

On the freshwater ostracods (Crustacea, Ostracoda) of the Sudan, with special reference to the Red Sea Hills, including a description of a new species

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Abstract

A collection of freshwater ostracods from the Sudan is studied and 18 species are recorded. *Paracyprretta amati* sp.n. is new to science. A redescription of the holotype female of *Paracyprretta aratra* (Brady, 1904) (not recorded in this collection) and a provisional key to the species of *Paracyprretta* are given. *Heterocypris giesbrechtii* (G. W. Müller, 1898) is re-described; *Heterocypris sobrinus* (Masi, 1932) is placed in the synonymy of *H. fretensis*; *Hemicypris intermedia* (Lindroth, 1953) is recorded for the first time since its original description and is redescrbed, while *Cyprinotus largeretia* Rome, 1969 is transferred to *Hemicypris*. The zoogeographical composition of this fauna is briefly discussed.

Introduction

To date, nothing has been published about the recent freshwater ostracods of the Sudan. Daday (1910b) described a new genus and six new species from the Egyptian part of the River Nile and Klintz (1907) reported *Cypris sculpta* from the Nile. The description of the latter author, however, is so incomplete that even the genus cannot be identified with certainty from his paper. It is most likely a *Chrissia*- or *Stenocypris*-species.

The present paper deals with ostracods collected by Dr H. J. Dumont (Ghent) and Dr A. El Mogh-raby (Khartoum) in the Red Sea Hills in December 1981. Eighteen species were found to be present in the samples, of which 12 could be identified with certainty and one is new to science. Three *Hemicypris* species and one (probably new) species of *Ilyocypris* were not identified for various reasons. It is remarkable that none of the species described by Daday (op. cit.) were present in this material.

A list of localities and of species recorded, is given below.

Localities

1. 15.12.1981 El Khaiare, River Rahad and Blue Nile, at camping site near main road Wadi Medosi-Kassala (stagnant water).
2. 16.12.1981 Showak, River Atbara. (Temp: 26.5 °C, conductivity 410 $\mu\text{S cm}^{-1}$, pH 8.3).
3. 16.12.1981 El Hadjiz, 28 km S of Kassala. Rainpool. (Depth \pm 1 m, temp. 30 °C, conductivity 1 700 $\mu\text{S cm}^{-1}$, pH 8.5).
4. 17.12.1981 Chor Amat
5. 18.12.1981 Chor Ashat, 2 pools near the entrance of canyon.
6. 19.12.1981 Chor Komosar, near railway. Shallow.
7. 20.12.1981 Chor Dim. Shallow well (depth 1.5 m) and pool (depth 20 cm).
8. 20.12.1981 Chor Arbaat (upstream), 3 guelta's.
9. 21.12.1981 Chor Arbaat (downstream). Pool and flowing water. Shallow.
- *10. 23.12.1981 Chor Baraka (near Tokar). Shallow, muddy pool and flowing water.

* No ostracods in this sample.

11. 26.12.1981 Fishponds S of Khartoum, near White Nile.

Species recorded	Localities
<i>Limnocythere stationis</i>	7, 9
<i>Ilyocypris gibba</i>	2, 8, 9
<i>Ilyocypris biplicata</i>	3
<i>Ilyocypris</i> sp. 1	1
<i>Candonopsis cf. africana</i>	5, 7
<i>Heterocypris incongruens</i>	6
<i>Heterocypris fretensis</i>	4, 7
<i>Heterocypris giesbrechtii</i>	4, 5, 8, (9?), 11
<i>Hemicypris intermedius</i>	3, 8
<i>Hemicypris</i> sp. 1	(6), 8
<i>Hemicypris</i> sp. 2	3, 8
<i>Hemicypris</i> sp. 3	8
<i>Cypretta seurati</i>	5, 6, 7
<i>Paracyprretta amati</i> sp.n.	4
<i>Stenocypris major</i>	5
<i>Plesiocypridopsis newtoni</i>	5
<i>Cypridopsis vidua</i>	8
<i>Potamocypris producta</i>	11

Notes on selected species

Subclass	OSTRACODA Latreille, 1806
Order	PODOCOPIDA G. W. Müller, 1894
Suborder	PODOCOPA Sars, 1866
Superfamily	CYTHERACEA Baird, 1850
Family	LIMNOCYTHERIDAE Klie, 1938
Subfamily	LIMNOCYTHERINAE Klie, 1938
Genus	<i>Limnocythere</i> Brady, 1868

Limnocythere stationis Vávra, 1891 Figs. 1-16

Material: 7 females and 1 empty valve, possibly belonging to a male from loc. 7; 10 females from loc. 9.

Measurements: 6 specimens. Range, with mean \pm S.D. in brackets. length: 372-396 μ m (380 \pm 15 μ m); height: 204-228 μ m (218 \pm 9 μ m), width: 204-228 μ m (216 \pm 11 μ m), L/H: 1.68-1.83 (1.77 \pm 0.07), L/W: 1.63-1.94 (1.79 \pm 0.11).

Description of female:

RV* (Fig. 9) more broadly rounded in the front

* RV = right valve; LV = left valve; C = carapace.

than at the caudal side, ventral side curved, dorsal side straight, sloping downwards towards the caudal side; external side of the valve with two dorsal globular protuberances, an anteroventral globular protuberance, a posteroventral alar and, near the central muscle scars, a central protuberance. Surface covered with a net-like structure of ridges. LV (Fig. 10) symmetrical to the right valve, overlapping the latter both frontally and caudally. In dorsal view of C (Figs. 12, 13), anterior side forming a sharp beak, posterior side more rounded.

Posteroventral alar showing a triangular shape in ventral view of C (Fig. 11).

Frontal beak obvious in frontal view (Fig. 16), dorsal side almost straight in this view.

Muscle scars (Fig. 14) consisting mainly of 4 large scars in a vertical row.

Pore-channels along margin of valves straight, not branched and scarce. Hinge lophodont.

Antennula (Fig. 1) 5-segmented; number of setae for each segment: 0-1-1-6-2, terminal joint also bearing a bifurcated (sensory?) structure.

Antenna (Fig. 2) 4-segmented, terminal joint bearing 3 slender claws, exopodite long, stout and undivided.

Mandible (Fig. 3) small and stout, palp with one long stout hair and one short seta on the external side of the second segment.

Maxillular palp (Fig. 4) with terminal segment cylindrical, bearing 3 claws, penultimate joint with apically three long marginal hairs and one shorter seta.

Maxilla (Fig. 5) a walking limb, first segment with 2 + 1 marginal and 2 apical setae.

First thoracopod (Fig. 6), being the largest of the three walking limbs, with the first segment bearing 2 + 1 marginal and 1 apical setae.

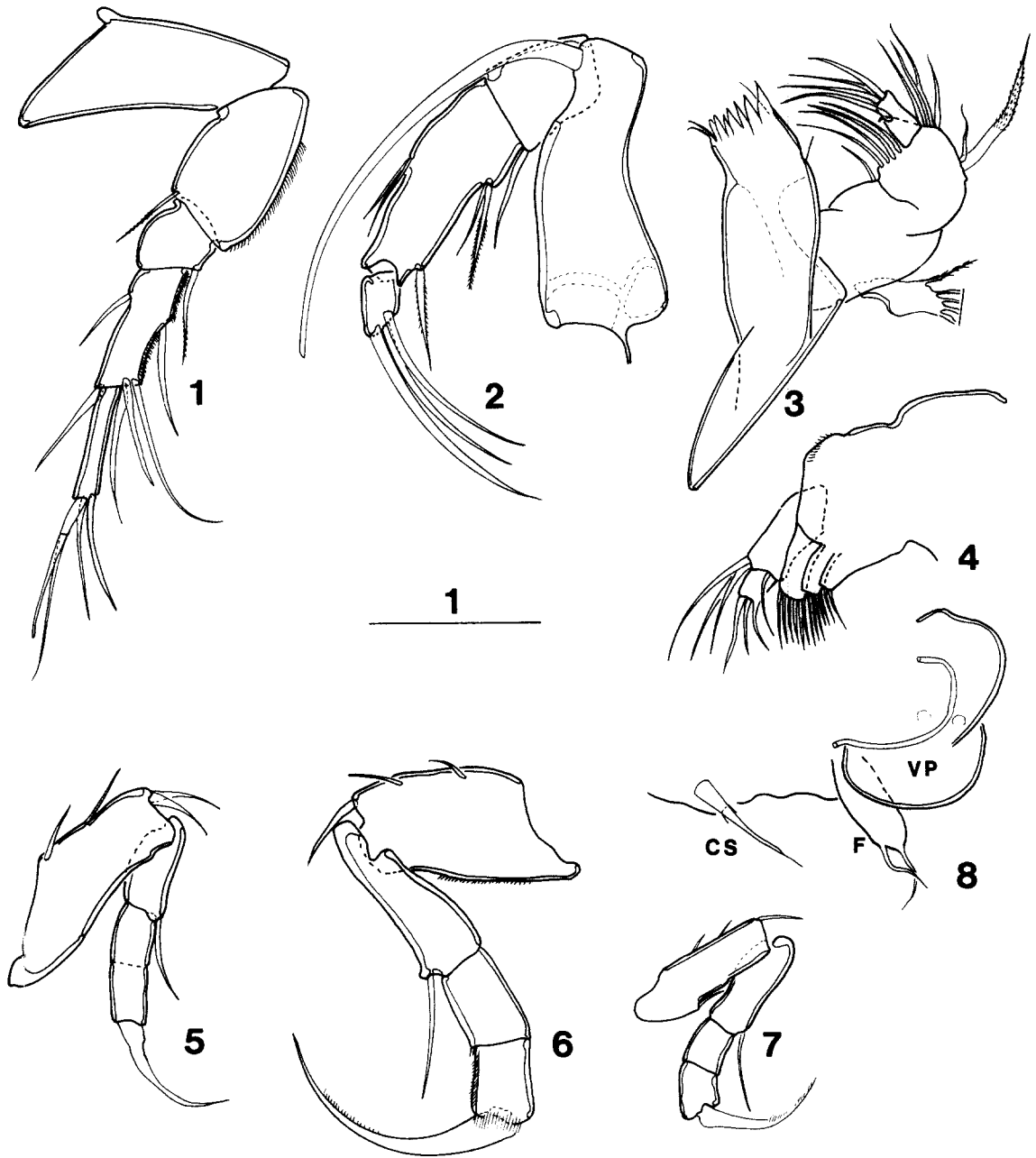
Second thoracopod (Fig. 7) strikingly small, first segment with 2 + 1 marginal and 1 apical setae.

Furca reduced, with a relatively long base and 1 short flagellum, caudal setae almost as long as the furca, vaginal plate well developed (Fig. 8).

Male: unknown. One empty valve from the pool in Chor Dimmy (Fig. 15) has a wider caudal side. It is possible that this valve belongs to a male.

Remarks

One of the ovigerous females from Chor Dim had a respiratory plate on the mandibular palp, which had no plumous rays, but instead a row of



Figs. 1-8. *Limnocythere stationis* Vávra

1. Antennula; 2. Antenna; 3. Mandibula + palp; 4. Maxillula; 5. Maxilla; 6. first thoracopod; 7. second thoracopod; 8. Abdomen, lateral view. (1, 2, 5-8 from loc. 9; 3, 4 from loc. 7). Scale: 1 = 50 μm for 1-7 & 18 μm for 8. cs = caudal seta, f = furca, vp = vaginal plate.

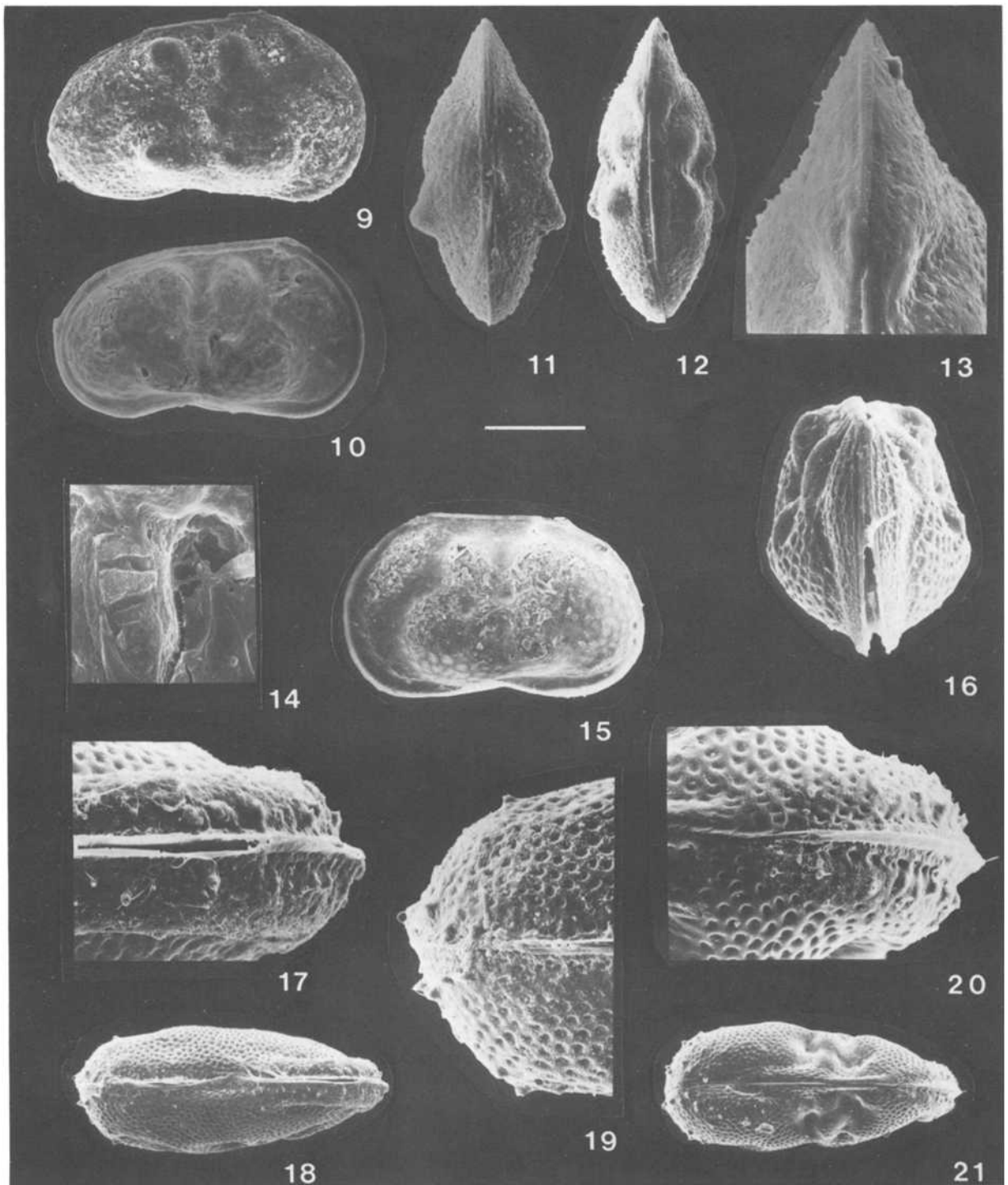
fine, short setae. Other specimens had this respiratory plate with a normal shape (Fig. 3).

Discussion

Limnocythere stationis is a very rare species, which was described by Vávra (1891) from Bohemen. Klie

(1938) mentioned that it was also known from Germany, France and Finland. Petkovski (1964) reported the species from Yugoslavia, while Diebel (1962, in Petkovski, 1964) found the species as a fossil in the Eem-glacial from Berlin.

In all these cases, *L. stationis* exhibited 2 postero-



Figs. 9–21. *Limnocythere stationis* Vávra (9–16) & *Ilyocypris biplicata* (Koch) (females) (17–21)

L. stationis: 9. RV, external view (female); 10. LV, internal view (female); 11. C, ventral view (female); 12. C, dorsal view (female); 13. C, dorsal view, detail front (female); 14. muscle scars, LV (female); 15. RV, internal view (male?); 16. C, frontal view (female). (All from loc. 7).

I. biplicata: 17. C, ventral view, detail front; 18. C, ventral view; 19. C, ventral view, detail caudal part; 20. C, dorsal view, detail front; 21. C, dorsal view. (All from loc. 3)

Scale: 21 μm for 14; 70 μm for 13; 135 μm for 17, 20; 145 μm for 19; 150 μm for 16; 220 μm for 9, 10, 11, 12, 15; 445 μm for 18, 21.

dorsal spines (sometimes also 1–3, Petkovski, 1964) on the right valve and only females were found.

In the present specimens, the shape of the valves and the morphology of the soft parts are identical to what was described by Vávra (1891), except for the dorsal spines on the right valve which are missing completely. But this is not important enough to establish a new species, nor is there enough material from North African populations to decide whether the absence of dorsal spines is constant in this region and whether it might be important on a sub-specific level. The latter seems unlikely, as De Deckker (1981c) illustrates that the number of dorsal spines in the Australian *Limnocythere dorso-cicula* De Deckker, 1981 can vary from 3 to 6, while the spines can even be completely absent (De Deckker, pers. comm.).

L. stationis is closely related to *L. notodonta* Vávra, 1906, *L. ohridense* Klie, 1934 and *L. karamani* Petkovski, 1960 (in Petkovski, 1961). The beak-shaped front of the carapace, however, is absent in *L. notodonta* and has a different morphology in *L. karamani*. *L. stationis* is furthermore separated from other European *Limnocythere*-species by the presence of a seta on the ventral and on the dorsal margin of the penultimate segment of the antenulla (Petkovski, 1964). Other European species of this genus only have a seta on the dorsal margin of this segment.

Limnocythere stationis was so far thought to be restricted to European waters.

Superfamily	CYPRIDACEA Baird, 1845
Family	ILYOCYPRIDIDAE Kaufmann, 1900
Genus	<i>Ilyocypris</i> Brady and Norman, 1889

Ilyocypris biplicata (Koch, 1838) Figs. 17–21, 88

Material examined: 3 females and 2 males from loc. 3.

Measurements: number of specimens given in brackets. Male (1): length: 0.707 mm, height: 0.392 mm, width: 0.284 mm, L/H: 1.80, L/W: 2.50. Female: length: 0.774–0.882 mm (3), height: 0.446 mm (1), width: 0.338–0.370 mm (2), L/H: 1.74 (1), L/W: 2.30–2.40 (3).

Remarks

The specimens from El Hadjiz are morphologically very similar to Gauthier's (1938) description of *Ilyocypris biplicata* var. *anomala*. Gauthier separates this variety, based mainly on the crest which runs from the dorsal to the ventral side, along the front of both valves.

This crest is totally absent in the nominate form, but the hemipenis (Fig. 88) and the other soft parts are identical in both forms. De Deckker (1981) illustrated the same feature for *I. australiensis* Sars, 1889. The ecological significance of this feature, which can be present or absent within the same species, even within the same population, is not yet understood. Therefore, one should refrain from setting a taxonomic significance upon such variations.

Ilyocypris sp. 1

Fig. 89

Material examined: one male from loc. 1, deposited in the Museum voor Dierkunde, University of Ghent.

Measurements: length: 0.688 mm, width: 0.275 mm, L/W 2.5.

Remarks

This specimen probably belongs to an undescribed species, the morphology of the hemipenis (Fig. 89) differs from all known species. However, as only one specimen was collected, I will not establish a new taxon and leave it with open nomenclature.

Family	CANDONIDAE Kaufmann 1900
Subfamily	CANDONINAE Kaufmann 1900
Genus	<i>Candonopsis</i> Vávra 1891

Candonopsis cf. africana Klie 1944 Figs. 22–28

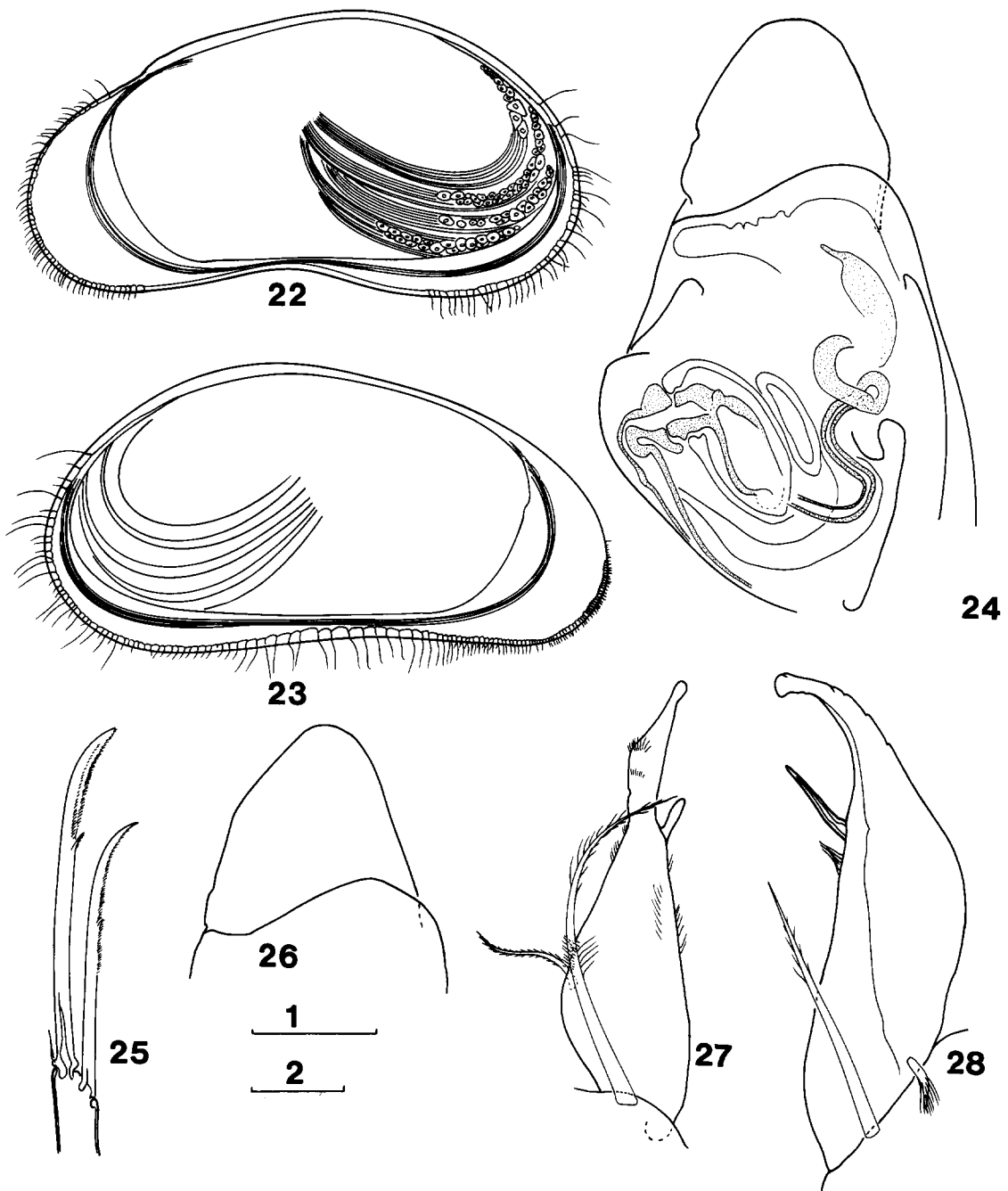
Distribution: very common in Africa.

Material examined: 3 males and 2 females from loc. 5, 10 males and females from loc. 7.

Remarks

This form belongs to the group of species which have a spine on both furcal claws, although both spines were not clearly visible in all specimens from this collection.

The present specimens differ from *C. dorsoerecta* Rome 1962 and *C. navicula* Daday 1910a in the



Figs. 22–28. Candonopsis cf. africana Klie

22. RV, internal view (male); 23. LV, internal view (male); 24. Hemipenis; 25. Furca, detail distal part; 26. Hemipenis lobe; 27. Left prehensile palp (male); 28. Right prehensile palp (male). (All from loc. 7).

Scales: 1 = 200 μm for 22, 23; 2 = 30 μm for 24–28.

morphology of the valves, from *C. solitaria* (Vávra, 1895) in the morphology of the penis and from *C. depressa* Rome 1962 and *C. spec.* Brehm 1938 in the morphology of the furcal claws. The wide geographical gap makes conspecificity with the Australian *C. tenuis* (Brady, 1886) highly unlikely. The valves of the latter species, illustrated by De Deckker (1982), are similar to our specimens, but show small differences in the male valves, such as a straighter ventral margin in the right valve and a different length–height ratio in the left valve.

The present specimens agree in most features with *C. africana* Klie 1944. Only the left prehensile palps are slightly different (Fig. 27). After a comparison with *c. africana* from Lake Kivu¹ it was decided to refer the present specimens to this species.

Family CYPRIDAE Baird, 1845
 Subfamily CYPRINOTINAE Bronstein, 1947
 Genus *Heterocypris* Claus, 1893

Heterocypris fretensis (Brady & Robertson, 1870)
 Figs. 29–47

syn *Cyprinotus rostrata* Lowndes, 1932 (non *Heterocypris rostrata* Baldescu, 1961) (Harding, 1955)
 syn *Cyprinotus inaequalis* Bronstein, 1928 (Petkovski, 1964)
 syn *Cyprinotus sobrinus* Masi, 1932 syn. nov.

Material examined: a large population of females from locs. 4 and 7 (Red Sea Hills, the Sudan); 2 ovigerous females from the Cufra-Oasis (Lybia) (coll. Leonard, nr. 3828,² 5.1.1965, = topotype material of ex-*Cyprinotus sobrinus* Masi, 1932); a large population of females and larvae in Ain Essameur, Tassili-n-Ajjer (Algeria) (coll. Dumont, 13.9.1979).

¹ Reported in Rome and De Deckker (1977), material deposited at 'Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussels, Belgium.

² In this material, a large population of *Darwinula stevensoni* and 2 females of *Herpetocypris chevreuxi* were also present.

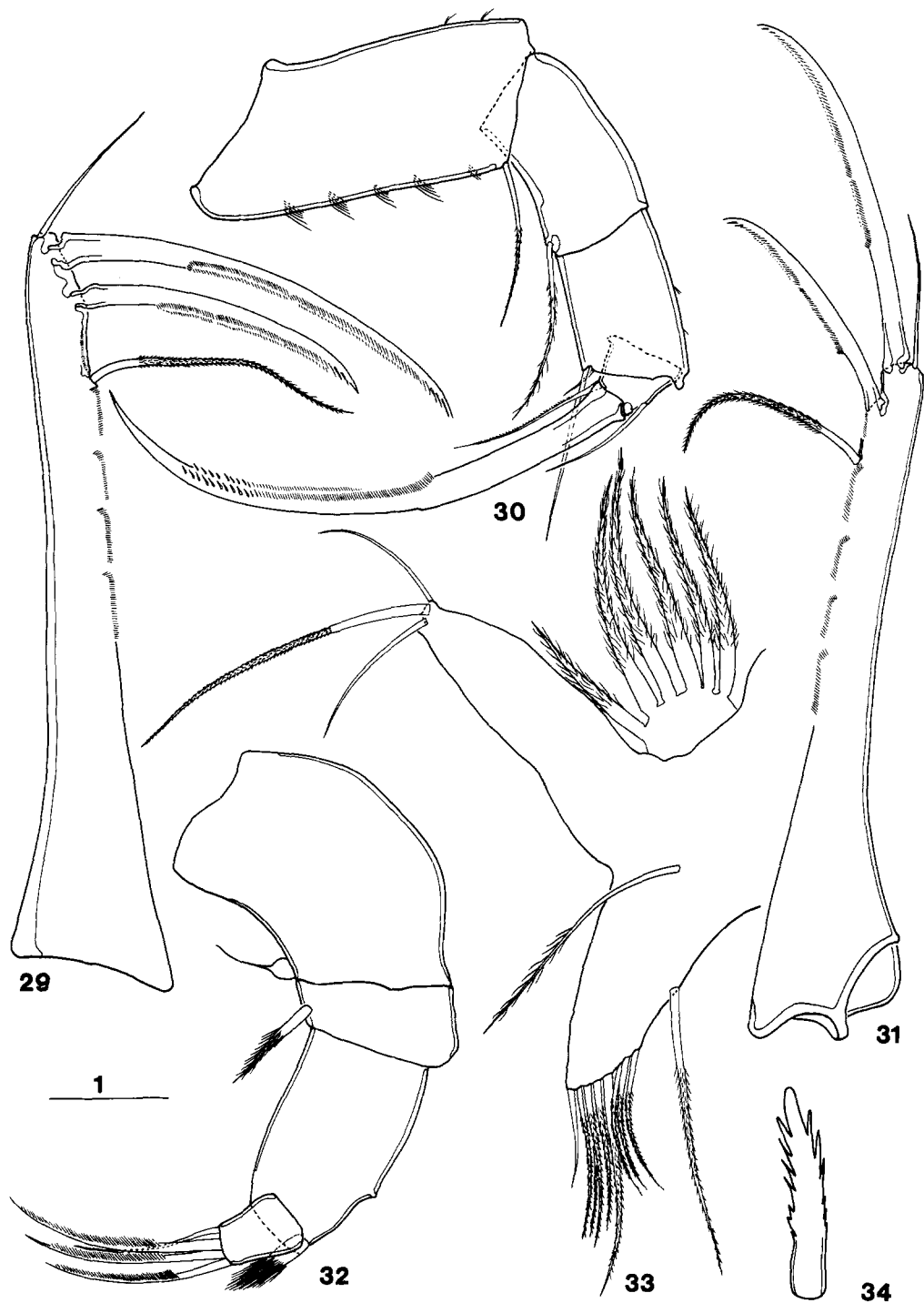
Remarks

A large number of papers by different authors deals with the status of *Heterocypris fretensis* as a valid species. Sars (1928), Bronstein (1928) and Petkovski (1964) separate the species from *H. salina* (Brady, 1868); Brady and Norman (1891) (in Gauthier, 1928), Harding (1955) and Gauthier (1928) consider *H. fretensis* synonymous with *H. salina*.

Harding (op. cit.) also synonymises *Cyprinotus rostrata* Lowndes, 1932 with *H. salina*, relying on the original description of the species. Petkovski (1964) places *Cyprinotus inaequalis* Bronstein, 1928 into the synonymy of *H. fretensis*, arguing that he found transitional forms between the 'inaequalis'-form, with huge dorsal expansion of the left valve, and the nominate form, without this dorsal expansion. In the specimens from Chor Amat and Chor Dim, the same transitional morphology can be observed (Figs. 35–37). The same is true in a population of *H. fretensis* from Ain Essameur (Algeria). In all these specimens, the soft parts are identical.

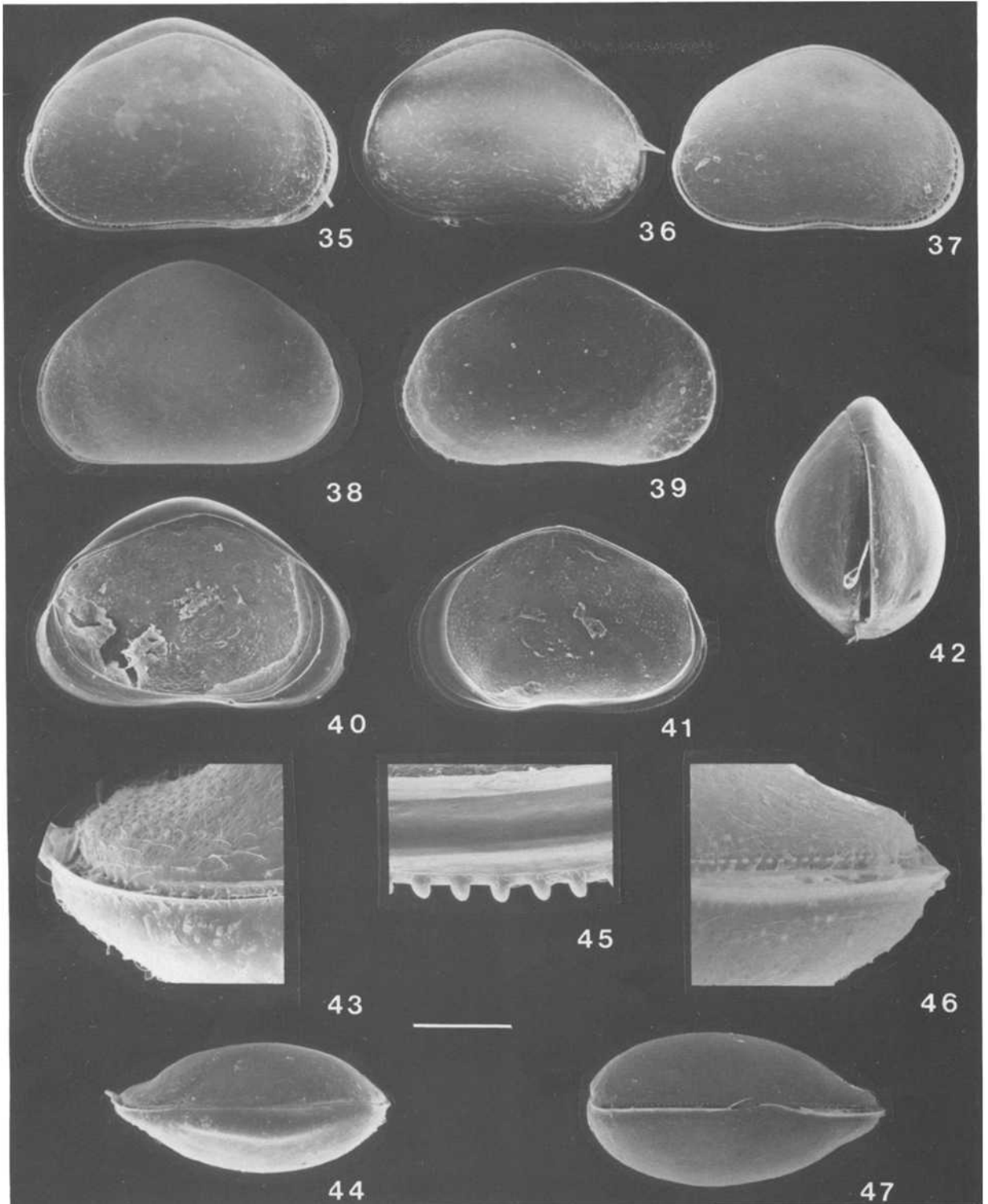
Masi (1932) described *Cyprinotus sobrinus* from the Cufra Oasis (Lybia). In this paper, he did not indicate any difference with *H. fretensis*. I was unable to locate the type-material of this species; however, I examined two topotype female specimens from the Cufra Oasis. Although the valves of these specimens were strongly decalcified, the soft parts were in excellent condition. The most striking similarities between *C. sobrinus* and *H. fretensis* are illustrated here: the presence of four groups of setulae on the ventral side of the furcal ramus, proximal of the ventral seta (Figs. 29, 31); the presence of 5 groups of setulae on the second segment of the first thoracopod (cf. also the figure of this limb in Masi, op. cit.) as well as the implantation and the length-ratios of the setae and claw on this appendage (Fig. 30); the morphology and number of setae on the maxilla (Fig. 33); the morphology of the α , β and γ setae on the mandibular palp (Fig. 32) and the morphology of the 'zahnborsten' on the third endite of the maxillula (Fig. 34). The antennula, antenna and second thoracopod were similar but without special features. The valves did not exhibit the dorsal expansion of the left valve and were very similar to the typical *H. fretensis* form. Therefore, *C. sobrinus* should be considered synonymous with *Heterocypris fretensis*.

The status of *H. fretensis* as a valid species, how-



Figs. 29-34. *Hererocypris fretensis* (Brady & Robertson) (females)

29. Furca; 30. first thoracopod; 31. Furca; 32. Mandibular palp, showing α , β and γ setae; 33. Maxilla; 34. 'Zahnborste' on third endite of maxillular palp. (29, 30, 32, 33, 34 = ex-*H. sobrinus*, Cufra Oasis, Lybia; 31 = *H. fretensis*, Chor Amat, the Sudan). Scale: 1 = 50 μm for 29-33; 18 μm for 34.



Figs. 35-47. Heterocypris fretensis (Brady & Robertson) (females).

35. C, lateral view, showing RV; 36. idem; 37. idem; 38. LV, external view; 39. RV, external view; 40. LV, internal view (frontal margin damaged); 41. RV, internal view; 42. C, frontal view, showing dorsal expansion of LV; 43. C, dorsal view, detail front; 44. C, dorsal view; 45. RV, internal view, detail of ventro-caudal margin; 46. C, ventral view, detail front; 47. C, ventral view. (All from loc. 4).
 Scale: 45 μm for 45; 90 μm for 43, 46; 285 μm for 42; 340 μm for 35-41, 47; 360 μm for 44.

ever, remains uncertain. Experiments with *H. salina*, in which environmental parameters such as temperature and salinity were varied, might show if the two morphological types can be correlated with environmental conditions and in fact belong to the same species.

Heterocypris giesbrechtii (G. W. Müller, 1898)
Figs. 48–53, 62–68, 125

Cyprinotus giesbrechtii G. W. Müller, 1898:
Aldabra

Cyprinotus giesbrechtii Daday 1910a: Kilima-
Ndjaro (Kenya–Tanzania)

Heterocypris giesbrechtii McKenzie, 1971: Al-
dabra

syn ? : *Cyprinotus rotundus* Rome, 1969: En-
nedi (Chad)

Material examined: approximately 40 males, fe-
males and juveniles in locs. 4, 5, 8, (9?), 11.

Measurements: number of specimens given in
brackets. Male. RV (2): length: 0.792–0.804 mm,
height: 0.384–0.408 mm, L/H: 1.97–2.06. LV (2):
length: 0.828–0.840 mm, height: 0.420–0.432 mm,
L/H: 1.92–2.00. Toto (1): length: 0.840 mm, width:
0.395 mm, L/W: 2.13. Female. RV (2): length:
0.960–0.984 mm, height: 0.480–0.492 mm, L/H:
2.00. LV (2): length: 0.996–1.008 mm, height:
0.504–0.528 mm, L/H: 1.91–1.98. Toto (2): length:
1.044 mm, width: 0.540–0.564 mm, L/W: 1.85–1.93.

Re-description of male

RV (Fig. 67) elongated, dorsocaudal side with an
obtuse angle, ventro-caudal side with and ventro-
frontal side without a row of tubercles, calcified
part of inner lamella with a wide frontal and a nar-
row caudal part.

LV (Fig. 68) overlapping RV dorsally, ventrally,
frontally and caudally, dorsocaudal side with an
obtuse angle, caudal part of calcified inner lamella
wider than in RV, no tubercles along margins. Dor-
sal view of C (fig. 63): front pointed, somewhat like
a rostrum, greatest width situated at about two-
thirds of the length.

Antenna (Fig. 50) with 3 large and 1 very short
claw on the penultimate segment and 1 large and 1
short claw on the terminal joint, natatory setae
reaching beyond the tips of the claws with about

half their length, large claws on terminal and penul-
timate segments set with a row of stout spines.

Terminal joint of maxillular palp with 3 + 3
claws. Right prehensile palp (Fig. 53) with an ob-
tuse angle on the ventro-caudal side of the terminal
joint. Left prehensile palp (Fig. 52) with an elongat-
ed terminal segment.

Hemipenis (Fig. 51) with a relatively small blunt
lobe.

Furca (Fig. 48) with a proximal furcal claw which
is distinctively curved in the distal half. Near the
attachment of both claws, a row of spines is present.

Zenker organ with 22 whorls.

Re-description of female

Valves (Figs. 62, 64, 65, 66) distinctively larger than
in the male. Shape as in the male.

RV also with a row of tubercles on the ventro-
caudal side only. Dorsal view with the greatest
width just behind the middle. Front without a ros-
trum.

Antenna with 3 large claws on the penultimate
segment and one large and one shorter claw on the
terminal joint, denticulation on larger claws less
than in males, natatory setae somewhat shorter
than in the male.

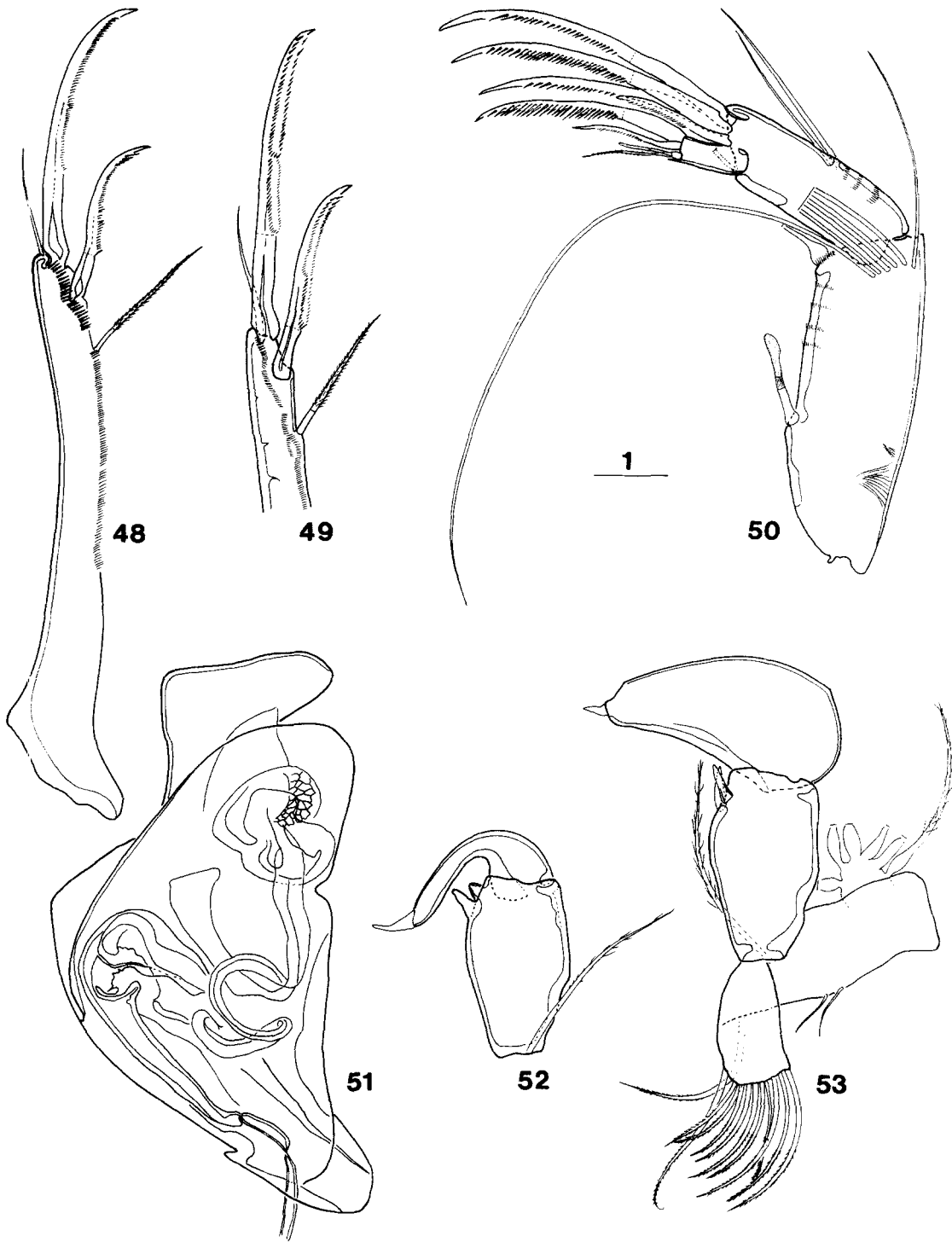
Furca with proximal furcal claw sometimes less
obviously curved and with a row of hairs near the
attachment of both claws (Fig. 49).

Remarks

The position of the tubercles on the RV and the
curved proximal furcal claw indicate that the spec-
imens from the Red Sea Hills belong to the species
group *H. giesbrechtii* (G. W. Müller, 1898), *H. imus*
(Gauthier, 1934), *H. rotunda* (Rome, 1969).

H. imus described by Gauthier (1934) from Ma-
dagascar, differs from the present form and from *H.*
giesbrechtii sensu Müller (1898) in the presence of a
'talon' on the heel of the hemipenis-lobe and in the
presence of 3 + 2 claws on the terminal joint of the
maxillular palp. The morphology of the left pre-
hensile palp in the males is also somewhat different
(see Fig. 52).

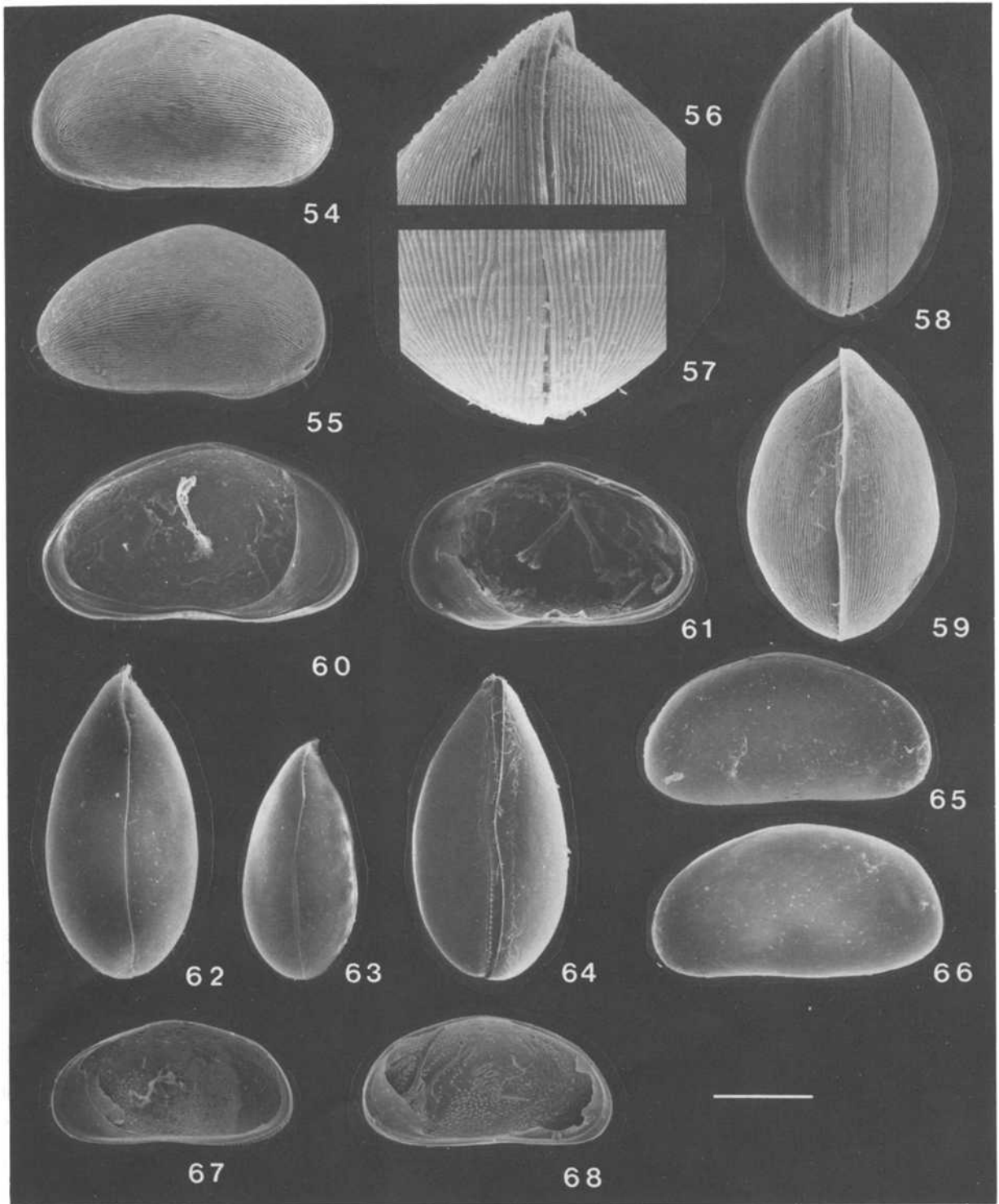
The only difference between the present spec-
imens and *H. giesbrechtii* is the length/height ratio
of the valves, which is 1.83 for Müllers' specimens.
However, this does not seem important enough to
establish a new taxon, and we therefore refer our
present specimens to this species.



Figs. 48–53. Heterocypris giesbrechtii (G. W. Müller).

48. Furca (male); 49. Furca, detail distal part (female); 50. Antenna (male); 51. Hemipenis; 52. left prehensile palp (male); 53. right prehensile palp (male). (50 from loc. 4; 49 from loc. 8; 48, 51, 52, 53 from loc. 11).

Scale: 30 μm for 48–53.



Figs. 54–68. *Paracyprretta amati* sp. n. (female) (54–61) & *Heterocypris giesbrechtii* (G. W. Müller) (62–68)

P. amati: 54. LV, external view; 55. RV, external view; 56. C, dorsal view, detail front; 57. C, dorsal view, detail caudal part; 58. C, dorsal view (specimen slightly charging); 59. C, ventral view; 60. LV, internal view; 61. RV, internal view. (All from loc. 4).

H. giesbrechtii: 62. C, dorsal view (female); 63. C, dorsal view (male); 64. C, ventral view (female); 65. RV, external view (female); 66. LV, external view (female); 67. RV, internal view (male); 68. LV, internal view (male). (63 from loc. 4; 62, 64 from loc. 5; 65–68 from loc. 11). Scale: 80 μm for 56, 57; 225 μm for 54, 55, 58–61; 330 μm for 62–68.

H. rotunda, described by Rome (1969) from E-nedi, only differs from *H. giesbrechtii* in that it has a hemipenis with a pointed tip (rounded in *H. giesbrechtii*) and a right prehensile palp with a rounded ventro-caudal side on the terminal joint (with an obtuse angle in *H. giesbrechtii*). The length/height ratio of the valves however, is very similar to that of the Sudan specimens: 1.91.

Whether the former small differences in the male genitalia are real, or due to bad observation or drawing is still uncertain. Until the type material is examined, the proposed synonymy of *H. rotunda* with *H. giesbrechtii* remains provisional.

Genus *Hemicypris* Sars, 1903

Kempf (1980) lists 26 species in this genus. However, *Cyprinotus largereticulatus* Rome, 1969 clearly belongs to *Hemicypris*, as the margin of the left valve is denticulated and the right valve overlaps the left on both frontal and caudal side (Rome, 1969: 1088, Figs. 36, 41). The species should therefore be named *Hemicypris largereticulata* (Rome, 1969) and be included in the list. The systematic position of the species in the genus is still very confused and the descriptions of many species, at present referred to *Hemicypris*, are clearly insufficient. Only one out of four species present in the material from the Red Sea Hills has been identified with certainty, and a second species is perhaps referable to *H. kliei* (Lindroth, 1953, syn *H. posterotruncata* Bate, 1970?).

Hemicypris intermedia (Lindroth, 1953)
Figs. 69–85, 11–124, 125

Cyprinotus intermedius Lindroth, 1953: East Africa, swamp N of Ngong Hills

Hemicypris intermedius Bate, 1972: no record

Material examined: a large population of males and females from loc. 3; about 10 males and females from loc. 8.

Measurements: number of specimens given in brackets. Male. RV (2): length: 0.936–0.972 mm, height: 0.552–0.564 mm, L/H: 1.70–1.72. LV(1): length: 0.924 mm, height: 0.540 mm, L/H: 1.71. Toto (2): length: 0.950–1.020 mm, width: 0.432–0.450 mm, L/W: 2.11–2.36. Female. RV (2): length:

1.128–1.140 mm, height: 0.648–0.660 mm, L/H: 1.73–1.74. LV (3): length: 1.056–1.128 mm, height: 0.648–0.672 mm, L/H: 1.62–1.68. Toto (2): length: 1.128–1.12 mm, width: 0.528–0.540 mm, L/W: 2.13–2.14.

Re-description

The carapace of both males and females are well described by Lindroth (1953) and are illustrated in this paper in Figs. 111–124.

Male

Antennula (Fig. 69, 69') with length ratio of 5 terminal segments 33:23:16:12:11, sensorial club on second segment bottle-shaped, natatory setae 2.4 times as long as the length of the 5 terminal segments combined.

Antenna (Fig. 70) with natatory setae reaching beyond the tip of the claws by about one-fifth of their length, penultimate joint with 2 long and one very short claw, terminal segment with one long and one short claw.

Mandible (Fig. 75) with masticatory process somewhat separated from the rest of the coxal plate, bearing 9 teeth. Mandibular palp as illustrated in Fig. 71.

Maxillular palp (Fig. 85) with a terminal joint which is broader than long, bearing 3 long and 3 short claws. 'Zahnborsten' on third endite smooth.

First thoracopod as illustrated in Fig. 73, with penultimate joint divided, 2 setae present on the distal edge of segment 3b. Second thoracopod (Fig. 74) typical for the genus, setae on this limb set with different types of setulae.

Furca (Figs. 77, 79) with slender claws, short distal bristle and with proximal bristle longer than proximal claw, ramus somewhat curved, about 1.65 times the length of the distal claw.

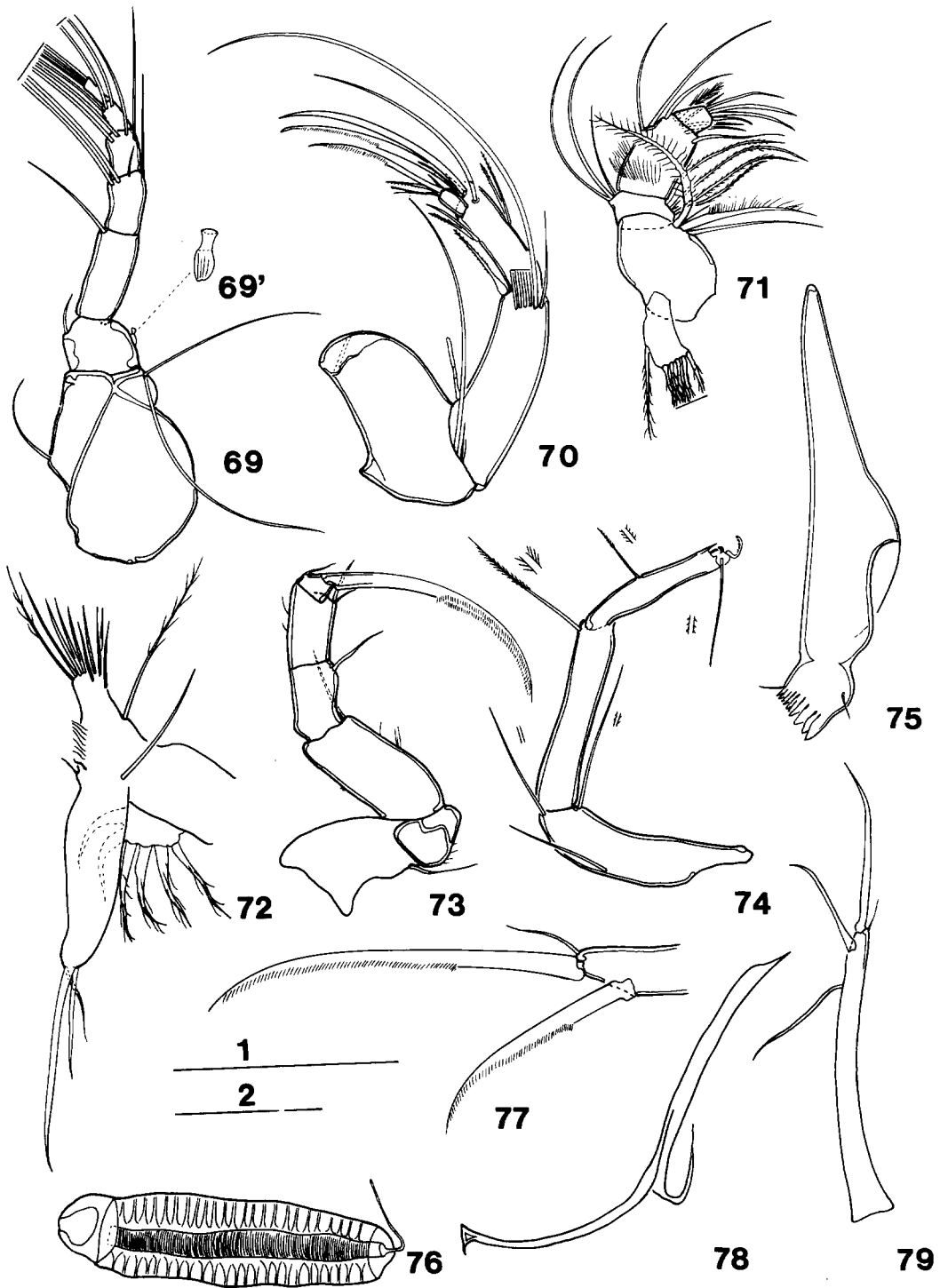
Zenker organ with 24 whorls (Fig. 76).

Right and left prehensile palps (Figs. 80, 83) with 6 plumous rays on the respiratory plate, terminal joints of these palps moderately asymmetrical.

Hemipenis (Figs. 81, 82) with a somewhat variable lobe, the latter having a broad base and an obtuse point, heel absent.

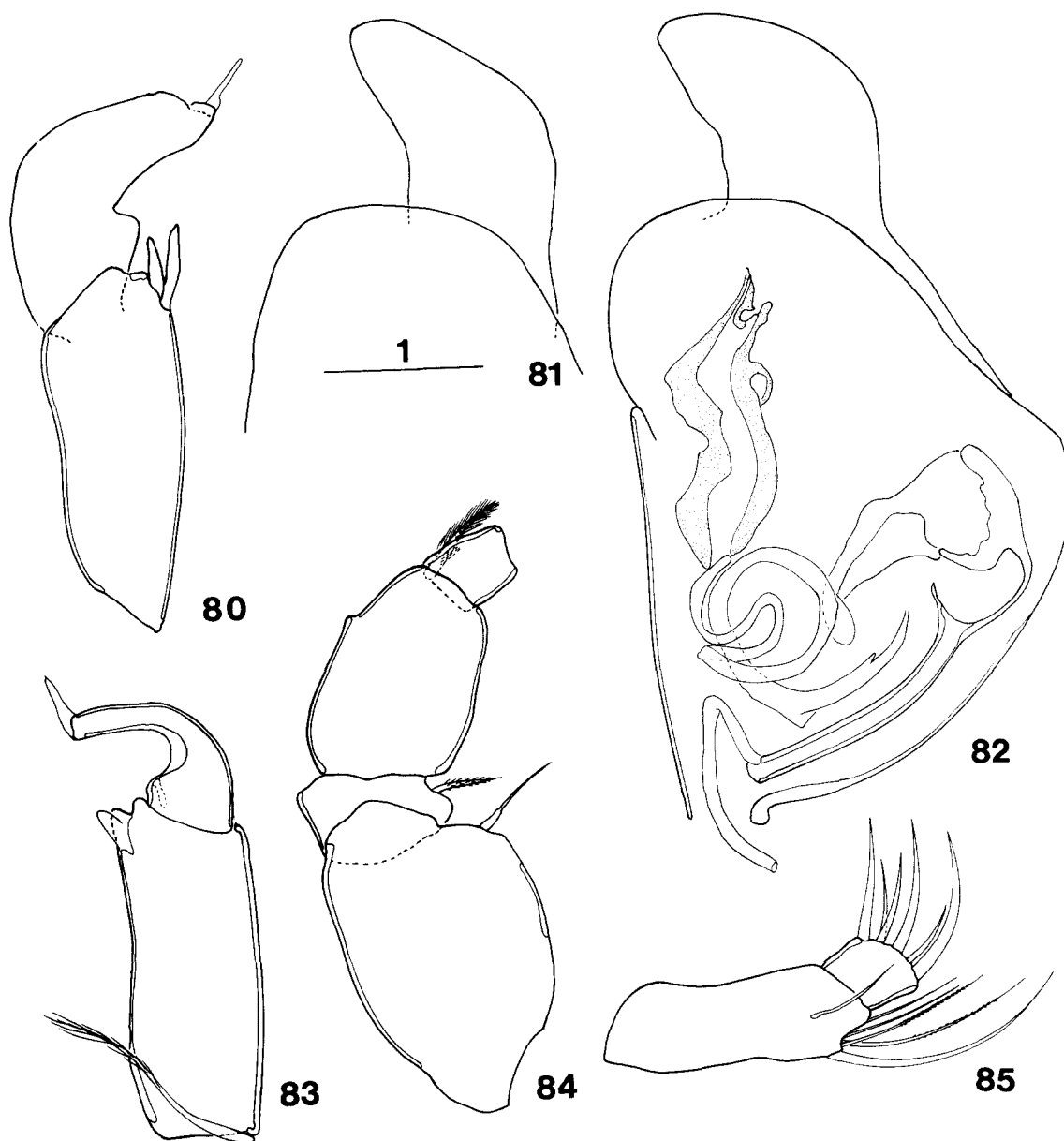
Female

Antenna with 3 long claws on penultimate joint and one long and one short claw on the terminal segment. α , β , γ -setae on mandibular palp, as illus-



Figs. 69-79. Hemicypripis intermedia (Lindroth)

69. Antenna (male); 69'. 'Rome organ' on second segment of antenna (male); 70. antenna (male); 71. mandibular palp (male); 72. maxilla (female); 73. first thoracopod (male); 74. second thoracopod (male); 75. mandibula (male); 76. Zenker organ (ductus ejaculatorius); 77. furca, detail distal part (male); 78. furcal attachment (female); 79. furca (male). (All from loc. 3).
 Scales: 1 = 200 μm for 69-76, 78, 79, 2 = 50 μm for 77.



Figs. 80–85. *Hemicypris intermedia* (Lindroth).

80. right prehensile palp (male); 81. hemipenis lobe; 82. hemipenis; 83. left prehensile palp (male); 84. mandibular palp, showing alpha, beta and gamma setae (female); 85. maxillular palp (male). (All from loc. 3). Scale: 50 μm for 80–85.

trated in Fig. 84. α -setae with a wide, almost rectangular base.

Maxilla with 6 rays on the respiratory plate (Fig. 72), protopodite of this appendage with one long and stout and 2 shorter setae, length ratio's of the latter: 77:42:31.

Furcal ramus somewhat straighter than in the

male, furcal attachment as in Fig. 78. Antennula, mandible and mandibular palp, maxillula, first and second thoracopod as in the male.

Discussion

The present specimens are separated from all but 5 species in this genus by the huge frontal overlap of

the left by the right valve. This species differs in the shape of the prehensile palps and of the hemipenis lobe from *H. dentatmarginata* (Kiss, 1959), where the lobe is more pointed, and from *H. humbertii* (Gauthier, 1933), in which the base of the hemipenis-lobe is narrower and the prehensile palps less asymmetrical.

The hemipenis-lobe is completely rounded in *H. anomala* (Klie, 1938) and the furca has a sinusoidal ramus and a seta-like proximal claw in *H. decoratus* (Daday, 1910b) from Egypt. The present specimens agree in all important features with *H. intermedia* (Lindroth, 1953). The furcal ramus is somewhat straighter in the male and the Zenker organ has 24 whorls instead of 27–29. These minor differences, however, are of no taxonomic importance.

Remarks

As stated above, the base of the α -seta on the mandibular palp in this species has parallel sides (Fig. 83). In some *Heterocypris* species (eg. *H. frentensis*, Fig. 32), the base of this seta is wider and more rounded. It would be interesting to see whether this difference is constant between both genera.

Subfamily HERPETOCYPRIDINAE
Kaufmann 1900
Genus *Stenocypris* Sars, 1899

Stenocypris major (Baird, 1859) Figs. 86, 87

Material examined: 2 females and 2 juveniles from loc. 5.

Measurements: number of specimens given in brackets. Length: 1.60–1.70 mm (2), height: 0.64–0.68 mm (2), width: 0.56 mm (1), L/H: 2.5 (2).

Remarks

The proximal furcal claws in both furcal rami are strongly curved, while the (distal) furcal bristles are somewhat longer than usual (Figs. 86, 87). All other features are normal.

Family CYPRIDOPSIDAE, Kaufmann
1900
Subfamily CYPRETTINAE, Hartmann
1963
Genus *Paracyprretta* Sars 1924 Fig. 125

Generic diagnosis (modified after Sars, 1924)

Shell tumid, width at least half of the length, left valve overlapping right valve caudally and ventrally and by much at the anterior extremity. Surface of both valves closely set with longitudinal ridges. Anterior inner lamella in both valves broad.

Antenna slender, claws long and narrow. Mandibular palp with α seta short and fine, β seta stout, broad and densely set with long setulae, γ seta long and stout. Terminal joint of maxillular palp cylindrical. Furcal rami slender, with two claws and two setae.

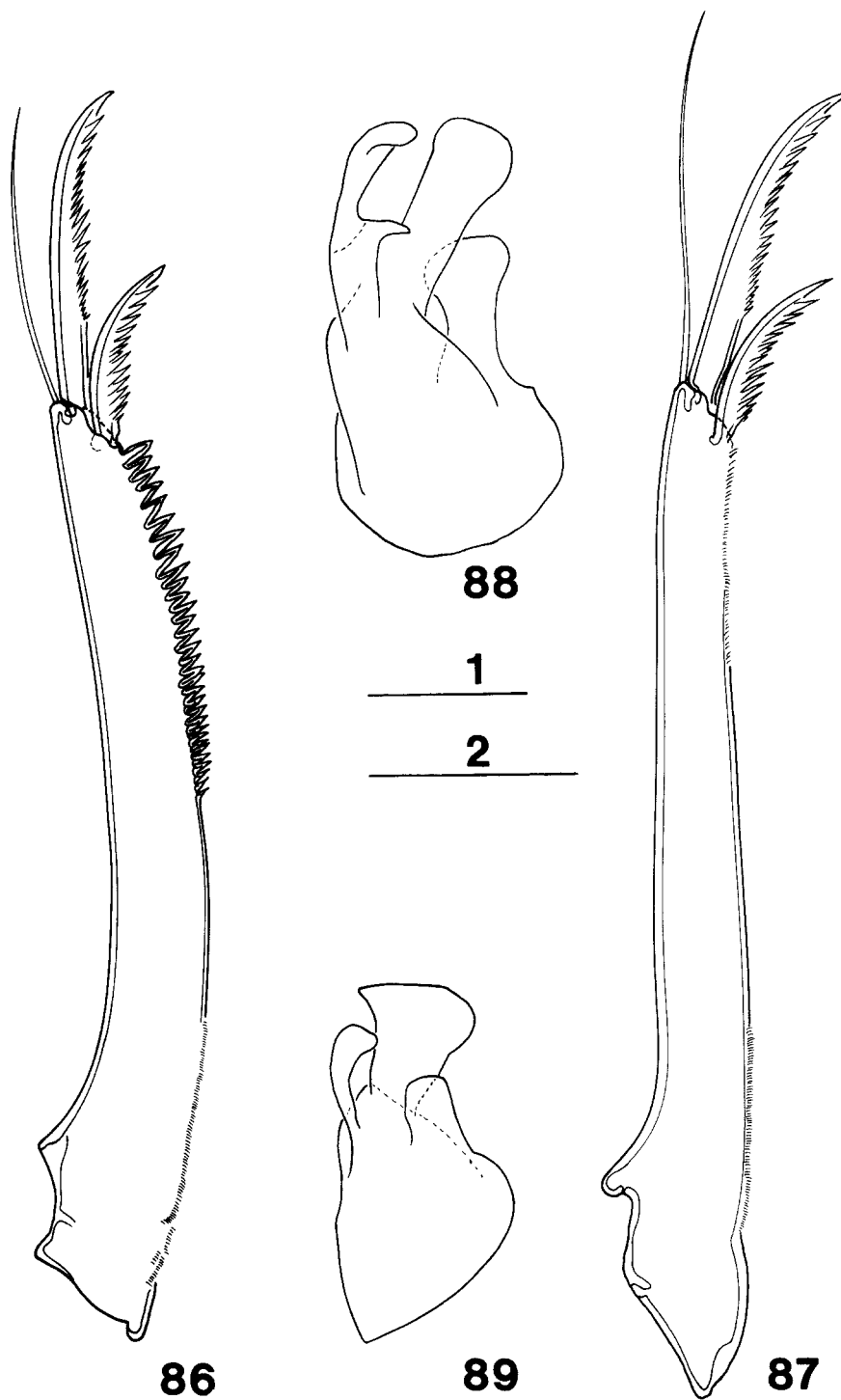
Remarks

The septa in the margin of the right valve and the imperfectly developed respiratory plate on the maxilla are omitted from the original diagnosis, because these features are different in the species described in below. The length of the natatory setae of the antenna are highly variable and should not be included in a generic diagnosis. No males have been found so far in this genus, but experiments would be necessary before one can prove that all species are exclusively parthenogenetic, as was stated by Sars (op. cit.).

Based on Mc Kenzie's (1977) description of *Paracyprretta ampullacea* and *P. amati* sp.n. in the present paper, the morphology of the α , β and γ -setae on the mandibular palp is added to the generic diagnosis, as it is considered to be of importance at a generic level.

For a comparison with related genera, see De Deckker (1981b).

Six species are at present referred to this genus: *P. ampullacea* Sars, 1924 (Green point Common, South Africa, = the type species of this genus), *P. acanthifera* Sars, 1924 (Cape town, S.A.), *P. aratra* (Brady, 1904) (Greytown, Natal, S.A.), *P. rubra* Sars, 1924 (Bergvliet Flats, S.A.), *P. syngramma* (G. W. Müller, 1908) (Zeekoeflei, Fish Hoek, S.A.), *P. syngramma* var. *minor* (G. W. Müller, 1914), *P. amati* sp.n. (Chor Amat, the Sudan).



Figs. 86–89. *Stenocypris major* (Baird) (female), *Ilyocypris biplicata* (Koch) (male) & *Ilyocypris* spec. indet. (male).
S. major: 86. left furcal ramus; 87. right furcal ramus (both from loc. 5).
I. biplicata: 88. hemipenis (from loc. 3); *I. spec. indet.*: 89. hemipenis (from loc. 1).
 Scales: 1 = 100 μm for 88, 89; 2 = 100 μm for 86, 87.

Paracyprretta aratra (Brady 1904) Figs. 90–97
Cypris aratra Brady 1904: Greytown, Natal
Paracyprretta aratra Mc Kenzie 1971b: no record

This species was not recorded in the present material. However, because the length/width ratio of the valves, as obtained from Fig. 35, Pl. 7 in Brady (1904), was close to the ratio in *P. amati* sp.n., the holotype of *P. aratra* was examined to see whether our specimens were conspecific with this species.

This opportunity will be taken to redescribe the anatomy of this species, as the original description was very brief.

The holotype slide contained two crushed valves for which the outline was not recognisable. The marginal row of septa in the right valve, described by Sars (1924) for his species, was not visible in this specimen.

Redescription of the anatomy

(Holotype female, nr 1.03125, deposited in the Hancock Museum, Newcastle-upon-Tyne, U.K. Slide containing 2 crushed valves and with some soft parts still recognisable, though the slide is partly dried.)

Antennula (Fig. 90) 7-segmented; natatory setae 1.75 times as long as length of 5 terminal segments combined.

Antenna (Fig. 91) with natatory setae reaching beyond tips of claws; terminal joint small, 2.7 times as long as top width; penultimate segment with 3 long claws, terminal joint with one long and one shorter claw; sensory club on ventral side of second segment large (Fig. 91').

Mandible (Fig. 95) stout; palp of normal shape; morphology of α , β and γ -setae not recognisable.

Maxillulla and maxilla not recognisable in the slide.

First thoracopod (Fig. 96) with 2 apical setae on second segment and only one apical seta on segment 3b; claw long and stout.

Second thoracopod (Figs. 93, 94) with fourth segment not separated from penultimate joint, bearing one seta, one relatively small 'broad hair', set with one recognisable row of setulae and at least two chitinised hook-like structures.

Furca (Fig. 97) long and slender; proximal claw shorter than distal claw; furcal attachment with

undivided ventral and dorsal branches.

Rate-like organs as illustrated in Fig. 92.

Remarks

Brady (1904) stressed the importance of the armament of the fourth segment of the second thoracopod. Probably due to the age of the slide, not all the hooks he indicated were recognisable in the holotype. The validity of the 'several small claw-like processes' (1904: 126) as a specific feature, can therefore, at present, not be confirmed.

Paracyprretta amati sp.n. Figs. 54–61, 90–110

Type material: 1 holotype female, soft parts dissected in glycerine and valves stored dry; about 15 paratype females. Holotype deposited in the Museum voor Midden-Afrika, Tervuren (Belgium).

Type locality: loc. 4 (Chor Amat, Red Sea Hills, the Sudan).

Derivatio nominis: the species is named after the type locality.

Measurements: (4 specimens)

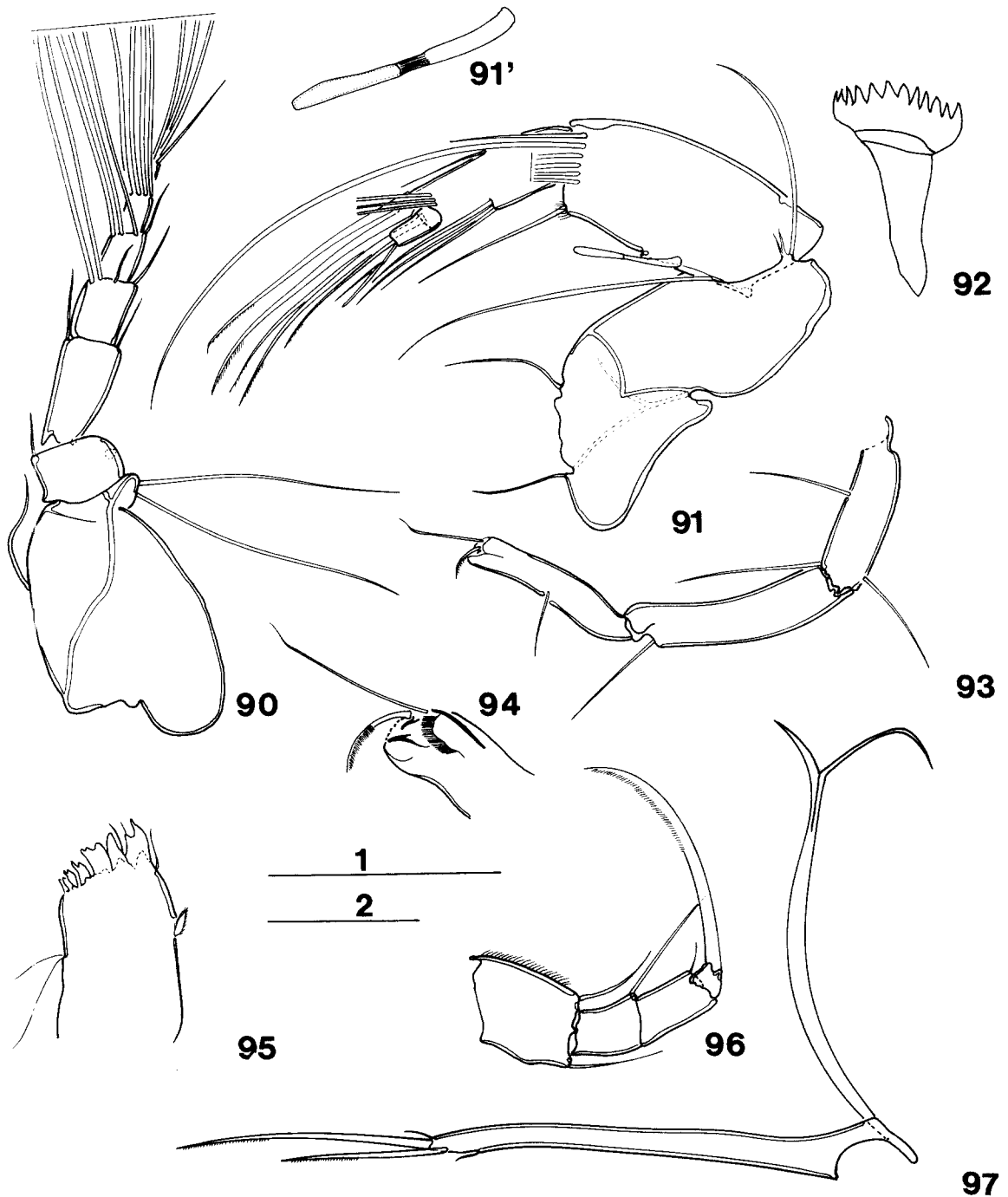
LV: length = 0.696–0.708 mm, height = 0.384–0.408 mm, L/H = 1.74–1.81. RV: length = 0.660–0.672 mm, height = 0.384–0.396 mm, L/H = 1.67–1.72. Toto: length = 0.660–0.672 mm, width = 0.408–0.444 mm, L/W = 1.57–1.65, W/L = 0.61–0.64.

Description of female

RV (Figs. 55, 61) more broadly rounded in the front than at the caudal extremity; greatest height situated somewhat before the middle; dorsum with an obtuse angle; ventral side curved downwards in the first fourth of the valve; calcified part of the inner lamella broad in the front, absent in the caudal part.

LV (Figs. 54, 60) similar to RV in outline; inner lamella present, though narrow, in the caudal part.

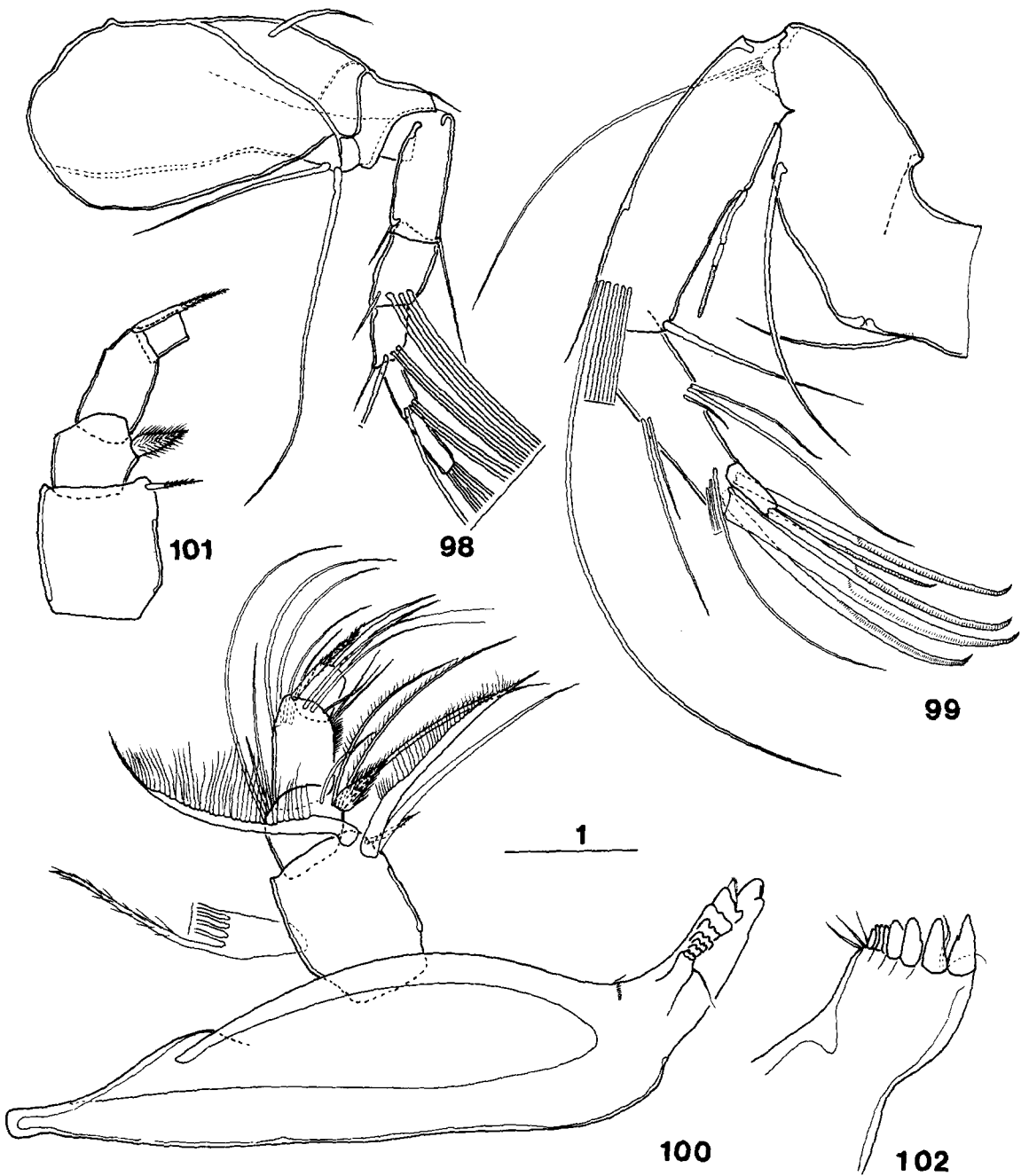
Both valves set with rows of longitudinal ridges on the external side; these ridges not running continuously from the anterior to the posterior side, but interrupted, branched and following the margins of the valves; both at the front and the back, the ridges running over the centre part of the valves are interrupted at a certain distance from the edges, allowing about 10 ridges on each valve to run from the dorsal to the ventral margin, along the frontal and caudal margins.



Figs. 90-97. *Paracyprella aratra* (Brady) (Holotype, female).

90. antenna; 91. antenna; 91'. sensory club on second segment of antenna; 92. rate-like organ; 93. second thoracopod, 94. second thoracopod, detail distal part; 95. mandibula, detail of coxal plate; 96. first thoracopod; 97. furca and furcal attachment. (from type-locality: Greytown, Natal).

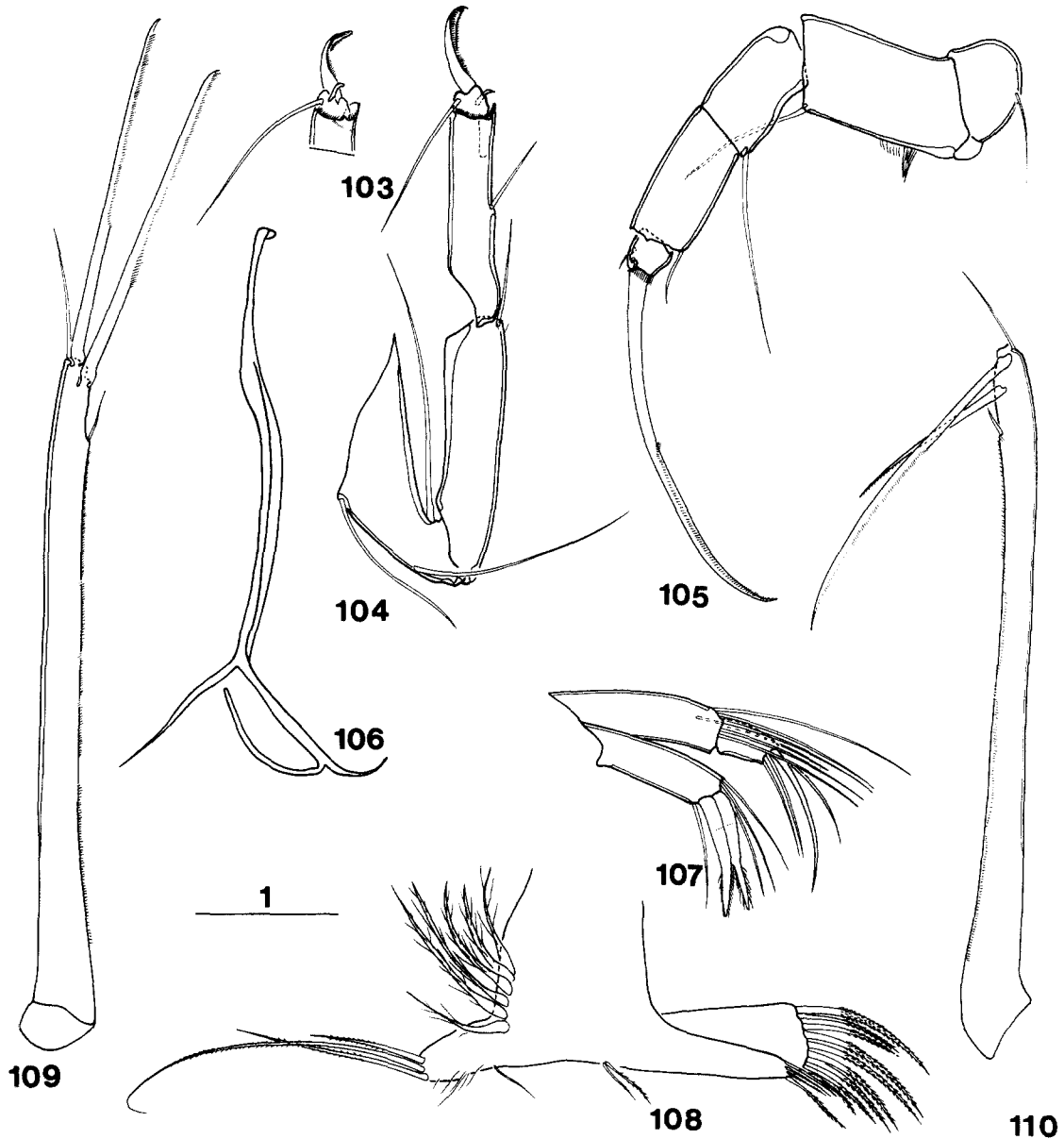
Scales: 1 = 200 μm for 90, 91, 93, 95, 96, 97; 2 = 50 μm for 91', 92, 94.



Figs. 98-102. Paracypretta amati sp.n. (female).

98. antennula; 99. antenna; 100. mandibula + palp; 101. mandibular palp, showing alpha, beta and gamma setae; 102. mandibula, detail of coxal plate (all from loc. 4).

Scale: 50 μ m for 98-102.



Figs. 103–110. *Paracypretta amati* sp.n. (female).

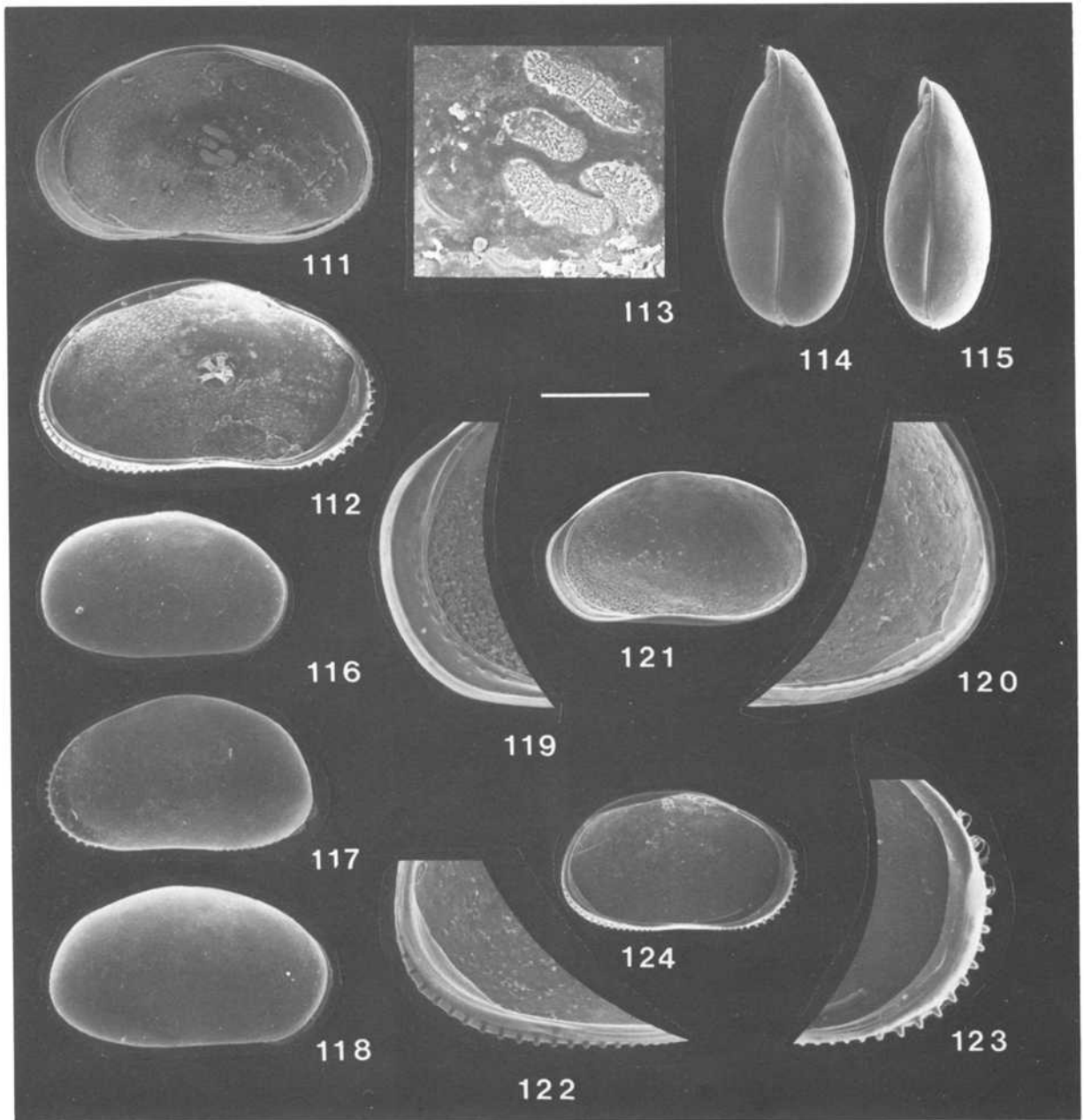
103. second thoracopod, detail of distal part; 104. second thoracopod; 105. first thoracopod; 106. furcal attachment; 107. maxillular palp and third endite; 108. maxilla; 109. furca; 110. furca (all from loc. 4).
Scale: 50 μm for 103–110.

In dorsal view (Figs. 56–58) LV overlapping RV widely in the front, moderately in the back; RV slightly overlapping LV dorsally, front part of both valves forming a weak rostrum; greatest width situated in the middle.

In ventral view (Fig. 59) LV overlapping RV ventrally; rostrum obvious. Colour of live animals unknown.

Antennula (Fig. 98) 7-segmented; length-ratio's of 5 terminal segments: 32:19:14:14:16; terminal joint clearly longer than penultimate segment; natatory setae equal to 2.5 times length of 5 terminal segments combined.

Antenna (Fig. 99) with minute terminal segment, the latter being about 3 times as long as wide; natatory setae reaching beyond tips of claws with a



Figs. 111–124. Hemicypris intermedia (Lindroth).

111. RV, internal view (female); 112. LV, internal view (female); 113. muscle scars, LV; 114. C, dorsal view (female); 115. C, dorsal view (male); 116. RV, external view (male); 117. LV, external view (female); 118. RV, external view (female); 119. RV, internal view, detail front (male); 120. RV, internal view, detail caudal part (male); 121. RV, internal view (male); 122. LV, internal view, detail caudal part (male); 123. LV, internal view; detail front (male); 124. LV, internal view (male) (all from loc. 3).

Scale: 83 μm for 113; 190 μm for 119, 120, 122, 123; 360 μm for 111, 112; 430 μm for 114–118, 121, 124.

fraction of their length; 3 long claws on penultimate segment and one long and one short claw on second segment; sensorial club on ventral side on second segment long.

Mandible (Fig. 100) stout, with four-segmented palp; α , β and γ setae on the latter as shown in Fig. 101, shape of these setae as in the generic diagnosis.

Maxillular palp (Fig. 107) with cylindrical terminal joint, the latter bearing 1 stout claw and 3 shorter setae; 2 'zahnborsten' on third endite set with setulae on the distal half.

Maxilla (Fig. 108) with a respiratory plate bearing 6 plumous rays; 3 setae on protopodite set with setulae, length-ratio's: 80:46:27.

First thoracopod (Fig. 105) long and slender; penultimate joint with one apical seta.

Second thoracopod (Fig. 104) with 3 setae on the first segment, one apical seta on the second, one marginal seta halfway the third segment and fourth segment with 1 seta, 1 'broad hair', set with 2 rows of setulae, and one hook-like structure; the latter segment is fairly well separated from the penultimate joint.

Furca (Figs. 109, 110) long and slender, with 2 claws and 2 setae; proximal claw either considerable shorter or almost equal in length to the distal claw.

Furcal attachment (Fig. 106) with dorsal branch bifurcated, the upper part being short and bent towards the front, the lower part longer and slender, bent towards the ventral branch, thus forming an imperfect eyelet.

Males unknown.

Differential diagnosis

The new species is clearly separated from all *Paracypretta*-species, except for *P. aratra*, by the width/length ratio of the valves. It is separated by the presence of the imperfect eyelet in the furcal attachment from the species in which the morphology of this structure is known: *P. ampullacea* (Mc Kenzie, 1977) and *P. aratra* (this paper).

Due to the latter feature, *P. amati* sp.n. has an isolated position in the genus, as it is very likely that the other species of the genus also lack the eyelet.

The large geographical gap (all other *Paracypretta*-species are restricted to Southern Africa) further substantiates this separation.

Provisional key to the species of *Paracypretta*

This key is mainly based on descriptions by Brady (1904), Müller (1908, 1914), Sars (1924) and McKenzie (1977).

Since important features of some species remain as yet unknown (furcal attachment, number of rays on the respiratory plate of maxilla, importance of the septa in the anterior margin of the RV), this key uses features which are of less taxonomic significance, and therefore remains provisional. It does not reveal the isolated position of *P. amati* sp.n., nor does it illustrate the possibly close relationship between *P. aratra* and *P. rubra*.

1. a. Width of shell less than 3/4 of length..... 2
- b. Width of shell equal to or larger than 3/4 of length 3
2. a. Furcal attachment with bifurcated dorsal branch, forming an incomplete eyelet with ventral branch; width/length ratio of carapace about 0.60–0.65 *P. amati*
- b. Furcal attachment with undivided dorsal and ventral branches; width/length ratio of carapace about 0.70; colour of live animals greyish-green *P. aratra*
3. a. Width/length ratio of carapace equal to about 0.75 4
- b. Width almost equal to length *P. ampullacea*
4. a. Shell surface armed with spines..... *P. acanthifera*
- b. Shell surface without spines..... 5
5. a. Shell densely covered with long hair, colour of live animals reddish... *P. rubra*
- b. Shell scarcely covered with hair, colour of live animals green or brown..... *P. syngramma* 6
6. a. Colour of live animals green; length 1.0–1.1 mm..... *P. syngramma* f.typ.
- b. Colour of live animals brown; length 0.95 mm *P. syngramma* var. *minor*

Zoogeography

The sample from the Red Sea Hills (localities 4–10) contain 15 species of which the distribution or origin is known. *Heterocypris fretensis*, although quite common in North Africa (Gauthier, 1928) is believed to be of Palaearctic origin. *Limnocythere*



Fig. 125. African localities for the genus *Paracyprretta* (+), for *Hemicypris intermedia* (x) and for *Heterocypris giesbrechtii* ⊕.

stationis is no doubt a European species.

Four species have an african origin: *Hemicypris intermedia*, *Heterocypris giesbrechtii*, *Candonopsis africana* and *Paracyprretta amati* n.sp. The three unidentified species of *Hemicypris* are either Oriental or Ethiopian, as this genus is restricted to these realms.

Six species have a wider distribution (*Stenocypris major*, *Cyprretta seurati*, *Ilyocypris gibba*, *Plesioocypridopsis newtoni*, *Cypridopsis vidua* and *Heterocypris incongruens*). At least the latter four are cosmopolitan. This relatively high number of cosmopolitan species is probably due to the type of biota that was mostly sampled: ephemeral pools in temporary rivers.

Apart from this, it is clear that the main part of the fauna has an African origin. This is not surprising, because the Red Sea Hills are connected with the River Nile through temporary river systems such as the Wadi Amur and the Nile constantly introduces Ethiopian faunal elements. The genus *Paracyprretta* has a very intriguing distribution: thus far it was believed to be restricted to southern Africa. *P. amati* is separated from its congeners by a wide geographical gap, as no representatives of this genus are found between Natal and the Red Sea Hills; even from the East African Rift Valley lakes, which be-

long to the best studied aquatic biota in Africa, no *Paracyprretta*-species are reported (see Vávra, 1897; Daday, 1910a, Lindroth, 1953 and many smaller contributions by different authors). Whether such a discontinuous distribution is to be considered as a relict of an ancient, more widespread areal of the genus, or is caused by recent (human?) introduction cannot be said.

The Palaearctic element in our samples is more limited, though still present. Dumont (1978) suggested that a large wave of European species invaded the Red Sea area during glaciations in Europe. It is beyond the scope of this paper to confirm whether *H. fretensis* and *L. stationis* are relicts of such an invasion. Nevertheless, the presence of mainly *L. stationis* in an area where Ethiopian faunas were repeatedly introduced, doubtlessly offers support to Dumont's theory. A survey of the late Quaternary sediments of these biota could solve this problem.

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The author is Research Assistant at the National Fund for Scientific Research (Belgium).

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