

Morphology of *Cypretta kawatai*  
Sohn and Kornicker, 1972  
(Crustacea, Ostracoda), with a  
Discussion of the Genus

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and  
LOUIS S. KORNICKER

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## ABSTRACT

I. G. Sohn and Louis S. Kornicker. Morphology of *Cypretta kawatai* Sohn and Kornicker, 1972 (Crustacea, Ostracoda), with a Discussion of the Genus. *Smithsonian Contribution to Zoology*, number 141, 28 pages, 18 figures, 1973.—All 34 species previously referred to *Cypretta* are reviewed, and four of these are removed from the genus because they lack the characteristic anterior septate margins. The morphology of septa along the anterior margins is discussed and illustrated. The life cycle of *C. kawatai* was observed in the laboratory, where the species proved to be parthenogenetic. Ontogenetic studies showed the following: in dorsal view the outline changes from pointed ends and greatest width at approximate midlength in early stages to a blunter posterior end and greatest width at a distance of approximately one-third from the posterior end in adults; the lateral outline changes from subtriangular in early stages to subovate in adults. The following characters are restricted to adults: septate anterior margins; ventroposterior nodes on the right valve and opposing scalloped structures on the left valve; columns on the anterior margin of both valves that are either superposed on or adjacent to the septa and are present on the ventroposterior margin of the right valve only. A lectotype is designated for *Cypretta globulosa* (Sharpe, 1910), considered here to be a valid species.

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# Morphology of *Cypretta kawatai* Sohn and Kornicker, 1972 (Crustacea, Ostracoda), with a Discussion of the Genus

*I. G. Sohn and  
Louis S. Kornicker*

## Introduction

We have previously described (Sohn and Kornicker, 1972a) laboratory experiments demonstrating that the species *Cypretta kawatai* is an effective predator of 1- to 3-day-old *Biomphalaria glabrata* (Say, 1818), a vector snail of the blood fluke that causes the tropical and subtropical disease schistosomiasis.

Because of the growing interest in the biological control of trematode diseases, additional studies of the predation behavior of ostracodes may be undertaken; consequently, we present here a detailed morphologic analysis of *C. kawatai*. Our study of the genus *Cypretta* Vávra, 1895, disclosed certain species that we do not consider to belong in this genus. *Cypretta globulosa* (Sharpe, 1910) is redefined and a lectotype is designated.

ACKNOWLEDGMENTS.—We wish to thank Dr. F. Ferguson, Tropical Disease Section, U.S. Public Health Service, San Juan, Puerto Rico, for the information that the strain of snails that we used originated in Brazil, and Mr. Ichiro Okubo, Okayama Shujitsu Junior College, Japan, for an un-

identified species of *Cypretta* for comparison. We thank Prof. R. V. Kesling, University of Michigan, Ann Arbor, for specimens of *Cypridopsis vidua* and Prof. G. Hartmann, Hamburg, Germany, for a copy of a paper by W. Klie (1941). Our colleagues R. H. Benson and J. M. Berdan reviewed the paper, and J. E. Hazel made available photographic equipment for transmitted light. W. R. Brown, Smithsonian Institution, made the scanning electron microscope pictures; R. P. Christian, U.S. Geological Survey, made the electron microprobe picture; and H. E. Mochizuku printed all the negatives. Carolyn B. Gast prepared the drawings of appendages and Elinor Stromberg composed the figures.

## Family CYPRIDIDAE Baird, 1845

### Tribe CYPRETTINI Hartmann, 1964

Hartmann (1964:128) included in this tribe *Paracyprretta* Sars, 1924, and "*Prionocypris*." The latter is probably a typographical error for *Pionocypris* Brady and Norman, 1896, because *Prionocypris* Brady and Norman, 1896, has a well-developed furca.

McKenzie (1971a:159) elevated the tribe Cyprettini Hartmann, 1964, to subfamily status as Cyprettinae and established the tribe Bradycyprini to include the two genera *Bradycypris* Sars, 1924, and *Paracyprretta* Sars, 1924. He based this elevation

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on the presence of very slender furcae, better developed than those in the Cypridopsinae, and the presence of radial septa along the anterior margins of one or both valves. Although it is reasonable to have a subfamily category between the tribe and family categories, the morphology of the genera involved is as yet too poorly known to accept the Cyprettinae as a subfamily. *Cypridopsis hartwigi* Müller, 1900, for example, has radial septa on the anterior margin, a character diagnostic of the Cy-

pretini, but the furca is reduced and characteristically cypridopsid.

### Genus *Cypretta* Vávra, 1895

*Cypridopsis* (*Cypretta*) Vávra, 1895:6.

*Cypretta* Vávra.—Müller, 1898:283.—Furtos, 1934:279 [part].—Gauthier, 1939:226, 228.

TYPE-SPECIES.—By monotypy: *Cypridopsis* (*Cypretta*) *tenuicauda* Vávra (1895:7, fig. 2, pts. 1–3.) Zanzibar.

TABLE 1.—Appendages that have been illustrated in species of *Cypretta* in addition to *C. kawatai*.

Species and reference	Antenna		Mandible	Maxilla	Leg 1	Leg 2	Leg 3	Furca	Males known
	1	2							
<i>baylyi</i> McKenzie, 1966	x			x			x		
<i>bilicis</i> Furtos, 1936							x	x	x
<i>brevisaeptha</i> Furtos, 1934							x	x	x
<i>brevispina</i> Farkas, 1959							x	x	x
<i>cordata</i> Klie, 1938								x	
<i>costata</i> Müller, 1898					x	x	x	x	
<i>dubiosa</i> (Daday, 1901)				x	x	x		x	
<i>fontinalis</i> Hartmann, 1964								x	
<i>foveata</i> Hartmann, 1964								x	x
<i>globula</i> (Sars, 1889)	x	x	x	x	x	x	x	x	
<i>globulosa</i> (Sharpe, 1910)							x	x	
<i>hirsuta</i> Henry, 1923							x	x	
<i>infesta</i> Klie, 1941								x	
<i>intonsa</i> Furtos, 1936						x	x	x	
<i>judayi</i> Tressler, 1937						x	x	x	
<i>kenyensis</i> Klie, 1939								x	
<i>lindbergi</i> Hartmann, 1964								x	x
<i>lutea</i> McKenzie, 1966	x		x	x		x		x	
<i>margalefi</i> Brehm, 1949				x			x	x	x
<i>minna</i> (King, 1855)		x							
Sars (1894)								x	
<i>murati</i> Gauthier, 1939								x	
<i>nigra</i> Furtos, 1936						x	x	x	x
<i>nukuhivana</i> Furtos, 1934						x	x	x	
<i>oxyuris</i> Daday, 1910		x				x	x	x	
<i>papuana</i> Vávra, 1901						x	x	x	
<i>raciborskii</i> (Grochmalicki, 1915)						x	x	x	
<i>remota</i> (Vávra, 1906)								x	
<i>reticulata</i> Lowndes, 1932								x	
<i>sarsi</i> Brady, 1902							x	x	
<i>schubarti</i> Farkas, 1959								x	x
<i>seurati</i> Gauthier, 1929								x	
Petkovsky (1957)								x	x
<i>tenuicauda</i> Vávra, 1895								x	
<i>turgida</i> (Sars, 1896)								x	
Sars (1924)		x		x				x	
Chapman (1963)								x	
<i>ridis</i> (Thomson, 1879)						x	x	x	
Sars (1894)								x	
Chapman (1963)						x	x	x	

DIAGNOSIS.—Small, less than 1 mm in greatest length, globulose, smooth, punctate or reticulate ostracodes; right valve larger, with septate anterior margins in adults; furca with two narrow elongated claws, ventral seta present or absent, one dorsal seta (except *Cypretta judayi* Tressler, 1937, which has two); ovary coiled at its inception.

DISCUSSION.—Furtos (1934:279) listed 14 species referable to *Cypretta*. Later, Furtos (1936:494) expanded the dichotomous, 11-species key constructed by Müller (1912:204) to include 21 species and excluded *Cypridella lemurensis* Vávra, 1895. In addition to *Cypretta kawatai*, 34 species are referred herein to *Cypretta*. Unfortunately, the appendages of only a few species have been illustrated (Table 1).

Table 1 shows that all the appendages of only one species, *C. globula* (Sars, 1889), were illustrated. In order to gain some insight concerning the range of variability of the individual appendages, we have dissected more than 10 individuals of *C. kawatai* in various stages of growth and two syntypes of *C. globulosa* (Sharpe, 1910). All of our dissections are of parthenogenetic species; consequently, we have no data on the variation in the male genitalia. On the basis of dissections and the available published information, there appears to be no interspecific variation in the basic construction of the appendages in *Cypretta*. We did, however, note some minor variations in the details of the second antenna, mandible, and furca that may be of specific value.

*Second antenna:* We noted interspecific differences in the length of the "sense club" (Kesling, 1951:20, 22) on the ventral side of the first podomere of the endopodite (Figures 1, 11b; Table 2).

*Mandible:* The outline of the outer surface of the basal podomere appears to be constant within each species and variable between species. This outline cannot be used because its orientation in dissections cannot be controlled; it rotates when the cover glass is placed on the dissection. We noted that the seta on the basal podomere differs (Figure 11c-e) in *C. kawatai* and in *C. globulosa* (Sharpe, 1910), but the discrimination of this seta also depends on the orientation of the mandible in the dissection.

*Furca:* The furca has been illustrated for all the species known in *Cypretta*. This appendage

TABLE 2.—Length of "sense-club" of second antenna in eleven specimens of five species of *Cypretta* in the National Museum of Natural History.

Species	Sense clubs	
	USNM number	(mm)
<i>C. globulosa</i> (Sharpe, 1910) .....	39514	0.052, 0.052
	139854	0.052, 0.052
<i>C. intonsa</i> Furtos, 1936 .....	71380	0.048, 0.049
<i>C. judayi</i> Tressler, 1937 .....	71517	0.040, 0.041
<i>C. kawatai</i> Sohn and Kornicker, 1972 .....	140955	0.040, 0.044
	140960	0.040, 0.044
	139850	0.042, 0.042
	140993a	0.044, 0.044
	140993b	0.046, 0.046
<i>C. nukuhivana</i> Furtos, 1934 .....	140993c	0.046, 0.046
	68067	0.050, 0.051

has been used in keys as a criterion for discriminating many of the species in *Cypretta* (Müller, 1912; Furtos, 1936; Tressler, 1959). This organ, consisting of two thin terminal claws and two thinner setae, is one of the characteristic features of *Cypretta*, but the setae are subject to damage during dissection (McKenzie, 1966:274; and our experience) and possibly also in nature. The presence or absence of one or the other seta, therefore, is not a good criterion for specific determination unless intraspecific variability is known. Gauthier (1939:221, figs. 19e,f) illustrated the furca of two individuals of *C. murati* Gauthier, 1939, of which one did not have the dorsal seta and the other did not have the ventral seta. However, the relative sizes of the claws and setae, when present, may be used in discriminating the species.

*Shell structure:* Triebel (1963) discussed the various interpretations of the "septate" structure characteristic of the anterior margins of *Cypretta* and concluded that they are indeed vertical struts that connect the infold with the outer lamella. We have determined that the septate anterior margins are present in *C. kawatai* only in the adult stage, as can be seen in Figures 2, 4, 5d-f, 8, 9, 14, 17, 18. We examined valves of *C. kawatai* with transmitted light, with scanning electron microscope, and determined the calcium content of the septa with an electron probe. We concur with Triebel that the septa connect the inner sides of the outer lamella and the infold. Figure 3 shows that calcium is present at the contact of the septum with the outer

lamella and the infold. In lateral and medial views the septa appear to be connected to each other at their proximal ends by an arch (Figures 8j,k). The arch is caused by a slight thickening of the inner surface of the infold between the proximal ends of the septa (Figure 4).

Triebel (1953, 1963) noted that *Stenocypris* Sars, 1889, also has septate anterior margins. These, how-

FIGURE 2.—*Cypretta kawatai*. Series of inside views of anterior and posterior margins showing differences between instars and adults and between left and right valves. A-3? instar: a, right anterior; b, left anterior; c, right posterior; d, left posterior. A-1 instar: e, right anterior; f, left anterior; g, right posterior; h, left posterior. Two adult paratypes (USNM 140961): i, m, right anterior; j, n, left anterior; k, o, right posterior; l, p, left posterior.

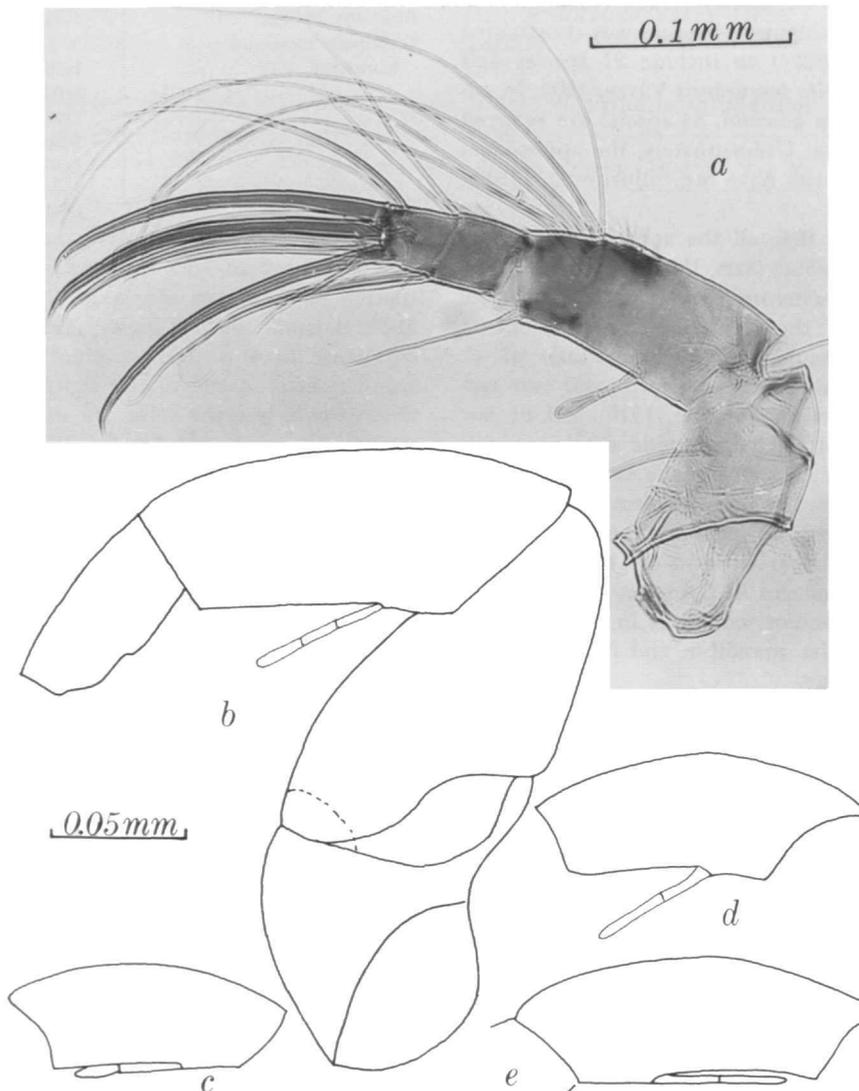
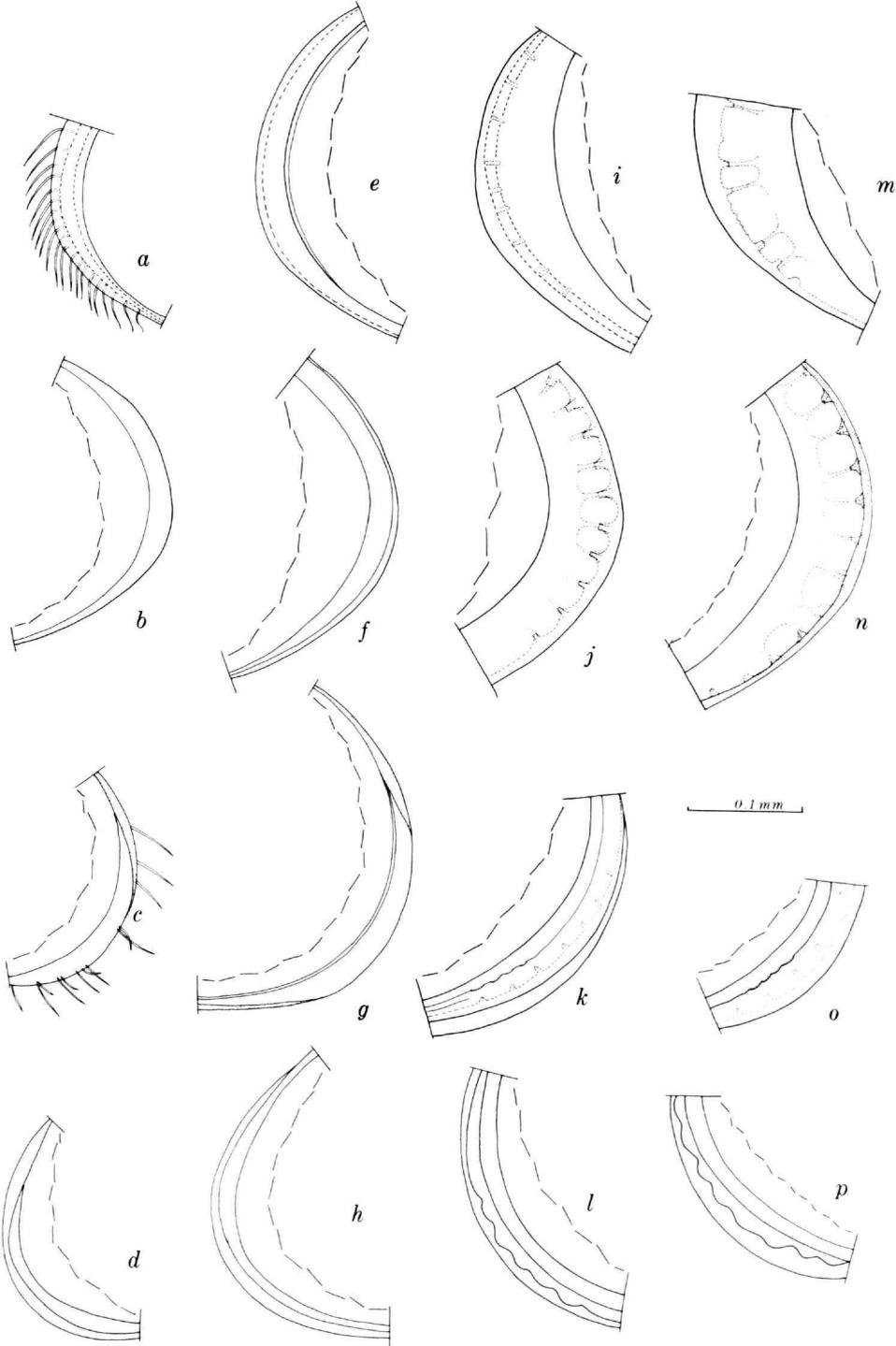


FIGURE 1.—"Sense club" of second antenna: a, *Cypretta kawatai*, holotype (USNM 139850); b, *C. globulosa* (Sharpe, 1910), lectotype (USNM 39514), habitat in doubt; c, *C. intonsa* Furtos, 1936, paratype (USNM 71380) from Florida; d, *C. nukuhivana* Furtos, 1934, paratype (USNM 68067) from Nukuhiva, Marquesas Islands; e, *C. judayi* Tressler, 1937, holotype (USNM 71517), from northern Celebes Island. (Magnification in b-e is the same.)



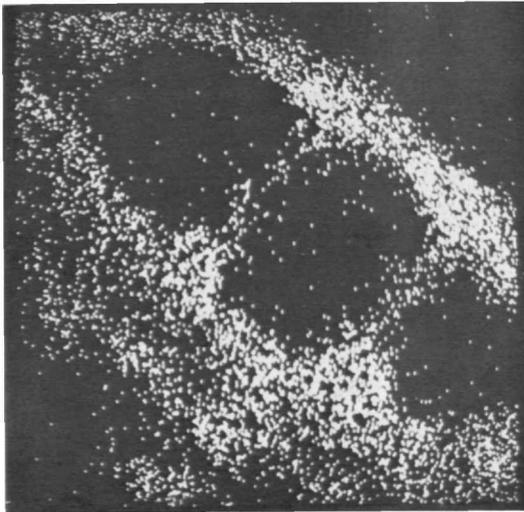


FIGURE 3.—*Cyprretta kawatai*. Electron probe photograph (approximately  $\times 5500$ ) of a polished surface through the anterior of the left valve of an adult carapace showing the distribution of calcium in the septa wall, shell, and infold.

ever, differ from those in *Cyprretta* in that they are present around the entire free margins and do not have arches between them at their proximal ends when viewed laterally or medially. Study of the growth stages of *C. kawatai*, here illustrated, disclosed the fact that the infold is strongly calcified, that the inner margin is well defined by the list in all the preadult stages (Figures 8a,c-f; 14, 17), and that the infold in adults differs in that the inner margin is not well defined along the anterior (Figures 5a-f; 8k; 18a,b,f,i,l). We assume that the loss of a well-defined inner margin along the anterior is the result of the infold becoming progressively less calcified proximally. This is permitted by the development of the septate structure (Figure 4b). The subconcentric striae on the external surface of the infold are reflected also on the internal surface of the infold, and they appear to be present only in adults (compare Figures 14 and 17 with Figure 18). These striae are present in other genera in the Cyprididae. Triebel (1953, pl. 1: fig. 4) showed these striations in *Stenocypris major* (Baird, 1859), and we illustrate them (Figure 5a-c) in *Cypridopsis vidua* (O. F. Müller, 1776). These photographs show that in *Cyprretta* the first two striae proximal to the list are concentric and subparallel to the list and do not anastomose, and

those proximal to the first two striae anastomose. Kesling (1951:66, fig. 7) described and illustrated the anastomosing striae (which he called "grooved area") in *Cypridopsis vidua*.

Nodes along the ventroposterior margin of the right valve were originally illustrated for *Cyprretta lutea* McKenzie, 1966, *Cypridella remota* Vávra, 1906 [= *Cyprretta remota* (Vávra, 1906)], *Cyprretta reticulata* Lowndes, 1932, *C. sarsi* Brady, 1902, and *C. seurati* Gauthier, 1929. Similar nodes were originally illustrated on the left valve of *C. baylyi* McKenzie, 1966, and were recorded in *Cypridopsis globulus* Sars, 1889 [= *Cyprretta globula* (Sars, 1889)]. In *C. kawatai*, nodes along the ventroposterior margin of the right valve were not observed by us on juvenile specimens as large as 0.65 mm in greatest length; they are poorly developed in some adults but well developed in others (Figures 2k,o; 5d; 18b,l,m).

**SPECIES REMOVED.**—Gauthier (1939:229) noted that the left valve overlaps the right valve in *C. brevisaepta* Furtos, 1934, *C. bilicis* Furtos, 1936, and *C. nigra* Furtos, 1936, and he suggested that these species might be referred to a new genus. To these should be added *C. schubarti* Farkas, 1959, and *Cypridopsis raciborskii* Grochmalicki, 1915. Although Brehm (1949:104) did not agree with this concept, our examination of Furtos' three species indicates that they indeed do not belong in *Cyprretta*.

*Cyprretta brevisaepta brevisaepta* Furtos, 1934, is represented by many paratypes (USNM<sup>1</sup> 68159), and we opened a gravid female in order to examine the marginal structures. The anterior margin does not contain septa that are typical of *Cyprretta*; it contains funnel-shaped radial pore canals, each with a hair passing through it (Figure 6). The "nine to thirteen short, inconspicuous, radiating septa" that Furtos (1936:495) ascribed to this species are represented in the valve by 22 circular expressions of the diameters (about 0.02 mm) of the funnel-shaped radial canals and are not typical septa of *Cyprretta* as shown in Figure 4.

*Cyprretta nigra* Furtos, 1936, is represented only by the holotype, a female (USNM 71379), the

<sup>1</sup> Specimen numbers with the abbreviation USNM are in the Smithsonian Institution, National Museum of Natural History, formerly the United States National Museum.

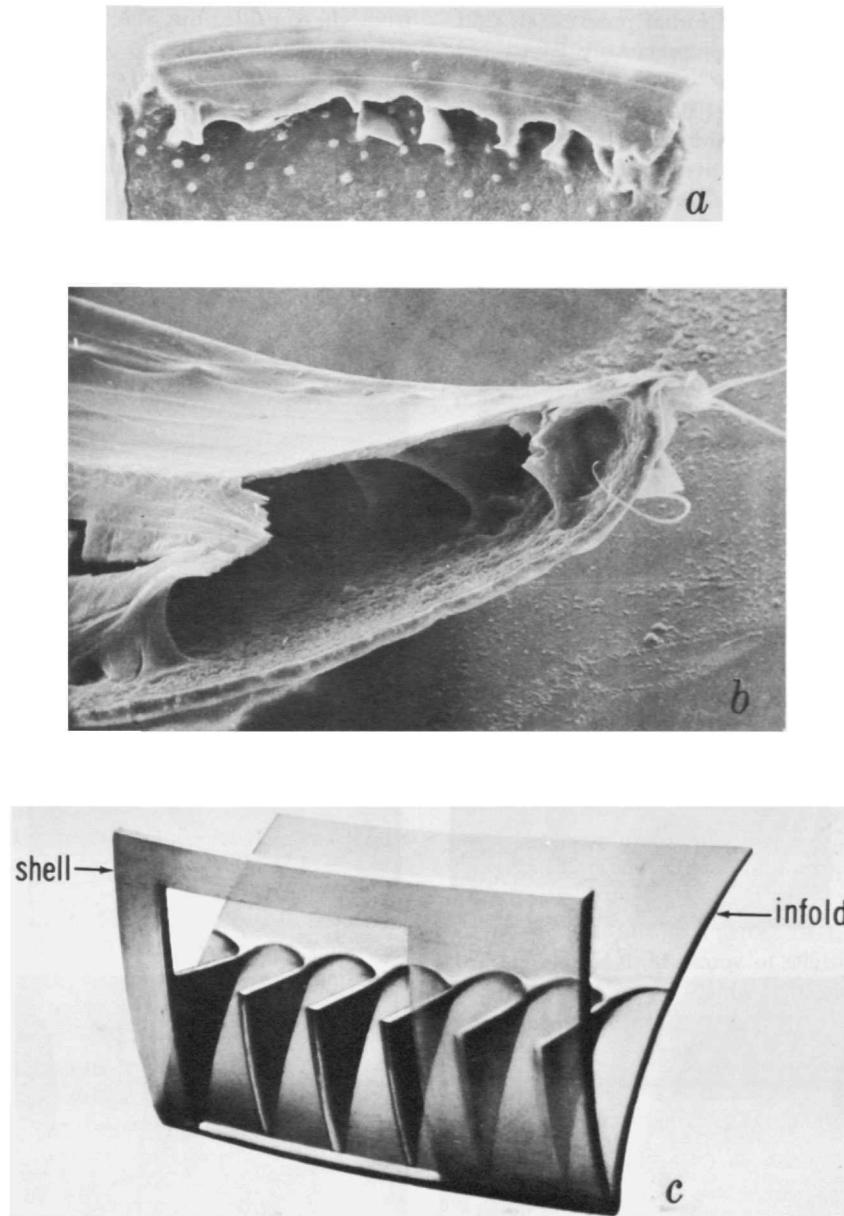


FIGURE 4.—*Cypretta kawatai*. *a*, Medial view ( $\times 330$ ) of fragment of anterior of left valve with part of the infold removed. Note normal pores on shell continuing into septate area, infold with concentric striae, and edges of septa as darker areas. Paratype, USNM 140962; *b*, oblique view ( $\times 625$ ) into fragment of anterior of left valve showing septa. Note striae and collapsed proximal thinner part of infold. The thickening of the infold at the proximal end of the second septum from the right represents the arch shown in *c*. The five mounds on the infold subparallel and removed from the margin may be due to the pillars within the anterior margin. *c*, Diagram showing our interpretation of the septate structure.

valves of which are preserved in alcohol. The right valve has 24 funnel-shaped radial pore canals that are similar to those of the previously illustrated species.

*Cypretta bilicis* Furtos, 1936, is represented by the holotype, an undissected female (USNM 71377), and by a dissected male paratype without the valves preserved (USNM 71378). The vial with the holotype, however, contained also fragments of shell of a male, determined by fragments of testes adhering to part of the anterior and ventral margins.

The holotype does not show any septa when viewed from the outside, but the fragment of the male, possibly belonging to the dissected paratype, has at least 16 funnel-shaped radial pore canals similar to those illustrated for "*Cypretta*" *brevisaepta* (Figure 6).

On the basis of the absence of a septate anterior margin and of the left-over-right valve overlap along the anterior, we conclude that these three species do not belong in *Cypretta* and should be removed to a distinct genus.

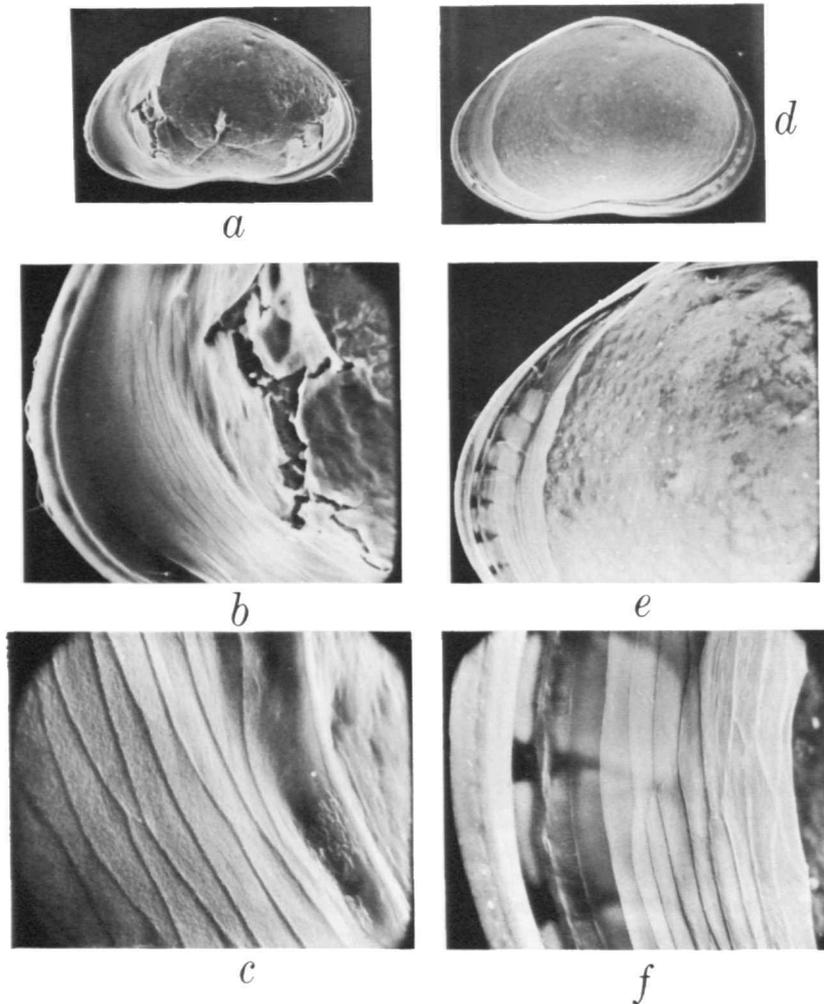


FIGURE 5.—Inside views of right valve: a-c, *Cypridopsis vidua* (O. F. Müller, 1776), adult (USNM 140963) from Ann Arbor, Michigan; d-f, *Cypretta kawatai*, adult paratype (USNM 140964). (Magnification: a, d, x 65; b, x 250; c, x 1000; e, x 125, f, x 500.)

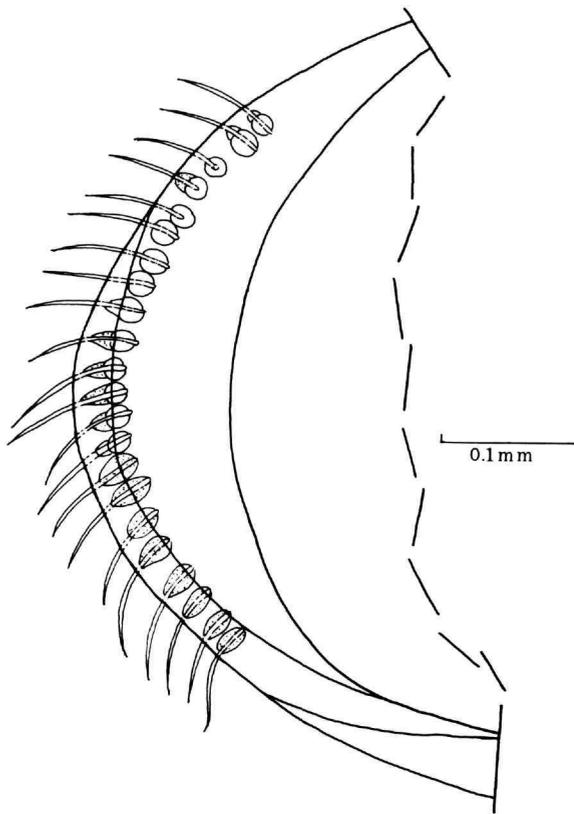


FIGURE 6.—*Cypretta brevisaepta brevisaepta* Furtos, 1934, adult paratype (USNM 139290) from Florida: Anterior of right valve showing marginal canals.

*Cypretta schubarti* Farkas, 1959, was described as "Auf dem vorderen Teil der rechten Schale sind Chitinverdickungen, Septa zu finden, die auf der linken Schale, sowie auf den Schalen den Männchen fehlen oder kaum wahrnehmbar sind" (Farkas, 1959:277). Illustrations by Farkas do not show any septa but clearly indicate that the left valve overlaps the right along the anterior. The same is true for *Cypridopsis reciborskii* Grochmalicki, 1915, which was referred to *Cypretta* by Furtos (1936:494).

Males have been recorded in the following species: *Cypretta bilicis* Furtos, 1936, *C. brevisaepta* Furtos, 1934, *C. nigra* Furtos, 1936, *C. schubarti* Farkas, 1959, *C. reticulata* Danforth, 1948, not Lowndes, 1932 (= *C. brevispina* Farkas, 1959), *C. foveata* Hartmann, 1964, *C. lindbergi* Hartmann, 1964, and *C. margalefi* Brehm, 1949. Petkovski

(1957:53) identified males in *C. seurati* Gauthier, 1929. The first four of these species were eliminated from *Cypretta* in our discussion of left-over-right overlap, and *C. brevispina* Farkas, 1959, also does not belong in *Cypretta*. The holotype and allotype of *C. brevispina* are in the collections of the National Museum of Natural History (USNM 90718, 90719) and we have examined them. The presence of ovaries and eggs proves that the holotype is an adult. However, because the valves of both holotype and allotype have no vestige of septa along the anterior margins, this species has to be removed from *Cypretta*, and from the Cyprettini. Incidentally, Danforth's (1948, pl. 2) illustration of *C. reticulata* is mislabeled "*Cypriconcha barbata* Sars 1926 (non *Cypris barbatus* Forbes 1938)." Hartmann's two species apparently belong in *Cypretta*, but the information is inadequate to confirm Brehm's species and Petkovski's males of *C. seurati* Gauthier, 1929.

**ONTOGENY.**—The only mention of juveniles in *Cypretta* is by McKenzie (1966:273), who examined, but presumably did not dissect, a juvenile of *Cypretta* sp. McKenzie, 1966. Ghetti (1970) pointed out the importance of distinguishing between adult freshwater ostracodes and preadult stages and cited examples of preadult stages that had been described as distinct species and referred to genera other than the ones to which the adults belong. In addition to the presence of fully developed genitalia, adults in *Cypretta* have septa along the anterior margins of both valves (Figures 2, 18). *Cypretta nukuhivana* Furtos, 1934, is represented in the National Museum of Natural History by many paratypes (USNM 68066). The recorded length for this species was 0.60 mm (Furtos, 1935:281), but a right and left valve with septate anterior margins that we examined were 0.63 mm and 0.65 mm in greatest length. A smaller right valve with a greatest length of 0.48 mm had no septa on the anterior margin; this valve probably represents the A-2 stage. The ontogeny of *C. kawatai* will be discussed later, but the fact that septate anterior margins do not form until late in the ontogeny is important because a completely septate anterior margin is an additional criterion for determining adults in this genus. All the previously described species that we consider to belong in *Cypretta* have septate anterior margins regard-

less of their size. The lack of septate anterior margins in preadults may, in part, explain the paucity of published data on young stages of *Cypretta*.

**SPECIES RETAINED.**—Table 3 lists all the species that we assign to *Cypretta*, the recorded greatest length, and the recorded geographic occurrences.

**GEOLOGIC RANGE.**—There are only two records of fossil *Cypretta*—those of *Cypris viridis* Thomson, 1879, by Hornibrook (1955), and *Cypretta?* U 146 by Grekoff (1960). Hornibrook (1955:273, figs. 5,

19, 32) illustrated a specimen as *Cypridopsis viridis* (Thomson) with a septate anterior that was found in a late Pleistocene white limy clay at 7 feet below the top of the Pyramid Valley Swamp of New Zealand. He very generously sent us a right valve which enabled us to confirm that this species belongs in *Cypretta*, the genus to which Henry (1923: 273) assigned it. Grekoff (1960:39, fig. 4, pl. 7: figs. 49, 50) illustrated a left valve (from the Lower Cretaceous Wealdian-B in the Congo Basin, Africa)

TABLE 3.—Species of *Cypretta* in addition to *C. kawatai*.  
(Measurements in parentheses are from Hartmann, 1964.)

Original name	Greatest length (mm)	Geographic distribution
<i>Cypretta baylyi</i> McKenzie, 1966	0.50	Western Australia and Northern Territory, Australia.
<i>C. cordata</i> Klie, 1938	0.68	Near Panga, Belgian Congo.
<i>C. costata</i> Müller, 1898	0.66 (0.50–0.72)	Majunga, Madagascar; Juan de Nova, Mozambique; Brazil.
<i>Cypridella dubiosa</i> Daday, 1901	0.60	New Guinea.
<i>Cypretta fontinalis</i> Hartmann, 1964	0.83–0.86	Palni Mountains, southern India.
<i>C. foveata</i> Hartmann, 1964	0.62–0.64	Kathiavar Peninsula, northwestern India.
<i>Cypridopsis globulus</i> Sars, 1889	0.70	Lagoon 4 miles from Rockhampton and water hole 20 miles from Cattle Station, Australia; Cape Province, South Africa.
<i>Cypris (Cypris) globulosa</i> Sharpe, 1910	0.77	Introduced on plants in greenhouse, University of Wisconsin.
<i>Cypretta hirsuta</i> Henry, 1923	0.88	Kosciusko, New South Wales, Australia.
<i>C. infesta</i> Klie, 1943	(0.7)	Peru.
<i>C. intonsa</i> Furtos, 1936	0.55	Near Childs, Riverview, and Okeechobee, Florida.
<i>C. judayi</i> Tressler, 1937	0.60	Pinelang Pond, northern Celebes.
<i>C. kenyensis</i> Klie, 1939	0.60	Nairobi.
<i>C. lindbergi</i> Hartmann, 1964	0.58–0.63	Coast of Persian Gulf.
<i>C. lutea</i> McKenzie, 1966	0.52	Northwestern Australia.
<i>C. margalefi</i> Brehm, 1949	0.95	Cuba.
<i>C. minna</i> King, 1855	0.92	Australia; Madagascar; South Africa; Ceylon; Bulgaria.
<i>C. murati</i> Gauthier, 1939	0.63–0.68 (0.61–0.71)	Lake Tchad, Africa.
<i>C. nukuhivana</i> Furtos, 1934	0.6	Nukuhiva, Marquesas Islands, South Pacific.
<i>C. oxyuris</i> Daday, 1910	0.73	East Africa.
<i>C. papuana</i> Vávra, 1901	0.78	Bismarck Archipelago.
? <i>Cypridopsis raciborskii</i> Grochmalicki, 1915	—	Java.
<i>Cypridella remota</i> Vávra, 1906	0.85	Sumatra.
<i>Cypretta reticulata</i> Lowndes, 1932	0.98	Abyssinia.
<i>C. sarsi</i> Brady, 1902	0.77	St. Thomas Island, West Indies; South Africa.
? <i>C. schubarti</i> Farkas, 1959	—	Pernambuco, Brazil.
<i>C. seurati</i> Gauthier, 1929	0.63–0.66	North Africa; Jugoslavia; Italy.
<i>C. tenuicauda</i> Vávra, 1895	0.6	Zanzibar; Bali.
<i>Cypridopsis turgida</i> Sars, 1896	0.89	Australia; New Zealand; South Africa; Madagascar; Sumatra; China; Beaufort, North Carolina.
<i>Cypris viridis</i> Thomson, 1879	0.95	Australia; New Zealand.

in lateral and dorsal views with photographs and line drawings. The generic affinities of the Cretaceous species cannot be determined from the discussion and illustrations. Because Grekoff questioned his generic assignment, the geologic range of *Cypretta* is Early Cretaceous (?), Pleistocene to Holocene.

**GEOGRAPHIC DISTRIBUTION.**—*Cypretta* has been considered a tropical and subtropical genus (Furtos, 1935; Danforth, 1948:352), although a few species are recorded from temperate climates. Thomson (1879:258) collected *Cypris viridis* [= *Cypretta viridis*] in blocks of ice and recorded that the ostracodes were quite lively as soon as they thawed. Figure 7 shows that species of *Cypretta* were recorded between latitudes of about 45° north and 50° south. Fox (1965:211, fig. 1h) reported *C. seurati* Gauthier, 1929, in northern Italy as part

of the highly adaptable rice-field biota. McKenzie (1971b:224) cited an unpublished record of *Cypretta* from sub-Antarctic islands.

Our experience with *C. kawatai* tends to support Sharpe's hypothesis that the northern record of *C. globulosa* is spurious. We collected our specimens in aquaria maintained for the breeding of the red mutant (albino) strain of the schistosomiasis vector snail *Biomphalaria glabrata* (Say, 1818) at The Johns Hopkins Medical School in Baltimore, Maryland, and also at the Department of Medical Zoology, Walter Reed Army Institute of Research, Washington, D.C. The Baltimore snails were obtained about five years ago from the Washington laboratory; consequently, we believe that the ostracode was introduced with the snails in the breeding aquaria in Baltimore. According to Dr. F. Ferguson, Tropical Disease Section, U.S. Public Health

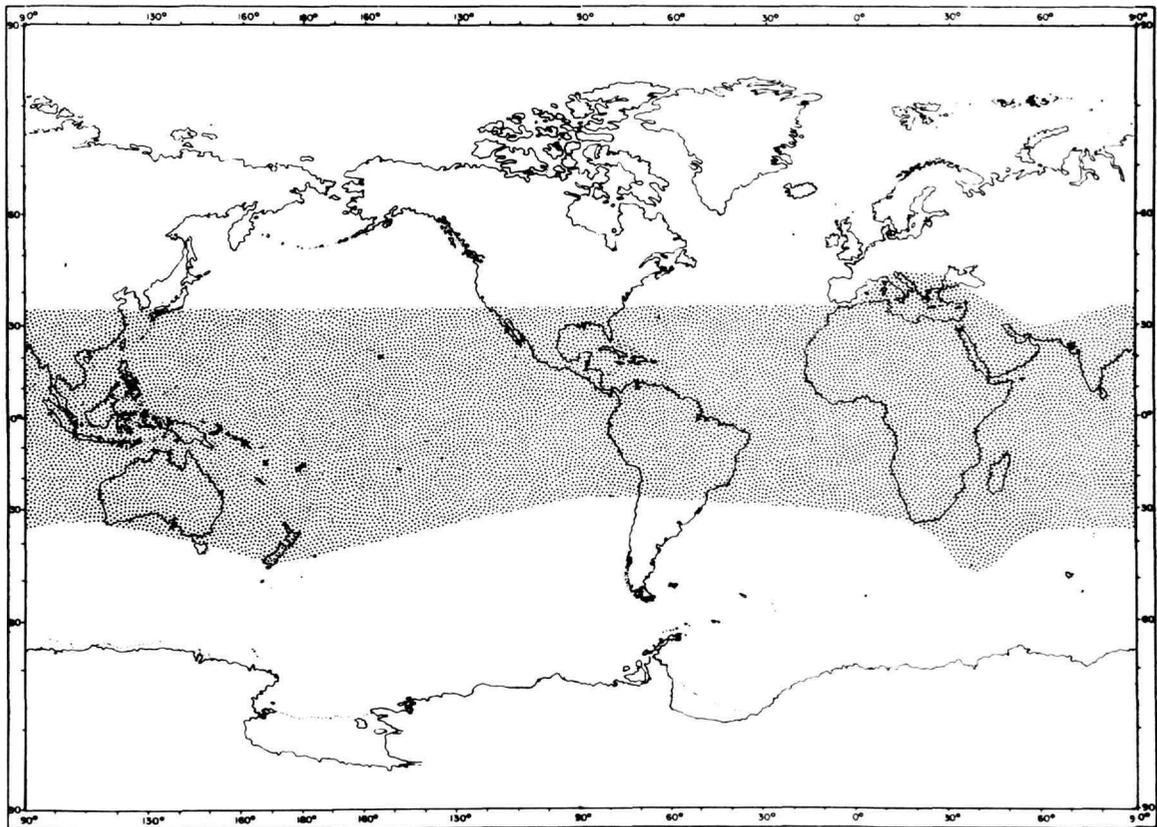


FIGURE 7.—Map showing latitudes (stippled area) within which species of *Cypretta* have been reported. Species live only in freshwater habitats.

Service, San Juan, Puerto Rico (verbal communication, September 1971), the albino strain of *B. glabrata* was first used by Dr. Lobato Paraense in Belo Horizonte, Brazil, and snails for breeding were imported from that area. We conclude that *Cypretta kawatai* was introduced to the United States with the snails, just as it was transported from Washington to Baltimore.

***Cypretta kawatai* Sohn and Kornicker, 1972**

FIGURES 1a, 2-4, 5d-f, 8-18

*Cypretta kawatai* Sohn and Kornicker, 1972a:1258 [deliberate nomen nudum]; 1972b:313, figs. 1-3.

HOLOTYPE.—USNM 139850. Female.

PARATYPES.—USNM 139851, 140953-140962, 140964-140993. Ontogenetic series.

MATERIAL.—Several hundred specimens in all stages of growth.

TYPE-LOCALITY.—Aquaria in The Johns Hopkins University, Baltimore, Md.

HABITAT.—Presumed to be freshwater ponds and ditches in Belo Horizonte, Brazil (see discussion).

DIAGNOSIS.—Ends pointed in dorsal outline; length of "sense club" of second antenna 0.040 to 0.048 mm; dorsal seta of furca less than one-fourth of adjacent claw. Males unknown.

DESCRIPTION.—The adult carapace is subovate in lateral outline, the dorsal margin is arched with the apex at approximate midlength, the ventral margin is straight to gently concave, the end margins are convex, and the dorsoanterior margin is long and sloping. The right valve is larger and overlaps and also overreaches the left valve with a protruding flange along the free margins, more so along the anterior margin. Along the midventral margin, the right valve overlap is sinuous with a wide lip, and along the posterior margin the overreach is narrowest; the left valve is slightly curved inward to form a distinct narrow concave nick that is seen best in dorsal and ventral outlines. The dorsal outline is subelliptical with the anterior narrower; the greatest width is slightly behind midlength, from which point the valves curve more sharply toward the anterior and more roundly toward the posterior. In end views the carapace is slightly wider than high, the greatest width approximately at midheight. The surface is finely punctate and sparsely covered with relatively long

hairs that do not seem to originate from centers of punctae. A narrow groove is present subparallel to and slightly removed from the edge of the free margins of the right valve.

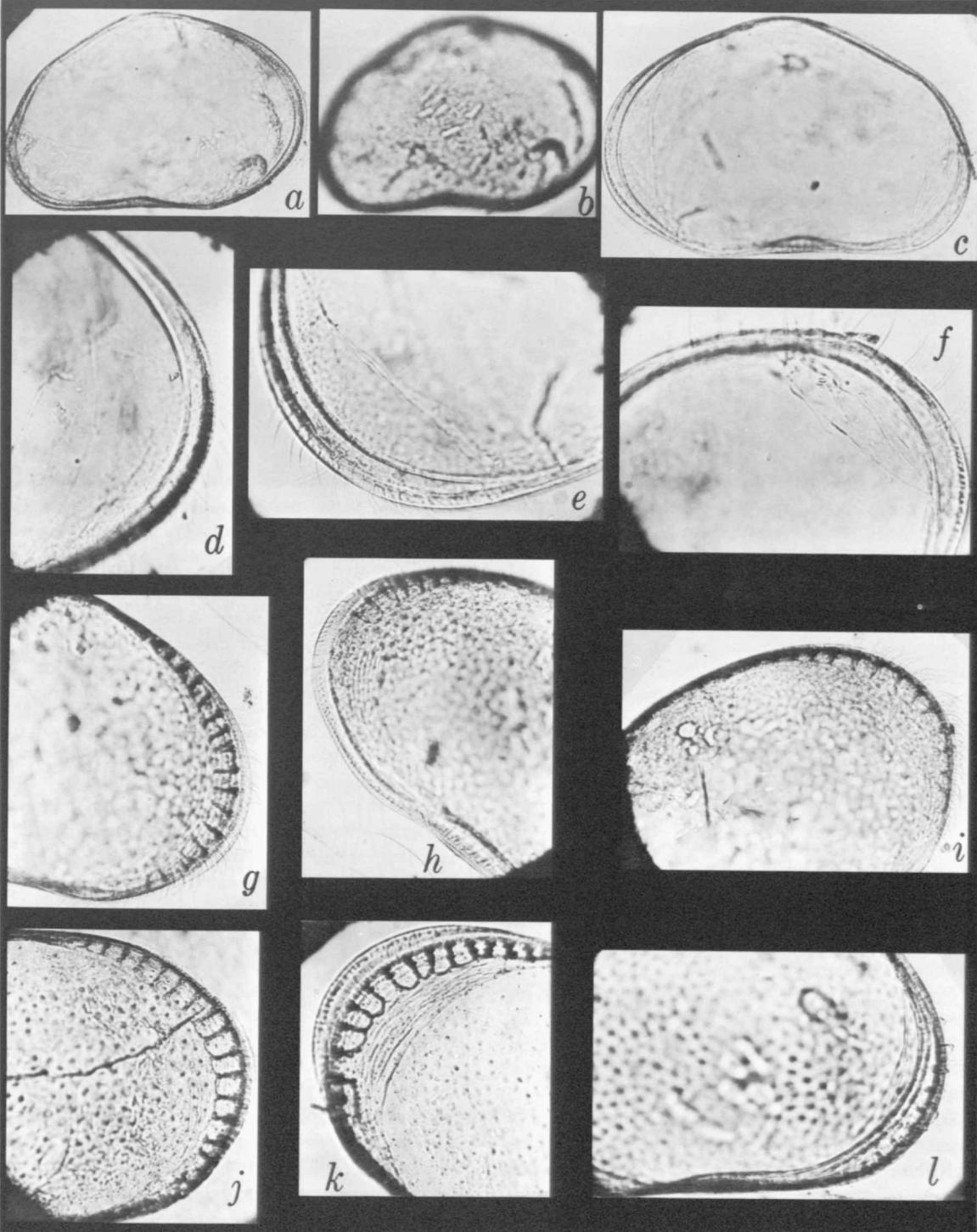
The adductor muscle-scar consists of six discrete scars: an elongated cap scar (Benson, 1967:217) is oblique and trends toward the ventroposterior; below are three elongated subparallel scars and two shorter scars. Ventrad and anterior to the muscle-scars are two elongated mandibular scars (Figures 8b,l, 9).

The hinge is bipartite. The part in front of the approximate greatest height consists of the edge of the left valve that fits into a wide shallow groove in the right (Figure 9a); the part behind the approximate greatest length is straight, about twice the length of the anterior part, and consists of a narrow groove in the left valve into which the dorsal edge of the right valve fits. Below the dorsal edge of the right valve is a narrow accommodation groove for the reception of the ridge along the ventral boundary of the groove in the left valve (Figure 9b).

The right valve has a relatively wide flange along the anterior margin. This flange narrows along the anteroventral margin and then widens to form a lip at approximately midlength; it then narrows again and continues along the ventroposterior, posterior, and dorsoposterior margins up to the end of the hinge. A narrow list extends from the anterodorsal margin around the entire free margins to the posterior end of the hinge. Along the anterior margin, the list is just proximal to the anterior margins of the septa. An outer wider ridge, which tends to split into ventroposterior nodes,

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FIGURE 8.—*Cypretta kawatai*. Paratype, USNM 140953, left valve of instar A-3, greatest length 0.45 mm: a, inside view; b, view focused on muscle scar. Paratype, USNM 140954, instar, either A-1 or A-2, greatest length 0.55 mm, inside views: c, right valve; d, left valve; e, right anterior of right valve; f, posterior of right valve. Adult paratype, USNM 140955, right valve, greatest length 0.70 mm: g, anterior in outside view; h, inside view. Adult paratype, USNM 140956: i, anterior half of left valve, greatest length 0.69 mm, inside view. Holotype, USNM 139850: j, anterior portion of left valve showing septa, inside view; k, right valve, greatest length 0.75 mm, inside view of anterior; l, same right valve, inside view showing muscle-scar pattern. (Magnification: d-f, x 240; a-c, g-l, x 120.)



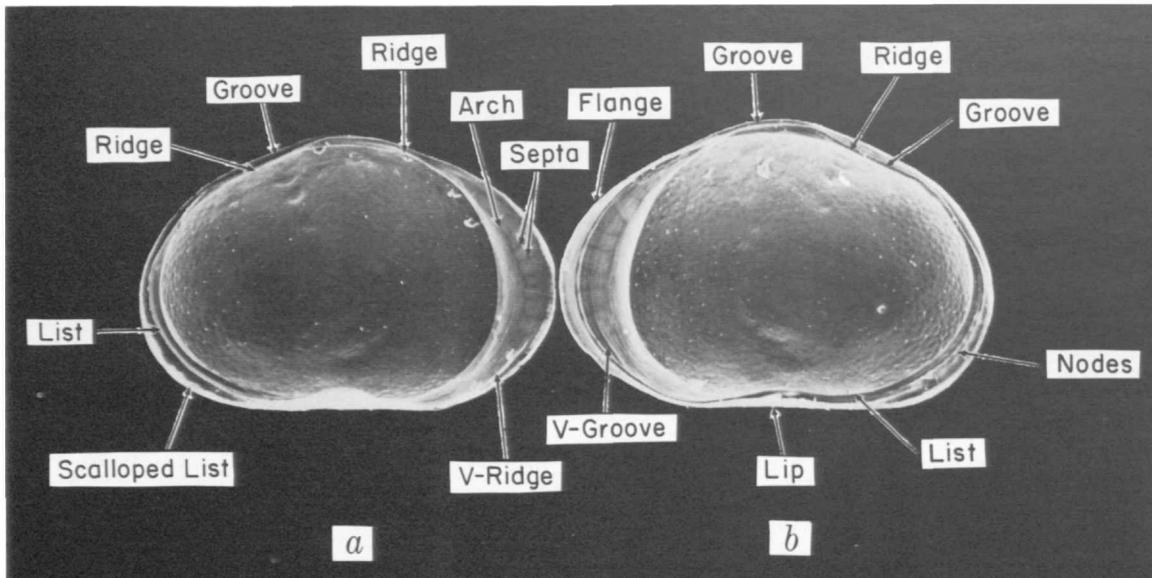


FIGURE 9.—*Cypretta kawatai*, paratype, USNM 140959, adult carapace, greatest length 0.66 mm, showing the hinge, marginal structures, and muscle scars: *a*, left valve; *b*, right valve.

branches from the list just posterior to the ventral lip of the flange.

The left valve does not have a flange. The list is absent along the anterior half of the valve. On the posterior half, the list divides at approximately the same point as on the right valve and forms a wide outer ridge that has scallops along its inner margin. These scallops may serve as sockets for the nodes along the ventroposterior of the right valve.

Along the ventroanterior part of the infold of the right valve, the list branches to form a V-shaped groove, and the ventroanterior infold of the left valve bears a short ridge which fits into the V-groove on the opposing valve. A similar structure is present also in *Cypridopsis* (Figure 5a) and it probably is a family character.

*Free margins:* The free margins of both valves have branching pore canals (Figure 10). Hairs are present along the end margins of both valves (Figure 2a,c). Both valves have characteristic septate anterior margins, but in *C. kawatai* these septate margins are quite variable in degree of development (Figures 2i,j,m,n, 8g-k). The septa may be well developed on one valve and poorly developed on the other. The morphology of the septa has been discussed under the genus. We have observed

and illustrated short pillars, less than half the length of the septa, within the anterior margins of each valve (Figure 2j,m,n). These structures may have been overlooked in previously described species because each is either superimposed on or slightly offset from a septum. Similar pillars also are present along the inner margin of the ventro-

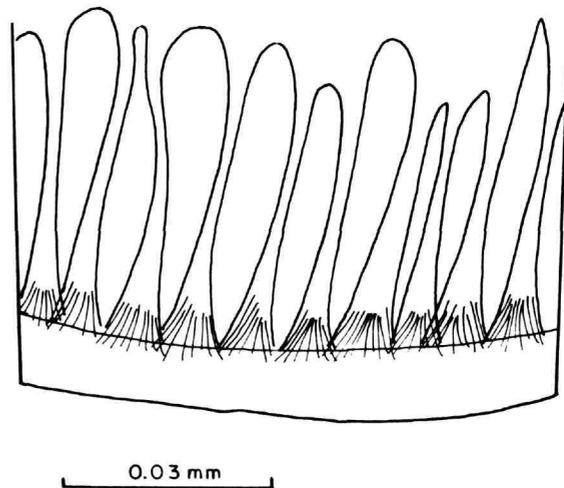


FIGURE 10.—*Cypretta kawatai*, showing branching pore canals on lip of ventral margin of right valve of adults.

posterior of only the right valve (Figure 2o,p). On some valves (Figure 2k) we have observed a pore canal transversing each pillar.

*First antenna* (Figures 11a, 12a): The limb has seven joints. The first podomere has one dorsal bristle and two ventral bristles, each with short marginal spines. The second podomere has one short dorsal bristle with short marginal spines and a small, faint sensory organ on the ventral margin. The third podomere has two subterminal bristles—one at the dorsal margin, the other at the ventral margin. Both the fourth and fifth podomeres have two long natatory dorsal and two short ventral bristles. The sixth podomere has four long natatory bristles, and the seventh or terminal podomere has three long natatory bristles and one shorter bristle that bears short marginal spines. Podomeres 4-7 have rows of very short spines near the distal margin. The natatory bristles are probably setose, but we could not observe them in ordinary transmitted light, even with oil immersion.

*Second antenna* (Figures 11b, 12b): The protopodite has two joints. The first podomere has three short spinose bristles. The second podomere has one long spinose bristle medially near the ventral margin and short spines distally on the medial surface.

The exopodite is small and is located laterally near the middle of the terminal margin of the second podomere of the protopodite. It bears three terminal bristles that progressively increase in length from the venter to the dorsum, the dorsal two being spinose.

The endopodite has three joints. The first podomere bears a "sense club" near the ventral margin about two-thirds from the distal end and six distally located bristles near the dorsal margin; five of these bristles are long, plumose, and reach past the terminal claws, and the other bristle is less than half as long and appears to be bare. The medial surface of the podomere is spinose, with longer spines near the base of the bristles. The second podomere has four ventral bristles distal to the middle; the dorsal bristle is short and the other three are about five times longer. The dorsal margin of the second podomere has two bristles near the middle and three long subterminal bristles. Two stout claws bearing marginal teeth are on the terminus of that podomere, and the

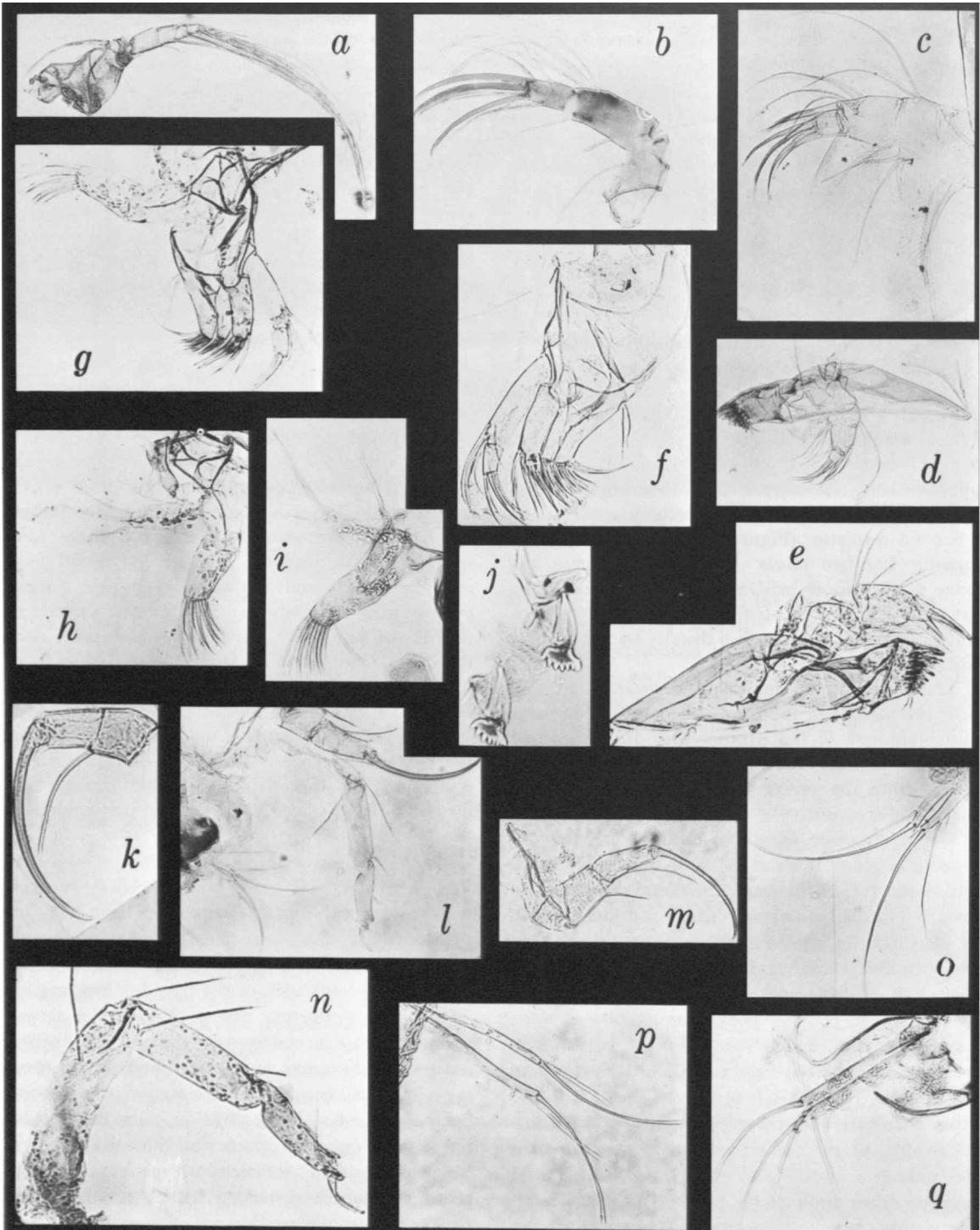
medial surface bears short spines that form clusters near the base of the bristles. The third or end podomere has one short bristle near the middle of the ventral margin, two stout terminal claws, one slender terminal claw, and one short lateral terminal bristle.

*Mandible* (Figures 11c-e, 12c-e): The protopodite has two joints. The podomere has teeth in seven rows on the inner distal end and spinose bristles between the rows of teeth. Two longer spinose bristles are present at the inner edge of the toothed end. One short, stout spinose bristle is on the anterior surface proximal to the teeth. The ventral margin of the second podomere has one short, bare bristle, one long, slender bristle with short marginal spines, and two broad, long plumose bristles.

The exopodite is platelike, with one anterior spinose bristle and five terminal spinose bristles.

The endopodite has three joints. The dorsal margin of the first podomere has three subterminal bristles, and the ventral margin has three long spinose bristles near the middle, one broad long terminal bristle, and one short, very stout spinose process with pointed tip. The medial surface of the second podomere has four distal bristles near the dorsal margin. The ventral margin has three terminal bristles, some with marginal spines. The lateral surface of the second podomere has three stout subterminal bristles, and the one nearest to the venter has marginal spines. The third or end podomere has three stout terminal claws. The medial surfaces of the second and third podomeres bear short spines.

*Maxilla* (Figures 11f,g, 13a): The maxilla consists of a branchial plate, three masticatory processes, and a two-jointed palp. The first joint of the palp has one short lateral bristle and four longer terminal bristles that are near the dorsal margin. The end joint of the palp has five bristles. The outer masticatory process has on the lateral surface a short, broad spinose process. The terminal end of the outer masticatory process has three stout pectinate bristles that are separated by sutures from short pedestals; in addition, there is a slender bristle with marginal spines and there are five bare bristles. The middle masticatory process has seven terminal bristles, which are either smooth or pectinate. The inner masticatory process has two bare



bristles proximally on the inner margin. The terminal end of the inner masticatory process has two long pectinate bristles on the inner edge and six shorter bare bristles.

*First leg* (Figures 11g,h, 13b): The limb consists of a protopodite, an endopodite, and an exopodite plate. The distal end of the protopodite has one proximal bristle, three subterminal and ten terminal bristles, all with marginal spines. The ventral margin of the distal part of the protopodite bears hair. Hairs are present also near the base of the three subterminal bristles.

The endopodite has three plumose terminal bristles. The exopodite plate is obscured in our dissections, but it appears to have several faint bristles.

*Second leg* (Figures 11k-m, 13c): The protopodite has two fused joints. The first podomere is bare; the second podomere has a short, spinose bristle in the middle of the ventral margin.

The endopodite has four joints. The ventral margin of the first podomere is spinose and bears one spinose subterminal bristle. The second podomere has on its ventral margin a long terminal spinose bristle that is about twice the length of the bristle on the first podomere. The third podomere has a short bristle on its ventral margin that reaches just past the distal end of the terminal joint. The terminal or end podomere has a claw slightly longer than the combined three joints of the endopodite. This claw has teeth along the distal part of the concave margin. Near the base of this claw, the terminal podomere has a cluster of spines and

one short bristle that is about the same length as the terminal bristle on the previous podomere.

*Third leg* (Figures 11n, 13d,e): The protopodite has two fused joints. The distal end of the first podomere has one medial bristle. The second podomere has one ventral subterminal bristle and one dorsal terminal bristle.

The endopodite has three joints. The ventral margin of the first podomere has one short terminal bristle. The ventral margin of the second podomere has one bristle near the middle of its length and a toothlike terminal process. Short spines are present along the dorsal margin, on the medial surface, and near the base of the toothlike terminal process. The third podomere is short and has a long backward-pointing, spinose bristle and a short, stout, curved terminal claw with teeth along its concave edge. At the base of the claw is a short lateral bristle. A short toothlike process is present on the third podomere near the ventral edge of the claw. This process appears to be the opposing tooth of the toothlike process on the second podomere.

*Furca* (Figures 11o-q, 13f): The furcal lamellae are slightly sigmoidal and are relatively slender, with a slight taper toward the distal end. They are 15 times as long as they are wide at their middle. One short spinose dorsal seta is removed by approximately its length from the base of the terminal claw. Each lamella has short spines along the dorsal margin proximal and distal to the dorsal seta. A shorter spinose seta is located ventrad to the terminal claw. The subterminal claw is spinose and about two-thirds the length of the terminal smooth claw.

*Rake organs* (Figure 11j): The vertical shafts of the rake-shaped organs are about twice as long as the toothed horizontal bar. Each bar bears nine teeth, of which the three teeth nearest the median plane are fused at their bases.

**ONTOGENY.**—On Nov. 15, 1971, we obtained three gravid females from the aquarium in Dr. Chiang's office in Baltimore, Md., and placed them on the sill of a south-facing window in a culture dish 75 mm in diameter filled with distilled water, to which CaCO<sub>3</sub> slurry, distilled water, and pieces of lettuce were added when needed. On Dec. 29, 1971, we counted all the living ostracodes in the colony; the results are shown in Table 4. On Feb.

FIGURE 11.—*Cyprretta kawatai*: a, left first antenna of adult, lateral view; b, left second antenna of adult, lateral view; c, left mandible of adult, protopodite and endopodite, lateral view; d, complete left mandible of adult, medial view; e, complete right mandible of instar A-1, lateral view; f, left maxilla of adult, lateral view; g, right maxilla of first leg of instar A-1, lateral view; h, right first leg of instar A-1, lateral view; i, left first leg of instar A-1, medial view; j, rake organs; k, left second leg of adult, distal part, medial view; l, right second and third legs and furca, medial views; m, right second legs of adult, lateral view; n, right third leg of adult, lateral view; o, furca of holotype; p, furca of adult paratype; q, furca of instar A-1, left lateral view. (Specimens: a, paratype, USNM 140957; b, d, f, l, o, holotype, USNM 139850; c, j, paratype, USNM 140958; e, g, h, q, paratype, USNM 140954; i, paratype, USNM 140956; k, paratype, USNM 140959; m, p, paratype, USNM 140960; n, paratype, USNM, 140955. Magnification: a-d, l, m,  $\times 120$ ; e-l, n-q,  $\times 240$ .)

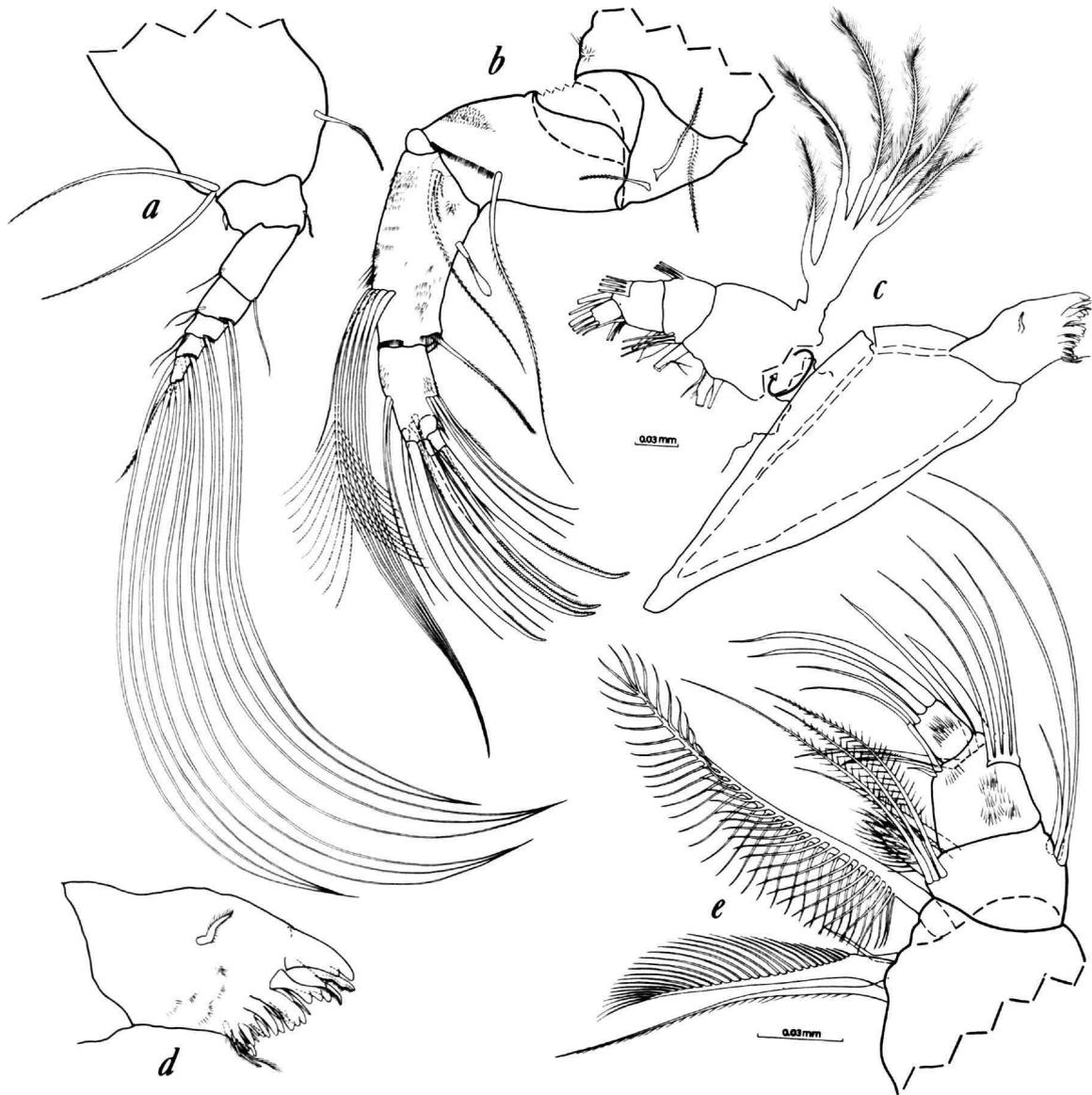


FIGURE 12.—*Cypretta kawatai*, paratype, USNM 140960: *a*, right first antenna, lateral view; *b*, right second antenna, medial view; *c*, right mandible, medial view, except first podomere of protopodite which is in lateral view; *d*, teeth of right mandible, lateral view; *e*, second joint of protopodite and endopodite of right mandible, medial view. [Closely packed bristles and claws on several appendages were drawn as they would appear if separated. Magnification same in *a-c*; same in *d, e*.]

15, 1972, the same colony consisted of a few adults and numerous young in various stages of growth. We believe that the adults and young listed in Table 4 represent the first generation. This could explain the absence in the colony on Dec. 29, 1971, of very young growth stages and the presence of eggs.

We obtained a suite of molted valves for measuring by filtering the residue. Many of the valves

were decalcified, and they crumpled when touched with a wet brush on the dry filter paper, a phenomenon that we have experienced in working with this species. We did, however, obtain a sufficient variety of solid valves for measurement. Table 5 shows the greatest length, greatest height, and growth stage obtained by measuring selected specimens from this colony. The first three growth stages were not represented by single valves, pre-

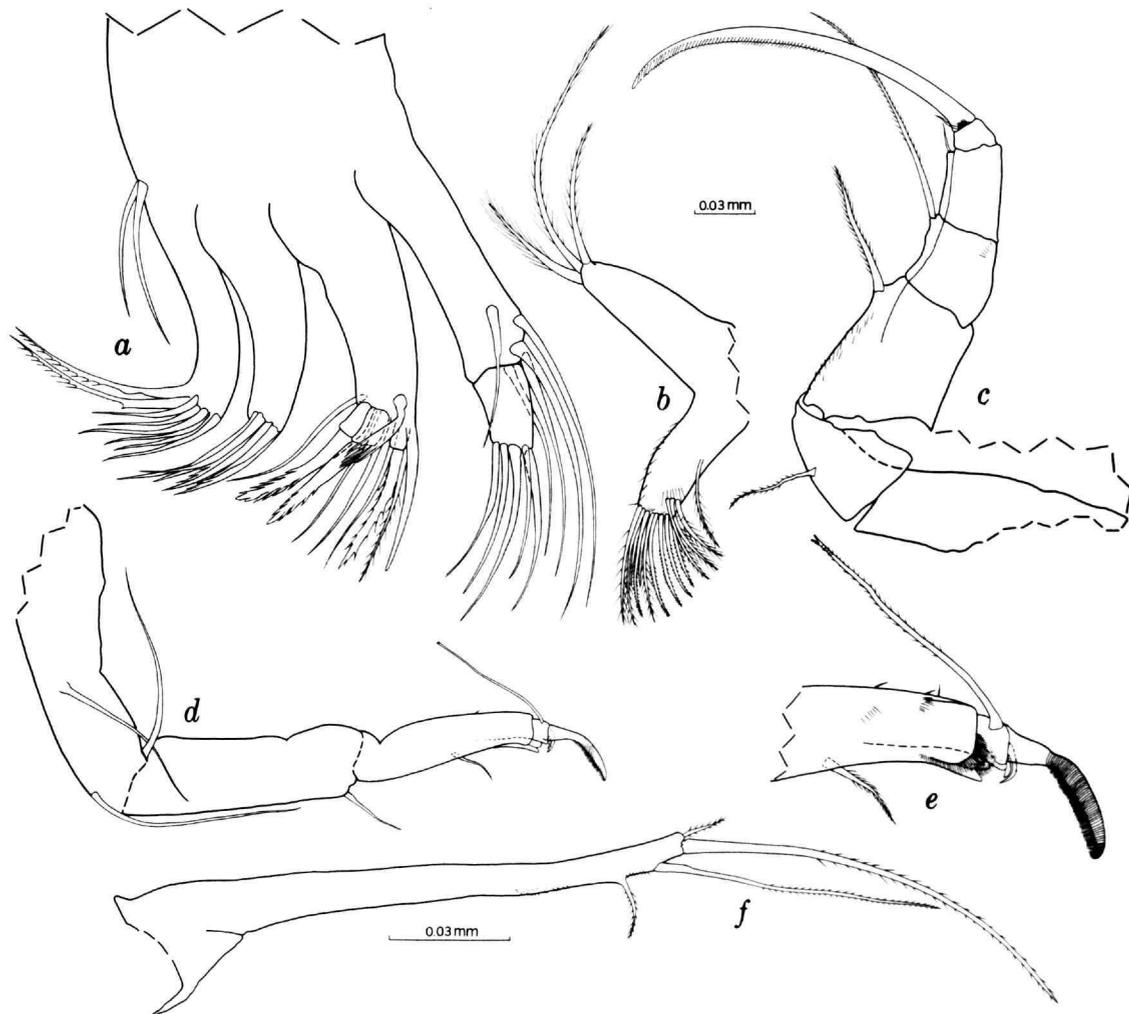


FIGURE 13.—*Cypretta kawatai*. Paratype, USNM 140960: *a*, right maxilla, lateral view; *b*, left first leg, medial view; *c*, left second leg, medial view; *d*, right third leg, medial view; *e*, detail of tip of right third leg. Holotype, USNM 139850; *f*, furca, right lamella, lateral view. [Closely packed bristles and claws on several appendages were drawn as they would appear if separated. Magnification same in *a-d*; same in *e, f*.]

TABLE 4.—Number of individuals and stages of growth of live ostracodes produced by three gravid females in 44 days.

Number of individuals	Stages of growth
common	eggs
1	A-3
4	A-2
7	A-1
94	adult

sumably because in these stages the valves are weakly calcified (Ghetti, 1970:104) and also possibly because they are subject to rapid destruction by both ostracodes and bacteria. We were, however, able to measure the right valve on carapaces that represent the third or A-6 growth stage by drying live individuals in this stage. In order to obtain the size of adults, a gravid female was dissected and the right valve measured. Later, we obtained from the same colony a solid right valve of the A-6 growth stage that measured 0.19 mm in greatest length (Figure 14a-c). The individual represented a generation later than the ones shown in Table 5. We measured four eggs in a clutch obtained when

TABLE 5.—Length and height measurements (in mm) of right valves of *Cyprretta kawatai* in a single colony.

Growth stage	Greatest length	Greatest height
A-6 (carapace only)	0.20	0.14
	0.23	0.16
A-5	0.26	0.19
	0.26	0.19
	0.28	0.20
A-4	0.32	0.23
	0.32	0.24
	0.32	0.25
	0.33	0.23
A-3	0.40	0.27
	0.40	0.30
	0.41	0.28
	0.41	0.29
A-2	0.48	0.34
	0.49	0.34
	0.50	0.37
A-1	0.64	0.43
	0.64	0.44
	0.65	0.43
Adult	0.78	0.51

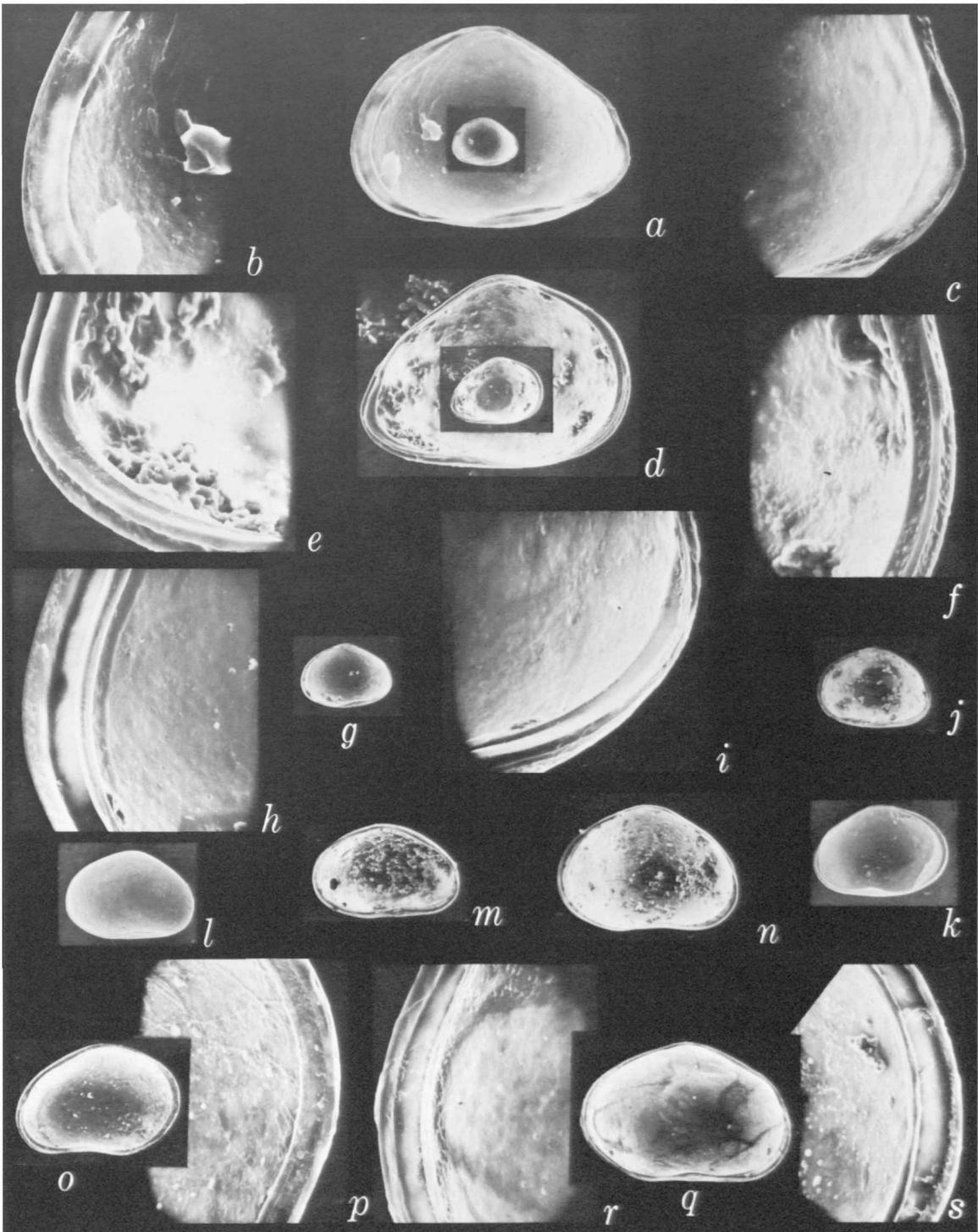
we counted the specimens in the colony derived from three adults. These eggs had an average diameter of 0.12 mm.

Figure 15 shows the length-height distribution of the specimens listed in Table 4 and of additional right valves and carapaces. Using the average length of each cluster, which we interpret to represent a single growth stage, we applied the method of calculating growth factors previously described (Sohn, 1950). Table 6 shows the calculated growth factors obtained by using the specimens in Table 4 only and also by using all the specimens on the graph.

TABLE 6.—Calculated growth factors for *Cyprretta kawatai*.

Growth stages	Single colony		All data	
	No. specimens	Growth factor	No. specimens	Growth factor
A-6	2		2	
		1.24		1.33
A-5	2	1.21	5	1.27
A-4	3	1.25	5	1.24
A-3	4	1.21	6	1.20
A-2	3	1.31	4	1.24
A-1	2	1.22	7	1.15
Adult	1		13	

FIGURE 14.—*Cyprretta kawatai*. Paratype, USNM 140974: a-c, right valve, interior views of instar A-6, greatest length 0.19 mm. Paratype, USNM 140975: d-f, left valve, interior views of instar A-5, greatest length 0.27 mm. Paratype, USNM 140976: g-i, right valve, interior views of instar A-5, greatest length 0.27 mm. Paratype, USNM 140977: j, right valve, interior view of instar A-4, greatest length 0.32 mm. Paratype, USNM 140978: k, left valve, interior view of instar A-4, greatest length 0.36 mm. Paratype, USNM 140979: l, left valve of carapace, outside view of instar A-4, greatest length 0.36 mm. Paratype, USNM 140980: m, right valve, interior view of instar A-3, greatest length 0.41 mm. Paratype, USNM 140981: n, right valve, interior view of instar A-2, greatest length 0.50 mm. Paratype, USNM 140982: o, p, left valve, interior view of instar A-2, greatest length 0.47 mm. Paratype, USNM 140983: q-s, right valve, interior view of instar A-1, greatest length 0.55 mm. Many of the valves contain debris. (Magnification: a, x 250; b, c, e, f, h, i, x 625; d, x 175; p, r, s, x 315; g, j-o, q and insets of a and d, x 65.



This table tends to support Sohn's (1950:431, 433) hypothesis that no single growth factor need apply to all the growth stages in a given species and that it may be difficult to differentiate between growth stages on size alone. Szczechura (1971) reviewed the literature on ostracode growth stages in her study of *Heterocypris incongruens* (Ramdohr, 1808). She concluded that the growth factor between all the growth stages is constant, and that it is approximately 1.26 for *H. incongruens*. She further concluded that when measurements of height-length fall in distinct groups on a graph the species lived under stable ecological conditions, and that unstable ecological conditions, such as temperature changes due to seasonal fluctuations, result in indistinct groupings on the graph.

Although we are dealing with few specimens in each growth stage, the presence of both adult and A-1 individuals at the same length of 0.65 mm indicates that Szczechura's conclusions do not apply to *C. kawatai*, and, by inference, possibly do not apply to some other freshwater species. Figure

16f shows a carapace of an adult on which we have seen septa along the anterior margin, whereas Figure 17g is of a right valve without septa.

In *C. kawatai* the dorsal outline changes during the ontogeny of the individual. The probable A-6 instar has pointed ends (Figure 16a), and its greatest width is at approximate midlength; the adult has the anterior end more pointed than the posterior, and its greatest width is at approximately one-third the distance from the posterior end. The lateral outline (Figures 14-18) also changes in the probable A-6 instar from subtriangular (Figure 14a-c) to subovate (Figure 18) through the progressive increase in height of the posterior margin. Septate anterior margins do not form until the adult stage. The detailed morphologic changes of the valves during ontogenetic development are illustrated in Figures 2, 14, 16-18.

**LIFE CYCLE.**—Eighteen newly hatched larvae were placed in water in individual containers, each with an area of 20 square centimeters. Eighteen days later, 5 of the 12 surviving specimens had

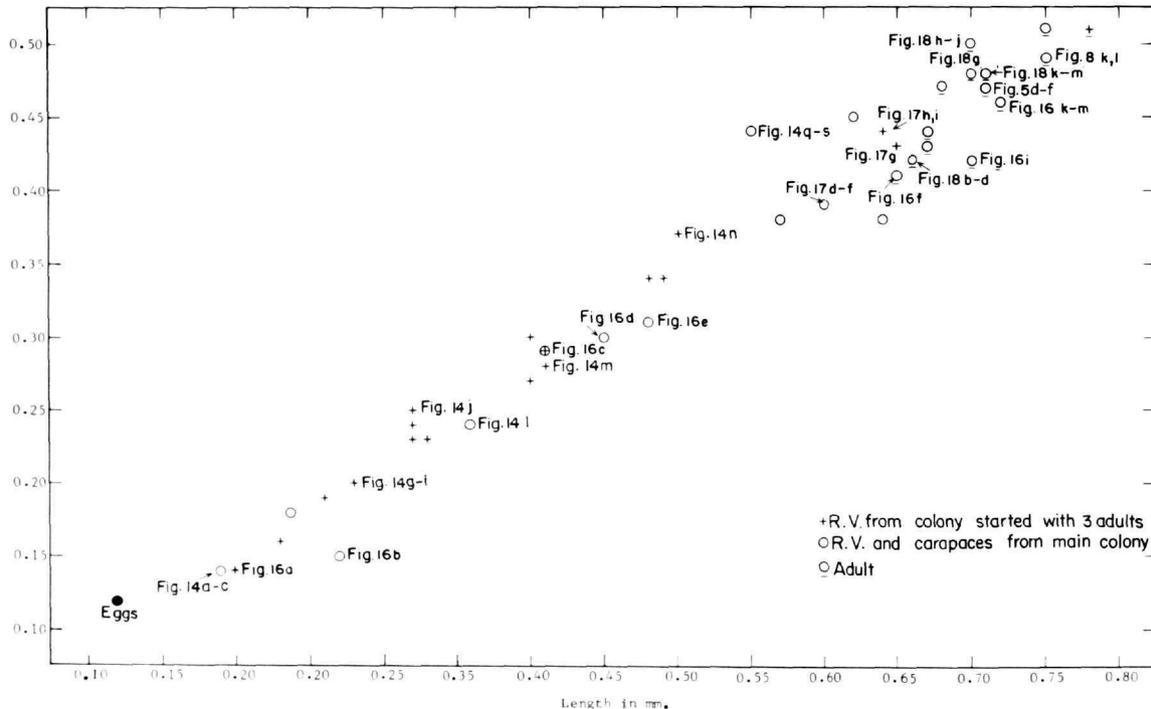


FIGURE 15.—Length-height distribution of growth stages of *Cypretta kawatai*. Crosses represent the specimens listed in Table 4; circles represent additional right valves and carapaces.

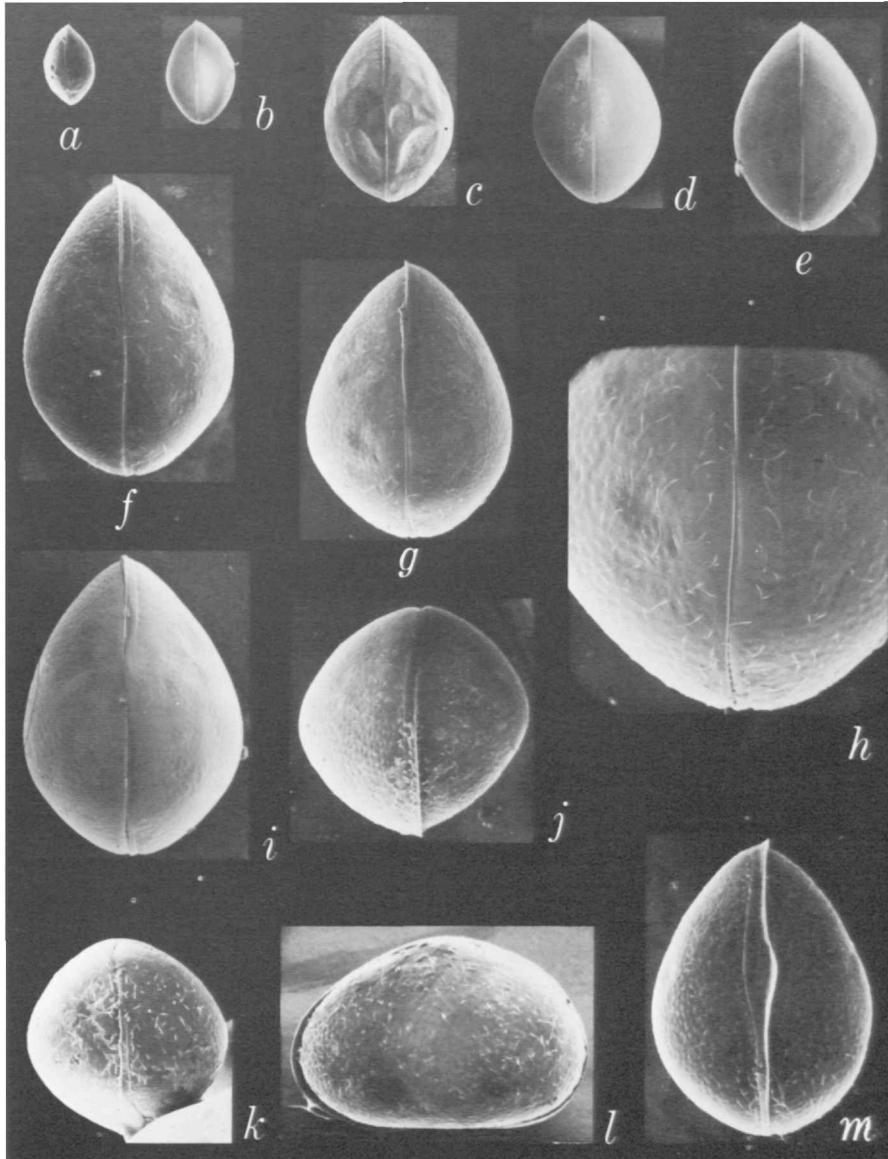


FIGURE 16.—*Cypretta kawatai*. Ontogenetic series showing outlines: *a*, Dorsal outline of instar, probably A-6, greatest length 0.20 mm (paratype, USNM 140965); *b*, dorsal outline of instar, probably A-5, greatest length 0.24 mm (paratype, USNM 140966); *c*, dorsal outline of instar, probably A-4, greatest length 0.41 mm (paratype, USNM 140967); *d*, dorsal outline of instar, probably A-3, greatest length 0.45 mm (paratype, USNM 140968); *e*, dorsal outline of instar, probably A-2, greatest length 0.48 mm (paratype, USNM 140969); *f*, dorsal outline of adult, greatest length 0.65 mm (paratype, USNM 140970); *g*, dorsal outline of adult (toothlike object near the anterior is an artifact), greatest length 0.67 mm (paratype, USNM 140971); *h*, posterior portion of the same carapace (note distribution of hair and double nick at the posterior end; the left portion of this nick is the indentation along the left valve, and the right portion marks the line of the overreaching right valve); *i*, dorsal outline of an adult carapace (hairs were removed with Clorox), greatest length 0.70 mm (paratype, USNM 139851); *j*, anterior view of adult, greatest length 0.70 mm (paratype, USNM 140972); *k-m*, posterior, left lateral, and ventral views of adult carapace, greatest length 0.72 mm (paratype, USNM 140973). (Magnification: *h*, approximately  $\times 125$ ; all others approximately  $\times 65$ .)

laid eggs. Four days later young ostracodes had hatched from some of the eggs. These experiments show that *C. kawatai* is capable of reproducing parthenogenetically. Ovaries were observed in specimens 14 days after hatching, indicating that this species can mature in as little as 14 days under laboratory conditions. As many as 30 juveniles

developed from eggs produced by one individual. A single individual was observed to lay 60 eggs during an 8-day period. According to our observations in the laboratory, the life span of an individual is about 2 months.

EGGS.—The eggs are whitish and have an average diameter of 0.12 mm. They are deposited in

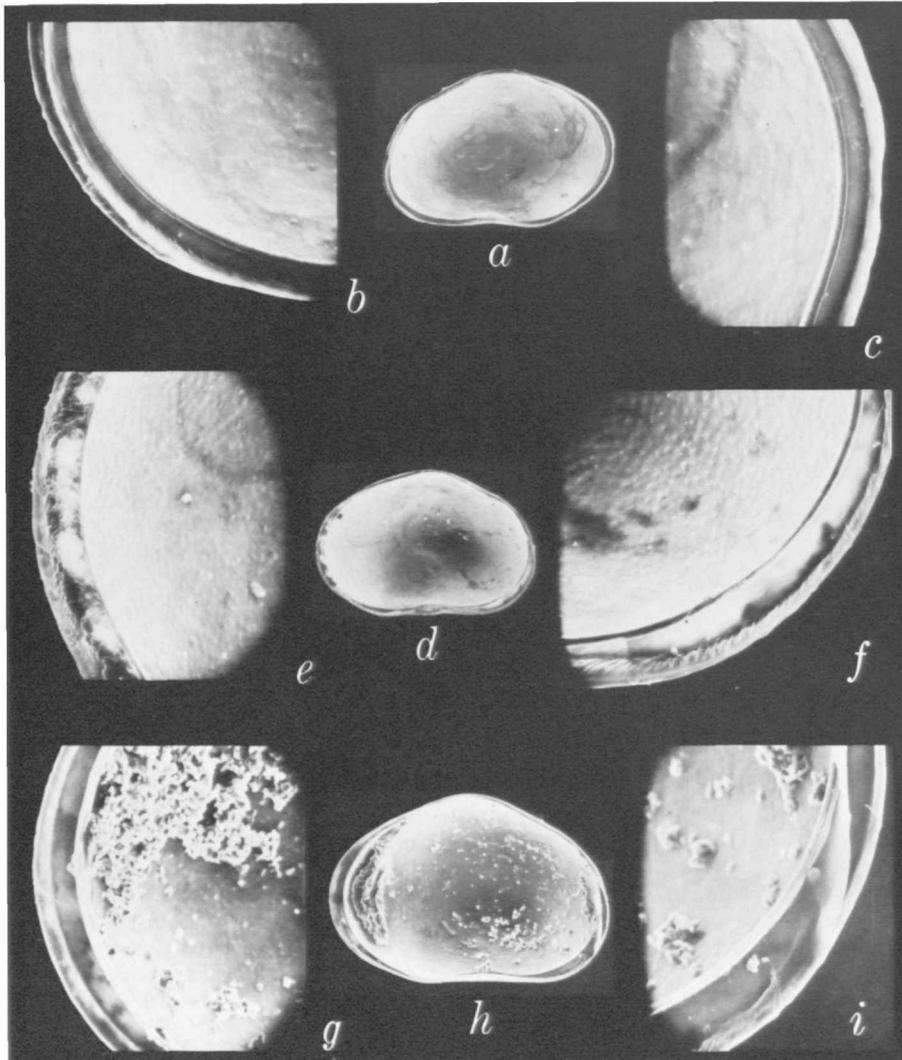


FIGURE 17.—*Cypretta kawatai*. Paratype, USNM 140984: *a-c*: interior views of left valve of instar A-1, greatest length 0.57 mm. Paratype, USNM 140985: *d-f*: interior views of right valve of instar A-1, greatest length 0.60 mm. Paratype, USNM 140986: *g*, interior view of right valve, anterior, of instar A-1, greatest length 0.65 mm. Paratype, USNM 140987: *h, i*, interior views of right valve of instar A-1, greatest length 0.65 mm (note the absence of septa along the anterior margin and of nodes along the posterior margin). (Magnification: *a, d, h*,  $\times 65$ ; *b, c, e, f*,  $\times 315$ ; *g*,  $\times 200$ ; *i*,  $\times 300$ .)

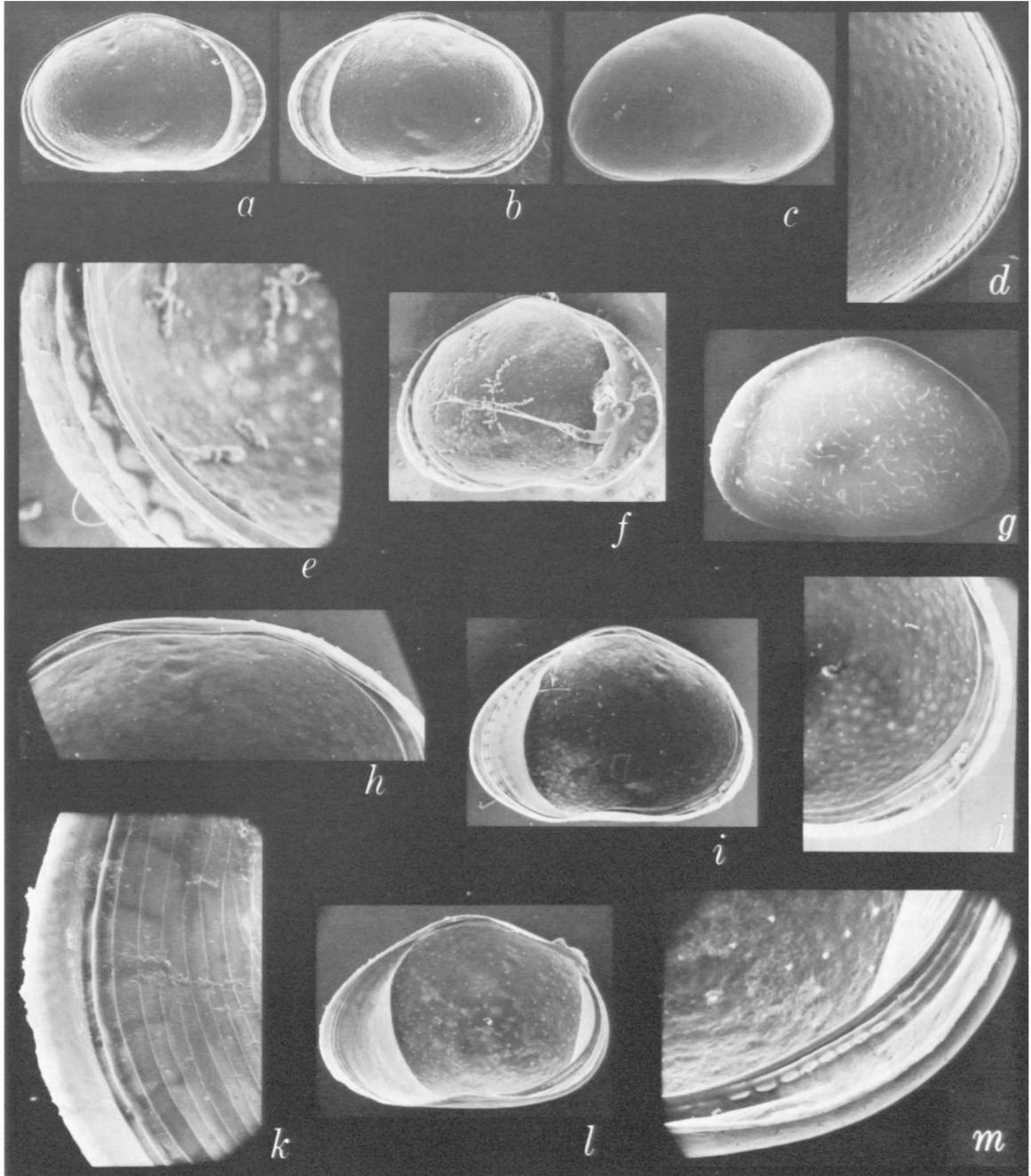


FIGURE 18.—*Cypretta kawatai*. Paratype, USNM 140959, adult carapace, greatest length 0.66 mm: *a*, left valve, interior view; *b*, *c*, right valve, interior and lateral views; *d*, anterior of right valve, lateral view. Paratype, USNM 140988: *e*, *f*, left valve of adult, greatest length 0.69 mm. Paratype, USNM 140989: *g*, right valve, carapace of adult, greatest length 0.70 mm. Paratype, USNM 140990: *h*–*j*, right valve of adult, greatest length 0.70 mm, interior views. Paratype, USNM 140991: *k*–*m*, right valve of adult, greatest length 0.71 mm, interior views. (Magnification: *a*–*c*, *f*, *g*, *i*, *l*, *x* 65; *d*, *x* 170; *e*, *m*, *x* 250; *h*, *j*, *x* 125; *k*, *x* 325.)

clutches on floating objects such as plants, pieces of lettuce, and strips of plastic and on the sides and bottom of the aquaria. In the laboratory, the eggs hatched in a minimum of four days at room temperature and in a minimum of twelve days at 18°C.

*Cypretta globulosa* (Sharpe, 1910)

FIGURE 1b

*Cypris* (*Cypris*) *globulosa* Sharpe, 1910:335, fig. 1a-d.  
*Cypretta dubiosa* (Daday).—Furtos, 1935[1934]:280.

LECTOTYPE.—USNM 39514, female; appendages and carapace on slides.

PARALECTOTYPES.—USNM 139854; four specimens in alcohol, one specimen dissected.

DIAGNOSIS.—Differs from *C. dubiosa* (Daday, 1901) in being more rounded and having a higher posterior margin in lateral outline and in having a more pointed posterior in dorsal outline. Differs from *C. kawatai* in having a longer "sense club."

DISCUSSION.—Sharpe described this species from specimens collected by Miss Effie J. Rigden from a tub containing several freshwater plants in the greenhouse at the University of Wisconsin. At present there is no record in the University of Wisconsin as to origin and kind of plants that were kept in the greenhouse (Prof. Hugh Iltis, January 1972, written communication); consequently, the habitat of this species is unknown. Furtos (1935:280) stated that this species "should undoubtedly be referred to *Cypretta dubiosa* (Daday)" and pointed out that the species can hardly be considered native to Wisconsin.

Literature Cited

- Benson, R. H.  
1967. Muscle-Scar Patterns of Pleistocene (Kansan) Ostracodes. In Curt Teichert and Ellis L. Yochelson, eds., *Essays in Paleontology and Stratigraphy, Raymond C. Moore Commemorative Volume*, pages 211-241. Lawrence, Kansas: University of Kansas Department of Geology.
- Brady, G. S.  
1902. On New or Imperfectly-Known Ostracoda, Chiefly from a Collection in the Zoological Museum, Copenhagen. *Transactions of the Zoological Society of London*, 16 (4):179-210, plates 21-25.
- Brady, G. S., and A. M. Norman  
1896. A Monograph of the Marine and Freshwater Ostracoda of the North Atlantic and of Northwestern Europe, Part 2, Sections 2 to 4: Myodocopa, Cladocopa and Platycopa. *Scientific Transactions of the Royal Dublin Society*, series 2, 5:621-784, plates 50-68.
- Brehm, V.  
1949. Datos para la fauna de agua dulce de Cuba. *Publicaciones del Instituto de Biología Aplicada*, 5:95-112, 7 figures.
- Chapman, M. A.  
1963. A Review of Freshwater Ostracodes of New Zealand. *Hydrobiologia*, 22 (1-2):1-40.
- Daday, E. von  
1901. Mikroskopische Süßwassertiere aus Deutsch-Neuguinea. *Természetrázi Füzetek*, 24:1-56, 3 plates. Budapest.
1910. Untersuchungen über die Süßwasser-Mikrofauna Deutsch-Ost-Afrikas. *Zoologica. Original-Abhandlungen aus dem Gesamtgebiete der Zoologie*, 59:1-314, 16 plates.
- Danforth, W.  
1948. A List of Iowa Ostracoda with Descriptions of Three New Species. *Proceedings of the Iowa Academy of Science*, 55:351-359, 3 plates.
- Farkas, H. K.  
1959. Die Beschreibung von *Cypretta schubarti* n. sp. (Ostracoda) aus Sudamerica. *Annales Historico-Naturales Musei Nationalis Hungarici*, 51:277-280, 8 figures.
- Fox, H. M.  
1965. Ostracod Crustacea from Ricefields in Italy. *Memorie dell'Istituto Italiano di Idrobiologia "Dott. Marco De Marchi," Pallanza*, 18:205-214, 1 figure.
- Furtos, N. C.  
1935[1934]. Two New Species of *Cypretta* (Ostracoda) from the Marquesas Islands and Florida with Notes on the Distribution of the Genus. *Bernice P. Bishop Museum Bulletin*, 114:279-286, 2 figures. [Preprint, *Pacific Entomological Survey*, article 21, publication 7, May 16, 1934.]
1936. Fresh-Water Ostracoda from Florida and North Carolina. *The American Midland Naturalist*, 17 (2):491-522, 15 figures.
- Gauthier, H.  
1929. Cladocères et Ostracodes du Sahara central. *Bulletin de la Société d'Histoire Naturelle de l'Afrique du Nord*, 20 (7):143-162, 11 figures, 6 plates.
1939. Contribution à l'étude de la faune dulcaquicole de la région du Tchad et particulièrement des Branchiopodes et des Ostracodes. *Bulletin de l'Institut Français d'Afrique Noire*, 1 (1):110-244, 23 figures.
- Ghetti, P. F.  
1970. The Taxonomic Significance of Ostracod Larval Stages: With Examples from the Burundi Rice Fields. *Bolletino di Zoologia* (Naples), 37 (2):103-120, 5 figures.
- Grekoff, N.  
1960. Ostracodes du Bassin du Congo, II: Crétacé. *An-*

- nales du Musée Royal du Congo Belge Tervuren (Belgique), *Sciences géologiques*, 35: 70 pages, 24 figures, 10 plates.
- Grochmalicki, J.  
1915. Beiträge zur Kenntnis der Süßwasserfauna Javas. Phyllopoda, Copepoda und Ostracoda. *Bulletin International de l'Académie des Sciences de Cracovie, Classe des Sciences Mathématiques et Naturelles*, series B, Sciences Naturelles:217-240, plate 7.
- Hartmann, G.  
1964. Asiatische Ostracoden, Systematische und zoogeographische Untersuchungen. *Internationale Revue der Gesamten Hydrobiologie*, Systematische Beihefte 3, 154 pages, 64 figures. Berlin: Akademie Verlag.
- Henry, M.  
1923. A Monograph of the Freshwater Entomostraca of New South Wales, Part 3: Ostracoda. *Proceedings of the Linnean Society of New South Wales for the Year 1923*, 49:267-285, plates 24-29.
- Hornibrook, N. de B.  
1955. Ostracoda in the Deposits of Pyramid Valley Swamp. *Records of the Canterbury Museum*, 6 (4):267-277, 34 figures.
- Kesling, R. V.  
1951. The Morphology of Ostracod Molt Stages. *Illinois Biological Monographs*, 21 (1-3):324, 96 plates, 36 figures.
- King, R. L.  
1855. On Australian Entomostraca. *Papers and Proceedings of the Royal Society of Van Diemen's Land*, 3 (1):56-75, plates 9, 10.
- Klie, W.  
1938. Ostracoden aus dem belgischen Kongogebiet. *Revue de Zoologie et de Botanique Africaines*, 30(3): 364-388, 36 figures.  
1939. Ostracoden aus dem Kenia-Gebiet, vornehmlich von dessen Hochgebirgen. *Internationale Revue der Hydrobiologie und Hydrographie*, 39:99-161, 79 figures.  
1941[1951]. Süßwasserostracoden. In E. Titschak, ed., *Beiträge zur Fauna Perus*, 1 (2):81-92, 4 figures. Hamburg: Conrad Behre-Verlag. [Reprint, 1951, in 2:77-88. Jena: Verlag Fischer.]
- Lowndes, A. G.  
1932. Report on the Ostracoda. Mr. Ohmer-Cooper's Investigation of the Abyssinian Fresh Waters (Dr. Hugh Scott's Expedition). *Proceedings of the Zoological Society of London*, 1932 (3):677-708, 6 plates.
- McKenzie, K. G.  
1966. Freshwater Ostracoda from North-Western Australia. *Australian Journal of Marine and Freshwater Research*, 17:259-279, 5 figures.  
1971a. Species List of South African Freshwater Ostracoda with an Appendix Listing Museum Collections and Some Further Determinations. *Annals of the South African Museum*, 57 (9):157-213.  
1971b. Paleozoogeography of Freshwater Ostracoda. In H. J. Oertli, ed., *Paléocéologie Ostracodes Pau 1970*, pages 207-237, 2 plates. *Bulletin Centre de Recherches Pau-SNPA*, 5, suppl.
- Müller, G. W.  
1898. Die Ostracoden. *Abhandlungen herausgegeben von der Senckenbergischen Naturforschenden Gesellschaft*, 21 (2):257-296, plates 13-19.  
1900. Deutschlands Süßwasser-Ostracoden. *Zoologica. Original-Abhandlungen aus dem Gesamtgebiete der Zoologie*, 30:1-112, 21 plates.  
1912. Ostracoda. *Das Tierreich*, 31:1-434, 92 figures. Berlin: R. Friedländer und Sohn.
- Petkovski, T. K.  
1957. Zweiter Beitrag zur Kenntnis der Ostracoden-Fauna Jugoslawiens. *Folia Balcanica, Institut de Pisciculture de la R. P. Macedoine*, 1 (9):51-56, 8 figures.
- Sars, G. O.  
1889. On Some Freshwater Ostracoda and Copepoda, Raised from Dried Australian Mud. *Christiania Videnskabs-Selskabs Forhandling*, 1889 (8):3-79, 8 plates.  
1894. Contributions to the Knowledge of the Fresh-Water Entomostraca of New Zealand as Shown by Artificial Hatching from Dried Mud. *Videnskabs-Selskabs Skrifter. 1. Mathem.-naturv. Klasse*. 1894 (5):3-59, 6 plates.  
1896. On Freshwater Entomostraca from the Neighbourhood of Sydney, Partly Raised from Dried Mud. *Archiv for Mathematik og Naturvidenskab*, 18:1-81, 8 plates.  
1924. The Freshwater Entomostraca of the Cape Province (Union of South Africa), Part II: Ostracoda. *South African Museum Annals*, 20:105-211, plates 21-25.
- Sharpe, R. W.  
1910. On Some Ostracoda, Mostly New, in the Collection of the United States National Museum. *Proceedings of the United States National Museum*, 38:335-341, 5 figures.
- Sohn, I. G.  
1950. Growth Stages in Fossil Ostracodes. *American Journal of Science*, 248:427-434, 1 figure.
- Sohn, I. G., and L. S. Kornicker  
1972a. Predation of Schistosomiasis Vector Snails by Ostracoda (Crustacea). *Science*, 175:1258-1259, 1 figure.  
1972b. *Cypretta kawatai*, a New Species of Freshwater Ostracoda (Crustacea). *Proceedings of the Biological Society of Washington*, 85 (28):313-316, 3 figures.
- Szczuchura, J.  
1971. Seasonal Changes in a Reared Fresh-Water Species, *Cyprinotus (Heterocypris) incongruens* (Ostracoda), and Their Importance in the Interpretation of Variability in Fossil Ostracodes. In H. J. Oertli, ed., *Paléocéologie Ostracodes Pau 1970*, pages 191-205, 7 figures, 1 plate. *Bulletin Centre de Recherches Pau-SNPA*, 5, Suppl.
- Thomson, G. M.  
1879. On the New Zealand Entomostraca. *Transactions and Proceedings of the New Zealand Institute*, 1878, 11:251-262, plate 11.

## Tressler, W. L.

1937. Ostracoda. *Internationale Revue der gesamten Hydrobiologie und Hydrographie*, 34 (3/5):188-207, 64 figures.
1959. Ostracoda. In W. T. Edmondson, ed., *Freshwater Biology*, 2d edition, pages 657-734, 197 figures.

## Triebel, E.

1953. Eine Fossile *Pelocypris* (Crust., Ostr.) aus El Salvador. *Senckenbergiana*, 34 (1/3):1-14, 2 plates.
1963. Die Schalenmerkmale der Ostracoden-Gattung *Oncocypris* G. W. Müller 1898. *Senckenbergiana Biologica*, 44(1):33-43, plates 7, 8.

## Vávra, V.

1895. Die von Herrn Dr. F. Stuhlmann gesammelten Süßwasser-Ostracoden Zanzibar's. *Beiheft zum Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten*, 12 (Jahrgang 1894):1-23, 9 figures.
1901. Die Ostracoden von Bismarck-Archipel. *Archiv für Naturgeschichte, Berlin*, 1 (2):179-186, plate 9.
1906. Ostracoden von Sumatra, Java, Siam, den Sandwich-Inseln und Japan. (Reise von Dr. Walter Volz). *Zoologische Jahrbücher. Abteilung für Systematik, Geographie und Biologie der Tiere*, 23(4):413-438, plates 24, 25.





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