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Triebelina ? pustulata KEIJ, 1974 from the Maldive Islands : more homeomorphy in the ornate Bairdiidae (Ostracoda)

by Rosalie F. MADDOCKS & Karel A. WOUTERS

Abstract

The male anatomy of *Triebelina ? pustulata* KEIJ, 1974 suggests affinities to *Paranesidea* rather than to *Triebelina*. It appears that as many as six lineages may have produced ornate reefal Bairdiidae : *Glyptobairdia, Triebelina, Mydionobairdia, Havanardia, Pterobairdia* and *Triebelina ? pustulata* and related species.
Keywords : Ostracoda, Bairdiidae, Indian Ocean, homeomorphy.

Résumé

La morphologie du mâle de *Triebelina ? pustulata* KEIJ, 1974 montre que l'espèce appartient plutôt au genre *Paranesidea* qu'au genre *Triebelina*. Il semble que parmi les Bairdiidae ornés des récifs de coraux, l'on puisse distinguer au moins six lignées différentes : *Glyptobairdia, Triebelina, Mydionobairdia, Havanardia, Pterobairdia* et *Triebelina ? pustulata* et espèces voisines.
Mots-clefs : Ostracoda, Bairdiidae, Océan Indien, homéomorphie.

Introduction

The ornate Bairdiidae are small to medium-sized, thick-shelled, heavily ornamented forms, largely but not entirely restricted to reefal habitats. In recent years the Holocene and young Cenozoic representatives have received considerable attention (POKORNÝ, 1968; KEIJ, 1973, 1974, 1976; VAN DEN BOLD, 1974; MCKENZIE & KEIJ, 1977; PALACIOS-FEST & GÍO-ARGÁEZ, 1979; MALZ & LORD, 1988; JELLINEK, 1989). As a consequence, the major features of carapace structure are now well documented for a number of species of *Triebelina, Glyptobairdia, Mydionobairdia, Havanardia* and *Pterobairdia*, and the phylogenetic relationships of some of these may be traced well back into the Cenozoic. However, it is not clear yet whether the modern ornate Bairdiidae are lineal descendants of similar Triassic representatives (KOLLMANN, 1960, 1963; BOLZ, 1971a, 1971b; KOZUR, 1971; KRISTAN-TOLLMANN, 1971). The obvious adaptive value of carapace structure and the frequency of homeomorphy in Ostracoda require that much care be used in testing phylogenetic hypotheses based on external characters.

Internal structures of the carapace, especially the hingement and muscle scars, add essential phylogenetic information but usually at a fairly high taxonomic level (tribe or subfamily). For example, accessory bairdoppilatan dentition links *Glyptobairdia* to *Bairdoppilata*, but otherwise hingement appears to be quite uniform in Bairdiidae. Adductor muscle-scar patterns may be classified roughly into four intergradational types (bythocyprid, neonesidean, bairdian, triebelinid), but some of these types may be found in several lines. Vestibules and radial pore canals are relatively invariant except in interstitial deep-sea dwellers, while normal pore canals and marginal spines merit further attention but are not yet well categorized. To test the taxonomic reliability of these carapace characters, comparison with the soft anatomy of living representatives is essential; not that appendages and genitalia are immune from evolutionary convergence, but the greater number of soft-part characters makes it easier to evaluate taxonomic reliability and to select especially apomorphic traits as phyletic indicators.

The soft anatomy has been fully described for only six species of ornate Bairdiidae. MÜLLER (1894) illustrated only the carapace, fifth limb, genital lobe and chewing apparatus of *Bairdia raripila*, referred to *Triebelina* by DORUK (1974) and MADDOCKS (1975). MADDOCKS (1969, following suggestions by MORKHOVEN, 1958 and ROME, 1960) demonstrated that *Glyptobairdia coronata* (BRADY, 1870) is allied with *Bairdoppilata*, and that its similarities to *Triebelina* result from convergence. Likewise, *Havanardia keiji* (MADDOCKS in MADDOCKS & ILIFFE, 1986) appears to link that genus with *Neonesidea* (by way of *Aponesidea*). MADDOCKS (1969, 1975) recognized the affinities of *Triebelina bradyi, T. sertata* and *T.* aff. *raripila* to *Paranesidea* but, having only females, found it difficult to write differential diagnoses for the two genera. A new species of *Mydionobairdia* from Tulear (MADDOCKS, in press), for which only males are known, appears to be allied with but distinct from *Triebelina*.

The discovery of a male specimen of *Triebelina ? pustulata* KEIJ, 1974, briefly led us to hope that we could describe the long-sought male anatomy of *Triebelina*. As it turns out, the anatomy of that specimen is closer to *Paranesidea* than to what is known of *Triebelina*. However, this find provides occasion to examine more closely the relationship between the two genera. Here it should

Figs. 1-4. - Triebelina ? pustulata *Keij, 1974, male specimen, No O.C. 1486 (3162M) from the Maldive Islands. 1. Antenna. - 2 and 3. Antennule. - 4. Maxillule. - Magnifications : 1, 3, 4, × 320 ; 2, × 245.*

be understood that the original concept of *Paranesidea* (Maddocks, 1969) was much too heterogeneous. *Paranesidea* should be restricted to a group of largely reefal species with asymmetrical, punctate carapaces and conspicuous patch patterns. Only 13 species of *Paranesidea* have had the soft anatomy even partially described (see Table 1).

The male anatomy of *Triebelina ? pustulata* clearly places this species into the *Paranesidea-Triebelina-Mydionobairdia* group, as distinguished from, for example, *Bairdoppilata-Glyptobairdia* on the one hand or *Neonesidea-Aponesidea-Havanardia* on the other. Table 1 compares the anatomy of this species with 13 species of *Paranesidea*, four of *Triebelina* and one of *Mydionobairdia*. It is apparent that in many details this species fits *Paranesidea* better than *Triebelina*. In order not to upset matters, the species

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Systematic account

ORDER PODOCOPIDA SARS, 1866
Superfamily BAIRDIACEA SARS, 1888
Family Bairdiidae SARS, 1888
Genus *Triebelina* VAN DEN BOLD, 1946
Triebelina ? pustulata KEIJ, 1974
(Figs. 1 - 20)

Triebelina pustulata KEIJ, 1974, p. 355, pl. 2, figs. 1-4.

MATERIAL

One live male collected in the Republic of Maldives, North Malé Atoll, Baros Island, North Beach, at 1 m depth (at high tide), washed from *Halimeda* between dead coral (MAL. 80/11, I.G. 26.073), by Dr. J. VAN GOETHEM, 17 January 1980, and a loose left valve from the same sample. Both specimens are deposited in the Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussels (No O.C. 1486 and O.C. 1487).

DIMENSIONS

Male specimen (O.C. 1486) : left valve, length 0.97 mm, height 0.52 mm; right valve, length 0.94 mm, height 0.46 mm. Loose left valve (O.C. 1487) : length 0.94 mm, height 0.51 mm. This is at the upper limit of the range reported by KEIJ (1974, fig. 2) for specimens from Java Sea (approximately left valve length 0.86-0.96 mm, height 0.48-0.56).

EMENDED DIAGNOSIS

Distal tips of limbs colorless, not pigmented. Distal claw of male antenna of medium length, entirely smooth, curved rather than sharply beveled tip; accessory claw fairly short, very faintly pectinate, with only about six tiny setules; anterodistal seta distinct, not much thickened, of medium length, somewhat shorter than accessory claw. Palp of maxillule has a fairly thick, fringed distal claw and one small seta; masticatory process 3 (next to palp) has a pectinate claw and three smooth claws of nearly equal size; masticatory process 2 has one distally enlarged, spatulate, fringed claw and five small setae; masticatory process 1 (ventral) has about six small setae, none with conspicuous setules. Fifth limb with four segregated, unfeathered setae, of which the three anterior setae are about the same length and end in flattened, wedge-shaped tips, and the posterior one is somewhat shorter and appears to end in a smooth point. Distal claws of sixth and seventh legs end in smoothly curving, pointed tips rather than sharply beveled points. Furca fairly short, with six setae, seta 2 very long, smooth, setae 1 and 3 of moderate length, seta 4 slightly shorter, setae 5 and 6 quite small. Hemipenis simple, without pigmented or heavily sclerotized structures, with hemioval median segment; distal lobe extended as thin, circular, lamellar disk; distal lobe without finger-like processes, sclerotized convolutions, or accessory lamellae or appendages of any kind; copulatory rod quite short, nearly straight, not penetrating or attached to distal lobe.

Two types of exterior sensillae of carapace : (1) large simple ones, tapering, fairly thick and short, and (2) very small polyfurcate sensillae, inconspicuous except under highest magnification. Normal pore canals simple; large ones with marginal rim, smaller ones rimless.

DISCUSSION

This specimen lacks the dark brown coloration of the distal regions of the limbs that is a conspicuous feature of most reefal Bairdiidae including *Triebelina*. The chitinous structures of the carapace and limbs are clear yellow rather than dark brown, and the carapace itself is translucent and colorless rather than opaque white. This absence of color is also seen in cryptic, interstitial, and anchialine forms.

The hexagonal lateral outline, heavy marginal rims, inner anterodorsal and posterodorsal ridges, scalloped ventrolateral ridge, and loop-shaped mediolateral thickening closely resembles similar ornament in both *Triebelina* and *Glyptobairdia*. The large size, ovate-hexagonal rather than quadrangular or rhomboidal outlines, irregular rather than linear punctation, absence of lateral and maxillule, correspond to *Paranesidea* rather than *Triebelina* or *Mydionobairdia*.

The adductor muscle scar pattern (fig. 11) of divided, widely spaced scars occupying a circular field is characteristic of *Paranesidea*, as contrasted with the diagonally elongated, zigzag-linear, lacy pattern of *Triebelina*.

It must be acknowledged that assigning *Triebelina ? pustulata* to *Paranesidea* would distort the homogeneous concept of that genus argued above and would only be a temporary solution. Typical species of *Paranesidea* have a well calcified but thinner, densely punctate carapace, which lacks the marginal rims, lateral ridges, alate expansion and flattened venter of *Triebelina ? pustulata*. How-

ever, pustulose carapace ornament is not uncommon : for example in *Neonesidea conulifera* BONADUCE *et al.* (1976, Gulf of Aqaba; probably not *Neonesidea*), in *Paranesidea fracticorallicola* of HARTMANN (1981, eastern Australia; not *P. fracticorallicola* MADDOCKS), in *Paranesidea nodulifera* (BRADY, 1890) of MCKENZIE (1986, Fiji), in *Paranesidea bipustulosa* TITTERTON & WHATLEY (1988, Solomon Islands), and in an undescribed species at Nosy Bé. Other anomalous species may prove to be related to *Triebelina ? pustulata* when soft parts can be investigated. These include *Triebelina amicitiae* KEIJ, 1974 (South China Sea, Philippine Islands), *Triebelina jellineki* MALZ & LORD, 1988 (Philippine Islands), and perhaps even *Paranesidea bensoni* TEETER, 1975 (Belize, Florida, Bermuda). It seems likely that these larger, more coarsely punctate, ridged and pustulose species will eventually form the core of a new genus of ornate Bairdiidae allied to *Paranesidea*.
KEIJ (1974) reported *Triebelina ? pustulata* from the Java Sea of Indonesia and Singapore. The material described here extends its range west to the Maldive Islands.

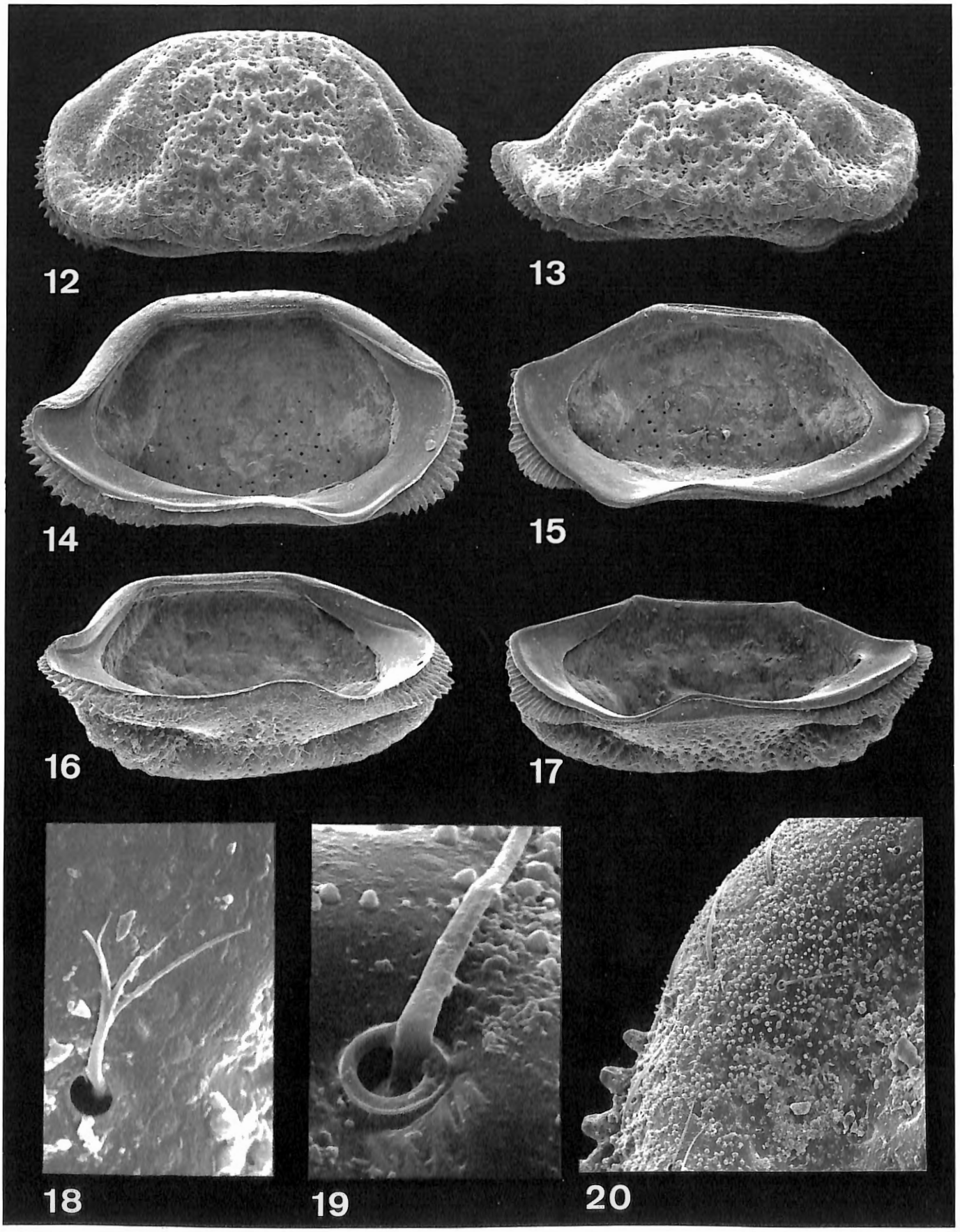
SPECIES INCLUDED IN TABLE 1

Species are listed by original binomen, with the locality from which the described specimens were collected :
Paranesidea algicola MADDOCKS, 1969; NOSY BÉ.
Bairdia arostrata KORNICKER, 1961; Bahamas.
Paranesidea fracticorallicola MADDOCKS, 1969; Nosy Bé.
Bairdia gigacantha KORNICKER, 1961; Bahamas.
Bairdia harpago KORNICKER, 1961; Bahamas.
Paranesidea onslowensis HARTMANN, 1978; west Australia.
Paranesidea parva HARTMANN, 1978; northwest Australia.
Paranesidea posidonia HARTMANN, 1979; southwest Australia.
?*Paranesidea problematica* HARTMANN, 1978; northwest Australia. The anomalous characters of this species show that it probably does not belong to *Paranesidea*, as HARTMANN recognized.
Triebelina ? pustulata KEIJ, 1974; Maldive Islands.
Paranesidea spongicola MADDOCKS. 1969; Nosy Bé.
Paranesidea sterreri MADDOCKS in MADDOCKS and ILIFFE, 1986; Bermuda.
Paranesidea sp. 2 of MADDOCKS, 1969; Mombasa.
Paranesidea sp. 3 of MADDOCKS, 1969; Ghardaqa.
Mydionobairdia sp. nov. MADDOCKS, in press; Tulear.
Triebelina bradyi TRIEBEL, 1948; Nosy Bé.
Bairdia raripila MÜLLER, 1894; Bay of Naples.
Triebelina aff. *T. raripila* (MÜLLER, 1894) of MADDOCKS, 1975; Ascension Island.
Triebelina sertata TRIEBEL, 1948; Nosy Bé.

Table 1
Anatomical characters of Paranesidea, Triebelina *and* Mydionobairdia.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
P. algicola	1	1	5	4	1	3	1	3	3	4	0	2	4	4	6	3	5	3	2	1	1	0	2	1	2
P. arostrata	3	1	5		1		1									3	5	3	2	1	1	0	2	1	2
P. fracticorallicola	2	1	5	4	1	3	1	3	3	4	0	2	4	4	5	3	4	3	3	1	1	0	1	2	1
P. gigacantha		1	5		1											3	5	3	2	1	1	0	2	2	2
P. harpago	1	1	5		1		1									3	4	3	3	2	1	0	1	2	2
P. onslowensis		1	5				1	3	0	3	0	3	4	4	9	3	5	3	3	1		0	3	2	1
P. parva		1	4				1	3	3	4	0	2	4	4	5	3	5	3	3	1	1	0	1	1	2
P. posidonia	3	1	5	4																			2	2	2
P. problematica		1		1		3		3	3	4	0	2	5	5	7	3	5	3	2	1	1	0			
P. pustulata	1	1	3		2		1	3	3	4	0	2	4	6	6	3	5	3	2	1	1	0	1	1	1
P. spongicola	3	1	5		1		1	3	3	4	0	2	4	5	6	3	5	3	2	1	1	0	1	1	2
P. sterreri	3	1	5	4	1	3	1	3	3	4	0	2	4	5	7	3	5	2	3	1	1	0	1	1	1
P. sp. 2	4	1		4		3	1	3	5	3	3	1	1	0	1	3	5	3	3	1	1	0	1		
P. sp. 3	1	1	4		1		1									3	4	3	2	1	1	0	1	2	2
M. sp. nov.		1	2		1		2	1	0	1	0	2	4	4	5	4	4	2	3	2	0	0	2	1	2
T. bradyi	4	1		2		2	3	2	2	0	0	2	4	5	5	4	5	4	4	1	1	0			
T. raripila	4																								
T. aff. *raripila*	4	2		2		3	2	4	4	4	0	2	4	5	6	3	4	3	3	1	1	0			
T. sertata	4	2		2		3	3	2	2	0	0	2	4	5	5	4	5	3	4	1	1	1			

Figs. 5-11. - Triebelina ? pustulata *KEIJ, 1974, male specimen, No O.C. 1486 (3162M) from the Maldive Islands. 5. Fifth limb. - 6. Sixth limb. - 7. Seventh limb. - 8. Mandible. - 9. Furca and hemipenis. - 10. Asymmetrical brush-shaped organ. - 11. Left valve, muscle-scar pattern, external view, specimen No O.C. 1487. - Magnifications : 5 to 10, × 320 ; 11, × 220.*



Figs. 12-20. - Triebelina ? pustulata *Keij, 1974, male specimen, No O.C. 1486 (3162M) from the Maldive Islands. - 12. Left valve, external view. - 13. Right valve, external view. - 14. Left valve, internal view. - 15. Right valve, internal view. - 16. Left valve, ventro-internal view. - 17. Right valve, ventro-internal view. - 18. Polyfurcate carapace sensilla and small rimless pore. - 19. Large simple carapace sensilla and large rimmed pore. - 20. Granular micro-ornament, antero-dorsal area of left valve. - Magnification : 12-17, × 80 ; 18, 19, × 4,450 ; 20, × 400.*

Character 2, distal antennal claw : 1 = smooth; 2 = sharply beveled and barbed at tip.
Character 3, accessory fused claw of male antenna : 1 = smooth; 2 = barbed at tip but not serrate or pectinate; 3 = very finely pectinate, with rather few setules; 4 = serrate or pectinate, with a long row of numerous fine setules; 5 = very coarsely serrate or pectinate.
Character 4, accessory fused claw of female antenna : as for character 3.
Character 5, length of anterodistal seta of male antenna : 1 = short (no more than half as long as fused claw); 2 = medium length (approaching length of fused claw); 3 = long (longer than fused claw).
Character 6, length of anterodistal seta of female antenna : as for character 5.
Character 7, distal claws of sixth and seventh legs : 1 = smooth; 2 = abruptly beveled; 3 = abruptly beveled and barbed.
Character 8, main distal claw of palp of maxillule : 0 = not distinguishable by size or appearance from other distal setae; 1 = smooth, clawlike, beveled; 2 = abruptly beveled and barbed but not pectinate; 3 = thick, clawlike, pectinate or fringed; 4 = distally enlarged and flattened, spatulate, and finely pectinate or fringed.
Character 9, masticatory process 3 of maxillule (MÜLLER's (1894) numbering, next to palp) : as for character 8.
Character 10, masticatory process 2 of maxillule : as for character 8.
Character 11, masticatory process 1 of maxillule (ventral edge) : as for character 8.
Character 12, total number of distal setae on the palp of the maxillule : 1 = 1, 2 = 2, 3 = 3, etc.
Character 13, total number of distal setae on masticatory process 3 (next to palp) of maxillule : as for character 12.
Character 14, total number of distal setae on masticatory process 2 of maxillule : as for character 12.
Character 15, total number of distal setae on masticatory process 1 (ventral) of maxillule : as for character 12.
Character 16, length of seta 1 (most distal seta, numbered from distal to proximal) of furca : 0 = absent; 1 = very thin, vestigial; 2 = short; 3 = medium length; 4 = long; 5 = very long, exceeding length of furcal ramus.
Character 17, length of seta 2 of furca : as for character 16.
Character 18, length of seta 3 of furca : as for character 16.
Character 19, length of seta 4 of furca : as for character 16.
Character 20, length of seta 5 of furca : as for character 16.
Character 21, length of seta 6 of furca : as for character 16.
Character 22, length of seta 7 (proximal) of furca : as for character 16.
Note : published drawings (MADDOCKS, 1969, fig. 31G) of specimen 140 USNM 121327 and unpublished photographs of specimen 139 USNM 121326, both identified as *Triebelina sertata* from Nosy Bé station 042, both show seta 7 to be distinctly present. Seven furcal setae are present in *Neonesidea* and *Bairdoppilata,* but only six in *Paranesidea* and *Triebelina bradyi* and only five in *Mydionobairdia* sp. nov. MADDOCKS, in press. This character needs further attention.
Character 23, length of copulatory rod on hemipenis : 1 = fairly short and straight; 2 = longer, somewhat curved; 3 = very long, curved.
Character 24, accessory distal appendages on hemipenis : 1 = absent; 2 = present.
Character 25, distal processes on terminal lobe of hemipenis : 1 = absent; 2 = present.

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Rosalie F. MADDOCKS
University of Houston
Department of Geosciences
Houston, Texas 77204-5503
U.S.A.

Karel A WOUTERS
Koninklijk Belgisch Instituut
voor Natuurwetenschappen
Department of Invertebrates
Vautierstraat 29
B-1040 Brussels, Belgium