Kinetocodium danæ n. g., n. sp. a new gymnoblastic Hydroid, parasitic on a Pteropod.

By

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(Read February 11th 1921.)

(Plate I.)

During the summer of 1920 Dr. Johs. Schmidt made an expedition on board the S/S "Dana" to the Western Atlantic between the Bermudas and the West Indies. The numerous plankton samples brought home by the expedition have been handed to the Invertebrate Department of the Zoological Museum in Copenhagen, where they have been sorted by the staff of the museum. Among the numerous pteropods in the samples a specimen of *Hyalæa (Diacria) trispinosa* Lesueur was found to be covered with a gymnoblastic hydroid. It was forwarded to me for examination, and I found that it was a new species of peculiar and interesting structure. It was very well preserved (in formalin), but as no other colonies were found, I had to be careful not to destroy the single specimen more than necessary.

In the hope of finding more material of the species, I looked through the whole collection of thecosome pteropods in the possession of the museum, and I succeeded to find some more colonies, collected between 1863 and 1872, and very badly preserved. One of them, however, is of considerable interest, as far as it proves the supposed parasitic nature of the species. At the same time I identified the other species of hydroids found on pteropod shells. A short account of the species in question will be found at the end of the present paper.

I am indebted to Dr. Johs. Schmidt for the permission to publish the description of the new species in this place.

Kinetocodium danæ n. g., n. sp.[1])

Description: The colony grows on the shell of *Hyalœa* (*Diacria*) *trispinosa* Lesueur; it consists of creeping stolons, nutritive polyps, and medusoid gonophores.

The nutritive polyps are placed on the foremost part of the pteropod shell (Plate I, fig. 1), mainly on the dorsal side close to the frontal margin and, ventrally, just behind the mouth of the shell; no polyps are found behind the lateral spines. The gonophores, on the other hand, are mainly found on the hind part of the shell, particularly along the lateral margins, though a good number are scattered over the ventral surface behind the mouth; only a few gonophores are placed on the dorsal side of the shell, and then only on the narrow part, the back spine.

The stolons form a meshwork of anastomosing threads running over the surface of the pteropod shell. The coenosarc is a narrow cylindrical or somewhat flattened tube not exceeding 0.04 mm in breadth; the cell layers are thin, particularly the ectoderm which consists of very large, flattened, polygonal cells (Pl. I, fig. 6). The coenosarc is surrounded by a very thin perisarc forming a delicate tube, very much flattened and several times broader than the coenosarc tube. Below each nutritive polyp the stolons are somewhat thickened, forming a kind of foot to the polyp (Pl. I, fig. 2).

The nutritive polyps (Pl. I, fig. 2) are naked; the delicate perisarc of the stolon stops somewhere at the foot of the polyp, but its limit cannot be distinguished. Each hydranth is borne by a long, slender, cylindrical pedicel, about 1 1/2—3 mm in length and 0.2 mm wide. Near the base the pedicel is abruptly bent at a right angle; this is not a casualty due to preservation, but a constant feature, causing the polyp, in its normal position, to be stretched horizontally over the support.

The histological structure of the pedicel shows some interesting peculiarities. Between the ectodermal epithelium and the complexly folded endoderm is the mesosarc, which is considerably thicker than is usually the case in hydroid polyps. This thickening of the meso-

[1]) From: κινητός, movable and κώδιον, diminutive of κῶας, fur.

sarc is particularly conspicuous on one side of the pedicel, *viz.* on the side turned towards the support. On this side the thickening stops abruptly at the sharp basal bending of the pedicel; on the other side it is continued over the "foot" of the pedicel. The thickened mesosarc is shown in Pl. I, fig. 2 and, still more explicitly, in the cross-section, fig. 5. — The muscular elements of the pedicel are much stronger than in ordinary hydroids; this is relevant to the longitudinal muscular fibrils of the ectoderm as well

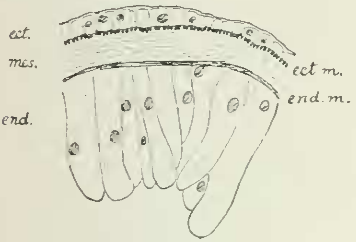

Fig. 1.

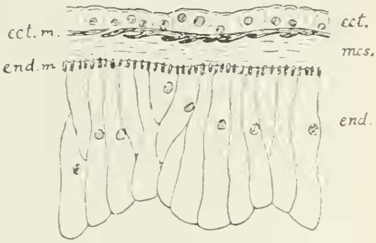

Fig. 2.

Figs. 1 and 2. — Transverse (fig. 1) and longitudinal (fig. 2) sections of the pedicel of a nutritive polyp, showing the thickened mesosarc (*mes.*) and the ectodermal (*ect. m.*) and endodermal (*end. m.*) muscular fibrils. — *ect.* ectoderm, *end.* endoderm.

as to the circular fibrils of the endoderm. Both systems are about equally developed all around the body. The muscular fibrils are more or less sunk into the mesosarc (Pl. I, fig. 5 and textfigs. 1 and 2). — The structure of the mesosarc, as described above, must lend a considerable amount of firmness and elasticity to the pedicel, and on account of the high development of the musculature, the polyp must be able to move very easily in all directions.

On one side of the pedicel, at the base of the hydranth, there is usually a fold, more or less deep, in which the mesosarc is considerably thickened (Pl. I, fig. 3). I am not absolutely sure, whether this fold is present in all the polyps of the colony, but I have found it in the four or five specimens, which I have isolated for further examination, and also in several of the polyps *in situ*. It corresponds to a sharp bending of the hydranth. Some of the polyps are irregularly twisted and contracted owing to the preservation, but in most cases the hydranth is clearly seen to be bent in the same direction as the basal part of the pedicel.

The hydranth is spindle-shaped or nearly cylindrical, with a well developed hypostome and a circlet of tentacles; the broadest part of the hydranth is a little below the latter. The number of tentacles is variable; the number most frequently found is 4, but there may be as many as 6, or the number may be reduced to 2; a few hydranths are even quite devoid of tentacles. The tentacles are very short and thick, egg-shaped or nearly globular; the ectoderm is fairly thin and, as far as I can see, destitute of nematocysts; though the histological structure is somewhat demolished, I am convinced that the large endoderm cells leave a hollow space in the middle of each tentacle. A thin layer of mesosarc separates the endoderm of the tentacles from that of the body of the hydranth; this separation is, however, usually not complete; there may be a small opening in the mesosarc, but the lumen of the tentacle is never in connection with the gastric cavity.

The cross-section (Pl. I, fig. 4) shows that the unilateral thickening of the mesosarc, so pronounced in the pedicel, is still indicated in the hydranth. — In the lower part of the hydranth the endoderm is complexly folded, but leaves a fairly spacious stomacal cavity (Pl. I, fig. 3). The distal part, from a little below the tentacles to the mouth opening, is characterized by the mighty development of the endoderm, which is divided into four longitudinal ridges. In this part the endoderm has a much denser character than further below and consists of several layers of spindle-shaped, radiating cells; near the mouth they are transformed into muscle cells. The ectoderm on the lateral sides of the hydranth forms a fairly thin epithelium, though with a well developed musculature; but around the mouth opening the ectoderm is much thickened and provided with a very heavy musculature, but no nematocysts. — In short, the hydranth is characterized by the strong development of the muscular elements, particularly around the mouth, and by the degenerate and rudimentary condition of the tentacles.

The gonophores (Pl. I, fig. 6) are mounted on short pedicels springing directly from the stolons. The gonophore is entirely surrounded by a delicate chitinous perisarc. It has a pear-shaped outline, and its organisation is medusiform. There is a low and broad manubrium and four radial canals, but even in the most advanced stages observed there are only three marginal tentacles. A fully developed gonophore is about 0.4 mm long (without the pedicel) by 0.25 mm wide.

The ectoderm of the exumbrella is densely set with nematocysts; these are found even in quite young stages (see below). The mesosarc is fairly thin. The four radial canals are narrow in the fully developed gonophore (Pl. I, fig. 7), but broad and wide in younger stages (textfig. 3); they are connected by a narrow circular vessel. — Well-developed gonophores possess three long tentacles with very large hollow bulbs. The filiform parts of the tentacles are rolled up inside the bell cavity (see Pl. I, figs. 6 and 7). Off the end of the fourth radial canal a slight swelling of the tissues may be discerned, indicating a fourth tentacular bulb. There is a narrow but well developed velum (Pl. I, fig. 7). — The manubrium is circular or somewhat quadrangular in cross-section; it has a thin ectodermal epithelium, in which I have not been able to find genital cells. The most interesting feature of the gonophore is, however, that the four perradial edges of the manubrium are confluent with the radial canals, forming four perradial "mesenteries" separating four interradial pouches between the manubrium and the subumbrella. The longitudinal section (Pl. I, fig. 7) has passed along a radial canal on the left hand side, whereas to the right it has passed one of the interradial pouches. The tentacular bulb on this side has been hit near the middle, but the section has gone clear of the radial canal and the mesenterium. The cross-section (textfig. 3) exhibits a younger stage with wide radial canals separated by interradial pouches of about the same width. The pouches may be traced almost to the very bottom of the body.

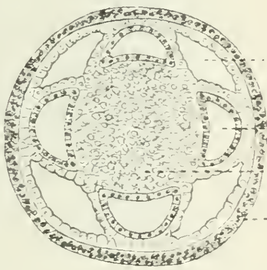

Fig. 3. — Transverse section of a gonophore. — *ex.* exumbrella; *man.* manubrium; *r.c.* radial canal; *ir.p.* interradial pouch of the bell cavity.

There can be no doubt but that the gonophores of this species develop into free medusæ. In the most advanced stages observed the gonophore has lost its organic connection with the stolon, but is still enclosed within the unbroken perisarc. The specimen figured in Pl. I, fig. 6 is connected with the stolon by a very thin and crumpled string without any nuclei and without a central canal. Thus the small medusa has closed its apical canal before it finally leaves the covering perisarc to live a free and independent life in the ocean. The furthest developed stages observed are undoubtedly very nearly ready for liberation; accordingly the medusa is liberated with 3 marginal tentacles, all very well developed. It is quite likely that a fourth or even a greater number of tentacles are developed later on.

Development of the gonophore. — On the stolons in the same region, where the gonophores are placed, I found some short cylindrical bodies, the surface of which is densely provided with nematocysts. They are, however, covered by a thin chitinous perisarc, and these bodies have nothing whatever to do with defensive polyps or anything like that. They are simply the first developmental stages of gonophores. — Owing to the scarcity of material I am unable to give a detailed account of the development of the gonophores, but I shall give a short record of the stages, which I have observed. Apart from the first stages, the general plan of the development seems to be in accordance with that usually found in medusoid gonophores of athecate hydroids. In its very first beginning the development is, however, very remarkable. It begins as an outgrowth from the stolon, this outgrowth developing into a cylindrical body several times longer than broad (Pl. I, fig. 6). The outgrowth is, however, not hollow, but contains a solid endodermal core of large cells in a single row; the ectoderm contains a large number of nematocysts, particularly in the distal part. The first trace of an interior differentiation of the body occurs near the base, where the endoderm cells begin to divide (textfig. 4), forming the first trace of a central space communicating with the lumen of the stolon; externally this process is indicated by a slight swelling of the body. After the central lumen has been formed the development, probably, proceeds in a normal way. It is remarkable, however, that two of the tentacular bulbs (opposite each other) are developed and reach a considerable size, while the interior parts of the gonophore are still at a low stage of development. Textfig. 5 exhibits an external view of a very young gonophore with two strongly developed tentacular bulbs, both somewhat unsymmetrical. Textfig. 6 is a longitudinal section of a little older gonophore; the subumbrella cavity has been formed, but there is no trace of the manubrium; the velar plate is seen deeply sunk between the two tentacular bulbs. In this stage of development (as demonstrated by the other sections belonging to the same series) there are, indeed, four radial canals separated from each other in the interradii, but the two, which

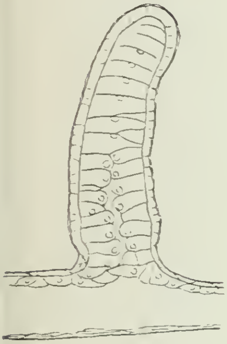

Fig. 4.

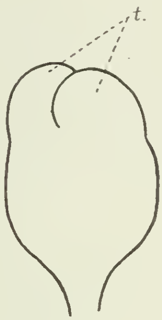

Fig 5.

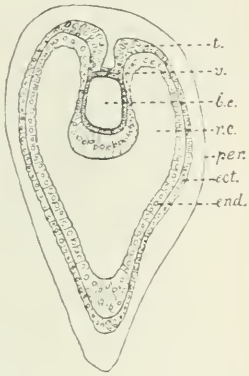

Fig. 6

Fig. 4. — Gonophore at a very early stage of development, showing the first trace of a central lumen.

Fig. 5. — External view of a young gonophore, with two large, unsymmetrical tentacular bulbs (*t.*).

Fig. 6. — Longitudinal section of a young gonophore. — *t.* tentacular bulb; *v* velar plate; *b. c.* bell cavity; *r. c.* radial canal; *per.* periscarc; *ect.* ectoderm; *end.* endoderm. — For further description see the text, p. 7.

are not hit in the section figured, do not reach beyond the level of the velar plate. — When the manubrium is developed, it is from its very first beginning radially connected with the canals, forming the mesenteries mentioned above. Textfig. 3 shows a cross-section of a fairly young gonophore with the radial canals still very wide; we see, how the subumbrella cavity at the level of the section is divided into four separated parts.

The third tentacular bulb is, probably, developed soon after the stage figured in textfig. 6. A stage, in which the velar plate has just been opened, possesses three large tentacular bulbs, all of about equal size. As mentioned above, the fourth bulb is not developed until after the liberation of the medusa. — The development of the thread-shaped part of the tentacles takes place after the opening of the velar plate.

Geographical distribution.

Atlantic Ocean:

Lat. 20° 39' N., Long. 61° 48' W. North of the Lesser Antilles. June 4th 1920, 3^{00} am. 2 m ring-trawl, 300 m wire. "Dana"-Exped. stat. 850. — The type specimen.

Lat. 36° 50' N., Long. 21° W. Between the Azores and Madeira. Andrea 1872. — On two specimens of *Hyalæa trispinosa.* Only some stolons and a few polyps left.

Lat. 2° 30' N., Long. 24° W. Between Africa and South America. Andrea 1863. — On four specimens of *Hyalæa trispinosa.* 1) A fairly large colony with several polyps, most of which are placed on the ventral surface of the shell behind the shell mouth; hydranths with 0—5 tentacles. Stolons without polyps (broken off) inside the lateral spines. Long stolons running backwards into the narrow hind part of the shell; no gonophores left. 2) Two young colonies, one with two polyps in the furrow behind the shell mouth, the other with one long stolon following the entire upper margin of the shell mouth, with two polyps. 3) A colony with two polyps, above the shell mouth. 4) One polyp, above the shell mouth.

Indian Ocean.

Lat. 31° S., Long. 47° E. — Lat. 32° S., Long. 43° 20' E. South of Madagascar. Andrea 1870. — On one *Hyalæa trispinosa,* two polyps left, on the dorsal surface of the shell, near the left spine.

The four localities are rather far distant from each other, which indicates that the species has a wide geographical distribution. Considering the large material of pteropods examined, the hydroid really appears to be somewhat rare; it is interesting to note, however, that in one locality not less than four specimens of *Hyalæa* were infested.

Vertical distribution. — The colony from the "Dana"-Expedition was taken about 100—150 m below the surface. The specimens of the old material have, probably, all been found near the surface.

Mode of feeding.

I have found no nutritive matter in the digestive cavity, but from the structure and position of the nutritive polyps we may draw some conclusions with regard to the mode of feeding of this animal. First of all, on account of the degenerate condition of the tentacles, the animal is absolutely incapable of catching food in the usual way. R. E. Lloyd (1907) has described a peculiar hydroid, *Nudiclava monocanthi,* epizoic on a pelagical fish, *Monocanthus tomentosus.* The hydranths are short, club-shaped, and devoid of tentacles; the endoderm is strongly developed with a powerful musculature. The author suggests that the closely packed hydranths open themselves like as many funnels, the widely gaping mouth openings directed forwards when the fish is swimming, thus receiving tiny organisms from the plankton during the progression of the fish through the water. This may be true in the case in question, where the polyps are short and stout, but it does not hold good for *Kinetocodium* with its long and slender polyps. — Is it a commensal animal? Does it steal food from the pteropod? I think not, considering the mode of feeding of the pteropod and the position of the hydroid polyps around the opening of the shell, particularly on the front margin of the latter. The pteropod feeds on pelagical organisms which are carried forwards towards the mouth by means of the ciliary motion of the epithelium on the ventral surface of the hind part of the foot. In *Hyalœa trispinosa* this part of the foot is comparatively long. When the pteropod is expanded, it must be impossible or, in any case, most inconvenient for the polyps to reach the ciliated ventral surface of the foot or the mouth opening, which is protected in front by the confluent lateral lips. Thus our species seems to be unfit for any form of feeding on pelagical organisms.

The strong development of the musculature in the mouth region lends the mouth the appearance of a sucking or biting organ. Moreover we must attend to the peculiar double bending of the pedicel. Finally the well-developed musculature of the pedicel renders the whole polyp very movable.

I have thought of the possibility that the hydroid might seek its food on the shell of the pteropod. But what kind of food might it find there? Surely only microscopical algæ or bacteries, and hydroids do not, as a rule, take vegetable food; moreover the pteropod shells are usually fairly clean, so that a hydroid colony consisting of several persons could hardly find sufficient food there.

Finally there is the possibility that the hydroid eats the mucus or the epithelium of the pteropod. In such case the only possible place for attack is the upper surface of the foot, including the wings. The polyps placed on the front margin of the shell cannot dip into the ventral mantle cavity of the pteropod. Indeed, their obvious outward direction indicates that they really attack the wings. This must be done in that way, that the muscular mouth of the polyps adheres to the wings, the whole body of the polyp following the constantly flapping movement of the wings. The polyps placed behind the shell opening should then attack the upper surface of the hind part of the foot. And, indeed, in one of the colonies from the old material, one of the polyps on the ventral side of the shell, behind the shell mouth, is bent forwards, the mouth opening tightly adhering to the surface of the partly retracted foot of the pteropod. I have cut sections of this foot in order to see, whether the tissues might be in any way destroyed by the parasite. The tissues are remarkably well preserved, considering the age of the material. On the dorsal surface of the hind part of the foot (which in the present case has been particularly exposed to the attack of the parasite) the epithelial cells are entirely uninjured. Towards the hind and lateral edges the cells are still covered with a gelatinous cuticula, but on the greater central part of the foot the cuticula has been rubbed off. This may be due to preservation, though it is worth noticing that, on account of the retraction of the animal, one part of the foot was concealed and protected inside the shell, and that the cuticula is in the same condition inside as well as outside the shell. Thus it seems quite likely that the cuticula has been eaten off by the hydroid, whereas the latter cannot afford to penetrate the very cell-layers of the host.

This may hold good or not. In any case there can be no doubt, but that *Kinetocodium danæ* really feeds on the surface of the foot of the pteropod. From their position around the opening of the shell the nutritive polyps attack the dorsal surface of the expanded foot, the flapping wings as well as the more quiet hind part. The powerful, muscular mouth sucks the tissue of the host, the long, slender, mobile pedicel following every movement of the swimming animal, until the foot is retracted, when of course the parasite must release its hold.

Systematical position.

Kinetocodium danæ has evidently been modified in accordance with its special mode of living, its structure partly being somewhat reduced, partly highly specialized. The modifications have not, however, gone so far as to efface the characteristics, necessary for determination of the systematical position of the species. Indeed, I have no doubt as to this point.

The arrangement of the tentacles in a single verticil below a conical hypostome at once direct the attention towards the family *Bougainvilliidœ*. The lack of perisarc around the nutritive polyps might indicate a relation to the *Hydractinia* group; but in *Kinetocodium* this feature is undoubtedly a matter of adaptation, and the presence of perisarc around the gonophores distinctly separates it from the *Hydractinia* group. A comparison with the genus *Perigonimus* will show a series of similarities, which can leave no doubt of the relationship between the two genera. The long slender polyps of *Kinetocodium* may be regarded as *Perigoniums*-polyps with reduced perisarc and degenerate tentacles. In several species of *Perigonimus* the gonophores are placed directly on the stolons in the same way as in *Kinetocodium*; they are surrounded by a perisarc and in certain species the perisarc remains unbroken until the gonophore has lost its connection with the mother polyp and closed its apical canal. Moreover the highly developed "mesenteries" in the gonophore of *Kinetocodium* demonstrate that the medusa, when liberated, belongs to the *Tiaridæ*, like the medusæ of *Perigonimus*. The early development of two opposite tentacular bulbs ahead of the next ones, points in the same direction. The "mesenteries" are, however, much farther developed in *Kinetocodium* than in gonophores or young medusæ of *Perigonimus*. We may state, accordingly, that the present species belongs to the family *Bougainvilliidæ* and, within the latter, to the same group as *Perigonimus*; but its difference from the latter, as well as from any other known genus, is so great that it must be the representative of a new genus, *Kinetocodium*. — The great variation in the number of rudimentary tentacles, which may even be quite absent, indicates that the species is still in a degenerating condition.

Remarks on some related species.

The two species of *Hydrichthys* as well as *Ichthyocodium sarcotretis* Jungersen all live in connection (directly or indirectly) with pelagical fishes and are greatly modified in accordance to their peculiar modes of living. The modifications go partly in the same directions as in *Kinetocodium*, but are much more highly accomplished, so much so, that a discussion of their systematical position can only be founded on the gonosomes, whereas the trophosomes give no idea whatever of the affinities of the species.

In his description of *Hydrichthys mirus*, Fewkes (1888) discusses the question of the systematical position of this interesting form. His considerations are, however, a series of more or less hazardous analogizings. It is not worth while to deal with his comparisons between *Hydrichthys* and *Tubularia* (pp. 229—230) or *Polypodium* (p. 232); nor do I apply much importance to his indications of a relationship to *Velella* (p. 231). With regard to the medusa of *Hydrichthys*, Fewkes states as follows (p. 228): "Shortly after its detachment, the medusa with two tentacles resembles a young *Stomotoca*" and (p. 229): "The medusa with two opposite tentacles was raised into one with four, passing out of the stage resembling *Stomotoca* into one like *Sarsia*". — Stechow (1909) in his description of *Hydrichtella epigorgia* (a hydroid epizoic on a Gorgonid) compares the encrusting hydrorhiza and the naked nutritive polyps, devoid of tentacles, of *Hydrichtella* with the corresponding structures in *Hydrichthys*. These features are, however, in both species matters of adaptation and have no systematic value at all. Owing to the capitate tentacles of the defensive polyps he refers *Hydrichtella* to the *Corynidæ*, and he adds (p. 33): "... dazu kommt die offenbar sehr nahe Verwandtschaft mit *Hydrichthys*. Dort weisen die Medusen, hier die Tentakel der Wehrpolypen mit grosser Bestimmtheit auf die Coryniden, und so schliesse ich auch diese Form den Coryniden an". This view is entirely wrong. The only points of likeness between *Hydrichtella* and *Hydricthys* are due to adaptation. With regard to the supposed resemblance between the medusa of the latter and the *Sarsia* medusæ, I am unable to see any likeness at all. On the other hand, the medusa of *Hydrichthys mirus*, as figured by Fewkes (Pl. V), is a typical Tiarid medusa: the manubrium which is cross-shaped in transverse section; the compressed, triangular tentacular bulbs; the characteristic basal bending of the tentacles; and the development of two opposite tentacles before the two next ones; everything points towards the *Tiaridæ* and is in absolute contradiction to the *Codonidæ*. The same holds good for *Hydrichthys boycei* Warren. Warren (1916) rightly remarks (p. 180): "The medusa ... recalls the medusa of *Perigonimus*", and (p. 183): "... *Hydrichthys* shows marked similarities to *Perigonimus*, and very possibly the differences which occur have arisen through adaptation to the parasitic habit". Warren, like Fewkes, indicates, though with duly reservation, the possibility of a connection between *Hydrichthys* and Siphonophores.

Another peculiar hydroid, *Ichthyocodium sarcotretis*, was described by Jungersen (1911). It is epizoic on a copepod, *Sarcotretis scopeli*, parasitic on the fish *Scopelus glacialis* of the northern Atlantic area. The polyps are devoid of tentacles, and some of them bear clusters of medusoid gonophores with two large opposite tentacular bulbs. Jungersen points out (pp. 25 and 27) the close resemblance between this interesting hydroid and *Hydrichthys mirus* Fewkes. With regard to the systematical position, Jungersen quotes the assertion of Stechow, mentioned above, and says: "Also *Hydrichthys* is referred by Stechow to the *Corynidæ*; in so far as this will prove to be well founded, our *Ichthyocodium* has to be included in the same family" (p. 27). — As in *Hydrichthys*, the gonophores of *Ichthyocodium* with the two large, triangular tentacular bulbs opposite each other, point distinctly towards the Tiarid medusæ. I am not convinced, however, that the gonophores of this species develop into free medusæ. In spite of a single remark ("In transverse sections the cavity of the manubrium is quadrangular", p. 23), I do not think that Jungersen has cut microtome sections of this species; in any case, I have found no preparates among the effects left by his death. This is deplorable, because some sections, made by me for comparison with *Kinetocodium*, seems to show that to a certain degree Jungersen has misunderstood the structure of the gonophore. He describes the two tentacles as "bent up and concealed inside the umbrella", and he states: "The umbrella contains four distinct, wide and simple radial canals, connected distally by a ring-vessel; a velum is indicated ..." (p. 23). I have sectioned two well-developed gonophores (see textfigs. 7 and 8), and I have found that the

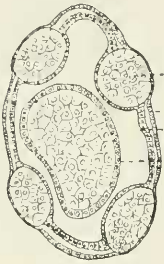

Fig. 7

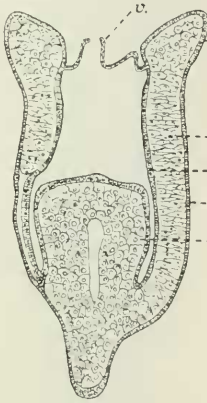

Fig. 8.

Figs. 7 and 8. — *Ichthyocodium sarcotretis.* Transverse (fig. 7) and longitudinal (fig. 8) sections of gonophores. — *ex.* exumbrella; *sub.* subumbrella; *man.* manubrium; *t.* tentacular bulb; *v.* velum; *r. end.* radial strings of endoderm.

radial "canals" are four solid strings of endoderm going from the base of the manubrium to the bell margin, terminating in triangular tentacular bulbs, two of which are much larger than the others. The endoderm strings are fairly thick, broadly elliptic in cross-section. The transverse section (textfig. 7) shows that they project more inwards (to the subumbrella side) than outwards, forming four longitudinal ridges on the subumbrella. There are no tentacles. What Jungersen considered to be tentacles, "bent up and concealed inside the umbrella", are really, I am sure, the thick longitudinal ridges, mentioned above. The velum is very broad, turned outwards between the tentacular bulbs. In the interradial spaces between the endoderm strings the two layers of ectoderm are only separated by a thin mesosarc; there is no endoderm lamella. The lack of tentacles in the two gonophores, sectioned by me, and the other characters by which they differ from Jungersen's description, cannot be explained by the specimens belonging to younger stages of development. As a matter of fact, they are so far developed that the second pair of tentacular bulbs have been formed and have reached a somewhat considerable size, though still distinctly smaller than the first pair. There is, accordingly, every reason to believe that the gonophores of *Ichthyocodium sarcotretis* remain attached to the hydranths, even when mature.

Jungersen has not offered any suggestion as to the mode of feeding of *Ichthyocodium*. The mouth of the hydranths has exactly the same structure as in *Kinetocodium* (observed in sections cut by me); the polyps are exclusively found on that side of the parasitic crustacean, which is turned towards the body of the fish. I can see no other possibility, therefore, but that the hydroid must feed on the epidermis of the fish.

As we have seen, the medusæ (or medusoid gonophores) of *Hydrichthys mirus* Fewkes, *Hydrichthys boycei* Warren, and *Ichthyocodium sarcotretis* Jungersen distinctly points towards the Tiarid medusæ as their nearest relatives. Medusæ belonging to the family *Tiaridæ* are, however, liberated from hydroids referred to two different families, *Bougainvilliidæ* (*Perigonimus* group) and *Clavidæ*, so that the knowledge of the structure of the medusa is not sufficient to determine the systematical position of the hydroid. The absence of a perisarc on the polyps might indicate that the three species in question should be referred to the *Clavidæ* rather than to the *Perigonimus* group. In this regard our new genus, *Kinetocodium*, is important, in so far as it demonstrates that the perisarc of the polyps may be entirely lost in a species, which undoubtedly is related to *Perigonimus*, as evident by other reasons (see above, p. 11). Now, apart from the strong development of the mesosarc and the muscular elements in the pedicel, the polyps of *Kinetocodium* bear a great resemblance to the polyps of *Hydrichthys*, as described by Fewkes and Warren, and of *Ichthyocodium*, as described by Jungersen and seen from sections made by me. The lack of perisarc is, therefore, no objection to the supposition of a relationship between the genera in question and *Perigonimus*. Indeed, I am of opinion that they may, without any risk, be placed within the hydroid family *Bougainvilliidæ* and, within the latter, in the *Perigonimus* group.

Looking through the "Pteropoda" by J. J. Tesch in "Das Tierreich", Lief. 36, 1913, I found (p. 50) a statement of *Hyalæa (Cavolinia) tridentata* frequently being overgrown by a hydroid, referred by Chun to *Perigonimus repens.* While searching (in vain) for a published record about the matter, I found that Chun (1889, p. 524) has described another *Perigonimus, P. sulfureus,* from a „*Hyalœa trispinosa*" near the Canary Islands. Steche who has reexamined the specimen (Steche 1907, p. 30—31), states, however, that the Pteropod was *Hyalæa* (*Cavolinia*) *tridentata.* — I quote Chun's description in toto:

"Von Hydromedusen erwähne ich einer auf pelagischen Thieren fixirten Hydroidencolonie. Dieselbe erschien Mitte Januar auf einer lebenden *Hyalæa trispinosa* festgeheftet. Offenbar gehört die Colonie zu der Gattung *Perigonimus* Sars, denn der kriechende Stamm mit seinen zahlreichen wurzelförmig sich verästelnden Ausläufern knospte direct die Medusen, während die keulenförmigen, mit 8—9 kurzen knopfförmigen Tentakeln versehenen Polypen der Medusenknospen entbehrten. Die Colonie bedeckte fast vollständig die eine Schalenhälfte und zerfiel in eine lediglich Medusen knospende und in eine mit Polypen bedeckte Partie. Die in allen Entwickelungsstadien vorhandenen Medusen sassen auf Stielen fest und liessen vor dem Loslösen vier an der Basis kolbig angeschwollene Tentakel erkennen. Das Entoderm der Polypen und der Innerraum des aus der Subumbrella nicht hervorragenden Magens waren schwefelgelb gefärbt. Ich beobachtete die Colonie einen halben Tag lang lebend und bemerkte nicht, dass die plumpen Polypen sich streckten oder dass ihre kurzen knopfförmigen in einer Ebene gestellten Tentakeln sich lang ausgezogen. Ich nenne die neue, dem *Perigonimus serpens* Allman nahe stehende Art *P. sulfureus.*"

Steche (1907) reproduces a drawing, made from life by Chun, but gives only a few additional remarks on the structure. The species described by Chun in a mere narrative of his voyage to the Canary Islands, might seem to be identical with the species, which I have just described. There are, however, some remarkable differences, sufficient, I think, for specific distinction: Chun describes (and Steche figures) the living polyps as being club-shaped and plump, with 8—9 knob-shaped tentacles, whereas the polyps of *Kinetocodium danæ* are very long and slender and with only about 4 tentacles, the greatest number observed being 6, and several polyps having less than 4, or even none at all. Moreover the gonophores of *K. danæ* have only 3 tentacles, not 4 as in *P. sulfureus* (the figure represents a gonophore with 4 equally developed, expanded tentacles). According to Steche the polyps are surrounded by a perisarc ("Periderm"), distinguished from that of other *Perigonimus*-species by the lack of foreign bodies. If there really is a perisarc, *P. sulfureus* is a true *Perigonimus* and constitutes a connecting link between the ordinary members of that genus and *Kinetocodium*, to which it is evidently related.

Remarks on other species of Hydroids occurring on Pteropod shells.

It is curious that nobody has ever taken up the idea to deal with the hydroids growing on pteropod shells. The matter seems rather inviting for study, but our knowledge is restricted to a few scattered remarks in the literature. Boas (1886, p. 34) found hydroid colonies on the following species of pteropods: *Cleodora balantium, Cl. cuspidata, Cuvierina columella,* and *Hyalæa trispinosa.* As far as the latter species is concerned, hydroids were particularly found on specimens from the South Atlantic and the Indian Ocean. The hydroids were not identified. Setting aside the problematic occurrence of *Perigonimus repens* on *Hyalæa tridentata* (mentioned above), altogether five species of hydroids are found on pteropod shells, *viz. Kinetocodium danæ* (the new species described in the present paper), *Perigonimus sulfureus* Chun (mentioned above), *Campaniclava cleodoræ* (Gegenbaur), *Campaniclava clionis Vanhöffen*, and *Laomedea striata* (Clarke). None of these five species are known to occur on any other kind of support. — I shall give a short account of the material which I have found in the collection of pteropods in the Zoological Museum of Copenhagen. — The state of preservation is very bad; accordingly I can give practically no additions to the morphology of the species; but the statements of the geographical distribution are rather surprising, considering the previous knowledge of the matter.

Campaniclava cleodoræ (Gegenbaur).

Syncoryne cleodorae Gegenbaur 1854, p. 11—13. Taf. I, Fig. 3 & 4.
Campaniclava cleodorae Allman 1864, p. 7.

Hitherto only known from the Strait of Messina (Gegenbaur), where it was found on 4/5 of all examined specimens of *Cleodora cuspidata* (= *tricuspidata*).

It is found on the same species of pteropod in several localities in the Atlantic between Lat. 43° 10' N. and 15° S., from the coast of Africa until Long. 34° 30' W.; moreover on Lat. 10° S., Long. 104° E. in the Indian Ocean.

Most of the colonies are fertile. They cover both sides of the shell without predilection for any side.

Campaniclava clionis Vanhöffen.

Vanhöffen 1910, p. 281. Fig. 7.
Jäderholm 1920, p. 1. Pl. 1, fig. 1.

This peculiar species was found by the German South-Polar Expedition in the tropical Atlantic between Lat. 20° N. and 10° S. on *Cleodora balantium*; recently Jäderholm (1920) has seen some colonies (in the Swedish State Museum) from Lat. 4° 38' N., Long. 27° 15' W., growing on the same species of pteropod. Jäderholm denies the presence of a gelatinous envelope around the short hydranth stem, as described by Vanhöffen. A perisarc is certainly present, but it is chitinous, not gelatinous; it surrounds the basal part of the polyp as a cylindrical tube, 2—3 times as long as broad.

Every specimen of *Cleodora balantium* in the Zoological Museum of Copenhagen is covered by *Campaniclava clionis*. Most of the specimens are from the Atlantic Ocean, between Lat. 21° 30' N. and 19° 30' S., from Africa as far out as Long. 36° W. — One specimen has been found at Lat. 33° S., Long. 58° E. in the Indian Ocean, and one in the Pacific near the Marquesas Islands.

Laomedea striata (Clarke).

Obelia striata Clarke 1907, p. 9. Pl. 6 and 7.

This species was found by the "Albatross" in the eastern tropical Pacific at Lat. 0° 34' N., Long. 117° 15.8' W. and Lat. 7° 12.5' S., Long. 84° 09' W., in both cases on pteropod shells, the species of which is, however, not stated. Clarke (1907) gives a number of excellent drawings of this pretty hydroid. The hydrotheca is mainly characterized by the marginal teeth having "well-developed crests projecting inward". Owing to the young medusa with 4 main tentacles, the species would certainly, in Nutting's classification, be placed in the genus *Clytia*. In accordance with the classification proposed by Levinsen and Broch I, however, refer it to the genus *Laomedea*.

Though hitherto only two colonies have been found (in the Pacific), this species is in fact exceedingly common in the tropical parts of the oceans. — Material examined:

On *Hyalœa (Diacria) trispinosa:*

Atlantic: Numerous localities between Lat. 27° 03' N. and 31° 16' S., from the coast of Africa to South America and the West-Indies.

Indian Ocean, from east of southern Africa to south of Madagascar, Lat. 30° 50'—38° 50' S. by Long. 24—47° E. Further at Lat. 23° S., Long. 72° E. and Lat. 25° 50' S., Long. 102° 50' E.

Pacific: one specimen, without further statement of locality.

On *Cuvierina columella:* among several hundreds of specimens examined only 4 were found to be covered with hydroids; the latter all belonged to *Laomedea striata*. Localities: Lat. 0° 30' N., Long. 29° W.; Lat. 14° 46' N., Long. 28° W.; Lat. 23° 24' N., Long. 81° 20' W.

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Explanation of Plate I.

List of abbreviations.

b. c. bell cavity.
c. v. circular vessel.
end. l. endoderm lamella.
ex. exumbrella.
f. fold (at the base of the hydranth).
ir. p. interradial pouch of bell cavity.

m. mouth.
man. manubrium.
mes. mesosarc.
per. perisarc.
r. c. radial canal.
sub. subumbrella.
t. tentacle.
t. b. tentacular bulb.
v. velum.

All figures are of *Kinetocodium danæ* n. g., n. sp.

Fig. 1. *Hyalæa (Diacria) trispinosa* Les. with *Kinetocodium danæ.* Ventral view. The foot of the pteropod is partly retracted. On the middle part of the shell is seen a polyp without tentacles. — The type-specimen. — × 10.
Fig. 2. A nutritive polyp. — × 30.
Fig. 3. Longitudinal section of a hydranth. — × 120.
Fig. 4. Transverse section of a hydranth at the level of the tentacles. — × 120.
Fig. 5. Transverse section of the pedicel of a nutritive polyp. — × 120.
Fig. 6. External view of a well-developed gonophore; the manubrium and the three tentacles are discerned inside the bell; two of the radial canals are indicated by double rows of nuclei. On the stolon are seen two very early developmental stages of gonophores. — × 120.
Fig. 7. Longitudinal section of gonophore. — × 220.

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