

*Jimmorinia*, a New Genus  
of Myodocopid Ostracoda  
(Cypridinidae) from the Bahamas,  
Jamaica, Honduras, and Panama

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and  
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## ABSTRACT

Anne C. Cohen, Louis S. Kornicker, and Thomas M. Iliffe. *Jimmorinia*, a New Genus of Myodocopid Ostracoda (Cypridinidae) from the Bahamas, Jamaica, Honduras, and Panama. *Smithsonian Contributions to Zoology*, number 605, 46 pages, 23 figures, 4 plates, 1 map, 2 tables, 2000.—A new genus and two new species of marine Ostracoda (Myodocopina: Cypridinidae), collected mostly from baited traps in the waters of the Bahamas and the Caribbean Sea, are described and illustrated. *Jimmorinia gunnari*, the type species, is nonluminescent and was captured at 88–99 m depth on a submarine escarpment in Exuma Sound near Lee Stocking Island and Great Exuma Island, Exuma Cays, Great Bahama Bank, Bahamas, and from shallower depths (3–15 m) off Discovery Bay, Jamaica, Roatan Island, Honduras, and the San Blas Islands, Panama, whereas *J. gamma* was collected only near Lee Stocking Island. Descriptions for adult females are given for both species, and descriptions of adult males and some juvenile stages are given for *J. gunnari*. Some sexual and geographic variation is described. A table of generic comparisons is presented. Some specimens of the new genus were tested and were found to be nonluminescent. *Jimmorinia* has an upper lip with fewer glandular processes (nozzles) than are present on the lips of Caribbean bioluminescent species. This paucity of nozzles may be related to a lack of bioluminescent capacity. The reduced number of ommatidia, very unusual in a cypridinid from shallow depths, may be related to the lack of luminosity, or perhaps it indicates an ancestral relationship to cypridinids from greater depths or from an anachiline cave.

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## Introduction

Myodocopid ostracodes were collected mostly from baited traps in the Bahamas, Jamaica, Roatan Island, Honduras, and San Blas Islands of Panama (Map 1) and were found to exhibit a number of unique morphological characters justifying proposal of a new genus in the myodocopid family Cypridinidae.

Taxonomic descriptions are solely the work of Cohen and Kornicker; Iliffe collected the specimens from the Bahamas, provided data and maps concerning the collecting localities in the Bahamas, and contributed to the nontaxonomic part of the monograph.

DISPOSITION OF SPECIMENS.—All specimens examined by Kornicker have been deposited in the National Museum of Natural History (NMNH), Smithsonian Institution, and have been assigned USNM (United States National Museum, collections now in the NMNH) catalog numbers (some of these also were examined by Cohen). Specimens examined only by Cohen have been deposited in the Los Angeles County Museum of Natural History and have been assigned LACM catalog numbers.

EXPLANATION OF SAMPLE NUMBERS.—Each sample is termed a “station” herein and is given the same number; the

number preceding the decimal refers to the geographic name of the collection site and the date of collection; the number following the decimal refers to a particular sample collected on that date in a particular location, habitat, time, etc. (samples collected on a particular date may have been from different localities or may have been collected by different methods; each sample number is recorded in A.C. Cohen and J.G. Morin field logs with copious data (habitat, time, display, etc.)). A particular specimen or specimens may be identified with a lower case letter in parentheses. For example, for “J11885.2(a),” the letter “J” stands for Jamaica; the number “11885” indicates that the sample was collected on 11 August 1985; the number “2” after the decimal refers to a particular sample (locality, habitat, time, etc.); and “(a)” identifies a particular specimen from that sample and is not part of the catalog number but is present on the museum label. The Smithsonian Institution and the Natural History Museum of Los Angeles County have a complete set of data for each sample. Station data for specimens examined is presented in the Appendix.

ABBREVIATIONS.—In the figures, Arabic numerals indicate limbs 1–7, as well as individual articles of each limb (the location indicating whether a limb or an article is indicated). Roman numerals I–IV indicate the endites. Arrows indicate anterior.

The following abbreviations are used in the illustrations and legends.

am	central adductor muscle attachments
ant	antenna
av	anterior view
bas	basale
Bo	Bellonci organ
cx	coxale
e	valve edge
end	endopodite
epi	epipodite
ex	exopodite

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MAP 1.—The Caribbean Basin showing the location of the Exuma escarpment (Bahamas), Roatan (Honduras), Discovery Bay (Jamaica), and San Blas Islands (Panama).

fk	frontal knob
fu	furca
gen	genitalia
gird	girdle
gl	gland
im	inner margin of infold
iv	inside view of valve
lc	line of concrescence
le	lateral eye
lft	left valve
lv	lateral view
me	medial eye
mnd	mandible
mv	medial view
mx	1st maxilla (4th limb)
N	number of specimens
nabs	not all bristles shown
ov	outside view of valve
precx	precoxale
prot	protopodite
pv	posterior view
rt	right
rv	right valve
ul	upper lip
Y-scl	Y-sclerite

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**Order MYODOCOPIDA Sars, 1866**

**Suborder MYODOCOPINA Sars, 1866**

**Family CYPRIDINIDAE Baird, 1850**

**Subfamily CYPRIDININAE Baird, 1850**

***Jimmorinia* Cohen and Kornicker, new genus**

DIAGNOSIS.—*First Antenna* (Figures 1*f*, 4*c*, 9*f-j*, 20*c*): Sensory seta of ventral 5th article with 5 long proximal filaments



followed by 3 long, more slender filaments and short subterminal filament at tip.

**Second Antenna** (Figures 5a,b, 20d): Endopod with only 2 articles, 2nd article rather elongate and with terminal seta and filament.

**Mandible** (Figures 5c, 6a, 20e,h): Terminal endopodial article without dorsal seta (with only 3 ventral setae and 3 claws).

**First Maxilla (Fourth Limb)** (Figure 21a–d, Plate 4b): Endite I with no more than 8 setae (Figure 12a). 1st endopodial article with 2 alpha- and 2 or 3 beta-setae (Figure 12c); 2nd article with 3 a- (middle seta with blunter tip and more pectinate), 3 b- (all ringed), 3 c- (1 short), and 3 d- (2 claw-like) setae (Figures 5d, 8d, 12d,e).

**Fifth Limb (Second Maxilla)** (Figures 6b, 22a–f, Plate 4b): Only 3 setae on anterior 1st exopodial article (2 setae together) (Figure 13c). 2nd exopodial article with 13 or 14 setae, all ringed (4 a-, 3 or 4 b'-, 4 b''-, 1 c-, 1 d-setae) (Figures 6b, 13c). 3rd article with 3 setae on inner lobe (Figure 6b). 4th and 5th articles fused with about 4 setae and 1 or 2 processes (Figure 6b).

**Seventh Limb** (Figures 11f, 22h): Total of about 10 or 11 setae in known species.

**Genitalia (Eighth Limb)** (Figure 6c,d, Plate 4e,f): Basal Y-sclerite with strut forming basal loop. Central lobe without setae. Outer lobe with large, only slightly tapered, hood; also with small rounded bare emergent thumb and 2 thumb setae. Inner lobe with 2 or 3 distal small triangular teeth.

**Furca** (Figures 2a, 7f, 23a,b, Plate 1a,e): 2nd and 4th claws fused to lamella; only 6 or 7 claws (plus a small posterior spine) in known species.

**Bellonci Organ** (Figures 1g, 20a): Short.

**Lateral Eye** (Figures 1f,g, 2a,b, 3c,f, 20a): Lenses without dividing line; known species with only 4 ommatidia (relatively few ommatidia may be diagnostic).

**Upper Lip** (Figures 1e, 3d, 8i, 13f, 23d–f, Plates 2d,e, 3, 4c,d): Unpaired ventral anterior field (Plate 2d,e) with relatively few glandular nozzles of dissimilar size (*J. gunnari* with 16 nozzles), unpaired field flanked posteriorly by pair of long tusks (Plates 2d, 3b,c, 4c) bearing proximal posterior tooth-like lobe (Plate 4c) and few glandular nozzles, paired (3rd) field (located anterior to mouth region, very dorsal and lateral on lip) (Plates 3c, 4c,d) with few glandular nozzles.

**ETYMOLOGY.**—Named in honor of James Gunnar Morin for his work on luminescent ostracodes.

**TYPE SPECIES.**—*Jimmorinia gunnari* by designation.

**COMPOSITION AND DISTRIBUTION.**—The genus includes two new species, *J. gunnari* and *J. gamma*. Both species were collected from off Lee Stocking Island, Exuma Cays, Great Bahama Bank, Bahamas, at depths of 88–105 m. *Jimmorinia gunnari* also was collected from Korbiski Reef in the San Blas Islands, Panama (9°33.23'N, 78°55.38'W), at a depth of 6 m; from Roatan Island, Honduras (~16.4°N, 87.8°W), at a depth of about 5 m; and from Discovery Bay, north coast of Jamaica (18.47°N, 77.42°W), from a depth of 40–50 m.

**DISCUSSION.**—**Diagnostic Morphology:** *Jimmorinia* appears to have three characters that are unique among the genera of the Cypridinidae. (1) The mandible lacks a terminal dorsal seta, instead having three terminal claws and only three setae. (2) The male copulatory (8th) limb has two or three small subterminal triangular teeth on the inner lobe, and the distal margin of the large outer hood has a rather unique blunt, rather than tapered, shape. (3) The upper lip has an apparently unique pattern of glandular valvular nozzles, with the unpaired ventral anterior field having only 16 nozzles of very different sizes.

*Jimmorinia* also appears to be unusual, but not unique, among the genera of the Cypridinidae in three characters. (1) The 5th limb (2nd maxilla) has only three anterior setae on the 1st exopodial article (only 2 in a row; shared with *Metavargula*), and the fused terminal 4th and 5th articles have two processes as well as setae. (2) The lateral compound eye has four ommatidia (all 4 lenses without a line bisecting the surface). (3) The terminal exopodial article of the 2nd antenna has only three setae.

**Functional Morphology:** The upper lip of the new genus has few glandular processes (only about 16 ventral nozzles and not more than 3 on each tusk) and paired, basally lobed tusks (Plates 2d,e, 3, 4c,d). Most presently known Caribbean species of cypridinids secrete bioluminescence from nozzles in their upper lips, producing not only a general antipredatory burst of light, but also more patterned species-specific male mating displays (Cohen and Morin, 1986, 1989, 1993; Morin, 1986; Morin and Cohen, 1988, 1991; Huvard, 1993). Lips of these bioluminescent cypridinids have many nozzles (at least 40; Cohen and Morin, 1993; Cohen and Morin, unpublished SEMs), as well as unlobed tusks. Some specimens of the new genus were tested and were found to be nonluminescent (see "Observations of Living Specimens" under description of *J. gunnari*, below). The paucity of nozzles may be related to a lack of bioluminescent capacity. Müller (1894) cited Claus's earlier (1873:214; 1891:15) postulation that the glands of the upper lip supplied digestive enzymes for ingested food, but he maintained that the strikingly well-developed upper-lip gland of *Pyrocypris* [= *Cypridina*] was related to the production of bioluminescence. Cannon (1931) deduced that the nozzles may also secrete a food entangling substance. Huvard (1993) described four types of secretory cells in the light organ of the upper lip of two species of luminescent ostracodes, of which one type of cells produced luciferin and another type produced mucus. Abe et al. (1995) and Abe et al. (1996) also suggested that the nozzles in nonluminescent species may secrete a digestive enzyme, which is secreted by some of the nozzles in luminescent ostracodes. Almost all other cypridinids known to be bioluminescent have lips with many nozzles. For example, *Vargula norvegica* (Baird) (type species of the genus *Vargula*) and *Kornickeria* species each have more than 50 nozzles in the ventral field alone, and the lips of ?*V. tsujii* Kornicker and Baker, *V. antarctica* (Müller), and many undescribed Caribbean bioluminescent species each have more than 30 nozzles (Cohen and Morin, 1993:74; Cohen and Morin, unpublished SEMs; *V. ant-*

*arctica* based only upon light microscope observations). The only exceptions are *Cypridina*, which has a very different lip divided into multiple tusks, and *?Vargula hilgendorffii* (Müller), with 22 nozzles on a divided ventral field and at least 14 more nozzles on each tusk of specimens examined (Cohen and Morin, unpublished SEMs).

Although *Jimmorinia* is found at relatively shallow depths (3–105 m), the compound lateral eyes of *Jimmorinia* have only four ommatidia. Reduction in the number of myodocopid ommatidia has occurred numerous times, apparently independently, in relation to the reduction in light with depth or anchialine habitat. We hypothesize that the reduction in ommatidia in *Jimmorinia* may indicate kinship with a deepwater (or anchialine) cypridinid (perhaps *?V. dentata* Kornicker, see below) and also could be correlated with the inability of *Jimmorinia* to produce bioluminescence. Most cypridinids have more than four ommatidia, except for some genera and species collected at relatively deep depths. These exceptions include *Gigantocypris*, *Azygocypridina*, *Isocypridina*, *Pseudodoloria*, *Rheina*, *Hadacypridina*, *Monopia*, *Vargula antarctica*, *?V. dentata*, some species of *Doloria*, *Paradoloria*, *Cypridinodes*, *Metavargula*, and *Bathyvargula* (Kornicker, 1992:230–231; Kornicker and Poore, 1996:181; Poulsen, 1962:220), and *Skogsbergia galapagensis* Kornicker and Iliffe from a dark underground Galapagos anchialine pool at 6–18 m depth (Kornicker and Iliffe, 1989:8, 10). All of the open-ocean species with reduced eyes were collected below 350 m, except *V. antarctica*, which was collected at 193 m, and *Metavargula iota* Kornicker and *V. stathme* Kornicker, which were collected at 117 m. Adult females of *Vargula antarctica* have no ommatidia (Cohen examination of syntypes; males are reported to have four (Müller, 1908:84), and juveniles have slightly more (Kornicker, 1975:156)), whereas *Metavargula iota* and *V. stathme* have three to five ommatidia. Within each of the five myodocopid families, reduction in eye size is generally correlated with depth (e.g., Kornicker, 1992:4; Kornicker and Poore, 1996:10–14).

*Jimmorinia* has been captured in abundance only in baited traps and is at least a facultative scavenger. None of the unique morphological characters of the genus appear to be related to this feeding mode. Other characters, such as strong claws on the mandible, 1st and 2nd maxillae (4th and 5th limbs), and furca, are shared with many other cypridinids (and myodocopids), many of which have not been captured in baited traps. Furthermore, not all scavengers have unusually strong furcal claws, e.g., *Skogsbergia lernerii* (Kornicker). Probably strong claws also have other functions and are useful preadaptations for scavenging.

**Ontogeny:** Selected characters for different growth stages of *J. gunnari* are presented in Table 1.

**Sexual Dimorphism:** The most noticeable difference between males and females of *J. gunnari* is valve shape and size. Males are smaller, with a more oval, somewhat less oblong, profile than females (Figure 2, Plate 1a,e). The com-

pound eyes are similar in actual size for adult males and females from the same locality. Thus, males have larger lateral eyes relative to valve size. Like other cypridinids, adult males also have large paired copulatory (8th) limbs, which are obvious if the body extends from the valves or after a valve is removed. Less obvious differences are noted in the description of the female.

**Geographic Variation:** Morphological differences are insufficient to justify separate taxonomic names for the specimens of *J. gunnari* from the localities studied. The only consistent difference noted was in valve size, with the specimens collected in Jamaica being larger. Although valve size is greater in Jamaican specimens, the range of absolute eye size is similar between Jamaican and Panamanian specimens but is smaller in Roatan females.

Country	Valve Length (mm)		Eye size (mm)
	Males	Females	
Jamaica	0.99–1.06 (N=4)	1.29–1.39 (N=10)	0.15–0.17 (N=18)
Bahamas	1.04 (N=2)	1.24 (N=1)	–
Roatan Id	–	1.15–1.22 (N=10)	0.13–0.15 (N=10)
Panama	0.85–1.01 (N=19)	1.10–1.18 (N=29)	0.15–0.18 (N=6)

Only specimens from the type locality and the Bahamas, however, have been designated as types because of the possibility that the other populations are actually cryptic species. Recent research comparing 16S rRNA mitochondrial sequences from geographically different populations of another widespread Caribbean cypridinid species indicated that populations from different localities are genetically distinct and are actually separate cryptic species (Torres et al., in press).

**COMPARISONS WITH OTHER GENERA.**—*Jimmorinia* has been collected in abundance only in traps. Furthermore, specimens from traps from Panama, Roatan, and Jamaica always are taken with another, even more abundant, larger, and very unrelated cypridinid, *Skogsbergia lernerii*. Because adult *Jimmorinia* are so small, the new genus was overlooked initially among the juvenile *Skogsbergia* in the traps. *Jimmorinia* may be easily distinguished from *S. lernerii* because the former has a more rectangular shape, a furca with two unsutured claws (4th as well as 2nd), an upper lip with one pair of long posteroventral tusks (not 2 or 3 short paired posteroventral fields), and eyes with obviously fewer ommatidia.

*Jimmorinia* shares one apparently unique character with *Vargula dentata*, namely an upper lip with a slender tooth-like lobe at the base of paired slender tusks (Table 2), and the two species may be closely related. The upper lips of *?Vargula tubulata* Poulsen, *?V. trifax* Kornicker, and *Monopia* have tusks with a somewhat similar lobe, but their tusks are much stouter, more tapered, and ornamented with a prominent vertical row of hairs. The latter three genera also have many characters differing from those of *Jimmorinia*, including a shell with a tubular-shaped caudal process, a 7th limb with a distal jaw (proximal to terminal setae) and recessed terminal teeth (no peg), and an 8th limb with a smaller and more complex hood (not described for *?V. trifax*). Although *Jimmorinia* shares a few other characters with

TABLE 1.—Ontogeny of selected characters of *Jimmorinia gunnari* (ab=limb absent; nb=no setae; nd=no data).

Character	Instar I	Instar III	Instar V	Adult
<b>First Antenna</b>				
setae of 4th article	0	2	2	2
filaments of sensory seta of 5th article (includes tip bifurcation)	0	7	9	9
<b>Second Antenna</b>				
setae 1st endopodial article	0	2	4	5
setae 9th exopodial article	2	3	3	3
<b>Mandible</b>				
setae ventral margin basale	2	7	7	7
setae 2nd endopodial article				
ventral	2	3	4	4
dorsal	6	7	9	11–12
<b>3rd endopodial article</b>				
ringed setae	2	2	3	3
unringed claws	2	3	3	3
<b>4th limb (1st maxilla)</b>				
alpha setae 1st endopodial article	1	2	2	2
beta setae 1st endopodial article	1	2	3	3
setae 2nd endopodial article	5	10	12	12
<b>5th Limb</b>				
pectinate teeth on main tooth	1	3	5	6
<b>6th limb</b>				
setae of end article	0	5	8	9
<b>7th limb</b>				
setae	ab	0	10	10–11
bells on setae	ab	nb	2–3	3
<b>Furca</b>				
claws	3	5	nd	6

?*V. dentata*, none are unique, and the two taxa differ in so many other characters that ?*V. dentata* cannot be placed within the genus *Jimmorinia*. *Jimmorinia* differs from ?*V. dentata* in having a more rectangular valve (?*V. dentata* is much rounder); fewer nozzles on the upper lip; four ommatidia (instead of none); a shorter Bellonci organ; no folds on the male dorsum; fewer endopodial articles and terminal exopodial setae on the 2nd antenna; fewer terminal setae on the mandible; no unringed claws on the 2nd exopodial article and fusion of the 4th and 5th articles of the 5th limb (2nd maxilla); fewer setae on the 7th limb; and a male copulatory (8th) limb with a reduced central lobe, an inner lobe with a group of more prominent triangular teeth, and an outer lobe with fewer thumb setae (Table 2).

The genus *Vargula* is currently defined by a combination of characters, none unique, and was shown to be polyphyletic in a cladistic analysis of some species of *Vargula* and some other genera of the Cyprinidae (Cohen and Morin, 1990). The relationship between *Vargula* and all other genera of the Cyprinidae will be explored in two forthcoming cladistic analyses (partial analysis in Torres et al., in revision; full analysis in Cohen and Morin, in prep.). ?*Vargula dentata*, ?*V. tubulata*, and ?*V. trifax*, now questionably assigned to *Vargula*, will be re-assigned in those papers.

Although *Jimmorinia* shares some characters with *Sheina*, *Vargula antarctica*, ?*V. magna* Kornicker, *Bathyvargula parvispinosa* Poulsen, and *Hadacypridina* (Table 2), it differs from all of these in the unique generic characters listed above and also in having a proximal tooth-like lobe on the tusk of the upper lip and fewer nozzles on the lip, only three terminal exopodial setae on the 2nd antenna, and the sensory seta of the 1st antenna with five long broad proximal filaments followed by three long slender filaments and a short subterminal filament at the tip (Table 2). *Jimmorinia* differs from these taxa in other ways as well (Table 2). *Sheina* has more ommatidia, three endopodial articles on the 2nd antenna, a mandible with a terminal seta with a bulbous base, a 1st maxilla (4th limb) with more pectinate a-setae and a claw-like b-seta, a 5th limb (2nd maxilla) with three claw-like a-setae on the 2nd article and only two setae on the terminal article, a 6th limb of different shape, a 7th limb with more setae, and a male 8th limb with a larger and setose central lobe and three thumb setae. *Vargula antarctica* has a larger and more oval valve, posterodorsal folds on the male body, three endopodial articles on the 2nd antenna, a 4th limb with more a-setae, a 5th limb (2nd maxilla) with a claw-like a-setae on the 2nd article and only unfused 4th and 5th articles, a 6th limb of different shape, a 7th limb with more

TABLE 2.—Comparison of adult characters of *Jimmorinia* with those of other possibly related taxa (\* = possibly only a species-level difference; L=length; Ht=height; R=right).

Character	<i>Jimmorinia</i>	<i>Vargula dentata</i>	<i>Rheina</i>	<i>V. magna</i>	<i>Sheina</i>	<i>V. antarctica</i>	<i>V. norvegica</i>	<i>Bathyvargula</i> <sup>†</sup>	<i>Hadacypridina</i>
<b>VALVE</b>									
shape	rectangular oval	round oval	round oval	~rectangular oval	~rectangular oval	oval	round oval	oval	oval
keel	~high flange	high (small) flange	high tube	very low rounded bump	high flange	rounded crescent bump	low curved bump	high tube	high tube
male L/Ht	1.7–1.8	1.3–1.4	1.5–1.6	no male	1.9	1.5	1.4–1.5	1.8	no male
<b>INFOLD</b>									
caudal list	plain with pocket	plain	posterior knobs	right with flange	plain	knob and flange	plain	crenulations?	R flange with knob
<b>UPPER LIP</b>									
*total no. of valve openings	fewer (and unequal sizes)=26	more, ~40–50?	many, ~80?	many, ~70?	more	many, ~60–70?	~100	more	many
tusk tooth	prox. lobe	prox. lobe	none	none	none	none	none	none	none
<b>EYE</b>									
*no. of ommatidia	4	0	0	16	16	0/few	male 14–19, female 9–10	0; 5–9	female 0
<b>BELLONCI ORGAN</b>	W>1/2 L	W<1/2 L	W<1/2 L	W<1/2 L	W<1/2 L	W<1/2 L	W<1/2 L	W<1/2 L	W>1/2 L
<b>BODY</b>									
*dorsal folds	0	male	male	male unknown, female 0	0	male	male	0	male unknown, female 0
<b>1ST ANTENNA</b>									
sensory seta; no. distal smaller filaments	3	3	2	2	2	2	2	2	2
*tip of male b-seta	proximal or reaching distal filament tip	distal to distal filament tip	distal to distal filament tip	male unknown	distal to distal filament tip	reaching distal filament tip	reaching distal filament tip	proximal to distal filament tip	male unknown
<b>2ND ANTENNA</b>									
endopod articles	2	3	3	3	3	3	3	2	2
exopod; *seta on 3rd article	spines and hairs	spines and hairs	hairs	hairs	hairs	spines and hairs	hairs	hairs	hairs
*no. setae on 9th article	3	4	4	4	4	4	4	4	4
shortest seta on 9th article	no long hairs	long hairs	no long hairs	no long hairs	no long hairs	long hairs	no long hairs	no long hairs	no long hairs
<b>MANDIBLE</b>									
basale; tip of longest d-seta	short spines	short spines	long hairs only	short spines	short spines	short spines	short spines	?	long hairs only
endopod; no. of end setae	3 (no dorsal setae)	4	4	4	4	4	4	4	4
terminal b-seta	tapered	tapered	tapered	bulbous base	bulbous base	tapered	tapered	tapered	tapered
<b>4th LIMB</b>									
* $\alpha$ : $\beta$ -seta	$\alpha > \beta$	$\beta > \alpha$	$\alpha > \beta$	$\alpha > \beta$	$\alpha > \beta$	$\alpha > \beta$	$\alpha > \beta$	varies	$\alpha > \beta$
a-setae pectinate?	middle 1 more	middle 1 more	inconspicuous	inconspicuous	all very	middle 1 more	inconspicuous	inconspicuous	inconspicuous



TABLE 2.—Continued.

Character	<i>Jimmorinia</i>	<i>Vargula dentata</i>	<i>Rheina</i>	<i>V. magna</i>	<i>Sheina</i>	<i>V. antarctica</i>	<i>V. norvegica</i>	<i>Bathyvargula</i> <sup>†</sup>	<i>Hadacypridina</i>
*no. a-setae	3	4	4	3	3	4	4-5	4	4
*claw-like b-seta	no	no	yes	yes	yes	no	yes	no	no and yes
*no. b-setae	3	3	3 or 4?	2 (or 4?)	2	3	3	3	3
no. c-setae	3	2	2 or 3?	3 (or 1?)	2	3	3	3	2
<b>5TH LIMB</b>									
*protopodial tooth	short, plain or bilobed	short, bilobed	long, ~bent	long, bumpy	short, plain	~long, ~bumpy	long, bumpy	short	long, bumpy
1st article; no. anterior setae	3	4	4	4	4	4	4-5	4	3-4
2nd article; no. and type of a-setae	4 ringed	4 claws	3 claws	4 ringed	1 ringed, 3 claws	4 claws	4	4	1 ringed, 3 claws; or 4 claws
*no. b-setae	7 or 8	7	7	9	9	8	7 or 8	7	6-7
3rd article; inner lobe no. setae	3	3	3	2	3	3	3-5	3	3
4th and 5th articles	fused	separate	separate	fused	fused	separate	separate	fused	fused
*no. setae	4 or 5	4+2	4+2	4	2	3+2	6-10+2	4-5	4-5
4th-5th *process?	usually 2	spines	one	no	no	one	one	one	one
<b>6TH LIMB</b>									
L:Ht	L>Ht	L>Ht	L~Ht	L~Ht	L~Ht	L>Ht	L>Ht	L>Ht	L>Ht
shape	~fan, both ends projected	posterior slightly projected	posterior projected	posterior slightly projected	posterior projected	posterior slightly projected	posterior slightly projected	posterior slightly projected	~fan, both ends projected
gap in end setae?	small	small	none	small	bigger	small	small	none	none
<b>7TH LIMB</b>									
*approx. no. setae	10-11	male 27	male 20	female 21-24	male? 20-27	male 25, female 28	male 36-40	male ~13	female 16-29
peg spines	lateral and tip	tip only or bare	bare	lateral and tip	tip only	tip only	tip only	tip only (a-seta)	bare
tooth inside comb?	no	2 triangular teeth	no	no	no	no	no	no	no
<b>8TH MALE LIMB</b>									
basal Y-sclerite	basal loop	basal loop	Y-shaped	male unknown	basal loop	basal loop	basal loop	Y-shaped	male unknown
hood tip	slightly tapered to blunt tip	?rather tapered	rather tapered	male unknown	rather tapered	not examined	narrowed to finger	rather tapered	male unknown
no. thumb setae	2	4-5	3	male unknown	3	~2 (from figure)	5-6	3	male unknown
distal inner lobe	pair small teeth	tiny teeth only	tiny teeth only	male unknown	tiny teeth only	unknown	small to tiny teeth	tiny teeth only	male unknown
central lobe	short, no setae	larger, with setae	short, with setae	male unknown	larger, with setae	not examined	larger, with setae	longer, with setae	male unknown
*no. cen. lobe setae	0	3	3	male unknown	6	unknown	4-5	2	male unknown
<b>FURCA</b>									
*no. claws	6-7	8	7	7-9	7	8-9	8-9	8	8-9
*fused claws	2nd, 4th	2nd, 4th	2nd	2nd, 4th	2nd, 4th	2nd, 4th	2nd, 4th; male also 3rd	0	0
<b>OTHER INFORMATION</b>									
ocean	NW Atlantic	SW Atlantic	NE Atlantic	NW Atlantic	SW Pacific	Antarctic	NE Atlantic	NE Atlantic and SW Pacific	NE Atlantic and SW Pacific
depth	shallow	deep	deep	shallow	shallow	mid and deep	mid and deep	deep	deep
bioluminescent?	no	unknown	unknown	unknown	yes	yes	yes	unknown	unknown

<sup>†</sup>Based upon type species, *B. parvispinosa*.

setae, and a furca with eight or nine claws. *Vargula magna* (male unknown) has a valve with a lower caudal process, more ommatidia, three endopodial articles on the 2nd antenna, a mandible with a terminal seta with a bulbous base, a 4th limb with less pectinate a-setae and a claw-like b-seta, a 5th limb (2nd maxilla) with a longer protopodial tooth and fewer setae on the inner lobe of the 3rd article, a 6th limb of different shape, and a 7th limb with more setae. *Bathyvargula* and *Hadacypridina* each have valves with a tubular caudal process, a furca with sutures at the base of all claws and with a total of about eight or nine claws, and a 4th limb with more, but less pectinate, a-setae. *Bathyvargula* has a 6th limb with a different shape, a 7th limb with an annulated peg with terminal spines, and a male 8th limb with a longer and setose central lobe and three thumb setae. *Hadacypridina* (male unknown) has no ommatidia, a ventral mandibular basis with its longest d-seta bearing only long hairs, a 1st maxilla (4th limb) with only two c-setae, a 5th limb (2nd maxilla) with a longer protopodial tooth, and a 7th limb with more setae and a bare peg.

Only two other genera, *Hadacypridina* Poulsen, 1962, and *Paracypridina* Poulsen, 1962, also have been described as having both a short bristle and a long filament on a well-developed terminal 2nd article of the endopodite of the female 2nd antenna; however, the 2nd article is relatively longer in *Jimmorinia*. Kornicker (1992, table 18) has shown that the number of bristles on the 9th exopodial article of the 2nd antenna is fairly constant within most genera, although it varies in *Skogsbergia* and *Pterocypridina*. *Paracypridina* is unique among the Cypridinidae in having a sensory seta of the 5th article of the 1st antenna with several proximal short spinous filaments followed by a few longer filaments. It also differs from *Jimmorinia* in having a 7th limb with a terminal tooth rather than a peg, a more oval valve with a protuberance on the rostrum, and other characters.

Male adult characters are essential in determining relationships among cypridinid genera (see Kornicker, 1981:33–35), and males are unknown in *Hadacypridina* and *Paracypridina*. For most routine identifications, however, male characters are unimportant because juvenile myodocopids more closely resemble adult females.

### *Jimmorinia gunnari* Cohen and Kornicker, new species

FIGURES 1–18; PLATES 1–4

ETYMOLOGY.—Named in honor of James Gunnar Morin, who collected many of the specimens of this study, and who has made important contributions to the systematics of the Cypridinidae.

HOLOTYPE.—LACM 83-312.1, adult male on slide and in alcohol; sta JM-6, specimen a, length 0.93 mm, height 0.57 mm.

TYPE LOCALITY.—San Blas Islands, Panama (Caribbean Sea) (9°33.23'N, 78°55.38'W) (see Cohen and Morin, 1989:338, fig. 14); at east end of Korbiski Reef near San Blas

Point; 6 m depth, on sand, 25 cm from coral, in mixed sand-coral slope; collected in baited cone trap by James Morin (see Cohen and Morin, 1986).

PARATYPES.—Exuma Cays, Bahamas: Sta 93-005: USNM 194317, 1 instar I on slide and in alcohol; USNM 194318, 1 adult female on slide and in alcohol (shell torn, length estimated as being between 1 mm and 1.25 mm); USNM 194319, 1 instar III on slide and in alcohol; USNM 194320, 1 instar V on slide and in alcohol. Sta 95-004: USNM 277655, 1 adult male on slide and in alcohol; USNM 277656, 1 adult female on slide and in alcohol; USNM 277657, 1 adult male on slide, in alcohol, and on SEM stub; USNM 277658, 1 adult male on SEM stub and in alcohol; USNM 277659, 1 adult male on SEM stub and in alcohol; USNM 277660, 1 adult male on SEM stub and in alcohol. Sta 95-005: USNM 194502, 2 specimens in alcohol. Sta 95-006: USNM 194496, 1 adult female in alcohol; USNM 194498, 2 juveniles in alcohol; USNM 194504, 8 specimens in alcohol.

San Blas Islands, Panama: Sta JM-6: USNM 194402, 1 adult female on slide and in alcohol; USNM 194403, 194404, 194408, 3 adult males on slides and in alcohol; USNM 194409, 6 undissected adults (3 females, 3 males); LACM 83-312.2(b), 1 dissected male with limbs on slide; LACM 83-312.3(c), 1 dissected adult female on slide and in alcohol; LACM 83-312.4(d), 54 specimens (10 adult males, 25 adult females, 19 juveniles) in alcohol; LACM 83-312.5(f,f'), 2 adult males in alcohol; LACM 83-312.6(h), 1 adult male in alcohol; LACM 83-312.7, 1 adult male in alcohol. Sta 11115.2: 2 undissected adult males and 2 undissected adult females on SEM stub; LACM 85-471.1(b), 1 adult male on slide and SEM stub; LACM 85-471.2(d), 28 specimens in alcohol. Sta 11115.7: LACM 85-471.3(a), 9 specimens, also vouchers for luminescence test by J. Morin and mtDNA (16S rRNA) study by E. Torres.

Discovery Bay, Jamaica: Sta Scanlon, 17 Mar 1991: LACM 91-205.1(a), 1 adult male on slide and in alcohol; LACM 91-205.2(b), 18 undissected males and 1 partly dissected male in alcohol. Sta J11085.2: LACM 85-472.1(a), 1 adult female on slide and in alcohol; LACM 85-472.2(b), 1 adult male on slide and in alcohol; LACM 85-472.3(c), 47 undissected adult males, females, and juveniles in alcohol. At least 20 additional specimens of *J. gunnari* are present in the collections from Jamaica, but the samples containing them have not been fully sorted; these samples are, at present, in the collection of the

FIGURE 1 (opposite).—*Jimmorinia gunnari*, new species, paratypes, adult males from Panama: LACM 83-312.5(f): a, left valve, length 0.93 mm, showing infold and three amorphous anterior blobs (stippled), iv; b, c, anterior infold of right valve, showing amorphous blobs (stippled), iv. LACM 83-312.7(i): d, 1st and 2nd articles of 1st antenna showing internal sclerites (dashed lines) and spine rows, mv; e, anterior of body showing medial eye and Bellonci organ, frontal knob, upper lip, left lv. LACM 85-471.1(b): f, left 1st antenna and lateral eye (flattened on slide and showing four ommatidia), mv. LACM 83-312.6(h): g, Bellonci organ on medial eye, left lateral eye with four ommatidia (4 circles), left lv.





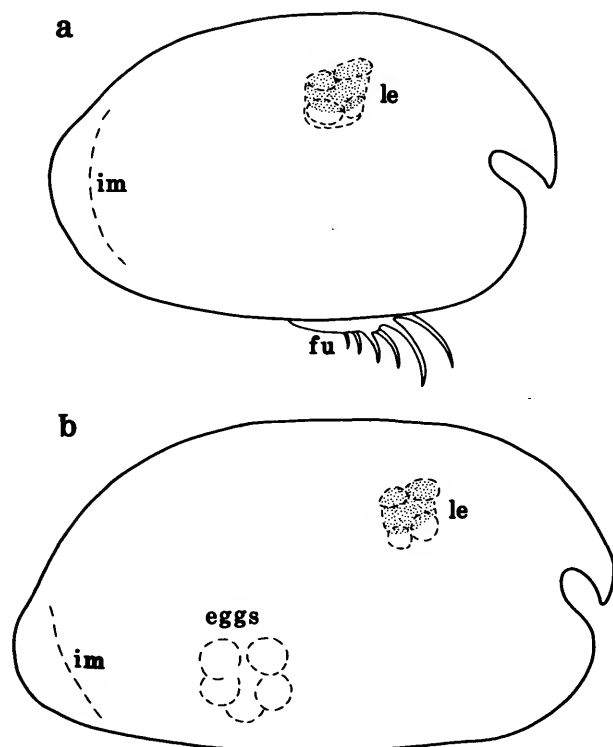


FIGURE 2.—*Jimmorinia gunnari*, new species, paratypes from Bahamas, whole specimens drawn at same magnification: adult male, USNM 277655, length 1.04 mm: *a*, whole specimen showing right valve, furca, lateral eye (4 ommatidia, dotted circles), and caudal infold (dashed line), lv. Adult female, USNM 277656, length 1.24 mm: *b*, whole specimen showing right valve, lateral eye (4 ommatidia, dotted circles), five eggs as visible from exterior (posterior dotted circles), and caudal infold (dashed line), lv.

senior author, but some specimens probably will be deposited in a museum at a later date.

Roatan Island, Honduras: Sta R07058.2: LACM 88-403.1(a), 1 adult female on slide and in alcohol; LACM 88-403.2(b), 19 females and juveniles in alcohol.

Exuma Cays, Bahamas: Sta 96-034: USNM 194519, 1 undissected specimen in alcohol (length 1.04 mm, height 0.73 mm). The height of this specimen slightly exceeds the diagnostic range of height for the species based on the other specimens; thus, it is designated *J. ?gunnari* here and in Appendix 1, and it cannot be considered a paratype.

San Blas Islands, Panama: Sta JM-6: At least 50 additional nontype specimens of *J. gunnari* are present in the collection from the San Blas Islands, but the samples containing them have not been fully sorted. These samples are, at present, in the collection of the senior author, but some specimens probably will be deposited in a museum at a later date.

DISTRIBUTION.—Collected in the San Blas Islands, Panama (6 m), off Discovery Bay, Jamaica (~15 m), Roatan Island,

Honduras (4.6 m), and near Lee Stocking Island and Great Exuma Island, Exuma Cays, Great Bahama Bank, Bahamas (88–105 m); known depth range 4.6–105 m.

DIAGNOSIS.—Valve shape (Figures 1*a*, 2*a,b*, 3*a,e,f*, 4*a,k*, 7*a*, 8*a*, 10*a*, Plate 1*b,e*) an oblong oval, with caudal process extending above midpoint of valve; anteroventral edge of right valve scalloped (tiny points on margin), that of left valve nearly smooth (Plate 1*b*) (except left valves of Bahamian specimens also scalloped) (Plate 1*d*). Valve relatively small and elongate; male length 0.85–1.06 mm, height 0.57–0.65 mm; female length 1.10–1.39 mm, height 0.63–0.76 mm. Average ratio of length to height in males  $1.66 \pm 0.07$  mm (range 1.56–1.82 mm,  $N=17$ ), in females  $1.80 \pm 0.06$  mm (range 1.67–1.88 mm,  $N=26$ ).

Infold (Figures 1*a-c*, 3*b*, 9*b*, Plates 2*a,c*, 4*a*) of rostrum with 10–14 setae in male, 14–17 in female, forming bent row just within anterior and ventral margins, 1 or 2 setae posterior to row, and 0–2 setae anterior to rostral row. Anteroventral infold with narrow list bearing 12–24 setae. Anteroventral margin between infold and outer shell with row of slight indentations marking internal undulate structure. Two or 3 amorphous and irregular soft globs/balls just posterior to anterior infold (1 on rostrum, 1 or 2 anteroventral) (Figures 1*a-c*, 3*b*, 9*a,c*, 10*b,c*, Plate 2*a,c*). 1st antenna (Figures 1*d,f*, 4*c-e*, 8*g*, 9*f-j*, Plates 2*a*, 3*a*) of females from Bahamas and Roatan with minute spines on 1st article, usually absent in most males and other females; male subterminal b- and c-setae each with 2 or 3 minute suckers each on 2 distal filaments. 2nd antenna (Figures 5*a,b*, 7*d*, 11*a-d*, Plate 1*a,d-f*) with seta of 2nd exopodial article having 17–23 ventral spines. Mandible (Figures 5*c*, 6*a*, 7*e*, 8*c*, 11*e*, Plate 4*a,c*) of female, but not male, with many long teeth on 2 ventral terminal claws of 3rd endopodial article. 5th limb (2nd maxilla) (Figures 6*b*, 13*a-d*, Plate 4*a,b*) with distal protopodal tooth small, plain (not undulate). Endite IV of 6th limb (Figure 13*e*) with only 1 seta. 7th limb (Figures 5*e*, 11*f*) with terminal setal group consisting of 6 setae, none much longer than other setae; terminus much broader on peg side (at base of terminal peg setae) opposite comb. Each lamella of furca with 6 claws and 1 small posterior spine (Figures 2*a*, 3*a,e,f*, 7*f*, 8*e,f*, 12*f*, 23*a-c*, Plate 1*a*).

OBSERVATIONS OF LIVING SPECIMENS FROM PANAMA (James Morin, pers. comm., 1996).—Gut dark brown or brown with yellowish gold reticulations; area above medial eye with rather distinctive funnel-shaped purple pigment; valves darker than other myodocopid species collected from area; region of upper lip with only very small, dark brown, thin line where light organ is located in luminescent species.

Both mechanical and chemical (freshwater and alcohol) tests of Panamanian specimens conducted by J. Morin indicated that this species is not luminescent. No luminescent specimens were collected in the Jamaican trap sample either (J. Morin, field notes). The relative paucity of lip nozzles is probably related to the lack of a light organ in the lip of this taxon (see "Discussion" for *Jimmorina*, above).

**DESCRIPTION OF ADULT MALE** (Figures 1, 2a, 3f,g, 4, 5, 6c,d, 7, Plates 1a-d, 4).—Carapace oblong-oval in lateral view, with projecting, evenly rounded, caudal process, process higher than midpoint of valve (Figures 1a, 3f, 4a,k, 7a, Plate 1a). Anteroventral edge of right valve scalloped (tiny points on margin), that of left valve nearly smooth (Plate 1b,d), except Bahamian specimens with anteroventral margins of both valves scalloped.

**Ornamentation** (Figure 7c, Plate 1a-d): Ventral and posterior of valve with scale- or shingle-like pattern, more pronounced near margins; scattered single setae emerging from pores with raised rim (setae missing from some pores (may be broken) (Plate 1b,c); in shingle-like area, pores centered in irregular rosette of 4 or 5 shingles (Plate 1c); anterior margin of valves with narrow groove (Plate 1b,d). Tip of rostrum with small projection lateral to lamellar prolongation of selvage (detail in Figure 1b).

**Infold** (Figure 1a-c, Plates 2a-c, 4a): Rostrum (Plate 2a) with 10–14 setae forming bent row just within anterior and ventral margins, 1 seta posterior to row, and 0 or 1 seta anterior to rostral row. Anteroventral infold (Plates 2a,c, 4a) with narrow list bearing 12–21 setae (Figure 1c); ventral infold with 2 or 3 widely spaced setae; posteroventral infold with 1 seta. Infold of caudal process (Plate 2c) with narrow sclerotized anterior ridge bearing 8–14 minute setae. Right valve with bar at dorsal end of ridge of caudal process.

**Structures within Anteroventral Edge of Valve** (Plate 2a,c): Anteroventral margin between infold and outer shell and between line of concrescence and shell edge with undulate internal structure parallel to valve edge; undulations appear to be thimble-like internal “pockets”; pockets indicated by shallow interior surface indentations in SEMs and may be better developed on one valve than on other. Right valves of USNM 194403, 194404, 194408 with pockets of right valve better developed than those of left valve.

**Structures Posterior to Anterior Infold of Valve** (Figure 1a-c): Two to 3 (usually 3) amorphous, rather round soft globs always present posterior to anterior infold (1 posterior to rostrum, 1 or 2 ventral to incisur; 5 males from 3 localities examined).

**Central Adductor Muscle Attachments:** Comprising about 15 oval attachments.

**Carapace Size** (length, height in mm): Panama: USNM 194403, 1.01, 0.62. USNM 194404, 0.99, 0.62. USNM 194408, 0.95, 0.59. USNM 194409, 3 males: 0.92, 0.59; 0.94, 0.59; 0.93, 0.57. LACM 83-312.5, 2 males, length only: f, 0.93; f', 0.93. LACM 83-312.1(a) (holotype), 0.93, 0.57. LACM 83-312.6, length only: h, 0.95; f, 0.95. Length range of 19 males from Panama, including 9 specimens given above, 0.85–1.01 mm; height range of same males 0.57–0.62 mm. Jamaica: LACM 85-472.2(b), 1.06, 0.65. LACM 85-472.3(c), 3 males: 0.99, 0.61; 0.99, 0.59; 1.03, 0.61. LACM 91-205.2(b), 4 males: 1.06, 0.61; 1.02, 0.57; 1.03, 0.65; 1.06, 0.61. Bahamas: USNM 277655, 1.04, 0.63. USNM 277657, 1.04, 0.57.

**First Antenna** (Figures 1d,f, 4c-e, Plates 2a, 3a): 1st article bare in 5 males (Panama, Figure 1f; Jamaica, Bahamas), few short spines seen on one Bahamian male. 2nd article with ventral, dorsal, and medial spines. 3rd article with row of long lateral spines, short medial spines, and 2 setae (1 ventral, 1 dorsal), both with few marginal spines. 4th article with 2 setae (1 ventral, 1 dorsal), both with few marginal spines. Sensory seta of 5th article with 5 long broad proximal filaments followed by 3 long slender filaments and short subterminal filament at tip. Medial seta of 6th article about same length as combined articles 6–8, with few indistinct marginal spines. 7th article: a-seta slightly longer or shorter than seta of 6th article; b- and c-setae each with stout proximal filament with large round sucker (sucker much larger on c-seta, Plate 2a), additional 2 slender filaments with single row of 2 or 3 small round suckers; tip of b-seta extends beyond sucker filaments; c-seta with about 6 additional distal short filaments with marginal teeth. 8th article: d- and e-setae about 3 times length of b-seta, bare with blunt tips; f-seta slightly longer than sensory seta of 5th article, with 8 or 9 filaments, some with spines; g-seta about same length as c-seta, with 9 filaments, some with spines; b-, c-, f-, and g-setae with bifurcate tips.

**Second Antenna** (Figures 5a,b, 7d, Plate 1a): Protopodite with short medial seta. Endopodite (Figures 5a,b, 7d) with 2 articles: short 1st article with 4 proximal setae (3 short, 1 longer) and 1 long spinous distal seta; 2nd article tapering distally, with 1 short terminal or subterminal seta and 1 long terminal filament. Exopodite: seta of 2nd article reaching to between 6th and 9th articles, with 17–20 ventral spines (terminal spine longest), 0–3 minute proximal dorsal spines; seta of 3rd article long, with dorsal hairs, long slender proximal ventral spines, and distal ventral natatory hairs; setae of articles 4–8 with natatory hairs, no spines; 9th article with 3 setae (1 short dorsal with few small spines, 1 longer with proximal slender dorsal spines and natatory hairs, 1 very long with slender proximal dorsal spines and distal natatory hairs); 2nd article with few indistinct dorsal spines; articles 3–8 with basal spines increasing in length on distal articles and row of minute lateral spines along distal edges; basal spine of 8th article slightly longer than 9th article; 9th article with lateral spine about 1¼ times length of article. Aberrations observed on one limb of some Panamanian males: LACM 83-312.1(a) (Figure 5a) with only 8 exopodial articles and 3 setae on 8th article; LACM 83-312.2(b) (Figure 5b) with unusually long seta on 2nd endopodial article and 4 setae on 9th exopodial article.

**Mandible** (Figures 5c, 7e, Plate 4a,c): Coxale endite spinous, with 2 stouter terminal spines and with elongate peg between them (peg obscure on some specimens); small seta near base of endite. Basale: ventral margin with 2 unequal medial a-setae (longer seta ringed and spinous), 1 small lateral b-seta, 2 c-setae (1 minute, 1 longer ringed and spinous), and 2 d-setae (proximal medial long with few short spines, distal long with proximal wreaths of long spines and distal short spines); dorsal margin with long proximal hairs and 3 setae (1 near

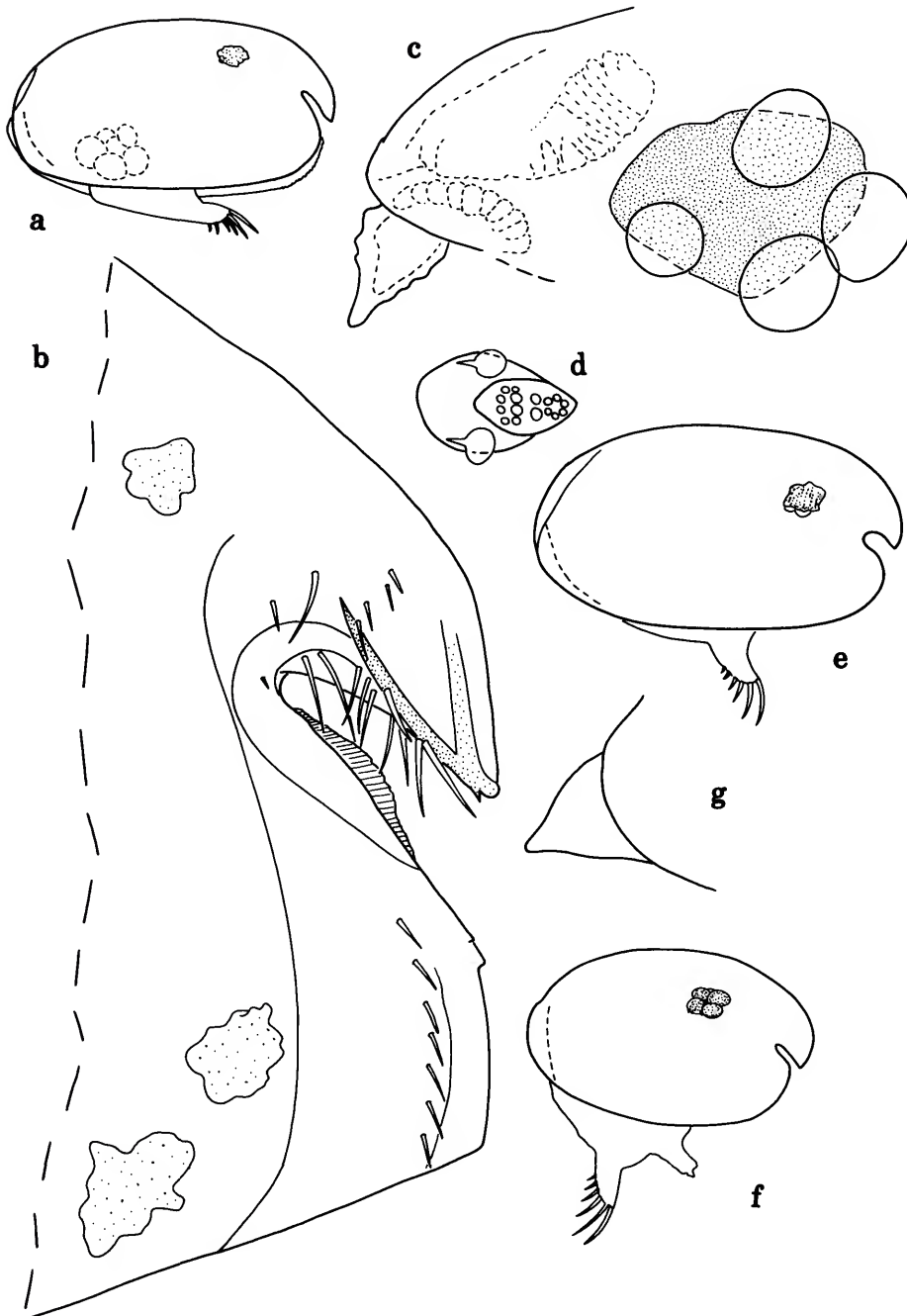


FIGURE 3.—*Jimmorinia gunnari*, new species: adult female from Roatan, LACM 88-403.1(a): *a*, whole specimen, length 1.15 mm, showing valves, furca, lateral eye (stippled, inside valve), eggs (dotted circles), and caudal infold (dashed line), right ov; *b*, anterior infold showing rostrum with sclerotized ridge (stippled), part of anteroventral infold, and three amorphous blobs (stippled), iv; *c*, Bellonci organ on medial eye and left lateral eye with four ommatidia (pigmented area stippled), left lv; *d*, upper lip, ventral view, anterior to right. Adult female from Jamaica, LACM 85-472.1(a), length 1.31 mm: *e*, whole specimen showing valves, furca, lateral eye (stippled), and caudal infold (dashed line), right ov. Adult male from Jamaica, LACM 85-472.2(b), length 1.06 mm: *f*, whole specimen showing valve, furca and copulatory limb, lateral eye (stippled), and caudal infold (dashed line), right ov; *g*, Bellonci organ.

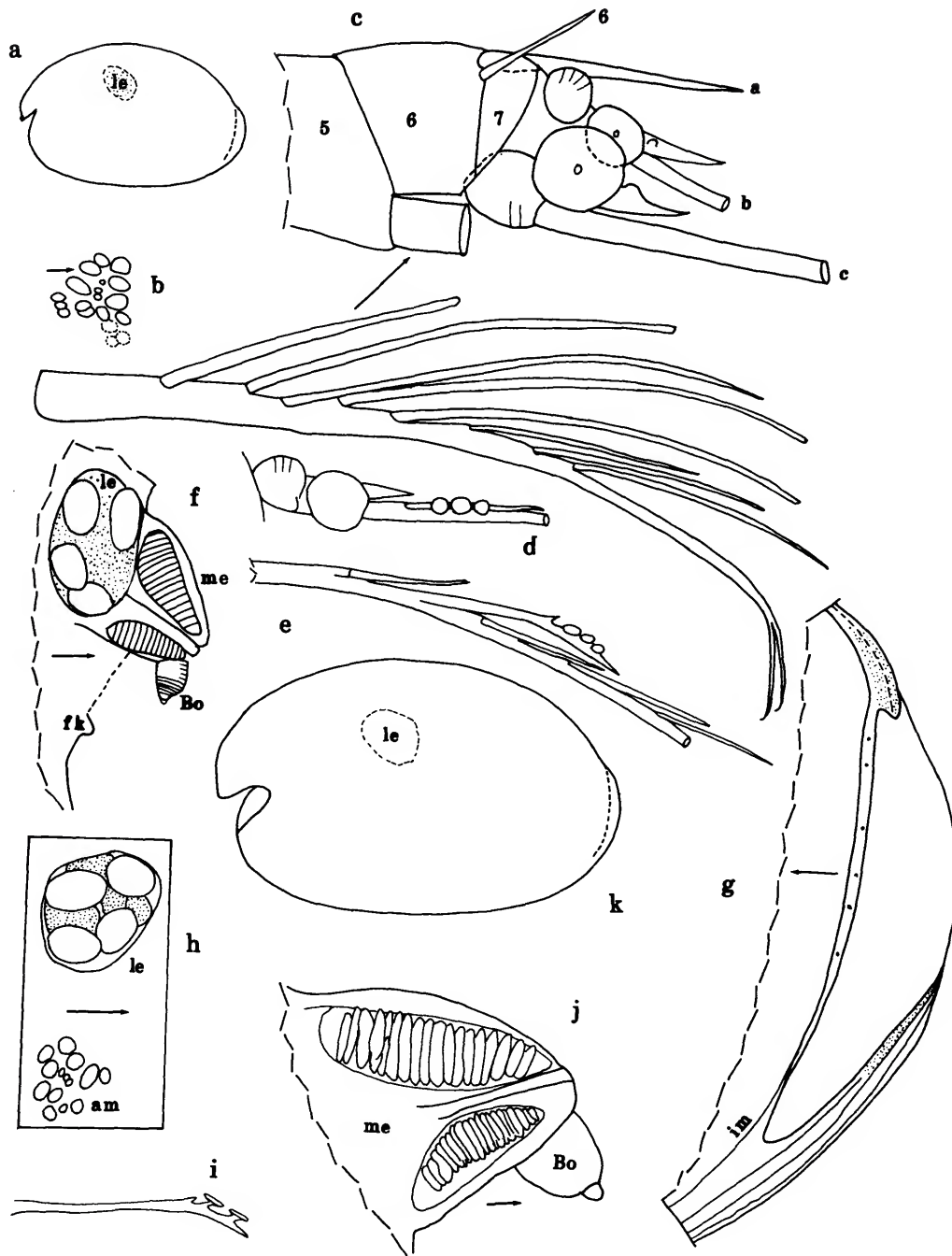


FIGURE 4.—*Jimmorinia gunnari*, new species, paratypes, adult males from Panama: USNM 194404, length 0.99 mm: a, left valve showing lateral eye and caudal infold (dashed line), ov; b, central adductor muscle scars, anterior to right (see arrow); c, distal 1st antenna showing distal article 5 and enlargement of sensory seta (see arrow), articles 6 and 7 (a-seta, proximal parts of b- and c-setae), mv; d, e, from 1st antenna, proximal part of b-seta and distal portion of c-seta. USNM 194408: f, lateral eye and Bellonci organ; g, caudal infold of right valve, mv; h, lateral eye showing four ommatidia, pigmented area (stippled), and central adductor muscle scars (am), anterior to right; i, distal sucker filament of c-seta on 1st antenna; j, medial eye and Bellonci organ; k, left valve showing lateral eye and caudal infold (dashed line), left ov.



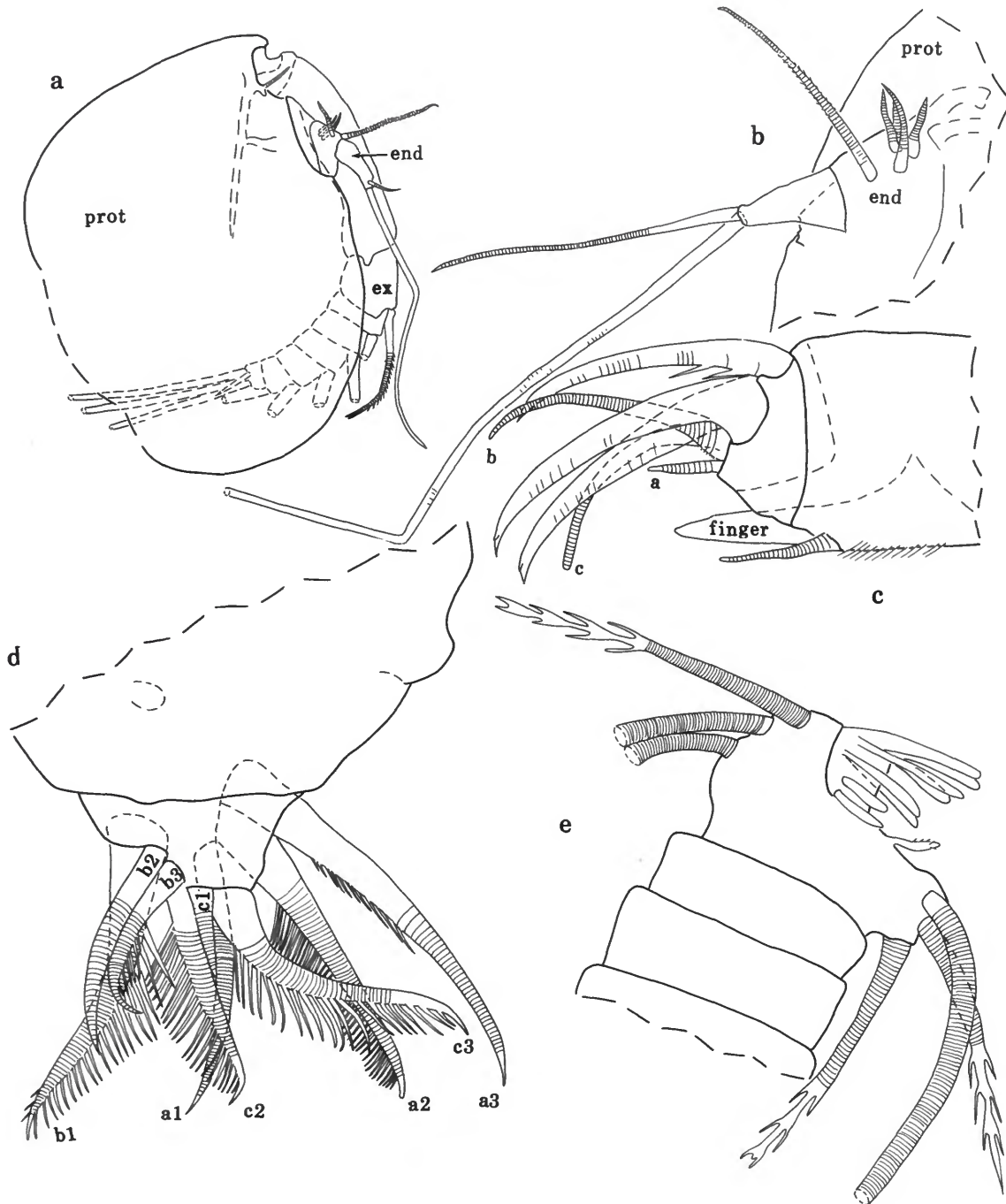


FIGURE 5.—*Jimmorinia gunnari*, new species, adult males from Panama: LACM 83-312.1(a) (sta JM-6), holotype: a, left 2nd antenna, showing protopodite, typical endopodite, and atypical exopodite with only eight articles (only basal part of natatory setae shown) (other limb with nine articles), mv. LACM 83-312.2(b), paratype: b, endopodite of right 2nd antenna with atypically stout 2nd article with atypically longer seta, mv; c, terminal endopodite of left mandible showing distal ventral sclerotized finger and seta of 2nd article, and claws and setae (lettered) of 3rd article, lv; d, terminal endopodite of right 4th limb, setae of 1st article and d-seta of 2nd article not shown, mv; e, terminus of 7th limb, only proximal parts of long terminal setae shown.



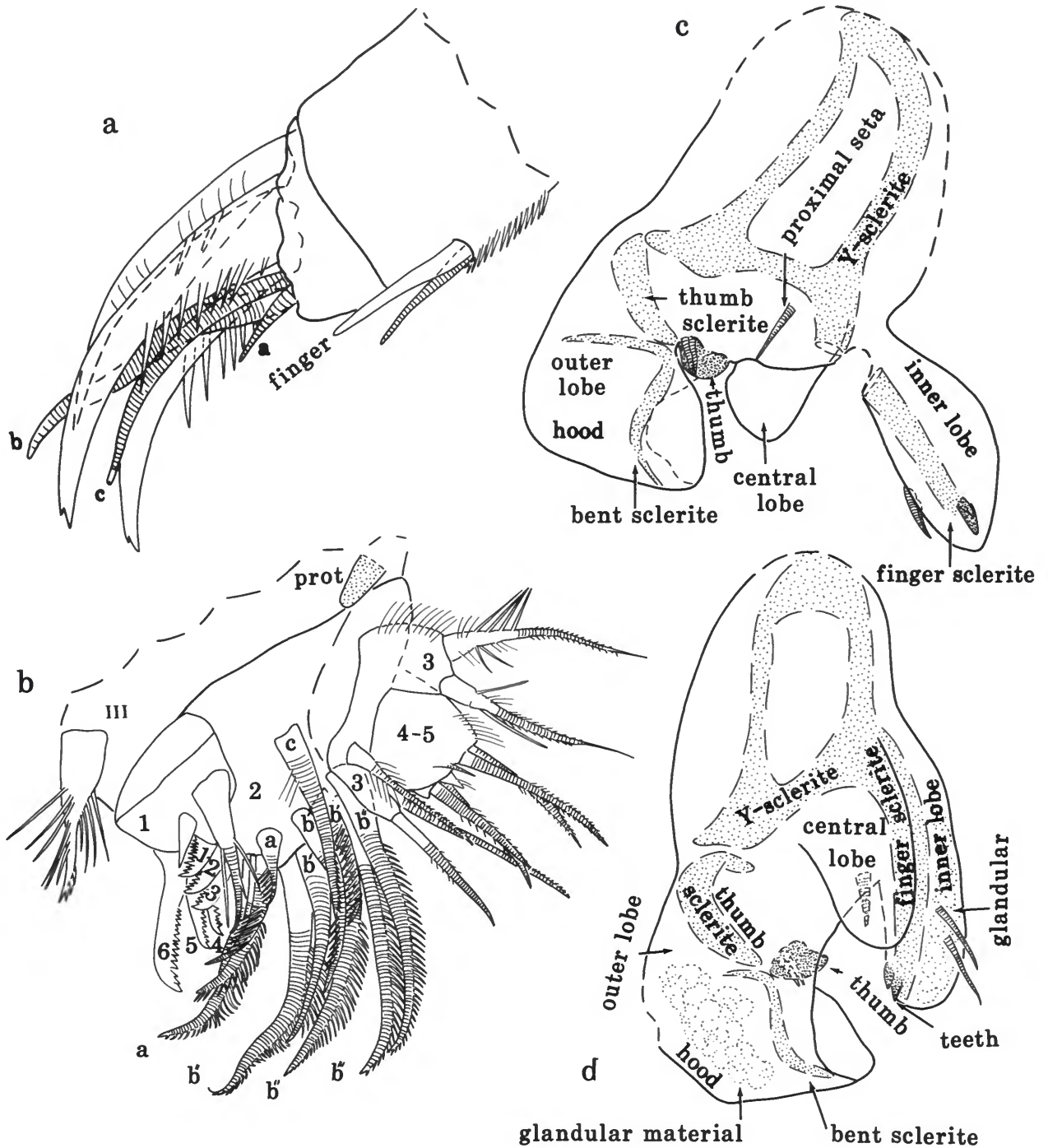


FIGURE 6.—*Jimmorinia gunnari*, new species, Panama: paratype, adult female, LACM 83-312.3(c): a, terminal endopodite of left mandible showing distal ventral sclerotized finger and seta of 2nd article, claws and setae (lettered) of 3rd article, mv; b, fifth limb, distal protopodite (showing stippled tooth and posterior seta of endite III), and exopodite (articles numbered; six teeth on 1st article numbered; a-, b-, and c-setae of 2nd article lettered), pv. Holotype, adult male, LACM 83-312.1(a): c, d, copulatory (8th) limbs (sclerites stippled, protruding ones darker; glandular material shown as dotted circles), c, anterior lateral view, d, posterior medial view.

midlength with indistinct minute spines, 2 spinous terminal); medial surface with few rows of spines near dorsal margin. Exopodite about same length as dorsal margin of 1st endopodial article or slightly shorter (length and width somewhat variable), with hirsute diaphanous tip and 2 terminal setae (proximal seta spinous, distal seta less than  $\frac{1}{2}$  length of proximal seta). 1st endopodial article (Plate 4a,c) with 4 ventral setae (1 minute, 1 short with short spines, 2 long setae (lateral seta with short spines, medial seta with long proximal and short distal spines)) and with row of small terminal spines on dorsal margin. 2nd endopodial article: medial rows of short spines; ventral margin spinous, with 2 single slender pointed ringed setae and a terminal pair of 1 slender pointed lateral seta and 1 stout longer unringed sclerotized pointed medial digit (Figure 5c); dorsal margin (Plate 4a) with 11 or 12 setae (6 medium-length to long setae with short spines and 5 or 6 short setae (1 with fairly stout long spines)); medial surface with rows of indistinct spines. 3rd endopodial article (Figure 5c) with 2 stout bare ventral claws, 1 slender shorter (except longer in Bahamian specimens) dorsal claw (either bare or with few proximal ventral teeth), and 3 ringed ventral setae (1 minute bare, 2 about same length as claws and with few short spines (ventral of these stouter, particularly in proximal part)).

*First Maxilla (Fourth Limb)* (Figure 5d, Plate 4a,b): Similar to adult female. 2nd endopodial article with 3 a-setae (posterior proximally pectinate with thread-like tip, middle pectinate to tip and with longer teeth and less pointed tip, anterior shorter bare and with thread-like tip), 3 b-setae (2 pectinate, middle seta bare), 3 c-setae (1 short bare, 2 longer pectinate), and 3 pectinate d-setae (not shown in Figure 5d; only posterior seta ringed).

*Fifth Limb (Second Maxilla)* (Plate 4a,b): Similar to adult female.

*Sixth Limb:* Similar to adult female.

*Seventh Limb* (Figure 5e): Distal group with 4 (rarely 5) setae (2 on a side) each with 3 bells; terminal group with 6 setae (3 on a side) each with 3 bells. Comb with 6–8 (probably 7) alate teeth (middle tooth longest; 0–3 (usually 2) short lateral teeth on each side); single straight thin spinous peg opposite comb, but recessed from terminal setae on expanded limb tip.

*Genitalia (Eighth Limb)* (Figures 6c,d, 7j–l, Plate 4e,f): Each copulatory limb with 3 distal lobes (terminology based on Cohen and Morin, 1993, figs. 2, 3). Proximal muscular part with internal sclerotized Y-sclerite with well-defined strut forming basal loop; internal finger-sclerite branching from basal loop and extending into inner distal lobe. Inner lobe distally branched, bearing 2 short distal ringed setae on one branch and a pair of small triangular teeth on other branch (Plate 4f), low distal longitudinal ridge, and very few additional distal minute teeth or knobs. Outer lobe terminates in large hood (Plate 4e) with striated velum along inner edge and only slightly tapered bare tip; basal outer lobe with internal thumb-sclerite (articulating proximally with distal basal-looped

FIGURE 7 (opposite).—*Jimmorinia gunnari*, new species, paratype, adult male from Panama, USNM 194403: a, complete specimen from left, length 1.01 mm, also showing lateral eye, ov; b, anterior left valve, ov; c, caudal process of left valve, ov; d, endopodite, right 2nd antenna, mv; e, tip of left mandible showing 3rd and distal 2nd articles, stippling indicates sclerotization, mv; f, posterior of body from left side showing furca, copulatory limb, Y-sclerite, girdle; g, lateral eye with four ommatidia (stippling indicates brown pigment); h, part of anterior of body from right side, showing medial eye, Bellonci organ, and frontal knob; i, tusk of right upper lip, anterior to right; j, left copulatory limb, pv, parts labeled; k, right copulatory limb, pv, parts labeled; l, distal left copulatory limb, mv; m, part of posterior of body from left side.

sclerite) and small protruding rounded sclerotized thumb at base of hood (Plate 4e,f); 2 ringed thumb setae adjacent to thumb (Plate 4e,f); 1 proximal ringed seta. Inner lobe reaching hood of outer lobe and tucked under hood in retracted position. Central lobe (middle posterior-most lobe) short and without setae.

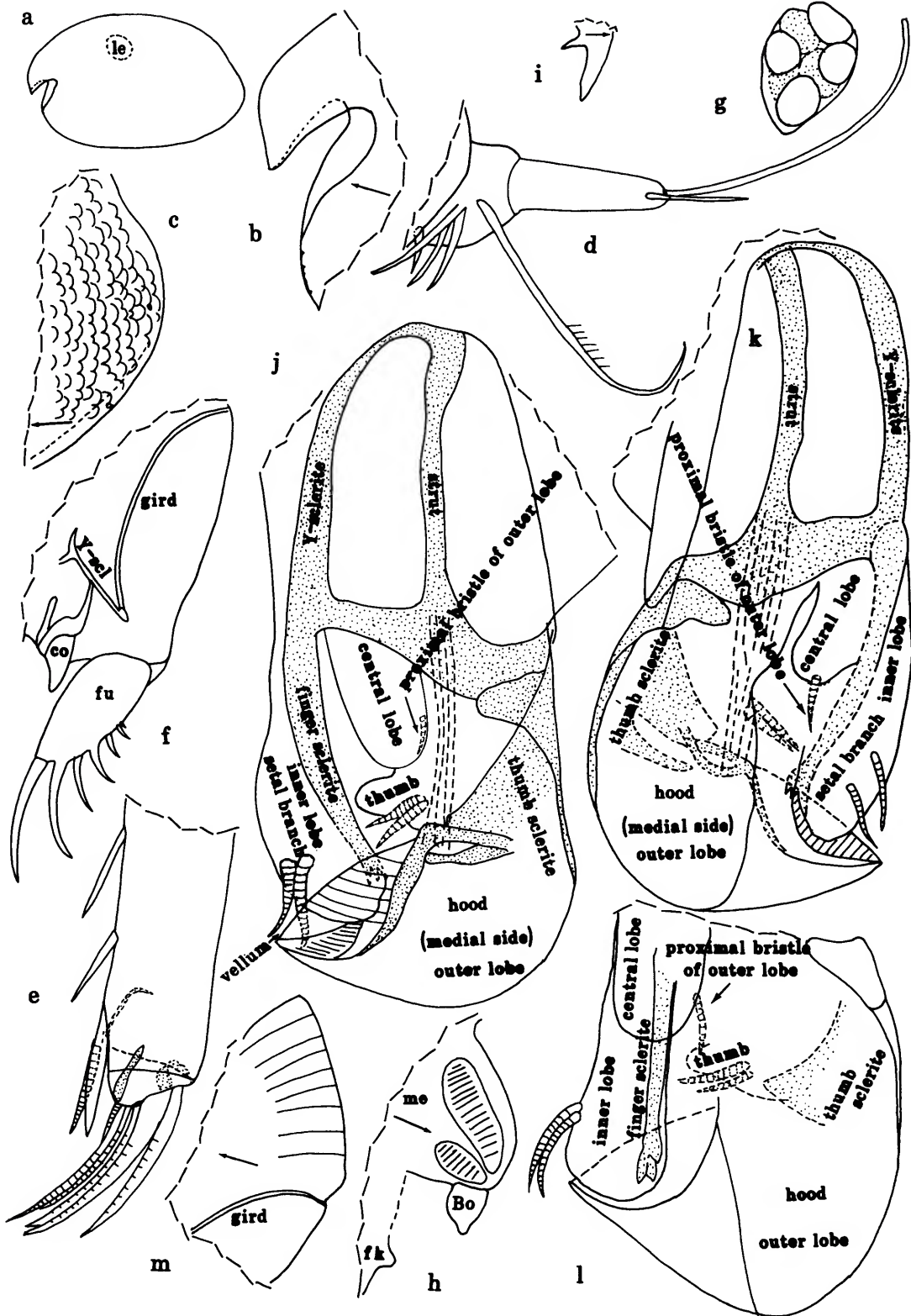
*Furca* (Figures 2a, 3f, 7f, Plate 1a): Each lamella with 6 claws decreasing in length along lamella; claw 4 broader than claw 3; claws 2 and 4 nonarticulated; all claws with teeth along posterior edges; small spine posterior to claw 6; right lamella anterior to left by width of claw 1.

*Bellonci Organ* (Figures 1e,g, 3c,g, 4f, 7h): Short, tapering to broad point or columnar with small terminal nipple. Bellonci organ attached to ventral part of medial eye.

*Eyes:* Lateral eye with brown pigment and 4 large clear undivided ommatidia (Figures 1f,g, 2a, 3f, 4h, 7g). Medial eye large with sloping dorsal margin and with stack-like light amber-colored structures (Figures 1e,g, 3c, 4f,j, 7h).

*Frontal Knob* (Figure 4f,j): Single rounded anterior process between medial eye and upper lip.

*Upper Lip* (Figures 1e, 3d, 7i, Plates 2d,e, 3, 4c,d): Consisting of 3-part ventral area (Plates 2d, 3c): unpaired anterior part with glandular valvular processes (nozzles) (Plate 2e), paired more-posterior tusks (Plates 2d, 3b, 4c), and paired posterior hirsute lobes (Plate 3c); additional small flat posterior field of glandular valves (Plates 3c, 4c,d) located more proximally near mouth. Unpaired anterior glandular field rather flat, with only about 16 nozzles of unequal sizes (Plate 2e), largest nozzles in central double row (8 valves), smaller nozzles in posterior row (3 valves) and laterally (5 or 6 valves, i.e., 1 more anterior and 1 or 2 more posterior on each side of central row). One pair of long tusks lateral to posterior end of unpaired field (Plates 2d, 3b, 4c); each tusk with proximal posterior tooth-shaped lobe (Plate 4c), 1 medial and 1 lateral longitudinal hair rows, 1 or 2 distal horizontal hair rows, short hairs on tip, 1 minute glandular process along posterior edge near midlength, and several diaphanous glandular processes at tip (processes obscured by hairs in Plate 3b). Pair of small posterior proximal flat glandular fields located near mouth and dorsal to posterior hirsute paired lip area, not clearly visible with light microscope but observed with SEM (Plates 3c, 4c,d), each field consisting of 2 valves (nozzles) (Plate 4d).



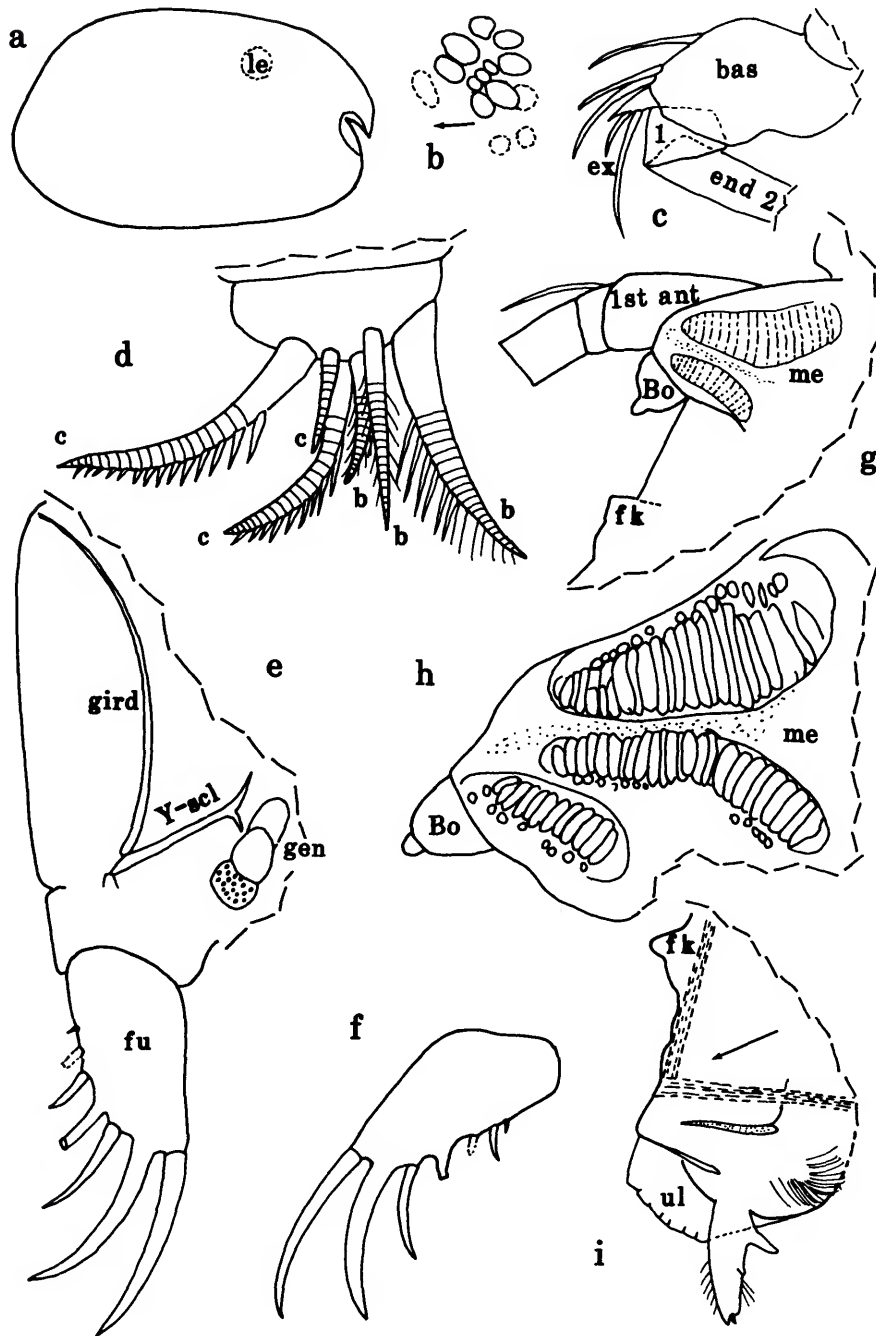


FIGURE 8.—*Jimmorinia gunnari*, new species, paratype, adult female from Panama, USNM 194402, length 1.15 mm: a, right valve showing lateral eye, right ov; b, central adductor muscle scars projecting from body, anterior to left; c, midportion of left mandible, not all setae shown, lv; d, 2nd endopodial article of left 4th limb (1st maxilla), only b- and c-setae shown, mv; e, posterior of body and right lamella of furca, showing Y-sclerite and right genital lobe (8th limb), right lv; f, left lamella of furca (teeth of claws not shown); g, dorsal anterior portion of body showing medial eye, Bellonci organ, frontal knob, and base of right 1st antenna, left lv, under cover slip; h, medial eye (stippling indicates pigment) and Bellonci organ; i, part of anterior of body from left side showing frontal knob, upper lip, some muscles (dashed lines), and a sclerite (stippled).



*Posterior of Body* (Figures 3f, 7f,m): Bare and without processes or folds (many internal muscle bands).

*Y-Sclerite* (Figure 7f): Typical for Cypridininae.

**DESCRIPTION OF ADULT FEMALE** (Figures 2b, 3a–e, 6a,b, 8–13, Plate 1e,f).—Carapace more oblong than adult male; caudal process projecting less than on adult male (Figures 2b, 3a,e, 8a, Plate 1e). Anteroventral margin of left valve scalloped, right valve somewhat variable (USNM 194318 (Exuma) with anteroventral edge of left valve scalloped (Figure 9a,c), whereas USNM 194402 (Panama) and additional Panamanian specimens with only 2 projecting points on anteroventral edge of left valve (at ventral end of line or ridge extending dorsally to inner end of rostrum) (Figure 3b, Plate 1f)). Anteroventral margin of right valve scalloped on all specimens. Tip of rostrum with small projection lateral to lamellar prolongation of selvage (detail in Figure 3b), as in male.

*Ornamentation* (Figure 9a, Plate 1e,f): Similar to adult male.

*Infold* (Figures 3b, 9b,c,e): Rostrum with 14–17 setae, forming bent row just within anterior and ventral margins, 1 or 2 setae posterior to row, and 0–2 setae anterior to rostral row. Otherwise, in general, similar to that of adult male. Infold of caudal process with more minute setae on anterior ridge than in male.

*Vestment*: Without setae or spines described for *J. gamma*.

*Structures within Anteroventral Edge of Valve* (Figures 9c, 10b–d): Anteroventral margin between infold and outer shell and between line of concrescence and shell edge with undulate internal structure parallel to valve edge; undulations appear to be thimble-like internal pockets. In SEMs, pockets indicated by shallow interior surface indentations and may be better developed on one valve than on other.

*Carapace Size* (length, height in mm): Panama: USNM 194402, 1.15, 0.69. USNM 194409, 3 females: 1.17, 0.68; 1.18, 0.68; 1.15, 0.67. Length range of 29 females including above 1.10–1.18; height range of same specimens 0.63–0.69. Roatan: LACM 88-403.1(a), 1.15, 0.65. LACM 88-403.2, 9 females: 1.15, 0.65; 1.19, 0.65; 1.21, 0.65; 1.18, 0.65; 1.24, 0.66; 1.20, 0.68; 1.22, 0.66; 1.18, 0.65; 1.22, 0.65. Jamaica: LACM 85-472.1(a), 1.31, height not measurable. LACM 85-472.3(c), 9 females: 1.29, 0.72; 1.39, 0.76; 1.31, 0.72; 1.29, 0.70; 1.29, 0.72; 1.29, 0.68; 1.31, 0.72; 1.29, 0.72; 1.35, 0.76. Bahamas: USNM 194318, 1.24, 0.68 (approximate) USNM 194496, 1.16, 0.68.

*Central Adductor Muscle Attachments* (Figure 9d): Similar to those of adult male.

*First Antenna* (Figure 9f–j): 1st article with or without spines. 2nd, 3rd, 4th, 5th, and 6th articles similar to adult male, except 3rd and 4th articles with ventral spines. 7th article: a-seta slightly stouter than seta of 6th article, with few indistinct marginal spines; b-seta slightly longer than a-seta, with 1 short proximal spine-like filament, few indistinct minute distal spines, and minute terminal papilla; c-seta about ¼ longer than sensory seta of 5th article, with about 7–9 filaments. 8th article:

setae, in general, similar to those of adult male; f-seta oriented dorsally on USNM 194318.

*Second Antenna* (Figure 11a–d): Protopodite and endopodite similar to those of adult male. Exopodite, in general, similar to that of adult male; seta of 2nd exopodial article with 18–24 ventral spines, sometimes with minute proximal dorsal spines and 2 long proximal hairs.

*Mandible* (Figures 6a, 8c, 11e): Except for terminal ventral unringed digit of 2nd endopodial article being much more slender, mandible, in general, similar to that of adult male. Females (Figure 6a) with many long prominent ventral teeth on stout ventral claws of 3rd endopodial article.

*Fourth Limb (First Maxilla)* (Figures 8d, 12a–e): Similar to adult male. Coxale with stout plumose dorsal seta and thin fringe of dorsal hairs. Endite I with 8 or 9 spinous setae, some with spear-like tips; endite II narrower than endite I, with 5 or 6 setae with long spines; endite III about same width as endite II, with 1 short proximal seta and 4 or 5 long stout terminal setae with long proximal and short distal spines (Figure 12a). Basale with 2 or 3 setae along distal margin (Figure 12b). Exopodite stout, hirsute, with 3 setae (proximal and outer terminal setae plumose, outer terminal seta also with distal short spines, inner terminal seta bare) (Figure 12b). 1st endopodial article (Figure 12b–e) medially hirsute, with cutting tooth with none or 1 small proximal cusp and larger distal squarish cusp, 2 alpha-setae (outer with long hairs, inner shorter bare), and 3 beta-setae (outer stout pectinate, middle short less pectinate or bare, inner shorter bare) (Figure 12c). 2nd endopodial article as in male (Figures 8d, 12d,e).

*Fifth Limb (Second Maxilla)* (Figures 6b, 13a–d): In general, similar to adult male. Epipodite with 39–44 plumose setae. Endite I with 5 or 6 stout setae with long spines; endite II with 5 or 6 setae (4 or 5 distally ringed and with long spines, 1 unringed and with short teeth); endite III with 6 or 7 setae (most posterior seta stoutest, with long proximal hairs and distally ringed with moderately long spines or thin teeth; shortest seta bare and triangular; 2 setae unringed with short teeth; 0 or 1 seta ringed and pectinate; 2 anterior setae longer, distally ringed and spinous (1 with long proximal hairs)) (Figure 13a). Protopodite with small anterior tooth (stippled in Figures 6b, 13c) with slightly variable shape (thumb-like as in Figure 6b or stouter and more tapered as in Figure 13c, not undulate). 1st exopodial article (Figures 6b, 13c,d): anterior side with 2 closely spaced setae (with long proximal spines and distal pectination) and 1 seta (with long proximal spines or hairs) closer to protopodial tooth (Figure 13c); main tooth consisting of triangular peg with few minute spines, and 6 pectinate teeth; 1 seta (with long proximal and short distal spines) on posterior side of article proximal to peg (Figures 6b, 13d). 2nd exopodial article (Figures 6b, 13b–d) with 1 plumose anterior d-seta (with distal rings and short spines) close to outer lobe of 3rd exopodial article, 1 proximal posterior c-seta (with few long proximal hairs and short distal spines) near inner lobe of 3rd exopodial article, 4 pectinate ringed a-setae, 3 (or sometimes

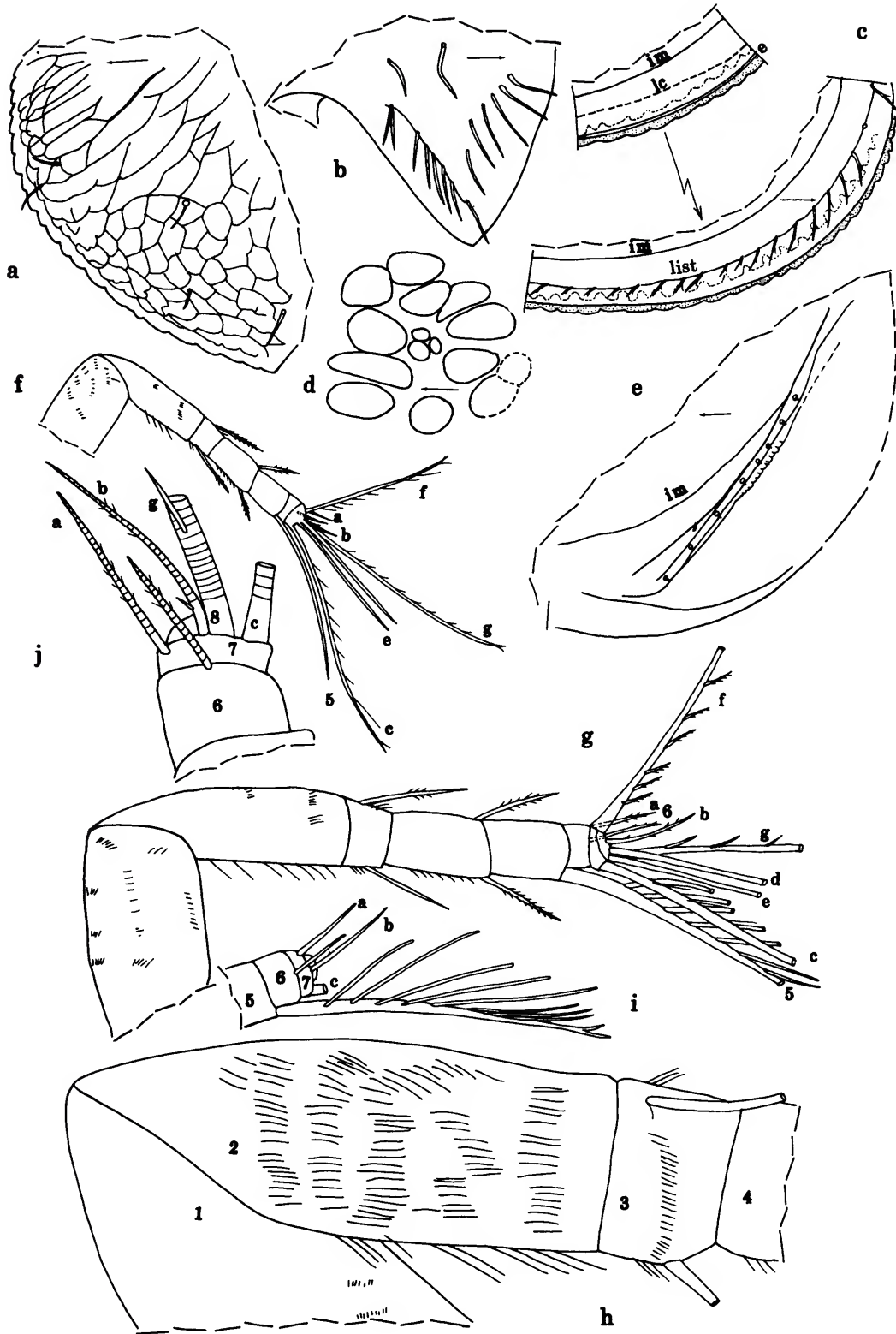




FIGURE 9 (opposite).—*Jimmorinia gunnari*, new species, paratype, adult female from Bahamas, USNM 194318, length ~1.24 mm: *a*, left anteroventral valve showing external ornamentation, *ov*; *b*, left rostral infold, arrow indicates anterior to right, *iv*; *c*, left anteroventral infold (part) showing internal pockets (dotted line), *iv*; *d*, central adductor muscle scars, right valve, anterior to left (arrow), *iv*; *e*, right caudal infold, *iv*; *f,g*, right 1st antenna (terminal setae labeled), *lv*; *h*, proximal left 1st antenna (only part of 1st and 4th articles shown), *mv*; *i*, distal left 1st antenna showing only setae of articles 5–7, *mv*; *j*, distal left 1st antenna showing only setae of 6th and 7th articles and basal g-seta of 8th article, *mv*.

4) pectinate ringed b'-setae, and 4 pectinate ringed b"-setae (Figures 6b, 13b,d). 3rd exopodial article (Figures 6b, 13c,d): inner lobe with 3 ringed setae (1 proximal with long proximal hairs and short distal spines, 1 subterminal with distal short spines, 1 terminal with few short spines); outer lobe hirsute, with 2 ringed setae with thread-like tips (both either with long proximal and short distal spines, or inner with only short spines). Hirsute 4th and 5th articles fused, with 2 central terminal processes (inner stouter and spinous node, other thin and at least sometimes spinous) and 4 (rarely 5) spinous ringed setae (2 on each side of processes) (sometimes 3rd small bare process on inner side of fused articles) (Figures 6b, 13d).

*Sixth Limb* (Figure 13e): Hirsute, with 1 or 2 short epipodial setae. Endite I with 1 or 2 short hirsute medial setae and 1 long terminal seta with long spines; endite II with 0–2 short medial setae and 2 long terminal setae with long proximal and short distal spines (1 minute medial seta sometimes present between 2 long spinous terminal setae); endite III with 3 terminal setae (1 minute seta with short spines between 2 long setae with long proximal and short distal spines); endite IV narrow, with 1 long terminal seta with long proximal and short distal spines. End article with 5–7 anterior setae (with long proximal and medium distal spines) separated by short space from 1 similarly spinous seta and 2 longer hirsute posterior setae.

*Seventh Limb* (Figure 11f): Similar to that of adult male.

*Genitalia* (*Eighth Limb*) (Figures 8e, 12f,g): Small complex oval with attached spermatophore on each side of body anterior to furca.

*Furca* (Figures 3a,e, 8f, 12f, Plate 1e): In general, similar to that of adult male. Small process following claw 6 is minute indistinct diaphanous peg.

*Bellonci Organ* (Figures 3c,g, 8g,h, 11g): Similar to that of adult male.

*Eyes*: Lateral eye (Figures 2b, 3a,c,e) similar to that of adult male except appearing slightly smaller relative to shell length (absolute size ~0.15–0.17 mm in both sexes, except slightly smaller in Roatan specimens, ~0.13–0.15 mm). Medial eye (Figures 3c, 8g,h) similar to that of adult male. Medial eye of USNM 193318 fragmented and with inner structures missing.

*Frontal Knob* (Figure 8i): Similar to that of adult male.

*Upper Lip* (Figures 3d, 8i, 13f,g): Similar to that of adult male (but females not examined with SEM).

*Posterior of Body* (Figures 8e, 13h): Evenly rounded, bare.

*Y-Sclerite* (Figures 8e, 13h): Similar to that of adult male.

INSTAR V (INSTAR A–1) (Sex Unknown) (Figures 14, 15).—

Carapace of unique specimen oval in lateral view with narrow evenly rounded caudal process (Figure 14a,g,h). Left valve appearing narrower than right valve, but dorsal margin may be folded inward (Figure 14h). Anteroventral edge of shell less prominently scalloped than on adult.

*Ornamentation*: Similar to that of adult female (Figure 14a).

*Infold*: Rostrum with 11 setae forming row just within anterior and ventral margins and 2 posterior setae similar to those of adult (Figure 14d). Infold of caudal process similar to that of adult (Figure 14f). Anteroventral infold with narrow list bearing 14 divided setae.

*Structures within Anteroventral Edge of Valve*: Left valve with undulations similar to those of adult (Figure 14c), but on right valve thimble-like pockets appear as enclosed and unconnected entities (Figure 14e).

*Carapace Size* (length, height in mm): USNM 194320, separated right valve, 0.90, 0.67; separated left valve, 1.00, 0.60.

*First Antenna* (Figure 14i): Limb similar to that of adult female (filaments of setae of 7th and 8th articles not counted).

*Second Antenna* (Figure 14j,k): Similar to that of adult except 1st endopodial article with 3 (2 short, 1 slightly longer) instead of 4 proximal bristles.

*Mandible* (Figure 15a): Similar to that of adult except dorsal margin of 2nd endopodial article with 3 (1 with long spines) short setae instead of 6.

*Fourth Limb* (*First Maxilla*): Similar to that of adult (only 2 distal setae (1 long, 1 short) observed on basale).

*Fifth Limb* (*Second Maxilla*) (Figure 15b–d): Epipodite with 36 or 37 plumose setae. Protopodial tooth and endites similar to that of adult (endite I with 6 spinous setae). 1st exopodial article similar to that of adult except main tooth with 5 instead of 6 pectinate teeth. Exopodial articles 2–5 similar to those of adult.

*Sixth Limb* (Figure 15e): Epipodial and endite setae similar to those of adult. End article similar to that of adult except with 5 instead of 6 anterior setae.

*Seventh Limb* (Figure 15f): With same number of setae (10) as on adult, but setae tapering distally and with fewer bells (8 setae with 1 bell and 1 seta (terminal) with 2 bells, instead of all with 3 bells).

*Genitalia*: None observed, possibly missing on incomplete specimen.

*Furca*: Missing from specimen.

*Bellonci Organ and Medial Eye*: Not observed, possibly missing from specimen.

*Lateral Eye* (Figure 15g): With brown pigment and 4 large amber-colored undivided ommatidia, as in adult.

*Upper Lip* (Figure 15g): Similar to that of adult.

*Age of Specimen*: The tapered bristles of the 7th limb and the presence on them of fewer bells than on the adult indicates that the USNM 194320 specimen is a juvenile. The conclusion that it is an A–1 instar is based on the main tooth of the 5th

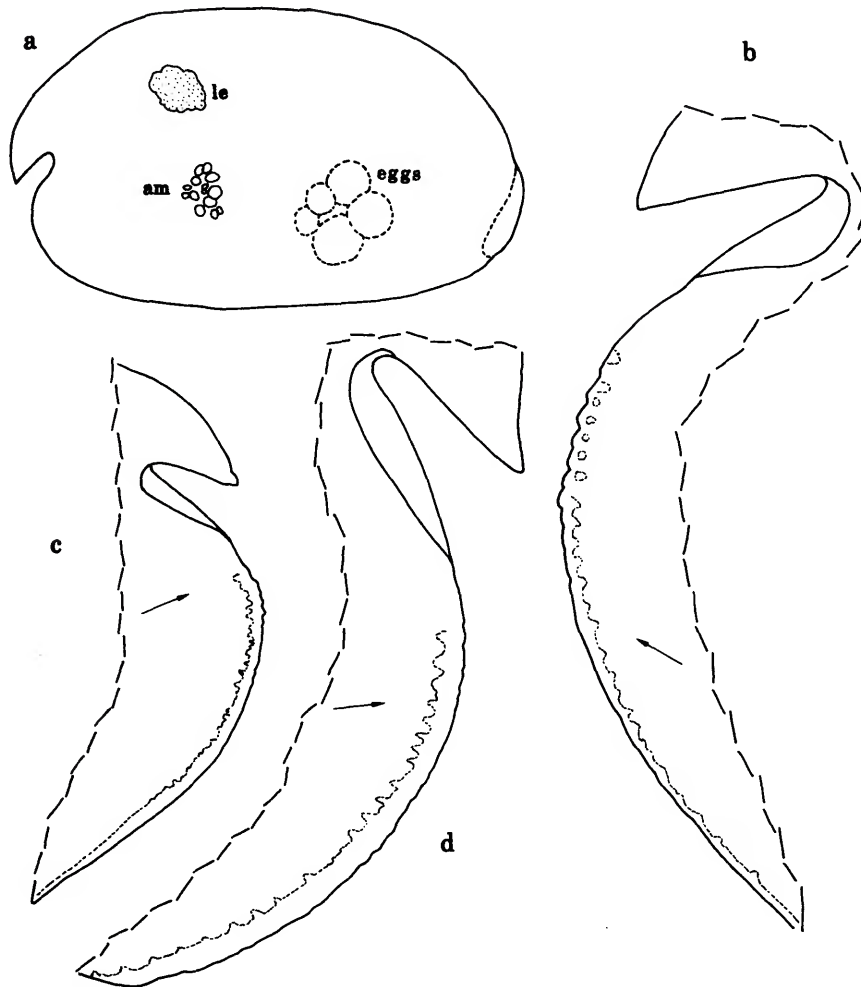


FIGURE 10.—*Jimmorinia gunnari*, new species, paratype, adult female from Bahamas, USNM 194496, length 1.16 mm: *a*, complete specimen from left side showing lateral eye (stippled), central adductor muscle scars, eggs, and caudal infold (dashed lines), ov; *b*, left anterior valve showing internal undulate structure, ov; *c, d*, right anterior valve, X2 magnification, showing internal undulate structure, ov.

limb (2nd maxilla) having five instead of six pectinate teeth (Kornicker, 1991:4). It is assumed to be an instar V because members of the Cypridininae generally have five juvenile instars (Hiruta, 1983:667).

**INSTAR III (INSTAR A-3)** (Figures 16, 17*a-d*).—Carapace flexible and distorted but, in general, similar in shape to that of adult.

**Ornamentation:** Indistinct striations visible in small areas. Single setae sparsely distributed over surface, as on adult.

**Infold:** Not examined in detail, but ridge of caudal process similar, in general, to that of adult.

**Structures within Anteroventral Edge of Valve:** Undulate pockets present in valves of adult and instar V absent.

**Carapace Size** (length, height in mm): USNM 194319

(shell distorted), left valve, 0.67, 0.40.

**First Antenna** (Figure 16*a*): Articles 1–4 and 6 similar to those of adult limb except ventral seta of 4th article shorter. Sensory seta of 5th article with 3 long broad filaments followed by 3 long slender filaments and 1 short subterminal filament. 7th and 8th articles: a-seta similar to that of adult; b-seta with minute spines but without proximal spine-like filament; c-seta long but with tip missing, 5 filaments on remaining part. 8th article: d- and e-setae similar to those of adult; f-seta oriented dorsally, with 5 filaments; g-seta long, with 6 filaments.

**Second Antenna** (Figure 16*b*): Limb differs from that of adult in having only 1 short proximal seta and 1 long distal seta on 1st endopodial article.

**Mandible** (Figure 16*c*): Coxale, basale, and 1st endopodial

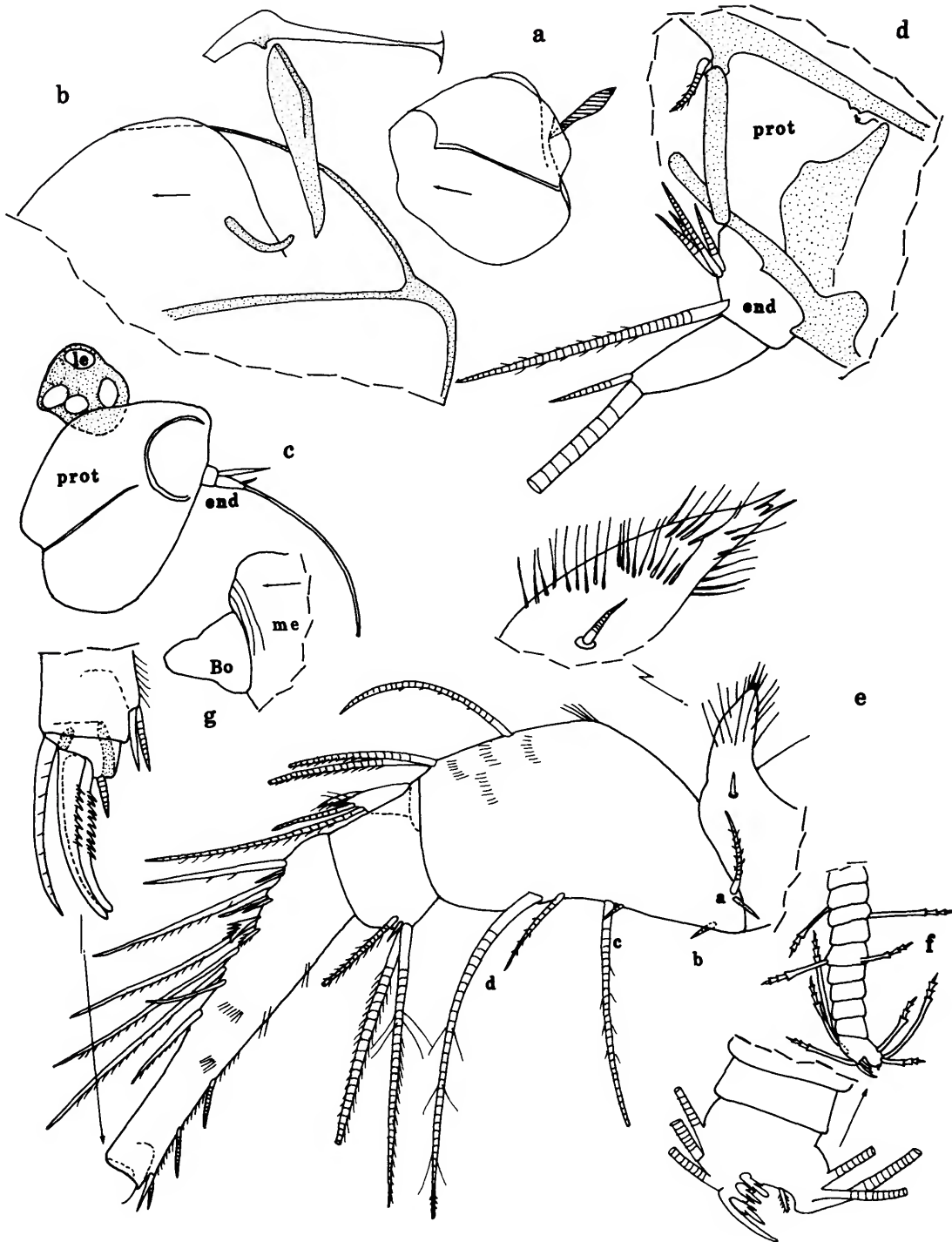


FIGURE 11.—*Jimmorinia gunnari*, new species, paratype, adult female from Bahamas, USNM 194318: *a-d*, right 2nd antenna: *a*, protopodite (striped area indicates sclerotized fulcrum), mv; *b*, part of protopodite shown in *a*, fulcrum and sclerites stippled, mv; *c*, complete protopodite, distal endopodite, and right lateral eye, lv; *d*, endopodite and distal protopodite (sclerites stippled), mv. *e*, right mandible (ventral setae of basale lettered), mv; *f*, distal 7th limb; *g*, Bellonci organ on distal medial eye.



FIGURE 12.—*Jimmorinia gunnari*, new species, paratype, adult female from Bahamas, USNM 194318: *a-e*, 4th limb: *a*, endites, right limb, mv; *b*, whole left limb less endites (suture between basale and distal articles not shown, setae of endopodite not shown), mv; *c*, distal endopodite of right limb showing tooth (stippled) and setae of 1st article (setae of 2nd article not shown), mv; *d*, distal endopodite of right limb showing tooth (stippled) only of 1st article and a-setae only of 2nd article, mv; *e*, distal endopodite of right limb, showing tooth (stippled) only of 1st article, b-, c-, and d-setae and sclerites (stippled) of 2nd article (a-setae not shown), mv. *f*, right lamella of furca and right genital lobe (8th limb) with spermatophore; *g*, left genital lobe (8th limb) with spermatophore.

article similar to those of adult female. 2nd endopodial article: ventral margin with 1 single slender pointed seta and a terminal pair of slender pointed setae (medial seta unringed); dorsal

margin with 4 medium-length to long setae and 3 short setae (1 with long spines). 3rd endopodial article similar to that of adult except without minute ventral seta.



FIGURE 13.—*Jimmorinia gunnari*, new species, paratype, adult female from Bahamas, USNM 194318: a-d, 5th limb (2nd maxilla): a, endites, left limb, pv; b, a-, b-, and c-setae of 2nd exopodial article, left limb, pv; c, distal protopodite of right limb, with tooth (stippled) and exopodite (only anterior setae of 1st article and d-seta of 2nd article shown), av; d, distal protopodite of left limb, with posterior seta of endite III and exopodite (only teeth and posterior seta of 1st article, c-seta of 2nd article, and all setae of remaining articles shown), pv. e, left 6th limb, endites numbered, lv; f, upper lip, right lv; g, upper lip, angled av; h, portion of posterior body bearing Y-sclerite, right lv.



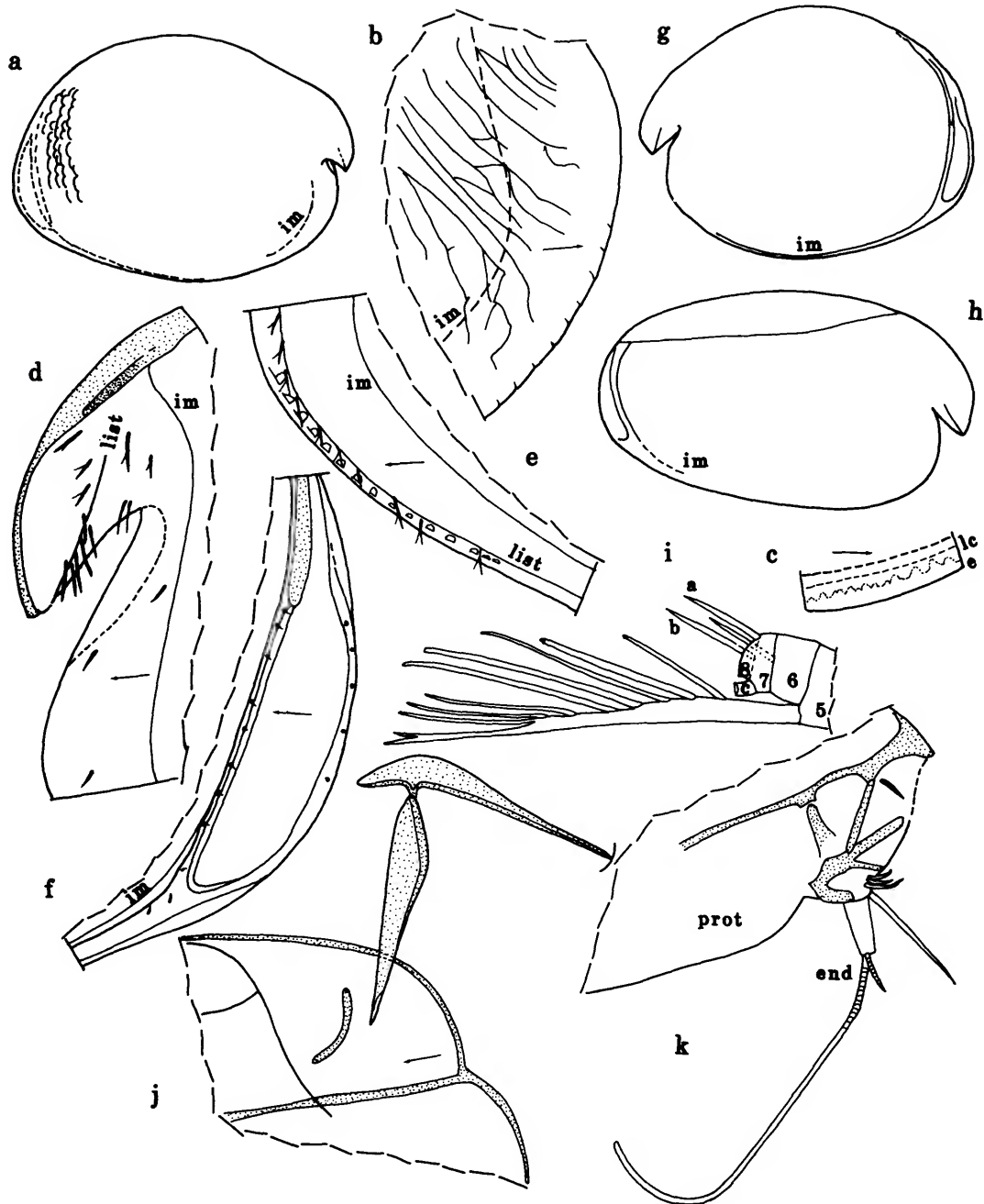


FIGURE 14.—*Jimmorinia gunnari*, new species, paratype, A-1 instar from Bahamas, USNM 194320, length 0.90 mm: a, right valve partially showing infold (dashed line) and external ornamentation, ov; b, partial view of anteroventral margin of right valve, ov; c, part of anteroventral margin of left valve showing valve edge (e), line of concrescence (lc), and interior pocket-like structures (dotted line), iv; d, anterior of right valve showing setae of rostral infold and some anteroventral setae, iv; e, part of anteroventral margin of right valve showing interior pocket-like structures next to setae, iv; f, caudal infold of right valve, sclerotized bar stippled, iv; g, right valve, iv; h, left valve, iv; i, tip of left 1st antenna (setae of 8th limb not shown), lv; j, posterodorsal corner of proto-podite of right 2nd antenna (sclerites stippled) and fulcrum with attached body sclerite (both sclerites stippled), mv; k, endopodite and distal proto-podite of left 2nd antenna (sclerites stippled), mv.



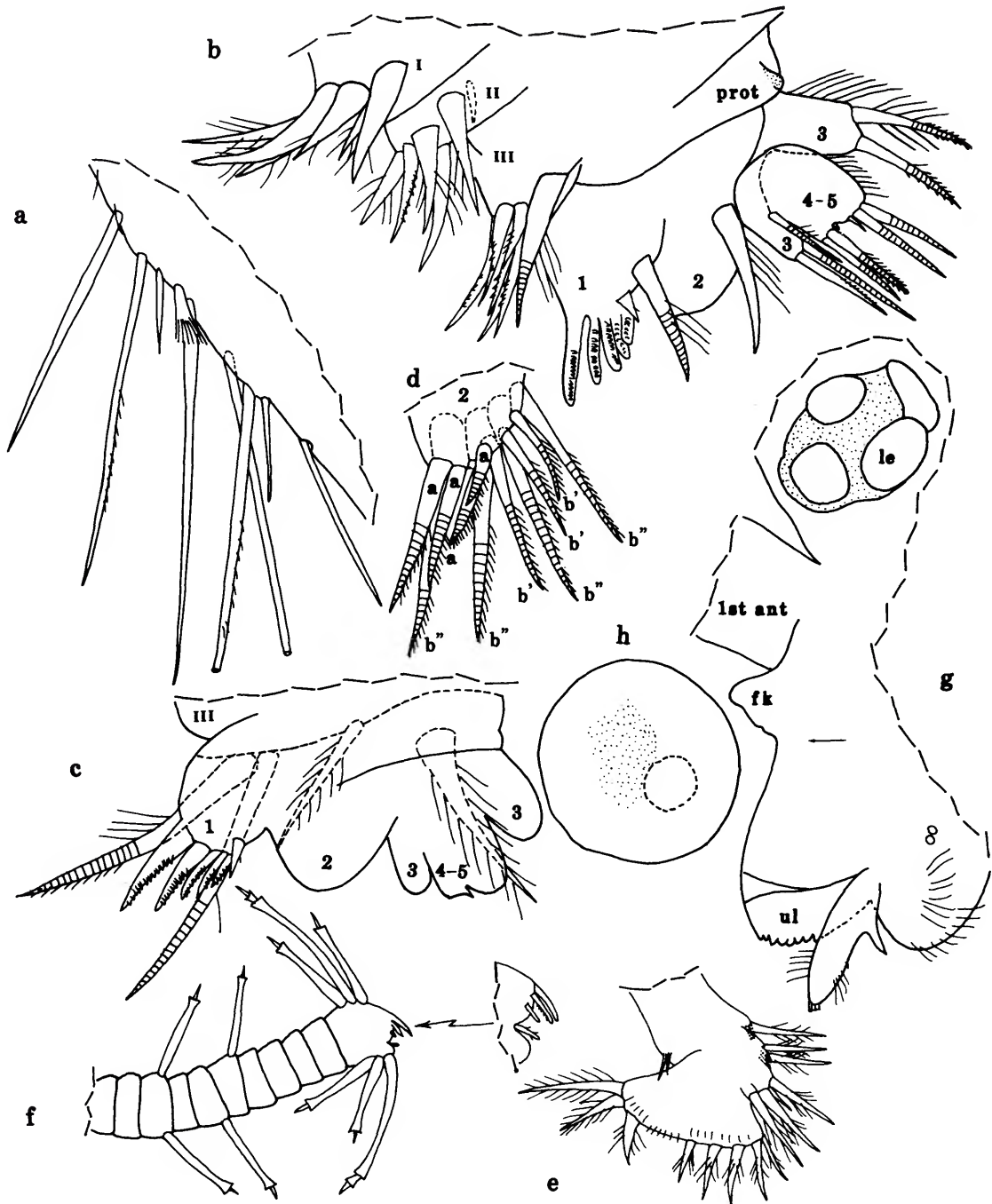


FIGURE 15.—*Jimmorinia gunnari*, new species, paratype, A-1 instar from Bahamas, USNM 194320: a, dorsal setae of 2nd endopodial article of right mandible, mv; b, distal right 5th limb (2nd maxilla) showing endites (Roman numerals), protopodal tooth (stippled), only teeth and anterior seta of 1st article, only c-seta of 2nd article, and all setae of remaining articles, pv; c, distal protopodite and exopodite of right 5th limb (2nd maxilla) showing all but posterior peg seta of 1st article, only d-seta of 2nd article, and none of remaining setae, pv; d, 2nd article of right 5th limb (2nd maxilla) showing a- and b-setae, pv; e, right 6th limb, lv; f, 7th limb; g, anterior of body showing lateral eye with four ommatidia, frontal knob, and upper lip; h, detail of ommatidium in g.

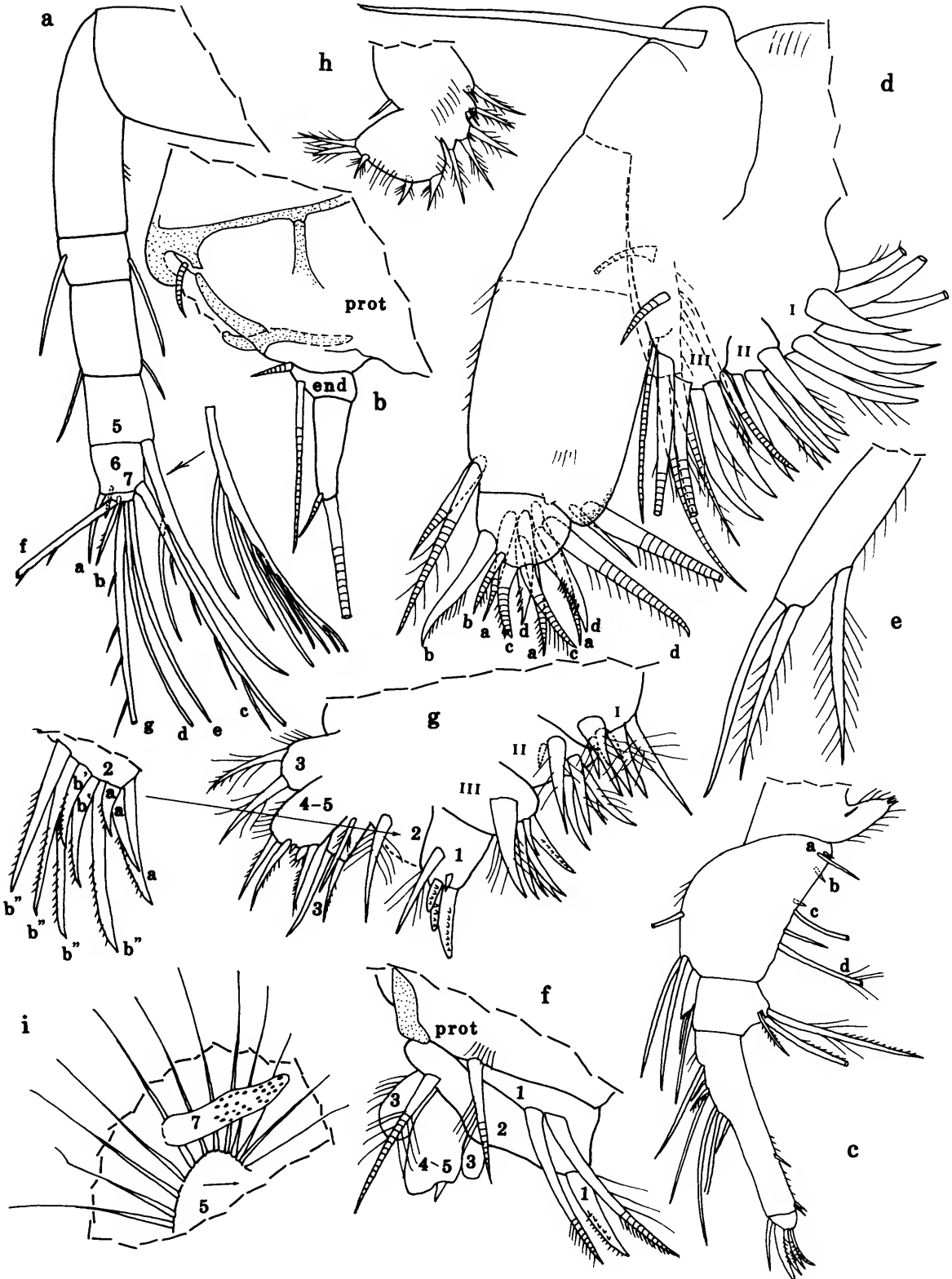


FIGURE 16 (opposite).—*Jimmorinia gunnari*, new species, paratype, instar III from Bahamas, USNM 194319: *a*, left 1st antenna (most distal articles numbered and setae lettered), lv; *b*, endopodite and distal protopodite of right 2nd antenna, mv; *c*, right mandible (ventral basale setae lettered), mv; *d*, right 4th limb (endites identified by Roman numerals, terminal setae by letters), mv; *e*, exopodite of right 4th limb, mv; *f*, partial anterior view of distal right 5th limb (2nd maxilla) showing only distal protopodal tooth (stippled), anterior setae of 1st article, d-seta of 2nd article, and process of fused 4th and 5th articles; *g*, distal left 5th limb (2nd maxilla) showing endites (Roman numerals), exopodial articles (numbered), and insert of a- and b-setae of 2nd article, pv; *h*, right 6th limb, lv; *i*, epipod (5) of 5th limb (2nd maxilla) (attached posteriorly to proximal part of limb) and adjacent bud of 7th limb (7).

*First Maxilla (Fourth Limb)* (Figure 16*d,e*): Coxale with long dorsal seta (bare or with short hairs). Endites I and II with 8 and 5 setae, respectively; endite III with 1 short proximal and 5 terminal setae (posterior setae slender bare, others stout spinous). Basale with 2 distal setae (1 long, 1 short) near ventral margin. Exopodite similar to that of adult (Figure 16*e*). 1st endopodial article differs from that of adult in having 2 instead of 3 beta-setae. 2nd endopodial article with 2 b-setae (3 in adult) and 2 long pectinate c-setae (3 in adult).

*Fifth Limb (Second Maxilla)* (Figure 16*f,g*): With 33 plumose epipodial setae. Endites, protopodite, and 1st exopodial article similar to those of adult except main tooth with 3 instead of 6 pectinate teeth. 2nd exopodial article differs from adult in having 3 instead of 4 a-setae and 2 instead of 4 b'-setae (Figure 16*g*). Exopodial article 3 differs from that of adult in having both setae of outer lobe with many long proximal spines. Fused exopodial articles 4 and 5 differ from those of adult in having 3 instead of 4 or 5 long terminal setae.

*Sixth Limb* (Figure 16*h*): With 1 epipodial seta. Endite I with 1 short hirsute medial seta and 1 long hirsute terminal seta; endite II with 1 short hirsute medial seta adjacent to longer spinous medial seta, and with 1 long spinous terminal seta; endites III and IV similar to those of adult. End article with 2 spinous anterior setae separated by wide space from 1 spinous seta and 2 longer hirsute posterior setae.

*Seventh Limb* (Figure 16*i*): Elongate bare and filled with minute cells.

*Genitalia*: Absent.

*Furca* (Figure 17*a*): Differs from that of adult in having 5 instead of 6 claws; posterior spine present.

*Bellonci Organ and Medial Eye* (Figure 17*b*): Not observed on undissected specimen, but medial eye and Bellonci organ possibly represented by a transparent oval with faint striations and a short thumb-like process that were observed in proper location on mounted limbs.

*Upper Lip* (Figure 17*c,d*): Similar to that of adult.

*Posterior of Body* (Figure 17*a*): Differs from adult in having row of spines just dorsal to posterior end of girdle.

*Y-Sclerite* (Figure 17*a*): Similar to that of adult.

*Age of Specimen*: Estimated to be an instar III because specimen with only 3 pectinate teeth on 5th limb (2nd maxilla) and because 7th limb bare.

INSTAR I (INSTAR A-5) (Figures 17*e-i*, 18).—Shape, in general, similar to that of adult (Figure 17*e*). Scallops along anteroventral margin fewer than adult, weakly developed, and located slightly proximal and lateral to valve edge.

*Ornamentation*: None observed.

*Infold*: Not examined in detail, but setae present on rostral and anteroventral infolds, and ridge present on infold of caudal process.

*Structures within Anteroventral Edge of Valve*: Absent.

*Central Adductor Muscle Attachments* (Figure 18*j*): Consisting of about 14 ovoid attachments.

*Carapace Size* (length, height in mm): USNM 194317, 0.53, 0.36.

*First Antenna* (Figure 17*f*): 1st article bare. 2nd article with dorsal hairs. 3rd article with 2 setae (1 ventral, 1 dorsal). 4th article bare. Sensory seta of 5th article without filaments but with terminal papilla or hair. 6th article similar to that of adult. 7th article differs from that of adult female in b-seta not having proximal spine-like filament and in c-seta not having filaments. 8th and 9th articles: d- and e-setae similar to those of adult; f- and g-setae differ from those of adult in not having filaments, but each with terminal papilla; f-seta not oriented dorsally.

*Second Antenna* (Figure 17*g,h*): Protopodite, in general, similar to that of adult (Figure 17*g*). Endopodite differs from that of adult in having no setae on 1st article (Figure 17*g*). Exopodite differs from that of adult in having 2 instead of 3 setae on 9th article, in having smaller basal spines on articles 3-8, and in having a smaller lateral spine on article 9 (Figure 17*h*).

*Mandible* (Figure 17*i*): Coxale endite similar to that of adult. Basale: ventral margin with only 2 setae (probably 1 c-seta and 1 shorter d-seta); dorsal margin similar to that of adult. Exopodite differs from that of adult in being slightly shorter relative to length of dorsal margin of 1st endopodial article. 1st endopodial article differs from that of adult in having 2 instead of 4 ventral setae. 2nd endopodial article: ventral margin with only 1 seta (terminal, medial, unringed); dorsal margin with 4 medium-length to long setae and 2 short setae (proximal with indistinct long spines). 3rd endopodial article with 3 claws and 1 long ventral seta (dorsal claw has internal cross-lines resembling annulations).

*First Maxilla (Fourth Limb)* (Figure 18*a,b*): Usual dorsal seta of coxale absent from both limbs (possibly broken off). Endite I with 5 spinous setae; endite II with 4 spinous setae; endite III with no proximal seta and about 4 terminal setae. Basale with 2 distal setae. Exopodite similar to that of adult. 1st endopodial article with single triangular cutting tooth, 1 long hirsute alpha-seta, and 1 long pectinate beta-seta. 2nd endopodial article with 2 a-setae (anterior with more spines), 1 pectinate b-seta, and 2 pectinate d-setae.

*Fifth Limb (Second Maxilla)* (Figure 18*d*): Epipodite with 29 plumose setae. Endite I fragmented (with at least 1 seta); endites II and III each with 3 spinous setae. Protopodite without anterior tooth. 1st exopodial article without anterior setae; main tooth consisting of small smooth triangular peg and stout

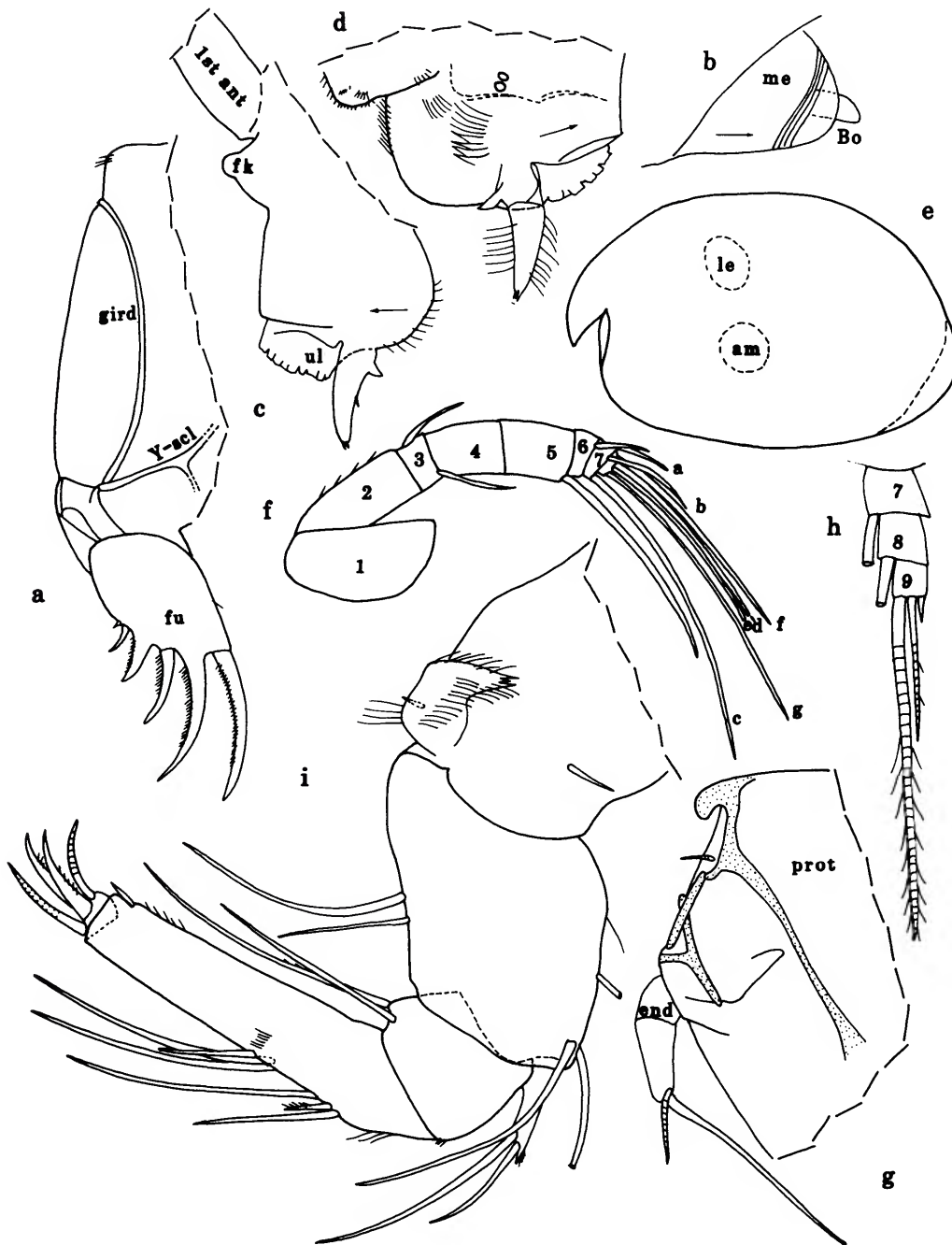


FIGURE 17.—*Jimmorinia gunnari*, new species, paratypes, juveniles from Bahamas. Instar III, USNM 194319: *a*, posterior of body showing right furcal lamella, Y-sclerite, and girdle, lv; *b*, medial eye and attached Bellonci organ, anterior to right, right lv; *c*, anterior of body showing frontal knob, upper lip, left lv; *d*, upper lip, anterior to right, right lv. Instar I, USNM 194317, length 0.53 mm: *e*, left valve showing position of lateral eye, central adductor muscles, and caudal infold (dashed line); *f*, left 1st antenna (7 of 8 articles numbered, setae of 7th and 8th articles lettered), mv; *g*, endopodite and distal protopodite (sclerites stippled) of right 2nd antenna, mv; *h*, 7th–9th exopodial articles of 2nd antenna (only bases of setae of 7th and 8th articles shown); *i*, left mandible, mv.

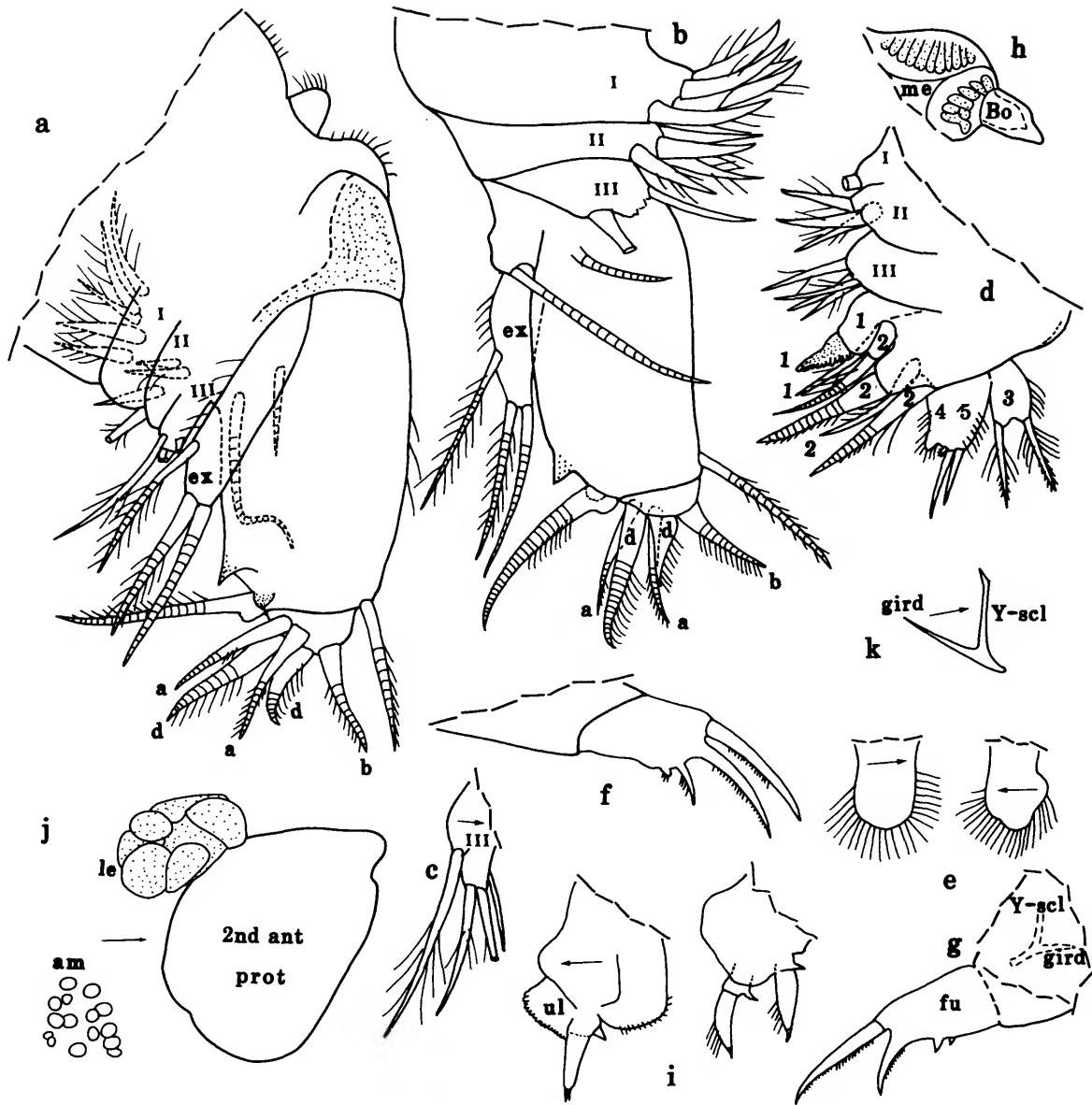


FIGURE 18.—*Jimmorinia gunnari*, new species, paratype, instar I from Bahamas, USNM 194317: a, right 4th limb, lv; b, left 4th limb, mv; c, right 4th limb, endite III; d, distal 5th limb (2nd maxilla) showing endites and exopodite (posterior peg on 1st article not shown); e, paired 6th limbs; f, right furcal lamella, lv; g, left furcal lamella, Y-sclerite, and girdle, lv; h, medial eye and attached Bellonci organ, right lv; i, upper lip shown in left lateral and anterolateral views; j, central adductor muscle scars, lateral eye, and protopodite of 2nd antenna; k, Y-sclerite and girdle, lv.

pectinate tooth (proximal cusps larger); spinous posterior seta present proximal to peg. 2nd exopodial article with spinous anterior seta, 1 spinous posterior seta (this seta could be interpreted to be in place of inner lobe of 3rd exopodial article but is probably located on 2nd article), 1 or 2 stout pectinate a-setae,

and 1 stout b-seta with few long proximal spines and distal slender teeth. 3rd exopodial article with inner lobe absent; outer lobe with 2 spinous setae (proximal spines long). Terminal fused 4th and 5th articles with 2 spinous setae and small spined peg adjacent to large process with hairs.



*Sixth Limb* (Figure 18e): Small, spinous, without setae.

*Seventh Limb*: Absent.

*Furca* (Figure 18f,g): Each lamella with 1 stout articulated claw followed by 1 slightly shorter nonarticulated claw, 1 short nonarticulated claw, and 1 small nonarticulated spinous process (incipient claw). Claws with teeth along posterior edges.

*Bellonci Organ and Medial Eye* (Figure 18h): Medial eye oval. Bellonci organ elongate with tapered tip.

*Lateral Eye* (Figure 18j): With undivided ommatidia.

*Upper Lip* (Figure 18i): Similar to that of adult.

*Y-Sclerite* (Figure 18g,k): Fused to girdle.

### *Jimmorinia gamma* Cohen and Kornicker, new species

FIGURES 19–23

ETYMOLOGY.—From the name of the submersible *Nekton Gamma*, which was used to collect the species.

HOLOTYPE.—USNM 194497, adult female (with large unextruded eggs) on slide and in alcohol, length 1.43 mm, height 0.86 mm.

TYPE LOCALITY.—Sta 95-006, off Lee Stocking Island, Exuma Cays, Bahamas; at 88 m depth, near cave entrance on the submarine escarpment; 7 May 1993; collected in baited bottle trap by T. Iliffe.

DIAGNOSIS OF FEMALE (male unknown).—Valve an oblong oval, with caudal process below midpoint of valve; anteroventral margin smoothly rounded (not scalloped) (Figure 19a,b). Valve relatively large and less elongate than in *J. gunnari*, length 1.43 mm, height 0.86 mm, length:height ratio 1.66 (N=1).

Infold (Figure 19c,d,f) of rostrum with total of ~33–38 setae (forming irregular bent row of ~13 setae parallel to anterior margin, continuing with 11 along incisur, plus 4 more along posterior list and about 5 other posterior setae). Anteroventral infold with narrow list bearing about 38 anterior setae plus about 70 ventral setae (ventral list and setae continuing to about valve midlength and posterior setae more widely spaced) (Figure 19c,d,f). Anteroventral margin between infold and outer shell without row of slight indentations or pockets marking internal undulate structure (Figure 19c). Without amorphous and irregular soft globs/balls just posterior to anterior infold. 1st antenna (Figure 20a–c) with 1st article bare. 2nd antenna (Figure 20d) with seta of 2nd exopodial article with 7 or 8 ventral spines. Mandible (Figure 20e–h) with only a few long teeth on 2 ventral terminal claws of 3rd endopodial article. 5th limb (2nd maxilla) (Figure 22a–f) with small distal protopodal tooth with 2 round lobes. 6th limb (Figure 22g) with 2 setae on endite IV. 7th limb (Figure 22h,i) with terminal setal group consisting of 7 setae, with 1 comb seta much longer than other setae; terminus symmetrical (peg side not extended). Each lamella of furca with 7 claws and a tiny posterior spine (Figure 23a–c).

DESCRIPTION OF ADULT FEMALE (Figures 19–23).—An oblong oval in lateral view, with rounded caudal process below midpoint of valve; anteroventral margin smoothly rounded (not scalloped) (Figure 19a,b). Tip of rostrum with small projection

lateral to lamellar prolongation of selvage (Figure 19c).

*Ornamentation*: Ventral and posterior of valve with scale- or shingle-like pattern; scattered setae.

*Infold* (Figure 19c,d,f): Rostrum with total of about 33–38 setae (forming irregular bent row of about 13 setae parallel to anterior margin and 11 along incisur, plus 4 more along posterior list and about 5 other posterior to row; 0 setae anterior to rostral row) (not all setae shown in Figure 19c). Anteroventral infold with 2 setae posterior to incisur and narrow list bearing about 38 anterior setae (Figure 38c) plus about 70 ventral setae (those in posterior part more widely spaced); about 10 widely spaced setae on ventral infold between valve midlength and caudal process; ventral list and setae continuing to about valve midlength and posterior setae more widely spaced) (Figure 19c). (Infold of caudal process with narrow sclerotized anterior ridge bearing 11–22 minute setae (Figure 19d,f). Left valve of holotype with small setae near ventral end of caudal process (Figure 19f). Right valve with bar at dorsal end of ridge of caudal process.

*Vestment*: Left valve of holotype with small but distinct seta anterior to ventral end of anterior ridge of caudal process (Figure 19d); right valve with 2 slender spines (setae) with broad bases proximal to inner margin of infold of posteroventral corner of valve (Figure 19f) and 1 similar spine proximal to infold near dorsal end of caudal process (Figure 19f). (Seta and spines anterior to ridge of caudal process not previously reported in the Cypridinidae.)

*Carapace Size* (length, height in mm): Bahamas: USNM 194497 (holotype), 1.43, 0.86.

*Central Adductor Muscle Attachments* (Figure 19e): Similar to those of adult *J. gunnari*.

*First Antenna* (Figure 20a–c): Similar to that of adult female *J. gunnari*. 1st article bare.

*Second Antenna* (Figure 20d): Similar to adult female *J. gunnari* except 2nd exopodial article with 7 or 8 ventral spines (and in holotype with minute proximal dorsal spine).

*Mandible* (Figure 20e–h): Similar to adult female *J. gunnari* except ventral claws of 3rd endopodial article with shorter, fewer, and less prominent ventral teeth (Figure 20h).

*Fourth Limb (First Maxilla)* (Figure 21): Similar to that of adult female *J. gunnari*.

*Fifth Limb (Second Maxilla)* (Figure 22a–f): Similar to adult female *J. gunnari* except distal protopodal tooth small, with 2 round lobes.

*Sixth Limb* (Figure 22g): Similar to adult female *J. gunnari* except endite IV with 2 setae.

*Seventh Limb* (Figure 22h,i): Similar to adult female *J. gunnari* except terminus more symmetrical and terminal setal group consisting of 7 setae, with 1 comb seta much longer than other setae.

*Genitalia (Eighth Limb)* (Figure 23g): Small complex oval with attached spermatophore on each side of body anterior to furca. Thin transparent lobe appears to separate left and right genitalia.

*Furca* (Figure 23a–c): Similar to adult female *J. gunnari*,

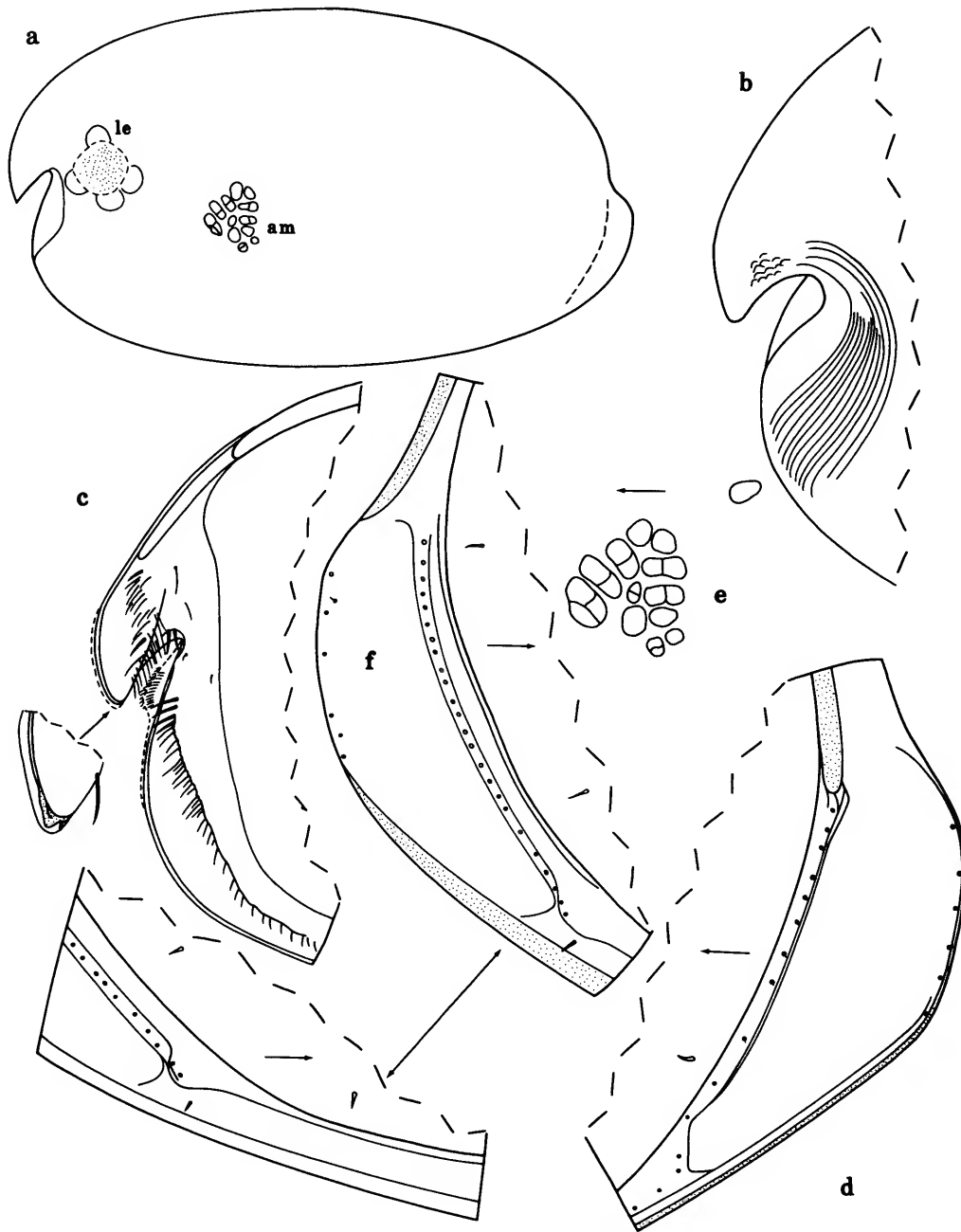


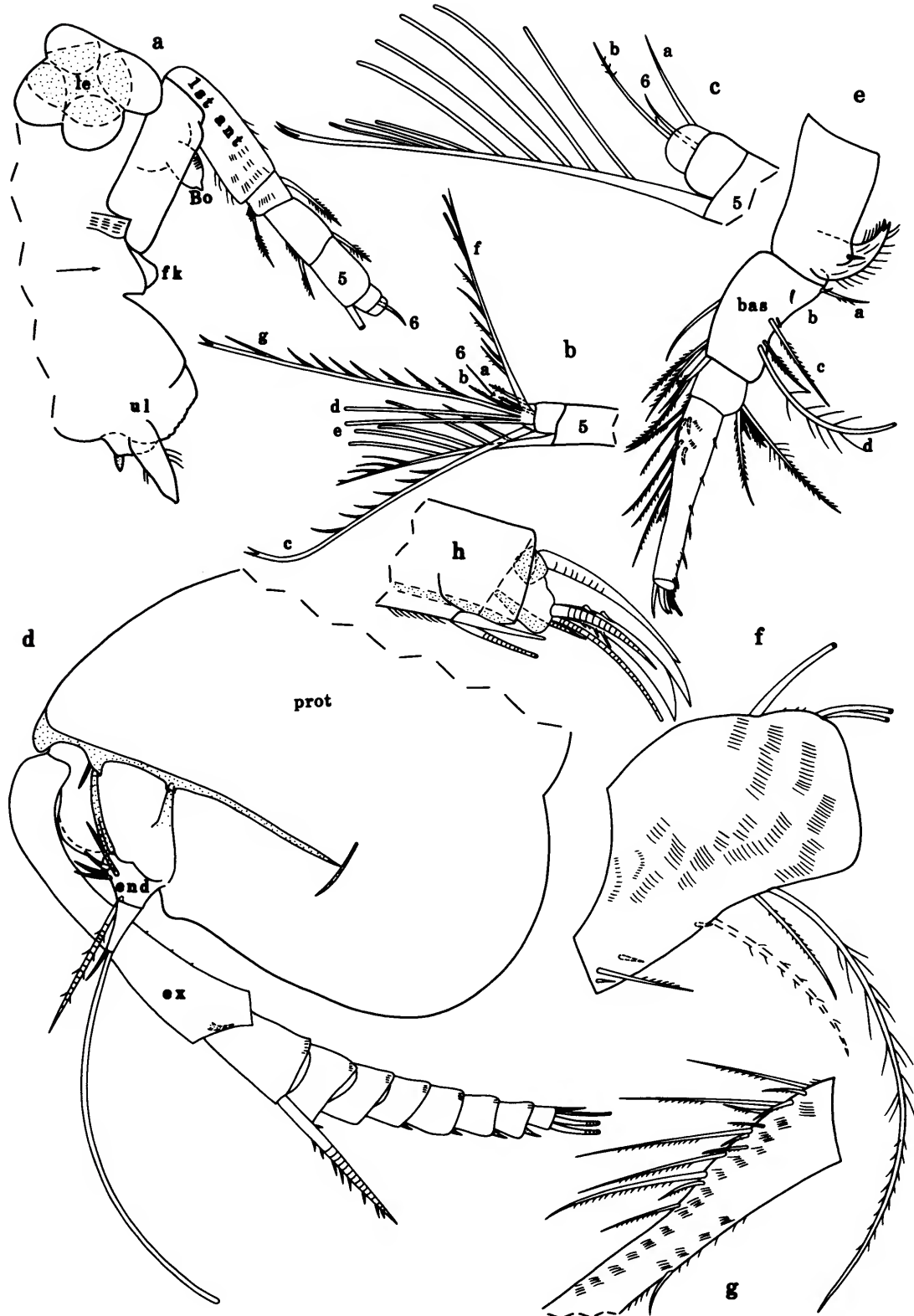
FIGURE 19.—*Jimmorinia gamma*, new species, holotype, adult female from Bahamas, USNM 194497, length 1.43 mm: *a*, complete specimen from left side (pigmented area of lateral eye stippled; inner margin of infold of caudal process dashed); *b*, detail of anterior from *a* showing a few of the scallops on rostrum and faint lines on shell; *c*, anterior right valve, iv; *d*, caudal process right valve, iv; *e*, adductor muscle attachments of left valve (with body removed), ov; *f*, caudal process of left valve, iv.

except each lamella of holotype with 7 claws and a tiny posterior spine.

*Bellonci Organ* (Figures 20a, 22j): Similar to adult female

*J. gunnari*; striated in holotype of *J. gamma*.

*Eyes*: Lateral and medial eyes (Figures 19a, 20a, 22j) similar to those of adult female *J. gunnari*.



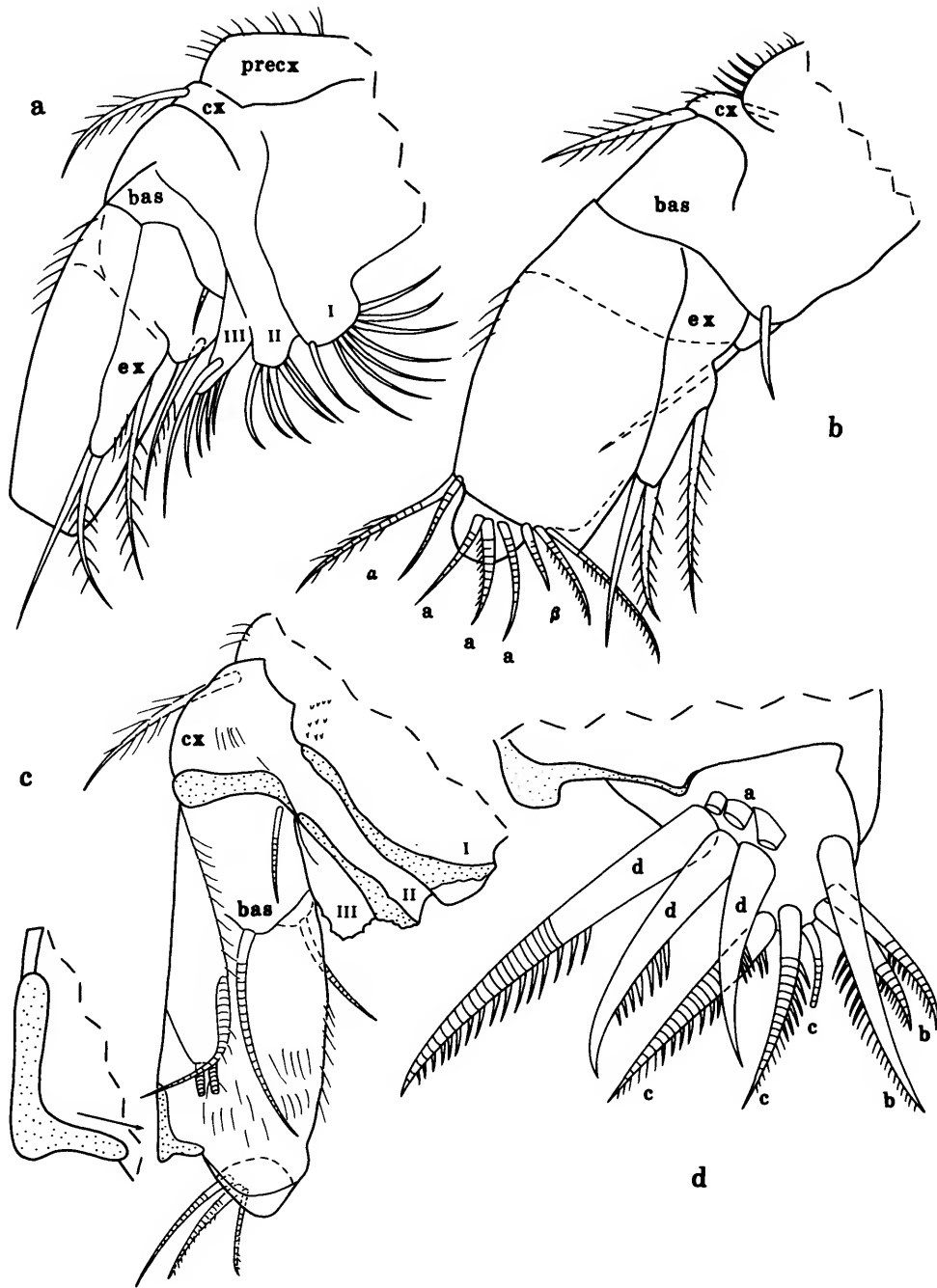


FIGURE 20 (opposite).—*Jimmorinia gamma*, new species, holotype, adult female from Bahamas, USNM 194497: a, anterior of body from right side with 1st antenna (nabs); b, distal left 1st antenna, lv; c, distal left 1st antenna, lv (nabs); d, right 2nd antenna, mv (nabs); e, left mandible, lv; f, basale of left mandible, mv; g, 2nd endopodial segment of right mandible, mv; h, distal left mandible, mv.

FIGURE 21 (above).—*Jimmorinia gamma*, new species, holotype, adult female from Bahamas, USNM 194497, 4th limb: a, left limb, lv (nabs and not all spines on bristles shown; limb not under cover slip); b, left limb, lv (nabs; limb not under cover slip); c, endopodite of left limb, mv (nabs; under cover slip); d, distal right limb showing 2nd and distal 1st articles, lv (nabs; under cover slip).

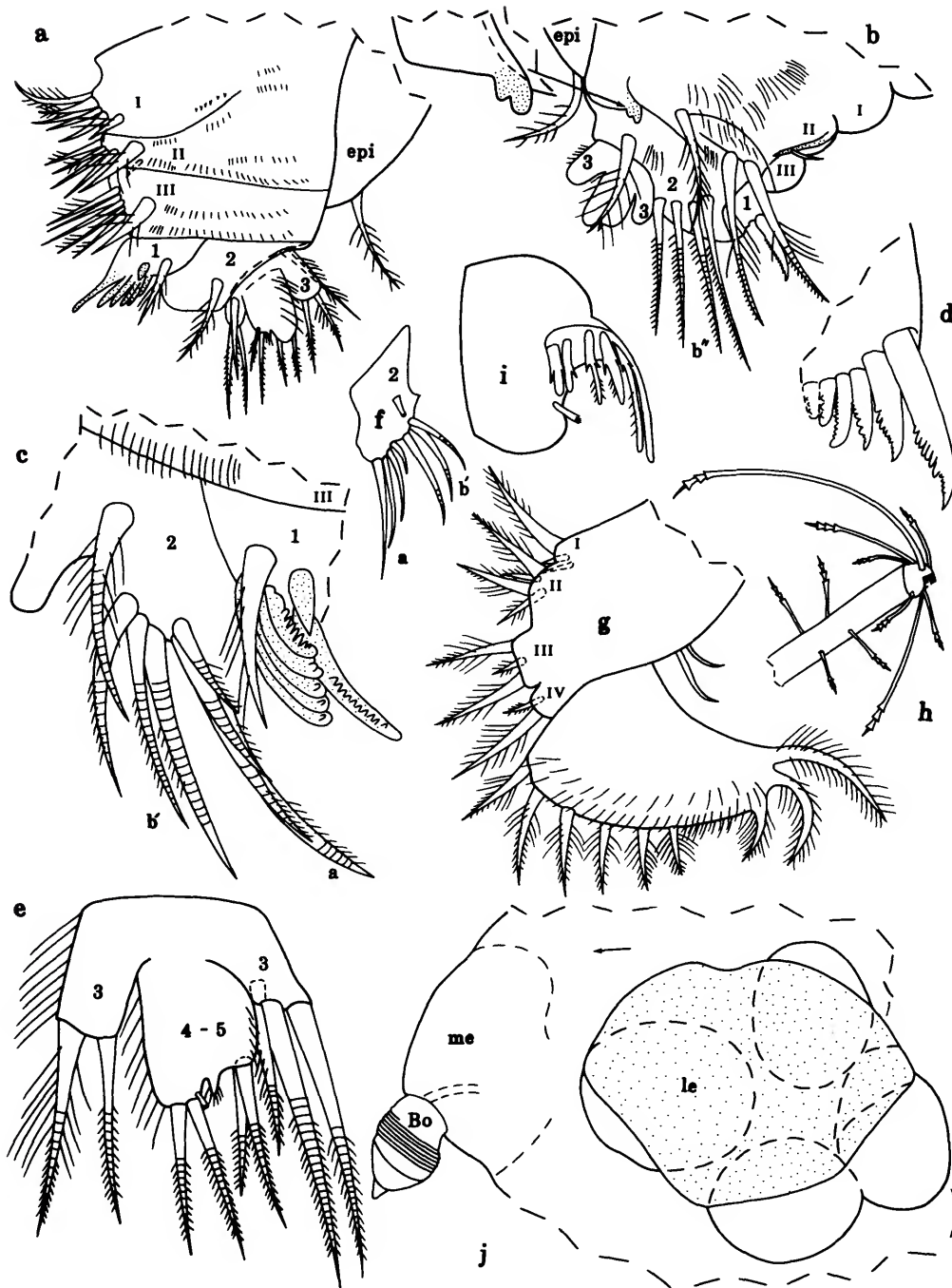


FIGURE 22.—*Jimmorinia gamma*, new species, holotype, adult female from Bahamas, USNM 194497: *a*, right 5th limb (2nd maxilla), pv (nabs, cusps of teeth of 1st exopodal article not shown); *b*, distal right 5th limb (2nd maxilla), av (nabs); *c*, left 5th limb (2nd maxilla), exopodal articles 1 and 2, pv (nabs); *d*, pectinate teeth of 1st exopodal article of right 5th limb (2nd maxilla), av; *e*, 3rd-5th articles of 5th limb (2nd maxilla), detail from *b*; *f*, right 5th limb (2nd maxilla) showing 2nd exopodal article, pv (nabs); *g*, left 6th limb, lv; *h*, distal 7th limb; *i*, tip of 7th limb (nabs); *j*, anterodorsal part of body from left side showing medial eye, Bellonci organ, and left lateral eye (area of pigment stippled).





FIGURE 23.—*Jimmorinia gamma*, new species, holotype, adult female from Bahamas, USNM 194497: *a*, right lamella of furca (mv) and small part of left lamella (lv); *b*, left lamella of furca, lv; *c*, posterior of body from right side; *d*, upper lip and frontal knob from left side (sclerite and tooth stippled); *e*, right tusk of upper lip, mv (tooth stippled); *f*, upper lip, pv (teeth stippled); *g*, genitalia with lobe between them (not under cover slip).

*Frontal Knob* (Figure 20a): Similar to that of adult female *J. gunnari*.

*Upper Lip* (Figures 20a, 23d-f): Not examined with SEM, but, in general, similar to that of adult male *J. gunnari*.

*Posterior of Body*: Evenly rounded, bare.

*Y-Sclerite* (Figure 23c): Similar to that of adult male *J. gunnari*.

COMPARISON OF SPECIES

The two known species of *Jimmorinia* are partially sympat-

ric (in the Bahamas) and are generally similar in morphology, but they differ in a number of diagnostic characters. The most readily visible differences are as follows: *Jimmorinia gamma* (known only from a single female) is much larger (valve length 1.43 mm) than *J. gunnari* from any locality (female valve length 1.10–1.39, N=26) and has more furcal claws (7 plus a minute spine) than *J. gunnari* (6 plus a spine). Additionally, *J. gamma* has many more infold setae (>100 on the anteroventral

infold) than *J. gunnari* (<30), but the former has distinctly fewer setal spines (about 7 or 8 rather than 17–23) on the second exopodial article of the 2nd antenna. *Jimmorinia gamma* also has a more undulate protopodal tooth on the 5th limb (2nd maxilla) and one more seta on endite IV of the 6th limb. The 7th limb terminus of *J. gunnari* is uniquely extended outward on the peg side, whereas the 7th limb of *J. gamma* is unusual in having one terminal seta much longer than the others.

## Plates

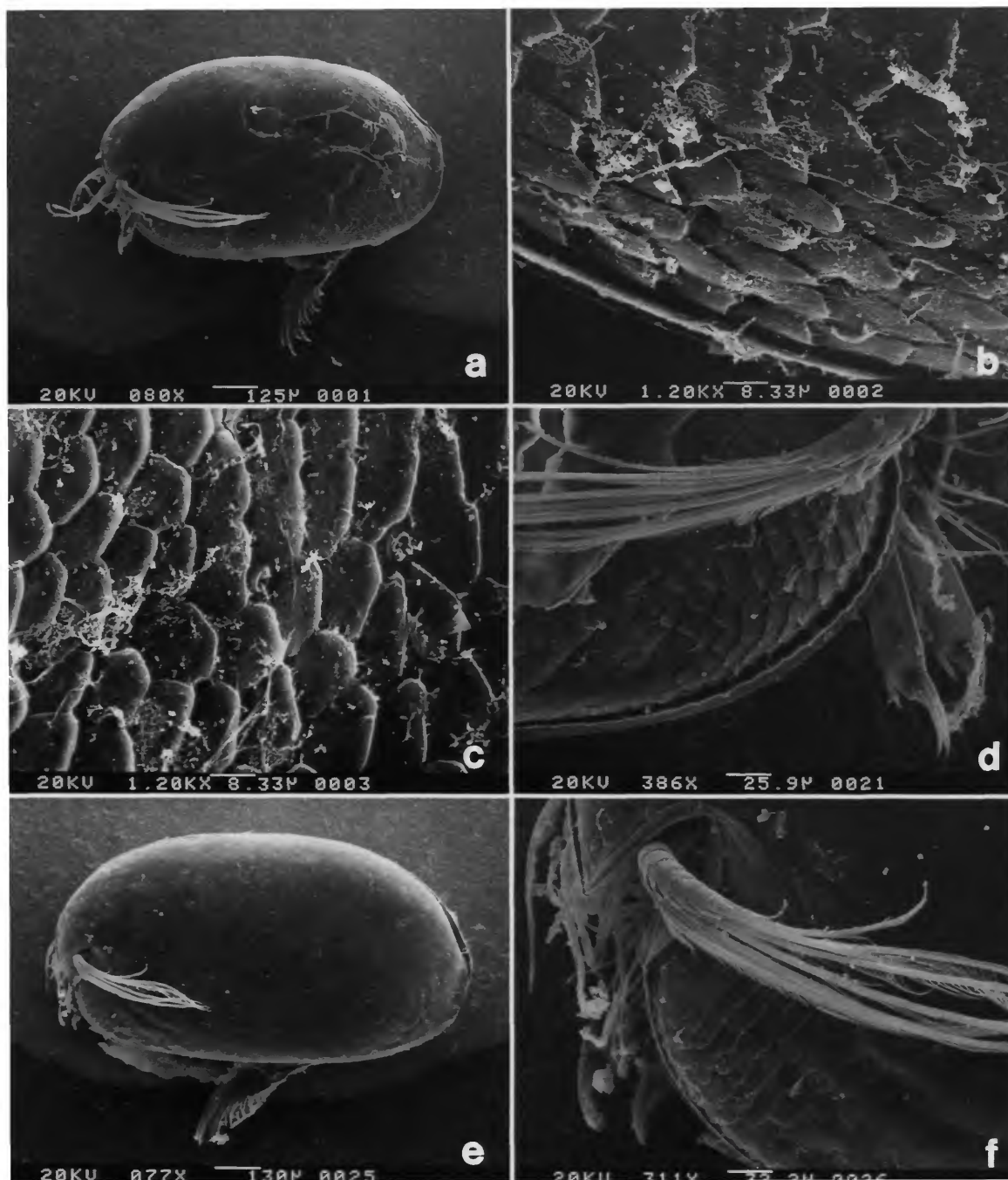


PLATE 1.—*Jimmorinia gunnari*, new species, paratypes from Panama, LACM 85-471.1, sta 11115.2, adult male (specimen b1-4), length 0.94 mm: *a*, whole specimen, left ov, showing valve, furca, distal 1st and 2nd antennae, and mandible; *b*, left anteroventral margin of valve, from *a*, ov; *c*, surface of valve, from *a*, ov. Adult male (specimen b1-1), length 0.94 mm: *d*, anteroventral right valve, also showing mandible and distal exopodite of 2nd antenna. Adult female (specimen b1-3), length 1.17 mm: *e*, whole specimen, left ov, showing valve, furca, and distal 1st and 2nd antennae; *f*, anterior of left valve, also showing distal 1st and 2nd antennae. Scale bars indicate size.

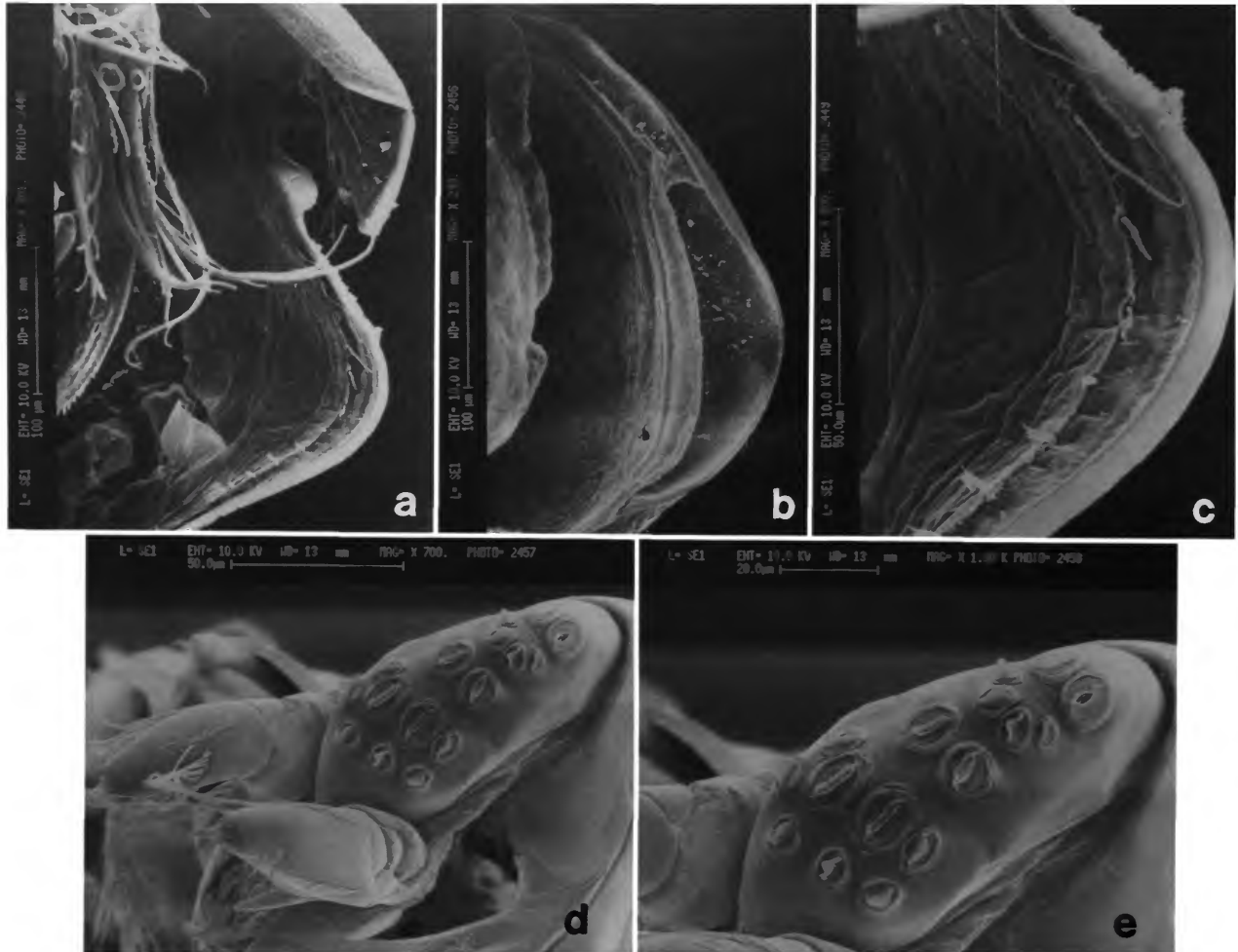


PLATE 2.—*Jimmorinia gunnari*, new species, paratypes, adult males from Bahamas: *a*, USNM 277659, anterior left valve (iv), detail from Plate 3*a*, also showing distal 1st antenna (note large basal suckers on *b*- and *c*-setae), part of exopod of 2nd antenna under 1st antenna; *b*, USNM 277658, caudal process (keel) (iv) showing ridge of list; *c*, USNM 277659, anterior left valve (iv), detail from *a* showing row of slight indentations marking internal undulate structure; *d*, USNM 277660, upper lip, left posterior ventral view showing unpaired anterior field of glandular processes (nozzles) and paired posterior tusks (lip torn dorsal to left tusk); *e*, USNM 277660, enlargement of unpaired field, from *d*. Scale bars indicate size.



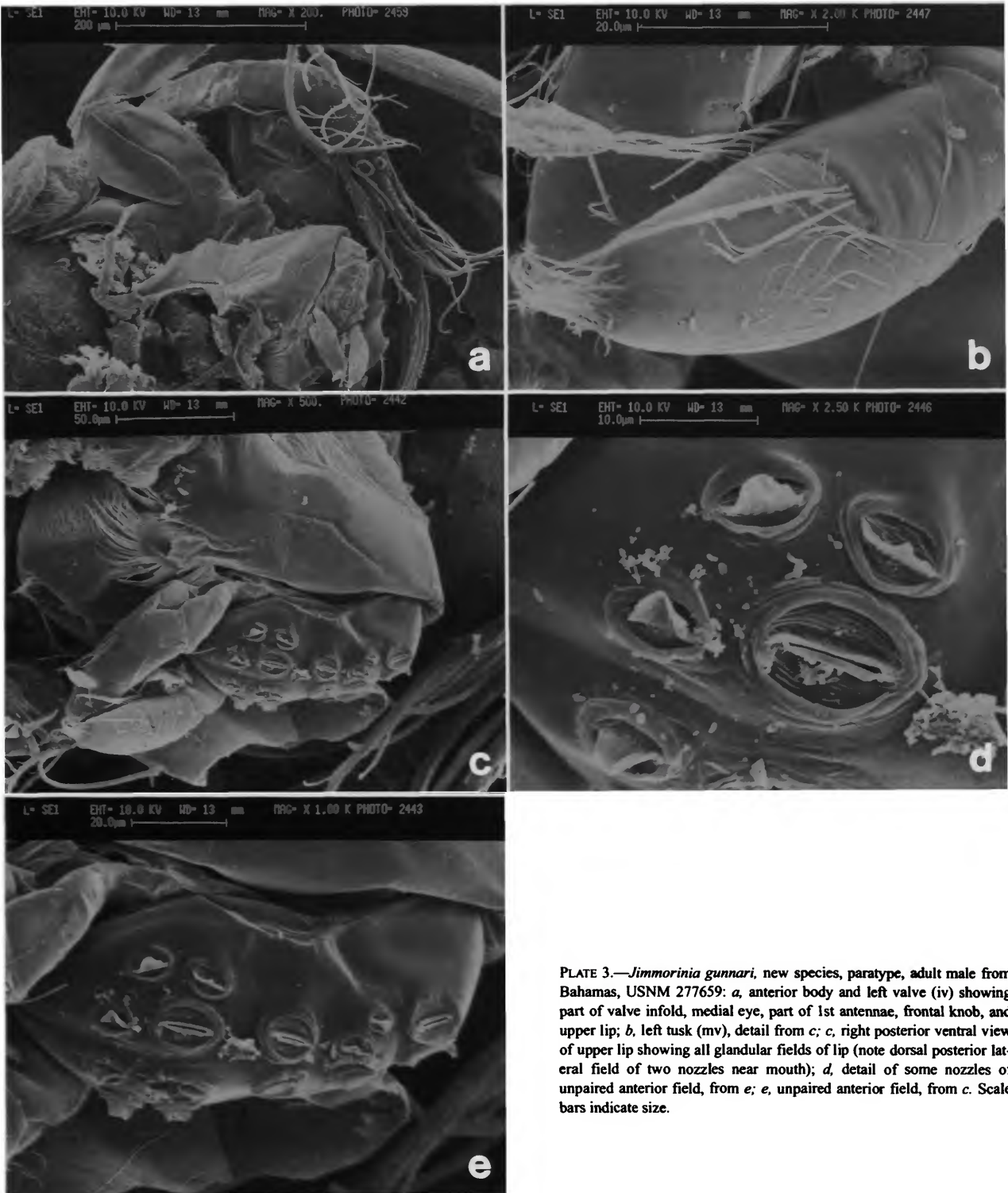


PLATE 3.—*Jimmorinia gunnari*, new species, paratype, adult male from Bahamas, USNM 277659: *a*, anterior body and left valve (iv) showing part of valve infold, medial eye, part of 1st antennae, frontal knob, and upper lip; *b*, left tusk (mv), detail from *c*; *c*, right posterior ventral view of upper lip showing all glandular fields of lip (note dorsal posterior lateral field of two nozzles near mouth); *d*, detail of some nozzles of unpaired anterior field, from *e*; *e*, unpaired anterior field, from *c*. Scale bars indicate size.

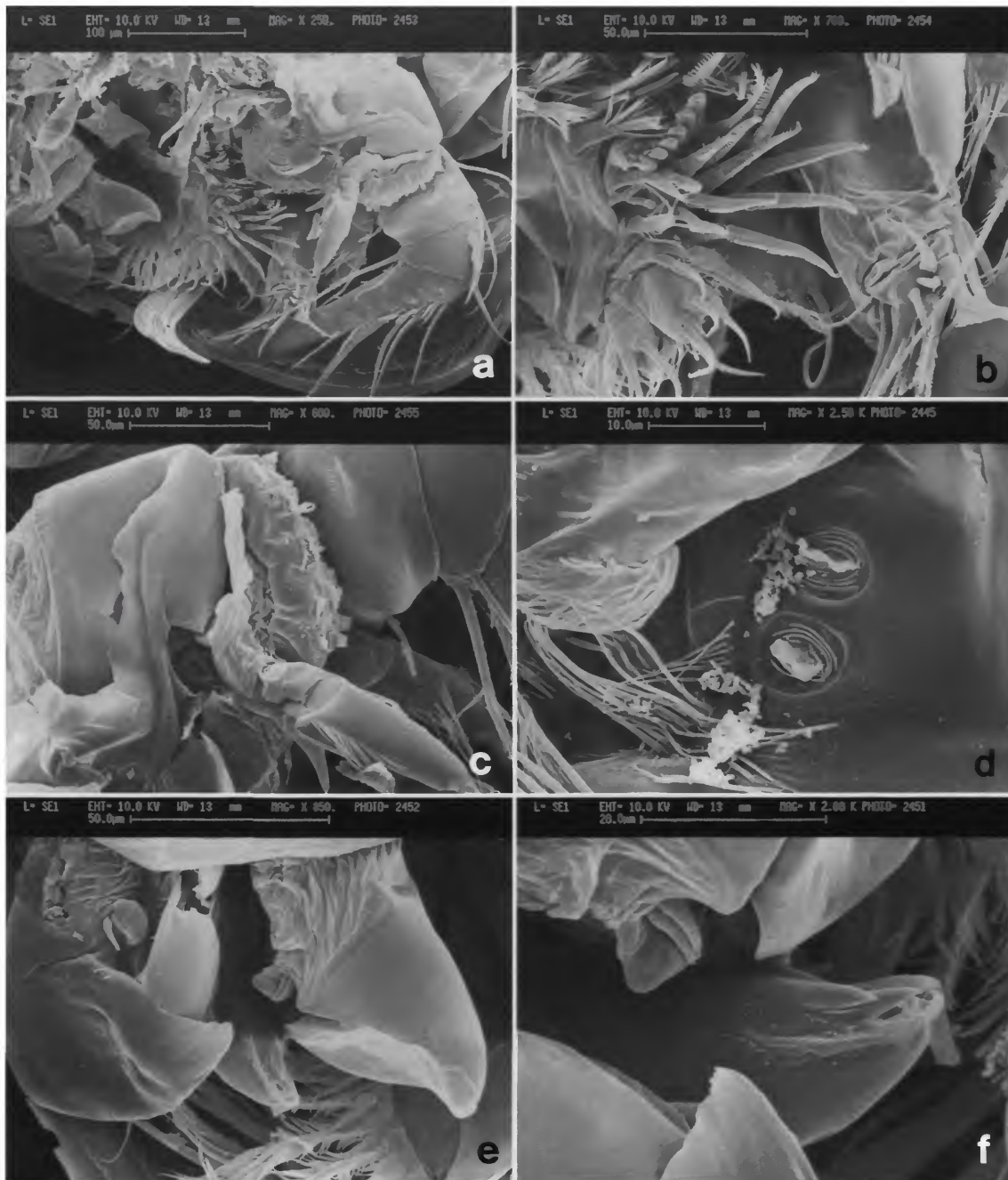


PLATE 4.—*Jimmorinia gunnari*, new species, paratypes, adult males from Bahamas: *a*, USNM 277658, ventral anterior view of limbs and left valve showing upper lip, left mandible (mv), left 4th limb (mv), left 5th limb (2nd maxilla) (posterior mv), and both copulatory (8th) limbs (twisted so that anterior view shown); *b*, USNM 277658, detail from *a* showing 4th and 5th limbs, mv; *c*, USNM 277658, detail from *a* showing all three glandular fields of upper lip; *d*, USNM 277659, dorsal posterior lateral field of two nozzles near mouth, detail from Plate 3c; *e*, USNM 277658, both copulatory (8th) limbs (av) showing hood, thumb and thumb setae of outer lobe of both limbs, and toothed inner lobe of right limb, detail from Plate 3a; *f*, detail from *e* showing closer view of thumb and thumb setae of outer lobe, distal teeth of inner lobe of right limb, and hood tips of both limbs. Scale bars indicate size.

# Appendix

## Station Data with Specimens Collected

### Panama (Caribbean Sea)

San Blas Islands; 9°33.23'N, 78°55.38'W (see Cohen and Morin, 1989:338, fig. 14); at east end of Korbiski Reef near San Blas Point, on sand 25 cm from coral in a mixed sand-coral slope; depth 6 m; collected by James Morin in a baited cone trap (see Cohen and Morin, 1986); collected with many *Skogsbergia* sp.

Sta JM-6: 1 Sep 1983; ~1900–2000 hours.

*Jimmorinia gunnari*: LACM 83-312.1(a), holotype, adult male; LACM 83-312.2(b), 1 adult male; LACM 83-312.3(c), 1 adult female; LACM 83-312.4(d), measured specimens: 10 adult males, 25 adult females, 19 juveniles; LACM 83-312.5(f,f'), 2 adult males; LACM 83-312.6(h), 1 adult male; LACM 83-312.7, 1 adult male; USNM 194402, 1 adult female; USNM 194403, 194404, 194408, 3 adult males; USNM 194409, 6 undissected adults (3 females, 3 males). At least 50 additional specimens not cataloged.

Sta Morin 11115 (=111185): 11 Nov 1985; 1820 and 1933 hours (twilight). (On 12 Nov 1985, part of the trap contents was relaxed in a 1:1 mixture of seawater and 0.36 M magnesium chloride, fixed for about 20 minutes in buffered 4% formalin, and then transferred to 70% ethanol; these are samples 11115.1 and 11115.2.)

*Jimmorinia gunnari*: sample 11115.2(a): 2 undissected adult males and 2 undissected adult females (presently uncataloged but will be deposited at USNM); LACM 85-471.1(b), 1 adult male; LACM 85-471.2(d), 28 specimens. Sample 11115.7(a): LACM 85-471.3, vouchers for bioluminescence test and for mitochondrial DNA analysis: 9 specimens of adult males and juveniles. At least 6 additional uncataloged specimens.

Sta (unnumbered): 29 Nov 1985; 0918–1025 hours (daylight).

Ostracoda: None.

### Honduras

Roatan Island; Coco View Resort, Coco View East; about 16.4°N, 87.8°W; "Doughnut" (spur and groove area); bottom depth 4.6 m; collected by James Morin in box trap baited with fish; trap also collected *Skogsbergia* and isopods.

Sta Cohen and Morin R07058: 7 May 1988; 18:45–20:00 hours.

*Jimmorinia gunnari*: sample R07058.2; LACM 88-403.1(a), 1 adult female; LACM 88-403.2(b), 19 females and juveniles.

### Jamaica

West end of Discovery Bay, Jamaica (north coast), off Discovery Bay Laboratory, in vicinity of LTS buoy, 18.47°N, 77.42°W.

Sta Scanlon: 16–17 Mar 1991; 1915–0740 hours; along sand channel in spur and groove reef formation in vicinity of LTS buoy; depth ~15 m; collected by Lori Scanlon in Scanlon tubular trap on trapline.

*Jimmorinia gunnari*: LACM 91-205.1(a), 1 adult male; LACM 91-205.2(b), 19 males. Additional specimens of *J. gunnari* present but not sorted, counted, or cataloged.

Sta Morin J11085: sample J11085.2; 11 August 1985; 1914–2010 hours; baited Morin box trap on sand plateau near LTS buoy; depth 14 m.

*Jimmorinia gunnari*: LACM 85-472.1(a), 1 adult female; LACM 85-472.2(b), 1 adult male; LACM 85-472.3(c), 47 adult males, females, and juveniles. Additional specimens of *J. gunnari* present but not sorted, counted, or cataloged.

### Great Bahama Bank

The Great Bahama Bank is dissected by several steep-sided submarine canyons, including the Exuma Sound, which reach oceanic depths. The upper rim of Exuma Sound is a steep escarpment. At the top of the escarpment, shallow submarine cliffs at 20 m or less have overhanging surfaces cut by sea-level still stands. Pronounced sea-level notches and ledges are especially evident on the nearly sheer rock face at 80–120 m depths. (For a description of the escarpment, see Kornicker and Illiffe (In press: "Description of Collecting Localities").

Ostracodes from sta 93-005, 95-004, 95-005, and 95-006 were collected in baited tube traps placed on ledges along the submarine escarpment off Lee Stocking Island, Exuma Cays, with the robot arm of the manned submersible *Nekton Gamma*. (See Kornicker and Illiffe (In press: "Sampling Methods") for a description of the tube trap.) Along with ostracodes, the traps

yielded small fish, copepods, amphipods, polychaetes, isopods, and nebuliaceans.

Sta 93-005: 7 May 1993; Transect BB Buoy; salinity 36 ppt; collected with tube trap baited with sandwich meat and set on a sandy ledge near "possible cave entrance" (see Kornicker and Iliffe (In press: "Description of Collecting Localities") for definition) at 88 m depth for 48 hrs.

*Jimmorinia gunnari*: USNM 194320, 1 instar V; USNM 194319, 1 instar III; USNM 194317, 1 instar I; USNM 194318, 1 adult female on slide and in alcohol (shell torn, length estimated as being between 1.0 mm and 1.25 mm).

Sta 95-004: 15 May 1995; Transect BB; collected with tube trap baited with lobster legs and set on a sandy ledge near possible cave entrance at 99 m depth for 24 hrs.

*Jimmorinia gunnari*: USNM 277655, 1 adult male; USNM 277656, 1 adult female; USNM 277657, 1 adult male; USNM 277658, 1 adult male; USNM 277659, 1 adult male; USNM 277660, 1 adult male.

Sta 95-005: 15 May 1995; Transect BB Buoy; collected with tube trap baited with lobster legs and set on bare

rock ledge near possible cave entrance at 96 m depth for 24 hrs.

*Jimmorinia gunnari*: USNM 194502, 2 specimens.

Sta 95-006: 14 May 1995; Transect BB Buoy; collected with tube trap baited with lobster legs and set on a sandy ledge near possible cave entrance at 105 m depth for 24 hrs.

*Jimmorinia gamma*: USNM 194497, holotype (adult female).

*Jimmorinia gunnari*: USNM 194496, 1 adult female; USNM 194498, 2 juveniles; USNM 194504, 8 specimens.

Sta 96-034: 14 Sep 1996; submarine escarpment off Georgetown, Great Exuma Island, Exuma Cays, about 50 km southeast of stations from off Lee Stocking Cay; collected with suction sampler operated from submersible *Clelia* from sandy ledges at 90–100 m depth. (See Kornicker and Iliffe (In press: "Sampling Methods") for description of suction sampler.)

*Jimmorinia ?gunnari*: USNM 194519, 1 specimen.



## Literature Cited

- Abe, K., T. Nagata, and H. Hashizume  
 1996. Digestive Enzymes from the Upper Lip of a Bioluminescent Ostracod, *Vargula hilgendorfii*. *Reports of Faculty of Science, Shizuoka University*, 30:35–40.
- Abe, K., J. Vannier, and Y. Tahara  
 1995. Bioluminescence of *Vargula hilgendorfii* (Ostracoda, Myodocopida): Its Ecological Significance and Effects of a Heart. In J. Riha, editor, *Ostracoda and Biostratigraphy, Proceedings of the Twelfth International Symposium of Ostracoda, Prague/Czech Republic/26–30 July, 1994*, pages 11–18. Rotterdam: A.A. Balkema.
- Baird, W.  
 1850. *The Natural History of the British Entomostraca*. 364 pages, 36 plates. London. [Printed for the Ray Society.]
- Cannon, H.G.  
 1931. On the Anatomy of a Marine Ostracod, *Cypridina (Doloria) levis* Skogsberg. *Discovery Reports*, 2:435–482, figures 1–12, plates 6, 7.
- Claus, C.  
 1873. Neue Beobachtungen über Cypridinen. *Zeitschrift für Wissenschaftliche Zoologie*, 23(2):211–227, plates 10, 11.  
 1891. *Die Halocypriden des Atlantischen Oceans und Mittelmeeres*. 83 pages, 26 plates. Vienna: Alfred Hölder.
- Cohen, A.C., and J.G. Morin  
 1986. Three New Luminescent Ostracodes of the Genus *Vargula* from the San Blas Region of Panama. *Contributions in Science, Natural History Museum of Los Angeles County*, 373:1–23, 8 figures.  
 1989. Six New Luminescent Ostracodes of the Genus *Vargula* (Myodocopida, Cypridinidae) from the San Blas Region of Panama. *Journal of Crustacean Biology*, 9(2):297–340, 14 figures, 1 table.  
 1990. Morphological Relationships of Bioluminescent Caribbean Species of *Vargula* (Myodocopa). In R. Whatley and C. Maybury, editors, *Ostracoda and Global Events*, 381–400, 2 figures, 3 appendices. New York: Chapman and Hall.  
 1993. The Cypridinic Copulatory Limb and a New Genus *Kornickeria* (Ostracoda: Myodocopida) and Four New Species of Bioluminescent Ostracodes from the Caribbean. *Zoological Journal of the Linnean Society*, 108:23–84, 24 figures, 6 appendices.  
 In prep. Revision of the Cypridinidae (Ostracoda: Myodocopida) and Evolution of Morphology and Bioluminescence within the Family.
- Hiruta, S.-I.  
 1983. Post-Embryonic Development of Myodocopid Ostracoda. In R. Maddocks, editor, *Applications of Ostracoda, Proceedings of the Eighth International Symposium on Ostracoda July 26–29, 1982, University of Houston*, pages 667–677, 5 figures. Houston: University of Houston.
- Huvar, A.L.  
 1993. Ultrastructure of the Light Organ and Immunocytochemistry of Luciferase Localization in Luminescent Marine Ostracodes (Crustacea: Ostracoda: Cypridinidae). *Journal of Morphology*, 218:181–193, 18 figures.
- Kendall, Christopher G. St. C., R.F. Dill, and E.A. Shinn  
 1990. *Guidebook to the Marine Geology and Tropical Environments of Lee Stocking Island, the Southern Exumas, Bahamas*. Fifth edition, 74 pages. San Diego, California: KenDill Publishers.
- Kornicker, L.S.  
 1975. Antarctic Ostracoda (Myodocopina). *Smithsonian Contributions to Zoology*, 163:1–720, 432 figures, 9 plates, 21 tables.  
 1981. Revision, Distribution, Ecology, and Ontogeny of the Ostracode Subfamily Cyclasteropinae (Myodocopina: Cyndroleberidae). *Smithsonian Contributions to Zoology*, 319:1–548.  
 1991. Myodocopid Ostracoda of Enewetak and Bikini Atolls. *Smithsonian Contributions to Zoology*, 505:1–140, 71 figures.  
 1992. Myodocopid Ostracoda of the Benthédi Expedition, 1977, to the NE Mozambique Channel, Indian Ocean. *Smithsonian Contributions to Zoology*, 531:1–243, 109 figures, 4 tables.  
 1994. Ostracoda (Myodocopina) of the SE Australian Continental Slope, Part 1. *Smithsonian Contributions to Zoology*, 553:1–200, 111 figures.
- Kornicker, L.S., and T.M. Iliffe  
 1989. Troglolitic Ostracoda (Myodocopa: Cypridinidae, Thaumatoocypridinidae) from Anchialine Pools on Santa Cruz Island, Galapagos Islands. *Smithsonian Contributions to Zoology*, 483:1–38, 17 figures, 15 tables.  
 In press. Myodocopid Ostracoda from Exuma Sound, Bahamas, and Marine Caves and Blue Holes in the Bahamas, Bermuda, and Mexico. *Smithsonian Contributions to Zoology*, 606.
- Kornicker, L.S., and G.C.B. Poore  
 1996. Ostracoda (Myodocopina) of the SE Australian Continental Slope, Part 3. *Smithsonian Contributions to Zoology*, 573:1–186, 102 figures, 17 tables.
- Morin, J.G.  
 1986. “Firefleas” of the Sea: Luminescent Signaling in Marine Ostracode Crustaceans. *Florida Entomologist*, 69:105–121.
- Morin, J.G., and A.C. Cohen  
 1988. Two New Luminescent Ostracodes of the Genus *Vargula* (Myodocopida, Cypridinidae) from the San Blas Region of Panama. *Journal of Crustacean Biology*, 8:620–638, 7 figures, 1 table.  
 1991. Bioluminescent Displays, Courtship, and Reproduction in Ostracodes. In R. Bauer and J. Martin, editors, *Crustacean Sexual Biology*, pages 1–16, 4 figures, 1 table. New York: Columbia University Press.
- Müller, G.W.  
 1894. Die Ostracoden des Golfes von Neapel und der angrenzenden Meeres-Abschnitte. *Fauna und Flora des Golfes von Neapel*, 21: 404 pages, 40 plates.  
 1908. Die Ostracoden. *Deutsche Südpolar-Expedition 1901–1903*, 10(2): 52–178, plates 4–19.
- Poulsen, E.M.  
 1962. Ostracoda—Myodocopa, 1: Cypridiniformes—Cypridinidae. *Dana Reports*, 57:1–414, 181 figures. Copenhagen: Carlsberg Foundation.
- Sars, G.O.  
 1866 (“1865”). Oversigt af Norges marine Ostracoder. *Forhandlinger i Videnskabs-Selskabet i Christiania*, 8:1–130. [1865 preprint; serial published in 1866.]
- Torres, E.  
 1997. Genetic Diversity in *Skogsbergia lernerii*: Evidence for Multiple Sibling Species within a Widely Distributed Marine Ostracode. In *Molecular Systematics and Taxonomy of Cypridinid Ostracodes: Patterns and Evolution of Bioluminescence and Luminescent Courtship Behavior*, 163 pages. Unpublished doctoral dissertation, University of California at Los Angeles.
- Torres, E., A. Cohen, R. Wayne, and J. Morin  
 In revision. Evolution of Bioluminescence in Cypridinid Ostracode Crustaceans Based on 16S rRNA Sequences and Morphology. *Systematic Biology*.







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