

Cerataspis nearly twice the length of the antennal scale, in *Cerataspides* it is jointed but very short less than one fifth the length of the antennal scale. The mandibular palp is three-jointed, but has only a few setae. The pereopods four and five have each only a short, unjointed endopod. The pleopods are small, uniramous and unjointed limb-buds in both genera.

Mysis II.

The larva has grown in size, especially in *Cerataspides* it has been much elongated. The flagella of the first antenna are still unjointed in *Cerataspis*, and in *Cerataspides* the first and second joints of the peduncle have coalesced. The flagellum of the second antenna is in *Cerataspis* nearly reaching the tip of the pterygomian spine or horn, in *Cerataspides* it has only enlarged a little. In *Cerataspis* the first maxillipede has developed an arthrobranchia, and the fourth and fifth pereopods have both a five-jointed endopod. In *Cerataspides* all the pereopods have developed more stiff setae, the gills are only small gill-buds, the endopods of the fourth and fifth pereopods are now also five-jointed in *Cerataspides*, the pleopods are still small limb-buds.

Mysis III.

Only small changes have taken place except about 50 per cent growth in size in *Cerataspis* and a little less in *Cerataspides*. In the latter species the first antenna has still two unjointed flagella, but the medial one which in the two preceding stages were even a little shorter than the lateral one is now the longest, about fifty per cent longer than the lateral one. In *Cerataspides*, however, the lateral, olfactory, flagellum is about 50 per cent longer than the medial one, and in both the large basal joint has grown, and more smaller distal joints have been added. In *Cerataspis* the flagellum of the second antenna is now about twice as long as the pterygostomian spine. The mandible shows a clear separation between the incisor and molar parts, and a suture divides caput mandibulae from corpus mandibulae. In *Cerataspis* the fifth pereopod has developed a pleurobranchia, and in *Cerataspides* the endopod of the fourth pereopod which became five-jointed in the preceding stage, has developed several setae, the endopod of the fifth pereopod has still only very few setae.

The pleopods in *Cerataspis* are small, but they are now all divided into protopods and exopods, and the last two ones have also a diminutive endopod. In *Cerataspides* the last two pairs have enlarged, but are still both unjointed and uniramous consisting of a non-divided protopod and exopod.

Mysis IV.

Cerataspis has grown to a total length of 22–23 mm, *Cerataspides* has grown to not less than 40 mm, but the rostrum and the last abdominal segment count for the larger part of the growth. Only smaller changes occur. In *Cerataspis* the medial flagellum of the first antenna has grown and developed a few rings. The flagellum of the second antenna has enlarged further, the antennal scale has developed more setae along its margin, and the statocyst has continued its development since the second Mysis. In *Cerataspides* the statocyst first starts in the fourth Mysis, the statocyst spine now appears, placed at the lateral base of the first antenna, thus this has two spines: the characteristic medial spine found in *Cerataspides* and the lateral statocyst-spine below. In the second antenna of this genus the endopodial flagellum has become nearly as long as the antennal scale, and the later has a large lateral spine and a brim of setae from the spine around the distal tip and down along the medial margin.

The second and third maxillipedes have developed long, stiff setae on the endopod along the medial and lateral margins. The first three pereopods have grown a lateral swelling on the fourth joint, the beginning of the fixed finger in the coming chela.

The pleopods of *Cerataspis* have developed further in size. The exopods are long and with embryonic setae on the distal half. The endopods are much shorter and thinner and without setae except at the tip. In *Cerataspides* a suture has appeared between the protopod and the exopod. In number one and two are no endopods present, but number three has developed a small bud for the endopod, and number four and five

has a short endopod. Exopods and endopods (where developed) are only tipped with a few embryonic setae, no marginal setae on the exopods, as in *Cerataspis*, were observed.

Mysis V.

This stage is the last known Mysis stage and of much interest because it shows that Penaeids can also have five Mysis stages like the up to five Furcilia stages in the Euphausiids. In *Cerataspis* the abdomen remains still very small as in the Brachyuran and some Reptantian larvae. The flagella of both first and second antennae have grown in length, but the olfactory lateral flagellum of the first antenna is still unjointed which is rather remarkable in so late a larval stage. The antennal scale is rounded off at the tip and has either a vestigial or no lateral spine. In *Cerataspides* the statocyst in the first antenna has now got the statical sensecells in its wall and a ventral lobe is growing up to close the groove. The two flagella are of equal lengths and annulated, but the lateral one is divided in a thick basal part with olfactory hairs and a slender distal part without such hairs. The flagellum of the second antenna has also enlarged being now longer than the antennal scale. The latter has a well-shaped lateral spine, marginal setae, and a nearly square-cut tip. The mandibular palp, still three-jointed, has developed many setae in both genera. The endopod of the second maxilla has in *Cerataspides* grown a line of setae also along the lateral margin. In both genera the exopod of the first maxillipede has developed a fan-shaped lobe on its basal half with a line of stiff setae along its lateral margin; this lobe is bent in over the stem so that the setae point medially. In *Cerataspides* the endopods of the two last maxillipedes and of the pereopods have grown several lines of stiff setae all turned medially. The chelae of the three first pereopods are still undeveloped with only a small lobe on the fourth endopodial joint for the coming fixed finger.

In *Cerataspis* the pleopods have enlarged. The endopods of number one and two are only small notches, but the exopods are very long. In the following three pairs the exopods decrease and the endopods increase in length, although the exopod on the last pair still is longer than the endopod. In *Cerataspides* the pleopods are developed as in *Cerataspis*, only the protopods of the two last pairs are very swollen.

DIAGNOSIS FOR THE LARVAE OF *CERATASPIS*

Large penaeid Mysis larvae with both post-orbital and pterygostomian horns; short, ventrally bent rostrum without teeth. Four pairs of dorsal tubercles and lateral swellings on the carapace, and both anterior and posterior dorsal organs. Short abdomen without spines, a penaeid telson with three lateral spines and six setae on each side inside the furca. Large eyes. Short lateral flagellum on the first antenna. None or only vestigial lateral spine on the antennal scale. Mandible with a single incisor tooth and a cutting ridge combining it with the molar part. Three-jointed mandibular palp. Mastigobranchiae on all maxillipedes and pereopods except the fifth. The three first pereopods with a beginning chela. Gills lobose, and in older stages the margins of the single lobes are again divided into lobes.

Cerataspis petiti GUERIN.

Figs. 206-262.

Cerataspis petiti, GUERIN 1844, p. 18.*Cerataspis petiti*, GIARD-BONNIER 1892a, pp. 350-354.*Cerataspis petiti*, BONNIER 1899, pp. 27-49, pl. 3, Figs. 1-4.**Localities.****Mysis I.**

Dana St. 343, 24°53' N-56°13' W. St. Croix 40-48 mW. 18.8.1911, 1 spec.

— — 1162, 13°35' N-30°11' W. 40-48 mW. 6.11.1921, 1 spec.

— — 3720 IV, 21°10'5" N-124°31' E. 50 mW. 25.5.1929, 1 spec.

Mysis II.

Dana St. 343, 24°53' N-56°13' W. St. Croix 40-48 mW. 10.8.1911, 2 spec.

— — 345, 35°15' N-44°9' W. 40-48 mW. 9.9.1911, 3 spec.

— — 884, 28°49' N-54°10' W. 50 mW. 15.7.1920, 1 spec.

— — 3543 III, 21°50' N-50°12' W. 100 mW. 12.8.1928, 1 spec.

Mysis III.

Dana St. 345, 35°15' N-44°9' W. 40-48 mW. 9.9.1911, 1 spec.

— — 1110 IV, 34°18' N-8°10' W. 50 mW. 15.9.1921, 1 spec.

— — 1160 II, 15°50' N-26°32' W. 1000 mW. 4.11.1921, 1 spec.

Mysis IV.

Dana St. 3665 III, 29°37' S-156°46' E. 300 mW. 25.2.1929, 1 spec.

Mysis V.

Dana St. 3999, 3°45' S-10°00' W. 300 mW. 2.3.1930, 1 spec.

Description.**Mysis I.**

Figs. 205-223.

No younger stage than the first Mysis is known.

This larva is very characteristic with its swollen, tubercular carapace, provided with long horns and a small, in size reduced, abdomen bent in under the thorax. The whole animal looks like a small squarish box with tubercles all over and with five long horns at the anterior end.

Carapace.

The carapace is provided with four pairs of large tubercles along its dorsal side, and laterally it runs out in an ala on each side pointing backwards beyond the abdomen which is bent ventrally under the thorax. The eyes are stalked, and the rostrum is ventrally curved reaching down towards the middle of the eye-globe. The rostrum is smooth without any spines over the eyes. The carapace has over the eye-stalks a pair of flat supra-orbital spines reaching to near the base of the eye-globe. Behind these spines the enormously developed post-orbital spines extend dorsally as a pair of very long and bulbous processes or spines like a pair of horns, hence the name of the genus. In the opposite direction, pointing ventrally, are the pterygostomial spines, also these are extremely large, even larger than the post-orbital spines, and they are S-shaped curved with the distal tip pointing a little forward. Laterally the carapace is also tubercular, but here the tubercles on each side are placed like pyramide-stubs upon each other ending in a short conical spine pointing latero-posteriorly. In front of this spine a ridge runs from the dorsal base of the pterygostomial spine above the lateral swellings until or close to the dorsal border of the lateral ala, dividing the lateral part of the carapace from the dorsal part with its eight tubercles and giving the carapace a squarish appearance. Just before the ridge reaches in line with the pyramidal swellings it is itself shaping a compressed cone. Ventrally of this is a second, much

smaller cone, and one or two more are placed just in front of the pyramidal swellings, but ventrally to them. Further the carapace has a clearly defined cephalic part with a clearly visible anterior dorsal organ in the middle. Near the posterior border of the carapace between the fourth, most posterior pair of dorsal tubercles is a smaller posterior dorsal organ.

Abdomen.

The normal six segments and the abdomen are in the first Mysis large compared with the following stages during which they increase not nearly as much as the size of the carapace. The first segment has a ring-shaped depression in the middle, which divides it into an anterior and a posterior section, of which the anterior one mostly is hidden underneath the carapace. The following four segments are about equal in size, and the fifth segment as usual, especially in Penaeids, much longer, about three times the length of the preceding segments. All segments are smooth without any kind of spines or tubercles, only the lateral pleura have started to develop, and the last segment has a large ventral spine.

Telson.

The telson plate is elongated and flattened, about four times as long as wide and ends in a cleft. The two lobes of the cleft terminate with a long spine, further three shorter spines are placed on the lateral margins of the telson, with the most distal spine just anteriorly of the terminal spine, the next in line with the bottom of the cleft, and the third spine with an equal distance farther forward on the telson, its distance from the tip being about one fourth of the total length of the telson; along each margin of the cleft are placed six spines.

Appendages.

The peduncle of the first antenna is divided into the three joints usual for the Mysis stages and later stages. The basal joint is far the largest, at its base is the beginning swelling for the statocyst. The statocyst spine is present as well as the arch for the later opening, the arch has a few short hairs. The second joint is less than half the length of the first one. The third joint is only half the length of the second joint and tipped with the rudiments of the two flagella which both are unjointed and of about equal lengths. The lateral one has a row of sensory hairs along its medial margin which not are found on the medial lobeshaped flagellum. The last is tipped with two setae. The second and third joints of the peduncle are furnished with two and three stiff hairs placed with about equal intervals along their medial margins. On the disto-lateral corner the first and the second joints have each a short stiff seta.

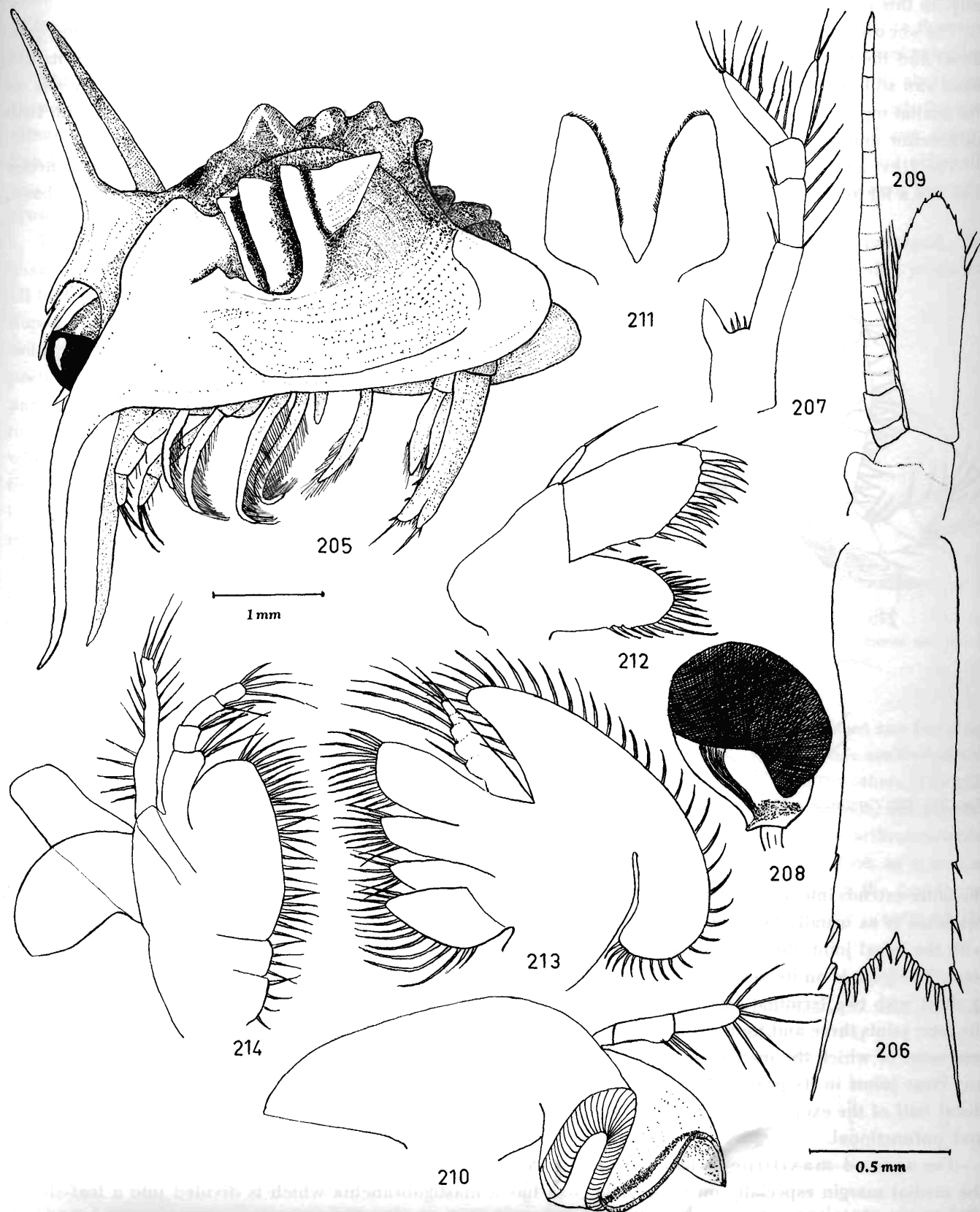
The second antenna has a weakly two-jointed protopod which is about to coalesce into one joint. The exopod is a flattened, elliptical plate, the beginning of the antennal plate. Along its medial margin a line of stiff hairs has started to develop, around its rounded distal margin one can see where the hairs appear only as short buds each in an incision of the margin. Laterally the two most proximal ones have developed as short hairs, about in line with the two most distal ones on the median margin. The endopod is a conical flagellum twice as long as the exopod, and its annulation has started.

The labrum is large and flat with a small anteriorly directed cone.

The mandible has a large corpus mandibulae which includes both a part molaris and a pars incisor. The latter is large, and its cutting part is an S-shaped edge, its teeth have not yet appeared, but a little behind the edge an irregular swelling is observed. Also the molar part is more like a ridge but wider and not sharp with an edge like the incisor part. The palp of the mandible is three-jointed with the second joint being the longest. Both joints are tipped with setae, the first joint on the distal corner toward the corpus mandibulae and the second one on its whole tip, but most densely on the corner towards the corpus mandibulae.

The labium covers the mouth-opening posteriorly, it consists of a short peduncle and two long, movable lobes tipped as usual with fine hairs at their distal and medial borders.

The first maxilla has no clear separation in coxa and basis, but is furnished with two endital lobes. The distal lobe, basi-endite, is by far the largest and lined at its medial margin with conical spines and with a line of fine hairs behind these on the lateral side of the lobe. The basi-endite, is very strong and seems to function partly as a cutting or tearing organ partly as a second mandible. The coxa-endite is much smaller

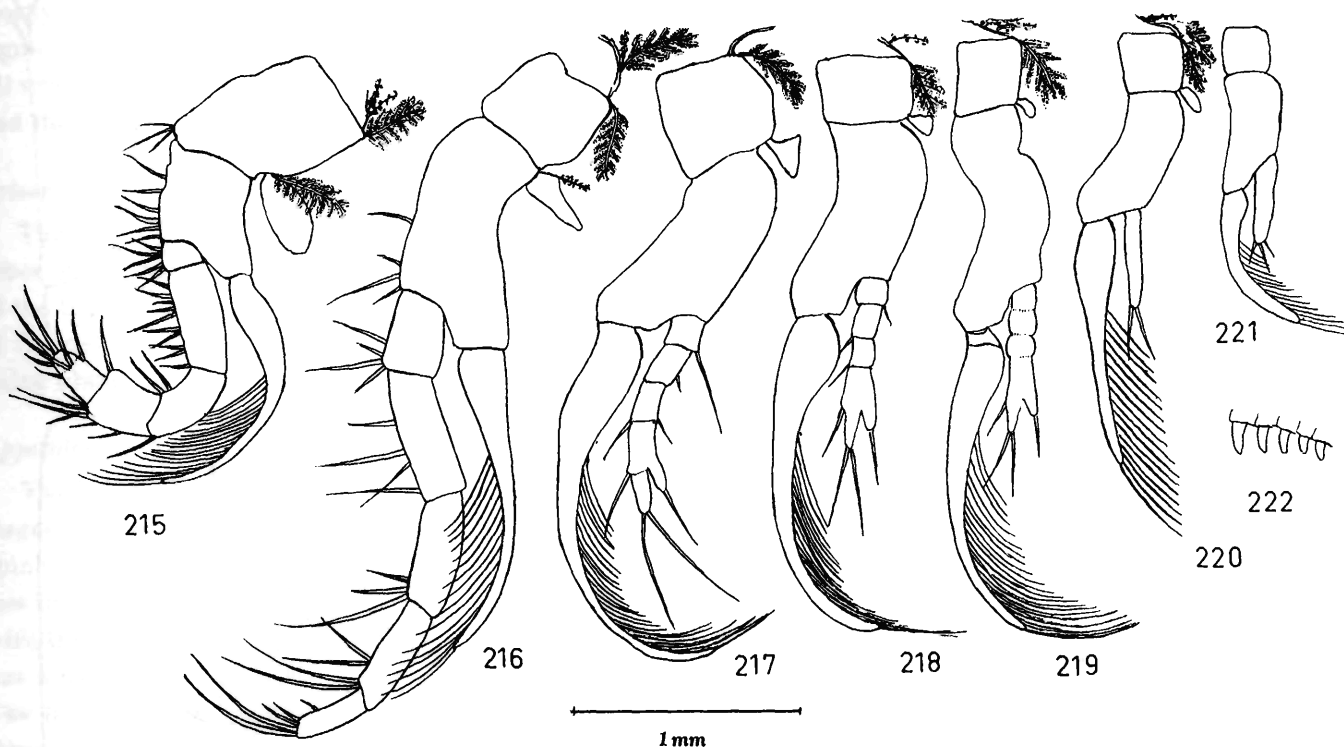


Figs. 205–214. *Cerataspis petiti*. First Mysis. Fig. 205, larva from lateral. — Fig. 206, telson. — Fig. 207, first antenna. — Fig. 208, eye. — Fig. 209, second antenna. — Fig. 210, mandible. — Fig. 211, labium. — Fig. 212, first maxilla. — Fig. 213, second maxilla. — Fig. 214, first maxillipede.

and judging from the shape of its setae more a brushing organ. Distally on the protopod is a small endopodial palp, in this stage tipped with a single seta. The exopod is not present.

The second maxilla has the usual four endites: two coxa-endites and two basi-endites. The most proximal and the most distal endites are the largest. The endopod is already in this stage vestigial, but its five joints can still be seen, although not very distinctly. Each of the four proximal joints is tipped with a seta on the medial margin, the fifth joint with three setae. The exopod is already flattened and leaf-shaped with both an anterior and a posterior lobe, and fringed along the free margins with plumose setae.

The first maxillipede has a squarish, thin protopod, semiglobular with the concavity on the anterior side like a lid to prevent food from escaping backwards. There is no clear distinction between coxa and basis,



Figs. 215-222. *Cerataspis petiti*. First Mysis. Figs. 215-216, second and third maxillipedes. — Figs. 217-221, first to fifth pereopods. — Fig. 222, buds of pleopods.

the latter extends into a distal lobe. The whole medial margin is fringed with short, plumose setae. The mastigobranchia is as usually large, it is divided into two lobes of nearly equal sizes. The endopod is four-jointed with the basal joint almost as long as the two following ones together, or three times as long as the second joint. The joint is on its medial margin provided with a lamellar lobe tipped by three setae. The second joint is short with two terminal setae at its medial corner. The third joint is twice as long and seems to include the later joints three and four, it has two medio-terminal setae. The distal joint is short with two pairs of terminal setae of which the medial pair is the largest. The exopod is about as long as the endopod, but not with any clear joints in its proximal part; the lateral margin is widened into a lunate lobe fringed with setae. The distal half of the exopod has a line of original swimming setae on both sides, but the setae are rather vestigial and unfunctional.

The second maxillipede has a strong protopod with well-defined coxa and basis and with setae on the medial margin especially on basis. The coxa has a mastigobranchia which is divided into a leaf-shaped elliptical part closest to basis and a filamental branch posteriorly of it. A similar division is also found in the mastigobranchia of this limb in *S. sp. larva nodulosa*, but not in any of the other *Solenocera*. In *S. sp. larva nodulosa*, however, there is a true podobranchia halfway up on coxa, whereas in *Cerataspis* the podobranchia

starts to branch off from the mastigobranchia for in later stages to be separated from it, although still placed close to it. *S. sp. larva nodulosa* must thus have two podobranchiae on the second maxilliped, only here the filiform part is placed distally of the leafshaped part and has no shaft, contrary to the other gills in that species. The coxa is further furnished with a well developed arthrobranchia and two budding pleurobranchiae.

The basis is a little smaller than the coxa, but nearly as long. The first endopodial joint is very short, and the second one is the longest. The following three equally long joints are bent like a subchela towards the proximal part of the limb. On the last, fifth, joint the setae are placed in two rings, the proximal one along a fine line in the cuticle dividing the joint into a distal and proximal part indicating that the joint originally was two-jointed, and that thus a sixth joint has existed. A sixth joint is known from some of the most primitive crustacea. The exopod is a well-developed swimming branch.

The third maxillipede has like the rest of the original, thoracal limbs a two-jointed protopod. The coxa is short and squarish, the basis is more than twice as long as the coxa. The five endopodial joints are all long and slender, and in the Mysis stages this long endopod on the extended protopod is used by the larva to hold the prey and especially to push the torn or cut food particles into the mouth, as well as for cleaning the mouth-parts mainly the first and second maxillae and when turned backwards also the thoracopods. This function, which persists through all the Mysis stages, was several times noticed in *Solenocera* where the endopod is still longer compared to the other limbs. On coxa is a small mastigobranchia with a budding podobranchial branch one third from its base, a well developed arthrobranchia at the proximal corner of the joint, and two pleurobranchiae, the one nearest to the limb is fully developed, the other is only about to develop.

The three first thoracopods have developed beginning chelae. All thoracopods have a small squarish coxa and an elongate basis, two to three times as long as coxa. The endopod is short and without any function, the food is entirely managed by the maxillipedes and the true mouth-appendages. The exopods are well developed swimming organs. Number four and especially number five are much smaller than the others. The gills are varying on the different thoracopods. A mastigobranchia is present on numbers one to four, but a podobranchial branch or a free podobranchia is lacking. Numbers one to four have each one arthrobranchia, one pleurobranchia on number four is placed so close to the arthrobranchia that it may look as a second arthrobranchia. Number five has no branchiae at all. No pleurobranchiae were observed on the first thoracopod, one was budding out, but not much developed, on the second, two small ones were present on the third and fourth, and none on number five.

The gills for the first Mysis stage can be summarized in the following formula :

	Mxp ₁	Mxp ₂	Mxp ₃	Pe ₁	Pe ₂	Pe ₃	Pe ₄	Pe ₅
Mastigobranchia	1	1	1	1	1	1	1	0
Podobranchia.....	0	(1)	(1)	0	0	0	0	0
Arthrobranchia	0	1	1	1	1	1	1	0
Pleurobranchia	0	2	2	0	1	2	2	0

The pleopods are all present but only as very tiny simple limb-buds; the uropods are about fully developed only the numbers of setae are still a little low, on the ventral side of the protopod is placed a large spine.

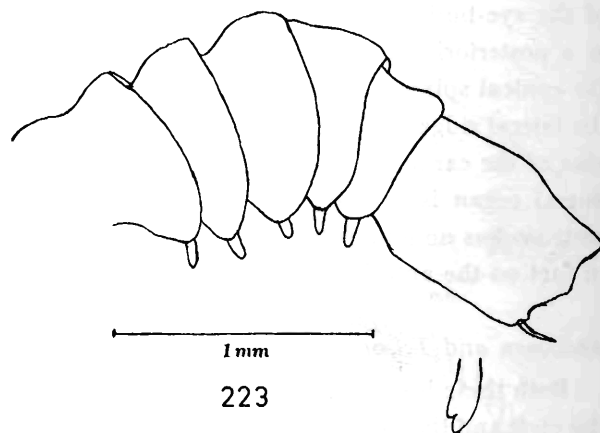


Fig. 223. *Cerataspis petiti*. First Mysis, abdomen and one of the pleopods from anterior.

Dimensions:

Total length 8,5 mm; length of carapace without rostrum 4 mm, elevation of same 2,5 mm; rostrum 1 mm; abdomen 2 mm; telson 1,5 mm.

Mysis II.

Figs. 224-237.

The second Mysis shows no larger changes. It is somewhat larger and several parts of its body and appendages have developed further.

Carapace.

A large median cephalic swelling is developed in front of the eight dorsal tubercles of which the most anterior pair is by far the largest. The rostrum is enlarged and still bent ventrally, but it now reaches in front of the eye-bulbs. The post-orbital spines which pointed nearly straight dorsally in the first Mysis are bent in a posteriorly directed curve, and so are the pterygostomian spines. The lateral box-shaped swellings and the conical spine at their apex, as well as the lateral ridge from the pterygostomian spine have become larger, the lateral ridge forms a posterior elongation of this spine along the lateral side of the carapace. The posterior alae of the carapace are almost unchanged, extending backwards on each side of the abdomen. The anterior dorsal organ is placed much more anteriorly than it is in *Solenocera*, just behind the rostrum, and as the rostrum has no long ridge on the carapace as in *Solenocera*, its placement appears even more anteriorly being in fact on the anterior part of the cephalic swelling and not backwards of it near the cervical groove.

Abdomen and Telson.

Both these body parts are about unchanged from the first Mysis, only the telson has narrowed a little behind the cleft and the two longitudinal, dorsal ridges from the base of telson to the first lateral spine are appearing, although still only little prominent. A dark pigmented spot at the tip of each lobe of the telson was especially clear in the figured individual, but as this specimen is close to moulting it may not be a real pigment spot, but sooner a concentration of new cells.

Appendages.

In the first antenna very small changes occur. The statocyst arch and spine are a bit more prominent, and the sensory setae on the lateral flagellum are more numerous. Both flagella are still unjointed.

The second antenna has a few more marginal setae on the antennal plate, and the endopodial flagellum is now well twice the length of the rostrum and reaches to near the tip of the pterygostomian spine.

The mandible is still without clear teeth along the incisor ridge, but more buds for coming teeth are visible. The molar part of the mandible is a little more well-defined.

The lobes of the labium are a little more rounded with a more distinct division in a peduncle and a rounded leaf which by closing in on the mandibles and the labrum makes a perfect external mouth-cavity.

The first maxillipede has an unchanged protopod, a small arthrobranchia has been added to the large, double mastigobranchia. The endopod has increased its number of joints to five by a division of the third joint into two joints. The exopod is unchanged.

In the second and third maxillipedes no remarkable changes have taken place, only the distal joint in the endopod of the second maxillipede seems a little shorter, and its setae therefore appear as more densely placed.

The first four thoracopods have each added a small budding podobranchia and have started to develop two small pleurobranchiae. The fifth thoracopod has as usual no gills. Its endopod is now five-jointed as in the other thoracopods.

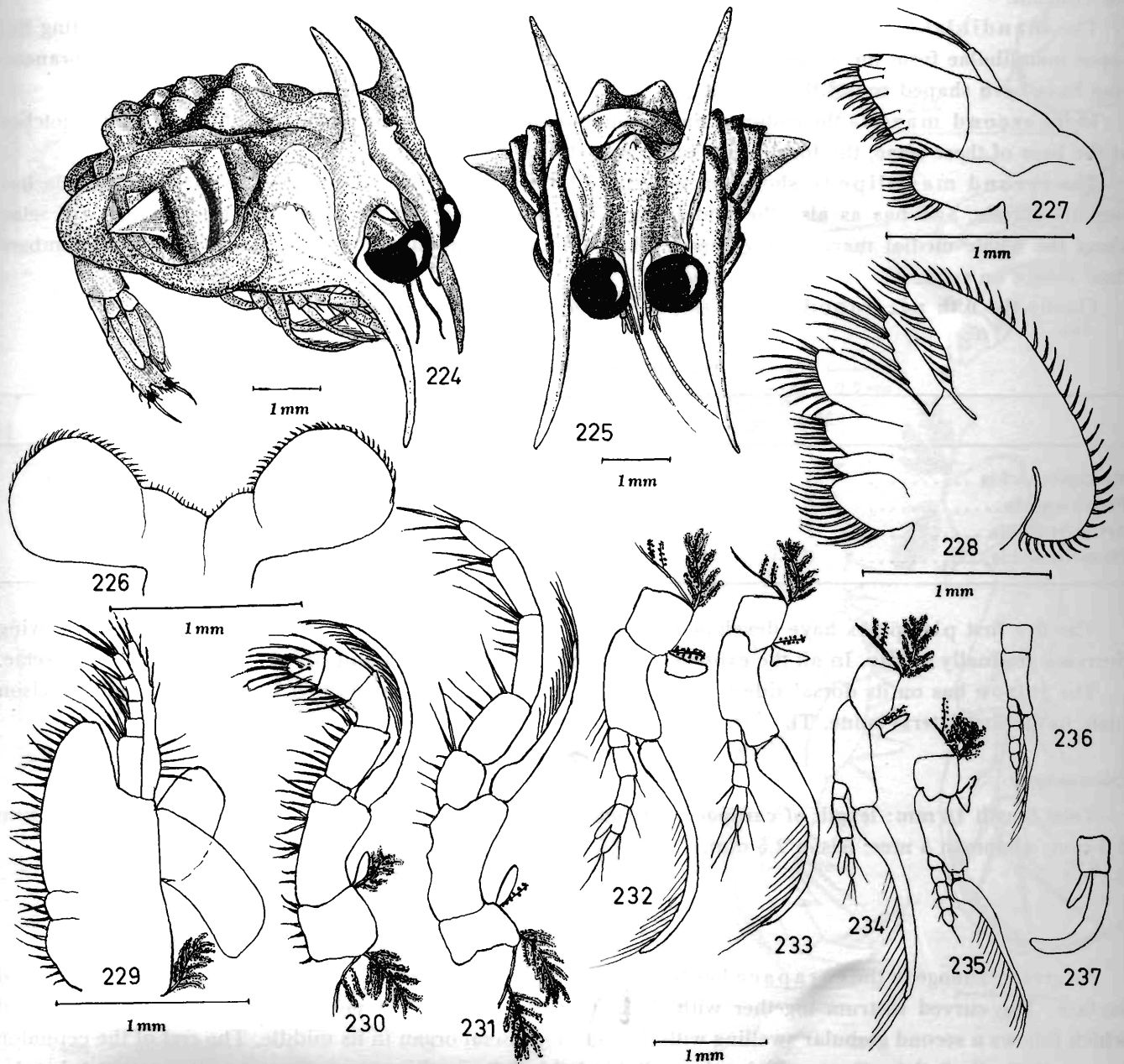
The pleopods have each developed from a little bud to a bifurcate limb with unjointed protopod, endopod and exopod. The exopod is much larger than the endopod, this is especially the case for the most anterior

pairs, because the general decrease in size backwards first and foremost affects the exopod with the effect that the two branches are of nearly equal size on the most posterior segments.

The uropods are fairly unchanged from the last stage.

Gill formula:

	Mxp ₁	Mxp ₂	Mxp ₃	Pe ₁	Pe ₂	Pe ₃	Pe ₄	Pe ₅
Mastigobranchia	1	1	1	1	1	1	1	0
Podobranchia	0	(1)	(1)	(1)	(1)	(1)	0	0
Arthrobranchia	1	1	1	1	1	1	1	0
Pleurobranchia	0	2	2	2	2	2	2	0



Figs. 224-237. *Cerataspis petiti*. Second Mysis. Fig. 224, larva from lateral. — Fig. 225, same from anterior. — Fig. 226, labium. — Fig. 227, first maxilla. — Fig. 228, second maxilla. — Figs. 229-231, first, second and third maxillipedes. — Figs. 232-236, first to fifth pereopods. — Fig. 237, fourth pleopod.

Dimensions:

Total length 10,5 mm; length of carapace without rostrum 4,5 mm, height of same 2,5–3 mm; rostrum 2 mm; abdomen 2,5 mm, telson 1,5 mm.

Mysis III.

Figs. 238–249.

Except for the larger size only small changes take place from the second to the third Mysis.

In the first antenna the statical nerve has grown into the statocyst and the sensory hairs have developed, but the statocyst itself is still open on the ventral side of the antenna. The hairs along the medial side of the peduncle have increased in number, but the two flagella are about unchanged and still unjointed.

In the second antenna the endopodial flagellum has grown and is now three to four times as long as the rostrum.

The mandible shows a clear distinction between incisor and molar parts, and a ridge is dividing the caput mandibulae from the corpus mandibulae, and with the thickening of the cuticle a clear, membranous ring have been shaped round the base of the mandibular palp to ensure its more free movement.

In the second maxilla the endopod has become unjointed, but by the placement of the setae and notches at the base of these setae, the former five joints can still be recognized.

The second maxillipede shows in its distal joint a clear division into two. The mastigobranchia has become elliptic, and has as also the podobranchia grown larger. On all three maxillipedes the stiff setae along the whole medial margin have increased in numbers; they are now also placed in larger numbers than before on coxa.

Finally the fifth pereopod has developed a small pleurobranchia.

The gill formula is as follows:

	Mxp ₁	Mxp ₂	Mxp ₃	Pe ₁	Pe ₂	Pe ₃	Pe ₄	Pe ₅
Mastigobranchia	1	1	1	1	1	1	1	0
Podobranchia.....	0	1	1	1	1	1	0	0
Arthrobranchia	1	1	1	1	1	1	1	0
Pleurobranchia	0	2	2	2	2	2	2	1

The five first pleopods have developed further. The most anterior pair is the largest and the following decrease gradually in size. In all the exopod is by far the largest branch and has developed embryonic setae.

The telson has on its dorsal side developed two longitudinal ridges running from the base of the telson plate to the first lateral spine. The furcal cleft has become a little more open.

Dimensions:

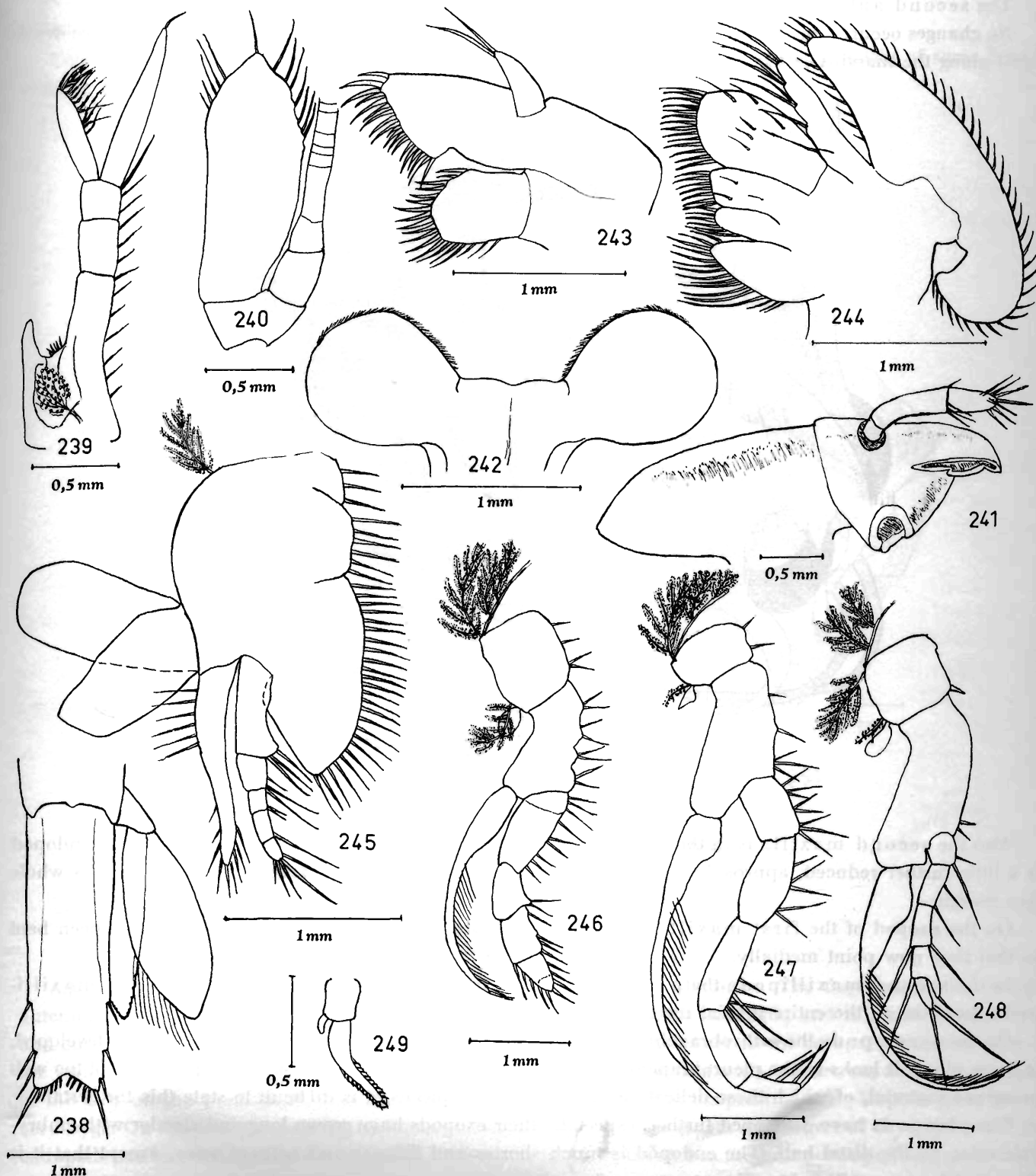
Total length 16 mm; length of carapace without rostrum and alae 7 mm, height of same 4 mm; rostrum 2,5 mm; abdomen 4 mm; telson 2,5 mm.

Mysis IV.

Fig. 250.

No greater change in the carapace has taken place except an increase in size and perhaps a more rounded surface. The curved rostrum together with the supra-orbital spines shape a curved frontal shield behind which follows a second globular swelling with the anterior dorsal organ in its middle. The rest of the cephalon is posteriorly limited by the cervical groove. Behind this follows the proper thorax with its eight tubercles arranged in four pairs in a dorsal line, and with the tubercles decreasing in size in posterior direction. Behind the last pair is the posterior dorsal organ. The lateral ridge from the pterygostomial spine runs in a dorsally

pointing curve towards the anterior tubercle, below the dome of this are three small tubercles in a line parallel to the basal part of the pterygostomian spine. The lateral pyramids with a spine on the top have increased in size. Also the abdomen is now larger in comparison with the rest of the animal, but still bent in under the thorax.



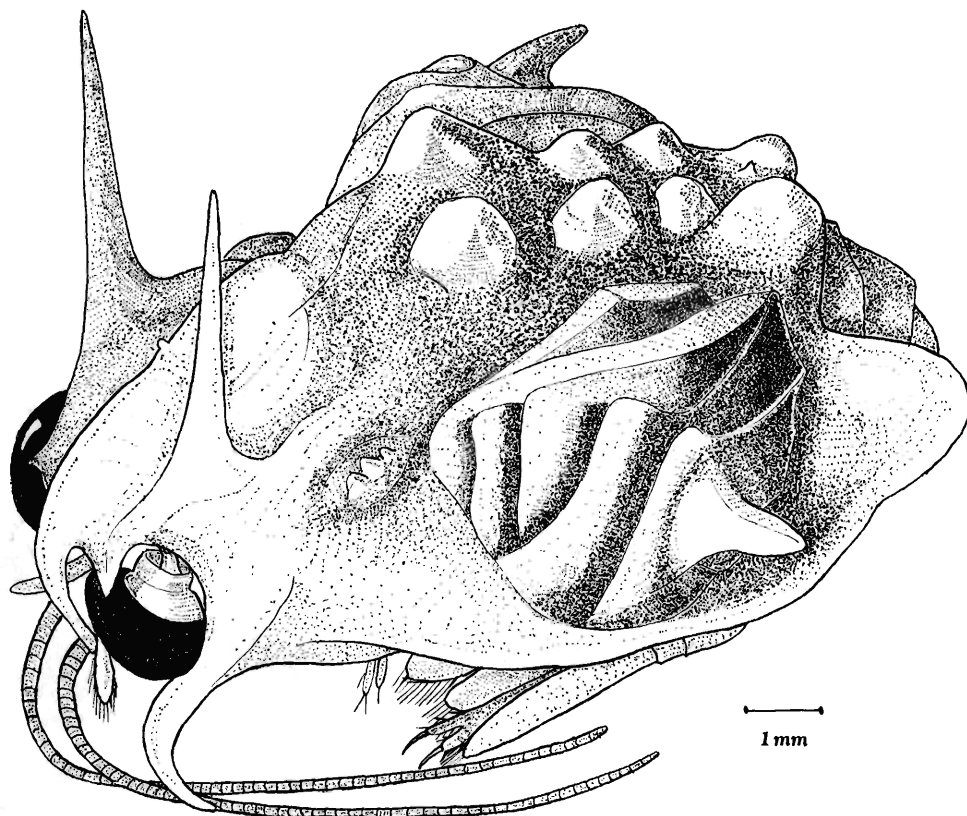
Figs. 238-249. *Cerataspis petiti*. Third Mysis. Fig. 238, telson with right uropod. — Fig. 239, first antenna from ventral. — Fig. 240, second antenna. — Fig. 241, mandible. — Fig. 242, labium. — Fig. 243, first maxilla. — Fig. 244, second maxilla. — Figs. 245-247, first, second and third maxillipedes. — Fig. 248, first pereopod. — Fig. 249, fifth pleopod.

The Appendages.

The first antenna is about unchanged, and the median lobe for the coming medial flagellum has enlarged to about twice the length of the lateral lobe and has started to become annulated. The lateral lobe is still short and unjointed, provided with sensory hairs on its medial margin.

The second antenna has now a long endopodial flagellum about as long as the thorax.

No changes occur in the mandible or in the first maxilla except that a few more stiff setae have developed along the margins of the lobes.



250

Fig. 250. *Cerataspis petiti*. Fourth Mysis from lateral.

Also the second maxilla is in the main unchanged, only the endites have enlarged a little, the endopod is a little further reduced, approaching the adult state, and the exopod has developed setae along its whole free margin.

On the exopod of the first maxillipede the setae along the base of its lateral margin have been bent so that they now point medially.

In the second maxillipede the podobranchiae have enlarged, and in this and in the third maxillipede the setae on the entire medial margin have increased in length and number.

On the pereopods the arthrobranchiae and pleurobranchiae have grown very large and well-developed, in some places it looks as the pleurobranchiae have multiplied by side-branching, but due to the not too well preserved material, of which these delicate parts easily fall to pieces, it is difficult to state this for certain.

The pleopods have developed further, especially their exopods have grown long and slender with embryonic setae on the distal half. The endopod is much shorter and thinner and without setae, except that it is tipped with two small embryonic setae.

The uropods are nearly of the same length as the telson, and their exopods have started to develop distally the characteristic lateral tooth.

The furca of the telson is more open, and the setae in the furcal cleft are becoming vestigial, but still present in full number. The lateral teeth have moved farther forward so that the most distal one is in line with the bottom of the cleft.

The gill formula is unchanged.

Dimensions:

Total length 23 mm; length of carapace without rostrum and lateral alae 10 mm, height of same 5 mm; rostrum 3 mm; abdomen 7 mm; telson 3 mm.

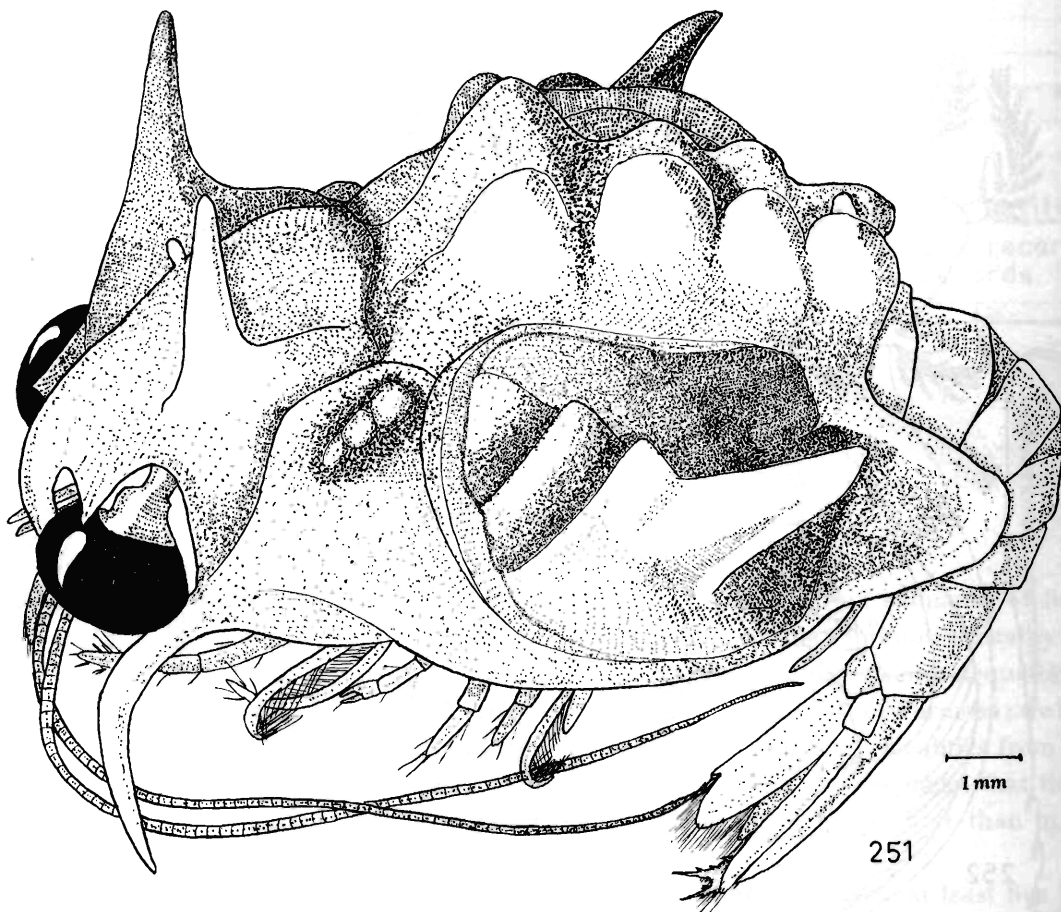
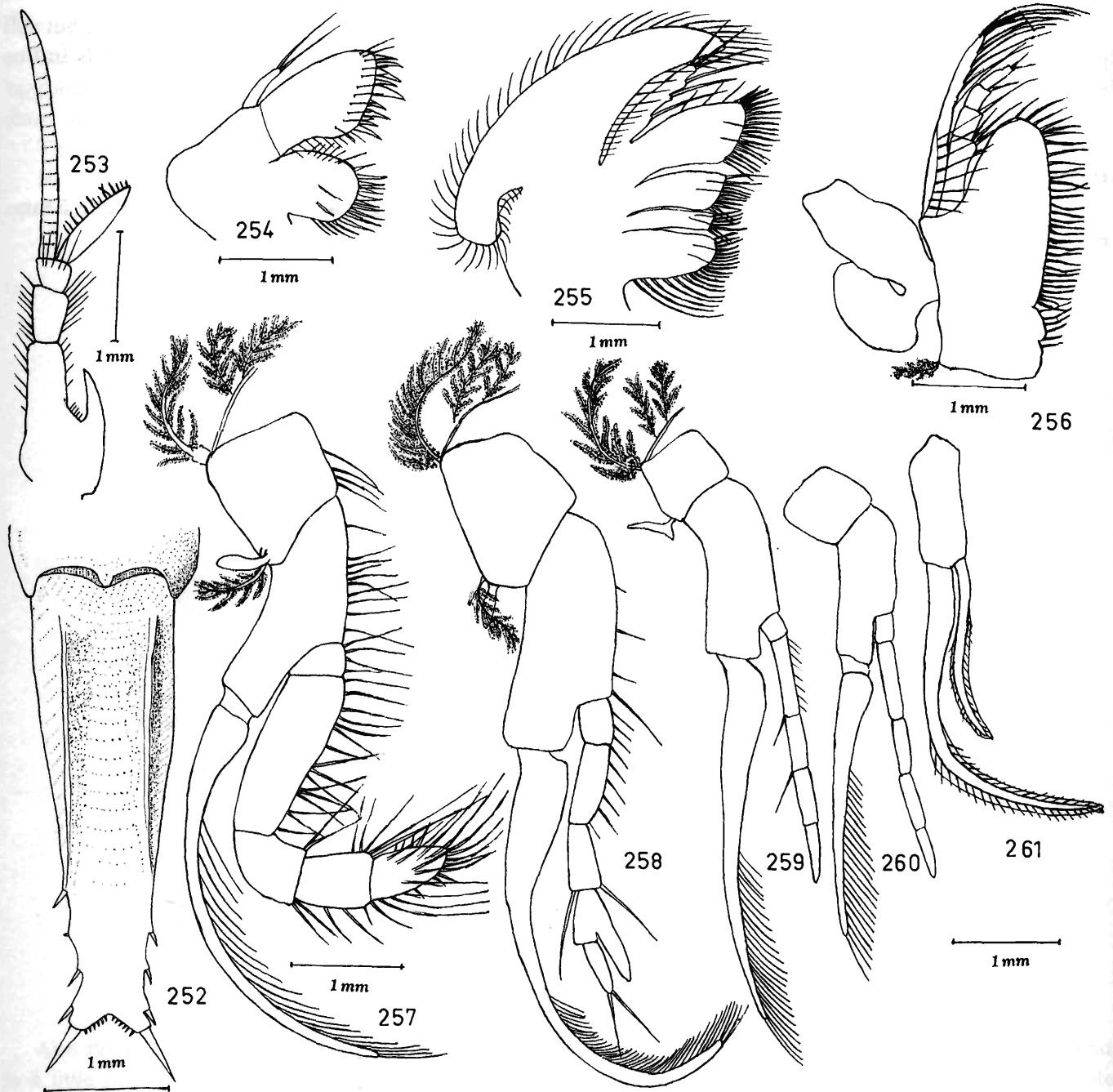


Fig. 251 *Cerataspis petiti*. Fifth Mysis from lateral.

Mysis V.

Figs. 251-261, 263.

Again we have an increase in size, relatively strongest for the abdomen. The flagellum of the second antenna has increased in length. The rostrum has only increased little in length, and it is still without teeth and curved ventrally between the eyes. It is flattened, but has a small keel on the carapace reaching close to the frontal dorsal organ. On the first maxillipede the double mastigobranchia has grown, and so have most of the gills on the pereopods, but their formula is unchanged. The exopods of the pleopods have grown very large. On the first pleopod the endopod is only a small bud, the length and degree of development of the endopods are increasing backwards so that on the fifth pleopod which has the best developed endopod, this is about half as long as the exopod. In the uropods the exopod has a distinct lateral tooth distally, and the keels on the telson have become rather prominent. The two spines terminating the lobes of the furca are strong and well-developed and by far the largest of the spines of the telson.



Figs. 252-261. *Cerataspis petiti*. Fifth Mysis. Fig. 252, telson. — Fig. 253, first antenna. — Fig. 254, first maxilla. — Fig. 255, second maxilla. Figs. 256-257, first and second maxillipedes. — Fig. 258, first pereiopod. — Figs. 259-260, fourth and fifth pereiopods. — Fig. 261, fifth pleopod.

Dimensions:

Total length 27 mm; length of carapace 12 mm, height of same 7 mm; rostrum 4 mm; abdomen 7,5 mm; telson 3,5 mm.

Average measurements of different Mysis stages in mm.

Mysis stage:	I	II	III	IV	V
Total length.....	8.5	10.5	16	23	27
Carapace.....	4 × 2.5	4.5 × 3	7 × 4	10 × 5	12 × 7
Rostrum.....	1	2	2.5	3	4
Abdomen.....	2	2.5	4	7	7.5
Telson.....	1.5	1.5	2.5	3	3.5

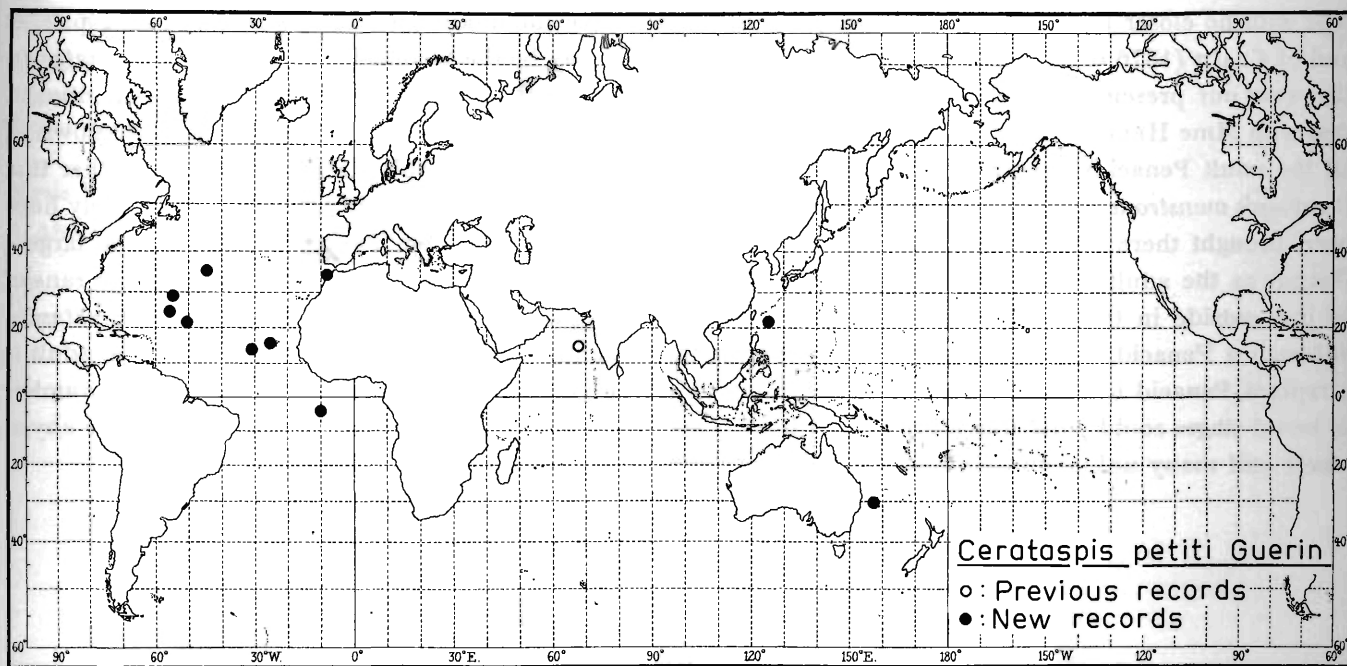


Fig. 262. Map of distribution.

262

Distribution and Remarks.

Fig. 262.

From previous records in the literature are only known two specimens from stomachs of fish captured in the Indian Ocean and described by GUERIN (1839) and one specimen from an unknown locality (lab. Wime-reux). This new material shows that this penaeid larva is a tropical species with a circum-aequatorial distribution. From the Pacific it is recorded near the East coast of Australia and from east of Formosa; we have further GUERIN'S old record from the Indian Ocean and to these are added eight "Dana" localities from the tropical part of the Atlantic Ocean; these larger numbers from the Atlantic Ocean do not mean that the species is more frequent here, but are caused by the number of stations being much higher here than in other parts of the oceans where "Dana" has cruised.

The species is a true pelagic form which also is shown by the many larval stages: at least five Mysis stages are recorded here, and possibly there may be one or two stages more before the first post-larval stage is reached. In coastal forms of *Caridea* and *Penaeidae* two Mysis stages are most common.

The coastal and subtropical species, e. g. *S. membranacea*, have only two Mysis stages, but the true tropical species *S. sp. larva sumatransis* at least four and *S. sp. larva danae* at least three Mysis stages. That consumption of much food does not give a shorter period between the instars is understandable from the fact that the larvae are able within certain limits to grow inside their cuticle, because of the soft and partly elastic membranes between the segments. The result is a certain variation in development of the larvae of the same species in the same larval stage. They are actually in a slightly different stage of development, when moulting takes place.

BOAS (1880) has without any doubt placed the *Cerataspis* species in the Penaeidae. BOUVIER (1908) has suggested that they were larvae of *Aristeomorpha*, and BURKENROAD (1936, p. 85) without referring to BOUVIER states without any explanation that *Cerataspis petiti* is the larva of *Aristeomorpha wood-masoni* CALMAN 1925 and *Cerataspis monstrosa* the larva of *A. foliacea* (Risso). Now this statement can not be true because *Cerataspis* and *Aristeomorpha* after our present knowledge not have the same distribution, and further HELDT (1955) described the larval stages of *Aristeomorpha foliacea*, and they agreed with larvae of the normal penaeid

type with no closer resemblance to *Cerataspis*. Further we have the unknown larva of DOHRN (1871 p. 377) and of CLAUS (1876 p. 17) from the Strait of Messina, which may be the second Protozoa stage of *Cerataspis*. However our present knowledge only indicates that it belongs to the Penaeidae. It must here be mentioned that with Mme HELDT's description of the larval stages of *Aristeomorpha foliacea*, Mysis stages are known of all the adult Penaeids observed in the Mediterranean. Against BURKENROAD's statement speaks further that *Cerataspis monstrosa* has been recorded from the Mediterranean (Wimereux), although it may possibly have been brought there through the Strait of Gibraltar. However, it is even then hardly possible that so large a shrimp as the adult must be, judging from the size of *Cerataspis*, can live pelagically in the Mediterranean or just outside in the Atlantic without being known. It is therefore possible that the adult of *Cerataspis*, although a Penaeid, is not to be looked for among the Natantia but among the Reptantia, that the adult is a reptant Penaeid living in the abyss of the ocean. Also the very small abdomen and the size and number of larval stages could point this way. It must have reached a certain size before it can descend into the abyss, where still many unknown animals may be expected to live.

Cerataspis monstrosa GRAY.

Figs. 264-295.

- Cerataspis monstrosus*, J. E. GRAY 1828, p. 8, pl. 4, Fig. 5.
Cryptopus defrancii, LATREILLE 1829, p. 100.
Cerataspis monstrosus, MILNE-EDWARDS 1837, vol. 2, p. 238.
Lepsia tuberculosa, QUOY 1839, pp. 4-3, pl. 1.
Cerataspis monstrosus, DOHRN 1874, pp. 362-372, pl. 28, Figs. 23-34.
Cerataspis monstrosus, BOAS 1880, pp. 42-45, pl. 6, Fig. 189.
Cerataspis monstrosa, GIARD et BONNIER 1892, pp. 350-354.
Cerataspis monstrosa, BONNIER 1899, pp. 27-49, pl. 3-6.
Cerataspis monstrosa, BOUVIER 1908, pp. 13-14.

Localities.

Mysis I.

- 19°49' N-69°15' W. ANDREA 10-1862, C. Z. M. 12.1893, 1 spec.
 8°10' S-12°-13°20' W. ANDREA 1864, C. Z. M. 12.1893, 1 spec.
 9°40' N-109°20' E. ANDREA 1869, C. Z. M. 12.1893, 1 spec.

Mysis II.

- 34° N-32° W. HYGOM, C. Z. M. 12.1893, 1 spec.
 31°-32° S-42°21'-47° E. ANDREA 1870, C. Z. M. 12.1893, 2 spec.
 Dana St. 3536 III, 34°08' N-13°05' W. 100 m.W. 27.7.1928, 1 spec.
 — — 3718 IV, 20°04' N-123°59' E. 100 m.W. 25.5.1929, 1 spec.

Mysis III.

- 8°10' S-12°-13°20' W. ANDREA 1864, C. Z. M. 12.1893, 2 spec.
 no locality, C. Z. M. 12.1893, 4 spec.

Mysis IV.

- The Azores. (Horta), FRANCISCO S. CHAVES, C. Z. M. 8.1892, 1 spec.
 34° N-32° W. Stomach of *Coryphaena*, HYGOM, C. Z. M. 8.1892, 2 spec.
 "Dana" St. 1149 X, 33°22' N-21°55' W. 150 m.W. 21.10.1921, 1 spec.
 No locality, C. Z. M. 12.1893, 1 spec.
 No locality, C. Z. M. 12.1893, 3 spec.

Mysis V.

St. Miquel, the Azores from fish stomach. Dr. ALFONSO CHAVES, 14.12.1922, C. Z. M., 1 spec.

"Dana", St. 3535 III, 34°21' N-12°19' W. 100 m.W. 26.7.1928, 1 spec.

Japan (no further data) B. M. 45.37, 1 spec.

Mysis VI.

S. African waters, Dr. K. H. BARNARD, B. M. 1957, 11.6.26, 1 spec.

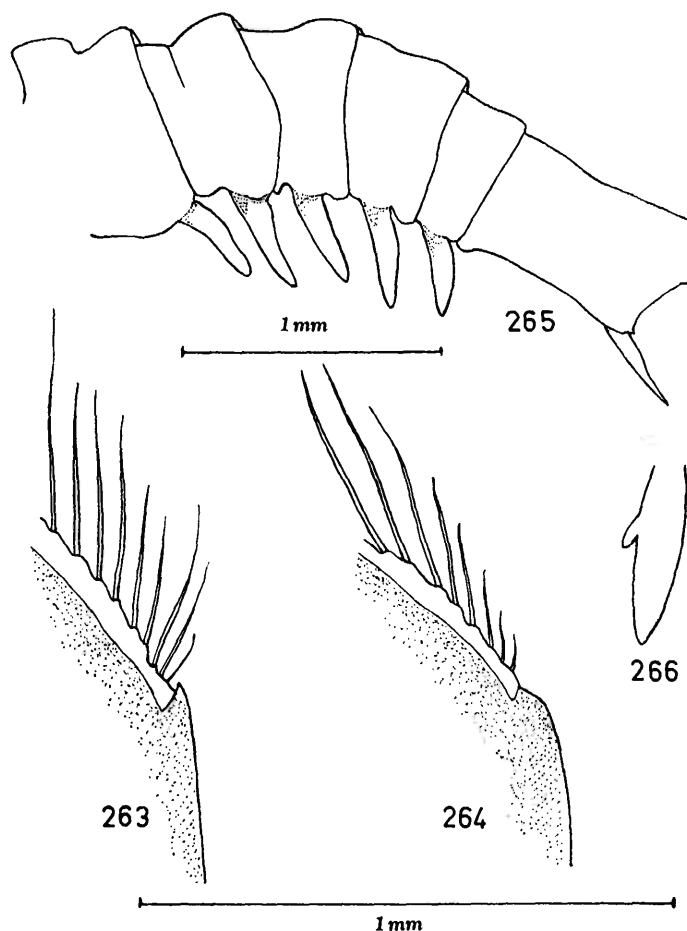


Fig. 263, *Cerataspis petiti*, fifth Mysis, latero-distal corner of antennal scale. — Fig. 264, same of *Cerataspis monstrosa*, fifth Mysis. — Figs. 265-266, *Cerataspis monstrosa*, first Mysis. — Fig. 265, abdomen. — Fig. 266, one of the pleopods, showing the large exopod and the tiny endopodial bud.

Description.**Mysis I.**

Figs. 264-266.

No younger stages than the first Mysis are known.

This species is very similar to *Cerataspis petiti*. If it was not for the characteristic sculpture on the carapace in which the two species are distinctly different, there would hardly be any reason to separate them, also as both have about the same distribution. But due to this marked difference in carapace and some other minor differences it is necessary with the present knowledge to retain them as two separate species.

Carapace.

The carapace has the same four pairs of tubercles dorsally as in *C. petiti* and the same paired spines: fronto-dorsally a curved post-orbital spine, a perhaps a little more flattened supra-orbital spine, a curved ptery-

gostomian spine, and posteriorly directed alae, one from each side of the carapace. The rostrum is a little longer, but this may be due to the species being a little larger than in *C. petiti*. The lateral sides of the carapace, however, differ considerably. The conical spine on the top of the pyramid stubs in *C. petiti* is absent in *C. monstrosa*, but the surface in this area is strongly convoluted and has the same function as a float for the larva. Figs. 267-268 show the arrangement of this convoluted surface in the second Mysis stage, viewed laterally and frontally. Also the three small tubercles placed in a line in front of the convoluted surface are absent in *C. monstrosa*.

Abdomen and Telson. Fig. 265.

The abdomen is much the same in the two species, perhaps the dorsal surface is a little more folded, and the ventral spine on the last segment larger and stouter in *C. monstrosa* than in *C. petiti* (Figs. 265, 223). On the telson the two terminal spines on the branches of the furca are a little curved towards each other in *C. monstrosa*. The number of setae inside the furca are 5-7 on each lobe, but 6 on all the examined specimens of *C. petiti*, the material is too small to state whether this is a true difference or not. In *C. monstrosa*, the most distal of the three lateral spines on the telson is placed in line with the bottom of the cleft of the furca already in the younger stages. The most proximal spine is placed only little more than one third of the length of telson from its distal point. In *C. petiti* the most distal spine is more distally placed in the younger stages, and the most proximal spine is situated nearly one fourth of the length of the telson from its distal point.

Appendages.

Also here the differences are very small. No important difference can be found in the first antenna. In the second antenna the lateral spine of the antennal plate is present, though very minute, in *C. petiti*, but not found in *C. monstrosa* where the external margin is rounded towards the beginning of the setae at the place where the spine should have been. (Fig. 263-264). This holds true only for the older stages from the third Mysis, in the first two Mysis stages no difference can be seen in this organ between the two species.

In the mandible the molar part is a little stronger and the palp a little longer in *C. monstrosa* than in *C. petiti*, but again here the differences are so small that they can not be recognized without having a specimen of each species to compare, and further it must be remembered that the mandibles always vary somewhat, even the right and left mandible of the same specimen are never true mirror replica of one another. The lips of the labium are a little shorter with a more rounded distal margin in *C. monstrosa* than in *C. petiti*, and the endites of the first maxilla are a little more setose in the former.

The gills on the thoracopods are in the same stages generally more developed and larger in *C. monstrosa*, but otherwise the gills and their development seem the same in the two species.

The pleopods are well developed in the first Mysis stage. They are beginning to be bifurcate, but are still unjointed. The axis of the limb continues from the protopod into the exopod, and the endopod is placed as a small bud on the medial margin, one third from the basis of the limb. The uropod has a spine on the ventral or medial side of the protopod.

This larva is a little larger than the same stage in *C. petiti*, but again it must be remembered that the material is too small to permit final conclusions. The larva is a little larger, but at the same time its development is slightly more advanced than in the first Mysis stage of *C. petiti*. In *C. monstrosa* the flagellum of the first antenna had 10-15 rings and is a little longer than the antennal scale. The molar part of the mandible is a little better developed, and so are the pleopods. But as it has been pointed out in the chapter on ratio of growth this can be explained by a larger and better development of the Protozoa in *C. monstrosa* than in *C. petiti*.

Figs. 267-281. *Cerataspis monstrosa*. Second Mysis. Fig. 267, larva from anterior. — Fig. 268, same from lateral. — Fig. 269, telson. — Fig. 270, first antenna. — Fig. 271, second antenna. — Fig. 272, mandible. — Fig. 273, labium. — Fig. 274, first maxilla. — Fig. 275, second maxilla. — Figs. 276-278, first, second and third maxillipedes. — Fig. 279, first pereopod. — Fig. 280, first pleopod. — Fig. 281, fifth pleopod.

