

along the branchio-cardiac groove is a row of spines which no longer are placed exactly in the groove line, but have moved a little more or less outside the line. One of these spines, the post-cardiac spine, is placed at the end of the carapace and at the end of the line of the lateral spines.

Abdomen.

Spine formula for segment I: 1. 2., segments II-V: 1. 2. 3., and for segment VI: 1. (2). 3. 4.

Because of the carapace reaching farther backwards in the older stages, the dorso-lateral spine of the first segment gets in the way for the carapace, and is therefore lost already in the third Mysis. The lateral process on the same segment has enlarged in the dorso-lateral direction and is more lamellar than before, further it is very low in its most dorsal part, where the muscles later are penetrating into it. Also the pleura of the first five segments have grown and a few small, accessory spines have been added on the dorsal ridge of some of the dorsal spines especially on that of the fifth segment. The sixth segment of the previous stage had a double row of small spines along the dorsal ridge of the segment, these have in the third Mysis decreased in number, and only a few of them remain. But the material for examination is too small to show whether this is a general character or due to variations in the specimens. The lateral spine which was very large in the second Mysis is practically lost or present only as a pointed lobe in the third Mysis; in the fourth Mysis it will completely disappear. Also the ventro-lateral spines on the same segment are small and very delicate in shape.

Telson.

The plate has become more elongate. It is still furnished with the same numbers of spines and setae, but the terminal spines on the two branches of the furca have decreased to about the same size as the three lateral spines, which are placed with nearly equal intervals along less than the distal third of the lateral margin of the telson. Also the furca itself has changed becoming very open so that the telson has a nearly square-cut posterior margin with a lobe in the median line. The furca has enlarged in length and decreased in width.

Appendages.

The first antenna has the usual three joints in the protopod; the statocyst in the proximal joint has developed further, the groove is now clearly visible on the ventral side of the joint and still open, but it is about to be covered by a lobe from its proximal border which will close the groove to the exterior except for the distal opening for the intrusion of the statoliths. Inside the groove the static nerve has now developed the static sense-organs, which can be seen as big, clear cells each in connection with a fine nervethread from the static nerve. More plumose setae have developed along the sides of the three joints of the protopod. The two flagella have not grown and are still unjointed, but olfactory hairs have developed in groups on the most lateral of the two flagella.

On the second antenna the antennal scale or exopod is now shaped like in the adult, the setae along its lateral margin have disappeared, the latero-distal spine has enlarged, and the numbers of setae on the distal and medial margins have increased in number. Also the endopodial flagellum has grown much longer and is now a long, flexible rod reaching well beyond the tip of the rostrum and the antennal scale, but it is still without any clear annulation.

The labium has developed some ridges and a pair of lateral ears which covers a part of the mandibles.

The labrum has enlarged its two lobes with a soft-skinned distal part which, when not used, can be folded back behind the mandibles so that the fold becomes inserted between the proximal, stiff part of the lobes and the mandible.

The mandible has a clear division between corpus mandibulae with its strong muscles and caput mandibulae with the well-developed incisor and molar parts. The palp of the mandible which is placed on the corpus mandibulae just behind the line to the caput mandibulae is two-jointed. It has grown a little, and its distal joint is tipped with three plumose setae.

The first maxilla is nearly unchanged, the coxa-endite has increased a little in size, and its setae are placed in two groups, one proximal with longer setae and one distal with very short setae towards the basi-endite, possibly to allow the latter a more free movement.

The second maxilla is almost unchanged in the endites and the endopod. On the first Mysis the exopod had one very long posterior seta, which in the second Mysis was multiplied to two long and four short setae. In the third Mysis all the posteriorly turning setae are longer than the others, but not nearly as long as the single long seta in the first Mysis.

The first maxillipede is enlarged since the preceding stage. The coxa is provided with a very large, leaf-shaped mastigobranchia. The exopod has developed longer swimming setae, the endopod is still only four-jointed. All the setae on the medial margin of the limb are long, plumose, filtering setae. But the setae on basis, extending over part of both exopod and endopod in the second Mysis, have been lost in the third Mysis.

The second maxillipede has enlarged both the mastigobranchia and the podobranchia on coxa. The endopod has no clear border between the first and the second joints. The exopod has grown and its setae are more numerous. Both the swimming setae on the exopod and the trapping setae on the medial margin of protopod and endopod have become longer.

The third maxillipede is as long as the following pereipods. It is provided with one mastigobranchia with hairy setae on the margin, with one podobranchia and one arthrobranchia.

The following four pereipods are each provided also with one mastigobranchia with a hairy margin—the hairy margin has not been seen in any earlier stages—one podobranchia and one arthrobranchia. The fifth pereipod has no branchiae. In all five pairs the exopod is a strong swimmeret with many long swimming setae in the distal part. All over the endopod many stiff, but plumose, setae have appeared (see Figs. 147, 148).

The five pairs of pleopods are a little longer than in the previous stage but otherwise unchanged and unfunctional for swimming.

The uropods are now longer than the telson plate, projecting well beyond it.

Dimensions:

Total length 17 mm; length of carapace 5 mm, width of same 4 mm; length of rostrum 2.7 mm; length of abdomen 7 mm.

Mysis IV.

Figs. 150–152.

Carapace.

Formula: 2. 3. (4). (5). 7. 8. 9. 10. 11. 12. 13. 15. 17. 18. 19. 20. 21. 24. (28). (29). 30.

The carapace has in this stage reached a step further towards the post-larval stage. The rostrum is stouter and the dorsal keel from the rostrum on the carapace is higher and includes at its base the anterior dorsal organ, the external bud of which is elevated a little from the posterior base of the rostral carina. The dorsal organ proper has become very small; this together with other characters of the stage suggests that it possibly is the last Mysis stage.

All the spines on the carapace are like those in the previous stage. Two of the spines from the branchio-cardiac groove have moved away from the groove-line into a more medial position, one so far that it, like in the previous stage, is named post-cardiac spine. The branchio-cardiac groove has practically disappeared, it is only marked by the position of three spines in a line. Instead several smaller, longitudinal grooves and ridges have appeared (Fig. 150), but none of them are continuous through the full length of the carapace. Of the marginal dentated filaments the branchiostegal one has disappeared and of the postero-marginal one, already diminished in the previous stage, now only a tiny part with vestigial teeth is left. Close to it is the postero-branchial groove spine, which can no longer be considered a proper spine, because it has widened further into the carapace at a right angle to the longitudinal axis, but at the place where the spine was earlier.

The medio-posterior marginal spine is a small outstanding crest with three to four filamental teeth. Against this crest and just in front of it are the last remnants of the posterior dorsal organ.

All these parts: spines, dental filaments, filamental crests and wings are larval characters and will all be lost in the first post-larval stage. This renders it so difficult, even if the adult should be a known species, to refer a larva to its proper adult form, without being able either to observe the first post-larval cuticle below the last larval skin or, still better, to follow the ecdyses.

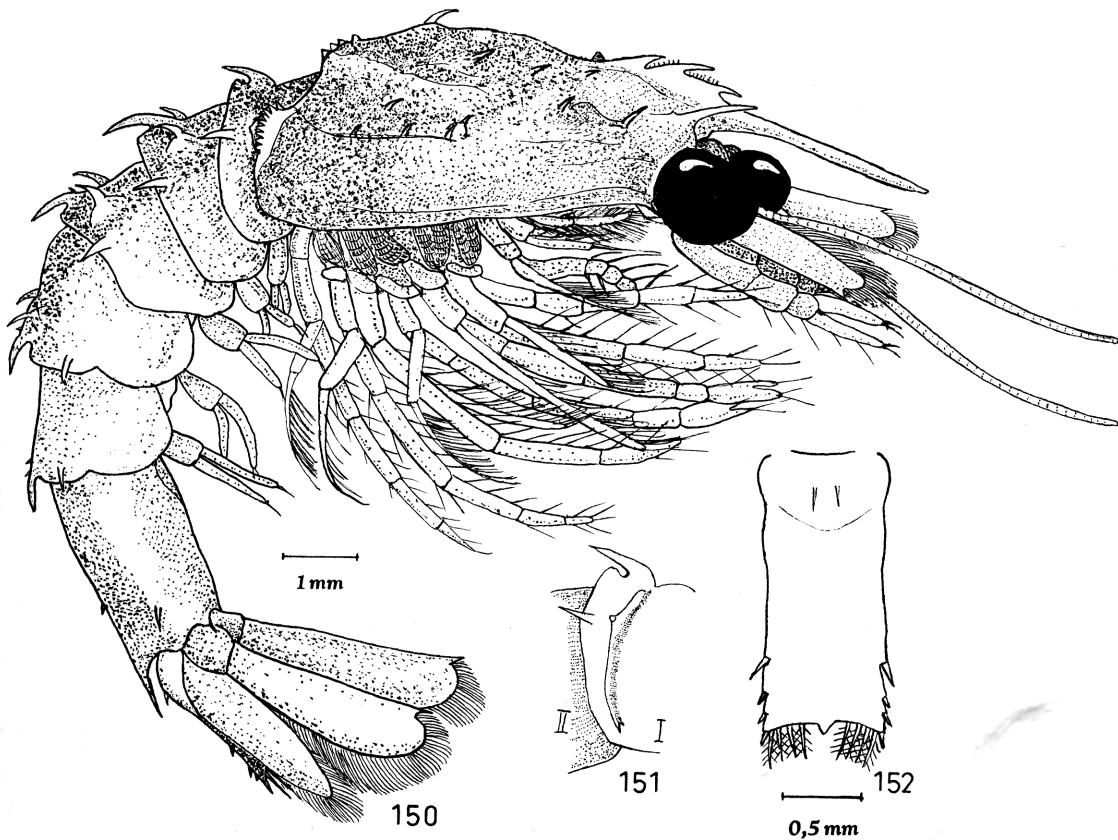
Abdomen.

Formula, segment I: 1. 2., segments II–V: 1. 2. 3., segment VI: 1. 3.

The pleural plates have developed further, some of the accessory spines on the dorsal spines have become larger, and as a dorsal keel has appeared along the dorso-medial line, some of these accessory spines have moved a little away from the dorsal spine, on which they started, now riding (more separately) on the adjoining keel. This is first and foremost the case for the posterior segments of the abdomen. Also the lateral process on the first abdominal segment has become more membranous and has developed a small extruding spinal bud, placed where the membrane is highest, about one third from its dorsal outspring. On the sixth segment the lateral spine is only a rounded arch of the posterior margin, and also the ventro-lateral spines are very vestigial.

Telson.

The telson has become more elongate so that the three lateral spines are placed on the distal one fourth of the lateral margin. A pair of tiny spines has now appeared on the dorsal side of the telson near its base on each side of the distal part of the dorsal spine from the sixth segment, from where they reach in over the base of the telson (Fig. 152). The lateral margins of the telson plate are still parallel, but the posterior free



Figs. 150–152. *Solenocera* sp. larva *sumatransis*. Fourth Mysis. Fig. 150, larva from lateral. — Fig. 151, first abdominal segment with lateral process. — Fig. 152, telson.

margin of the plate is now nearly square-cut with a very shallow furca and a triangular lobe at the bottom of the furca.

Appendages.

The change from the previous stage is only small. The statocyst in the basal joint of the first antenna is now closed except for the small distal opening which remains throughout life. No statoliths have yet been placed in the cavity, but along its inner wall seems to be a fine ramification of branches from the nervus staticus and the fine sense-organs, on which the statoliths are to rest. The two flagella of the first antenna are still unjointed and about as long as in the previous stage.

The endopodial flagellum of the second antenna has grown to about twice the length of the antennal scale and has started to become annulated, which makes it more flexible. The protopod of the same limb has developed a short, but pointed and conical, spine on its disto-lateral corner just in front of the antennal spine of the carapace.

The mandibular palp is still two-jointed but has become larger, reaching in front of the labium.

The two lobes of the labrum are no longer bent distally towards their proximal parts, but form instead a bulge over the caput mandibulae which reaches forward to meet the posterior margin of the labium.

The first maxilla has still a three-jointed endopod. The exopod of the second maxilla is placed as a large, semilunate leaf covering the mouth region laterally and reaching forward nearly as far as the mandibular palp, exteriorly or laterally of it.

The three pairs of maxillipedes are stout feeding organs and have nearly the same shape as in the previous stage. This also holds good for the five pairs of pereopods. The three first pairs are chelate, but have still many trapping setae also on the chela. This makes this distal part of the limbs useless as proper chelae, but they can serve as a good trap for catching the prey. The fifth pair of pereopods are still without gills of any form. It is of interest to note that the mastigobranchiae on the pereopods in the third and fourth Mysis are setose.

The pleopods have grown in size, but not in development. They are hardly of any locomotory function for the larva.

The uropods are well developed, and their exopods are more than twice as long as the telson plate.

Dimensions:

Total length 22 mm; length of carapace 7 mm, width of same 5 mm; length of rostrum 3.5 mm; length of abdomen 11 mm; length of telson 3.5 mm.

Average size in mm of different Mysis stages.

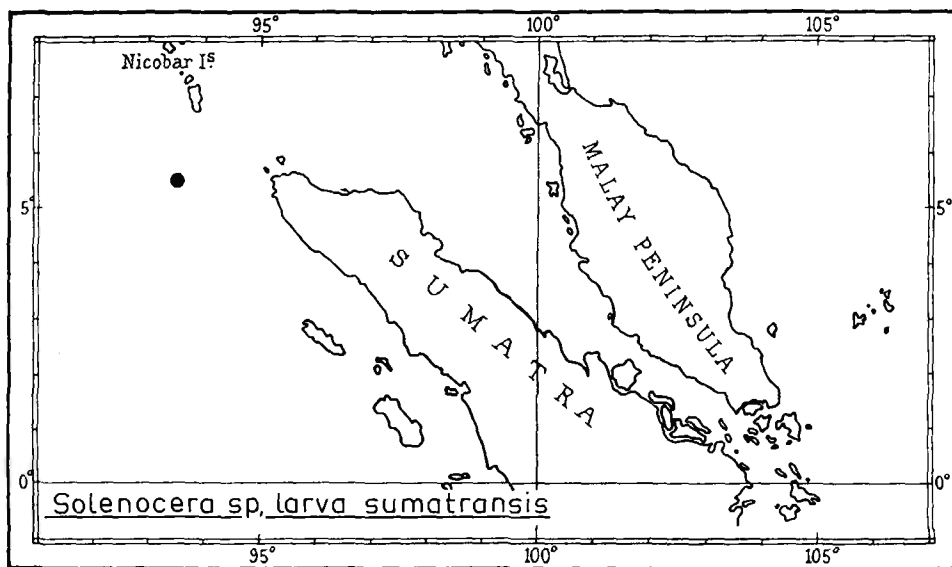
Mysis stage	I	II	III	IV
Total length.....	6	10	17	22
Carapace.....	2 × 2	3 × 3	5 × 4	7 × 5
Rostrum.....	1	1.8	2.7	3.5
Abdomen.....	2.5	3.7	7	11
Telson.....	1	1.3	1.5	2

Distribution and Remarks.

Fig. 153.

All the specimens of this species are from the same locality Dana St. 3903, south of the Nicobar Islands a few miles west of the northern point of Sumatra. They were caught at different depths between 10 and

200 m with 50 to 300 meter wire. The only complete larval development of a *Solenocera* which is known at least for its last part is that of *S. membranacea* with two Mysis stages. But two of the larvae described in this paper have more than two Mysis stages, so this number can not be constant for the genus *Solenocera*. In *S. sp. larva danae* we found three Mysis stages. It has already been mentioned under remarks to *S. sp. larva danae* (pp. 102–104), that it is likely that still more Mysis stages are to follow the known three stages in this species. For *S. sp. larva sumatransis* four Mysis stages are described in this paper, and both the third and the fourth Mysis of this species seem closer to the adult form than the third Mysis in *S. sp. larva danae*. The fourth Mysis of *S. sp. larva sumatransis* may be the last or one of the latest Mysis stages, although nothing can be said definitely about it.



153

Fig. 153. Map of distribution.

The following points are in favour of the assumption that the fourth Mysis of *S. sp. larva sumatransis* is one of the last Mysis stages in this species: The rostrum has almost the adult form with a strong toothed carina on the carapace and a stiff, nearly straight, pointed, free part. The lateral margins of the carapace are straightened out and have no longer larval lobes. The statocyst is about ready to function, the telson has nearly lost its furca, and the uropods reach beyond the telson. The pleura are well developed. The lateral spine on the sixth abdominal segment has disappeared in the fourth Mysis stage, and the pleopods have developed elongated exopods and endopods. It is of interest to note that the mastigobranchiae in the first and third Mysis develop a setose margin not found in any first or second Mysis, nor in the third Mysis of *S. sp. larva danae* where the mastigobranchiae are smaller and more pointed at the tip than in *S. sp. larva sumatransis*.

Of the two species which come closest to having a true tropical oceanic occurrence, *S. sp. larva sumatransis* and *S. sp. larva danae*, the larvae have a more carnivorous life than the other *Solenocera* larvae. This is seen not only from their very large and well-developed mandibles, but also from the facts that the basiendite of the first maxilla is rather mandibular in shape and can function as a secondary mandible and from the many stiff, but plumose, trapping setae on the other mouth appendages as well as on the pereopods. As the demand for food is growing with age of the larva we also observe an increasing development in size and number of these trapping setae especially in those on the pereopods after each moult.

Solenocera sp. larva *nodulosa*

Figs. 154-169.

Localities.**Mysis II.**

Dana St. 3921 III. 3°36' S-58°19' E., 300 mW. 11.12.1929. 1 spec.

Description.**Mysis II.**

Only a single specimen, a second Mysis, exists of this interesting species which in many points links up to the *Solenocera* but in others is different. Of the here described *Solenocera* larvae, *S. sp. larva sumatransis* comes closest to it. Due to our scarce knowledge of the genus it is difficult to decide whether the larva belongs to *Solenocera* or a related genus, but it can not be doubted that it belongs to the Solenoceridae.

Carapace.

Formula: 2. 3. 4. 6. 7. 9. 11. 12. 13. 15. 16. 23. 24. 27.

The carapace is a large, swollen globe or sooner one larger globe above the thorax and one smaller over the cephalon. One of the most characteristic features of the species is that it is the only known *Solenocera*, or related form without a dorsal or epicardiac spine. The rostrum is short and bent in front of the animal as normally the case in early Protozoa-stages, but it extends backwards as a strong ridge on the carapace with a single diminutive epigastric-rostral tooth. Posteriorly of the base of the rostral ridge is the small anterior dorsal organ; the still smaller posterior dorsal organ, is situated at the base of the medio-posterior marginal spine or partly inserted into the base of the spine. The spine is smooth without larval filament. Along the margin of the carapace the supra-orbital spine extends laterally to the rostrum, covering the eye in its full length. Laterally to it is the antennal spine, which together with the rostrum is shaping a large, shallow orbit between the two spines. Posteriorly of the antennal spine, but still on the margin, is a single branchiostegal spine shaped as an anteriorly pointing apex on a large branchiostegal lobe. After this spine follows a smooth margin nearly to the posterior corner of the carapace, only for the last interval towards the postero-branchial groove spine the margin is dentated with nine large branchio-lateral filamental teeth. After this filament follows the already mentioned postero-branchial groove spine, which is without filament, but very large. Inside the margin of the carapace are the two dorsal cones, the cephalic and the thoracal. They have no spines on their surface, but laterally on the carapace are two other cones on each side, both tipped by a spine. The anterior cone is the smallest. The spine on its top seems to represent the post-antennal spine. The second larger cone placed more posteriorly has the single and the only existing branchio-cardiac or lateral spine as its apex.

Abdomen.

Formula, segments I-V: 1. 2. 5., segment VI: 1. 2. 4.

The pleura have started to develop, but they do not yet cover the postero-ventral part of each abdominal segment, which is free below the pleura and furnished with a large, conical, ventral spine. Only on the sixth segment the ventral spine is missing and replaced by a pair of ventro-lateral spines. Each segment is further furnished with a large dorsal spine and a smaller lateral spine, the lateral spines increase in size from segment one to five, on segment six the lateral spine is again only small. The disto-lateral corners of the protopod of the uropods are prolonged into a spine, which is in line with the ventro-lateral spine of the sixth segment. On the first abdominal segment the lateral process is flattened; it starts at the lateral spine of the segment and continues as a membranous ridge into the pleuron.