

NEW DESCRIPTIONS

EXISTENCE OF THE ORDER BATHYNELLACEA (CRUSTACEA, SYNCARIDA) IN SOUTH ASIA: A NEW SPECIES OF GENUS *HABROBATHYNELLA* SCHMINKE 1973, FROM RIVER PENNAR, SOUTH INDIA¹Y. RANGA REDDY²¹Accepted February 2001²Department of Zoology, Nagarjuna University, Nagarjunanagar 522 510, Andhra Pradesh, India.

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A new species of the genus *Habrobathynella* Schminke 1973, is described from River Pennar near Cuddapah, South India. Named *Habrobathynella schminkei*, the new species belongs to Family Parabathynellidae. It differs from its two known Madagascan congeners, *H. milloti* and *H. jeanneli* (Delamare and Paulian 1954) in several morphological details, namely the presence of one ventral plumose seta at distal inner angle of sympodite of uropod; two strongly unequal setae on the basal segment of maxilla; much elongated endopodite on uropod; absence of seta on third endopodite segment of thoracopods I-VII. A key to the identification of the three species of *Habrobathynella* is also given.

This is the first report of the Order Bathynellacea in South Asia, while the record of *Habrobathynella* in South India fills the vast gap in the distribution range of the Family Parabathynellidae, and lends support to the East Asian origin of this family.

Key words: *Habrobathynella schminkei* sp. nov., Bathynellacea, Parabathynellidae, taxonomy, India

INTRODUCTION

Bathynellacea are minute, eumalacostracan crustaceans, usually inhabiting the mesopsammon, i.e. the interstitial water in the spaces between sand grains of lakes, rivers, streams and wells. The only exceptions are two species living as relicts in Lake Baikal at a depth of 100-1440 m (Bazikalova 1954) and one species in an Australian marine beach (Schminke 1972). The living Bathynellacea represent one of the oldest groups of freshwater carcinofauna, whose ancestors inhabited the sea during the Carboniferous period, or even earlier (Schminke 1974). Today bathynellaceans are known from all over the world, except Antarctica. It is paradoxical that despite the fact that the first Asian species was recorded from a cave in Malaysia as far back as 1929 (Sars 1929), and that the centre of evolution of Bathynellacea is East Asia, practically nothing is known of this group from the whole of the South Asian region. There are, however, several published reports from other parts of Asia (see Lopretto and Morrone 1998).

The Order Bathynellacea is comprised of two families: Bathynellidae and Parabathynellidae. Schminke's (1986) survey has revealed more than 150 known species belonging to 42 genera in these two families.

This paper gives the description of a new species of the genus *Habrobathynella* Schminke 1973, belonging to the Family Parabathynellidae. While revising this family, Schminke (1973) established the above genus for two species, both from Madagascar: *Habrobathynella milloti* (Delamare and Paulian 1954), the type species, and *Habrobathynella jeanneli* (Delamare and Paulian 1954). *Habrobathynella*

schminkei sp. nov. is the first representative of the Order Bathynellacea from South Asia, as well as of the genus *Habrobathynella* from Asia.

It is hoped that this fortuitous discovery of *H. schminkei* sp. nov. will be a precursor to studies on the possibly rich biodiversity of the neglected hyporheic and phreatic environment of South Asia. This hypogean habitat is a promising place not only for biologists to look for new insights into adaptation and speciation (Barr 1968, Rouch 1986), but for geologists as well to delve into the evolutionary history of the earth.

METHODS

The sampling site was River Pennar at Chennur, c. 15 km from Cuddapah town, South India. About ten core samples were collected at various points of the submerged riverbank, overlaid with a loose deposit of fine sand. A rigid PVC tube (length 70 cm, diameter 4 cm) was used for coring. The cores taken from the sediment surface to a depth of 20-30 cm were pooled into a bucket and vigorously stirred with the habitat water. The supernatant was filtered through bolting silk plankton nets (mesh size 70 µm). The filtrate was fixed in 20% alcohol and then preserved in 70% alcohol. Specimens were dissected in glycerol, using a stereoscopic binocular microscope at 90x; body parts were mounted under cover slips and sealed with Araldite. Measurements were made with an eyepiece micrometer, and drawings made with Camera Lucida on a compound microscope at magnifications of 150x, 270x, 450x 675x or 1000x. Appendages were largely dissected

before drawing, while lateral views were drawn *in situ*. Body length was measured from the anterior margin of the head to the end of the caudal furca.

KEY TO THE SPECIES OF THE GENUS *Habrobathynella*

- 1 Sympodite of uropod with a seta at distal inner corner; pleotelson setae shorter than caudal furca *H. schminkei* sp. nov.
- Sympodite of uropod without seta at distal inner corner; pleotelson setae as long as caudal furca 2
2. Antennule elongate, apophysis on segment 4 shorter than segment 5; exopodite of uropod with spinous projection at inner terminal corner *H. milloti*
- Antennule short, apophysis on segment 4 reaching end of segment 5; exopodite of uropod without spinous projection *H. jeanneli*

Systematic position

Subclass Eumalacostraca Packard 1892

Superorder Syncarida Packard 1885

Order Bathynellacea Chappuis 1915

Family Parabathynellidae Noodt 1965

Habrobathynella schminkei sp. nov. (Figs 1-4)

Type locality and material examined: River Pennar at Chennur, c. 15 km from Cuddapah town (14° 28' N, 78° 49' E), South India, 45 males, 60 females, 15 juveniles. 18.i.2000. Coll. M.V.S. Kishore Kumar.

Holotype (female), allotype (male), paratypes (10 males, 10 females), all undissected, were deposited in the Natural History Museum, London. Regn. nos.: Holotype: 2002.5, allotype 2002.6, paratypes 2002.7-26. Dissected and some undissected paratypes (25 males, 40 females) are in the author's collection.

Other locality: River Godavari at Rajahmundry town (16° 9' N, 81° 47' E), South India. Only 2 females from fine sand at the middle of the river basin, water depth c. 1.25 m, 29.i.1999. Coll. Y. Ranga Reddy.

Description of adults

Adult female: Total length: Holotype 1.04 mm; paratypes 0.80-1.04 mm, mean 0.90 ± 0.06 mm ($n = 55$). Body elongate, 13 times longer than maximum width. In lateral view, abdominal segments wider than thoracic segments (Fig. 1). In dorsal view, body vermiform uniformly narrow. Head 27.7% longer than wide, and about as long as first 2 thoracic segments combined. Anal operculum protruding, concave medially, sometimes extending to end of caudal furca (Fig. 2d), in lateral

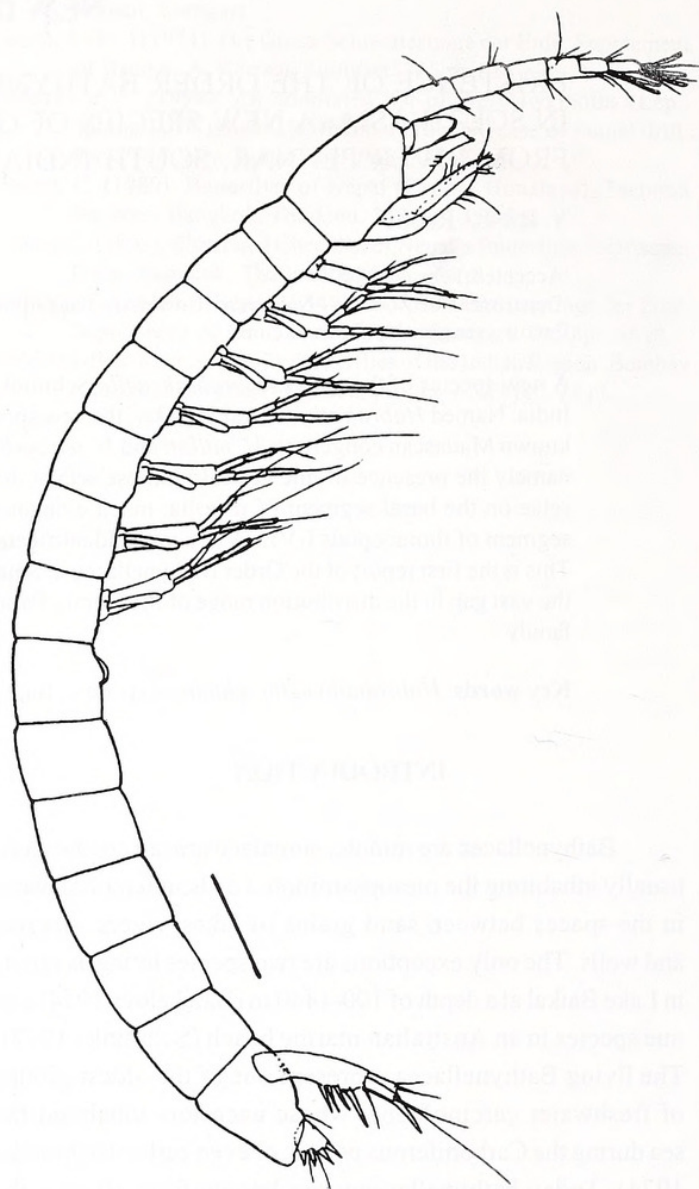


Fig. 1: *Habrobathynella schminkei* sp. nov., adult female, holotype, lateral view. Scale = 100 μ m

view, posterodorsal end variable in shape (Figs 2e-j). Pleotelson with 1 seta on either side at base of caudal furca; seta bare, shorter than caudal furca.

Caudal furca only slightly longer than maximum width, distal part expanded and rounded, with 2 terminal and 2 inner, pointed, serrulate spines, and 2 dorsal setae; terminal spines longer than inner ones. Furcal organ small, ventral.

Antennule (Fig. 2k) 6-segmented, 34.5% longer than head; first segment thickest, the remainder becoming progressively thinner. Length of first 3 segments distinctly greater than that of last 3; apophysis of segment 4 slender, overreaching only mid-length of next segment. No sexual dimorphism. Segments 5 and 6 with 2 and 3 aesthetascs, the former somewhat longer. Setation, as observed under optical microscope, illustrated in Fig. 2k.

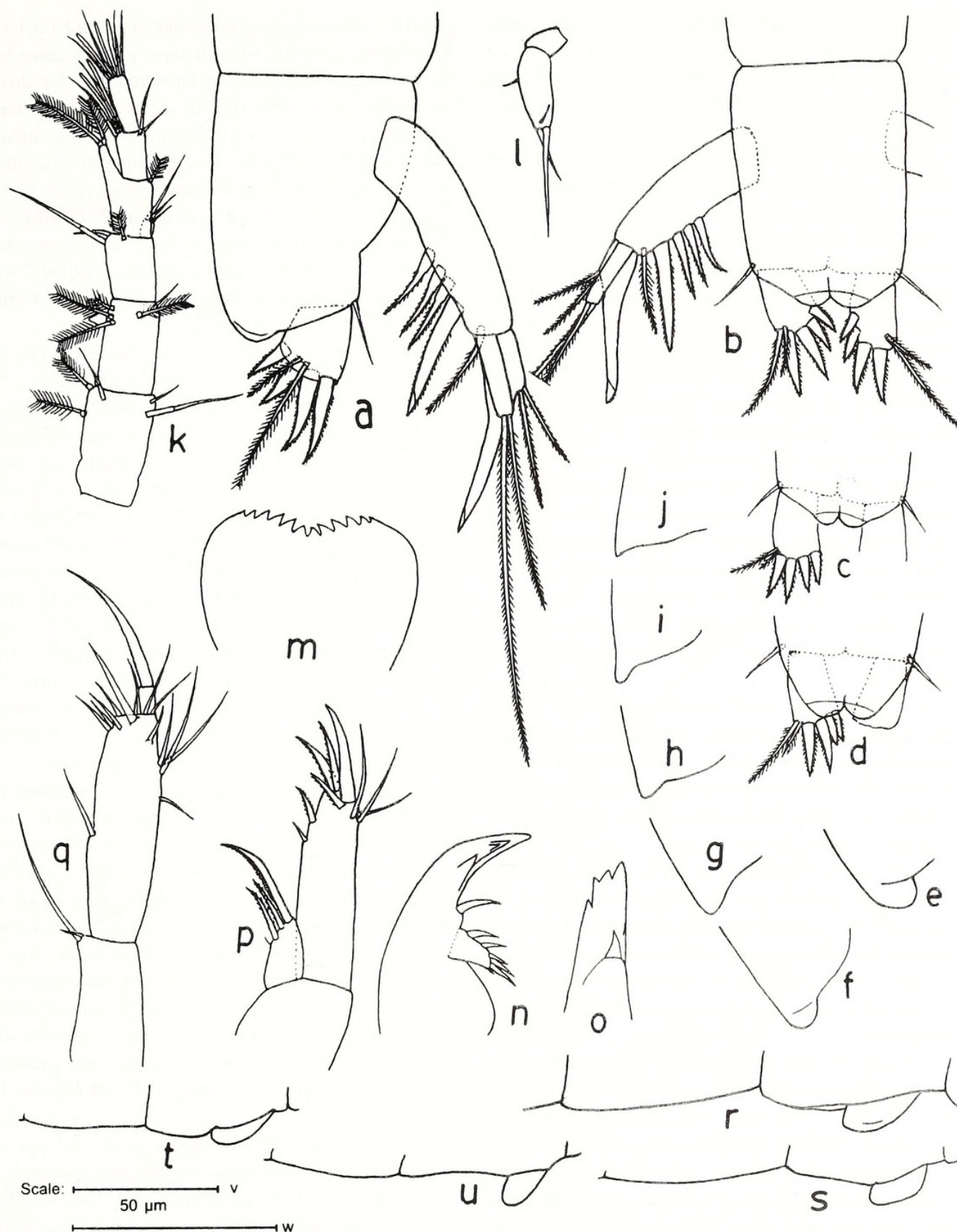


Fig. 2: *Habrobathynella schminkei* sp. nov., adult female. a. pleotelson, lateral; b. pleotelson, dorsal (right uropod omitted); c. posterior part of pleotelson, dorsal (right caudal furca omitted); d-j. posterior end of pleotelson, lateral view; k. antennule dorsal view; l. antenna; m. labrum, ventral view; n. mandible, lateral view; o. mandible, *pars incisiva* (with proximal tooth), frontal view; p. maxillule; q. maxilla; r-u. thoracic segment 8 and abdominal segment 1, lateral view. Scale: v (for figures a-k, r-u) = 50 µm; w (for figures l, m-q) = 50 µm.

Antenna (Fig. 2l) small, 2-segmented; proximal segment much smaller than distal one and unarmed; distal segment 2.5 times as long as wide, with 2 unequal terminal setae, 1 small subterminal seta on dorsal surface and 1 similar seta on outer proximal margin.

Labrum (Fig. 2m) dentate margin somewhat vaulted on either side, bearing 10 main, nearly uniform, pointed teeth and 1 smaller tooth on each side.

Mandible (Figs 2n, o) distal part of *pars incisiva* with 4 unequal teeth, distal tooth relatively large; proximal tooth large, curved and pointed. *Pars molaris* developed into somewhat pyriform outgrowth, carrying 2 isolated, curved teeth on inner margin and 3 straight pointed, unequal teeth in a group at proximal end; also, 1 denticle occurring at outer proximal corner, all teeth smooth, articulate and apparently without setules. Palps completely absent.

Maxillule (Fig. 2p) consisting of 2 endites; proximal endite small, elongately oval, carrying 1 long, thick, falcate, terminal spine with finely serrulate inner margin, 2 small, equal setae, and 1 setule on subterminal inner margin. Distal endite cylindrical, 2.5 times as long as proximal endite and with 4 terminal claws, distal one large and smooth, others with serrulate margins; also, 2 unequal spines occurring on subterminal inner margin and 3 setae on subterminal outer margin.

Maxilla (Fig. 2q) 3-segmented; basal segment 1.7 times as long as wide, with 2 strongly unequal setae on small protuberance at distal inner corner. Second segment nearly twice as long as basal segment and armed with 13 setae, and 1 straight spine at distal inner corner. Third segment small, oval, carrying 1 stout claw and no setae.

Thoracopods I-VII (Figs 3a-g) 7 pairs of well-developed thoracopods, gradually increasing in size from pairs I to III, last 5 pairs of nearly similar size; well-developed, biarticulate, club-shaped epipodite on pairs II-VII, at least 0.7 times as long as basis. On all thoracopods, coxa with distinct conical projection at distal inner border, and basis with 1 weak seta at similar position.

Thoracopod I (Fig. 3a) short, exopodite 2-segmented, 0.7 times as long as endopodite; segment 1 only slightly longer than segment 2 and with 2 short, almost equal, plumose setae, 1 dorsal, 1 ventral; segment 2 with 2 terminal setae, outer one plumose and slightly shorter than spiculated inner one; ctenidia lying at base of inner seta. Endopodite 4-segmented, segment 1 about half of segment 2 and with 1 weak seta at distal inner corner; segment 2 longest with 1 plumose seta at distal outer corner; third segment unarmed; segment 4 shortest, rectangular, with 2 unequal, smooth, terminal claws.

Thoracopods II-VII (Figs 3b-g): Exopodite 2-segmented,

about 0.8 times as long as endopodite; segment 1 1.3-1.5 times longer than segment 2, with 2 unequal plumose setae, ventral one as long as segment 2 on Thoracopod II, but distinctly shorter on Thoracopods III-VII; segment 2 with 2 terminal, unequal setae, outer one plumose, inner one spiculated; ctenidia at base of inner seta. Endopodite 4-segmented, segment 1 short, unarmed; segment 2 longest and with 1 outer plumose seta, extending beyond segment 4 and also with ctenidia at distal inner corner and spinules on inner margin, except for a short distance proximally; segment 3 without seta, but with ctenidia as on segment 2; segment 4 smallest, rounded, with 1 terminal claw.

Thoracopod VIII (Fig. 2r-u) relatively large, undifferentiated, plate-like or somewhat crescentic.

Uropod (Figs 2a, b): Sympodite nearly 4 times as long as wide, bearing 4 spines, and 1 seta on inner distal margin; distal spine almost straight, serrulate, distinctly stouter and 29% longer than others; other spines equal in size, setiform, with proximal fourth slightly dilated, beyond which lateral margins serrulate; proximal spine generally curved anteriorly. Exopodite cylindrical, 4 times longer than wide, measuring 34% of sympodite length and carrying 2 terminal, unequal, plumose setae. Endopodite falcate, reaching 86% of sympodite length; distal inner margin serrulate; 2 unequal, relatively short, plumose setae at proximal fourth of outer margin.

Adult male: Total length: allotype 0.96 mm, paratypes 0.72-0.96 mm, mean 0.83 ± 0.07 mm ($n = 40$). Body and all appendages except Thoracopod VIII as in female.

Thoracopod VIII (Figs 3h-j) large, subglobular and longer than wide. Outer lobe conical, apparently smooth, defined at base and blunt apically. Dentate lobe large, concave at mid-length, longer than inner lobe, with 2-3 rows of fine denticles along free margin and also a group of additional denticles at anterior corner (Fig. 3j); a large, somewhat crescentic lobe adnate to anterior half of dentate lobe, seen clearly in latero-external view. Inner lobe linguiform in rostral view. Basipodite triangular, ending in pointed hook and carrying 1 lateral seta. Two tiny triangular lobes of slightly unequal size, probably representing exo- and endopodites, lying close to each other at distal angle of basipodite below the terminal hook.

Description of juveniles: In all, 14 juveniles, representing only two distinct instars, were recorded.

Instar I: Sexually undifferentiated. Total length 0.58-0.65 mm, mean 0.61 ± 0.02 mm ($n = 6$). Body form as in adult, 12 times longer than maximum width. Abdominal segments wider than thoracic segments. Head 26.5% longer than wide. Antennule 32.5% longer than head. Body segmentation and various details of cephalic appendages and caudal furca as in adult, but differing in the following respects:

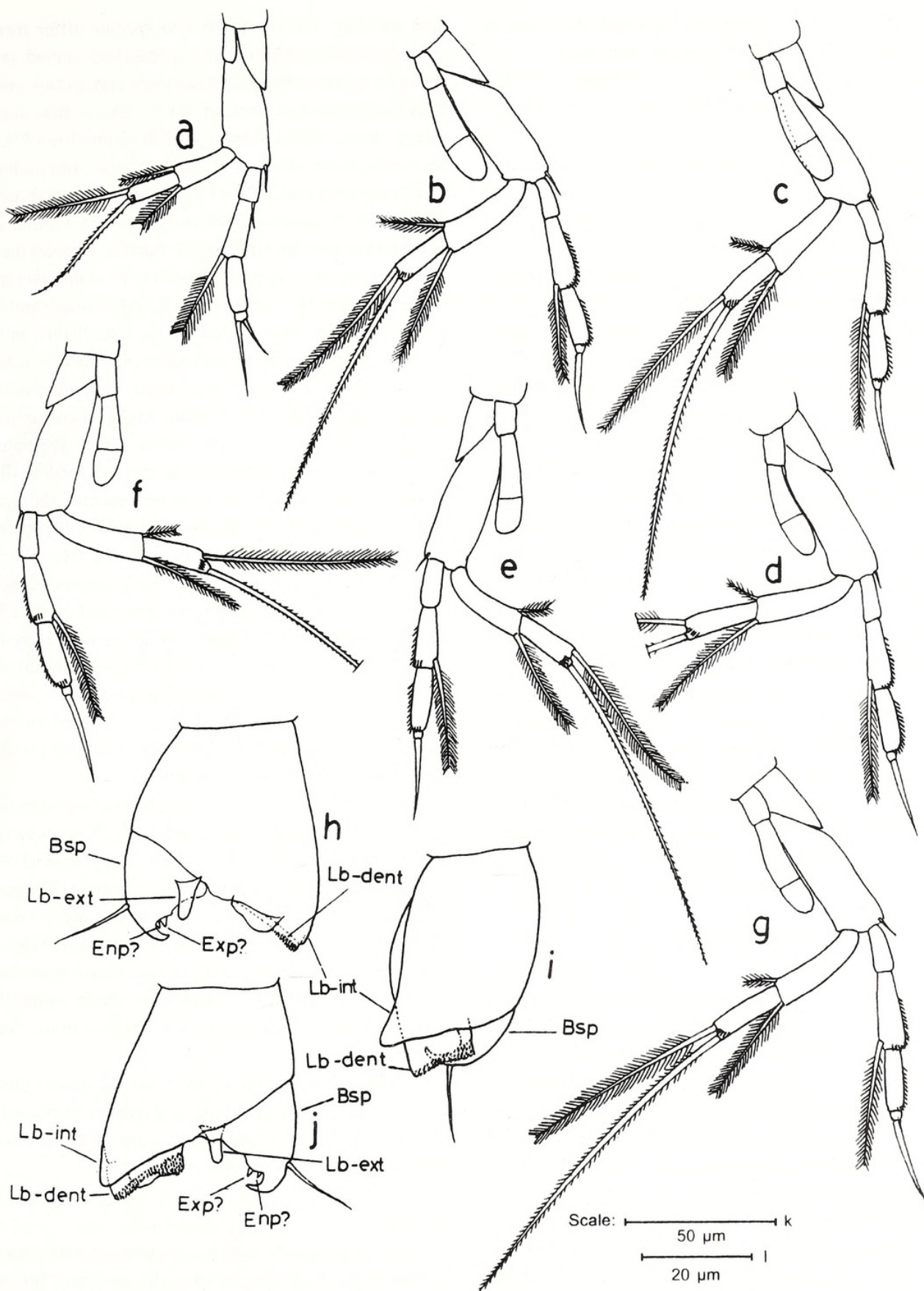


Fig. 3: *Habrobathynella schminkei* sp. nov., adult female, a-g, thoracopods I-VII, respectively. Adult male, h-j, Thoracopod VIII (Bsp = basipodite or basis; Lb-ext = external lobe; Lb-int = internal lobe; Lb-dent = dentate lobe; Exp = exopodite; Enp = endopodite): h, latero-external view; i, rostral view; j, latero-internal view.

Scale: k = 50 µm (for figures a-g); l = 20 µm (for figures h-j)

1. Sympodite (Fig. 4a) has only 3 spines, distal one of which is distinctly large and 26% longer than others.

2. Thoracopods I-IV (not illustrated) are adult-like; last 4 thoracic segments have rounded sternum (in lateral view, Fig. 4c), the thoracopods V-VII being absent.

Abnormality: In one specimen, the right caudal furca with 5 spines (Fig. 4b).

Instar II: Sexually differentiated, 7 males, 2 females, Total length of male 0.62-0.81 mm, mean 0.72 ± 0.06 mm ($n = 7$); of female 0.63-0.70 mm. Body and all appendages except thoracopods V-VII (Figs 4d-f) invariably bent posteriorly unlike thoracopods I-IV. Endopodite unsegmented, 0.7 times as long as basis; basis without inner seta. Thoracopods V and VI equal in size, Thoracopod VII somewhat longer. Exopodite cylindrical, shorter than endopodite, with 2 unequal terminal setae. Endopodite unsegmented, unarmed.

Thoracopod VIII (Fig 4g): Basipodite fused to protopodite and ending in large, sharply incurved hook-like spinous process; lateral seta absent. Outer lobe well-developed, conical in form. Dentate lobe undifferentiated, smooth, shorter than inner lobe. Exo- and endopodites not discernible.

Population variation: In the adults, the anal operculum varies widely in both sexes, and a similar trend is noticed in Thoracopod VIII female also. In one specimen, three aesthetascs were noticed on the fifth antennular segment – perhaps an abnormality. No variation is apparent in the number of spines borne by the sympodite of uropod.

Etymology: The new species is named in honour of Prof. H.K. Schminke, C.V.O. Oldenburg University, Germany, for his significant contributions to the study of Bathynellacea.

DISCUSSION

Schminke (1973) characterized the genus *Habrobathynella* as follows: antenna 2-segmented; labrum strongly vaulted, with 8 main teeth; mandible having, in place of "Borstenlobus", an outgrowth bearing 5 teeth. Maxilla 3-segmented, prehensile. Antennule 6-segmented, penultimate segment with 2 aesthetascs. Thoracopods with 2-segmented exopodite. Sympodite of uropod with a row of dissimilar spines, distal spine being thicker and longer.

The specimens under study closely fit the generic diagnosis. *Habrobathynella schminkei* sp. nov. appears to be somewhat closer to *H. milloti* than to *H. jeanneli*, as evident, *inter alia*, from the following features: antennules elongate, and apophysis of segment 4 shorter than the next segment; maxillule with six claws on distal endite; maxilla carrying two claws; setae on endopodite of uropod shorter

than its tooth. However, the two species differ from each other as follows: labrum of new species less vaulted, proximal endite of maxillule bearing only three claws (two small, one large) and one setule, instead of four claws (three small, one large). In the uropod, distal spine on sympodite 44% shorter than endopodite (30% in *H. milloti*), exo- and endopodites constitute 34% and 86% of sympodite length respectively (42% and 65%, in *H. milloti*) and exopodite without spinous projection at inner terminal corner. Further, whereas the female Thoracopod VIII is well developed in *H. schminkei* sp. nov., it is "completely absent" in *H. milloti* (Delamare and Paulian 1954). The male Thoracopod VIII is also distinct in the two species. Its inner lobe in latero-internal view is triangular, reaching almost the same level as the basipodite in the new species, whereas it is rounded and higher than basipodite in *H. milloti* (see Delamare and Serban 1974); the nature and arrangement of denticles on the dentate lobe is different between the two taxa. Also, in the new species, the exopodite is much reduced in size and the endopodite (?) represented by a tiny triangular projection instead of a seta.

H. schminkei sp. nov. can be easily separated from both of its congeners by the following principal criteria: (i) one ventral plumose seta present at distal inner angle of sympodite of uropod; (ii) two strongly unequal setae on basal segment of maxilla; (iii) endopodite of uropod much elongated; (iv) female Thoracopod VIII large; (v) third endopodite-segment of thoracopods I-VII without seta; and (vi) setae on pleotelson shorter than caudal furca.

H. schminkei sp. nov. is also clearly distinguishable by some of its mandibular characters. *Pars molaris* as an outgrowth has five teeth in all, besides a proximal denticle, instead of only four teeth without a denticle. The proximal three teeth along with the denticle are more compactly arranged in a group than in the other taxa, and are also devoid of setules. The proximal tooth of *pars incisiva*, occurring at a somewhat higher level than *pars molaris*, cannot be said to be uniformly fused with *pars molaris* as in the other two species.

The author is of the opinion that the shorter pleotelson setae and the slight mandibular differences displayed by the new species are of consequence only at the species level [cf Schminke's (1973) generic diagnosis].

Habitat

The type locality of *H. schminkei* sp. nov. was rich in detritus at the time of sampling; the sand was fine and the current velocity moderate. The co-occurring fauna included: *Parastenocaris* sp. which was fairly common, followed by *Parastenocaris curvispinus* Enckell. Other copepods were represented by stray specimens of *Onychocamptus*

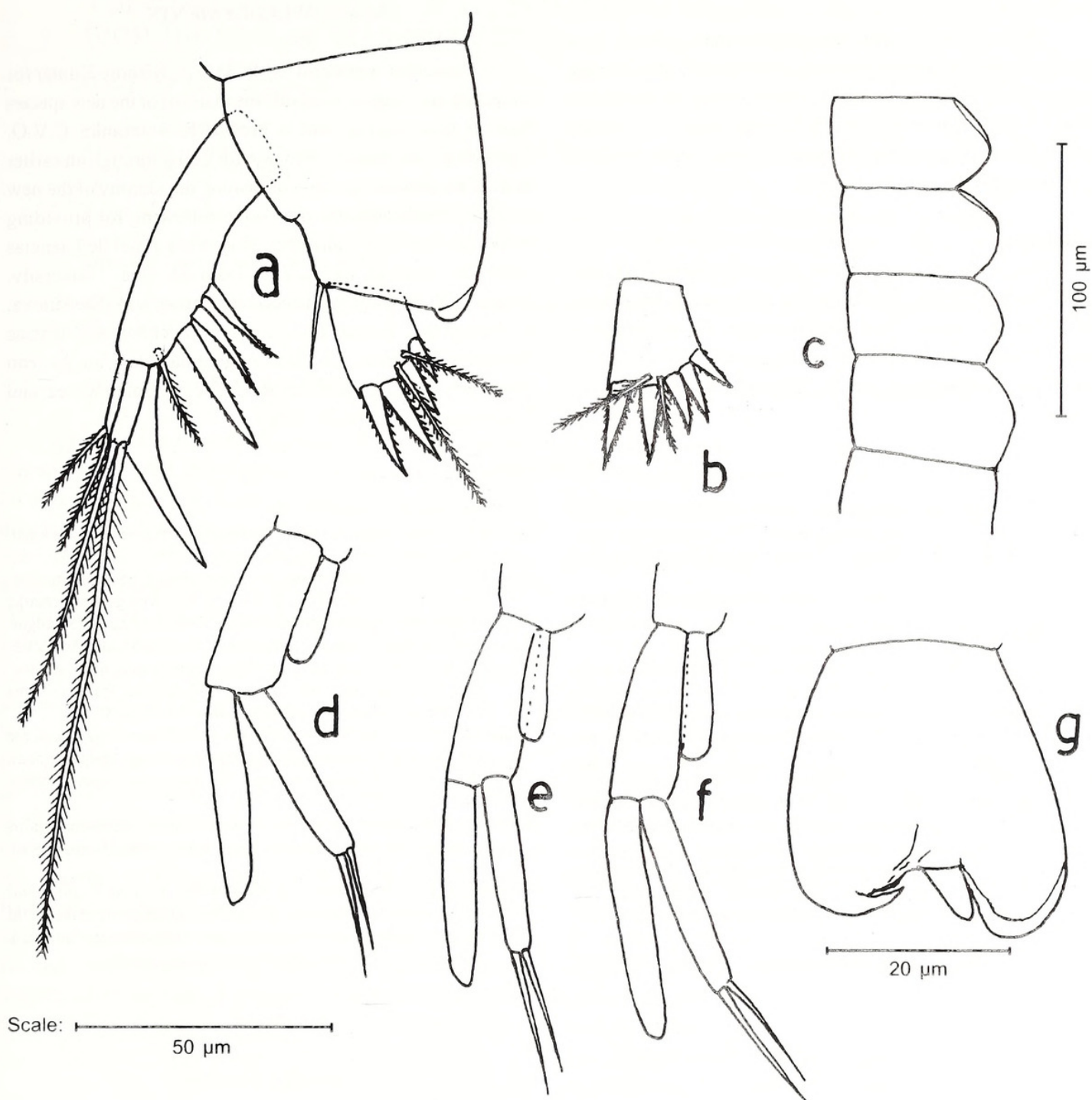


Fig. 4: *Habrobathynella schminkei* sp. nov., Instar I (as meant in the text). a. pleotelson, lateral view; b. abnormal right caudal furca, dorsal view; c. thoracic segments 5-8 (counted from above). Instar II (as meant in the text); d-g. thoracopods V-VIII, respectively. Scale: for figures a, b, d-f = 50 μ m

chathamensis (Sars), *Elaphoidella* sp., *Nitokra* sp., *Eucyclops* sp., and *Paracyclops* sp. Unidentified ostracods were abundant. Among insects, mayfly nymphs were common along with *Chironomus* larvae. Nematodes were few.

Distribution

Outside its type locality, *H. schminkei* sp. nov. is known from the River Godavari at Rajahmundry. It was noticed in

January at both the localities. It is likely to be found in other peninsular rivers as well, but may not be frequent. In the River Krishna, however, it is apparently replaced by *Habrobathynella indica* Ranga Reddy and Schminke.

This discovery of the genus *Habrobathynella* in South India fills the long-existing and large gap in the distribution of Bathynellacea. It also further testifies to the East Asian origin of the Family Parabathynellidae (Schminke 1974).

Conclusion

The hyporheic and phreatic environment of South Asia with its diversified geomorphology, hydrography and climate, is quite likely to support a rich faunal diversity as elsewhere (Pesce 1985). However, little is known about this special habitat. Hence stygobiological research in this region is bound to be rewarding.

Addendum

Since the acceptance of this manuscript of this paper for publication, the following two species have been added to the genus *Habrobathynella*: *H. nagarjunai* Ranga Reddy, 2002 (see *Hydrobiologia* 470: 37-43, 2002) and *H. indica* Ranga Reddy & Schminke (*J. nat. Hist.* in press)

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