

THE TROGLOBIC ATYIDAE OF MADAGASCAR
(CRUSTACEA DECAPODA NATANTIA)

by

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The first subterranean Decapod to be known from Madagascar was the species described by FAGE in 1946 under the name *Caridina microphthalmma*. The fact that no cavernicolous shrimps had been reported from the island before, though several authors had studied the freshwater *Natantia* of that region, caused the impression that these animals are poorly represented in Madagascar. It came therefore as a surprise that a small collection of *Atyidae*, which I recently received from Madagascar, contained not less than four species of true cave shrimps. This extremely interesting collection was kindly placed at my disposal by Dr R. Paulian, directeur-adjoint of the Institut Scientifique de Madagascar at Tananarive, whom I also have to thank for his extensive informations concerning the habitat of the various species.

Three of the four species dealt with here are new, while also both genera represented in the present material proved to be new to science. Preliminary diagnoses of the new species and genera have been inserted in a paper dealing with the subterranean shrimps of the world (HOLTHUIS, 1956). Two more species of the family *Atyidae*, both belonging to the genus *Caridina*, have been found in a Madagascar cave. These species, however, probably are only incidental visitors of this subterranean habitat and will not further be dealt with here, they will be reported upon later in a paper dealing with the Madagascar species of the genus *Caridina*.

Typhlopatsa Holthuis, 1956

Definition. — Carapace without supra-orbital and pterygostomial spines. Antennal spine placed on the lower orbital angle and merged with it. Eyes strongly reduced and bullet-shaped, without any pigment. Second maxilliped without podobranch. A single arthrobranch is pre-

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sent on the third maxilliped, while each of the pereopods possesses one distinct pleurobranch. No arthrobranch at the base of the first leg. The first three pereopods are provided with epipods, while well developed exopods are present on all the legs. The chelae have the fingers less than twice as long as the palm and provided with tufts of hair at their tips. The carpi of both the first and the second pair of legs are deeply excavate anteriorly. The diaeresis of the uropodal exopod bears no spinules.

The absence of arthrobranches from the bases of the pereopods and the absence of supra-orbital spines shows that the present genus belongs in BOUVIER'S « série caridellienne ». In this « série » it is closest related to the genera *Typhlatya* Creaser and *Antecaridina* Edmondson. These three genera are perhaps closer related to the genera of BOUVIER'S « série paratyenne » than to his « série caridellienne » to which, according to BOUVIER'S (1925) key, they, should belong.

Typhlopatsa may be immediately distinguished from *Typhlatya* by the presence of the antennal spine and by the absence of an epipod from the fourth pereopod. From *Antecaridina* it differs in the entirely different shape of the eyes, in the absence of a pterygostomial spine and in the absence of the epipod from the fourth pereopod.

The name *Typhlopatsa* refers to the blindness of the animals and to the vernacular name « patsa » which in Madagascar is used for small *Atyidae*.

***Typhlopatsa Pauliani* Holthuis, 1956**

Grotte de Mitoho, lac Tsimanampetsotsa, pays Mahafaly, S. W. Madagascar, may 1951, R. Paulian. — 26 specimens, 4-13 mm.

The rostrum consists of a single sharp point, which is directed forwards or obliquely upwards, it is rather high and bears no spines or teeth. It reaches to or slightly beyond the middle of the eyes. No supraorbital spines are present. The antennal spine is distinct, and is merged with the lower angle of the orbit. It is sharply pointed and reaches somewhat beyond the rostrum. The antero-lateral angles of the carapace are rounded. The integument of the carapace is soft and thin.

The abdomen has the pleurae of the first five segments broadly rounded. The sixth segment is about twice as long as the fifth and about 1.5 times as long as the telson. The pleura of this segment is rectangular, the postero-lateral angle is broadly rounded. The telson is elongate and narrows a little towards the rather broad posterior margin. The upper surface of the telson near the lateral margins bears two pairs of spines. The anterior pair is placed behind the mid-

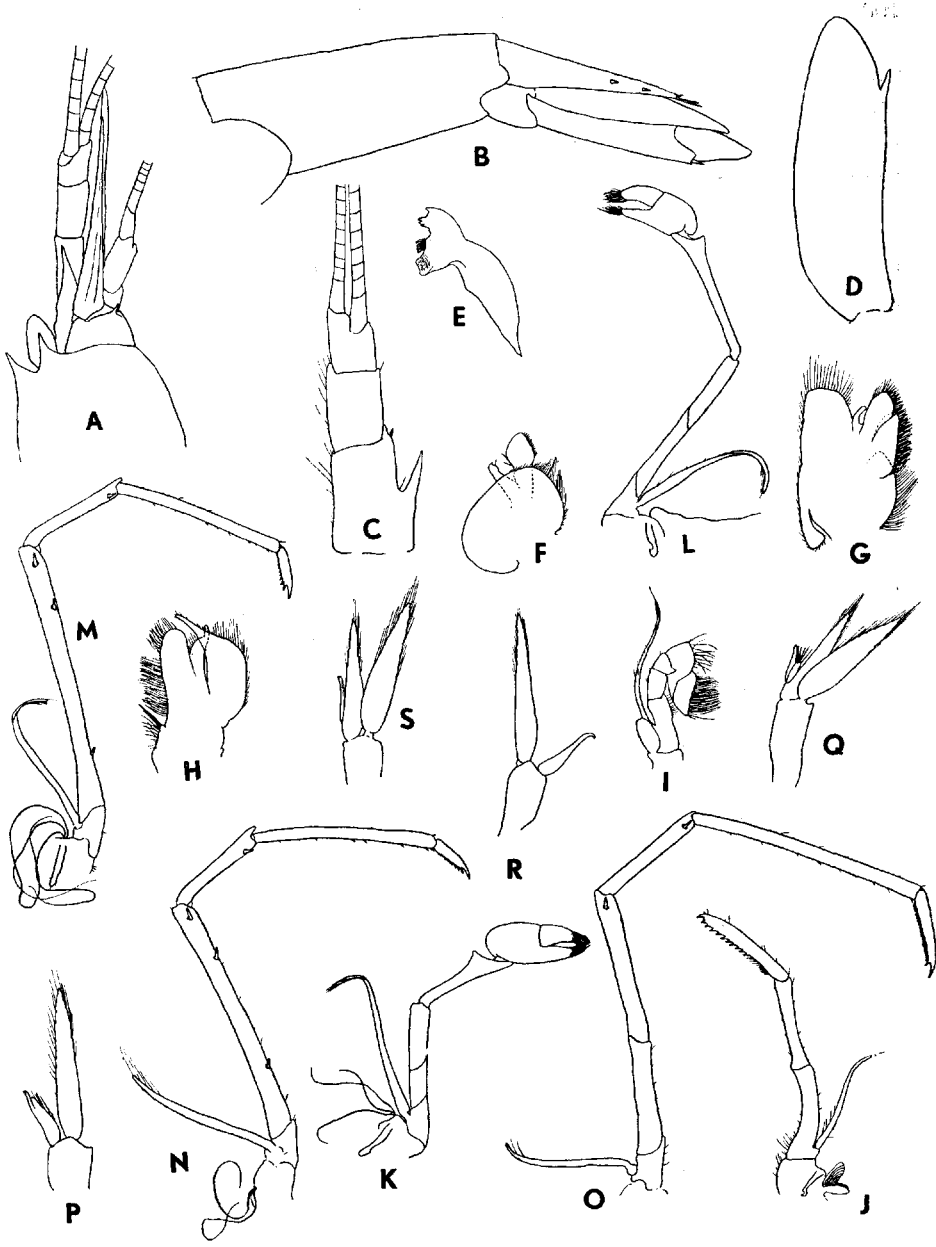


Fig. 1. -- *Typhlopatsa Pauliani* Holthuis. -- a, anterior part of body in lateral view : b, posterior part of abdomen in lateral view : c, antennula : d, scaphocerite : e, mandible : f, maxillula : g, maxilla : h, first maxilliped : i, second maxilliped : j, third maxilliped : k, first pereopod : l, second pereopod : m, third pereopod : n, fourth pereopod : o, fifth pereopod : p, first pleopod of male : q, second pleopod of male : r, first pleopod of female : s, second pleopod of female. (a, b, k-o, $\times 40$: c-j, p-s, $\times 50$).

The first pereopod reaches about to the end of the eyes. The chela is short and swollen. The fingers are about two thirds of the length of the palm, their tips are blunt and provided with a tuft of hair. The carpus is about as long as the chela. It is fully three times as long as high and is distinctly excavate anteriorly. The merus is two thirds of the length of the carpus and is almost twice as long as the ischium. The second pereopod is more slender than the first, it reaches somewhat beyond the end of the basal segment of the antennular peduncle. The chela strongly resembles that of the first leg. The carpus is somewhat less than twice as long as the chela and is fully five times as long as high ; it is distinctly excavate anteriorly. The merus is about half as long as the carpus and is shorter than the ischium. The third leg reaches slightly beyond the scaphocerite. The dactylus ends in two teeth and has the posterior margin with a row of about seven small additional teeth, it is slender and measures about one third of the length of the propodus. The latter bears a few spinules on the posterior margin. The carpus is about two thirds as long as the propodus, it bears a strong spine in the distal part of the external surface. The merus and ischium are fused, together they are about as long as the combined length of carpus and propodus. In the distal part of its external surface this fused joint bears a strong movable spine near the distal margin and one somewhat more proximally and closer to the posterior margin. In the proximal half of the joint a similar movable spine is visible on the posterior margin. The fourth leg, which reaches almost to the end of the scaphocerite, is very similar to the third, the propodus is relatively longer, being almost four times as long as the dactylus and almost twice as long as the carpus. The fusedmero-ischial joint is distinctly shorter than the carpus and propodus together. The fifth leg reaches slightly less far than the fourth. The dactylus is relatively longer, and bears about 30 spinules on the posterior margin. It is distinctly more than one third of the length of the propodus. The posterior margin of the latter bears a few small spinules. The carpus is half as long as the propodus, and, like that of the two previous legs, possesses a spine in the distal part of the external surface. The merus, which in this leg is distinctly separated from the ischium, bears a spine similar to that of the carpus ; no other spines are present either on the merus or the ischium. The ischium is distinctly shorter than the merus.

The first pleopod of the male has the endopod short, blunt and provided with a slender appendix interna, which overreaches the blade of the endopod ; in the females the endopod regularly tapers to a slender point. The endopod of the second pleopod of the male bears a short and thick appendix masculina which at the top bears a num-

ber of strong spines. The appendix interna distinctly overreaches the appendix masculina. The protopod of the uropods ends in a rounded postero-lateral lobe. The exopod has the outer margin ending in a small tooth at the inner side of which there is a movable spine. The diaeresis bears no spinules at all. The endopod is shorter than the exopod.

The species is named for Dr R. Paulian, who collected the material and who did so much to further our knowledge of the fauna of Madagascar.

Parisia Holthuis, 1956

Definition. Carapace without supra-orbital or pterygostomian spines; antennal spine present, sometimes merged with the lower orbital angle. Eyes sometimes reduced, though then still with a small pigment spot. Second maxilliped with a vestigial podobranch. Third maxilliped with a distinct arthrobranch, sometimes a rudiment of a second arthrobranch is visible. Each of the pereopods with a single pleurobranch. No arthrobranch at the base of the first pereopod. None of the pereopods with an exopod, but the first four pairs bear epipods. Chelae of the first two pereopods with the fingers less than twice as long as the palm and provided with tufts of hairs at their tips. Carpus of first leg deeply excavated anteriorly, that of the second leg hardly so. Diaeresis of the uropodal exopod with a row of spinules.

This genus strongly resembles *Caridina* H. Milne Edwards, but may immediately be distinguished by the absence of the arthrobranch of the first pereopod. This character would place the genus in BOUVIER'S (1925) « série caridellienne » in which group it comes closest to the genus *Caridella* Calman, but differs from it in the branchial formula.

The type species of this genus is *Caridina microphthalmia* Fage, 1946, dealt with below. The name *Parisia* is given in honour of the Italian carcinologist Dr Bruno Parisi.

The three species of this genus may be distinguished as follows :

1. Eyes strongly reduced with only a small pigment spot. Antennal spine merged with the lower orbital angle 2
- Eyes with the cornea well developed and rounded, provided with dark pigment. Antennal spine distinctly separated from the lower orbital angle. Rostrum well developed, with teeth on both upper and lower margin **macrophthalmia**
2. Rostrum well developed, reaching about to the end of the antennular peduncle, with teeth on both upper and lower margin
..... **microphthalmia**
- Rostrum short, not reaching beyond the eyes, without either dorsal or ventral teeth **edentata**

Parisia microphthalma (Fage, 1946)

Caridina microphthalma Fage, 1946, *Bull. Mus. Hist. nat. Paris*, sér. 2, vol. 18, p. 324, fig. 1, 2.

Grotte des Fanihy, Ankarana Mts., N. of Ambilobé, N. W. Madagascar ; in a freshwater pool of about 10 m long and 2 or 3 m deep in the end of the cave in total darkness, april 1951, R. Paulian. — 1 specimen, 16 mm.

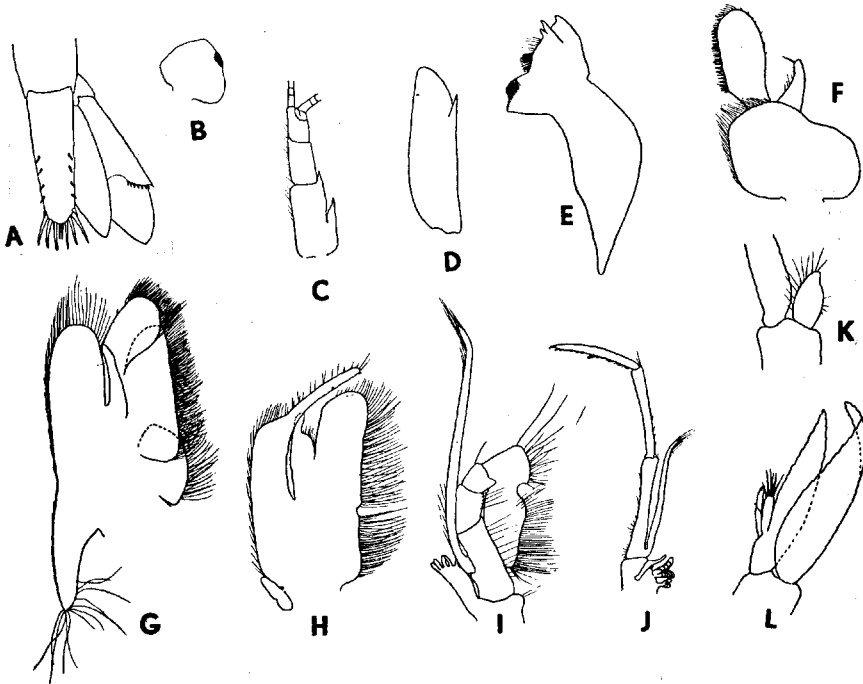


Fig. 2. — *Parisia microphthalma* (Fage). — a, telson and uropods in dorsal view ; b, eye ; c, antennula ; d, scaphocerite ; e, mandible ; f, maxillula ; g, maxilla ; h, first maxilliped ; i, second maxilliped ; j, third maxilliped ; k, first pleopod of male ; l, second pleopod of male. (a, c, d, j, $\times 20$; b, $\times 40$; e-i, k, l, $\times 50$).

The rostrum just attains the end of the antennular peduncle, the upper margin bears twelve, the lower two teeth. The infraorbital angle is merged with the antennal spine.

The sixth abdominal segment is about twice as long as the fifth and is distinctly longer than the telson. The posterior margin of the telson bears five pairs of spines, the external of which are very short and rather strong, the median pair of spines is more slender and distinctly shorter than the three intermediate pairs.

The scaphocerite has the final tooth far outreached by the lamella.

The mandible has the incisor and molar processes indistinctly separated. The former process bears three distinct teeth, the latter is blunt and provided with numerous minute transverse ridges. The maxillula has the lower lacinia broad and is externally produced to a broad, rounded lobe. The upper lacinia is very high, its inner margin bears small spines. The palp is well developed. The maxilla has the endites well developed, the upper being deeply cleft. The palp is elongate, the epipod has the lower end pointed and provided with long hairs. The endites of the first maxilliped are separated by a notch, the palp is suddenly narrowed at the top, the exopod has the flagellar portion distinct, a small epipod is present. The second maxilliped has the distal inner margin with a rather deep rounded incision. The two distal segments are fused, at least no line separating the two could be found in my specimen. The exopod is well developed, the epipod bears a podobranch. The third maxilliped is slender. The ultimate joint is about as long as the penultimate and bears a few spines in the distal part of the lower margin. The antepenultimate segment is slightly longer than the ultimate. An epipod and two arthrobranchs are present, one of the latter being quite small.

The branchial formula runs as follows :

	Maxillipeds			Pereiopods				
	1	2	3	1	2	3	4	5
pleurobranchs	—	—	—	1	1	1	1	1
arthrobranchs	—	—	1+r	—	—	—	—	—
podobranchs	—	1	—	—	—	—	—	—
setobranchs	—	—	—	+	+	+	+	+
epipods	1	1	1	1	1	1	1	—
exopods	1	1	1	—	—	—	—	—

The first pleopod of my only specimen (a male) has the endopod broadly oval, with the distal part of the inner margin somewhat concave. There is no appendix interna and no retinacula were seen. The second pleopod has the appendix masculina rather short and broad, with slender spinules on the distal end. The appendix interna slightly overreaches the appendix masculina. The protopod of the uropods ends in an acute outer angle. The outer margin of the exopod ends in a sharp small tooth, while a row of about seven spinules is placed on the diaeresis.

Distribution. — The species until now was only known from the types, which were collected in a subterranean rivulet in the « grotte des Fanihy » near Ankarana, Madagascar. The specimen examined by me was collected at the type locality.

Parisia edentata Holthuis, 1956

Southern part of the Antsingy Mts between the Manambolo and Morafenobé rivers, near Bekopaka, Majunga province, W. Madagascar ; in a very dark, deep well in a limestone region, under rocks, july 1949, R. Paulian - 13 specimens, 5-16 mm.

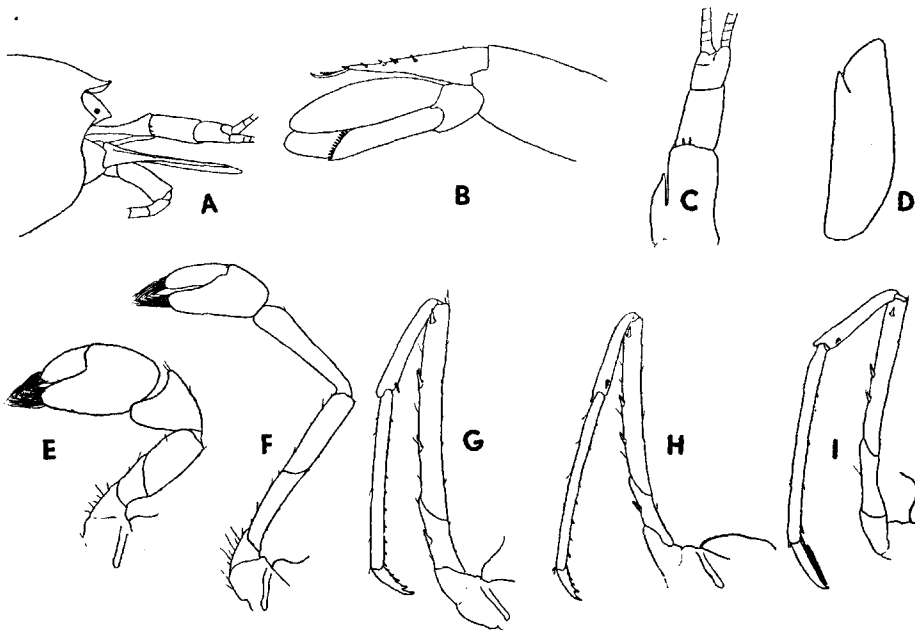


Fig. 3. — *Parisia edentata* Holthuis. — *a*, anterior part of body in lateral view ; *b*, telson and uropods in lateral view ; *c*, antennula ; *d*, scaphocephrite ; *e*, first pereopod ; *f*, second pereopod ; *g*, third pereopod ; *h*, fourth pereopod ; *i*, fifth pereopod. (*a*, $\times 30$; *b-i*, $\times 40$).

The rostrum is very short, it extends to the end of the eyes or even fails to reach so far. The lower margin is rather strongly convex, the upper margin generally being somewhat concave ; neither margin bears teeth or spines, a few hairs are present on the lower margin. The lower orbital angle is merged with the antennal spine. The pterygostomian angle is rounded.

The pleurae of the first four abdominal segments are broadly rounded, that of the fifth is bluntly pointed. The sixth segment is somewhat less than twice as long as the fifth and slightly longer than the telson. The pleura of the sixth segment is bluntly pointed. The postero-lateral angle of this segment is truncate posteriorly, with a little sharp tooth in the upper part of the truncate posterior margin.

The telson bears four pairs of dorsal spinules in its posterior half. The posterior margin bears five or six pairs of spines, the external of which are very short, the inner pair being somewhat longer, the rest much longer. The arrangement of these spines strongly resembles that of the previous species. The tips of the spines are somewhat curved upwards.

The eyes are degenerate. They end anteriorly in a blunt point and show on the outer surface a tiny pigment spot. In some of the small specimens this pigment spot is not visible.

The antennular peduncle has the stylocerite well developed and pointed, it reaches about three fourth of the length of the basal segment of the peduncle. The antero-lateral angle of the basal segment is hardly produced, while a few spinules are placed on the anterior margin of that segment. The second segment of the peduncle is about two thirds as long as the first and twice as long as the third.

The scaphocerite reaches slightly beyond the antennular peduncle, it is somewhat more than three times as long as broad. The external margin ends in a rather broad final tooth, which is distinctly overreached by the lamella ; the latter being somewhat produced antero-internally. No distinct spine is present at the base of the scaphocerite.

The mouthparts do not show any essential differences from those of *P. microphthalmus*. The third maxilliped bears a single arthrobranch, no trace of the second, rudimental, arthrobranch could be found in my specimens. The branchial formula is as follows :

	Maxillipeds			Pereiopods				
	1	2	3	1	2	3	4	5
pleurobranchs	—	—	—	1	1	1	1	1
arthrobranchs	—	—	1	—	—	—	—	—
podobranchs	—	1	—	—	—	—	—	—
setobranchs	—	—	—	+	+	+	+	+
epipods	1	1	1	1	1	1	1	—
exopods	1	1	1	—	—	—	—	—

The first pereiopod is short and thick, it fails to reach the end of the basal segment of the antennular peduncle. The fingers are blunt and somewhat shorter than the palm, they end in a distinct tuft of hairs. The carpus is very short, being somewhat less than twice as long as high, it is deeply excavate anteriorly. The merus is about as long as the carpus. The second legs are far more slender than the first, they reach to the end of the scaphocerite. The fingers are somewhat longer than the palm, and gape slightly. Their tips are blunt and bear a distinct tuft of hairs. The third leg is very slender and reaches with slightly less than half the propodus beyond the sca-

phocerate. The dactylus ends in two teeth, while the posterior margin bears some three additional spinules. The propodus is fully 3.5 times as long as the dactylus, it bears some minute spinules on the posterior margin. The carpus is about 0.6 times as long as the propodus and bears a distinct movable spine in the distal part of the external surface near the posterior margin. The merus is longer than the propodus and bears three strong spines, two of these are placed in the middle of the posterior margin, the third being situated on the external surface near the distal margin. The ischium is about one third as long as the propodus and bears one posterior spine. The fourth leg reaches somewhat beyond the scaphocerite. It is similarly armed as the third. The propodus is four times as long as the dactylus and twice as long as the carpus, being slightly longer than the merus. The fifth leg reaches slightly beyond the scaphocerite. The dactylus bears at its posterior margin about 32 comb-like arranged spinules. The propodus is somewhat more than three times as long as the dactylus, twice as long as the carpus and distinctly longer than the merus. The propodus, the carpus and the merus of the fifth leg are similarly armed as in the third and fourth legs, except for the fact that no spine is found on the ischium. The protopod of the uropods ends in a rather acute point. The outer margin of the exopod ends in a small acute tooth and bears a row of about eleven small spinules on the diaeresis.

Parisia macropthalma Holthuis, 1956

Grotte des Fanihy, Ankarana Mts, N. of Ambilobé, N. W. Madagascar ; in a freshwater pool of about 10 m long and 2 or 3 m deep, in the end of the cave in total darkness, april 1951, leg. R. Paulian. 30 specimens 17-24 mm.

The rostrum is well developed and reaches about to the end of the antennular peduncle. In some specimens it falls a little short of the end of the third segment, in others it slightly overreaches the peduncle. The upper margin of the rostrum is armed with 17 to 27 (generally between 21 and 24) teeth, 2 to 5 (generally 3 or 4) of these teeth are placed behind the posterior limit of the orbit. The posterior tooth generally is distinctly smaller than those placed before it. The proximal teeth are distinctly articulated with the rostrum and perhaps better could be called spinules, the two to four ultimate teeth are actual teeth and do not articulate with the body of the rostrum. Behind these actual teeth there are some in which only a vague indication of an articulation is visible, forming thus a transition between the (proximal) spinules and the (distal) teeth. The teeth are distinctly

wider spaced than the spinules, which are placed close together. The ultimate tooth practically always is placed subapical. The lower margin shows one to five (generally three or four) rather indistinct appressed teeth. The rostrum is highest slightly distally of the middle of its length. The midrib is distinct, continues into the postorbital margin and then runs across the lower orbital angle to the antennal spine.

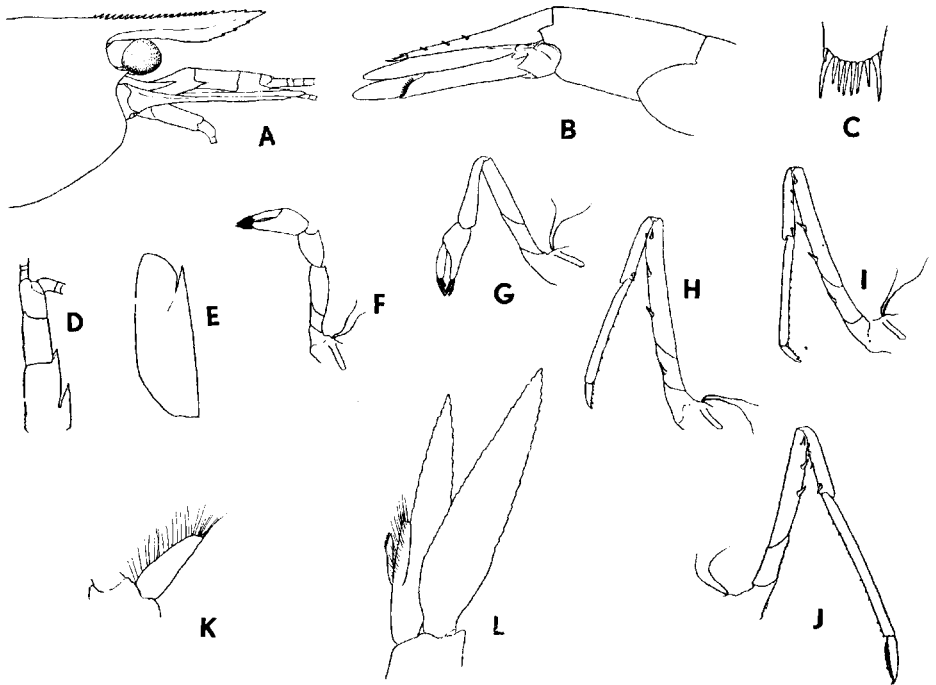


Fig. 4. — *Parisia macrophthalmalma* Holthuis. — *a*, anterior part of body in lateral view ; *b*, posterior part of abdomen in lateral view ; *c*, posterior margin of telson in dorsal view ; *d*, antennula ; *e*, scaphocerite ; *f*, first pereiopod ; *g*, second pereiopod ; *h*, third pereiopod ; *i*, fourth pereiopod ; *j*, fifth pereiopod ; *k*, first pleopod of male ; *l*, second pleopod of male. (*a*, *b*, *d*-*j*, $\times 20$; *c*, $\times 40$; *k*, *l*, $\times 50$).

The antennal spine is well developed and is distinctly separated from the lower orbital angle, which is about rectangularly rounded. No other spines are present, the pterygostomial angle is broadly rounded.

The pleurae of the first four abdominal segments are broadly rounded, that of the fifth is bluntly pointed. The sixth segment is about twice as long as the fifth and as long as the telson. The pleura is rounded, the postero-lateral angle is truncate with the upper angle of the truncated part produced to a small tooth. The upper surface of

the telson bears three, sometimes four, pairs of spines, all of which are placed in the distal half of the telson. The posterior margin of the telson is rounded and bears five pairs of spines. The outer pair is very short, the following (sublateral) pair is very long and rather heavy. The median pair is as long as or even slightly longer than the two intermediate pairs and much shorter than the large sublateral spines.

The eyes are well developed, the cornea is slightly shorter and broader than the eyestalk and possesses a dark pigment. The eye reaches slightly beyond the middle of the basal segment of the antennular peduncle.

The stylocerite is well developed and pointed, it reaches about three fourth of the length of the basal segment of the antennular peduncle. The antero-lateral angle of the segment is strongly produced and pointed. No spinules are seen on the anterior margin. The second segment is somewhat less than twice as long as the third. The two distal segments together are about as long as the first.

The scaphocerite reaches distinctly beyond the antennular peduncle. It is about 2.5 times as long as broad. The outer margin is slightly convex and ends in a strong and sharply pointed final tooth. This tooth is distinctly overreached by the lamella, which is somewhat produced antero-internally. A distinct external spine is visible near the base of the scaphocerite.

The oral parts strongly resemble those of *P. microphthalmma*. The lower of the endites of the first maxilliped being somewhat shorter in the present form, while the merus of the third maxilliped is relatively longer in Fage's species.

The branchial formula is exactly similar to that of *P. microphthalmma*. Unlike in *P. edentata*, a vestigial second arthrobranch is present here at the base of the third maxilliped.

The first pereopod reaches about to the end of the basal segment of the antennular peduncle. The fingers have the tips blunt and provided with the usual tuft of hairs. They are slightly longer than the palm. The carpus is two thirds as long as the chela and is deeply excavate anteriorly. The merus is somewhat longer than the carpus. The second legs are more slender and reach about to the end of the antennal peduncle. The fingers are distinctly longer than the palm, are blunt and provided with tufts of hair. The carpus is about 1.2 times as long as the chela and shows no anterior excavation. The merus is slightly shorter than the carpus. The third leg reaches with the dactylus beyond the scaphocerite. The dactylus ends in two teeth and has the posterior margin provided with four smaller additional spinules. The propodus is about 4.5 times as long as the dactylus, it bears several small spinules on the posterior margin. The carpus has about two

thirds of the length of the propodus, it bears a distinct spine in the distal part of the external surface, while sometimes one or more small spinules are visible on the posterior margin. The merus is twice as long as the carpus and bears two distinct spines on the posterior margin, a third spine being placed in the distal part of the outer surface near the articulation with the carpus. The ischium bears one posterior spine. The fourth leg is similar to the third. It reaches about to the end of the antennular peduncle. The dactylus bears on the posterior margin a row of about 40 very closely placed spinules, it is about 0.3 times as long as the propodus. Like in the previous legs the propodus bears several spinules on the posterior margin. It is fully twice as long as the carpus. The merus is about three fourth as long as the propodus. The spinulation of the merus and carpus is as in the third and fourth legs. The ischium bears no spine.

The endopod of the first pleopod in the male is elongate triangular in shape, with the inner margin almost straight and the distal margin oblique ; no retinacula are visible. In the female the endopod of the first pleopod is produced to a narrow slender point. In the second pleopod of the male the appendix masculina overreaches the appendix interna and is beset with long spine-like hairs. The protopod of the uropods ends in a rather sharply pointed postero-lateral angle. The external margin of the exopod ends in a tooth, the diaeresis bears about eleven spinules.

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