ON THE LARVAL GENUS PROBLEMACARIS STEBBING, AND ITS PROBABLE IDENTITY (CRUSTACEA, DECAPODA)

by

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Introduction

After the manuscript of my paper on *Problemacaris* (Gordon, 1960), had gone to press, Dr. R. B. Pike sent me notes and drawings of a larva that had been obtained by the "Sarsia" on 14 November 1957 and which he and Dr. D. I. Williamson had examined. When I told these two zoologists that this larva was apparently an older stage of one that I had just described, they decided not to proceed any further with their joint paper, and sent the larva for inclusion in the British Museum Collection.

However, Dr. Williamson and I did have some correspondence relating to the possible identity of the larva and we thought we had got a clue to the real adult. But it was hoped that an older larva might be found which could be quite conclusive, and I only added a note to some of the reprints of my paper that I sent to individuals likely to be interested in the question.

Then on December 12, 1962 Dr. Vagn Hansen of Copenhagen came to see me and informed me that *Problemacaris* larvae were moderately common and that he had seen specimens from as far afield as New Zealand. He also assured me that the larva has the curious habit of constructing "nests" from a radiolarian belonging to the family Thalassothamnidae (cf. Haecker, 1908). I told him what I thought was the probable adult genus to which this larval genus was referable, and asked him if he had seen an older stage than the "Sarsia" larva. He promised to send me the specimens that he had for study. However, he had to go to New Delhi; when he returned to Denmark on a rather brief visit, he looked out ten tubes of supposed larvae. But, when I came to examine these tubes, I found that only six of them had each a *Problemacaris* larva. Another tube had what may be a "nest" but with no larva therein or with it. The other three tubes contained respectively: one *Eryoneicus*; one *Ceratomysis* or allied form; two very juvenile spider crabs minus their legs. Perhaps, being busy and pressed for time, Dr. Han-

sen inadvertently sent me these tubes in error for others with *Problemacaris* larvae.

Later on Dr. L. B. Holthuis sent me one other larva from near Tristan da Cunha, obtained by the Norwegian Scientific Expedition, 1937-38.

Of the nine *Problemacaris* larvae thus placed at my disposal, eight are from various parts of the Atlantic Ocean and one is from the Pacific Ocean, off Christchurch, New Zealand. All the North Atlantic specimens have got three spines on the dorsal hump of the carapace and only two spines, one on each side, on the first abdominal somite. They thus all agree with the "Discovery" larva that I described in 1960, and which is included in the total of nine. The specimen from off Tristan da Cunha has also got three spines on the dorsal carapacial hump but lacks spines on the first abdominal somite. It also may develop spines on the first abdominal somite at a larger stage. Only the single larva from the South Pacific Ocean, off New Zealand, agrees with Stebbing's species, *P. spinetum* from off Table Mountain, South Africa, in having only two dorsal carapacial spines and two clusters of spines on the first abdominal somite. Since Stebbing's original description is very brief and his drawings are rather inadequate, I describe the New Zealand larva in some detail, with illustrations. I also add more information concerning the second species of the genus, that from the North Atlantic, and give additional figures, especially of the oldest known larva. It seems essential to give this species a specific name, just in case Dr. Williamson and I are mistaken in our guess as to the probable identity of *Problemacaris*; I therefore have pleasure in naming it in honour of Dr. H. Boschma, *P. boschmai* sp. nov. Following the descriptions of the larvae, I discuss the probable identity of these larval forms, and also the question of "nest" building mentioned to me by Dr. V. Hansen.

Problemacaris spinetum Stebbing (figs. 1, 2)

Problemacaris spinetum Stebbing, 1921, p. 626.
Problemacaris spinetum, Stebbing, 1924, p. 244, pls. 6, 7.

1 specimen from 43° 40′ S 176° 36′ E, off Christchurch, New Zealand, 8 January 1929; Station 3641 I, 300 metres of wire, net S 150, depth 340 m.

Description. — The specimen is as represented in fig. 1A and B and fig. 2; the abdomen is flexed beneath the carapace in the manner usual to preserved larvae (cf. fig. 4 of the other species). These figures have been made to illustrate as clearly as possible the number and arrangement of the numerous long spines with which the body is adorned. The carapace, measured from the posterior orbital border to the posterior dorsal margin is almost

2.5 mm. The rostrum, which is somewhat bent at the apex, measures approximately 3 mm to the posterior orbital margin, and bears four graded dorsal spines, the ventral margin being unarmed. The dorsal hump, mid way between the base of the rostrum and the posterior dorsal papilla, is characteristic of the larval genus *Problemacaris*. It bears only two large, forwardly directed spines and a papilla or spinule immediately behind the second spine. Somewhat below the orbit is a large anterolateral spine; the strong spinules

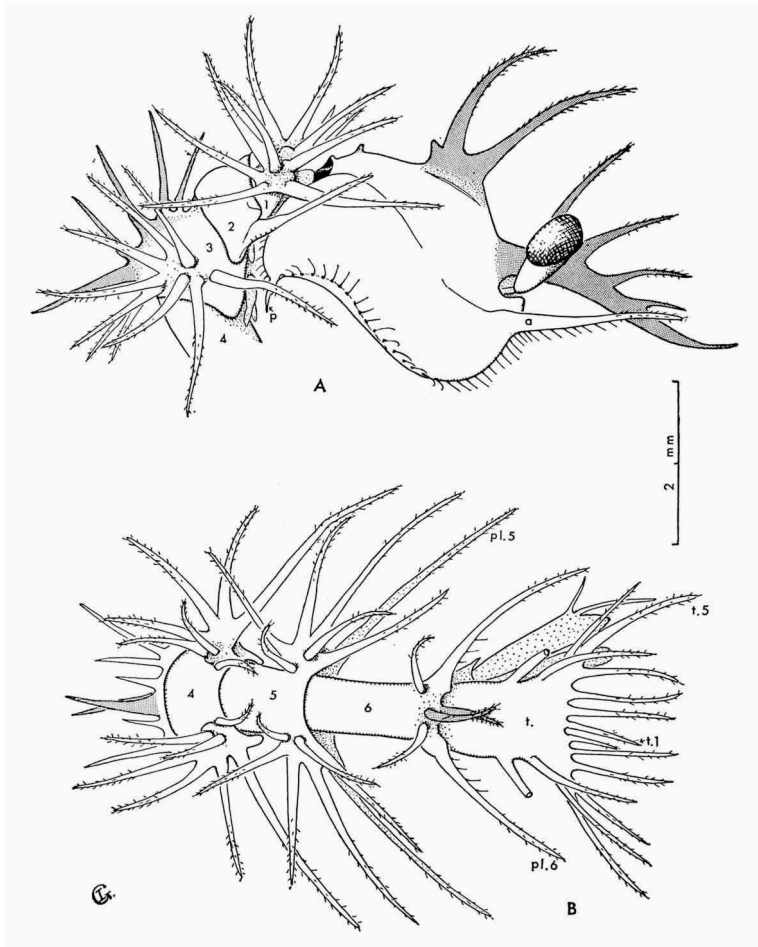

Fig. 1. *Problemacaris spinetum* Stebbing, from off Christchurch, New Zealand. A, carapace and abdominal somites 1 to 3, in lateral aspect; B, abdominal somites 4 to 6, telson and right uropod, in dorsal aspect. a, anterolateral spine of carapace; p, posterolateral spine of carapace; pl. 5 and pl. 6, posterolateral spine of abdominal somites 5 and 6; t, telson; t. 1 and t. 5, first and fifth terminal spines of telson. (Rostrum and spines on mid dorsal line stippled to distinguish them from more lateral ones).

on its lower proximal margin are continuous with the series on the anterior and ventral margins of the carapace (fig. 1A). This series of spinules departs somewhat from the actual ventral margin above the concavity in front of the short posterolateral spine, p. The series of spinules is continued on to the posterior margin, above the posterolateral spine. Faint lines or crests are present, as shown in fig. 1A, at the base of the dorsal hump, on the

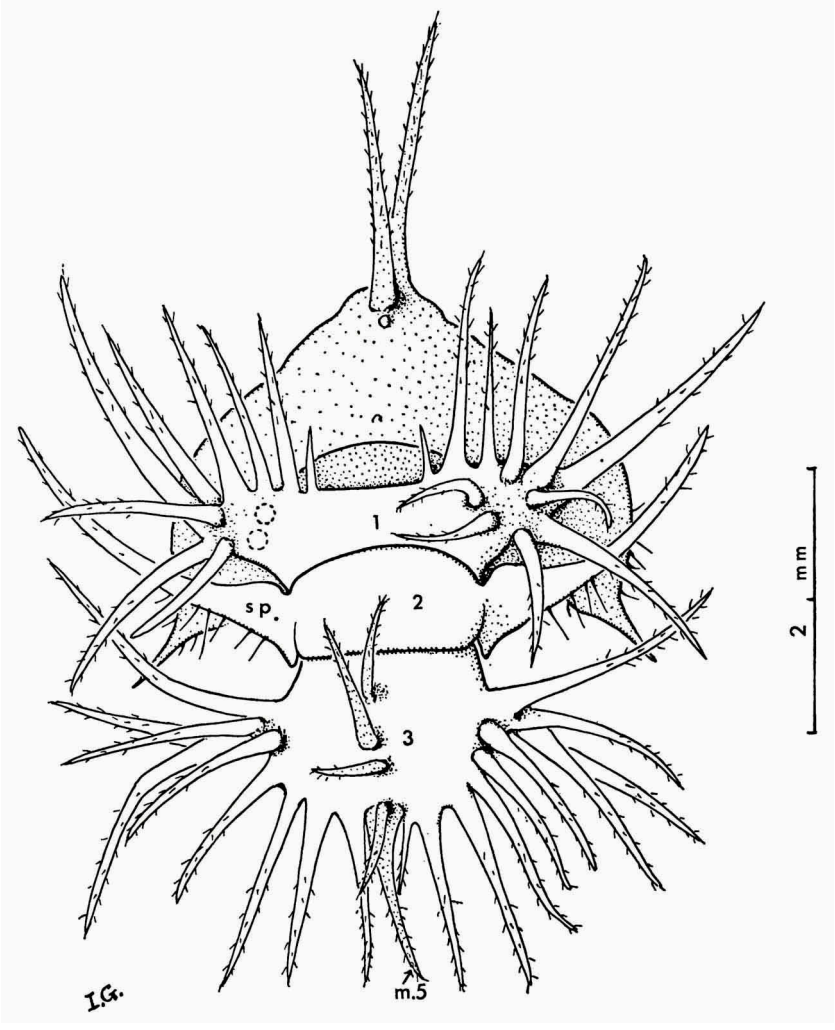

Fig. 2. *Problemacaris spinetum* Stebbing, from off Christchurch, New Zealand. Posterior portion of carapace and abdominal somites 1 to 3, in dorsal aspect, to show number and arrangement of spines. m. 5, fifth mid dorsal spine; sp., lateral spine on somite 2.

upper branchial region, and in continuation of the upper margin of the anterolateral spine.

The first abdominal somite is very short antero-posteriorly, but is wide and armed with two conspicuous clusters of spines (figs. 1A and 2). Each cluster consists of ten large spines and there is a small spine on the anterior margin just median to each cluster (fig. 2). Somite 2 is almost twice as long as somite 1 medially and has just one pair of enormous lateral spines which curve outward and forward. In addition to the minute thorns that adorn the distal portions of every spine, there are rather large spinules on the proximal posterior margin of each of these lateral spines (fig. 2, sp.).

The third abdominal somite is almost as long as somites 1 and 2 together and bears the largest number of spines. Five are arranged in series down the mid dorsal surface (these are stippled in fig. 1A); each lateral cluster is continuous with those on the posterior margin, as illustrated in fig. 2. There are nine spines on each side with an additional spine on the right, near the base of the fifth median spine (next m. 5 in fig. 2).

The fourth abdominal somite, which is shorter than either somite 2 or 5, also bears two lateral clusters each of seven spines (fig. 1B). The fifth somite, equal in length to the third, has two posterolateral clusters of six spines each, and in addition a pair of long posterolateral spines (pl. 5, fig. 1B). The sixth abdominal somite is almost equal to the sum of somites 4 and 5, is long and narrow, armed with two long posterolateral spines (pl. 6, fig. 1B), and four other spines. These are rather short and two are in the median line at and near the posterior margin (stippled) and two are more laterally placed.

The telson is almost as long as the sixth abdominal somite; on the distal half of each lateral margin are three spines and, on the posterior margin are five pairs of spines of which the centre pair is the smallest (t. 1) and the outer pair (t. 5) the largest. The uropod is somewhat longer than the telson; the outer margin of the exopod is unarmed for most of its length, a short distance from the apex it bears two spines, one backwardly directed and twice as long as the more laterally directed one (fig. 1B). The long setae on the distal portion of the outer, as well as those on the inner margin, are omitted in the figure.

The antennule is very similar to that of the Atlantic species that I described (Gordon, 1960, p. 44, fig. 9), except that there are fewer segments in each flagellum at this stage. The large basal segment of the peduncle bears two long spines, one near the centre and one near the distal end of the ventral surface. The second segment of the peduncle is longer than the third one. The outer, or principal, flagellum is more robust and much longer

than the subsidiary one, and has as yet only four segments, of which the proximal is the longest. The slender subsidiary flagellum has only two segments, the proximal one nearly twice as long as the distal one.

The long, narrow antennal scale bears the numerous long curved spines characteristic of *Problemacaris* larvae, at least ten in addition to the bifurcate subterminal one. The flagellum is only about half as long as the scale at this rather young stage.

The endopods of the peraeopods are as yet poorly formed, although the exopods are large. The pleopods are all present as small buds, the third pair being bifurcate in contrast to the more posterior pairs, which are simple.

Remarks. — This larva, although obviously at an earlier stage of development, resembles *Problemacaris spinetum* Stebbing in having only two spines on the dorsal carapacial hump; a large cluster of spines on each side of the first abdominal somite; six spines, including the posterolateral long pair, near the distal end of the sixth abdominal somite. Stebbing's (1924) pl. 6 fig. T shows these six spines on the last abdominal somite, but it also shows what seems to be a transverse suture line so placed as to imply that the sixth somite is very short. In the text (Stebbing, 1924, p. 244), however, he states that "the sixth [pleon segment is] nearly as long as the telson" thus proving that the suture has been inserted by mistake in the figure. The larva that Stebbing dissected and figured was clearly an older one because: (i) the antennular flagella are longer, with more numerous segments; (ii) the flagellum of the antenna is considerably longer than the scale; (iii) the endopods of the peraeopods are better developed; and (iv) the pleopods are all well formed and biramous. Stebbing omits one of the long spines on the antennular peduncle, and shows spinules or serrations on the outer margin of the exopod of the uropod. There are no spinules or serrations on this margin of the uropod, proximal to the two spines, in the larva from the South Pacific Ocean.

The telson in Stebbing's figure is relatively longer and narrower, and the spines are relatively shorter and somewhat differently arranged (cf. Stebbing's (1924) pl. 6 fig. T with fig. 1B of this paper). This may be largely due to the different stages of development of the two larvae (see p. 344).

This larva from off New Zealand is certainly very near to, probably actually identical with, *Problemacaris spinetum* Stebbing from off Table Mountain, South Africa. Both may be distinguished at once from all the other *Problemacaris* specimens that I have examined by the lateral clusters of spines on abdominal somite 1 and the two spines on the carapacial dorsal hump (cf. figs. 1A and 2 with figs. 3 and 4).

Problemacaris boschmai sp. nov. (figs. 3-6, 9 B)

Problemacaris sp., Gordon, 1960, p. 39, figs. 1-10.

North Atlantic Ocean:

I). "Discovery" St. 3162. 11 November 1954. 500 to 0 m. 48° 03′ N 9° 04′ W. TYFB. Time 2035 to 2310 hours. One specimen, holotype.

II). "Sarsia" 14 November 1957. "1603 hours, 46° N 6° 29′ W, shot trawl; 1654, paid out to 1000 fms.; 1920, hauled trawl; 2000, 47° 02′ N 6° 38′ W trawl surfaced and brought inboard. One specimen, the oldest known stage.

III). Danish material — St. 9308 V. 28 August 1954. Metres wire 800; depth 2900 m.

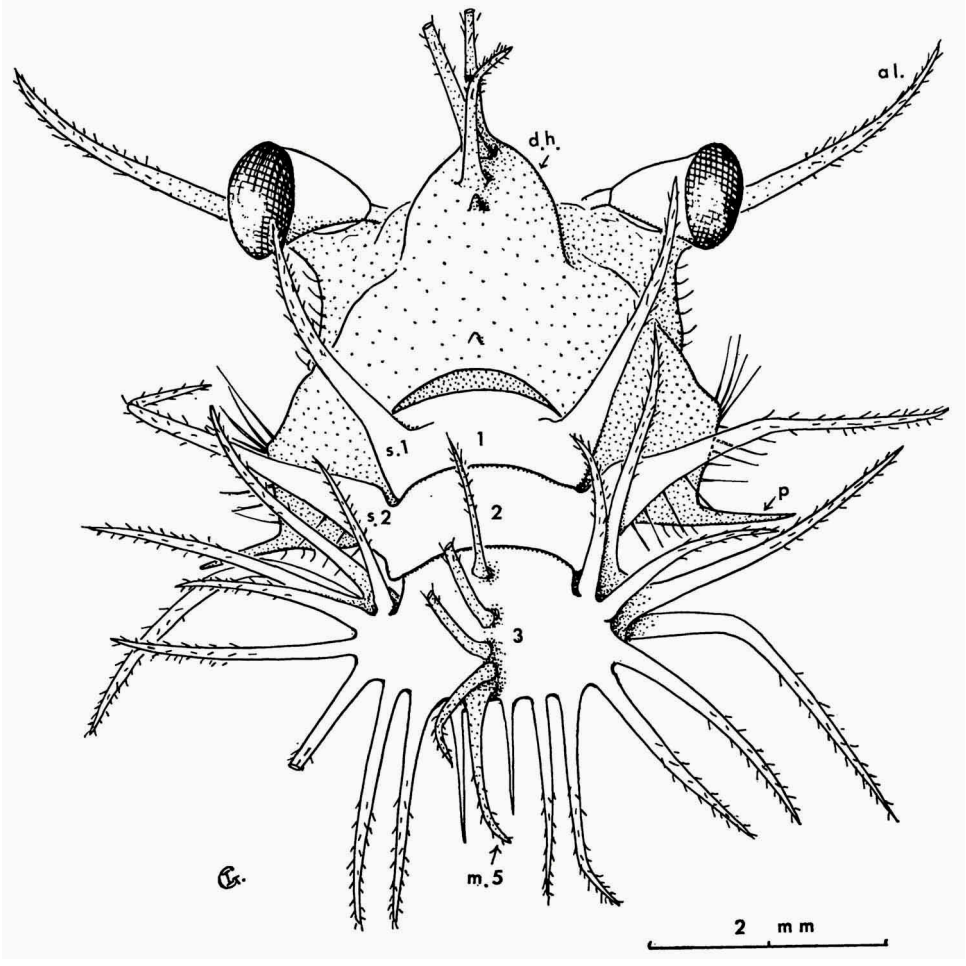

Fig. 3. *Problemacaris boschmai* sp. nov. from St. 9804 III (Danish material), for comparison with fig. 2. al., anterolateral spine; p, posterolateral spine; d.h., dorsal hump; s. 1 and s. 2, lateral spine on abdominal somites 1 and 2; m. 5, fifth mid dorsal spine on somite 3.

51° 00′ N 20° 56′ W. Pelagic trawl S.200. Time 2220 to 2320 hours. One specimen.

IV). S. 9804 IV. 20 August 1955. M.w. 100-50-25; depth 4560 m. 51° 00′ N 18° 00′ W. S.200. Time 0923 to 0953 hours. One specimen.

V). St. 9804 III. Data as for IV, but M.w. 200-150-125. One specimen.

VI). St. 10.598 II. 18 August 1957. M.w. 200-150-125; depth 1960 m. 51° 55′ N 12° 30′ W. S.200. Time 0740 to 0810 hours. One specimen.

VII). St. 10.988 I. 25 August 1958. M.w. 100-50-25; depth 1920 m. 51° 00′ N 12° 30′ W. S.200. Time 1208 to 1253 hours. One specimen.

[St. 9806 I. 21 August 1955. M.w. 1000-800; depth 780 m. 50° 55′ N 14° 00′ W. S.200. Time 0550 to 0620 hours. Radiolarian "nest"?, but no specimen of *Problemacaris*].

Descriptive Notes. — The larvae sent to me from the Danish collection are all rather smaller than the "Discovery" specimen but even the smallest one has already four pairs of pleopods and in all the others the fifth pair is present, though less well developed. In none of the specimens are there

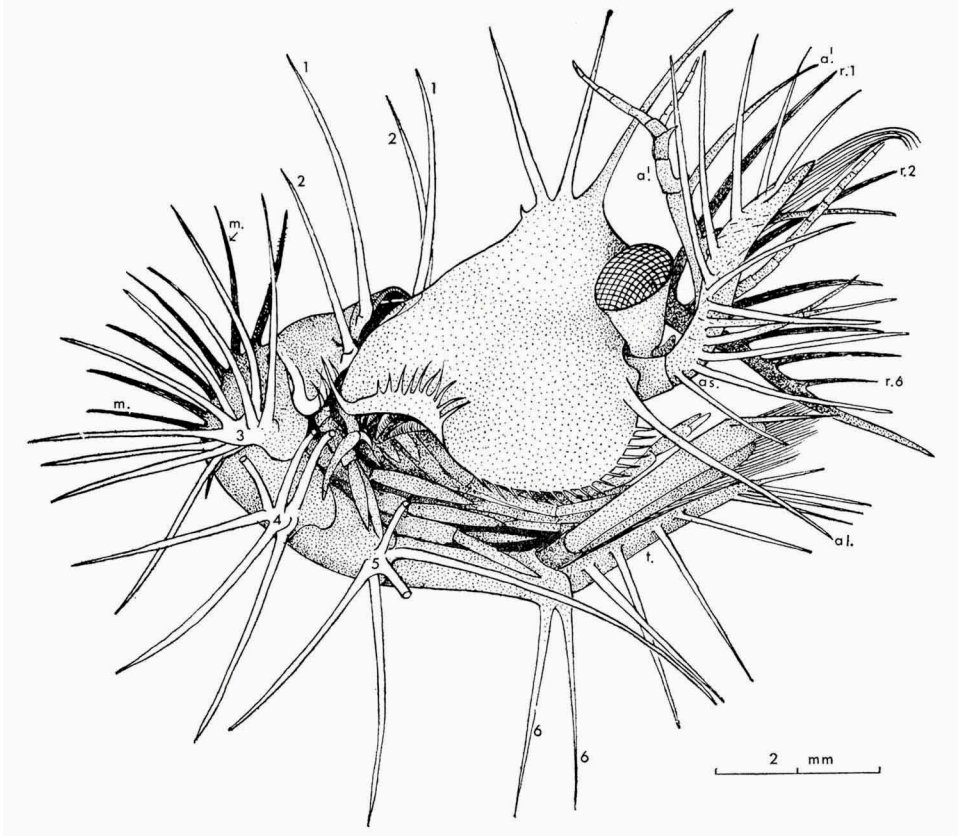

Fig. 4. *Problemacaris boschmai* sp. nov., largest larva, collected by "Sarsia", in lateral aspect. a^1, antennule; al., anterolateral spine; as., antennal scale; m, mid dorsal spines (dark), on somite 3; r. 1, r. 2 and r. 6, first, second and sixth rostral spines; t., telson. The numbers indicate the somites to which spines belong. Drawing by Dr. R. B. Pike.

spinules on the carapace, in front of the concavity, apart from the single series on the actual margin (cf. p. 341). In all, too, the telson is almost quadrangular with four pairs of spines on the lateral, and four pairs on the posterior, margins. There is slight variation in the number of dorsal spines on the rostrum, five being most common, four occasional as also a minute sixth one near the apex. There are either five or six mid dorsal spines on abdominal somite 3. Fig. 3 of one of these larvae is given for comparison with fig. 2.

In my description of the "Discovery" specimen (Gordon, 1960), I erroneously stated that peraeopod 5 has an exopod; only the first four pairs of peraeopods have exopods. Moreover, on careful examination, I find that there are more very minute spinules on the outer margin of the exopod of the uropod, proximal to the large spine. But, as the margin is somewhat rounded, these minute spinules are easily overlooked.

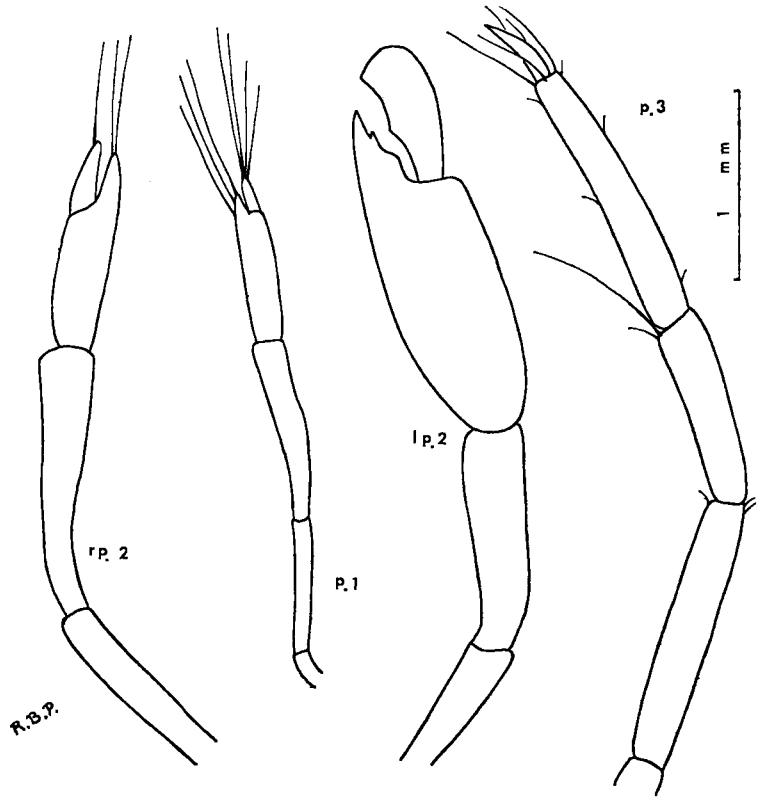

Fig. 5. *Problemacaris boschmai* sp. nov., appendages of oldest larva, that collected by "Sarsia", traced from Dr. Pike's sketches. p. 1, left peraeopod 1 (right one similar); lp. 2, left or larger peraeopod 2; rp. 2, right or smaller peraeopod 2; p. 3, third peraeopod.

The "Sarsia" larva, no. II in list of material, is at a larger and rather older stage in development. I think that the drawing made by Dr. R. B. Pike in 1959 merits reproduction as it gives a very good idea of the whole animal in the bent position usual in fixed specimens (fig. 4). I also have traced a number of his pencil sketches of appendages namely, those comprising fig. 5, and fig. 9B. of the telson. The very marked asymmetry of peraeopods 2 are illustrated in fig. 5, rp. 2 and lp. 2; Dr. Pike did not observe the faint but distinct subdivision of the carpus of the larger left peraeopod 2. When I had occasion to examine this larva in April, 1960, I saw that the muscle has broken up in the distal half of this carpus, and now I have seen the faint

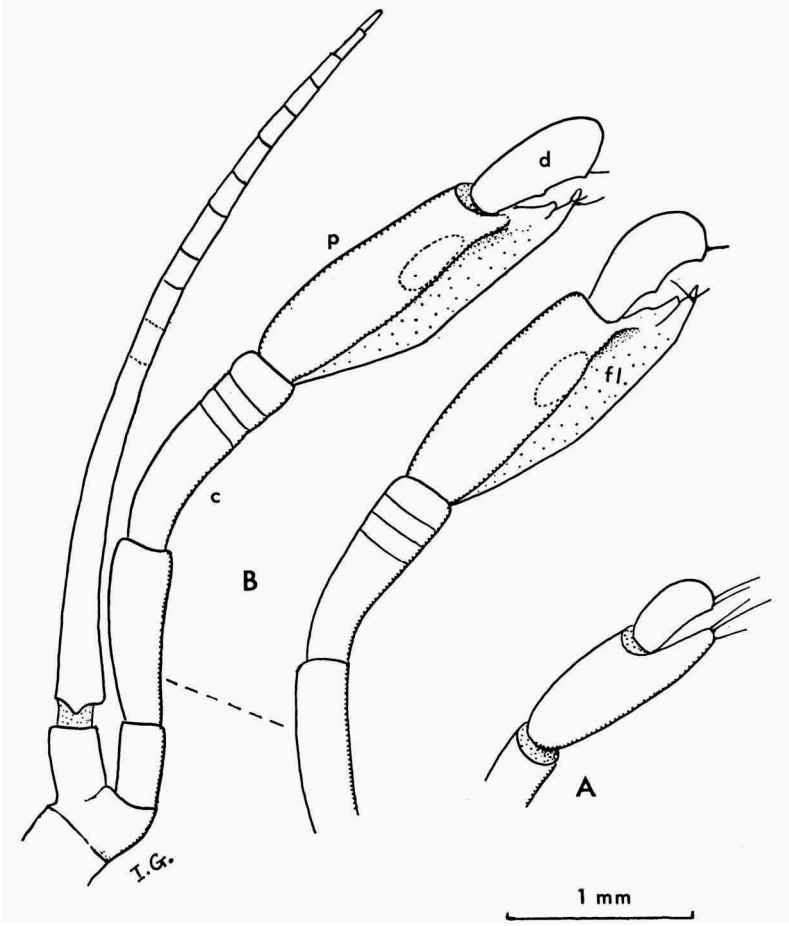

Fig. 6. *Problemacaris boschmai* sp. nov. A, distal portion of larger second peraeopod of "Discovery" specimen; B, larger second peraeopod of "Sarsia" specimen, to show subdivision of carpus, thin flange of propodus, and exopod (long setae omitted). c, carpus; d, dactylus; fl, flange; p, propodus.

suture lines represented in fig. 6B. The smaller right peraeopod 2 is not now with the specimen, so that I cannot say if the carpus of that limb is also subdivided, but it could easily have been. It was the curious form of the chela of the left second peraeopod that suggested to Dr. Williamson what the probable adult genus may be, and my observation would substantiate that suggestion (see p. 345).

Remarks. — These seven specimens are all from the same region off S.W. Ireland and off the Bay of Biscay. I have no doubt that they all belong to one species which I name in honour of Prof. Dr. H. Boschma, in case our suggestion with regard to the adult genus proves to be erroneous.

The question of "nest" building I shall refer to later (p. 346); pieces of a radiolarian were adhering to the spines of some of the specimens sent from Denmark, notably no. VII from St. 10.988 I. If the small bunch of Radiolaria from St. 9806 I does represent a "nest" it is disappointing not to have the larva that occupied it as well.

Problemacaris sp. (figs. 7, 8, 9 A)

Plankton haul either inside or outside the kelp zone, Tristan da Cunha, between 17 December 1937 and 4 January 1938. One specimen together with some *Munida* larvae and Euphausiacea.

Description. — This specimen is the youngest of all the material examined, having as yet no trace of pleopods. The carapace and first three abdominal somites are represented in dorsal aspect in fig. 7. The left eye is missing; the anterolateral spines on the carapace are relatively short and more upwardly directed than in the other larvae examined. The rostrum is relatively short and bears four dorsal spines (fig. 8, r.1 and r.t.). There are three spines on the dorsal carapacial hump as shown in fig. 8. A striking feature is the abundance of spinules on the margins of the carapace; in addition to the densely crowded marginal series extending from the proximal part of the anterolateral spine to the concavity, there are several sparser rows of spinules above the actual edge. Those on the arch, well above the concave margin, are exceedingly long as shown in figs. 7 and 8.

The first abdominal somite has no long spines, or spine clusters, but the lateral and anterior margins bear long and short spinules (fig. 7, 1). The second somite, on the other hand, has two enormous lateral wing-like expansions ending in spines ((fig. 7, s.2).

The third abdominal somite has, as usual for the genus, the most spines; there are four along the median line with a much smaller one in front of and to left of the series (figs. 7 and 8). On either side are seven spines, that on the posterior margin being small, the other six large. This total of nineteen spines is rather low in comparison with those shown in figs. 2 and

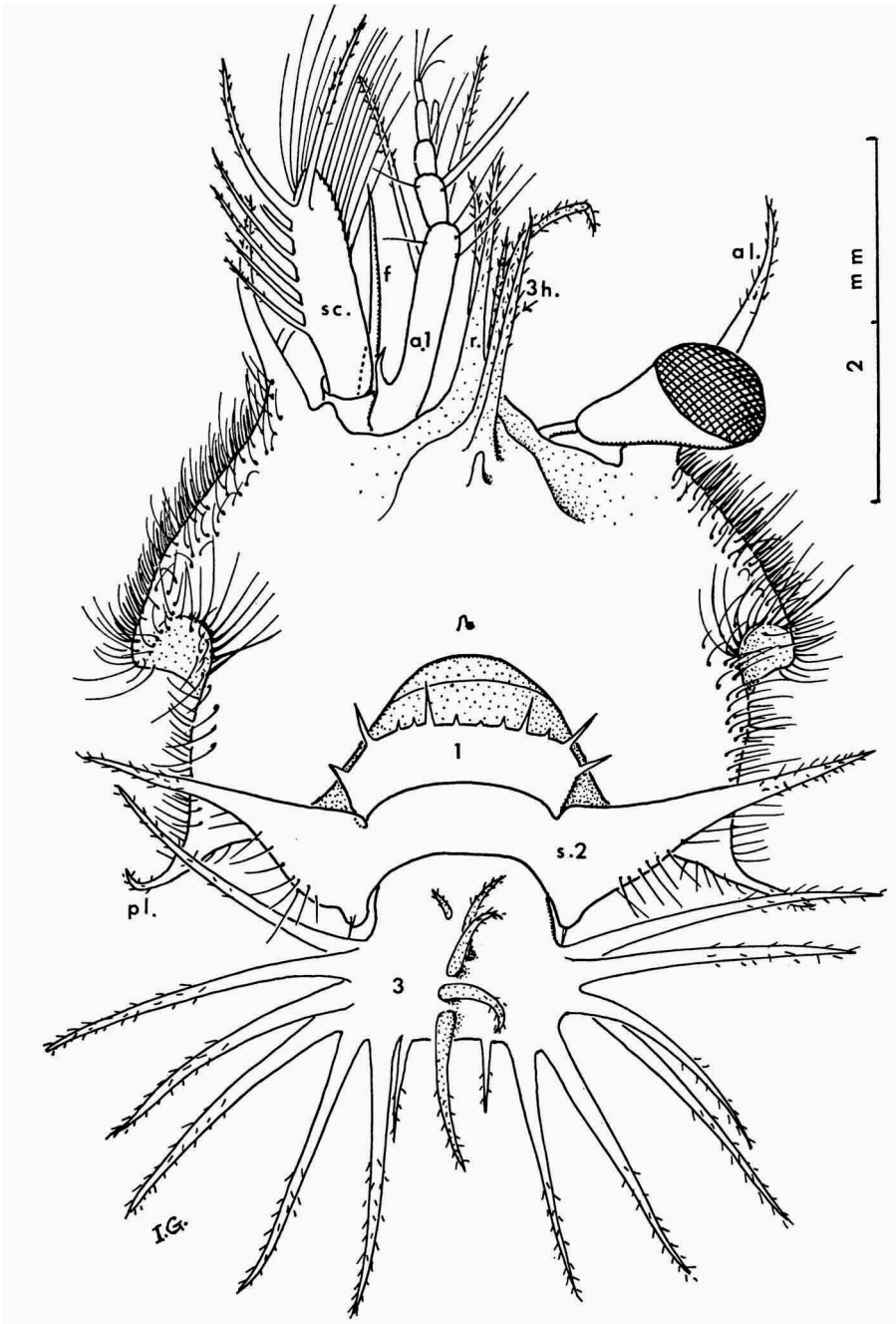

Fig. 7. *Problemacaris* sp., youngest larva, from off Tristan da Cunha, for comparison with figs. 2 and 3. a. 1, antennule; al., anterolateral spine; pl., posterolateral spine; f, antennal flagellum; 3 h., third spine on carapacial hump; r., first rostral spine; s. 2, spine on second abdominal somite.

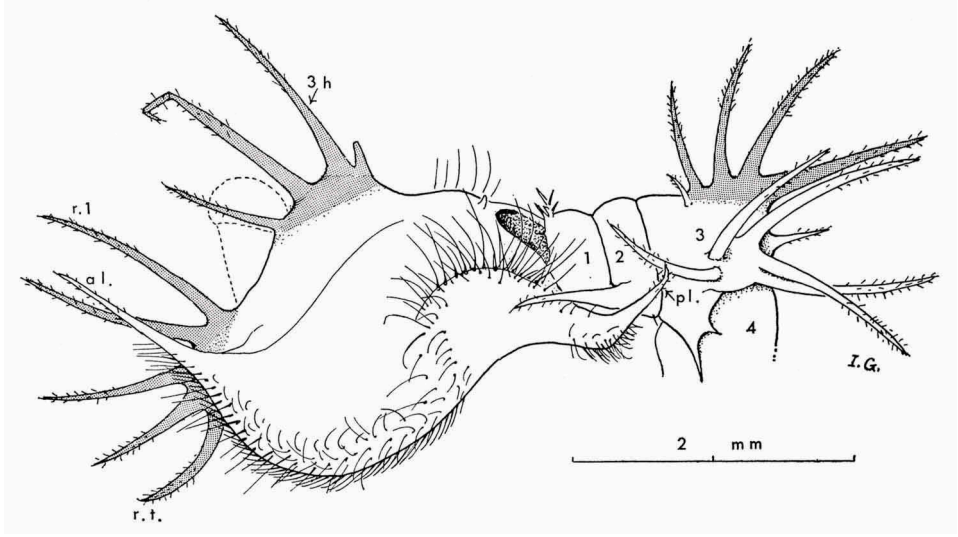

Fig. 8. *Problemacaris* sp., young larva from off Tristan da Cunha; carapace and first three abdominal somites, in lateral aspect. al. and pl., anterolateral and posterolateral spines; 3 h, third spine on hump; r. 1 and r.t., first spine and tip of rostrum. (Rostrum and mid dorsal spines stippled).

3, but there might be more spines at later stages in larvae from this locality.

On the fourth somite there are two clusters each of six spines, with a small pair on the posterior margin between the two groups. The fifth somite has, in addition to the pair arising from the posterolateral angles, five spines in each posterolateral cluster. On the sixth somite there is only the pair arising from the posterolateral angles, each directed obliquely upward and outward (fig. 9 A). The telson, also represented in fig 9 A, is relatively short, widened posteriorly, with the posterior margin concave; within the large pair of posterolateral spines are four pairs of smaller ones each fringed with marginal fine hairs. Only three of the eight pairs of marginal spines are placed on the lateral margins at this early stage of development. The endopod of the uropod is equal in length to the telson (minus spines); the exopod is somewhat longer and has some minute spinules on its outer margin proximal to the subterminal spine. The long setae on the distal portion of the outer, and on the inner, margin are omitted.

Remarks. — Since Stebbing's original specimens of *Problemacaris spinetum* came from off Table Mountain, South Africa, Dr. Holthuis and I thought that this larva from Tristan da Cunha would prove to belong to that species. But this does not appear to be the case, because there are three spines, not two, on the carapacial dorsal hump. In this respect it resembles all the specimens of *Problemacaris boschmai* from very much further north

in the Atlantic Ocean. It seems rather odd that there are no spines on the first abdominal somite at this stage, especially since the pair of lateral spines on the next somite are so fully developed (fig. 7, s. 2). The form of the telson and the arrangement of the marginal spines thereon are doubtless juvenile features. In later larvae the telson would doubtless be like that found in older specimens referred to *P. spinetum* and *P. boschmai* (cf. fig. 9 A with figs. 1 B, 4, 9 B, and with fig. 2 in Gordon, 1960).

Until all stages in the development of *Problemacaris* larvae are known, I hesitate to refer this specimen from Tristan da Cunha to *P. boschmai* on the presence of three spines on the carapacial hump alone. In no other specimens at my disposal are there so many rows of spinules on the margins of the carapace as are present in this larva (figs. 7 and 8). Perhaps it may belong to still a third species?

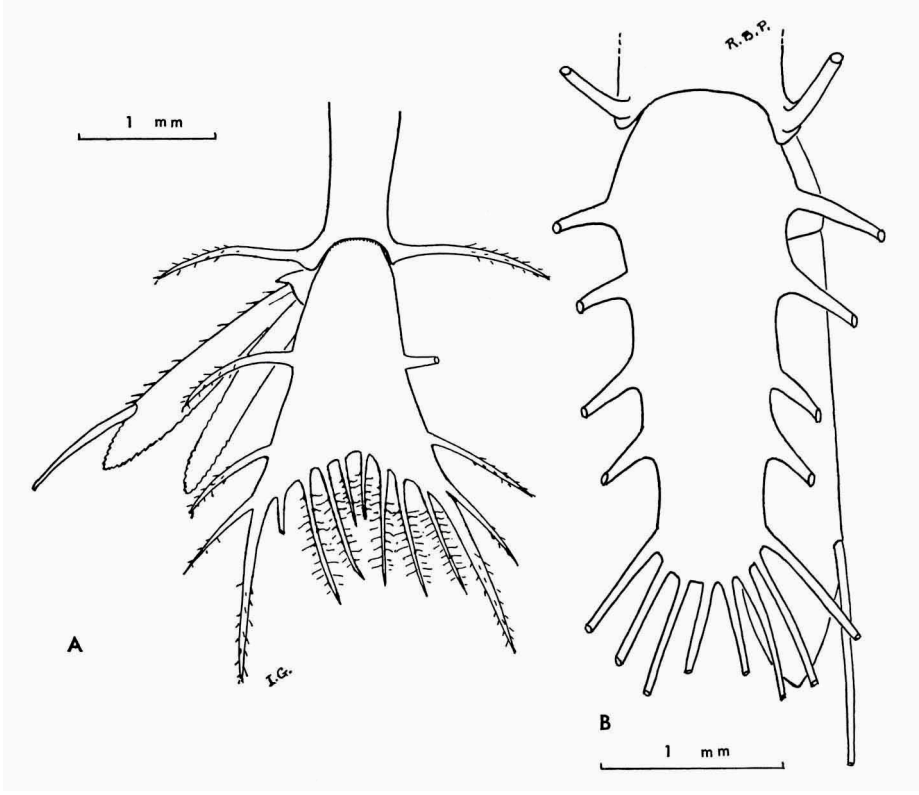

Fig. 9. Distal part of sixth abdominal somite and telson. A, *Problemacaris* sp. from Tristan da Cunha; B, *Problemacaris boschmai* sp. nov., "Sarsia" specimen (tracing of Dr. Pike's sketch).

LEONTOCARIS STEBBING MAY BE THE ADULT GENUS

When Dr. R. B. Pike sent me his drawings of, and descriptive notes on, the "Sarsia" larva of *Problemacaris* in 1959, I told him that I had a paper on a similar larva obtained by the "Discovery" in the press; the "Sarsia" larva seemed to be a somewhat older stage of the same species. On 24 October 1959, Dr. D. I. Williamson sent me the following card: "We look forward to your paper on *Problemacaris* as we have recently been examining one from the "Sarsia". Have reached no definite conclusions as to its identity but it shows some resemblances to *Bathypalaemonella*". In my reply I gave reasons why its identity with *Bathypalaemonella* was unlikely and there the question was shelved until April, 1960. On 12 April 1960 I received another post card from Dr. Williamson: "*Leontocaris lar* Kemp (1910) seems to have several features resembling *Problemacaris*. Is it possible to decide from the specimens and drawings you have whether *Problemacaris* = *Leontocaris*? Stebbing's specimen might have been *L. paulsoni*".

A glance at Dr. Pike's pencil drawings of the second pair of peraeopods with their marked asymmetry together with the curious form of the chela of the larger appendage were quite suggestive of such an hypothesis. Moreover, on examination, I saw that the muscle bands in the distal third of the carpus of the larger cheliped had definitely broken up in such a manner as to suggest that, at the next moult, three distinct subsegments might be formed immediately behind (proximal to) the chela. I replied to Dr. Williamson as follows: "There may be something in your suggestion that *Problemacaris* is perhaps the larva of the rare *Leontocaris*. I think I can see in the left second peraeopod of your larva, a later stage than mine, a hint of the muscles breaking up in the distal end of the segment next the chela (= carpus), suggesting that there might be three short segments formed there at the next moult. And, of course, *lar* has three spines on the dorsum of carapace, *paulsoni* only two... The shape of the dactylus of the chela in your [older] larva rather suggests *Leontocaris* and in that genus there is subdivision near the base of the chela [i.e. at distal end of carpus] to allow of the curious bending of the limb in the adult. One stage later might be decisive".

Now, on re-examination, I find that three faint but distinct suture lines are present but they are only visible with suitable lighting conditions, under a binocular stereoscopic microscope at rather high magnification (fig. 6B). It is unfortunate that the endopodite of the right second peraeopod of the "Sarsia" larva is now missing; it also ought to show subdivision of the distal part of the carpus.

I have re-examined specimens of *Leontocaris paulsoni* from off Cape Peninsula, Lion's Head, 140 fms., sent to me by the South African Museum in 1957 and am again impressed with the similarity of the chela of the larger second peraeopod to that of the "Sarsia" larva. Already, in that larval stage, the form of the dactylus, the suggested armature of the fixed finger, and the thin flange that extends backward from the base of the fixed finger recall those of the fully formed adult chela. Moreover, *Problemacaris spinetum* Stebbing was first found in the same locality as *Leontocaris paulsoni* Stebbing, 1905. Also, the specimens of *Problemacaris boschmai* occur in the right locality to be larval stages of *Leontocaris lar* Kemp. Nothing has been published as to the nature of the ground off Lion's head, Cape of Good Hope, where adult specimens of *Leontocaris paulsoni* occur. But Kemp (1910, p. 117) states that "*Leontocaris lar* has only been found at two stations. On each occasion the trawl brought up numerous specimens of *Antipatharia* and *Lophohelia*; it seems probable that the species is confined to areas where such Alcyonarians grow". It is also probable that the animal has some peculiar habit, perhaps associated with the presence of Alcyonaria, that might account for the very peculiar form of the adult second peraeopod on one side of the body (right or left).

If *Problemacaris* should indeed prove to be the larval stages of *Leontocaris,* then the adults must be more widely distributed than is at present known. *Leontocaris paulsoni* or a closely allied species must occur in the South Pacific, off New Zealand. And adult *Leontocaris* ought to occur in suitable places somewhere near Tristan da Cunha.

Do Problemacaris larvae build "nests"?

Dr. Vagn Hansen assured me, in a personal communication, that *Problemacaris* larvae have the curious habit of forming "nests" of a radiolarian belonging to the family Thalassothamnidae (Haecker, 1908). In his letter of 1 January 1963 he states that the radiolarian has been identified as *Cytocladus* sp. There are some fragments of a radiolarian adhering to some of the larvae that Dr. Hansen later sent me, and in one tube, as already stated, there is what may be a "nest" but it is empty and no larva accompanies it, nor have I a larva from the same station (see list of material, p. 337-338).

There was, as far as I know, no trace of Radiolaria on the larvae collected by the "Discovery" and the "Sarsia", nor did anyone mention this association to myself or to Drs. Pike and Williamson. My colleague Dr. R. H. Hedley, who works on recent Protozoa, tells me that these Radiolaria of the family Thalassothamnidae are gelatinous and he thinks that, should the larvae venture to make "nests" of them, it would be the Protozoon that would get

the best of the bargain. Dr. Hansen probably has first hand knowledge of the larvae; in other words he may have seen them when alive on board ship. But I do not understand why a free swimming larva, so well protected by its long spines, should want to live in a "nest" at all. Even assuming that the spines may be more for flotation than for protection, I cannot imagine what advantage the larva would gain from such an association. So I shall remain sceptical about this supposed habit until I have seen several *Problemacaris* larvae actually inside their "nests". Perhaps, when the Radiolaria are abundant they get into the plankton net where they could easily become entangled on the spines of the larvae.

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