachment; lighter area in right half is anterior to muscle attachment); *d*, detail of minute surface processes over muscle attachment area near midheight of *c*; *e*, part of bristle (proximal end of bristle to lower left, base not shown) and bosses on valve surface, detail from *a* posterior to adductor muscle attachments near midheight; *f*, detail of boss near middle of *e*. (Shell had been preserved in lactic acid.)



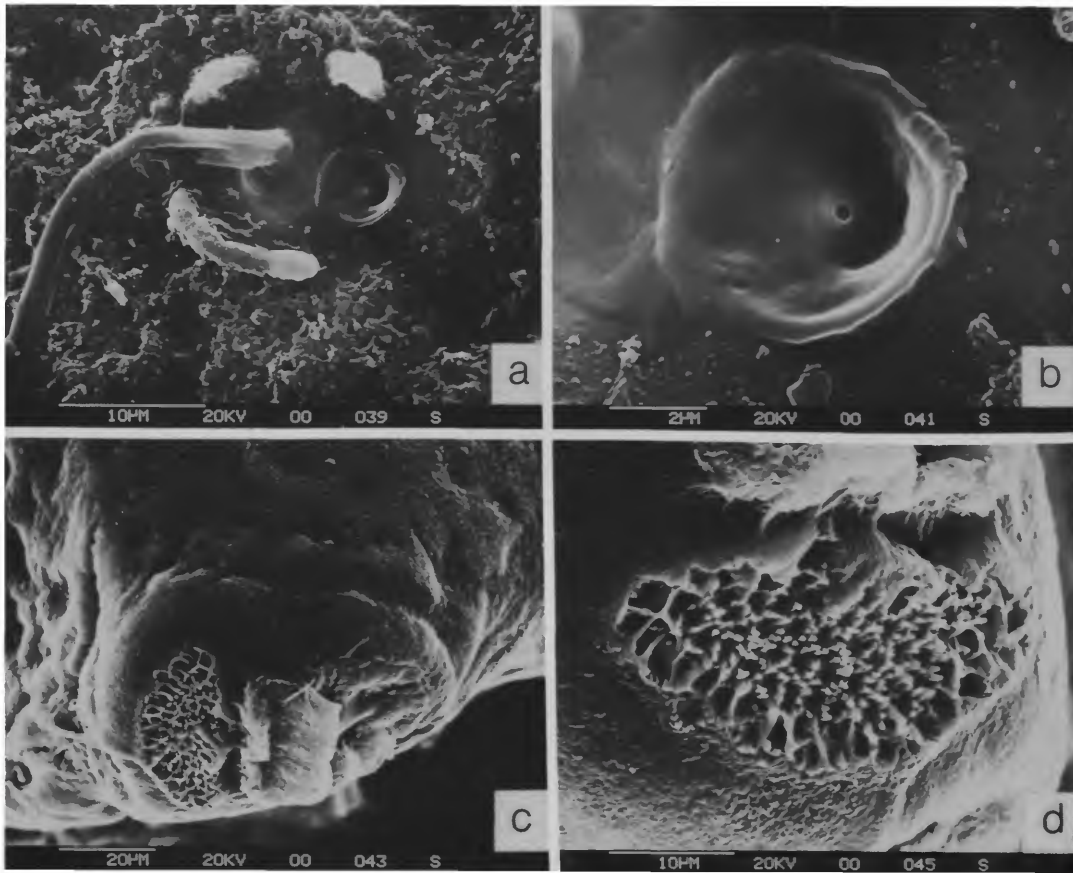


FIGURE 16.—*Deeveya styrae* Kornicker, new species, holotype, USNM 193451, adult male, length 3.12 mm: *a*, long bristle and 3 short processes near rimmed pore, from upper right of Figure 15*b*; *b*, detail of rimmed pore in *a*; *c*, glandular opening at tip of posterodorsal tubercle of right valve, anterior of valve to left, dorsal margin of valve to bottom (bristle posterior to gland in micrograph is folded, probably the result of drying process); *d*, detail of glandular opening in *c*, anterior of valve to bottom. (Shell had been preserved in lactic acid.)

like distal part, with widely spaced minute marginal spines (similar to those of f-bristle) and terminal papilla; minute bristle at dorsal corner of joint. Exopodite 9-jointed: 1st joint divided into long proximal and short distal parts; distal part with slender, bare, medial bristle reaching just past distal end of 5th joint; 2nd joint with long bristle with ventral spines along proximal  $\frac{2}{3}$  and natatory hairs; bristles of joints 3–8 with long bristles with natatory hairs; 9th joint with 4 bristles (2 short with marginal spines, 1 long with dorsal spines and natatory hairs, 1 long (ventral) with only natatory hairs).

**Mandible** (Figure 18*a–e*): Coxale endite with proximal and distal sets of teeth separated by space (Figure 18*a,c*): proximal set comprising 4 stout cusps (anterior cusp pointed, others rounded), a short slender spinous bristle on terminal anterior edge, and 1 stouter spinous bristle on posterior edge; surface between cusps and posterior to cusps with abundant slender spines; 2 spinous bristles medial to stout rounded tooth

between proximal and distal sets of teeth; 1 spinous bristle and 1 stout curved process (with few minute spines) proximal to distal set of teeth; distal set comprising 2 flat teeth: proximal tooth with 5 cusps (posterior cusp longest); distal tooth with 7 cusps (middle cusp stoutest). Basale (Figure 18*b,d*) with 4 long proximal bristles (3 stout plumose, 1 slender with short marginal spines) (Figure 18*b*). Basale endite: distal edge with 6 terminal triangular cusps (Figure 18*d*); lateral surface near distal edge with sharp tooth near midwidth; lateral surface distal to midlength with 4 slender bristles and 2 long stout entwined bristles (Figure 18*d*); anterior margin with 1 slender bristle; posterior margin with proximal spines and 2 short distal bristles (distal of these tubular). Endopodite 3-jointed (Figure 18*e*): 1st joint with 1 spinous terminal dorsal bristle, 1 spinous distal ventral bristle, and 5 spinous distal medial bristles; 2nd joint with 3 spinous terminal dorsal bristles (1 claw-like), and 1 spinous terminal ventral bristle; 3rd joint hirsute medially and

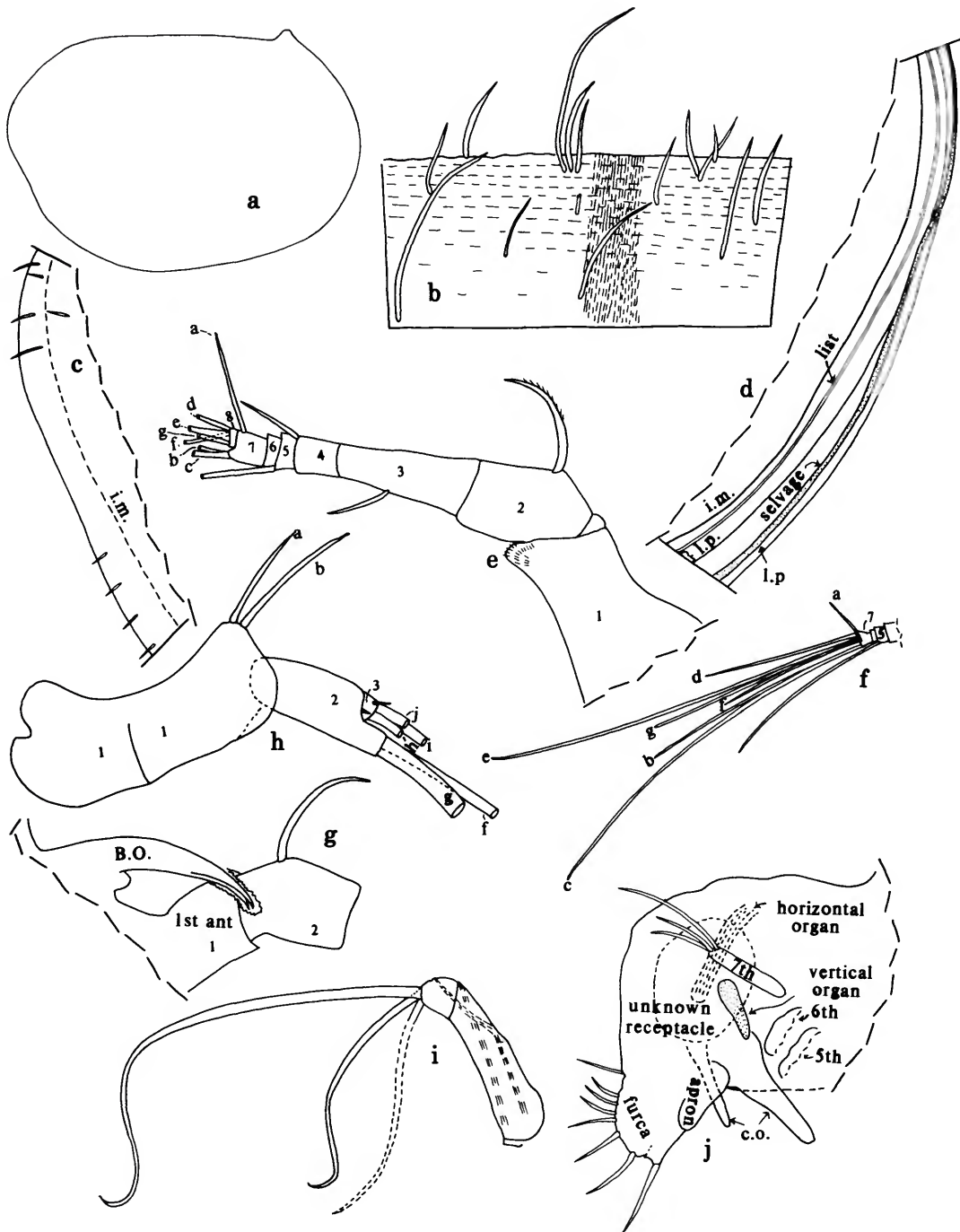


FIGURE 17.—*Deeveya styax* Kornicker, new species, holotype, USNM 193451, adult male, length 3.12 mm: *a*, outline of right valve from inside; *b*, outside view of dorsal margin of left valve just posterior to midlength (vertical dashes near midlength of illustration represent "threads" visible within whole shell); *c, d*, outside and inside views of anterior margin of left valve in vicinity of concavity; *e*, left 1st antenna (only proximal part of some bristles on distal joints shown), lateral view; *f*, bristles of joints 5-8 of left 1st antenna, lateral view; *g*, joints 1 and 2 of right 1st antenna and Bellonci organ, lateral view (part of 1st antenna left open in order to show tip of Bellonci organ); *h*, endopodite of left 2nd antenna (only proximal parts of some bristles shown), medial view; *i*, left 7th limb, lateral view; *j*, posterior of body from right side.



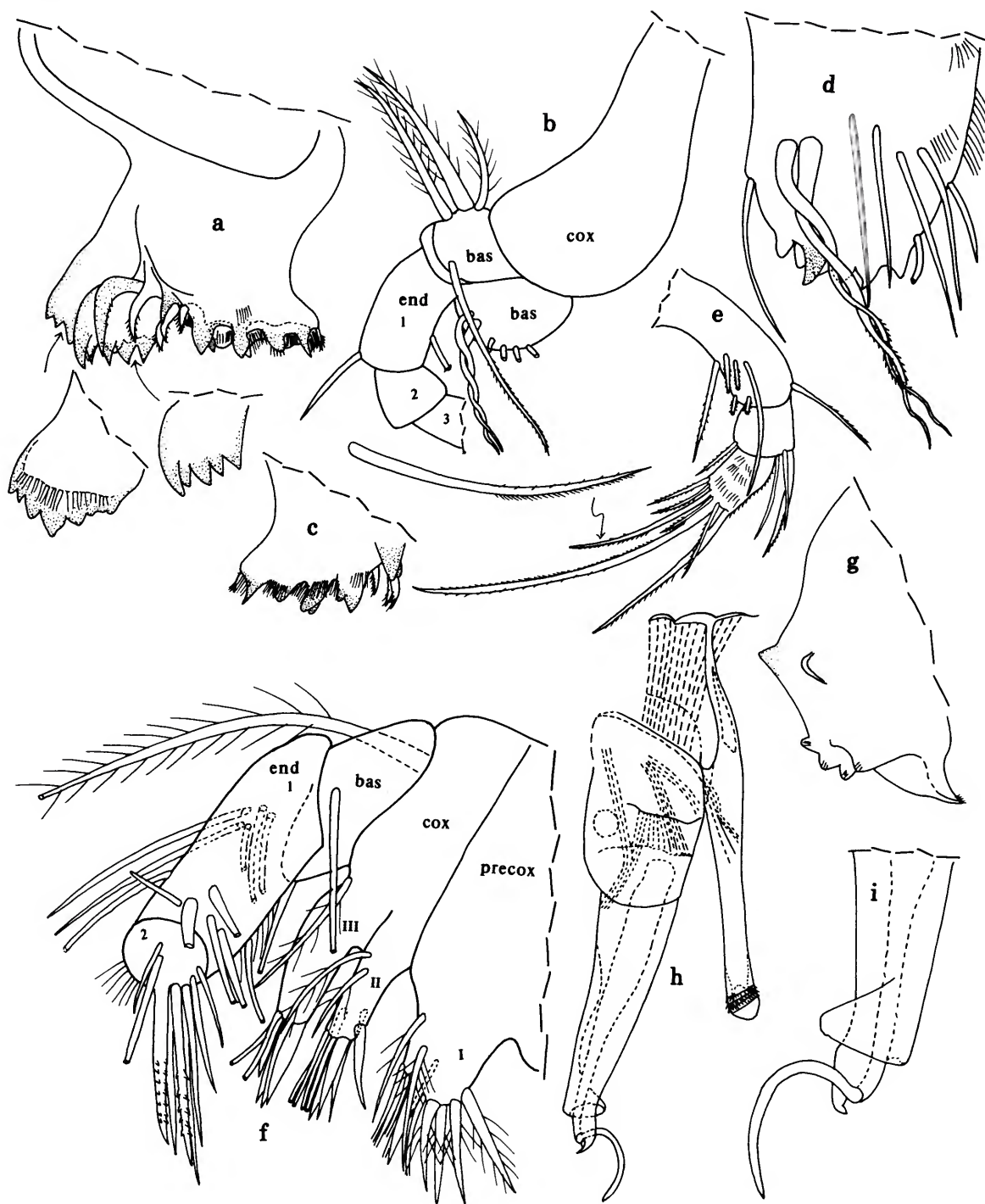


FIGURE 18.—*Deeweya styrax* Kornicker, new species, holotype, USNM 193451, adult male, length 3.12 mm (a-e, left mandible): a, coxale endite, medial view; b, mandible in place on body (not all bristles shown), lateral view; c, proximal tooth of coxale endite, lateral view; d, distal end of basale, lateral view; e, endopodite, medial view; f, left maxilla, lateral view; g, anterior of body showing upper lip at bottom; h, copulatory organ, lateral view, anterior to left; i, tip of anterior branch of copulatory organ, medial view, anterior to right.

along dorsal margin, with 4 medial bristles forming row, and 3 stout spinous terminal bristles (all marginal spines short; ventral bristle with closely spaced short spines (spines shorter than width of bristle) along distal dorsal half (detail in Figure 18e)).

**Maxilla** (Figure 18f): Coxale with 1 stout, hirsute, terminal, dorsal bristle. Endite I with 2 proximal bristles (both with long proximal hairs) and 11 terminal bristles (5 claw-like bare or with long hairs, 5 tubular, bare); endite II with 2 proximal bristles with long proximal hairs, and 11 subterminal and terminal bristles (1 short bare, 4 claw-like bare, 5 tubular, bare); endite III with 1 proximal bristle with long marginal hairs near basale and 6 terminal bristles (4 claw-like, bare, 2 tubular, bare). Basale with 1 slender bare ventral bristle and 1 slender bare medial bristle at midwidth. Endopodite: 1st joint with hairs along posterior surface and 12 bristles (5 proximal medial, 1 distal on anterior margin, 1 distal on posterior margin, 5 distal lateral, all either bare or with short marginal spines); 2nd joint with 2 stout pectinate claws, 7 slender bristles (bare or with short spines) and long hairs along terminal edge.

**Fifth Limb** (Figures 17j, 19a): Epipodite with bristles forming 3 groups: ventral group with 5 bristles (ventral bristle about  $\frac{2}{3}$  length of others); middle group with 5 or 6; dorsal group with 4 long and 1 short (dorsal). Protopodite with lateral glandular process with numerous papillae, and 2 ventral endites: endite I with 3 bristles (longest with long proximal spines, others with short marginal spines, shortest tubular); endite II with 1 proximal medial bristle and 4–5 ventral bristles (longest with long proximal spines, others either bare or with short spines, 3 or 4 tubular). Basale with 2 long lateral subventral bristles with long proximal spines, 1 proximal medial bristle, and 7 ventral bristles (1 long and 1 short unringed finely pectinate and claw-like, others ringed, tubular, bare or with short marginal spines). Endopodite with 1 proximal medial bristle, 1 proximal lateral bristle, 2 anterior bristles (1 with long proximal spines), and 6 ventral bristles (1 short triangular tooth-like medial, 2 claw-like unringed pectinate, others ringed, either bare or with short spines, 2 tubular). 1st exopodial joint divided into 2 parts: proximal part with 10 bristles (1 very long bare subterminal (almost terminal) dorsal bristle, 1 plumose bristle with base near dorsal margin and just proximal to subterminal bristle, 1 plumose lateral terminal bristle near dorsal margin, 1 lateral bristle near midwidth, 1 subventral medial bristle, and 5 ventral bristles); distal part with 5 bristles on or near ventral margin, all either bare or with short marginal spines. 2nd exopodial joint: dorsal margin with 1 distal bristle, ventral margin with 4 slender bristles near midlength. 3rd exopodial joint with 2 stout unringed pectinate claw-like bristles, and 2 slender ringed bristles with short marginal spines.

**Sixth Limb** (Figures 17j, 19b): Epipodite with bristles forming 3 groups (ventral and middle groups each with 5 bristles, dorsal group with 3 long bristles and 1 short bristle). Precoxale separated from coxale by distinct suture. Precoxale

and coxale each with 4 bristles (2 plumose, 2 with short spines); medial surface with long hairs. Basale with 7 plumose bristles (6 near ventral margin, 1 distal lateral, near endopodite); medial side with hairs in proximal ventral corner. Endopodite forming thumb-like process with 4 long bristles (terminal bristle longest and bare, others plumose). Exopodite 3-jointed: 1st joint with 6 bristles (bare or with short marginal spines) and few medial hairs; 2nd joint with 3 bristles (2 ventral with short spines, 1 dorsal bare); 3rd joint with 4 bristles (2 stout claw-like (pectinate ventrally, longest with stouter marginal teeth along distal third) and 2 slender bare).

**Seventh Limb** (Figure 17i,j): Elongate with long 1st and short 2nd joint and with 3 terminal bristles (dorsal bristle stouter and almost twice length of others).

**Furca** (Figures 17j, 19c): Each lamella with total of 7 claws; lamellae followed by unpaired dorsal bristle; claws 1–4 with faint teeth along distal dorsal margin; claws 5–7 with teeth along both margins; unpaired dorsal bristle about same length as claw 2, and with marginal spines; teeth of claw 7 only very slightly smaller than those of claws 5 and 6; small glandular peg between claws 1 and 2; left lamella of furca of USNM 193451 very slightly anterior to right lamella. Apron anterior to furca (Figure 19c).

**Bellonci Organ** (Figure 17g): Well-developed, bifurcate at midlength, with each branch tapering to point.

**Upper Lip** (Figure 18g): Not examined in detail but similar to that of *D. spiralis*.

**Copulatory Organ** (Figures 17j, 18h,i, 19e): Posterior branch with blunt tip and narrow subterminal rings with minute spines. Anterior branch with broad triangular subterminal process, small pointed sclerotized hook-like tip, and long vermiform process near tip (Figure 18i).

**Posterior of Body** (Figure 17j): Evenly rounded unsegmented.

**Hepatic Appendage** (Lumen): Similar to that of *D. spiralis*.

**Unknown Receptacle** (Figure 17j): 2 oval bodies on right and left of gut in posterior part of body having pearly sheen in reflected light; receptacles packed with coils of long thin thread-like filaments (visible in transmitted light ( $\times 10$  objective,  $\times 15$  ocular)). Small elongate brown "vertical organ" containing thread-like filaments in proximal part observed only on right side of body (stippled in Figure 17j); the organ appears to be positioned lateral to unknown receptacle and bends around ventral part of body to join inner surface of proximal part of posterior branch of copulatory organ. On each side of body, just lateral to, or just within unknown receptacle lies an elongate "horizontal organ" containing thin thread-like horizontal filaments (Figure 17j); the organ lies dorsal to the gut in lateral view and on each side of it in dorsal view. The functions of the unknown receptacle, as well as the vertical and horizontal organs are unknown.

**DESCRIPTION OF ADULT FEMALE** (Figures 20, 21, 22d, 29c).—Carapace similar to that of adult male (Figure 20a).

**Ornamentation** (Figures 20b, 29c): Carapace appearing

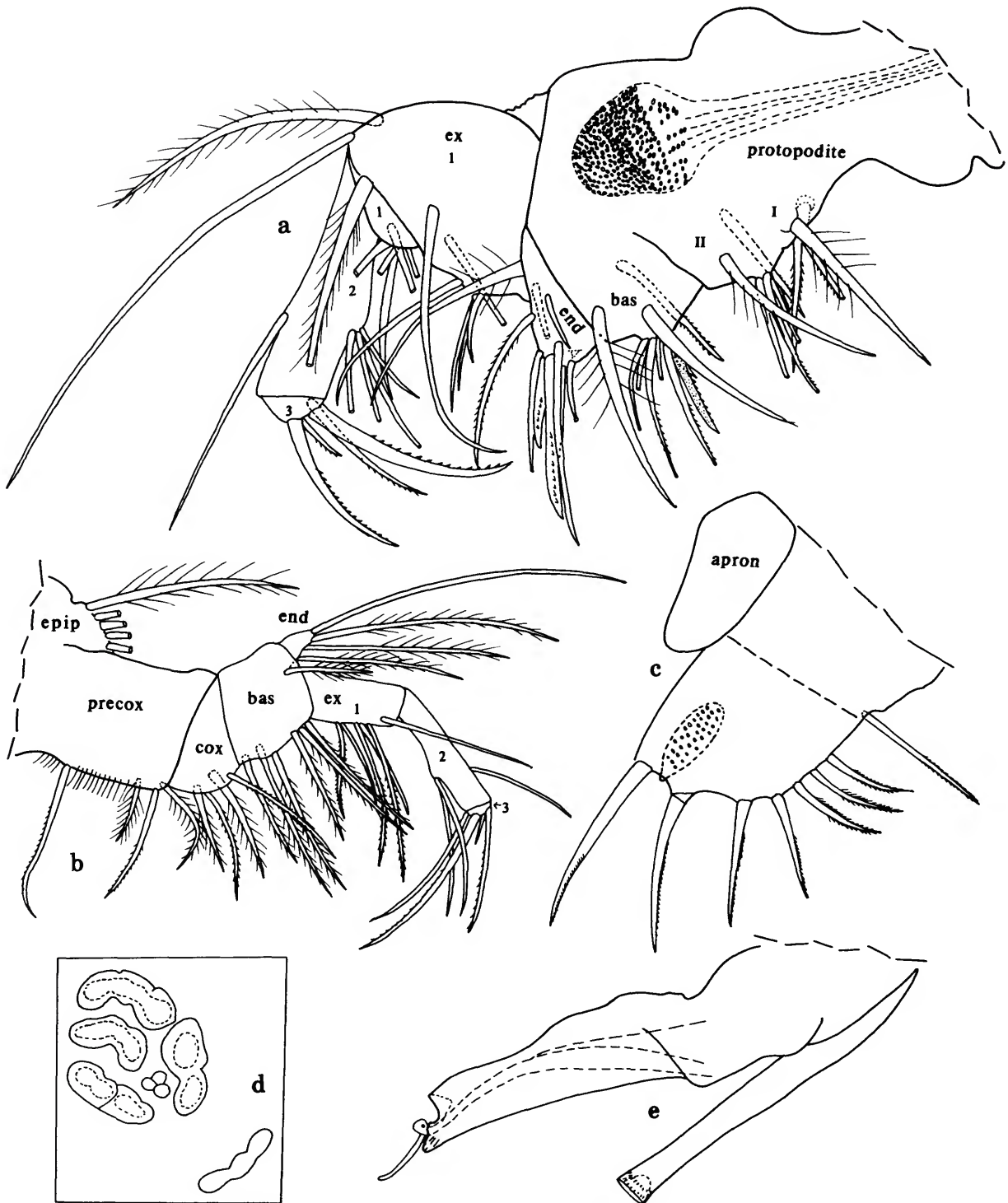


FIGURE 19.—*Deeveya styrax* Kornicker, new species, holotype, USNM 193451, adult male, length 3.12 mm: a, right 5th limb, lateral view; b, left 6th limb, lateral view; c, left lamella of furca, lateral view. Paratype, USNM 193586, adult male, length 3.19 mm: d, muscle attachment scars of right valve, lateral view; e, copulatory organ, lateral view, anterior to left.

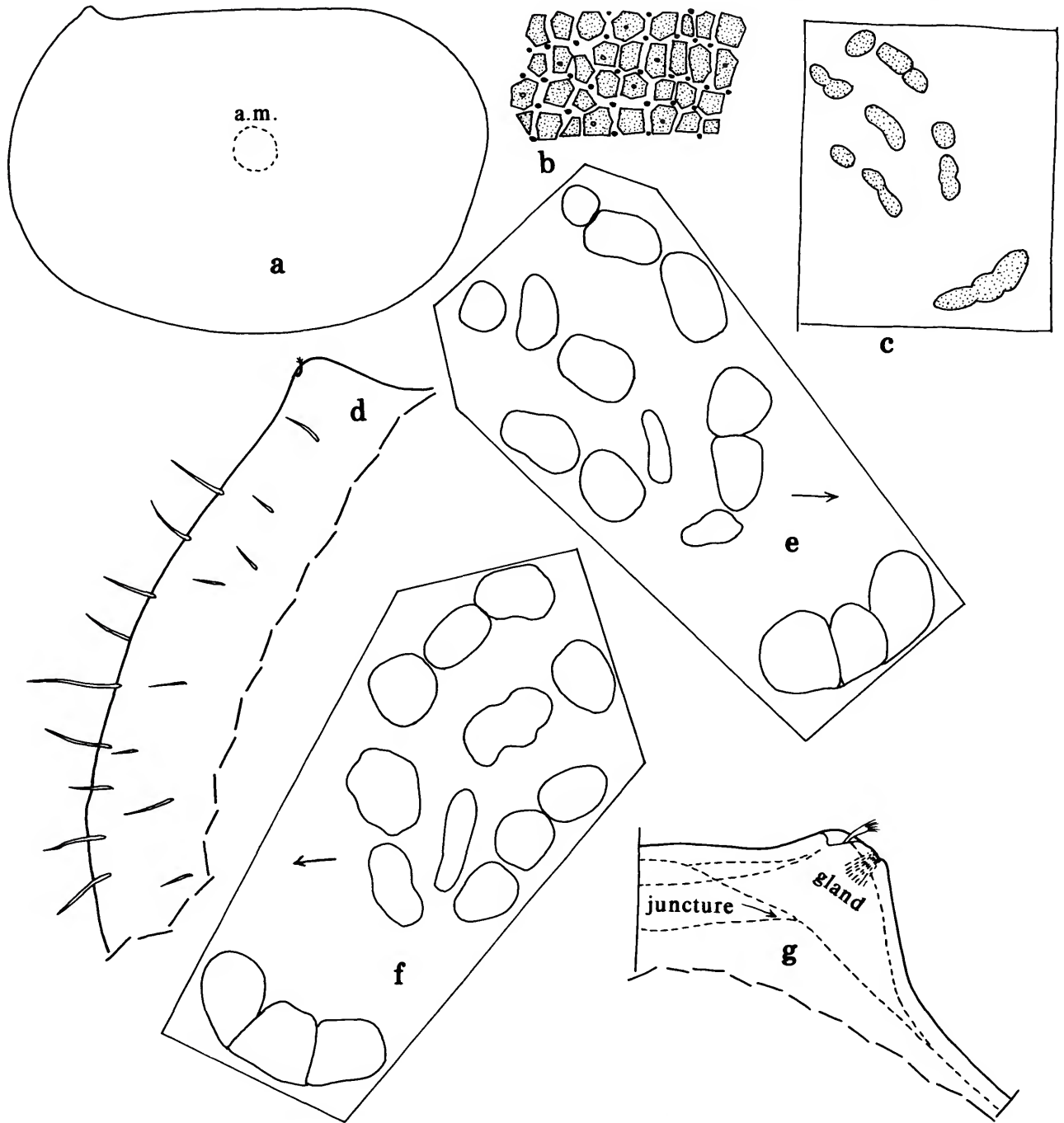


FIGURE 20.—*Deeveya styrax* Kornicker, new species, paratype, USNM 193482, adult female, length 3.06 mm: *a*, complete specimen from right side (dashed circle indicates area of central adductor muscle attachments). Paratype USNM 193485, adult female, length 3.01 mm: *b*, surface reticulations on right valve as seen in transmitted light; *c*, muscle attachments of right valve, lateral view, anterior to right. Paratype, USNM 193452, adult female, length 3.00 mm: *d*, outside view of posterior of right valve (setal bristle at top is just anterior to posterodorsal gland openings, which are not shown); *e, f*, muscle attachments on right and left valves, lateral views (arrow points toward anterior of valve); *g*, inside view of posterodorsal corner of right valve.



reticulate in transmitted light, but reticulations lie within translucent shell wall; shell surface smooth except for minute bosses occurring mostly at intersections of reticulate walls. Internal polygons mostly with 4 sides but some with 3 to 6 sides, and smaller and more numerous where muscles attach to shell.

**Bristles:** Lateral surface and valve margin with single bristles of various lengths but none as long as 2–4 posterior bristles of *D. spiralis* (Figure 20*d*). Small setal bristle present at tip of dorsal tubercle of right valve just posterior to glandular openings (Figure 20*g*).

**Infold and Glands** (Figure 20*g*): Similar to those of adult male.

**Muscle Attachments** (Figure 20*a,c,e,f*): Comprising about 12 individual attachments (fused on some specimens) in elliptical area oriented obliquely just anterior to valve midlength; 3 muscle attachments forming row just anterior and ventral to central adductor muscle attachments.

**Carapace Size:** USNM 193452, right valve, length 3.00 mm, height without tubercle 2.07 mm, height with tubercle 2.10 mm. USNM 193482, length 3.06 mm, height without tubercle 2.03 mm, height with tubercle 2.06 mm. USNM 193485, length 3.01 mm, height without tubercle 2.10 mm, height with tubercle 2.17 mm. USNM 193587, length 3.06 mm, height with tubercle 2.15 mm. USNM 193589, length 3.13 mm, height without tubercle 2.20 mm, height with tubercle 2.26 mm.

**First Antenna** (Figures 21*a,b,22d*): Similar to that of adult male.

**Second Antenna:** Protopodite and exopodite similar to that of adult male. Endopodite 3-jointed (Figure 21*c,d*): 1st joint with a-bristle reaching past midlength of b-bristle, joint without transverse sclerite present on adult male; 2nd joint separated from 3rd by weak suture, with slender f- and stout g-bristles similar to those of adult male, and minute lateral peg near insertion of 3rd joint; 3rd joint with h-, i-, and j-bristles similar to those of adult male; endopodites of left and right limbs similar.

**Mandible** (Figure 21*e*): Similar to that of adult male.

**Maxilla:** Not examined in detail but similar to that of adult male.

**Fifth Limb:** Epipodial appendage with bristles forming 3 groups: dorsal group with 4 long and 1 short (dorsal); middle group with 6 long; ventral group with 5 (ventral bristle about  $\frac{2}{3}$  length of others). Protopodite without glandular process, and with 2 ventral endites: endite I with 3 bristles (longest with long proximal spines, next longest with short spines, shortest tubular); endite II with 1 proximal medial bristle with short spines, 1 long subventral lateral bristle with long spines, and 5 shorter ventral bristles; both endites with spines forming medial row near ventral margin. Basale with 1 proximal medial bristle with short spines, 1 subventral lateral bristle with long spines, and 6 ventral bristles (2 claw-like, 4 tubular). Endopodite with 1 proximal medial bristle, 2 subventral lateral

bristles, 2 anterior bristles (1 or both with long proximal spines), and 5 ventral bristles (1 short triangular tooth-like, medial, 2 claw-like unringed, pectinate, 2 tubular). 1st exopodial joint divided by ventral suture into broad proximal and narrower distal parts (on medial side suture perpendicular to ventral margin and extending from ventral margin at midlength to joint midwidth, on lateral side suture angling from medial side at midlength to terminal end of dorsal margin at insertion of 1st exopodial joint): proximal part with 10 bristles (1 very long bare subterminal or terminal bristle on dorsal margin, 1 plumose dorsal bristle with base just proximal to subterminal bristle, 1 plumose lateral bristle near dorsal margin or at midwidth, 1 lateral bristle near midwidth, 1 subventral medial bristle with short marginal spines, and 5 ventral bristles); distal part with 5 bristles on or near ventral margin, all either bare or with short marginal spines. 2nd exopodial joint with 1 distal dorsal bristle and 4 slender ventral bristles near midlength. 3rd exopodial joint with 2 stout unringed pectinate claw-like bristles, and 2 slender ringed bristles with short marginal spines.

**Sixth Limb:** Epipodial appendage with bristles forming 3 groups: dorsal group with 6 long and 1 short (dorsal); middle and ventral groups with 5 each. Precoxale separated from coxale by distinct suture, each joint with 4 bristles (2 plumose, medial, subventral, 2 with short spines, ventral); medial surfaces with long hairs in ventral half. Basale with 7 plumose bristles (6 near ventral margin, 1 distal lateral near endopodite); medial side with hairs in proximal ventral corner. Endopodite forming thumb-like process with 4 long bristless (terminal bristle longest and bare, others plumose). Exopodite 3-jointed: 1st joint with 6 bristles on or near ventral margin (bare or with short marginal spines); 2nd joint with 3 bristles (2 ventral, 1 dorsal) either bare or with short marginal spines; 3rd joint with 4 bristles (1 stout, claw-like, pectinate ventrally, longer teeth distally, 1 dorsal, slender, tending to be claw-like, with few small dorsal teeth distally, and 1 slender ventral bristle almost length of long claw, and 1 short medial bristle).

**Seventh Limb** (Figure 21*f,i*): Similar to that of adult male.

**Furca** (Figure 21*g,h*): Neither left or right lamella anterior to other. Claws and unpaired bristle similar to those of adult male. Except for 8 claws on left lamella of USNM 193482, all with 7 claws. Small glandular peg between claws 1 and 2. Apron similar to that of adult male (Figure 21*h*).

**Bellonci Organ, Upper Lip, and Posterior of Body:** Similar to those of adult male.

**Genitalia** (Figure 21*h,i*): Small oval brown area on left side of body connected to narrow internal tube and adjacent to 2 small bristles.

**Unknown Receptacle:** Not observed.

**SEXUAL DIMORPHISM.**—Endopodite of 2nd antenna of male without clasper and similar to that of female; 5th limb of male with large gland in protopodite; copulatory organ of male comprising 2 branches.

**COMPARISONS.**—The carapace of *D. styra*x differs from that

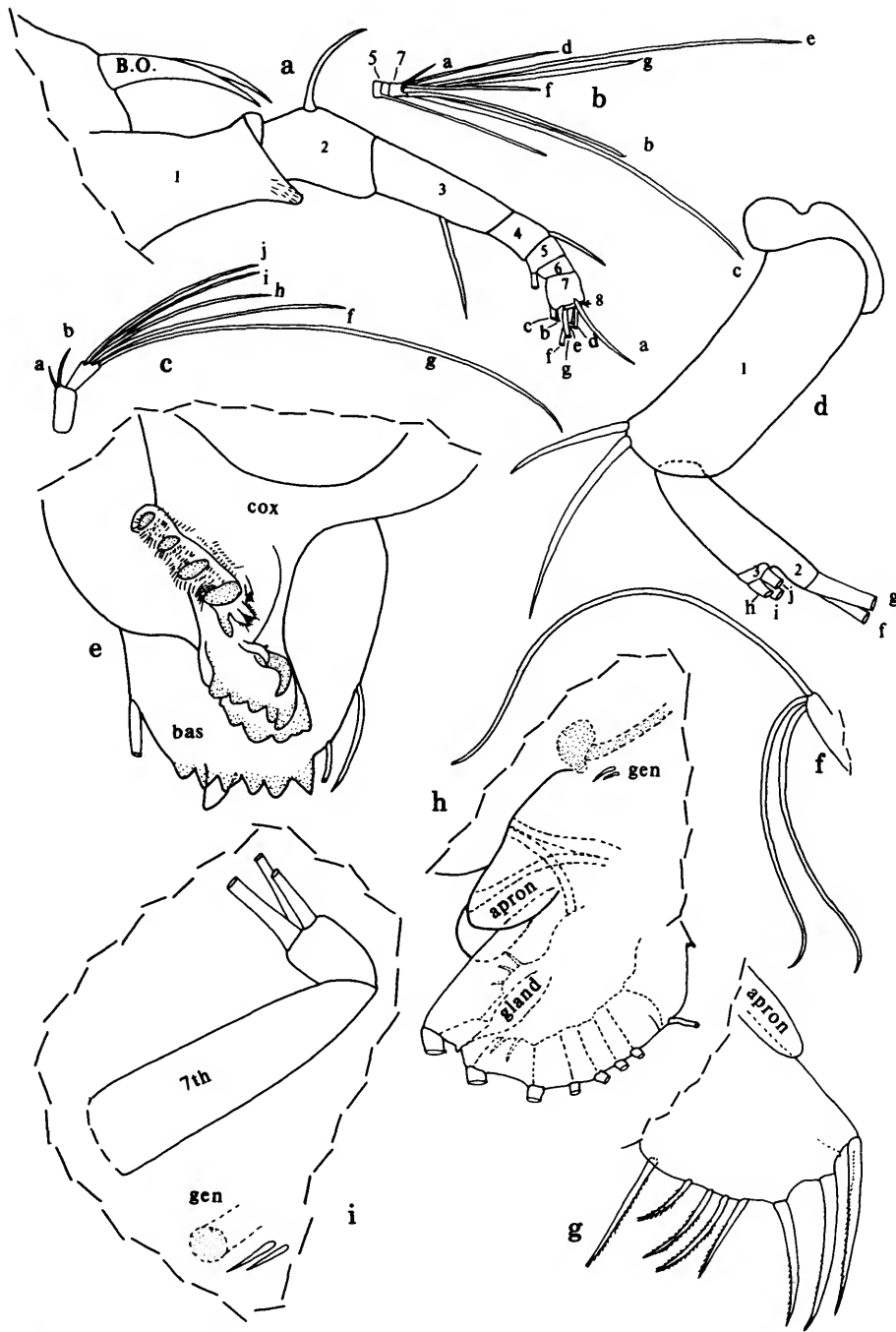


FIGURE 21.—*Deeveya styax* Kornicker, new species, paratype, USNM 193452, adult female, length 3.00 mm: a, right 1st antenna (only proximal part shown of bristles of distal joints) and Bellonci organ, lateral view; b, joints 5–8 of left 1st antenna, medial view; c, endopodite of left 2nd antenna, medial view; d, endopodite of right 2nd antenna (only proximal part shown of bristles of joints 2 and 3), medial view; e, distal parts of coxale and basale of right mandible, anterior to left (not under cover slip), medial view; f, right 7th limb, lateral view; g, right lamellar of furca, lateral view; h, posterior of body from left side (only proximal parts shown of furcal claws), anterior to left; i, posterior part of body from left side showing 7th limb and genitalia, anterior to left.

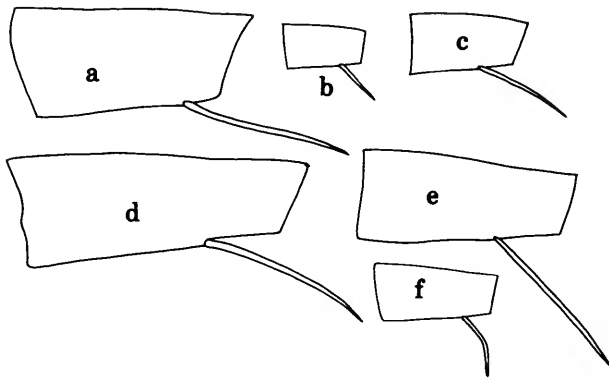


FIGURE 22.—Comparison at same magnification ( $\times 20$  objective,  $\times 15$  ocular) of 3rd joints of the 1st antennae of species of *Deeveya* (all except *D. jillae*, which is from an A-1 male, are from adult males or females): a, *D. spiralis*, holotype, USNM 193117, adult female, left limb, medial view; b, *D. jillae*, holotype, USNM 193298, A-1 male, left limb, medial view; c, *D. bransoni*, holotype, USNM 193301, adult female, left limb, medial view; d, *D. styrax*, paratype, USNM 193452, adult female, right limb, lateral view; e, *D. hirpex*, holotype, USNM 193593, adult female, right limb, lateral view; f, *D. medix*, holotype, USNM 193592, adult male, left limb, medial view.

of *D. spiralis* in having single rather than bifurcate bristles along the anterior margin. The terminal joint of the 5th limb has 4 bristles on *D. styrax* and 5 on *D. spiralis*.

The 3rd joint of the 1st antenna of adult females of *D. hirpex*, *D. styrax*, *D. spiralis*, and *D. bransoni*, an adult male of *D. medix*, and an A-1 male of *D. jillae* are compared in Figure 22. The width at the distal end of the 3rd joint of the 1st antenna (measured perpendicular to the ventral margin) as percent of the length of the dorsal margin for species of *Deeveya* are *D. styrax* 24%, *D. hirpex* 28%, *D. medix* 31%, *D. spiralis* 35%, *D. bransoni* 37%, and *D. jillae* 38%.

#### *Deeveya spiralis* Kornicker and Iliffe, 1985

FIGURES 22a, 23a-c, 29a, 30

*Deeveya spiralis* Kornicker and Iliffe, 1985:476, figs. 1-13.—Kornicker and Palmer, 1987:619, fig. 6.

**MATERIAL.**—Holotype, USNM 193117, adult female; paratype, USNM 193118, adult female.

**DISTRIBUTION.**—The Hole, a marine cave on Providenciales Island, Caicos Islands, Turks and Caicos Islands.

**REMARKS.**—Kornicker and Iliffe (1985:477) interpreted the 2 specimens of *D. spiralis* in their collection to be adult females; because of having only 7 claws on each lamella of the furca they were interpreted to be A-1 females by Kornicker and Palmer (1987:621); reexamination of the holotype revealed a well-developed genital tube, which, combined with the large size of unextruded eggs in the ovaries, led to the conclusion herein that the 2 specimens are adult females, as originally described.

**SUPPLEMENTARY DESCRIPTION OF ADULT FEMALE** (Figure 22a, 23a-c, 29a, 30).—Mandible (Figure 23a): Coxale endite with bristle on anterior and posterior ends of proximal tooth.

**Sixth Limb:** End joint of 6th limb of holotype with 4 or 5 bristles (2 claw-like, 1 short, 1 or 2 long ventral).

**Furca:** Gland leading to pore between 1st and 2nd claws.

**Genitalia** (Figure 23b,c): Left side of holotype with genital tube. 3 bristles in vicinity of tube and posterior to base of 7th limb.

#### *Deeveya bransoni* Kornicker and Palmer, 1987

FIGURES 22c, 23d,e, 29b, 30

*Deeveya bransoni* Kornicker and Palmer, 1987:610, figs. 1-6.

**MATERIAL.**—Holotype, USNM 193301, adult female; paratype, USNM 193302, A-1 female.

**DISTRIBUTION.**—Evelyn Green's Blue Hole and Stargate Blue Hole, South Andros Island, Great Bahama Bank.

**REMARKS.**—Kornicker and Palmer (1987:611) interpreted the 2 specimens in their collection to be A-1 female (holotype) and A-2 female (paratype). Reexamination of the A-1 female revealed a well-developed genital tube and 2 bristles in its vicinity; this led to the conclusion herein that the holotype is an adult female. The paratype is without genitalia and is interpreted to be an A-1 female.

**SUPPLEMENTARY DESCRIPTION OF ADULT FEMALE** (Figure 22c, 23d,e, 29b, 30).—Mandible (Figure 23d): Coxale endite with bristle on anterior and posterior ends of proximal tooth. Basale with 4 proximal bristles (1 long slender bristle with short marginal spines and 3 plumose bristles (2 long, 1 short)) (Kornicker and Palmer (1987:615, fig. 2a) overlooked the short plumose bristle).

**Furca:** Kornicker and Palmer (1987:617) incorrectly stated that a stout triangular protuberance follows claw 7; no protuberance is present, and its absence is correctly indicated in their illustration of the furca (Kornicker and Palmer, 1987, fig. 3d). (A triangular protuberance is present following the 6th furcal claw of the A-1 female, and it probably is an Anlage of the 7th claw of the adult.)

**Genitalia** (Figure 23e): Left side of holotype with genital tube. 2 bristles in vicinity of tube.

#### *Deeveya jillae* Kornicker and Iliffe, 1989a

FIGURES 22b, 23f,g, 29d, 30

*Deeveya jillae* Kornicker and Iliffe, 1989a:19, figs. 9-15.

**MATERIAL.**—Holotype, USNM 193298.

**DISTRIBUTION.**—Hatchet Bay Cave, Eleuthera Island, Great Bahama Bank.

**SUPPLEMENTARY DESCRIPTION OF A-1 MALE** (Figures 22b, 23f,g, 29d).—Mandible (Figure 23f): Coxale endite with bristle on anterior and posterior ends of proximal tooth. Kornicker and Iliffe (1989a:00) reported only 3 proximal

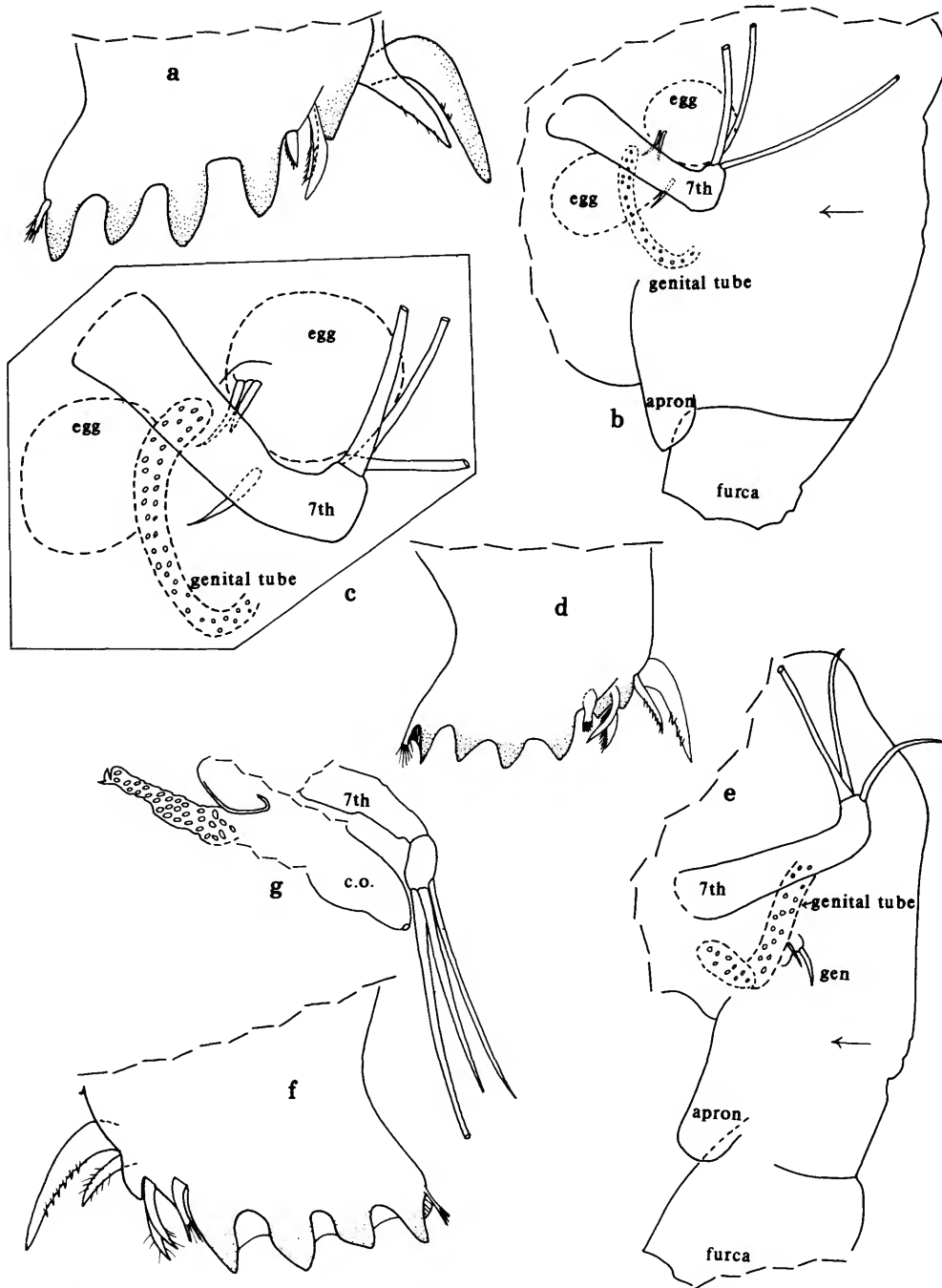


FIGURE 23.—*Deeveya spiralis* Kornicker and Iliffe, holotype, USNM 193117, adult female, length 2.87 mm: *a*, proximal tooth of coxale endite of right mandible, medial view, anterior to left; *b*, posterior of body from left side (claws of furca not shown; arrow points to anterior); *c*, detail from *b*. *Deeveya bransonii* Kornicker and Palmer, holotype, USNM 193301, adult female: *d*, proximal tooth of coxale endite of right mandible, medial view, anterior to left; *e*, posterior part of body from left side (claws of furca not shown; arrow points to anterior). *Deeveya jillae* Kornicker and Iliffe, holotype, USNM 193298, A-1 male: *f*, proximal tooth of coxale endite of left mandible, medial view, anterior to right; *g*, posterior of body from left side showing both branches of copulatory organ and 7th limb, anterior to left.



bristles on the basale; it is possible that 4 were present originally and 1 was broken off during dissection.

**Fifth Limb:** Protopodite without glandular process and with 2 ventral endites and medial hairs: endite I with 3 bristles (longest with long proximal spines, shortest tubular); endite II with 1 proximal medial bristle with short marginal spines, 1 subventral lateral bristle with long proximal spines, and 2 tubular ventral bristles. Basale with 2 long lateral subventral bristles with long marginal spines, 1 proximal medial bristle, and 5 ventral bristles (3 tubular, 2 pectinate). Endopodite with 1 proximal medial bristle and 7 ventral bristles (2 claw-like unringed pectinate). 1st exopodial joint divided into 2 parts: proximal part with 7 bristles (1 very long bare terminal dorsal bristle, 1 shorter plumose dorsal bristle just proximal to terminal bristle, 1 distal plumose lateral bristle at midwidth, 1 subventral lateral bristle, 1 subventral medial bristle with short marginal spines, and 2 ventral bristles); distal part with 3 bristles on or near ventral margin. 2nd exopodial joint with 1 dorsal and 2 ventral bristles. 3rd exopodial joint with 4 terminal bristles. Limb illustrated in Kornicker and Iliffe (1989a, fig. 13a).

**Copulatory Organ** (Figure 23g): With 2 branches: anterior branch more weakly developed and narrower than posterior branch, with transparent triangular process at tip; posterior branch with minute rounded process at tip. (It is possible that anterior and posterior branches are twisted on specimen and could be reversed.)

### *Deeveya hirpex* Kornicker, new species

FIGURES 22e, 24–26, 29e, 30

ETYMOLOGY.—From the Latin *hirpex* (rake, harrow).

MATERIAL.—Dan's Cave, Abaco Island, Little Bahama Bank (all specimens in alcohol): 9 Jun 1984: USNM 193593, adult female (holotype). 15 Jun 1984: USNM 193606, 1 adult female; USNM 193607, 2 juveniles.

DISTRIBUTION.—Known only from Dan's Cave, Abaco Island, Little Bahama Bank.

DESCRIPTION OF ADULT FEMALE (Figures 22e, 24–26).—Carapace oval in lateral view except for straight dorsal margin and slightly concave anterior margin (Figure 24a). Right valve with small tubercle on dorsal margin near posterior end.

**Ornamentation:** USNM 193606 with well-developed internal reticulations and fairly large clear disks at intersections of walls of reticulations (Figure 24k); disks are larger closer to valve margins. Reticulations of carapace of USNM 193593 almost completely obliterated by treatment of specimen with lactic acid; in transmitted light, small flat light amber bosses in center of clear disks (Figure 24b). (USNM 193607, 2 juveniles not described herein and not treated with lactic acid with structure of shell similar to that of USNM 193606 (Figure 29e).)

**Bristles:** Individual bristles sparsely distributed along

valve edge and lateral surface, none bifurcate. Setose bristle just posterior to glandular opening on dorsal tubercle of right valve (Figure 24a,f).

**Infold** (Figure 24a,g): Broad infold along anterior, ventral and posterior margins, narrowest opposite anterior concavity of margin. Narrow list present along anterior, ventral and posterior infolds, and bearing narrow lamellar prolongation with smooth outer edge. Selvage along outer margin with lamellar prolongation with smooth edge (Figure 24g).

**Glands** (Figure 24c): Glandular opening at tip of dorsal tubercle anterior to setose bristle (Figure 24f).

**Central Adductor Muscle Attachments** (Figure 24d,e): 18 or 19 individual attachment scars arranged in ellipse with long axis oblique to dorsal margin; 3 additional scars forming row anterior and ventral to ellipse.

**Carapace Size:** USNM 193593, length 2.36 mm, height excluding tubercle 1.65 mm, height including tubercle 1.73 mm. USNM 193606, length 2.36 mm, height including tubercle 1.73 mm.

**First Antenna** (Figures 22e, 24h,i): Elongate with 8 joints. 1st joint with terminal spinous lobe overlapping proximal ventral corner of 2nd joint. 2nd joint with dorsal midbristle with marginal spines; medial and lateral surfaces with distal spines. 3rd joint elongate with spinous ventral bristle distal to midlength. 4th joint short with slender terminal dorsal bristle. 5th joint shorter than 4th, with long terminal ventral bristle with short proximal ringed part and slightly broader filament-like distal part with minute widely spaced marginal spines and terminal papilla. 6th joint shorter than 5th, bare. 7th joint about same length as 4th, with short ringed lateral a-bristle near distal dorsal corner, and b- and c-bristles on terminal ventral pedestal (medial b-bristle less than  $\frac{2}{3}$  length of lateral c-bristle, with short ringed proximal part and unringed filament-like distal part with widely spaced minute marginal spines and terminal papilla; c-bristle about twice length of stem, ringed in proximal  $\frac{2}{3}$  and with widely spaced minute marginal spines (spines stouter than both those of b-bristle and bristle of 5th joint)). 8th joint with terminal d-, e-, f-, and g-bristles (d-bristle similar in structure, spinosity, and length to bristle of 5th joint; e-bristle about same length as c-bristle, distinctly ringed in proximal half, with widely spaced marginal spines (spines much stouter than those of d-bristle, similar to those of c-bristle) and terminal papilla; f-bristle at slight ventral angle, with same structure, spinosity, and about same length as d-bristle; g-bristle more than half length of e-bristle and with same structure and spines as d-bristle).

**Second Antenna** (Figure 25a,b): Medial and lateral surfaces with minute spines along proximal dorsal margin; longer distal lateral spines forming transverse rows at midwidth (Figure 25a). Endopodite (Figure 25b): 1st joint with a-bristle about  $\frac{2}{3}$  length of b-bristle. 2nd joint forming angle with 1st, with f-bristle more slender and about  $\frac{2}{3}$  length of g-bristle, with short ringed proximal part and unringed slightly broader filament-like distal part, and minute widely spaced marginal

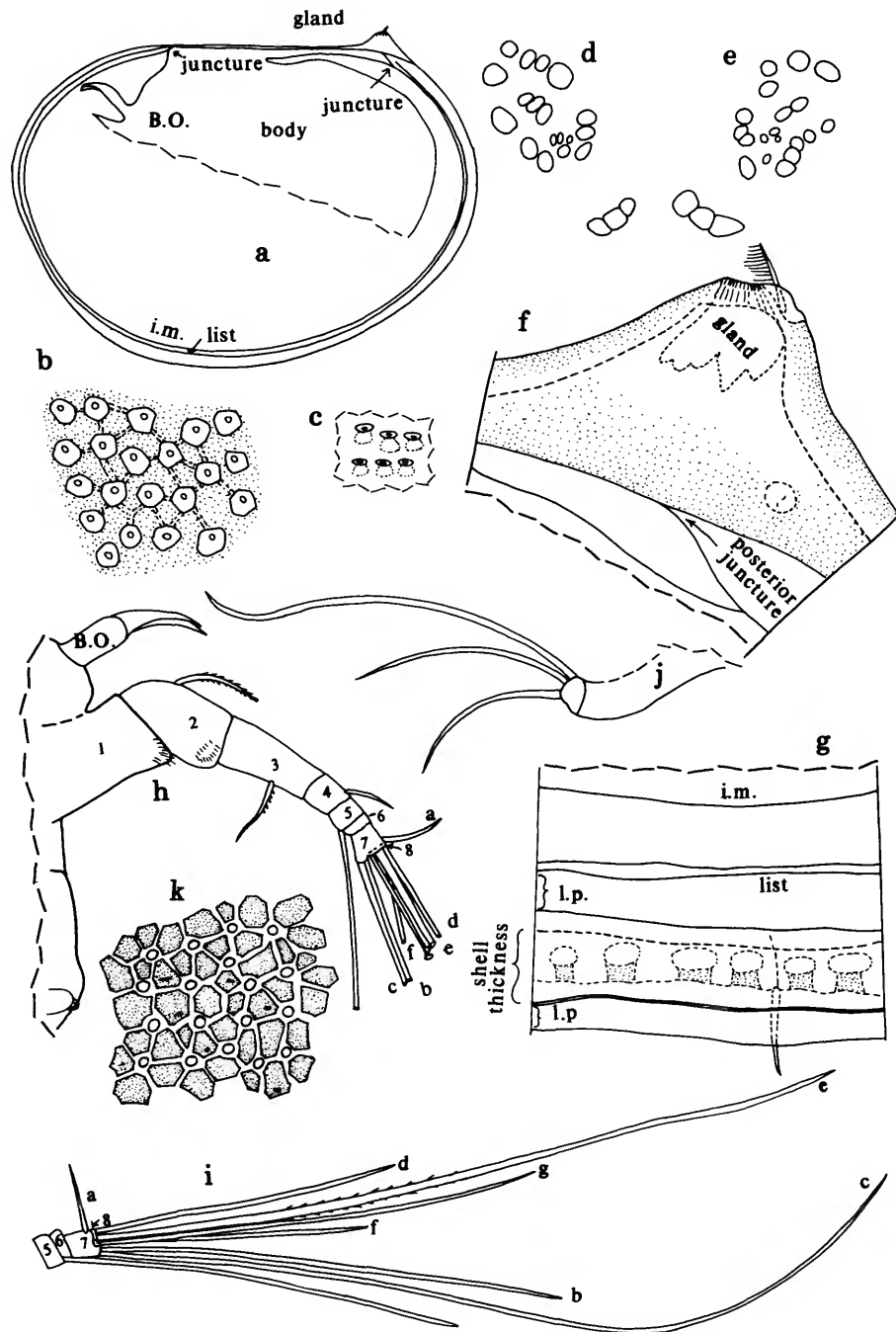


FIGURE 24.—*Deeveya hirpex* Kornicker, new species, holotype, USNM 193593, adult female, length 2.36 mm: a, inside view of right valve showing upper part of suspended body; b, outside view of left valve showing surface and internal structures (drawn in transmitted light); c, oblique view of reticules near edge of left valve (drawn in transmitted light); d, e, outside views of muscle attachments of right and left valves; f, inside view of posterodorsal corner of right valve; g, inside view of ventral margin of right valve; h, Bellonci organ and right 1st antenna (only proximal part shown of most bristles on distal joints); i, joints 5-8 of right 1st antenna, lateral view; j, right 7th limb, lateral view. Paratype, USNM 193606, adult female, length 2.36 mm: k, outside view of surface and internal structures of right valve near middle (drawn in transmitted light).



FIGURE 25.—*Daeveya hirpex* Kornicker, new species, holotype, USNM 193593, adult female, length 2.36 mm: a, distal end of protopodite of left 2nd antenna showing spines, lateral view; b, endopodite of left 2nd antenna (only proximal part shown of most bristles of 2nd and 3rd joints), lateral view; c, coxale endite of left mandible, medial view, anterior towards right; d, distal end of basale of left mandible, lateral view; e, endopodite of left mandible, medial view; f, basale of right mandible, lateral view; g, basale of right mandible (not all bristles shown), medial view; h, right maxilla (endite bristles not shown), medial view; i, endites of right maxilla, medial view.



spines and terminal papilla; g-bristle about twice length of protopodite, with distinct rings in proximal  $\frac{2}{3}$ , and minute widely spaced marginal spines (stouter than spines of f-bristle) and terminal papilla; minute lateral peg near insertion of 3rd joint; 3rd joint not well defined, with h-, i-, and j-bristles similar in structure and spinosity to that of f-bristle, and about half length of g-bristle. Exopodite 9-jointed: 1st joint divided into long proximal and short distal parts; distal part with slender, bare, medial bristle reaching 5th joint; 2nd joint with long bristle with ventral spines and natatory hairs; joints 3-8 with long bristles with natatory hairs; 9th joint with 4 bristles (1 short, bare, 1 medium with ventral spines, 1 long with spines and natatory hairs, 1 long with natatory hairs).

**Mandible** (Figure 25c-g): Coxale endite with proximal and distal sets of teeth separated by space (Figure 25c); proximal set comprising 4 stout cusps with indistinct tooth and numerous spines between cusps, a short slender bristle on terminal anterior edge, and 1 stouter spinous bristle on posterior edge; 2 spinous bristles medial to stout rounded tooth between proximal and distal sets of teeth; 1 spinous bristle and 1 stout curved process proximal to distal set of teeth; distal set comprising 2 flat teeth: proximal tooth with 5 cusps (proximal cusp slightly longer); distal tooth with 7 cusps (middle cusp stouter). Basale with 4 long proximal bristles (3 stout plumose, 1 long slender with short marginal spines) (Figure 25f). Basale endite: distal edge with 6 terminal triangular cusps (Figure 25d,g); lateral surface near distal edge with sharp tooth near midwidth; lateral surface distal to midlength with 3 or 4 slender bristles and 2 long stout entwined bristle crossing each other in 5 places (Figure 25d,g); anterior margin with 1 slender bristle; posterior margin with proximal spines and 2 short distal bristles (distal of these tubular). Endopodite 3-jointed (Figure 25e): 1st joint with 1 spinous terminal dorsal bristle, 1 distal ventral bristle, and 4 distal medial bristles; 2nd joint with 3 spinous terminal dorsal bristles (1 claw-like), and 1 spinous terminal ventral bristle; 3rd joint hirsute medially and along dorsal margin, with 4 medial bristles forming row, and 3 stout spinous terminal bristles (all marginal spines on bristles short; ventral bristle with closely spaced short spines (spines shorter than width of bristle) along distal dorsal half).

**Maxilla** (Figure 25h,i): Coxale with 1 stout, plumose, terminal, dorsal bristle. Endite I with 2 proximal anterior bristles (both with long hairs) and about 10 terminal bristles (1 short tubular, 3 long tubular, about 6 stout with pointed tips, bare or with long hairs); endite II with 2 proximal anterior bristles with long hairs, and about 9 terminal and subterminal bristles (some tubular, some claw-like); endite III with 1 proximal bristle (with long hairs) with base near basale, and about 5 terminal bristles (2 tubular, about 3 claw-like) (Figure 25i). Basale with 1 slender bare ventral bristle and 1 slender bare medial bristle at midwidth. Endopodite (Figure 25h): 1st joint with hairs along posterior surface and with 10 or 11 bristles (4 or 5 proximal medial, 1 distal on anterior margin, 1 distal on posterior margin, 4 distal lateral, all either bare or

with short marginal spines); 2nd joint with 2 stout pectinate claws, 5 slender bristles, and long hairs along dorsal half.

**Fifth Limb** (Figure 26a): Epipodite with plumose bristles forming 3 groups: ventral group with 5 (ventral bristle about  $\frac{2}{3}$  length of others); middle group with 6; dorsal group with 5 long and 1 short (dorsal). Protopodite without lateral glandular process and with 2 ventral endites: endite I with 3 bristles (longest with long proximal spines, others with short spines, shortest tubular); endite II with 1 proximal medial bristle with short spines, and 4 or 5 ventral bristles (longest with long proximal spines, others bare or with short spines, some tubular). Basale with 1 proximal medial bristle with short marginal spines, and 8 bristles on or near ventral margin (2 longest with long proximal spines, 1 or 2 claw-like, others bare or with short marginal spines, some tubular). Endopodite with 1 proximal medial bristle, 2 anterior bristles on ventral margin (1 or both with long proximal spines), and 7 additional bristles (1 short, tooth-like with short spines, 2 claw-like unringed pectinate, and 4 bristle-like, either bare or with short marginal spines). 1st exopodial joint with weak distal transverse suture; dorsal margin with 2 terminal bristles (proximal plumose, other bare); lateral surface near ventral margin with 2 long bristles (proximal bare, distal with long spines); medial surface and ventral margin with 9 bristles (5 proximal and 4 distal, bare or with short marginal spines). 2nd exopodial joint: dorsal margin with 1 distal bristle, ventral margin with 3 slender bristles near midlength. 3rd exopodial joint with 2 stout unringed pectinate claw-like bristles, and 2 slender ringed bristles, bare or with short spines.

**Sixth Limb** (Figure 26b): Epipodite with plumose bristles forming 3 groups: ventral group with 5 long bristles; middle group with 6 long bristles; dorsal group with 5 long and 1 short (dorsal). Precoxale separated from coxale by distinct suture, each joint with 4 bristles (2 plumose, 2 with short spines); medial surfaces with long hairs. Basale with 7 plumose bristles (1 distal lateral and near endopodite, others medial or ventral). Endopodite forming thumb-like process with 4 long bristles (terminal bristle longest and bare, others plumose). Exopodite 3-jointed: 1st joint with 4 distal ventral bristles, bare or with short marginal spines; 2nd joint with 3 bristles (2 ventral, bare or with indistinct minute marginal spines, and 1 dorsal bare); 3rd joint with 4 bristles (2 stout claw-like (longest pectinate ventrally and with stouter teeth along distal third, other with few distal dorsal spines); 2 slender bristle-like bare).

**Seventh Limb** (Figures 24j, 26c): Elongate with long 1st and short 2nd joint separated by weak suture, and 3 terminal bristles (dorsal bristle stouter and longer).

**Furca** (Figure 26c): Each lamella with total of 7 claws; lamellae followed by unpaired dorsal bristle; claws 1-4 with faint teeth along posterior margin; claws 5 and 6 with teeth along both margins (teeth of claw 6 slightly stronger); claw 7 with few indistinct teeth along anterior margin; unpaired bristle about same length as claw 2, and with marginal spines; small glandular peg between claws 1 and 2; left lamella of furca of



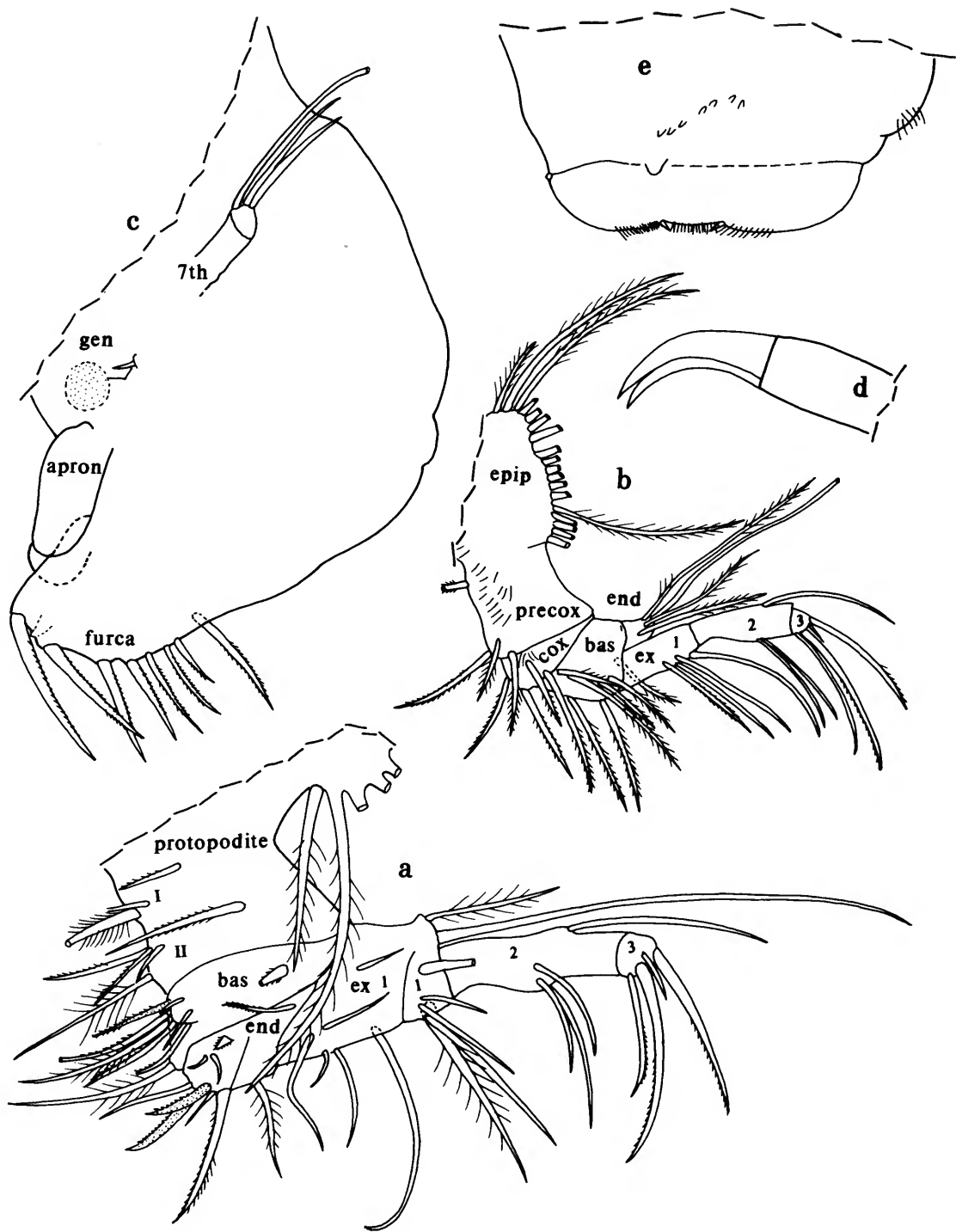


FIGURE 26.—*Deeveya hirpex* Kornicker, new species, holotype, USNM 193593, adult female, length 2.36 mm: *a*, right 5th limb, medial view; *b*, right 6th limb, medial view; *c*, posterior of body from left side; *d*, Bellonci organ from left side; *e*, anterior view of upper lip (anterior surface of left side fragmented so that some glandular processes are not shown).

USNM 193593 very slightly anterior to right lamella. Apron anterior to furca (Figure 26c).

*Bellonci Organ* (Figures 24h, 26d): Well developed, bifurcate at midlength, with each branch tapering to point.

*Upper Lip* (Figure 26e): Typical for genus.

*Genitalia* (Figure 26c): Small oval brown area on left side of body adjacent to small bristle.

*Posterior of Body* (Figure 26c): Rounded, not segmented.

*Unknown Receptacle*: Not observed.

COMPARISONS.—The carapace of *D. hirpex* is smaller than those of *D. styrax* and *D. spiralis*, and larger than that of *D. bransoni* (Figure 30). The adult of *D. jillae* is unknown but the small size of the A-1 instar suggests that adults will be much smaller than *D. hirpex* (Figure 30). The clear round disks at intersections of reticulations of *D. hirpex* are larger than those of *D. styrax*, *D. spiralis*, and *D. bransoni*, but slightly smaller than those of *D. jillae* (Figure 29). The 3rd joint of the 1st antenna of *D. hirpex* (Figure 22e) is more elongate than that of *D. jillae* (Figure 22b).

#### *Deeveya medix* Kornicker, new species

FIGURES 22f, 27, 28, 29f, 30

ETYMOLOGY.—From the Latin *medix* (curator).

MATERIAL.—Sagittarius Cave, Sweeting's Cay, Grand Bahama Island, Little Bahama Bank (all specimens in alcohol): 25 Jul 1984: USNM 193592, 1 adult male (holotype); USNM 193603, 1 adult ?female. 14 Dec 1984: USNM 193604A, 1 adult ?female; USNM 193604B, 1 adult female; USNM 193604C, 1 adult. 8 Jun 1987: USNM 193600, 1 adult female; USNM 193601, 1 adult. 12 Sep 1987: USNM 193602A,B, 2 adult males, USNM 193602C, 1 adult. 17 Dec 1987: USNM 193599, 8 specimens (crushed). All except holotype are paratypes.

DISTRIBUTION.—Known only from Sagittarius Cave, Sweeting's Cay, Grand Bahama Island, Little Bahama Bank (type locality).

DESCRIPTION OF ADULT MALE (Figures 22f, 27a-o, 28a-k).—Carapace oval in lateral view except for straight dorsal margin and slightly concave anterior margin (Figure 27a). Right valve with small tubercle on dorsal margin near posterior end. Shell strongly calcified, brittle.

*Ornamentation* (Figure 27b,p): Carapace when viewed in transmitted light with large disks appearing bright (Figure 27b,p); disks not represented by depressions on valve surface, which appears smooth; reticulations within shell walls easily visible on some specimens (Figure 27p; sex and age unknown) but not on others (Figure 27b); minute bright boss on valve surface between disks bosses appearing as projections along anterior and anteroventral shell edge. (Ornamentation also shown for USNM 193601, an adult of undetermined sex (Figure 29f)).

*Bristles*: Valve margins and lateral surface with few

undivided bristles (Figure 27b). Setal bristle at tip of dorsal tubercle of right valve.

*Infold* (Figure 27d): Broad infold along anterior, ventral, and posterior margins, narrowest opposite anterior concavity, widest at anteroventral corner. Narrow list present near inner margin of anterior infold but closer to outer margin along ventral infold; anteroventral and ventral list scalloped along inner edge. Selvage along outer margin of infold with narrow lamellar prolongation with smooth outer edge.

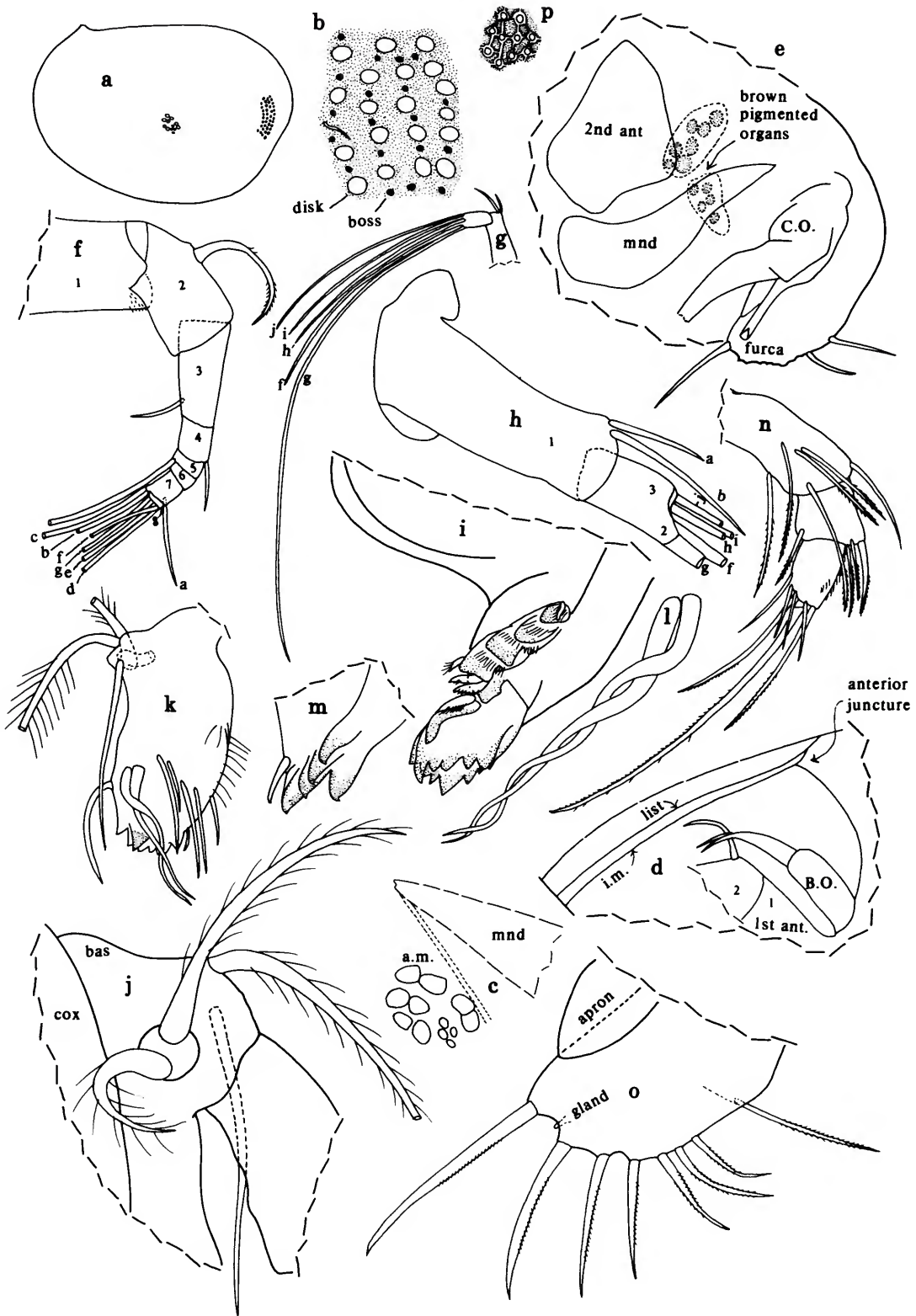
*Glands*: Glandular opening on tip of dorsal tubercle of right valve.

*Central Adductor Muscle Attachments* (Figure 27a,c): 12 individual attachments arranged in ellipse with long axis oblique to dorsal margin. Indistinct crescent shaped scar just anterior and ventral to central adductor muscle attachments.

*Carapace Size*: USNM 193592, length 1.73 mm, height including tubercle of right valve, 1.22 mm, height excluding tubercle 1.18 mm; USNM 193602A, length 1.67 mm, height including tubercle 1.19 mm; USNM 193602B, length 1.67 mm, height including tubercle 1.20 mm.

*First Antenna* (Figures 22f, 27d,f): Elongate with 8 joints. 1st joint with terminal ventral spinulose lobe overlapping proximal ventral corner of 2nd joint. 2nd joint with dorsal midbristle bearing short marginal spines. 3rd joint elongate (width of distal margin 31% length of dorsal margin), with distal ventral bristle. 4th joint short with short, slender, dorsal, terminal bristle. 5th joint shorter than 4th, with long, ventral, terminal, filament-like bristle. 6th joint slightly shorter than 5th, bare. 7th joint about same length as 4th, with short, distal, lateral a-bristle near dorsal margin, 1 long medial b-bristle and 1 long lateral c-bristle on short terminal ventral pedestal (both b- and c-bristles with widely spaced minute lateral spines and a terminal papilla, and reaching past tip of bristle of 5th joint);

FIGURE 27.—*Deeveya medix* Kornicker, new species, holotype, USNM 193592, adult male, length 1.73 mm: a, complete specimen from right side showing central adductor muscle attachments and representative "discs" near anterior margin; b, outside view of surface and internal structures of left valve drawn in transmitted light (discs are shown as open circles; bosses as filled-in circles); c, central adductor muscle attachments of right valve and proximal part of coxale endite of right mandible with attached muscle bundle (dashed), anterior toward right; d, inside view of anteroventral part of right valve, and Bellonci organ and proximal joints of left 1st antenna in place; e, part of body from left side showing location of protopodite of left 2nd antenna, coxale endite of left mandible, brown pigmented organs, copulatory organ (tip of anterior branch not shown), right lamella of furca (not all claws shown), and unpaired bristle posterior to furca; f, left 1st antenna (only proximal part shown of most bristles of distal joints), medial view; g, endopodite of right 2nd antenna, medial view; h, endopodite of left 2nd antenna (only proximal part shown of bristles of 2nd and 3rd joints), medial view; i, coxale endite of left mandible (not under cover slip), anterior toward right, medial view; j, proximal end of basale of left mandible (not under cover slip), anterior to right, medial view; k, basale of left mandible, anterior toward left, lateral view; l, entwined lateral bristles of basale of right mandible; m, anterior view of distal end of basale of left mandible, lateral side toward right; n, endopodite of left mandible, medial view; o, left lamella of furca, lateral view. Paratype, USNM 193599, sex and age and shell dimensions not determined; p, discs and reticulations of shell viewed in transmitted light (nodes not shown).





b-bristle filament-like; c-bristle stouter and almost twice length of b-bristle, ringed proximally and filament-like distally. 8th joint with terminal d-, e-, f-, and g-bristles (d-bristle reaching tip of bristle of 5th joint, with marginal spines and terminal papilla; e-bristle same length as c-bristle, with fairly stout widely spaced marginal spines and terminal papilla, ringed proximally and filament-like distally; f-bristle at slight ventral angle, slightly shorter than d-bristle, with widely spaced marginal spines and terminal papilla, filament-like; g-bristle with tip broken, remaining part more than half length of e-bristle, with widely spaced marginal spines, filament-like). (Marginal spines not shown on bristles of 7th and 8th joints of illustrated limb.)

*Second Antenna:* Protopodite with distal lateral spines (Figure 27e, spines not shown). Endopodite (Figure 27g-h): 1st joint with a-bristle about half length of b-bristle; 2nd joint of right limb of USNM 193592 at right angle to 1st joint (Figure 27g), but straight on left limb (Figure 27h), with long f- and g-bristles (f-bristle filament-like, more slender and about half length of g-bristle, and with terminal papilla; g-bristle ringed in proximal half, filament like distally and with terminal papilla); 3rd joint small, with filament like h-, i-, and j-bristles, all slightly shorter than f-bristle, each with terminal papilla. Exopodite 9-jointed: 1st joint divided into long proximal and short distal parts; distal part with slender bare medial bristle almost reaching distal end of 4th joint; 2nd joint with long bristle with ventral spines along distal  $\frac{2}{3}$  and natatory hairs; bristles of joints 3-8 long and with natatory hairs; 9th joint with 4 bristles (1 short bare, 2 longer with ventral marginal spines, 1 very long with natatory hairs).

*Mandible* (Figure 27c,e,i-n): Coxale endite with proximal and distal sets of teeth separated by space (Figure 27i): proximal set comprising 4 stout cusps (2 distal cusps with square tips, others more rounded); a short spinous bristle on both anterior and posterior edge of proximal set; surface between cusps and posterior to cusps with abundant slender spines; 2 spinous bristles medial to stout rounded tooth between proximal and distal sets of teeth; 1 spinous bristle and 1 stout curved process proximal to distal set of teeth; distal set comprising 2 flat teeth: proximal tooth with 5 cusps (posterior cusp longer); distal tooth with 7 cusps (middle cusp stouter). Basale with 4 long proximal bristles (3 stout plumose, 1 slender, medial, bare) (Figure 27j,k). Basale endite: distal edge with 6 terminal triangular cusps; lateral surface near distal edge with sharp tooth near midwidth; lateral surface distal to midlength with 4 slender bristles and 2 long stout entwined bristles (Figure 27k-m); anterior margin with 1 slender bristle; posterior margin with proximal spines and 2 short distal bristles (distal of these tubular). Endopodite 3-jointed (Figure 27n): 1st joint with 1 subterminal dorsal bristle, 1 spinous distal ventral bristle, and 4 spinous medial bristles; 2nd joint with 3 spinous terminal dorsal bristles (1 claw-like), and 1 spinous terminal ventral bristle; 3rd joint hirsute medially and along dorsal margin, with 4 medial bristles forming row, and 3 spinous

terminal bristles (all marginal spines short; ventral bristle with closely spaced short spines (spines shorter than width of bristle) along distal dorsal half).

*Maxilla* (Figure 28a-e): Coxale with stout, hirsute, terminal, dorsal bristle (Figure 28a). Endite I with 2 slender proximal bristles and 11 terminal bristles, some tubular (Figure 28c); endite II with 2 slender proximal bristles and 11 subterminal and terminal bristles (Figure 28d), some tubular; endite III with 1 subterminal bristle near basale and 6 terminal bristles (4 claw-like, 2 tubular) (Figure 28e). Basale with 1 slender ventral bristle and 1 slender terminal medial bristle at midwidth. Endopodite: 1st joint with 10 bristles (4 near anterior margin, 6 in vicinity of distal posterior corner); 2nd joint with 2 stout pectinate claws, 6 slender bristles, and long hairs on anterior surface (Figure 28b).

*Fifth Limb* (Figure 28f): Epipodite with hirsute bristles forming 3 groups: ventral group with 5 (ventral bristle about  $\frac{2}{3}$  length of others); middle group with 6; dorsal group with 4 long and 1 short (dorsal). Protopodite with lateral glandular field, and 2 ventral endites: endite I with 3 bristles (longest with long proximal spines, shortest tubular, other with short marginal spines); endite II with 1 proximal medial bristle with short spines and 5 ventral bristles (longest with long proximal spines, others either bare or with short spines and tubular). Basale with 2 long long lateral subventral bristles with long proximal spines, 1 proximal medial bristle with short marginal spines, and 8 ventral bristles (1 medial with long spines, 2 pectinate, somewhat claw-like, 5 tubular). Endopodite with about 10 bristles (1 proximal medial bristle with short marginal spines, 1 lateral subventral with long proximal spines, 2 anterior with long proximal spines, 2 claw-like ventral pectinate, 2 short tubular, 1 long ventral with short marginal spines, 1 short, medial, subterminal, with pointed tip; usual small triangular medial bristle not observed). 1st exopodial joint divided into 2 parts: proximal part with 10 bristles (dorsal margin with very long bare subterminal bristle, 1 plumose bristle just proximal to terminal bristle, 1 plumose terminal lateral bristle at joint midwidth, 1 slender bare lateral bristle near ventral margin, 2 proximal medial bristles, and 4 ventral bristles); distal part with 4 bristles on or near ventral margin, bare or with short marginal spines. 2nd exopodial joint: dorsal margin with 1 distal bristle; ventral margin with 4 slender bristles near midlength. 3rd exopodial joint with 2 stout unringed pectinate claw-like bristles, and 2 slender ringed bristles.

*Sixth Limb* (Figure 28g): Epipodite with plumose bristles forming 3 groups: ventral group with 5 long bristles, middle group with 6 long bristles, dorsal group with 5 bristles (4 long, 1 short (dorsal)). Precoxale separated from coxale by distinct suture, both joints with long medial hairs. Precoxale with proximal tubular bristle with short marginal spines, and 3 distal bristles (1 with short and 2 with long spines). Coxale with 4 bristles (2 with long spines). Basale with 7 plumose bristles (1 lateral, 6 medial or ventral), none close to endopodite. Endopodite forming thumb-like process with 4 long bristles



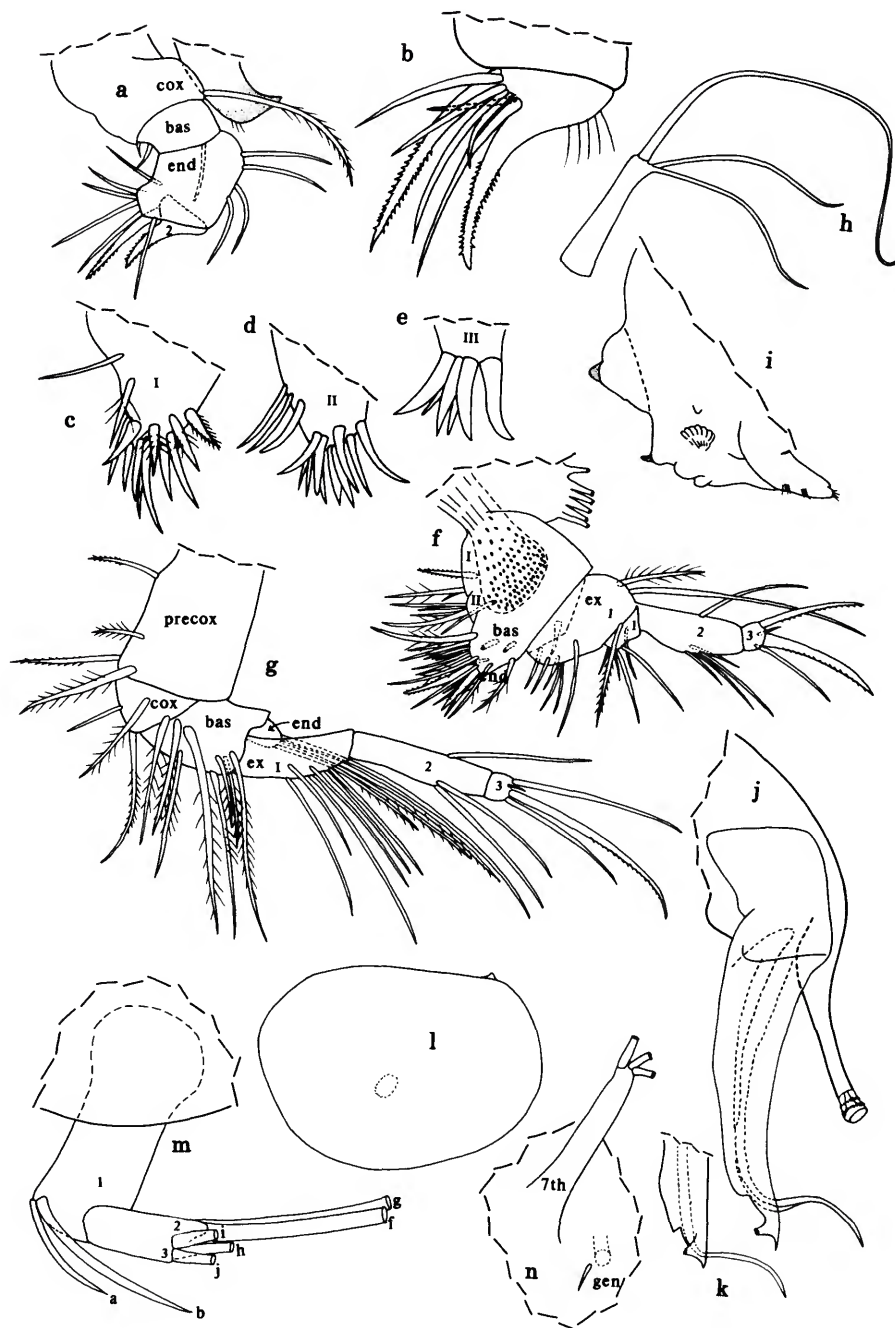


FIGURE 28.—*Deeveya medix* Kornicker, new species, holotype, USNM 193592, adult female, length 1.73 mm: a, left maxilla (not all bristles shown of endites and 2nd endopodial joint), lateral view; b, 2nd endopodial joint of left maxilla, medial view; c-e, endites of left maxilla, medial views; f, left 5th limb, lateral view; g, right 6th limb, medial view; h, left 7th limb, lateral view; i, anterior of body from left side with tip of lower lip at bottom; j, copulatory organ, anterior towards left. Paratype, USNM 193602B, adult male, length 1.67 mm: k, tip of anterior branch of copulatory organ. Paratype, USNM 193600, adult female, length 1.73 mm: l, complete specimen from left side (location of central adductor muscle attachments indicated by dashed oval); m, endopodite of left 2nd antenna (only proximal part shown of bristles of 2nd and 3rd joints), lateral view; n, part of posterior of body from left side showing 7th limb (only proximal part shown of bristles) and genitalia.

(terminal bristle longest and bare, others plumose); endopodite of USNM 193592 partly lateral to 1st exopodial joint. Exopodite 3-jointed: 1st joint with 6 bristles (bare or with short marginal spines); 2nd joint with 3 bristles (2 ventral, 1 dorsal). 3rd joint with 4 bristles (2 stout claw-like, longest with ventral marginal teeth distally and, 2 bristles slender bare).

**Seventh Limb** (Figure 28h): Elongate, unjointed, with 3 terminal bristles.

**Furca** (Figure 27o): Each lamella with 7 claws; lamellae followed by unpaired spinous dorsal bristle about same length as claw 2; claws 1-4 with teeth along posterior margin, claws 5-7 with small teeth along both margins; teeth of claw 7 only very slightly smaller than those of claws 5 and 6; small glandular peg between claws 1 and 2; right lamella of furca of USNM 193592 very slightly anterior to left lamella. Apron anterior to furca (Figure 27o).

**Bellonci Organ** (Figure 27d): Well developed, bifurcate at midlength, with each branch tapering to point.

**Upper Lip** (Figure 28i): Not examined in detail but similar to that of *D. spiralis*. Lower lip beak shaped process on each side of mouth.

**Copulatory Organ** (Figure 28j,k): Differs from that of *D. styrax* in having subterminal anterior toothed process on anterior branch.

**Posterior of Body**: Rounded unsegmented.

**Pigmented organs** (Figure 27e): 2 organs with brown pigment and containing rounded cells of darker brown pigment present posterior to protopodite of 2nd antenna and anterior to copulatory organ.

**Unknown Receptacle**: None observed.

**DESCRIPTION OF ADULT FEMALE** (Figure 28l-n).—Carapace similar to that of adult male (Figure 28l).

**Carapace Size**: USNM 193600, length 1.73 mm, height including tubercle 1.26 mm, height excluding tubercle 1.25 mm; USNM 193604B, length 1.67 mm, height including tubercle 1.21 mm, height excluding tubercle 1.20 mm. Sex uncertain (valves not opened): USNM 193603, length 1.75 mm, height including tubercle 1.30 mm, height excluding tubercle 1.26 mm; USNM 193604A, length 1.71 mm, height including tubercle 1.23 mm, height excluding tubercle 1.21 mm.

**First Antenna, Second Antenna** (Figure 28m), **Mandible, and Maxilla**: Not examined in detail but similar to those of adult male.

**Fifth Limb**: Protopodite without glandular field present on male. Limb not examined in detail but similar to that of male.

**Sixth Limb**: Similar to that of male except endopodite of

USNM 193600 medial to exopodite.

**Seventh Limb** (Figure 28n), **Furca, Bellonci Organ, and Upper Lip**: Similar to those of male.

**Genitalia** (Figure 28n): Not seen with certainty. Single bristle near genital area.

**COMPARISONS**.—Carapace of *D. medix* similar to that of *D. jillae* in having large disks. Adult *D. jillae* unknown, but length probably with range of 1.32-1.35 mm (determined by multiplying length of A-1 male (1.07 mm) by estimated growth factors of 1.23 and 1.26), much shorter than length of adult male *D. medix* (1.73 mm) (Figure 30). 3rd joint of 1st antenna of *D. medix* more elongate than that of *D. jillae* (width of distal end of 3rd joint of 1st antenna as percent of length of dorsal margin 31% for *D. medix* (Figure 22f) and 38% for *D. jillae* (Figure 22b)). Carapace of adult *D. hirpex* much larger than that of *D. medix* (length 2.36 mm compared to 1.73 mm) (Figure 30). Carapace of *D. medix* differing from that of *D. bransoni* in having larger disks at intersections of walls of reticulations (Figure 29b,f).

#### DISCUSSION OF GENUS

The carapaces of known species of *Deeveya* mainly differ in overall size (Figure 30) and in the diameter (relative to breadth of polygons) of disks at the intersections of walls forming polygons (Figure 29). The carapace of *D. spiralis* differs from those of other species in having bifurcating rather than simple bristles along the anterior margin. The 1st antennae of some species differ in length (relative to width) of the 3rd joint (Figure 22). The spination of the posterior bristle of the end joint of the endopodite of the mandible differs on some species (*D. spiralis* and *D. bransoni*). The end joint of the exopodite of the 5th limb of *D. spiralis* bears 5 bristles, whereas other species have only 4. The number of bristles in the 3 groups of bristles forming the epipodites of the 5th and 6th limbs may differ slightly among species but intraspecific variability is not known, and these bristles are difficult to count on an undissected specimen and easily break off during dissection. The 5th and 6th furcal claws of *D. spiralis* bear stouter marginal teeth than those claws of other species. The number of bristles on appendages of known species are compared in Table 2, but intraspecific variability is not known. The adult male is known only for *D. styrax* and *D. medix*, but the considerable differences in the tip of the anterior branch of the copulatory organ of those species indicates that it will be useful in identifying other species.

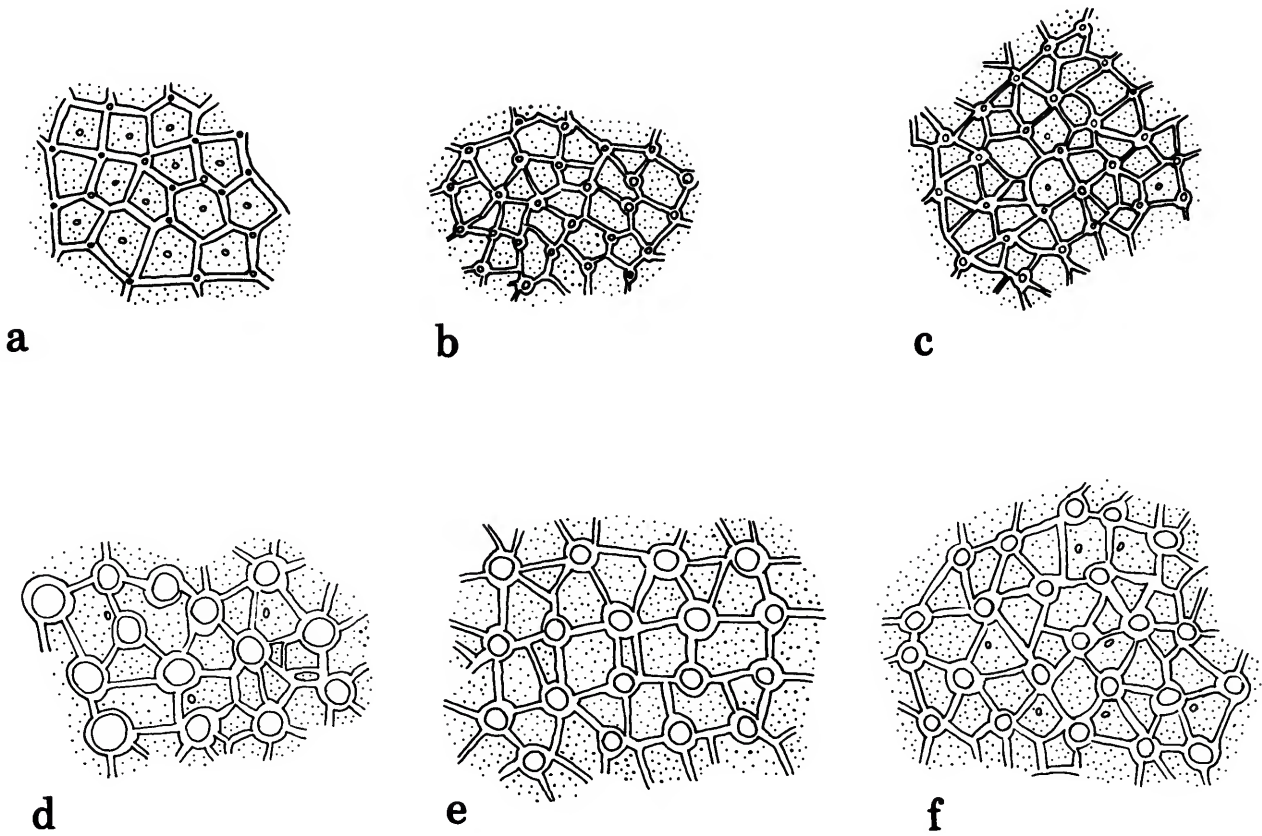


FIGURE 29.—Comparison of shell structures of species of *Deevya* viewed in transmitted light and drawn at same magnification ( $\times 40$  objective,  $\times 15$  ocular): *a*, *D. spiralis*, paratype, USNM 193118, adult female, length 2.67 mm; *b*, *D. bransoni*, holotype, USNM 193301, adult female, length 1.68 mm; *c*, *D. styrax*, paratype, USNM 193587, adult female, length 3.06 mm; *d*, *D. jillae*, holotype, USNM 193298, A-1 male, length 1.07 mm; *e*, *D. hirpex*, paratype, USNM 193607, juvenile, length 1.85 mm; *f*, *D. medix*, paratype, USNM 193601, adult (sex unknown), length 1.67 mm. (Note *d* and *e* from juveniles, others from adults.)

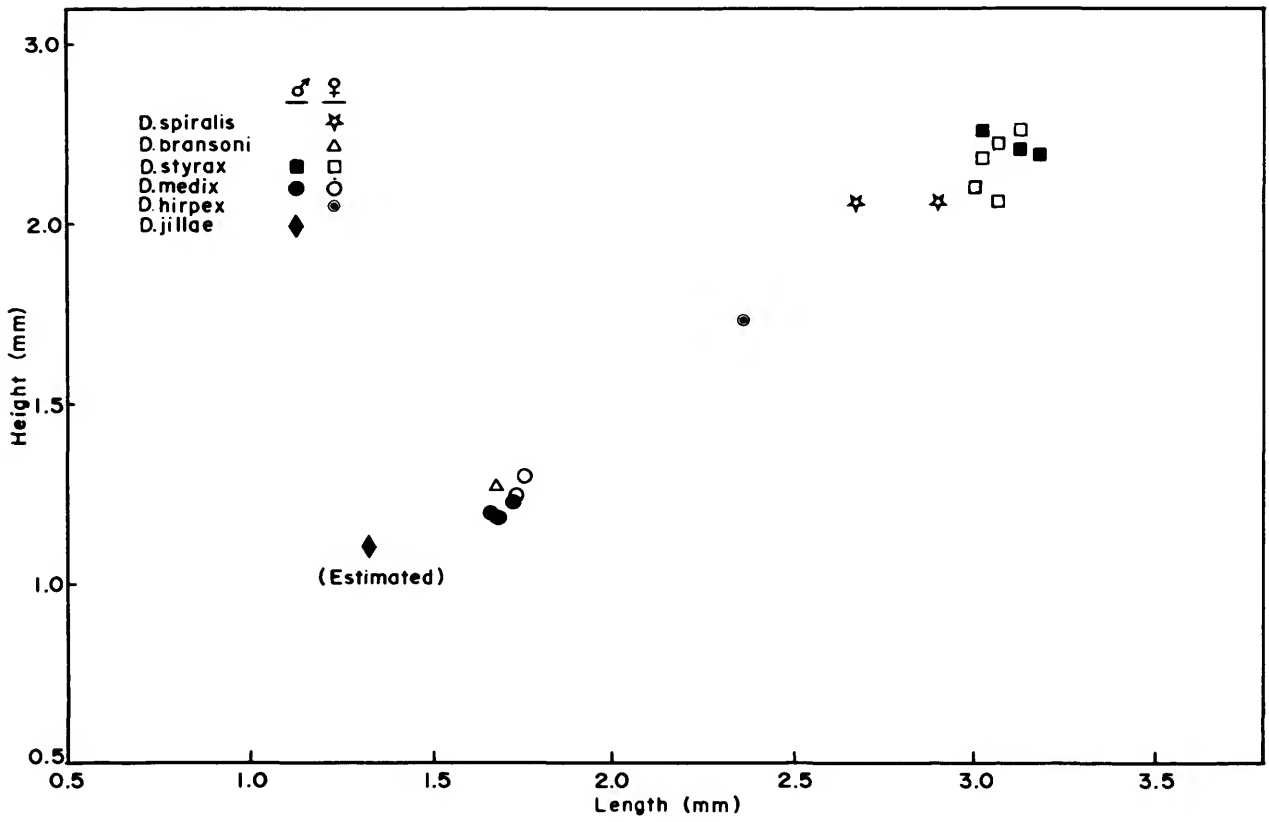


FIGURE 30.—Shell length-height graph of adult males and females of species of *Deeveya*.



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