I have not been able to find a natural explanation for the late final development of lenses in the nauplius eye in *Amphion*. Throughout the larval life the nauplius eye is without lenses and first in the adult (Figs. 141) a lens develops near each of the eye cups, and only at a distance from the sensory epithelium, which shows its inability to function. In this stage, in 2000–4000 m depth, the adults are living in absolute darkness. They have the stalked, lateral eyes with their luminescent organs, but why should there be lenses in a nauplius eye which is embedded in the brain tissues? Perhaps some glandular hormone function, of which we yet know so very little, is connected with it, or the lenses in the adult may have an atavistic explanation.

It is of interest to note the presence of the lateral process on the first abdominal segment. This is found in Penaeidea larvae and on the second abdominal segment on the Zoea in Brachyura but not found in Caridea before. It is now seen in *Amphion* from the first larval stage and continuously through the larval stages and at least to the second postlarva included. This must be considered a primitive character still remaining in this primitive Caridean shrimp. Here it can be noted that in a still unpublished paper, I have found the same abdominal process in another Caridea, *Chlorotocus crassicornis* (COSTA), Pandalidae. This is to my opinion also in many aspects a primitive Caridea. It may be more generally found in some Caridea, only having been overlooked. This has still to be investigated, in my Napoli investigation (HEEGAARD, 1963) I looked for the process on the investigated species, without finding it.

Only one *Amphion* species exists, *A. reynaudi* M.-EDW., for which *A. provocatoris* BATE is a synonym. Also *Amphionides valdiviae* ZIMMER is reduced to a synonym for *Amphion reynaudi*, being the postlarva and possibly the adult of this species.

The growth of the larvae appears to be very slow. We find here the largest number of larval stages in any known decapod species. The value of the growth factor has been discussed in an earlier paper (HEEGAARD, 1966). In Table I of the present paper it can be seen that in my *Amphion* investigations the growth factor ranges from 1.04 to 1.38, which shows firstly that it is extremely low, secondly that it varies considerably. The planktonic food for such small organisms is rather poor in the tropical parts of the oceans. We will therefore also find that the highest growth factor is from the first to the second stage where some yolk still remains from the egg. The growth factor from Promysis to Mysis may possibly still be a little larger, but this is unknown. After the yolk has been consumed the growth factor becomes extremely low for a long time, between 1.04 and 1.13, which may indicate great difficulties in nourishment for the larvae up to the Xth Mysis stage. From this stage the larva has developed enough pereiopods to shape a proper catching basket, which immediately results in the growth factor jumping from 1.05 to 1.38 and remaining around this figure until the twelfth Mysis stage, which is the second last Mysis stage. In the twelfth Mysis stage internal transformations towards the adult have started to take place, and now it grows more in width, a character not considered in the estimation of figures of the growth factor, which is based on total length.

In the postlarva and from this to the adult no growth factor has been estimated because a proper measure of the adult or postlarva was impossible due to the very soft and partly torn thorax of these stages. However, if this factor could be determined on dry material, as it really should, it would show a very low figure again, first of all because the food is much scarcer at 3000 to 5000 m depth where the shrimp now lives than in the surface water layers where the larval stages were passed.

In recent years attention has been paid to the fact that a given instar or larval stage of a species can vary. MCDONALD (1926, 1927) first called attention to this phenomenon in the Euphausids and later FRASER (1937) clearly confirmed this variation for *Euphausia superba*, and reduced its true number of larval stages to about one third. The understanding of this problem has in recent time advanced further by showing that the number of larval stages of decapod Crustacea may vary within the same species under different living conditions (PROVENZANO a.o.). However, the factors involved have not yet been clarified. But going to the extreme this means that no definite description is valid for a larval stage because there is a certain range of variation within each instar. This is further understandable from the fact that within the Crustacea the eggs themselves in most cases show a rather surprising variation in diameter within the batch of one and the same female. This again results in much more yolk in the larger eggs and a far better start in life for the larvae hatched from these eggs compared with those hatched from smaller eggs. This advantage for some of the larvae, which

begins at the moment of hatching increases through their larval life as they are more vigorous and therefore catch more food and obtain a better nourishment, enabling them to reach a higher degree of development between the ecdyses. It must be borne in mind that crustacean larvae, like all other larvae, grow constantly, but that in the Crustacea this is not macroscopically visible due to the cuticle, which until it is shed prevents an increase in size. But mitotic divisions of the cells occur continually as in all other growing organisms. In the Crustacea however, the new cells remain in an embryonic state which means that their nuclei and protoplasm are kept nearly as dry material inactive and taking up very little space, so that they can find room inside the existing cuticle, similar to what is the case in a plant-bud. First during the ecdyses these new cells absorb water at the same time becoming activated, living cells.

These advantages for the larvae hatched from the largest eggs are among the more important factors for a quick and evenly accelerated growth throughout the larval development, what can be seen for *Amphion* from the figures in Table III–V. In the early stages only a 1 mm difference exists between the smallest and the largest larva, and this continues up to the fifth Mysis stage. However, one must remember that the number of larvae of these first stages is relatively low in the material, which makes the figures for these stages a little less valid than for the later stages. Personally I am convinced that an adequate number would not have widened the range much, but all the same the tendency is clear and cannot be denied. In the sixth and seventh Mysis stages we have a maximal variation of 2 mm, in stage VIII and IX of 3 mm. This variation now accelerates quickly, also because of the development of a better catching apparatus, so that in the last two Mysis stages, XII and XIII, the difference in length between the smallest and the largest larvae of the same stage in the different oceans ranges from 9–14 mm, which is more than 50% of the total length. The length remains nearly the same from stage XII to XIII, but this has already been explained by the fact that in this interval the growth is mainly in the width of the thorax, and not in the total length which is used for these growth figures.

Another point of interest is the two completely different catching apparatuses. The first is found in the surface form of the larva, the Mysis, in which a catching and grabbing trap is shaped by the pereiopods and the two last maxillipedes. The second and differently built is found in the adult, which lives in depths between 2000 and 4000 m. Here the cuticle has become paper-thin as in many deepsea organisms and very little lime if any is encrusted in it. The reason for this is not absolutely clear, but it can be pointed out that the pH in the surface water of the ocean is about 8.2 but from about 1000 m and to the bottom this figure has fallen to about 7.8 or lower. We have in the ocean a balance between the carbonate and the bicarbonate ion and with decreasing pH the balance travels towards the bicarbonate ion so that we get more bicarbonate and less carbonate in the water. Because the Crustacea must use the carbonate ion for encrusting lime in the cuticle it means that animals living in deeper water layers have more difficulties and need more energy to build up the same calcareous cuticle which they were wearing in the surface layers, and this may be a reason why so many crustaceans from the abyssal zone have a thin cuticle with little lime in it. In the adult *Amphion* (Fig. 138) it can be seen that all the pleopods except the second, and the two last maxillipedes, have become thin-skinned strongly reduced limbs with very few muscle fibres, because these would have nothing to fasten to with the hardening of the external skeleton lost. Of limbs, the antenna, the mouth appendages, the second pereiopod, the pleopods and the tailfan have got all the available calcium carbonate, thus the external skeleton becomes strong enough for the muscle attachment of the only functional limbs.

But apart from this, the trap which served the *Amphion* larva well in the surface water would be of no use if it still existed in the adult in the abyssal zone as so few organisms live here that the adult shrimp would not be able to catch sufficient food through such a simple trap system, as that used by the surface larva.

Instead we have seen that the adult has developed a strong luminescent organ of the secreating type with luciferin in the stalked lateral eyes. By placing it in the eye the light beam can be steered together with the eye in different directions. With the light turned on it must be able to attract smaller organisms with either eyes or light sensitive organs living in these water layers.

We must then imagine that *Amphion* stands in the water moving as little as possible with the light on, the bell-shaped carapace open and hanging down and the abdomen strectched horizontally out from it. When

Table III. *Amphion.* Atlantic Ocean. Numbers and length in mm of specimens of each larval stage, I–XIII.

mm	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Number
XIII															5	33	29	22	14	15	14	5	3	0	2			142
XII															4	23	24	13	12	18	12	6	3	3	2			117
XI											10	42	76	71	42	6		1										248
X							2	19	124	94	103	57	6	1														406
IX						3	68	100	4																			175
VIII					7	121	58	5																				191
VII				5	63	19																						87
VI			4	59	36																							99
V			8	12																								20
IV		4	14																									18
III																												0
II		9																										9
I																												0
																											Total...	1512

Table IV. *Amphion.* Indian Ocean. Numbers and length in mm of specimens of each larval stage, I–XIII.

mm	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Number
XIII														3	20	35	51	17	33	35	21	17	1					243
XII													2	9	14	26	38	22	38	28	25	5	2		1		1	211
XI												48	94	62	42	9	4	3										262
X								9	125	153	108	75	6	2														478
IX							102	122	18	4																		238
VIII					21	129	64	4	2																			220
VII				4	84	15	1																					104
VI				108	21																							129
V		1	34	12																								47
IV		44	32																									76
III	2																											2
II	24	10																										34
I	1																											1
																											Total...	2045

Table V. *Amphion.* Pacific Ocean. Numbers and length in mm of specimens os each larval stage, I–XIII.

mm	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Number
XIII																11	18	7	14	14	9	7	5	4	2	1		92
XII															1	6	18	9	10	11	10	8	8	6	4	1		92
XI												1	47	52	29	10	2											141
X								6	43	42	64	54	3															212
IX							34	46	2																			82
VIII					5	61	14	1																				81
VII				2	43	10																						55
VI				46	17	1																						64
V			12	8																								20
IV		6	41																									47
III		1	2																									3
II	2	36																										38
I	2																											2
																											Total...	929

the prey comes near to the "lantern", *Amphion* must be expected to slowly move itself into a favourable position, so that it is able with the large antennal plates — furnished with strong muscles — and the pleopods to produce a strong current running forwards-backwards up through the bell of the carapace, which current will suck the prey into the bell. The bell can then be closed with its own, although weak, muscles so that its marginal setae meet from each side. The resulting fissure can then further be closed medially by the long first pleopods, and at both ends by the antennal plates and the telson fan formed by uropods and telson plate. All these parts can through contractions in their strong musculature be bent in underneath the bell-shaped carapace so that no escape is possible for the prey. After that the long second pereiopod with its fourth joint shaped as a lamp-brush can function like a piston within the bell and push the prey into the mouth. The hook-shaped fifth joint (Fig. 151), similar to the hooks given to many war-invalids who had lost an arm, is well fitted for pushing the last prey particles into the mouth. When the prey thus has been eaten *Amphion* can turn on the light again and prepare itself for another catch. A second function for the second pereiopod must be as a cleaning-brushing organ which easily can reach everywhere among mouth appendages, thoracopods, gills and even through the pleopods.

SYSTEMATIC POSITION

It has been mentioned (pp. 8–9) that H. MILNE-EDWARDS (1832, 1837), BOAS (1879, 1880, 1883, 1939) and ORTMANN (1893) placed *Amphion* near *Phyllosoma*.

CLAUS (1876), KOEPPEL (1902), and BALLS (1927) were of the opinion that *Amphion* belonged to the Sergestidae; CLAUS even that it was a species of *Acanthosoma*. KORSHELT & HEIDER (1892) and GURNEY (1924, 1936, 1942) referred it to the Caridea. In 1924 GURNEY noted a great similarity to the Eretmocaris larva which is usually placed in Lysmatidae, or as the genus *Lysmata* in Hippolytidae. Later (1936) he placed *Amphion* and *Amphionides* in their own family under the Caridea, and in 1942 *Amphion* was without argumentation claimed to be the larval form of *Amphionides*.

BATE (1888) established two species, *Amphion reynaudi* M.-EDW. from the Pacific with a rostral but without a post-rostral spine, and *A. provocatoris* BATE from the Atlantic without rostral but with post-rostral spine. This was rejected by ORTMANN (1893) and GURNEY (1936), and it is also rejected in the present paper, because all larvae, whether from the Pacific, the Indian or the Atlantic Ocean, have both rostral and post-rostral spine, the latter in younger larvae looking like an anterior dorsal organ. All hitherto known *Amphion* larvae belong therefore to one and the same species which by priority must be *Amphion reynaudi* M.-EDW.

Concerning the systematic placement to or near the Phyllosoma larvae can be said the following:

There are very strong superficial similarities between *Amphion* and the *Phyllosoma*, but I do not consider them to be of phylogenetic or systematic significance. Both have — it is true — a flattened carapace and thorax with a flattened, branched hepatopancreas, but whereas this organ is simple-branched in *Phyllosoma*, in *Amphion* it is divided into different sections, one of which is a pair of backwards-running tubes without secondary branches, but with many short lobal outgrowths. Further, the endopod of the thoracopods is four-jointed or, if the claw is included, five-jointed, in both *Amphion* and *Phyllosoma*, and five-jointed in the adult of both when functional. The gills, however, are pleurobranchiae in *Amphion*, but podobranchiae in *Phyllosoma*.

Cosidering the thoracopods, *Cerataspides longiremis* (DOHRN) of the Penaeidae could also be claimed a near relative. The thoracopods here, apart from their locomotory exopod, are also developed into a trap organ for catching plankton. But *Amphion* can belong neither to Reptantia like PHYLLOSOMA, nor to Penaeidae like *Cerataspides*. The shaping of thoracopods in much the same way in these three decapods is caused by almost identical living conditions: all are planktonic, feeding on smaller planktonic organisms in the upper layers of the open ocean, and all three have independently acquired nearly the same catching methods, which must be parallel running analogies, but no homology can be found in them. I consider them therefore of no phylogenetic bearing.

Phyllosoma has a typical flattened reptant abdomen, but both *Cerataspides* and *Amphion* have the typical natant, compressed abdomen. The antennae in *Amphion* are not reptant but caridean in development, and all mouth appendages are quite different from those of *Phyllosoma*. The two long lobes on the labium are placed close together in *Phyllosoma*, a reptant character, but in *Amphion* they are short and placed far apart. The first maxilla is with its slim, palp-shaped endopod of the reptant type in *Phyllosoma*, but in *Amphion*, as long as it is in function, which means in the surface-living stages, the endopod develops into a secondary, stout, masticatory process with stiff spines. Its later disappearance in the abyssal form is a secondary reduction without phylogenetic value. In the second maxilla of *Phyllosoma* the endites are fused into a single, undivided plate which is further enlarged in the adult *Palinurus;* the endopod is absent (small in *Palinurus*) and the exopod has the normal anterior and posterior processes of the scaphognath. *Amphion*, however, has three

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separate endites, one coxa endite and two basi-endites, but not the usual four endites. The endopod is shaped and functions as a fourth endite. In young stages the exopod has only the anterior process. The posterior process develops first during the larval stages, a fact which also may have some bearing on *Amphion*'s systematic position.

In the adult *Amphion* the three endites are still present but much reduced, the endopod is diminishing through the whole development and the exopod is enlarging. Thus, the developmental trends are just opposite of those in Palinuridae.

The first maxillipede in *Phyllosoma* is a small, rudimentary organ without an exopod, but still with a mastigobranchia. First in the adult *Palinurus* does it reach normal development. In *Amphion* it is the only functional maxillipede, with both exopod and endopod, gnathobase on the basale, and on the first endopodial joint, and a mastigobranchia from coxa. In *Amphion* the two following maxillipedes are developed as ordinary thoracopods and with an open space to the first maxillipede. Finally they are reduced together with the thoracopods in the adult. In *Phyllosoma* the second maxillipede is the functioning maxillipede and has very short and non-functional swimmerets.

An appendix interna is present, it is true as remarked by Boas (1939, p. 26), on the pleopods in both *Amphion*, *Polycheles*, *Homarus* and in many Reptantia, but it occurs also in some Caridae (*Pasiphaea*) and its presence in Leptostraca, Euphausiacea, and Stomatopoda shows that most likely it must be considered a primitive feature among the Malacostraca, therefore it can have no systematic bearing for Reptantia. Boas (1939, p. 24) finds a phylogenetic point in that in the thoracopods of both *Phyllosoma* and *Amphion* the first joint is short, the second long, while the third, fourth and fifth joints are equally long. This, however, can have no phylogenetic bearing. It is necessary for the shrimp to be able to displace the most flexible and more distal part of the limb a little from the thorax, so that it can be turned dorsally along the side of the thorax for shaping the semicircular part of the catching trap. To give the limb strength, the first joint must be shortened. The same procedure is adapted for shaping a long walking limb in both Reptantia and Caridea.

The arguments in the literature for *Amphion* being a reptantian and the objections to these arguments can be summarized as follows: 1. *Phyllosoma* appendages and hepatopancreas — but the former are found in other decapods and both have no systematic bearing. 2. A diminutive rostrum — but this is also found in some Caridea. 3. The gill formula — but this does not appear more closely related to Macrura than to Caridea, on the contrary, most reptants have at an early stage a multiplication of the pleurobranchia, *Amphion* has only one in each segment. 4. The late development of the pleopods — but this is also seen in other Caridea, and *Amphion* has no need for pleopods as long as it is a true plankton organism. 5. Appendix interna on the pleopods — but this is found also outside the decapods.

All these points should be more than sufficient for showing that there is no closer genetic relationship between *Phyllosoma* and *Amphion*. The points in which they resemble each other are only superficial, of a biological character, and acquired for serving the same mode of life in the same biotope, but do not indicate a closer genetic relationship. The mouth appendages especially show the great difference between the two forms. One is a reptant decapod, the other is not.

The second assumption advocated by Claus (1876), Koeppel (1902) and Balls (1927) that *Amphion* is a Sergestid must also be rejected.

The Sergestidae belong to the Penaeidea and like the rest of this group hatch as a Nauplius larva, after which follows a Protozoea, both with the first antenna as the locomotory organ.

When I in this paper, as in others, reserve the name Zoea for Brachyura and therefore use Mysis for all known *Amphion* larvae, it does not indicate that the earlier *Amphion* is not in a development which by some authors is called Zoea. — If *Amphion* were a Sergestid or closely related and thus included in the Penaeidae, we should expect the Protozoean first antenna in *Amphion*, but instead we find a first antenna as that of the non-Penaeid, decapod Crustacea. Further, the larva described in this paper as the first Mysis is by the character of its first antenna, first and second maxilla, telson and other organs definitely the first free stage after the hatching stage, and if it were related to the Sergestidae it should therefore show at least some Protozoean characters, which it does not. It is at present an open question whether some of the Penaeids have lost the

separate endites, one coxa endite and two basi-endites, but not the usual four endites. The endopod is shaped and functions as a fourth endite. In young stages the exopod has only the anterior process. The posterior process develops first during the larval stages, a fact which also may have some bearing on *Amphion*'s systematic position.

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The second assumption advocated by Claus (1876), Koeppel (1902) and Balls (1927) that *Amphion* is a Sergestid must also be rejected.

The Sergestidae belong to the Penaeidea and like the rest of this group hatch as a Nauplius larva, after which follows a Protozoea, both with the first antenna as the locomotory organ.

When I in this paper, as in others, reserve the name Zoea for Brachyura and therefore use Mysis for all known *Amphion* larvae, it does not indicate that the earlier *Amphion* is not in a development which by some authors is called Zoea. — If *Amphion* were a Sergestid or closely related and thus included in the Penaeidae, we should expect the Protozoean first antenna in *Amphion*, but instead we find a first antenna as that of the non-Penaeid, decapod Crustacea. Further, the larva described in this paper as the first Mysis is by the character of its first antenna, first and second maxilla, telson and other organs definitely the first free stage after the hatching stage, and if it were related to the Sergestidae it should therefore show at least some Protozoean characters, which it does not. It is at present an open question whether some of the Penaeids have lost the

Nauplius stages and hatch as Protozoea, but if this is the case, they do hatch as Protozoea with the typical first and second antenna as locomotory organs and never in shape of a Zoea or Mysis. These reasons alone are sufficient to prove that *Amphion* cannot be included among the Sergestidae or any other of the Penaeidae.

Finally, KORSHELT & HEIDER (1892, pp. 461–62) and GURNEY (1924, 1936, 1942) referred *Amphion* to, the Caridea, on the grounds that it was the only remaining group to which *Amphion* could belong (GURNEY. 1924, p. 105). On this I agree. *Amphion* has most of the typical characters of a Caridean larva.

Each time, however, GURNEY placed it differently within the Caridea. In 1924, p. 105, he thinks "it has a considerable degree of similarity to the *Eretmocaris* larva". This seems based mainly on the thoracopods, which are one of the most inconstant characters in decapod larvae, in *Eretmocaris* developed partly as a floating organ, partly as a trapping organ, as in *Amphion* and *Cerataspides*. Unfortunately, the mouth appendages of *Eretmocaris* are not described (GURNEY-LEBOUR, 1944, pp. 124–128), but both first and second maxillipedes are functioning as mouth appendages, while in *Amphion* only the first maxillipede has this function, even in the adult. It is also to be noted that *Eretmocaris* has no supra-orbital spines, but these are present in *Amphion*. Both antennae in *Eretmocaris* are quite different from those of *Amphion*. Thus, with our present knowledge we must leave that relationship out of consideration.

In 1936 and 1942 GURNEY placed *Amphion* as the larva of *Amphionides*. In 1936 as a possibility, in 1942 as a certainty. It is interesting to note that both GURNEY and ZIMMER, judging by their descriptions, have had the two stages here described as Postlarva I and II, but considered them as females of *Amphionides*, and that GURNEY without using the proofs at his disposal still felt that *Amphionides* was the adult of *Amphion*.

The next point is to see if there are any characters in *Amphion* which would indicate its placement in the Caridea.

The protopod of the second maxilla has only three endites, one on the coxa and two on the basale, a reduction from the normal 2+2. This reduction is compensated by the characteristic development of a fourth functional endite on the endopod, and of the masticatory lobes on the basale and first endopodial joint of the first maxillipede. Three true endites on the second maxilla are not common in the Reptantia, but are known from different Caridea: most Pandalidae, *Athanas nitescens*, *Leptochela carinata*, *Acanthophyra* (Oplophoridae), and in some other Caridea.

Further, the scaphognath of the second maxilla has a more detailed development than usual (Figs. 159–165). In the younger stages it points forward, and the normally in decapods developed posterior lobe seems missing (Fig. 159). In the fifth Mysis a posterior lobe starts to develop (Fig. 160). In the tenth Mysis it has reached a larger size (Fig. 161) but first in Mysis XIII, which is the last stage in the surface life, is it fully developed into a normal scaphognath. The exopod begins more like an exopod on a pereiopod and first later are the two lobes of the typical scaphognath developed. Finally in the abyssal postlarva and adult *Amphion* the anterior lobe of the scaphognath reaches an overwhelming dominance (Figs. 163–165), which must enable it to produce a strong water current inside the carapace-bell. This first part of the development up to Mysis XIII is found also in all the Pandalidae of which the younger larval stages are known, as well as in *Processa bermudensis* (Processidae), in *Mesocaris* sp. (Pontonidae) and in *Acanthephyra* (?) sp. (GURNEY, 1924. Fig. 40d) (Oplophoridae) and partly in *Phyllosoma* of the Reptantia. In *Amphion* the last development of a dominating anterior lobe in the scaphognath must be considered as a special development caused by the life in its abyssal stages.

As these first-described characters are found in all known younger larvae of Pandalidae it could be tempting to assume a closer relation between *Amphion* and the Pandalidae, but other characters speak against a closer relation, all Pandalids have a well-developed rostrum, but *Amphion* only an extremely diminutive one, and *Amphion* further develops a rostral plate in the post-larval and adult stages.

Also from the Oplophoridae *Amphion* shows several differences, e.g. the Oplophoridae have both pleurobranchiae and arthrobranchiae, but *Amphion* has only a single line of pleurobranchiae.

In the Pasiphaeidae the rostrum is small or lacking, endites on the second maxilla are vestigial, and exopods are present on all pereiopods, all this agrees with *Amphion*, but in Pasiphaeidae the basale of the first maxillipede is reduced, which is not the case in *Amphion* where it is very large in the surface form, and

in the adult — although partly reduced — still larger than general in the decapods. Further, the two first pereiopods are enlarged in Pasiphaeids. In *Amphion* only the second pereiopod is enormously enlarged, but more important is the presence in *Amphion* of a rostral plate which in Natantia only is known in the Penaeids. Finally, in *Amphion* only the first maxillipede is functioning as a maxillipede, but not the two following maxillipedes. Still more important is the presence of a large open space between the first and the second maxillipede so that the two last maxillipedes also to judge from their placement, still belong to the thoracopods. These points are very important because we have to go back right to the Euphausids to find an analogous structure of the maxillipedes, and this structure is by all investigators considered a primary primitive character.

Based on the above-mentioned considerations I place *Amphion* in its own family Amphionidae and as the only family within the sub-tribe Amphionidea under the Caridea (if not forming its own tribe), and consider it as possibly the most primitive of the known Caridea although some of its reductions are of a secondary character. It is primitive especially on account of its maxillipedes, rostral plate, and single line of pleurobranchiae.

TRIBE CARIDEA

Sub-Tribe Amphionidea

Caridea with only first pair of maxillipedes functioning as maxillipedes. The following two pairs of maxillipedes are developed like the following thoracopods. Exopods are present on all maxillipedes and pereiopods.

Pleura of second abdominal somit not overlapping those in front, and antennae without stylocerite.

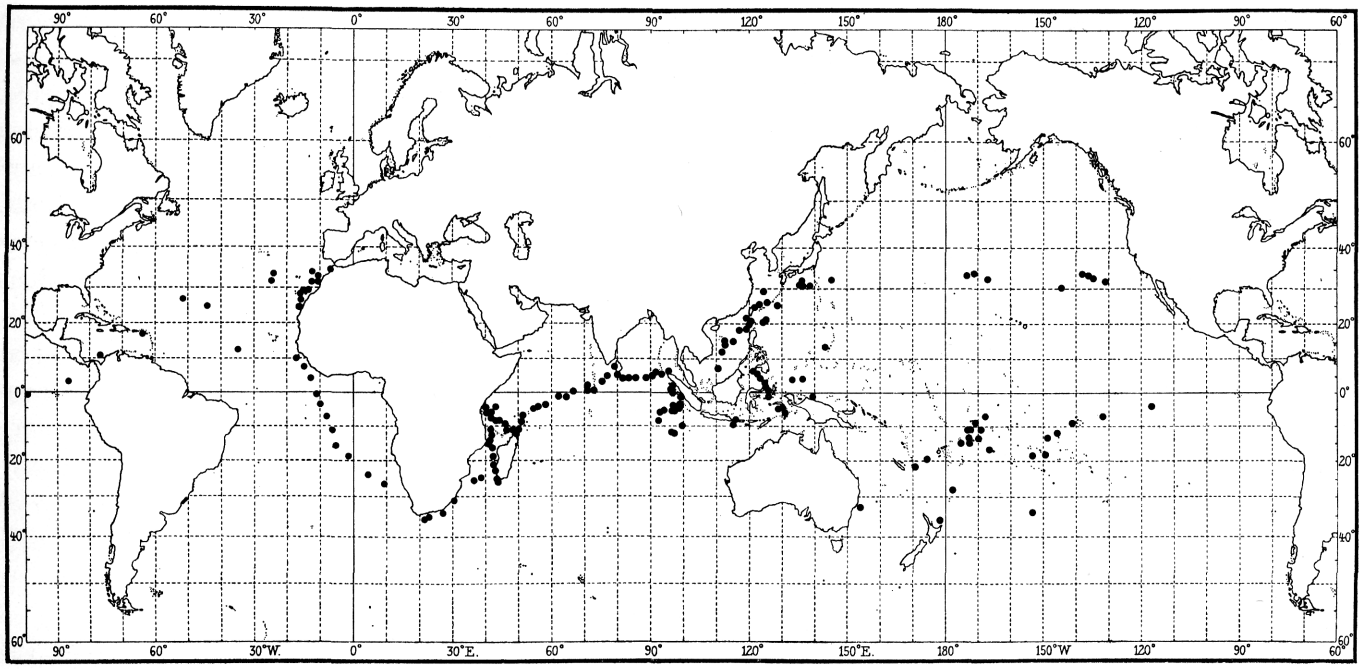
Family Amphionidae

Rostrum diminutive, rostral plate and nauplius eye present: second maxilla in larva first with exopod and endopod parallel with longitudinal axis of the protopod, later the endopodial axis turns 90° to the two others, and in the adult it returns to its original position: endites on same limb much reduced. Appendix interna on pleopods. Single line of pleurobranchiae on third maxillipede to fourth pereiopod. Fifth pereiopod missing in adult.

Genus **Amphion.**

Carapace in adult swollen, much enlarged, with anterior dorsal organ. Eye large and with luminescent organ, mandible reduced without molar part in adult. Limbs reduced, except second pereiopod, pleopods large. First pleopod developed into a special feeding organ in adult, all other pleopods with appendix interna also the first pleopod before its transformation.

Only one species is known, *Amphion reynaudi* H. Milne-Edw.



Map I. All "Dana" localities with *Amphion reynaudi*.

GEOGRAPHICAL AND VERTICAL DISTRIBUTION

Maps I–II. Tables VI–XIV.

In its geographical distribution *Amphion* is a typical tropical and subtropical form. It is found in all oceans between 36° North and 36° South. These are the boundaries for the "Dana" material as shown on Map. I. The "Discovery" Expedition had *Amphion* material only from the Atlantic, and the limits for the catches were 33° North and South.

Tables VI-VIII show the average number of catches of *Amphion* larvae from the different depths. With wire lengths of 600 m or less the gear has only been down about one third of the length of the wire. With wire lengths of 2000 m or more the gear has been hauled in depths about half the length of the wire.

Table VI. Atlantic Ocean. Number of *Amphion* surface stages I–XIII by depth zones and larval stages. Numbers caught and numbers converted to S-200 in 120 minutes.

Wire in m	surf.	50	100	200	300	600	1000	2000	3000	4000	5000	Total
Total number caught on 28 stations.....	10	1184	273	7	34	25	13	13	2	7	5	1573
Total converted.....	3840	1236	406	14	37	28	22	23	3	18	8	5635
Average conv. no. in % of total	68.14	21.93	7.20	0.25	0.66	0.50	0.39	0.41	0.05	0.32	0.14	99.99
Tot. conv. per stat. nearest full no.	137	44	15	1	1	1	1	1	0	1	0	202
Average conv. no. in % of tot. per stat.	67.82	21.78	7.43	0.5	0.5	0.5	0.5	0.5	0	0.5	0	100.03

Larval stage	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	Total
Number of measurable larvae..	0	9	0	18	20	99	87	191	175	406	248	117	142	1512
Number converted	0	11	0	405	407	452	92	205	577	1200	255	126	153	3883
Percentage caught	0	0.60	0	1.19	1.32	6.55	5.75	12.63	11.57	26.85	16.4	7.74	9.39	99.99
Percentage converted.....	0	0.46	0	10.43	10.48	11.64	2.37	5.28	14.86	30.9	6.57	3.24	3.94	100.57

Table VII. Indian Ocean. Number of *Amphion* surface stages I–XIII by depth zones and larval stages. Numbers caught and numbers converted to S-200 in 120 minutes.

Wire in m	surf.	50	100	200	300	600	1000	2000	3000	4000	5000	Total
Total number caught on 79 stations	16	1003	699	262	184	91	2	3	8	6	0	2441
Total converted	6144	1574	1066	315	245	138	5	6	16	13	0	9522
Average conv. no. in % of total	64.78	16.59	10.85	3.32	2.58	1.45	0.05	0.06	0.17	0.14	0	99.99
Total conv. per stat. nearest full no.	78	20	13	4	3	2	0	0	0	0	0	120
Average conv. no. in % of tot. per stat.	65.00	16.67	10.83	3.33	2.50	1.66						99.99

Larval stage	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	Total
Number of measurable larvae	1	34	2	76	47	129	104	220	238	478	262	211	243	2045
Total converted	2	1205	2	1638	64	961	151	706	362	1862	962	697	364	8976
Percentage caught	0.05	1.66	0.10	3.72	2.30	6.31	5.09	10.75	11.64	23.37	12.81	10.32	11.88	100.00
Percentage converted	0.02	13.47	0.02	18.30	0.72	10.74	1.68	7.82	3.99	20.74	10.74	7.72	4.01	99.97

Table VIII. Pacific Ocean. Number of *Amphion* surface stages I–XIII by depth zones and larval stages. Numbers caught and numbers converted to S-200 in 120 minutes.

Wire in m	surf.	50	100	200	300	600	1000	2000	3000	4000	5000	Total
Total number caught on 46 stations[1]	2	526	261	10	33	17	5	7	6	3	1	871
Total converted	768	1895	744	24	112	44	21	15	15	9	2	3649
Average conv. no. in % of total	21.09	52.05	20.43	0.44	3.08	1.21	0.58	0.41	0.41	0.25	0.05	100.00
Tot. conv. per stat. nearest full no.	17	41	16	0	2	1	0	0	0	0	0	77
Average conv. no. in % of tot. per stat.	22.08	53.25	20.78	0	2.60	1.30						100.01

[1] Samples from commercial vessels St. 4760–4820 not considered (see text).

Larval stage	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	Total
Number of measurable larvae	2	38	3	47	20	64	55	81	82	212	141	92	92	929
Number converted	9	87	400	167	65	271	191	272	322	1080	506	348	325	4043
Percentage caught	0.22	4.09	0.32	5.06	2.15	6.89	5.92	8.72	8.83	22.82	15.18	9.90	9.90	100.00
Percentage converted	0.22	2.16	19.91	4.14	1.61	6.72	4.73	6.74	7.78	26.77	12.54	8.62	8.05	99.99

From the "Discovery" material GURNEY (1936, p. 396) concludes "The figures do not prove anything, but suggest that *Amphion* may be more common between 200 and 500 m". The "Dana" material shows for all three oceans that *Amphion* in its Mysis stages — which were the stages GURNEY was referring to in the above citation — is a surface form occurring from the very surface and down to about 30 m depth. Only here must be taken into consideration that most of the "Dana" catches took place during evening and night.

The figures show that in the "Dana" material from the Atlantic Ocean 93% of the total converted number were caught in these upper layers, for the Pacific Ocean the figure is 96% and for the Indian Ocean 92.5%. Already in the hauls with 200 m wire, i. e. a gear working at about 60 m of depth, the numbers have decreased considerably to about 0–3% and these percentages are found down to a depth of 600 m. Below this depth the catch figures are still much lower, and all catches from these greater depths may have been taken in the net on its way up. Finally, Table IX includes all the hauls from stations with catches of *Amphion* with a wire length of 4000 m or more. This table shows that in the cases where specimens of *Amphion* were present in the net when it came on deck these may have been caught during the hauling up of the net when it passed through the upper water layers, as in all such cases there have been rather large numbers of *Amphion* taken in hauls with 50 and 100 m wire on the same station where the deep water hauls were made and at the same time.