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Two new species of the genus *Phlyctenophora* Brady, 1880 (Crustacea, Ostracoda) from the Indo-Pacific realm

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Abstract

Two new species of the genus *Phlyctenophora* are described, one from Cape Range, Australia, and one from Sulawesi, Indonesia. This is the first time that appendages of *Phlyctenophora* species are described with certainty. The discovery of a new organ on the antennule, and the morphology of the vestibulum of premature male valves are discussed. The taxonomic position of the genus *Phlyctenophora* and the status of the type species are commented upon.

Key words: Ostracoda, taxonomy, Indo-Pacific, new organ, premature valves, new species.

Resumé

Deux nouvelles espèces du genre *Phlyctenophora* sont décrites une du Cape Range, Australie et une du Sulawesi, Indonésie. Il s'agit de la première description des appendices de nouvelles espèces de *Phlyctenophora*. La découverte d'un nouvel organe, situé sur l'antennule et la morphologie du vestibulum chez des mâles prématures sont discutées. La position taxonomique du genre *Phlyctenophora* et la définition de l'espèce-type sont commentées.

Mots-clés: Ostracoda, taxonomie, Océan Indo-Pacifique, nouvel organe, valves prématures, nouvelles espèces.

Introduction

Although species of the genus *Phlyctenophora* Brady, 1880 are not uncommon in the Indo-Pacific, the taxonomic position of the genus has long been a matter of debate. This is largely due to the confusion created by the designation of the type species *Phlyctenophora zealandica* by Brady. The valves figured by Brady, and the soft parts do not belong to the same species. Subsequent authors therefore have used only a part of the species definition presented by Brady. The available type material of *Phlyctenophora zealandica* is from Humboldt Bay, Papua New Guinea. From this material Puri & Hulings (1976, plate 1, fig. 17-18) designated a lectotype of the species. There are no dissection slides preserved in the Brady collection (personal communication D.J. Horne). Comparison of the new species described in the present paper, with the type material in the Hancock Museum clearly shows that the species described here belong to the same genus, i.e. *Phlyctenophora*. It is hoped that the description of these two new species will contribute to a better understanding of this somewhat controversial genus.

Taxonomic descriptions

Subclass Podocopa Müller, 1984
Superfamily Cypridoidea Baird, 1845
Family Candonidae Kaufmann, 1900
Subfamily Paracypridinae Sars, 1923

Genus ***Phlyctenophora*** Brady, 1880

Phlyctenophora mesembria sp. nov.
(Figs 1-13, Plate 1, figs 1-4)

DERIVATION OF NAME

From Greek *mesembria* = the South, referring to Australia (*mesembria* is used as a noun in apposition).

TYPE LOCALITY

N.W. Australia, Cape Range, Yardie Creek rockhole (C510), 22°20' S, 113°49' E, leg. R.D. Brooks, 4th of July, 1993 (sample number BES 2357).

HOLOTYPE

A dissected male, with valves stored dry, and soft parts preserved in a glycerine preparation (WAM c24403), deposited in the Western Australian Museum, Perth, Australia.

PARATYPES

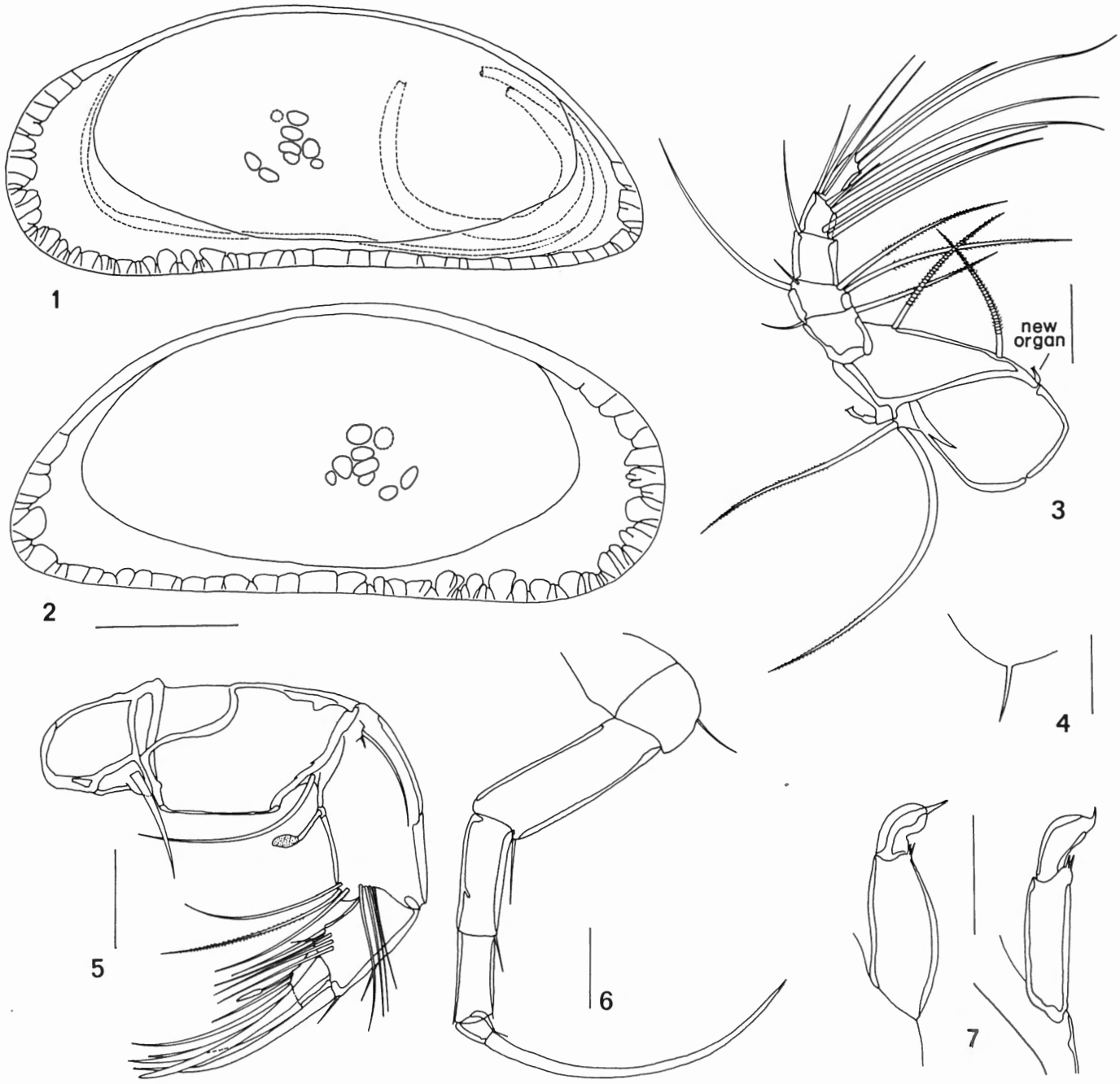
Five dissected males and four dissected females (WAM c24404-WAM c24412), 32 adult males and females and 21 juveniles preserved in ethanol, deposited in the Western Australian Museum (WAM c24413).
One dissected male and one female (O.C. 2231 and 2232) deposited in the Royal Belgian Institute of Natural Sciences, Brussels, Belgium.

DIAGNOSIS

Medium-sized to large valves, with blunt posterior extremity (in lateral view); dorsal process of dorso-median lobe of hemipenis narrow and medium-sized.

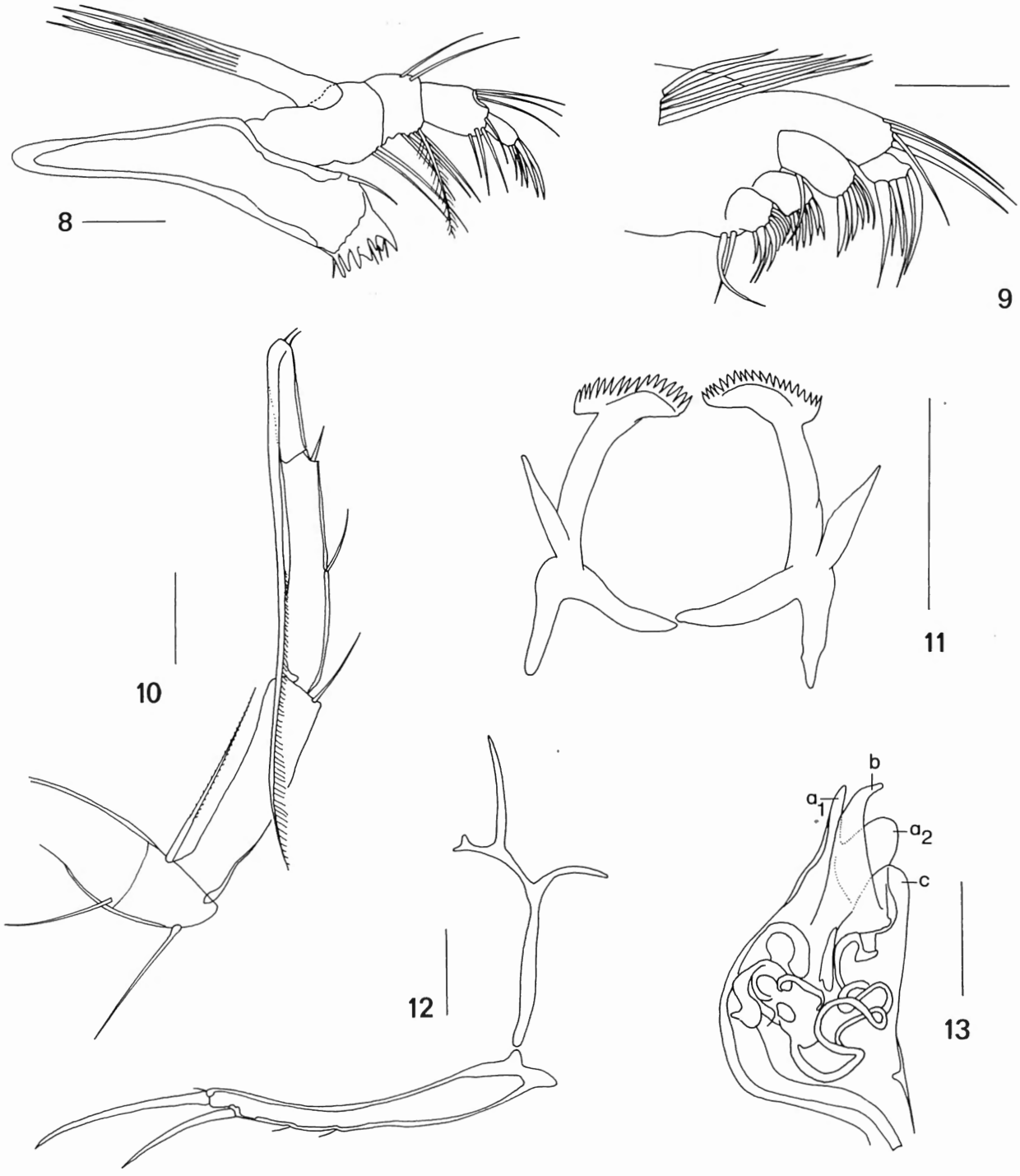
DESCRIPTION

Valves (Fig. 1, 2, Pl. 1, Fig. 1-4) large and elongate, relatively thick-shelled, translucent and very smooth, with



Figs 1-7. - *Phlyctenophora mesembria* sp. nov., Yardie Creek, Cape Range, Australia.
Fig. 1. Right valve, internal view, male, holotype (WAM c24403). Fig. 2. Left valve, internal view, female, paratype (WAM c24409). Fig. 3. Antennule, holotype. Fig. 4. Abdominal spine, female, paratype (WAM c24409). Fig. 5. Antenna, female, paratype (WAM c24409). Fig. 6. Second leg, holotype. Fig. 7. Male clasping organs, holotype. Scales: figs 1 - 2: 200 µm; 3 - 7: 50 µm.

an overall subtriangular shape; anterior margin broadly rounded; dorsal margin convex; antero-dorsal margin straight to very weakly concave (in the right valve); ventral margin nearly straight; transition between anterior, dorsal and ventral margins smooth, without angles; transition between dorsal and postero-ventral margin very narrowly rounded, almost pointed; greatest height located in front of mid-length; carapace in dorsal view spindle-shaped, with pointed extremities; greatest width somewhat in front of in the middle. Sexual dimorphism indistinct: female valves slightly higher than males. Anterior and posterior inner lamella wide; zone of concrescence narrow; numerous, strongly bifurcated marginal pore canals; anterior and posterior vestibulum deep and open; muscle scar pattern consisting of an anterior row of four oval to subcircular scars, and one large and one small scar behind this row; clearly visible subcircular fulcral point. Hinge adont.



Figs 8-13. - *Phlyctenophora mesembria* sp. nov. Yardie Creek, Cape Range, Australia.
Fig. 8. Mandible, holotype (WAM c24403). Fig. 9. Maxillule, holotype. Fig. 10. Third leg, cleaning limb, holotype. Fig. 11. Rake like organ, male, paratype (WAM c24407). Fig. 12. Furca and attachment, holotype. Fig. 13. Male copulatory appendage, holotype. All scales: 50 µm.

Antennule (Fig. 3) strongly developed; fairly slender, seven podomeres separate; segments 1 and 2 fused; setae long and slender; Rome's organ on second segment large; on opposite side of the first segment a new organ, resembling the Rome's organ in shape, but somewhat smaller.
Antenna (Fig. 5): five segments separate in males, four in females; podomeres 4 and 5 distinctly divided in males, but fused in females; short swimming setae reaching slightly beyond the tip of the terminal segment; Y-aesthetasc with a long stalk and an inflated terminal element, with granulated appearance.
Mandibula (Fig. 8): vibratory plate of palp with six indistinctly feathered rays, five long ones, one medium-sized and one short; molar teeth bifid or trifid.

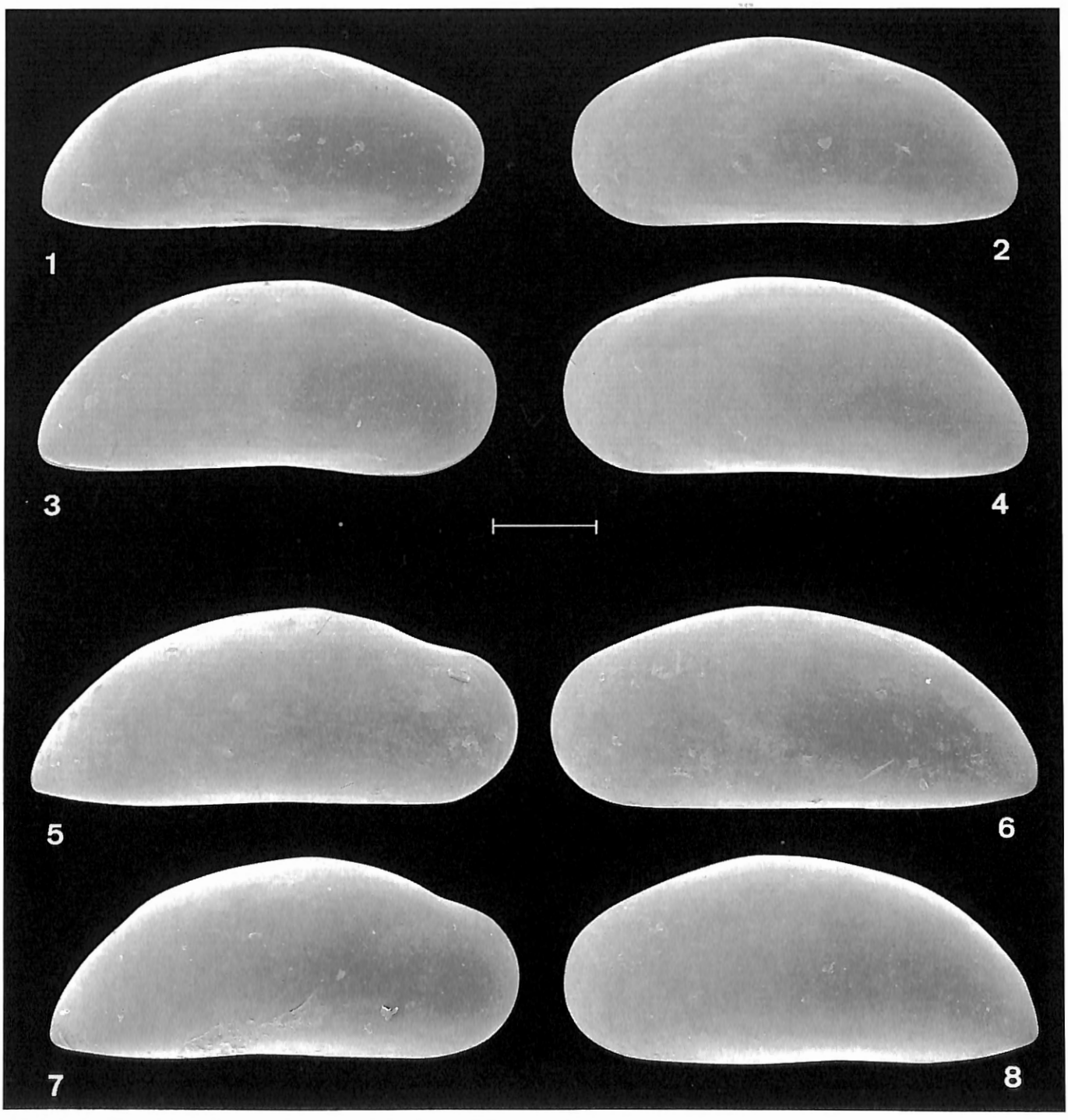


Plate 1

Figs 1-4. - *Phlyctenophora mesembria* sp. nov., Yardie reek, Cape Range, Australia. Scale: 200 µm.
Fig. 1. Right valve, male, paratype (WAM c24404). Fig. 2. Left valve, male, paratype (WAM c24404). Fig. 3. Right valve, female, paratype (WAM c24411). Fig. 4. Left valve, female, paratype (WAM c24411).

Figs 5-8. - *Phlyctenophora polygona* sp. nov., Sulawesi, Panikiang Island.
Fig. 5. Right valve, male, paratype (O.C. 2234). Fig. 6. Left valve, male, paratype (O.C. 2234). Fig. 7. Right valve, female, paratype (O.C. 2237). Fig. 8. Left valve, female, paratype (O.C. 2237).

Maxillule (Fig. 9): with a two-segmented short palp; terminal segment subrectangular; vibratory plate with five mouthward-directed rays.
First leg (Fig. 7): male clasping apparatus with elongated subrectangular body (first segment), and short, swollen terminal hook (second segment); pegs very short.
Second leg (Fig. 6): six-segmented, with a very long and slender curved terminal claw; terminal segment small.
Third leg (cleaning limb)(Fig. 10): five-segmented; two short terminal setae, and one long reflexed seta, with terminal setules arranged in a comb-like pattern.
Furca (Fig. 12): large and slightly curved; one short distal seta and two large slightly curved terminal claws; two short and thin posterior setae.
Furcal attachment (Fig. 12) simple, with slightly curved central axis and three branches.
Copulatory appendage (Fig.13) with three lobes: a large dorso-median lobe (a), consisting of a long and pointed dorsal process with nearly parallel lateral margins (a_1), and a broadly rounded dorso-median element (a_2), a large curved, hook-like median lobe (b) and a broadly rounded ventral lobe (c).
Lower lip (Fig. 11) developed as a rake with about sixteen to twenty teeth.
Zenker's organ: with five rosettes of spines and two end plates (for terminology, see Matzke-Karasz, 1997); distal end of spine simple, or in most cases bifid or sometimes even trifid; spines on rosettes absent in some specimens. The absence of spines is interpreted as being the premature state (see Wouters, 1998)

MEASUREMENTS

Holotype: length 0.92 mm; height 0.39 mm.
Paratypes: length 0.90 - 0.94 mm; height 0.36 - 0.41 mm.

OCCURRENCE & ECOLOGY

The new species is known from Yardie Creek, the type locality. Yardie Creek is a short, less than two kilometres long gorge, extending into Cape Range (Australia). This gorge is the only permanent inland water within c. 100 km. The creek, which is generally closed by a sandbar that is breached by exceptional tides and/or rainfall, is a mixohaline system that ranges from fully marine to freshwater (Hymphreys, in press).

DIFFERENTIAL DIAGNOSIS

Phlyctenophora mesembria sp. nov. closely resembles *Ph.* cf. *zealandica* Hartmann, 1979 from the west coast of Australia (between Perth and Eucla). Both species have a narrowly rounded, not pointed, posterior extremity (in lateral view). The new species, however, is higher, and more elongate, and has an evenly arched dorsal margin. Appendages of the latter species are unknown. *Ph.* cf. *zealandica* Hartmann, 1979 is closely related to, or identical with *Ph. bentleyi* Whatley, Cooke & Warne, 1996 from Lee Point (Northern Australia).
From *Ph. orientalis* (Brady, 1868), the new species differs by the rounded posterior extremity (in lateral view) and by the morphology of the hemipenis. In the new species the median lobe (b) is shorter and distally curved, and the dorso-median lobe (a_1) is much shorter. According to Whatley & Zhao (1987) and Mostafawi (1992), *Ph. zealandica* Brady, 1880 is a junior synonym of *Ph. orientalis* (Brady, 1868), a point of view which is accepted here.
Phlyctenophora polygona sp. nov. differs from other species by the pointed posterior extremity (in lateral view), and by the polygonal cellular pattern clearly visible in transmitted light.
Phlyctenophora bhatiai Jain, 1976 is less elongated, and higher than the new species, has a concave ventral margin, and a strongly arched postero-dorsal margin, especially in the right valve.

Phlyctenophora polygona sp. nov.
(Figs 14-23, Plate 1, figs 5-8)

DERIVATION OF NAME

From Greek *polygona*, because of the polygonal cellular pattern, visible in transmitted light.

TYPE LOCALITY

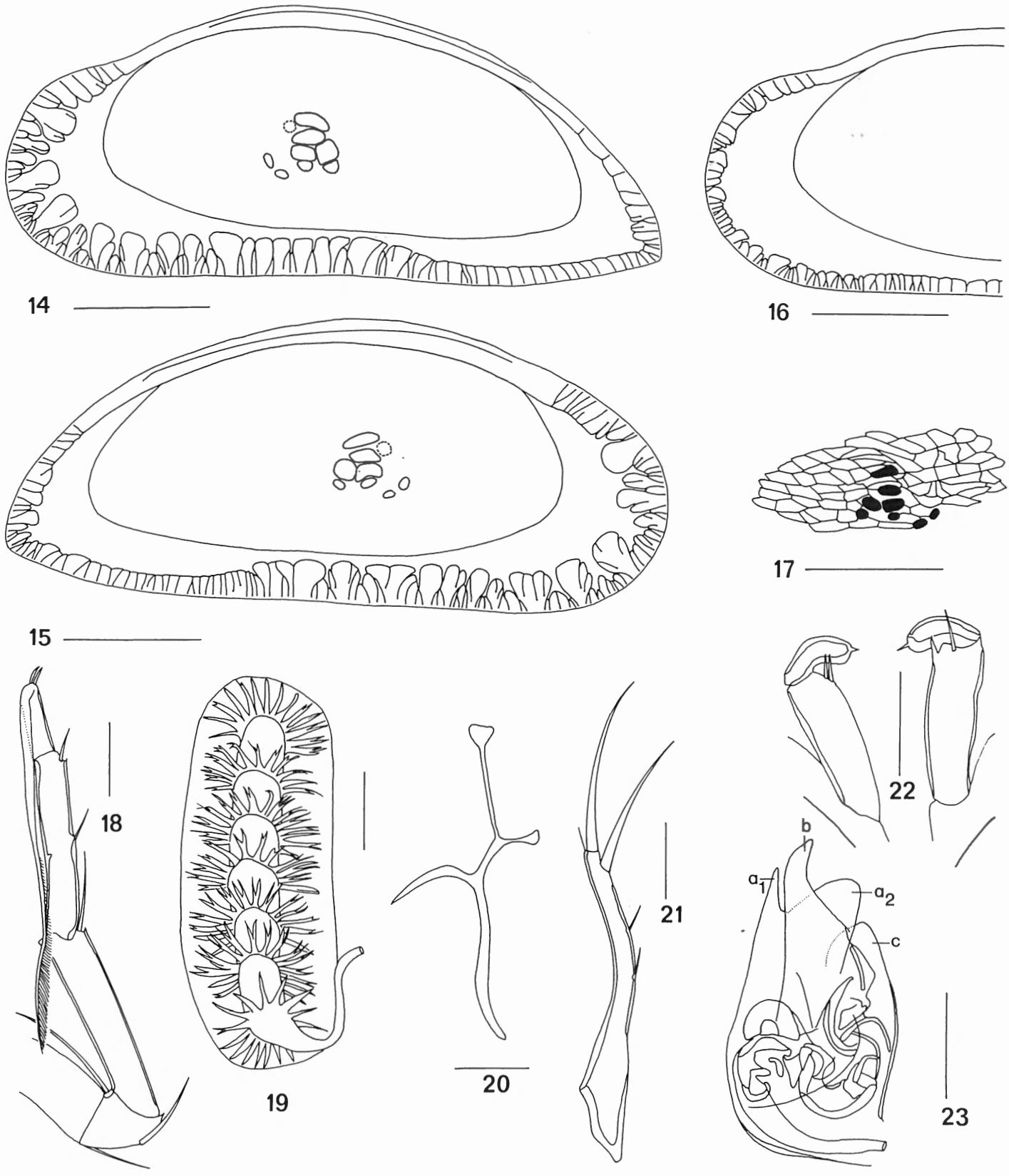
Indonesia, S.W. Sulawesi, Panikiang Island (a small island off the village of Garong Kong), 4°24' S, 119°35' E, collected on sand on a steep reef slope (45°) at a depth of 15 m. Leg.: Cl. Massin, 29 August 1994 (sample number 94/38).

HOLOTYPE

A dissected male, with valves stored dry, and soft parts preserved in a glycerine preparation (O.C. 2233), deposited in the Royal Belgian Institute of Natural Sciences, Brussels, Belgium.

PARATYPES

One dissected male (O.C. 2234), 13 adult valves and 2 carapaces, 5 juvenile valves and one carapace, deposited in the Royal Belgian Institute of Natural Sciences (O.C. 2235-2238).



Figs 14-23. - *Phlyctenophora polygona* sp. nov. Sulawesi, Panikiang Island.
Fig. 14. Right valve, internal view, male, holotype (O.C. 2233). Fig. 15. Left valve, internal view, male, holotype. Fig. 16. Right valve, internal view, male (immature), paratype (O.C. 2234). Fig. 17. Polygonal cellular pattern, seen in transmitted light, left valve, internal view, male, paratype (O.C. 2234). Fig. 18. Third leg, cleaning limb, holotype. Fig. 19. Zenker's organ, holotype. Fig. 20. Furcal attachment, male, paratype (O.C. 2234). Fig. 21. Furca, male, paratype (O.C. 2234). Fig. 22. Male clasping organs, holotype. Fig. 23. Male copulatory organ, holotype.

OTHER MATERIAL

One left valve from Bone Tambung Island, west of Ujung Pandang (Sulawesi), on sand, depth 24 m, leg.: Cl. Massin, 29 August 1994 (O.C. 2239).

DIAGNOSIS

Large valves, with pointed posterior extremity (in lateral view); antero-dorsal margin concave in right valve; distinct polygonal cellular pattern in transmitted light; dorsal process of dorso-median lobe of hemipenis short.

DESCRIPTION

Valves (Fig. 14-17, Pl. 1, Fig. 5-8) large, translucent and smooth; anterior margin broadly rounded; dorsal margin strongly convex; antero-dorsal margin with a distinct concavity; ventral margin nearly straight; transition between dorsal and postero-ventral margin pointed; greatest height located at one third of the length; carapace in dorsal view spindle-shaped, with pointed extremities and evenly curved lateral margins; greatest width in the middle. Sexual dimorphism weakly pronounced: female valves somewhat higher than those of males. Anterior and posterior inner lamella wide; zone of concrescence moderately wide, and irregular; numerous, strongly bifurcated and polyfurcated marginal pore canals, arranged in a complex marginal pore pattern; anterior and posterior vestibulum deep and open; striking cellular pattern consisting of numerous polygonal elements (Fig. 17) in transmitted light; muscle scar pattern consisting of an anterior row of four scars, and one large and one small scar behind this row; clearly visible small subcircular fulcral point. Hinge adont.

Antennule: as in the preceding species. New organ on first segment (opposite side to the large Rome's organ) present, of the same dimensions.

Antenna: five segments separate in males, four in females; podomeres 4 and 5 distinctly divided in males (fused in females); short swimming setae reaching beyond the tip of the terminal segment, but ending before one third of terminal claws; long, sigmoid male bristles; Y-aesthetasc with a long stalk and an elongate terminal element, with longitudinally striped appearance.

Mandibula: vibratory plate of palp with seven rays, five long ones, one medium-sized and one short; molar teeth strongly developed, bifid or trifid.

Maxillule: with a two-segmented short palp; terminal segment subrectangular; vibratory plate with five mouthward-directed rays.

First leg (Fig. 22): male clasping organ with elongated body (first segment); terminal hook (second segment) short, swollen and curved; pegs on first segment moderately long.

Second leg: six-segmented, with a long and slender curved terminal claw and short distal seta on fourth segment; terminal segment small.

Third leg (cleaning limb)(Fig. 18): five-segmented; two short terminal setae, and one long reflexed seta, with terminal setules arranged in a comb-like pattern.

Furca (Fig. 21): shaft curved; one short distal seta and two long an slender terminal claws; two short posterior setae.

Furcal attachment (Fig. 22): with curved central axis and three branches.

Copulatory appendage (Fig.23) with three lobes: a large dorso-median lobe (a), consisting of a moderately long pointed dorsal process with nearly tapering lateral margins (a_1), and an obliquely rounded dorso-median element (a_2), a large curved, hook-like median lobe (b) and a bluntly rounded ventral lobe (c).

Lower lip: as in the preceding species.

Zenker's organ (Fig. 19): as in the preceding species, with five rosettes of spines and two end plates; end of spines simple, bifid or trifid; one of the dissected males lacked spines.

MEASUREMENTS

Holotype: length 0.99 mm; height 0.42 mm.
Paratypes: length 0.95 - 1.01 mm; height 0.39 - 0.45 mm.

OCCURRENCE & ECOLOGY

The new species is known from the type locality, Panikiang Island, a small coral island, where it was collected at a depth of 15 m on a sandy slope. The salinity at the time of collection is unknown, but is supposed to be fully marine, with small (?) salinity fluctuations during the rainy season. One left valve was found at Bone Tambung Island, west of Ujung Pandang (Sulawesi), in sand, collected at a depth of 24 m.

DIFFERENTIAL DIAGNOSIS

Phlyctenophora polygona sp. nov. shows a close resemblance to *Ph. orientalis* (Brady, 1868). The new species, however, differs by the more steeply descending postero-dorsal margin, the distinct antero-dorsal concavity (in the right valve) and by the presence of a distinct polygonal cellular pattern (in transmitted light). The morphology of the lobes of the hemipenes of both species is markedly different. In *Ph. polygona* sp. nov. the dorso-median lobe (a_1) is much shorter, and the median lobe (b) is shorter and broader than in *Ph. orientalis*.

General discussion

TAXONOMY

The taxonomic position of the genus *Phlyctenophora* Brady, 1880 has long been a matter of debate. This is

largely due to the confusion created by the designation of the type species, *Phlyctenophora zealandica* by BRADY, and by the fact that subsequent authors may have used a different species definition than BRADY's. The valves figured by BRADY (1880, pl. 3, figs. 1a-d) and the appendages (pl. 3, figs 3e-m), probably do not belong to the same species. The valves figured by BRADY correspond very well with the specimens kept in the Hancock Museum. The appendages, however, do not comply with new material of *Ph. zealandica* from Indonesia (see below). The material of *Ph. zealandica* present in the BRADY collection in the Hancock Museum (Newcastle upon Tyne) consists of a micropalaeontological slide (n°2.09.20), with twenty juvenile specimens of *Bairdia amygdaloides* BRADY, 1865, and five strongly decalcified valves and one carapace of *Ph. zealandica*. There are no dissection slides of this species preserved in the BRADY collection (pers. comm. D.J. HORNE, February 2nd, 1999). PURI & HULINGS (1976) designated a left and right valve of a disarticulated carapace as the lectotype of the species, based on topotypic material from Humboldt Bay (BM.81.5.7). These authors emphasize that this may not represent BRADY's definition of this species. However, comparison of the specimens kept in the Hancock Museum, with figures 17 and 18 of PURI & HULINGS (1974) and with Fig. 1a, Plate 3 of BRADY (1880), clearly indicates that they all belong to the same species, and that BRADY's specimens from Humboldt Bay were certainly at the base of his description of *Ph. zealandica*, together with material of a second species (*Tasmanocypris* sp.?), from New Zealand. Material from Wellington Harbour (New Zealand, hence the specific name *zealandica*) is not preserved in BRADY's collection. As a matter of fact, the designation of a lectotype, from topotypic material is more a neotype than a lectotype. If, however, the designation of a lectotype by PURI & HULINGS (1974) is accepted, a point of view which I strongly recommend, then it is binding. According to article 74, a, i of the International Code of Zoological Nomenclature, (Third Edition, 1985) "The valid designation of a lectotype fixes the status of the specimens; no later designation of a lectotype has any validity", and article 74, a, iii: "The place of origin of the lectotype becomes the locality of the nominal species despite any previously published statement of the type locality". The type locality of *Ph. zealandica* then is Humboldt Bay, New Guinea (Irian Jaya), depth 37 fathoms. The designation of the lectotype is in agreement with what most subsequent authors called *Ph. zealandica*, and solved a taxonomical problem that has existed for more than a century.

From the description of the two new species, and the comparison with related species, it appears that the differences between *Phlyctenophora* species are not always very pronounced. In the cases presented here, the morphology of the appendages was an important tool in discriminating between species. The valves of *Ph. orientalis* and *Ph. polygona* sp. nov. are very much alike, with exception of a few details. On the basis of the differences in the morphology of the copulatory appendage, however, it is possible to distinguish unequivocally between these two species. A relatively large number of *Phlyctenophora* species has been described or mentioned in the literature. For a number of those, essential characteristics, such as the muscle scar pattern, the vestibulum and marginal pore canals, have not been figured or described. The revision of all known *Phlyctenophora* species, therefore, will be a rather extensive task. It is hoped that the description of the two new species in this paper is a first step towards unravelling the taxonomical confusion. The redescription of valves and appendages of *Ph. orientalis* (= *Ph. zealandica*), based on newly acquired material from Indonesia, together with a comparison with other genera, will be published in a forthcoming paper. The interpretation of the affinities of the genus *Phlyctenophora* with related genera, and especially with the genus *Aglaiella* DADAY, 1910, needs further elaboration. The taxonomy of marine and brackish cypridoideans remains difficult and confused, partly

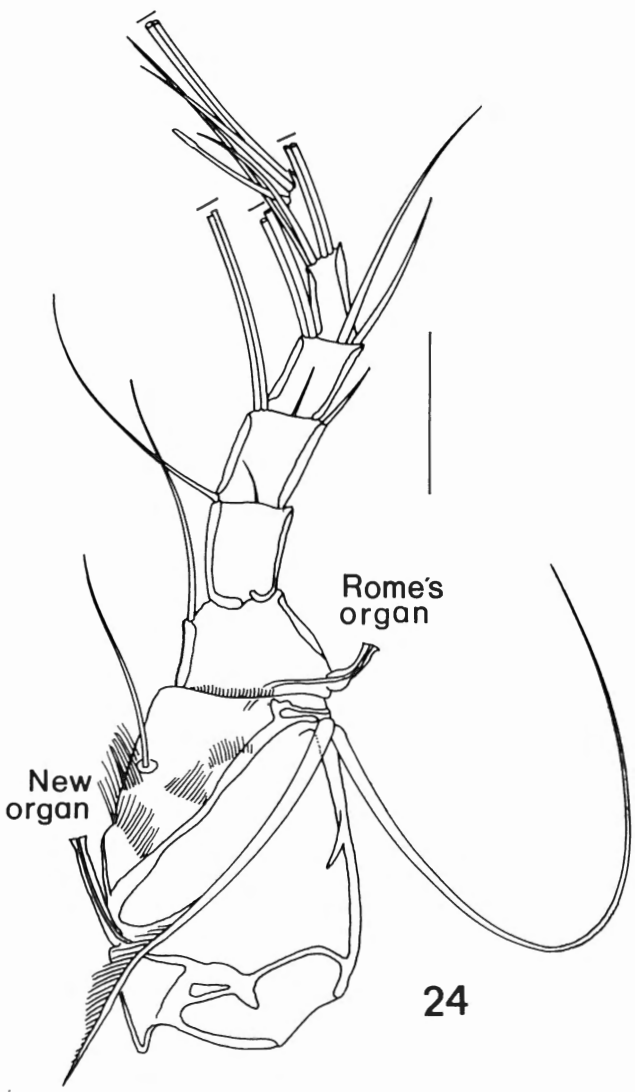


Fig. 24. -Antennule of male paratype of *Paracypria inujimensis* (OKUBO, 1980) from the Inland Sea of Japan, Inujima Island, intertidal zone (Leg.: I. OKUBO, 18 July 1978). Scale: 50 µm.

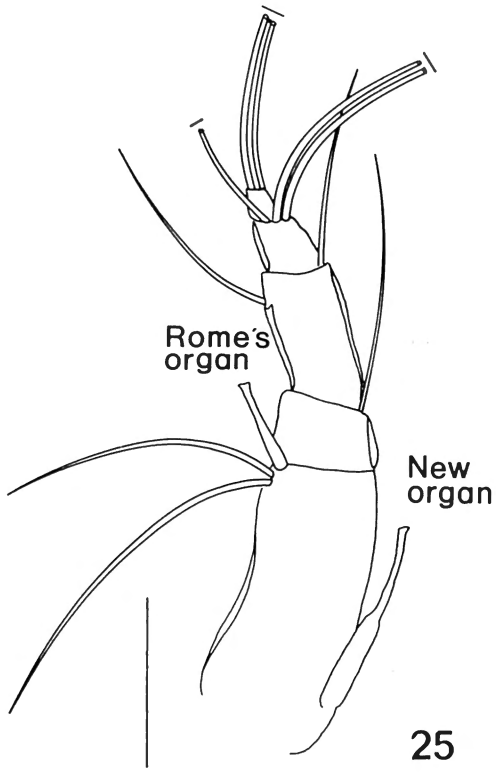


Fig. 25. -Antennule of male *Gerdocypris muelleri* McKenzie, 1983, from Corsica, Gulf of Calvi, Bay of Revellata, depth 25 m (Leg.: D. Bay, 17 July 1978). Scale: 50 µm.

because of insufficiently detailed descriptions of the type species of the different genera, and partly because of the presence of homeomorphies, as already emphasized by McKenzie (1982) and Maddocks (1988).

NEW ORGAN

Rome (1947) described for the first time a small organ on the dorsal side of the second segment of the antennule of *Herpetocypris reptans*. He interpreted it as a chemoreceptive organ. Later it was called "Glockenformiges Organ" (Hartmann, 1976), who reported it also from other cypridoidean species. Finally, this chemoreceptor organ was called Rome's organ by Broodbakker & Danielopol (1982).

The two new species of *Phlyctenophora* described here, both have a new organ, situated on the proximal ventral side of the first segment of the antennule, i.e. on the opposite side of the Rome's organ. It is generally smaller than the Rome's organ, but it has the same overall appearance. This new organ is not restricted to the new species described here, but it was also observed by the present author in other species, such as *Gerdocypris muelleri* McKenzie, 1983, *Gerdocypris croneisi* (Teeter, 1975)(comb. nov.), *Ghardaglaia triebeli* Hartmann, 1964, *Paracypria inujimensis* (Okubo, 1980), *Paracypria inopinata* (Klie, 1939)(comb. nov.), *Aglaiella stagnalis* Daday, 1910, *Aglaiella westfordensis* (Benson & Maddocks, 1964)(comb. nov.), *Mungava munda* Harding, 1962, *Mungava intermedia* Wouters, 1987, *Renaudcypris wolffi* (Harding, 1962) and *Hansacypris glabra* Wouters, 1984. In most of these species the new organ is small to very small, with exception, however, of *Paracypria inujimensis* (Fig. 24) and *Gerdocypris muelleri* (Fig. 25) where the new organ is remarkably large. The presence or absence of the new organ in other cypridoidean genera still needs to be assessed. It is likely that more genera of the Cypridoidea have the new organ, and if they do not have it, they may well have a pore, without a tube-like expansion, at the same position. The striking similarity between the Rome's organ and the new organ suggests a similar function, namely chemoreception. This hypothesis, however, needs further confirmation.

PREMATURE MALE VALVES

In the two new species described here, specimens were found with Zenker's organs without spines on the rosettes. As already pointed out by Wouters (1998), the absence of spines is an indication of the premature state of the specimen, and has no taxonomic value whatsoever. These premature specimens not only have rosettes without spines in the Zenker's organ, but also have a narrow zone of concrescence with short marginal pore canals in the valves (Fig. 16). Some other specimens, with adult dimensions, and with a Zenker's organ with spines, also showed a narrower zone of concrescence than in other mature males. This means that after the final molt, the chitinisation of the Zenker's organ (and of the hemipenes) is still not fully completed, but also that the calcification of the inner lamella is not yet complete, and that calcification, widening of the zone of concrescence and the elongation of the marginal pore canals continues until fully mature state is achieved. This has as a consequence that in a population consisting of loose adult valves there can be a marked variability in the width of the zones of concrescence, due to presence of (rare) premature specimens having zones of concrescence not fully developed. This difference in the width of the zone of concrescence could cause taxonomic misinterpretations. To avoid this, the observation of long series of specimens is required.

Acknowledgements

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