This species was previously known only from New Guinea. The doubtful determination is given because of the sex of the specimen.

Nerthra improcera Todd, 1959, Ibidem, n. ser. 10, pt. 1:73. NEW GUINEA: NE New Guinea, Mt. Piora, 1 ㅇ.
Nerthra indica (Atkinson), 1888, Journ. Asiatic Soc. Bengal, 57:345. CHINA: Kwangtung, Chukiang, Lungtaushan, 1 b̀, 2 ㅇ․

These are the first specimens recorded from China.
Nerthra infecta Todd, 1959, Nova Guinea, n. ser., 10, pt. 1:91. NEW GUinea: NE New Guinea, Bulldog Rd., 14 km S of Edie Ck., 1 ̂; NE New Guinea, Korn Farm, W Highlands, 1ô; NE New Guinea, Sinofi, 1ô; NE New Guinea, Tuwep, Salawaket Range, 1우; NE New Guinea, Tapo (Tapu), 3 km NW of Kainantu, 1 : NW New Guinea, Vogelkop, Surwai, SW of Lake Anggi Giji, 1 웅 Neth. New Guinea, Enarotadi, Wisselmeren, 16 ; Neth. New Guinea, Wamena, 2 ㅇ․
Nerthra laticollis (Guérin-Méneville), 1843, Rev. Zool. Travaux Ined., 6: 112. NEW GUINEA: NE New Guinea, Wau, Morobe Distr., 9 of, 3 ; NW New Guinea, Ifar, Cyclops Mts., 2 ㅇ․ NEW BRITAIN: Gaulim, Gazelle Pen., 19; Upper Warangoi, Gazelle Pen., 1 우; Illugi, Upper Warangoi, Gazelle Pen., 2 6, 5 앙․
Nerthra luteovaria (Distant), 1904, Ann. Mag. Nat. Hist., (7), 14:63. AUSTRALIA: Western Australia, Robe River, 1 b ; Northern Territory, Katherine, 7 § , 7 ㅇ.

The example from Robe River is the first recorded from Western Australia.
Nerthra macrostyla Todd, 1955, Univ. Kansas Sci. Bull., 37, pt. 1(11):428. SOLOMON ISLANDS: Santa Ysabel, Tamatshi, 1 b ; San Ysabel, Horora,
 Georgia Group, Gizo I., 1 웅 Vella Lavella, Ulo Crater, 1 웅.
Nerthra macrothorax (Montrouzier), 1855, Ann. Sci. Phys. Nat. Lyon, 2:110. PHILIPPINE ISLANDS: Leyte, Palo, 1 ऊ̂.
Nerthra mixta (Montandon), 1899, Bull. Soc. Sci. Bucarest, 8(4/5):404. NEW GUINEA: NE New Guinea, Wau, Morobe Distr., 7 §̂, 15 울 Lae, 1우: NE New Guinea, Dreikikir, Sepik Distr., 1웅 Neth. New Guinea, Genjam, 40 km W of Hollandia, 29. NEW BRITAIN: Illugi, Upper Warangoi, Gazelle Pen., 1 ㅇ.
Nerthra mixtella Todd, 1959, Nova Guinea, n. ser., 10, pt. 1:85. NEW GUINEA: NE New Guinea, Purosa, 20-26 km SE Okapa, 2 $\hat{6}$; NE New Guinea, $24-26$ km, SE Okapa, 1 ô; NE New Guinea, E Highlands, Purosa, 2 $\hat{\delta}, 1$ 웅 NE New Guinea, Karimui, 1 b , 2 우; NW New Guinea, Enarotadi,


NE New Guinea, 13-20 km SE of Okapa, 1 울 NE New Guinea, Wau, Morobe Distr., 1 ㅇ.
Nerthra omani Todd, 1955, Univ. Kansas Sci. Bull., 37, pt. 1(11):422. NEW BRITAIN: near Rabaul, 1 $\begin{array}{r}\text {. } \\ \text { SOLOMON ISLANDS: } \\ \text { San Cristoval, }\end{array}$ Napagiwae, 18 $\hat{\delta}, 13$; Guadalcanal, Tambalia, 35 km W of Honiara, 1 ㅎ; San Cristoval, Bweinaniawarikiapu to Manpwena, 19; Nuna Lava, Malaita, 25 km NE of Dala, 1 ㅇ.
The male from near Rabaul, New Britain is the first specimen studied from that island.

Nerthra recta Todd, 1959, Nova Guinea, n. ser., 10, pt. 1:80. NEW GUINEA: Neth. New Guinea, Genjam, 40 km W of Hollandia, 1̂̀, 1̊; NE New Guinea, Wau, Mt. Missim, Morobe Distr., 1 ㅇ.

The specimen from Wau is doubtfully determined as this species because of the sex.

Nerthra robusta Todd, 1955, Univ. Kansas Sci. Bull., 37, pt. 1(11):429. NEW GUINEA: NE New Guinea, Wau, Morobe Distr., 36, 5 ; ; NE New Guinea, Lae, Singuawa R., 1 우; Bulolo R., 1 아.
Nerthra tasmaniensis Todd ?, 1955, Ibidem, 37, pt. 1(11):437. AUSTRALIA: New South Wales, Mt. Victoria, 1 오
Nerthra toxopeusi Todd ?, 1959, Nova Guinea, n. ser., 10, pt. 1:92. PHILIPPINE ISLANDS: Mindanao, Agusan, S Francisco, 1 오․

Because the specimen is a female, the determination must be considered uncertain, but it appears to be toxopeusi which was previously known from Buru, Ceram, and Halmahera. The only species previously known from the Philippine Islands is the very distinct, widespread species, N. macrothorax (Montrouzier).
Nerthra unguistyla Todd, 1957, Proc. Ent. Soc. Wash., 59(4):152. INDIA: Karikal, 1 î.

Falls Church, Virginia, c/o U.S. National Museum, NHB-127, Washington, D.C. 20560.

# VARGULA TSUJII, A NEW SPECIES OF LUMINESCENT OSTRACODA FROM LOWER AND SOUTHERN CALIFORNIA (MYODOCOPA: CYPRIDININAE) 

Louis S. Kornicker, and James H. Baker

Many species of Ostracoda in the subfamily Cypridininae are luminous, but no species in this subfamily have previously been described from the western coast of North America. The new species described herein, Vargula tsuiji, was observed to be luminous by a collector who gave the specimens to Professor Frederick I. Tsuji, University of Southern California, a specialist in bioluminescence, who forwarded specimens to the senior author for identification. Additional specimens were supplied by Brad Myers, J. L. Barnard, and the junior author. The new species seems to be fairly abundant in some areas along the coasts of Lower and southern California and therefore, may prove useful as a nearby source of luciferin and luciferase, the glandular secretions known to produce luminescence in Ostracoda.

The holotype and some of the paratypes have been deposited at the National Museum of Natural History, Washington, D.C.; paratypes have been deposited at the Allan Hancock Foundation, University of Southern California, Los Angeles.

A key to the known species of Vargula is included.

## Station Data and Numbers of Specimens of Vargula tsuiii

Santa Catalina Island and Californian shelf; coll. Allan Hancock Foundation R/V Velero IV: Sta. 2847; 23 June 1954; $6.3 \mathrm{mi} 182^{\circ} \mathrm{T}$ (True N) from West End Light, Santa Catalina Island; $33^{\circ} 22^{\prime} 30^{\prime \prime} \mathrm{N}, 118^{\circ} 36^{\prime} 38^{\prime \prime} \mathrm{W} ; 931 \mathrm{~m}(1$ ad. ठ) .-Sta. 3208; 7 July 1955; $4.0 \mathrm{mi} 262^{\circ} \mathrm{T}$ from Santa Monica Pier Light, $34^{\circ} 00^{\prime} 03^{\prime \prime} \mathrm{N}, 118^{\circ} 34^{\prime} 40^{\prime} \mathrm{W} ; 45.7 \mathrm{~m}$ (1 ovig. ㅇ ).-Sta. 5201; 15 August 1957; $33^{\circ} 19^{\prime} 15^{\prime \prime} \mathrm{N}, 117^{\circ} 36^{\prime} 30^{\prime \prime} \mathrm{W}$; 88.1 m ; sediment temperature $10.8^{\circ} \mathrm{C}$; orange peel grab (28.3 liters); debris (1).-Sta. 5631; 22 February 1958; $33^{\circ} 22^{\prime} 50^{\prime \prime} \mathrm{N}$, $117^{\circ} 34^{\prime} 55^{\prime \prime} \mathrm{W}$; 17.1 m ; orange peel grab ( 0.8 liters); coarse gray sand and red algae ( 1 ad . o ).-Sta. 5745 ; 16 May 1958; $33^{\circ} 34^{\prime} 47^{\prime \prime} \mathrm{N}, 118^{\circ} 08^{\prime} 17^{\prime \prime} \mathrm{W}$; 83 m ; orange peel grab (12.4 liters) (1 ovig. ㅇ ).-Sta. 5749; 16 May 1958; $33^{\circ} 36^{\prime} 10^{\prime \prime} \mathrm{N}, 118^{\circ} 15^{\prime} 25^{\prime \prime} \mathrm{W} ; 78.6 \mathrm{~m}$; orange peel grab (3.7 liters) (1).Sta. 6432; 30 September 1959; $2.3 \mathrm{mi} 327.5^{\circ}$ T from Pinos Point Light; $36^{\circ} 39^{\prime} 57^{\prime \prime} \mathrm{N}, 121^{\circ} 57^{\prime} 30^{\prime} \mathrm{W}$; 89.6 m (1).-Sta. 6435; 30 September 1959; 3.65 mi $302^{\circ} \mathrm{T}$ from Pinos Point Light; $36^{\circ} 39^{\prime} 57^{\prime \prime} \mathrm{N}, 121^{\circ} 59^{\prime} 50^{\prime \prime} \mathrm{W}$; 115.2 m (1).

Santa Catalina Island: Big Fishermans Cove, collected about 1975, by Tony Chess; probably epibenthic ( 8 , including 4 ovig. 오 and 1 ad . $\hat{0}$ ).Offshore, coll. about 1975, Tony Chess; probably epibenthic ( 2 ovig. 오,

3 juv. ).-Santa Catalina Marine Biological Station, University of Southern California, plankton net, 1975; received from F. Tsuji (1 ad. \& ).
La Jolla, California, 7 May 1968, water depth 24 m ; from body of the pomocentrid fish Chromis atrilobata; coll. E. S. Hobson (1 juv. o ).

Bahía Los Angeles, Baja California, Mexico; Sta. SI0-62-216, 21 April 1962, shore sample, reef between Isla Ventana and Isla Cabeza de Caballo, tailings of fish sample; coll. Carl L. Hubbs and party, Scripps Institution of Oceanography; received from J. L. Barnard (1 ovig. 오, 4 ad. 훙, 9 juv.).

## Cypridininae Baird, 1850

The senior author takes this opportunity to correct a couplet in a published key to the genera of Cypridininae (Kornicker, 1975:86).
17. Furcal claws 2 and 4 united with lamella Siphonostra

Only furcal claw 2 united with lamella or no furcal claws united with lamella

Skogsbergia
Vargula Skogsberg, 1920
Type-Species.-Cypridina norvegica Baird, 1860.
Key to the Species of Vargula
(Expanded from Poulsen (1962:178) and Kornicker (1975:154), but with many changes.)

1. Furca with 12 or more pairs of claws. V. hilgendorfii (Müller)

Furca with 11 or less pairs of claws.
2. No furcal claws united with lamella.

Only 2nd furcal claw united with lamella.
2nd and 4th or 2nd, 3rd and 4th furcal claws united with lamella. 5
3. Tip of 7th limb with dorsal jaw.

Tip of 7th limb with dorsal peg.
V?. danae (Brady)
4. Tip of 7th limb with dorsal peg.
V. sutura Kornicker
V. tsujii, new species

Tip of 7th limb with dorsal jaw.
5. Tusks on upper lip with prominent proximal tooth.

Tusks on upper lip without proximal tooth.
7
Dorsal jaw at tip of 7th limb bare. V. spinosa Poulsen
Dorsal jaw at tip of 7th limb with spinelike hairs.
V. spinulosa Poulsen
7. Posterior of carapace with tubelike caudal process.
V. tubulata Poulsen

Posterior of carapace with narrow caudal process.
V. dentata Kornicker
8. Seventh limb with hook-shaped process within terminal comb.
V. hamata Kornicker


Fig. 1. Vargula tsuiii, holotype, ovig. $\uparrow$, USNM 156767, length 2.12 mm : a, Complete specimen showing central adductor muscle attachments, right lateral eye and position of eggs as seen through shell; b, Joints 1-4 and proximal part of 5th joint of right 1st antenna, medial view; c, Joints 6-8 and distal part of 5th joint of right 1st

Seventh limb with dorsal jaw opposite terminal comb.
V. harveyi Kornicker and King

Seventh limb with single peg opposite terminal comb.
9. Lateral eyes absent. V. lusca Kornicker

Lateral eyes of female with 4 or 5 ommatidia. 10
Lateral eyes of female with 9 or more ommatidia. 11
10. Carapace longer than 2.8 mm ; lateral eyes of females about $1 / 2$ length of rod-shaped organ. V. antarctica (Müller)
Carapace shorter than 2.25 mm ; lateral eyes of females slightly longer than rod-shaped organ. V. stathme Kornicker
11. Height of caudal process about $2 / 3$ height of valve. V. plicata Poulsen

Height of caudal process $1 / 3$ to $1 / 2$ height of valve. 12
12. Interval between c- and d-bristles of mandibular basale not considerably larger than width of larger d-bristle. V. bullae Poulsen
Interval between c- and d-bristles several times larger than width of larger d-bristle.
13. Caudal process projecting sufficiently to form well-defined angle where dorsal edge of process joins posterior margin of valve.
V. puppis Poulsen

Caudal process very narrow, forming little or no angle with posterior margin of valve.
14. Lateral eye with 9 or 10 ommatidia. V. norvegica (Baird)

Lateral eye with 14-16 ommatidia.
V. subantarctica Kornicker

## Vargula tsuiii, new species <br> Figs. 1-6

Etymology.-The species is named for Dr. Frederick I. Tsuji, University of Southern California, who submitted some of the specimens studied.
Holotype.-USNM 156767, length 2.12 mm , ovig. $\circ$ on slides and in alcohol.

Type-locality.—Bahía Los Angeles, sta. SIO 62-216.
Allotype.—USNM 157133, length 2.21 mm , ad. ô from same sample as holotype.

Paratypes.-USNM 157134a, b, 2 ad. ̊̀, same sample as holotype; USNM 157135,1 ad. of with torn carapace, and 9 juv., same sample as holotype; Baker slide 253, valves of $\widehat{\delta}$, USC sta. 2847; Baker slide 254, ad. os ap-

[^0]pendages, USC sta. $2847 ; 1$ mounted specimen, USC sta. $6435 ; 1$ ovig. ${ }^{\circ}$, USC sta. 3208 ; 1 specimen, USC sta. 5201 ; 1 ad. $\hat{\text { o }}$, USC sta. 5631 ; 1 specimen, USC sta. $5749 ; 1$ ovig. + , USC sta. $5745 ; 1$ specimen, USC sta. 6432. Big Fisherman’s Cove, Santa Catalina Island: USNM 157136A, B, 2 ovig. ${ }^{\circ}$; USNM 157136C, 1 ad. ô; 2 ovig. if plus 3 specimens returned to Brad Myers. Off Santa Catalina Island: 1 ovig. $\&$ and 1 juv. returned to Brad Myers. USNM 152300, 1 ad. $\ddagger$ and 1 ad. $\hat{\text { o }}$, off Santa Catalina Island Marine Station; USNM 149195, 1 juv. ô, off La Jolla, California.

Description of adult female (Fig. 1-3a, b).-Carapace (Fig. la) similar in shape to that of adult male.

Infold: Bristles not counted, but distribution similar to that of adult $\hat{\delta}$; list of caudal process similar to that of adult $\hat{\delta}$.

Size in mm: USNM 156767, length 2.12, height 1.28 ; ovig. ${ }^{\circ}$, USC sta. 3208 , length 2.31 , height 1.39 ; ovig. $\circ$, USC sta. 5745 , length 2.26 , height 1.35; USNM 157136A, length 2.10, height 1.17; USNM 157136B, length 2.05, height $1.17 ; 2$ specimens, Big Fisherman's Cove, Catalina Island, length 2.09, height 1.16, and length 2.03, height 1.16 .

First antenna (Fig. 1b, c) : First joint bare; 2nd joint with short spines forming rows; 3rd joint short, with 2 bristles ( 1 ventral, 1 dorsal) and few short medial spines; 4th joint elongate, with 2 bristles, 1 ventral, 1 dorsal; 5 th joint about $2 / 3$ length of 4 th; sensory bristle of 5 th joint with 8 long proximal filaments, 2 shorter and more slender distal filaments, and bifurcate tip; medial bristle of 6th joint short, bare. Seventh joint: a-bristle about same length as bristle of 6th joint, with short marginal spines; bbristle about $1 / 3$ longer than a-bristle, with 5 or 6 short marginal filaments; c-bristle longer than sensory bristle of 5 th joint, with 9 marginal filaments (some pectinate) and bifurcate tip. Eighth joint: d- and e-bristles bare, about twice length of b-bristle; f-bristle about $3 / 4$ length of $c$-bristle, with about 5 marginal filaments (some pectinate) and bifurcate tip; g-bristle longer than c-bristle, with 9 marginal filaments (some pectinate) and bifurcate tip.

Second antenna: Protopodite with short medial bristle (Fig. 1d). Endopodite 3 -jointed (Fig. 1d): First joint with 4 proximal bristles (1 long, 3 short) and 1 very long distal bristle; 2nd joint elongate with 1 short distal bristle; 3rd joint short, separated from 2nd joint by weak suture, with long terminal bristle with blunt tip. (Endopodite illustrated in Fig. 1d bears fine hairlike filaments interpreted as a foreign growth; this growth was observed on many appendages of the specimen.) Exopodite: First joint bare; bristle of 2 nd joint reaching 8 th or 9 th joint, with 11 stout ventral spines; natatory bristles without spines; 9th joint with 4 bristles of which short dorsal bristle bears a few short faint spines, remaining long bristles with natatory hairs but no ventral spines; basal spines of joints $3-8$ increasing in size on distal joints; basal spine of 8 th joint extending past distal end of


Fig. 2. Vargula tsuiii, holotype, ovig. ㅇ, USNM 156767: a, Left maxilla, posterior view (exopodite and some bristles of basale not shown); b, Endites and exopodite of right 5th limb, posterior view; c, Right 6th limb, medial view; d, Anterior of body showing medial eye, rod-shaped organ, anterior process, and upper lip; e, Right lateral eye, anterior to right.


Fig. 3. Vargula tsuiii, holotype, ovig. ㅇ, USNM 156767: a, 7th limb; b, Tip of 7th limb shown in "a". Adult $\widehat{0}$, paratype from USC sta. 5631, length 1.73 mm : c, Central adductor muscle attachments of right valve, outside view, anterior to right. Adult $\hat{\mathbf{o}}$, allotype, USNM 157133 , length 2.21 mm : d, Complete specimen showing position of

9th joint; lateral bristle of 9th joint about same length as basal spine of 8th joint.

Mandible (Fig. le, f): Coxale endite well developed, spinous (terminal spine stouter than others); basal bristle well developed. Basale: ventral margin with 2 a-bristles ( 1 long, 1 very short), 1 very short b-bristle (about same size as short a-bristle), 2 c-bristles ( 1 short, bare, and 1 long with short marginal spines), and 2 long d-bristles (proximal of these ${ }^{1 / 3}$ to $2 / 3$ length of distal bristle and with short marginal spines; remaining bristle with long marginal spines); dorsal margin with 3 bristles ( 1 subterminal, 2 terminal; 1 of terminal bristles about same length as subterminal bristle, other terminal bristle about twice length of other; both terminal bristles with short marginal spines). Exopodite about $3 / 4$ the length of dorsal margin of 1st endopodite joint, with 2 subterminal bristles (proximal bristle about twice length of other). Endopodite: First joint with 4 ventral bristles ( 1 of these minute, 1 short, 2 long); ventral margin of 2 nd joint with 2 short, single, ringed bristles, 1 short, ringed, subterminal, medial bristle, and a subterminal, lateral process with rounded tip reaching past distal end of 3rd joint; dorsal margin of 2 nd joint with 5 long bristles, 1 medium bristle, and 5 short bristles ( 1 of these with long stout spines along both margins); medial side of 2 nd joint with short faint spines forming short rows near dorsal margin. End joint with total of 7 claws and bristles (a pair of medial bristles near ventral margin, ventral of these minute; a short ventral bristle with bulbous base and ringed, narrow, distal part, possibly with opening at tip; 1 lateral and 1 medial claw near dorsal margin, both slender; 1 middle claw with broad base bearing medial teeth and 1 short, lateral bristle near dorsal margin).

Maxilla (Fig. 2a): Coxale with stout plumose bristle and dorsal fringe. Endite I with about 9 spinous bristles; endite II with about 4 spinous terminal bristles; endite III with about 6 spinous bristles, 1 proximal, 5 distal. Basale with 2 short bristles along distal margin. Exopodite with 3 bristles of about same length (proximal and posterior, terminal bristle plumose). Endopodite: First joint with spines along dorsal margin, a terminal tooth on inner margin having 2 teeth, 1 alpha-bristle with few long hairs, and 1 beta-bristle with spines along inner margin; end joint with 3 a-bristles with teeth along anterior margins, 2 b -bristles (anterior of these with spines along posterior margin, other with spines along anterior margin), 3 c -bristles

[^1](anterior of these minute, remaining 2 with spines along anterior margins), and 3 d-bristles with spines along anterior margins.

Fifth limb (Fig. 2b): Epipodial appendage with about 48 bristles. Endite I with 6 spinous bristles; endite II with 5 spinous bristles; endite III with 5 or 6 spinous bristles. Exopodite: main tooth of 1st joint with proximal smooth peg and 6 larger pectinate teeth; a pectinate bristle present near proximal peg of main tooth; 2nd joint with posterior bristle with long proximal hairs, about 13 terminal pectinate bristles, and 1 long spinous anterior bristle; inner lobe of 3rd joint with 1 short bristle with long proximal hairs and 1 long bristle with short, faint, marginal spines; outer lobe of 3rd joint with 2 bristles with short marginal spines; 4th and 5th joints fused, with total of 2 bristles with short marginal spines; joints 3-5 with abundant long hairs.

Sixth limb (Fig. 2c) : Three short bare bristles in place of epipodial appendage. Endite I small, with 2 short medial bristles and long terminal bristle; endite II with 3 short medial bristles and 2 long terminal bristles; endite III with 1 medial bristle and 3 terminal bristles (middle bristle short); endite IV with 1 medial bristle and 1 terminal bristle. End joint with 6 spinous anterior bristles separated by space from 1 short spinous bristle and 2 longer, plumose, posterior bristles; limb hirsute.

Seventh limb (Fig. 3a, b) : Comb side with 6 distal and 2 to 4 proximal bristles; peg side with 5 distal and 4 proximal bristles; each bristle with up to 5 bells and without marginal spines; comb with $10-12$ short squaretipped teeth (4-6 on each side), and 9 longer alate middle teeth; a single smooth peg present opposite comb.

Furca: Same as that of adult male described herein.
Medial eye and rod-shaped organ (Fig. 2d) : Medial eye pigmented; rodshaped organ short with more-or-less rounded tip.

Lateral eye: Pigmented, about twice diameter of medial eye, with about 19 ommatidia, not all ommatidia shown in illustration (Fig. 2e).

Genitalia: Consisting of 2 sclerotized oval rings, each with short lobe extending ventrally; 1 ring on each side of body anterior to furca.

Upper lip (Fig. 2d) : Similar to that of adult male described herein.
Eggs: USNM 156767-8; specimen from USC sta. 5745-8; USNM 157136A-8; USNM 157136B-9; specimen from Big Fishermans Bay, Catalina Island, returned to Brad Myers-10.

Description of adult male (Fig. 3c-l, 4-6).-Carapace elongate with convex dorsal and ventral margins, prominent caudal process and deep incisur (Fig. 3d-h ); anterior margin of rostrum evenly rounded; surface of valves smooth.

Infold (Fig. 3e, g) : Rostral infold with 10-13 double bristles forming row parallel to anterior margin of rostrum and 1 double bristle proximal to row; 2 bristles present at inner end of incisur; anteroventral and ventral


Fig. 4. Vargula tsuiii, paratype, Baker slide 254 from USC sta. 2847: a, Joints 1-4 and proximal part of 5 th joint of right 1st antenna, lateral view; b, Joints $6-8$ and distal part of 5th joint of right lst antenna, lateral view; c, Endopodite and distal part of protopodite of left 2nd antenna.
infold with 23-26 closely spaced double bristles followed by 6 short widely spaced bristles; infold of caudal process with list having minutely crenulate posterior edge; about 13 minute bristles present anterior to crenulate edge of list; about 10 minute bristles or processes present close to outer edge of caudal process.

Central adductor muscle scars: Consisting of 15-19 oval scars (Fig. 3c).
Size in mm: USNM 157133, length 2.21, height 1.21; USNM 157134a, length 2.20 , height 1.27 ; USNM 157134 b , length 1.66 , height 0.90 ; specimen, USC sta. 5631, length 1.73, height 0.96; USNM 157136C, length 1.73, height 0.97.

First antenna (Fig. 4a, b): Joints 1-4 similar to those of ad. 9 ; sensory bristle of 5th joint with 9 long proximal filaments, otherwise similar to that of ad. + ; 6th joint similar to that of ad. + . Seventh joint: a-bristle short, bare; b-bristle with short proximal process with broad rounded base and large distal disc; stem of b-bristle with 2 filaments with minute proximal tooth and 5-7 minute discs; c-bristle with proximal process similar to that on b-bristle but with somewhat larger disc; stem of c-bristle with 2 filaments with minute proximal tooth and 5 minute discs, other filaments bare except for terminal spine. Eighth joint: bristles in general similar to those of ad. ${ }^{\text {f. }}$

Second antenna (Fig. 4c) : Similar to that of ad. $\boldsymbol{q}$.
Mandible (Fig. 5a): Coxale endite similar to that of female, but missing from illustrated limb (Fig. 5a). Basale, exopodite, 1st and 3rd endopodial joints similar to those of adult female; 2nd endopodite joint similar to that of $q$ except 2 single bristles of ventral margin closer together on illustrated right limb (Fig. 5a), left limb of that specimen and both limbs of another specimen examined had bristles separated as on joint of $\circ$.

Maxilla and 5th limbs (Fig. 5b, c) : Similar to those of ad. 9.
Sixth limb (Fig. 5d): Four short bare bristles in place of epipodial appendage. Endite I with 2 short medial bristles and 2 long terminal bristles; endite II with 3 short medial bristles and 2-4 long terminal bristles; endite III with 1 medium length medial bristle and 3 terminal bristles (middle bristle short); endite IV with 1 medial and 1 terminal bristle. End joint with 5 spinous anterior bristles separated by a space from 1 short bristle with long proximal and short distal spines, and 2 long plumose posterior bristles; limb hirsute.
Seventh limb (Fig. 6b ) : Comb side with 6 or 7 bristles, 4 or 5 distal, 1-3 proximal; peg side with 9 bristles, 4 or 5 distal, 4 or 5 proximal, each bristle with up to 6 bells and without marginal spines; comb and peg similar to those of ad. ㅇ.

Furca (Fig. 3k): Each lamella with 9 claws; claw 2 fused to lamella, remaining claws separated from lamella by suture; claws with 1 or 2 rows


Fig. 5. Vargula tsuiii, paratype, Baker slide 254 from USC sta. 2847: a, Right mandible, medial view (not all marginal spines on bristles shown); b, c, Distal parts of 5th limbs; d, Right 6th limb, medial view.
of teeth along posterior margin; claws 1-4 with faint spines along anterior margin.

Medial eye and rod-shaped organ (Fig. 3i): Medial eye and rodshaped organ similar to that of adult female except rod-shaped organ with triangular tip.


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Cypridininae)." Proceedings of the Biological Society of Washington 90, 218-231.

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[^0]:    $\leftarrow$
    antenna, medial view; d, Endopodite and distal part of protopodite of right 2nd antenna, lateral view; e, Coxale endite and some bristles on ventral margin of basale of right mandible, medial view; f, 3rd endopodial joint and distal part of 2 nd endopodial joint of left mandible, medial view.

[^1]:    $\leftarrow$
    right lateral eye; e, Anterior of left valve, inside view; f, Anterior of right valve, outside view; $g$, Posterior of left valve, inside view; h, Posterior of right valve, outside view; i, Anterior of body showing medial eye, rod-shaped organ, anterior process and upper lip; j, Right lateral eye, anterior to right. Adult ô, paratype, Baker slide 254 from USC sta. 2847: k, Left lamella of furca, lateral view; l, Upper lip viewed from right side.

