Echinocheres globosus, n. gen., n. sp., a Copepod parasitic in spines of an Echinothurid.

By

H. J. Hansen.

With Plate XV.

About one year ago Dr. Th. Mortensen showed me a misshapen secondary spine of *Calveria gracilis* (Ag.); the specimen had been secured near the Philippine Islands by the „Challenger". The distal portion of the spine was somewhat thickened, and Dr. Mortensen had discovered that a small Crustacean inhabited a cavity in the swelling. He asked me to work it out, which I promised, but wished for more material. Dr. M. wrote to Prof. F. Jeffrey Bell at the British Museum, asking him to send some additional spines with the end thickened; these spines have been given him very obligingly, but only one of them contained the Crustacean.

I. The Habitation of the Parasite.

Of the two spines one was treated with very diluted muriatic acid in order to dissolve the chalk; the swelling of the other spine has been cut longitudinally with a knife, and this section, with the animal in its natural position, is shown in fig. 2. The first-named spine (fig. 1) measured 9.2 mm. in length; scarcely its distal fourth was thickened, with the diameter nearly twice as long as that at the middle of the spine. In both spines the end was truncate, and the

parasite was situated near the middle of the swelling, almost filling up the proximal half of a cavity. This cavity begins in the centre of the truncate end as a rather narrow duct (fig. 2), and widens proximally so that its diameter a little before the proximal end is nearly twice as long that of the terminal opening. The proximal part of the cavity is hemispherical, and the parasite lies with the abdomen directed towards the distal end of the spine. The wall of the cavity is smooth. Each cavity contained only one Crustacean: a female Copepod with two ovisacs. The cavity has evidently been formed by the animal; while it was young it has lived near the end of the spine in the narrow portion of the cavity; gradually it has grown larger and advanced forwards, producing a new and wider portion of the cavity. The adult female must remain within the cavity until it dies away, but the nauplii slip out through the apical aperture. The nourishment of the parasite must be the juices of the spine.

II. Description of the Species.

Of the two specimens one has been dissected; I wished to spare the other. The animal has been difficult to examine, being tiny and besides exceedingly swollen and globular (fig. 3), so that the area occupied by the appendages is proportionately small, and it was impossible to study most of the appendages without a detailed dissection. Fig. 3 being drawn I cut off the major dorsal part of the animal, cleaned the ventral portion of the head from the internal side by a small knife as well as possible under one hundred degrees of enlargement, examined it and prepared fig. 4, finally divided it into small portions and removed gradually most of the natatory legs. The result was fortunately so that I have been able to produce a tolerably complete description with drawings of all appendages (the maxillulæ partly excepted); it may be possible that a few setæ on the antennulæ have not been observed and that one or two apical setæ on the antennæ and a lateral seta on the peduncle of two pairs of natatory legs have been broken off.

The internal organs have been omitted: the condition of the ovisacs mentioned below proves that the omission has been necessary.

The Cephalothorax is exceedingly swollen, subglobular, in the dissected specimen of equal length, breadth and depth, in the other specimen (fig. 2) even considerably broader than long or thick. The swollen portion consists essentially only of the head and the first thoracic segment, while the other thoracic segments constitute together a low oblique cone which is very small as compared with the head. The skin on the dorsal and lateral surface of the head is thin submembranous. On the ventral side the head is separated from the first thoracic segment by a narrow transverse stripe (fig. 4, *l*) of membranous skin, but on the sides and on the back a folding of the skin of this strongly vaulted part prevented me from deciding the question, but most probably the first segment is here coalesced with the head. The rostrum (fig. 4, *a*) is short, depressed and with the end broadly rounded; it occupies the whole space between the basal joints of the antennulæ.

The Antennulæ (fig. 4, *b*; fig. 5) are a little longer than the maxillipeds without their terminal hook (compare fig. 4 with fig. 10: both drawn with the same degree of enlargement) and as long as the free thoracic segments and the abdomen together. In fig. 4 the left antennula (and the proximal portion of the right) is shown in the position in which I found it: is turns the front side essentially downwards, and it is therefore the anterior half of the antennula which is shown in that figure. Fig. 5 shows the right antennula from above; especially this drawing elucidates the essential features. The antennulæ consist of twelve very distinct joints. The second and third joints together are only as long as the first or the fourth; the fourth joint shows on the upper side a vestige of a division into two joints. The fifth joint, which is as long as the fourth, is very peculiar, its anterior half being distally produced as a rather short and very broad, rounded prolongation covering anteriorly as a cap the major part of the following short joint. The seventh joint is nearly as long as the three proximal joints together; seen from

above (fig. 5) its anterior margin shows two transverse impressions, indicating that the joint in reality is formed by the fusion of three joints. The eighth, ninth and tenth joints are all subequal in length and together only a little longer than the seventh; the penultimate joint is a little shorter than the two preceding ones together; the terminal joint is only a little shorter than the five proximal joints together, with the end blunt and irregularly cut off. On the distal angle of the penultimate joint is inserted an olfactory seta, the length of which is two-fifths of the whole antennula; this seta is very thick, but in the specimen examined a part of it beyond the middle seems to be collapsed in both antennulæ, and the portion in question is not similar in the two setæ (comp. fig. 4 with fig. 5). The setæ on the three proximal joints are very short and apparently few in number (some may be overlooked or broken off); the fifth joint possesses five long, robust setæ which taper gradually to the acute end, and each of nearly all the other joints has a single or two setæ of the same shape; the last joint has five very thin terminal hairs. On the seventh, eighth, ninth, tenth and twelfth joints are found several setæ of another shape: these setæ are considerably thicker in proportion to their length, taper gradually towards the end which is somewhat thickened and generally (perhaps always) emarginate or slightly cleft. The seventh joint has two short and two rather long setæ, the ninth joint one rather long and proximally very thick seta and one shorter and less thickened seta, each of the three other joints only one rather short seta of this kind. In my opinion, these setæ are scarcely supplementary olfactory organs, but it must be added that the state of preservation and the scantiness of material checked the study. — I do not venture to attempt an interpretation of all the joints of the antennulæ according to the formula of Giesbrecht, showing how the number has originated by fusion of certain groups of twenty-five joints, but I think that the joints in the proximal half of the antennulæ must be interpreted in the following way:

I.	II.	III.	IV.		V.		VI.	VII.			VIII.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.

The Antennæ (fig. 4, *d*; fig. 6) are slender and a little more than one third as long as the antennulæ. They consist of four joints. The first joint is considerably thicker than long, the second somewhat shorter than the two distal ones together, and the terminal joint a little shorter than the third. No seta exists on the three proximal joints; the fourth joint terminates in a seta which is as long as the fourth, the third and the first joint together, somewhat curved, very thick at the base and gradually tapering towards the acute end. At the base of this seta I have discovered only one rather short and thin hair. The exopod (*e*) is very small, oblong, exarticulate, inserted at the end of the second joint and adorned with two setæ, one of which is terminal.

The Mouth. Labrum and hypopharynx constitute together a sipho which encloses the mandibles and originates between the insertions of the antennæ. The sipho is seen vertically from in front in fig. 7; fig. 8 shows it from the side; in fig. 4 it is shown in an oblique position and therefore shorter in proportion to its breadth than in fig. 7. It is almost as long as the antennæ, twice as long as broad, oblong-ovate, but with the distal end produced into a short tube; besides it is considerably compressed (comp. fig. 8 with fig. 7), with the labrum very deep and strongly vaulted in front. The labrum is slightly shorter than the hypopharynx and cut off transversely; the hypopharynx is also cut off, but each lateral angle is produced into a small triangular projection which is bent backwards. The mandibles have no palp; they are exceedingly difficult to study: as far as could be observed their distal portion is exceedingly slender, without teeth, and the outline of their proximal part could not be discerned with certainty.

The Maxillulæ (first pair of maxillæ) are small (fig. 4, *g*). The drawing shows what I have been able to see on the preparation. I observed a very narrow plate which tapers distally and

terminates in a seta; the length from the base to the tip of the seta is about equal to the two distal antennal joints together. From the basal posterior edge of the plate originates another plate, which is very small, triangular and terminates in a single seta; this plate is shown more highly magnified in fig. 9. The maxillulæ are inserted close to the base of the maxillæ.

The Maxillæ (maxillæ of the second pair or first pair of maxillipeds, auct.) consist of two parts (fig. 4, *h*). The basal portion is a single joint about as long and thick as the six proximal joints of the antennulæ. The second part is a little longer than the basal joint, slender, looking nearly as an exceedingly thick seta, tapering towards the acute end, and its distal half is gradually strongly curved, forming a hook. At a short distance from the base this part is divided into two joints by a very oblique articulation. As to the morphological interpretation of the maxillæ I refer to p. 149 in the work of Giesbrecht mentioned below. These appendages are strong instruments most probably used by the animal for anchoring itself; auxiliary organs for the same purpose are the antennæ and especially the maxillipeds.

The Maxillipeds (figs. 3 and 4, *i*; fig. 10) are slender and very long, from the base to the end of the terminal claw about one fourth longer than the antennulæ. As the maxillæ they may be divided into two parts. The basal part is one slender joint which is not fully one half of the whole appendage; it has been examined form various sides, but it was impossible to detect any division into two joints. The distal part of the maxillipeds consists apparently of three joints; the proximal one is very short, the two others nearly equal in length. The second of these joints is very slender and has on the inner part of the end a thin and rather short seta; the third joint, which is shaped as a robust, a little curved seta, is, according to Giesbrecht, not a real joint but a terminal hook. — The maxillipeds are inserted at some distance from each other; fig. 4 shows their insertions and besides those of the other appendages of the head in their relative position.

Natatory Legs. They are well developed on the four anterior thoracic segments; the fifth thoracic segment is reduced so that it — as in other *Podoplea* — looks as an abdominal segment, and it shall be mentioned separately below together with its rudimentary legs. In figs. 11—14 the left leg of the four anterior pairs are shown from in front; all these figures, together with fig. 4 and fig. 10, have been drawn with the same degree of enlargement (220 times), and a comparison of these figures will therefore show the relative size of nearly all appendages of the animal. The peduncles of the natatory legs are two-jointed, as long as or a little shorter than broad; their inner margin has no seta; a seta was very distinct on the outer edge of the second joint of the second and third pairs, but on the two other pairs it could not be discovered (perhaps it has been broken off). The outer ramus is three-jointed in all pairs; the inner ramus is two-jointed in the first pair (fig. 11) and three-jointed in the other pairs. The third pair have the longest rami (fig. 13); in the first pair they are considerably shorter than in the second; in the fourth pair (fig. 14) the inner ramus is about as long as the outer, but in the three other pairs the inner ramus is rather considerably shorter than the outer one. A very long flattened spine, which is serrated along the outer margin, is found on the end of both rami of the third and fourth pairs and on the outer ramus of the second pair; on the end of the outer rami of the three posterior pairs a short, flattened spine, serrated along the outer margin, is inserted outside the long serrated spine. Besides three similar, short, flattened spines, serrated along the outer margin, are inserted on the outer margin of the outer branch of the second and third pairs of legs: one of these spines originates from the side of the third joint, and the two other spines from the distal edge of the two proximal joints. The shape of the joints and the number of the natatory setæ on each joint can be studied on the figures; it may be added that these (generally plumose) setæ are longer and thicker on the outer than on the inner ramus, but

some of them were broken, and I could therefore draw only their basal part.

Fifth thoracic Segment. As mentioned above this segment constitutes the anterior part of the abdomen (fig. 15 and 16, *a*), being even a little narrower than its first segment (*b*). The legs (fig. 17) are rudimentary, each consisting of an oblique plate with one seta on its outer edge and one very small ramus, which is oblong and rounded without any seta. This branch is certainly the outer one.

Abdomen. It consists only of two segments and the cerci (figs. 15 and 16). The genital segment (*b*) is somewhat broader than long and considerably broader than thick; the genital apertures are lateral, oblique fissures. The second segment is a little more than half as long as the preceding one and a little more narrow; in my specimen its basal part is a little withdrawn in the genital segment, but it was impossible to discover any vestige of an intermediate segment. The cerci are slightly longer than broad, one of them with six setæ, of which four are short, the two others long; the longest seta is as long as the distance from the base of the second thoracic segment to the end of the cerci and one third longer than the other seta. On the left cercus only five setæ could be discovered, of which two are short, one is somewhat longer than the genital segment, while the two long setæ had been broken off near the base.

Measurements. The specimen examined measures about 0.54 mm. in length from the anterior end of the globular head to the tip of cerci, 0.44 mm. in breadth and 0.44 mm. in thickness; as shown in fig. 3 the ventral side of the head is bent strongly downwards, and the distance from the rostrum to the end of the cerci is slightly more than 0.3 mm.

Ovisacs. In the specimen examined they measured about 0.28 mm. in length and 0.16 mm. in breadth. It has been impossible to me to form a real conception of the number of the eggs, the

layer at the external membrane of the ovisacs being quite dissolved, constituting a uniformly granular substance.

Locality. It has already been mentioned that the animals have been found in secondary spines of the Echinothurid *Calveria gracilis* (Ag.); the specimen in question has been secured by the „Challenger" Stat. 200: (Lat. 6° 47′ N. Long. 124° 28′ E.; 250 fathoms), Philippine Islands.

III. Position in the System.

In 1899 Dr. W. Giesbrecht published his voluminous and very valuable monograph: Asterocheriden (Fauna und Flora des Golfes von Neapel. . . . . 25. Monographie). From the beginning of the investigation of my new form I supposed that it probably belonged to the family named, and I have taken care to examine nearly all the external features mentioned by Giesbrecht in his fine work. My description of the female agrees moderately well with the diagnosis of the family *Asterocheridæ* given by Giesbrecht on p. 96. The antennæ, the sipho, the maxillæ, the maxillipeds, the four pairs of natatory legs and the fifth thoracic segment with its rudimentary legs agree completely; the antennulæ differ only by possessing a number of thick setæ with the apex a little swollen and emarginate; the maxillulæ differ scarcely in points of importance. The skin on the sides and on the dorsal surface of the enormous head is evidently weaker and more membranous than in the animals studied by Giesbrecht, but this feature, which coincides with the habitation of our parasite, is of slight systematic importance. I can point out only two more important differences between the new form and the *Asterocheridæ* of Giesbrecht. The number of the really abdominal segments is still more reduced, only two being present, while three or four are met with in earlier known forms; on the ventral side the head is separated from the first thoracic segment by a narrow membrane, while the head and the first thoracic segment are coalesced in the other genera. But the differences dis-

covered are too few and not important enough for necessitating the establishment of a new family, and I feel justified in referring the new species to the family *Asterocheridæ*.

It is easily seen that our animal can not be referred to any of the genera accepted in Giesbrecht's work. He has referred his twenty-one genera to five sub-families, but the new genus, *Echinocheres*, agrees badly with the diagnoses of these divisions; I must therefore establish a new sub-family, *Echinocherinæ*, and will attempt to produce a diagnosis as far as possible in accordance with those of Giesbrecht.

Diagnosis of the Sub-family Echinocherinæ. Female. Thoracic segments rounded on the sides; head together with the first thoracic segment longer than the rest of the body. Abdomen of the female with only one segment between the genital segment and the furca. Antennulæ with twelve joints; the penultimate joint with a very long olfactory seta; some of the joints with a number of rather short to moderately long, robust setæ which have their end somewhat thickened and generally emarginate. The antennæ shorter than the proximal part of the maxillipeds, with a very long, strong and somewhat curved terminal seta; the exopod oblong. Sipho nearly vertical on its surroundings, considerably compressed, seen from in front oblong oval with a short terminal tube. Mandibles without palp. Maxillulæ very small, with both branches. Maxillipeds moderately distant from each other, their proximal part is one-jointed, the distal part two-jointed (the long setiform hook not included). First pair of natatory legs with the inner ramus two-jointed, the outer three-jointed; the three following pairs normal, with three-jointed rami; the inner branch of the third (and fourth) pair terminating in one long, flattened spine serrated along the outer margin. Fifth rudimentary pair with the terminal joint oblong and rounded. — Parasitic.

As long as only the female of one species has been studied a diagnosis of the genus would, in my opinion, be very deficient, especially when the diagnosis of the sub-family has been given.

The anomalously swollen condition of the head with the first thoracic segment is certainly characteristic for the female of the genus, but most probably the male agrees more with the same sex of other genera as to the shape and condition of that portion of the body. The shape of the rostrum and especially of the genital segment — the latter being only a little broader than the following one — is certainly of generic value. The number and shape of the setæ and the spines on the rami of the natatory legs present other generic characters which can be extracted from my representation as soon as more forms of the new sub-family have been examined.

I will conclude this small contribution with a few remarks on the geographical distribution of the family and allied questions. The discovery of *Echinocheres globosus* in spines of an Echinothurid opens a small new field of searching: most probably some other species occupy cavities in spines of various Echinids. Giesbrecht writes on p. 203 and 204 that „die Zahl der bisher bekannten und ausreichend beschriebenen Species" is 46, all from Great Britain and Ireland, northern France, northern part of the Adriatic and the gulf of Naples, and a few of these species have besides been taken in some places at the western coast of Scandinavia and a single specimen in the Kara sea. „Ausserdem sind ganz vereinzelte Funde nur .... von Neuseeland und dem tropischen Theil des Atlantischen und Pacifischen Oceans zu verzeichnen". Furthermore he states on p. 204: „Die Asterocheriden gehören zur *Microfauna des marinen Litorals*, und das erklärt die Dürftigkeit der chorologischen Daten, die über sie vorliegen. Kein Theil der marinen Fauna ist so vernachlässigt; unsere Kenntnisse von der Microfauna der Küsten aussereuropäischer Meere sind kaum der Rede werth". This statement as to our ignorance is quite correct; I will add that according to my own experience on the „Ingolf"-Expedition the deeper parts of the ocean between 500 and 1500 fathoms are exceedingly rich

in small crustacea, much richer in several respects than for instance the gulf of Naples and the harbour of Messina, but our knowledge of this fauna is still more insignificant than our knowledge of the littoral microfauna in the seas at America, Asia and Australia! I am able to set forth a few supplementary remarks on the occurrence of the *Asterocheridæ*.

In bottom material — treated with a sieve clothed with silk-gaze (no. 7) and preserved in spirit — secured by the „Ingolf"-Expedition in various stations in the southern part of the Davis Strait I have found numerous Copepods and among them a number of *Asterocheridæ*, at least about five species belonging to various genera. At least the major part and perhaps all these Copepods have lived at the bottom, and the depths noted for the stations are: 318, 582, 1190 and 1435 fathoms. — In bottom material secured by Dr. Th. Mortensen two years ago in various localities in the gulf of Siam from depths between 1 to 30 fathoms I have found several forms of *Asterocheridæ*. — I am inclined to believe that the family contains several hundreds of species, and that they can be found in all seas from the shore to depths of at least 1500 fathoms.

Explanation of Pl. XV.

Fig. 1—17. ***Echinocheres globosus,*** n. gen., n. sp. ***Female.***

Fig. 1. Secondary spine of *Calveria gracilis* (Ag.) with the parasite occupying the distal swelling, $\times \frac{16}{3}$.

Fig. 2. Longitudinal section through the distal part of the spine, showing the parasite in its cavity, $\times 27$.

Fig. 3. The female, seen from the left side, $\times 82$; the ovisacs have been removed; *h.* maxilla, *i.* maxilliped.

Fig. 4. Ventral side of the head, showing the appendages, etc., in the natural position, $\times 220$; *a.* rostrum, *b.* antennula, *c.* its olfactory seta, *d.* antenna, *e.* its exopod, *f.* sipho, *g.* maxillula, *h.* maxilla, *i.* basal part of the maxillipeds, *k.* base of the peduncle of the first pair of natatory legs, *l.* membranous stripe between the head and the first thoracic segment.

Fig. 5. Right antennula, from above, $\times 400$; *VI.* the sixth joint, *VII.* the seventh joint.

Fig. 6. Left antenna, from the outer side, $\times 300$; *e.* exopod.

Fig. 7. Sipho, vertically from in front, $\times 300$.

Fig. 8. Sipho, from the left side, $\times 300$.

Fig. 9. Posterior lamella of the right maxillula, about $\times 400$.

Fig. 10. Left maxilliped, $\times 220$.

Fig. 11. Left natatory leg of the first pair, from in front,
Fig. 12. Left natatory leg of the second pair, from in front,
Fig. 13. Left natatory leg of the third pair, from in front,
Fig. 14. Left natatory leg of the fourth pair, from in front,
} $\times 220$.

Fig. 15. Abdomen, from the left side, $\times 150$; *a.* fifth thoracic segment with its rudimentary leg, *b.* genital segment.

Fig. 16. The same abdomen, from below, $\times 164$; the lettering as in the preceding figure.

Fig. 17. The fifth thoracic segment, from below, $\times 330$; *a.* rudimentary leg.

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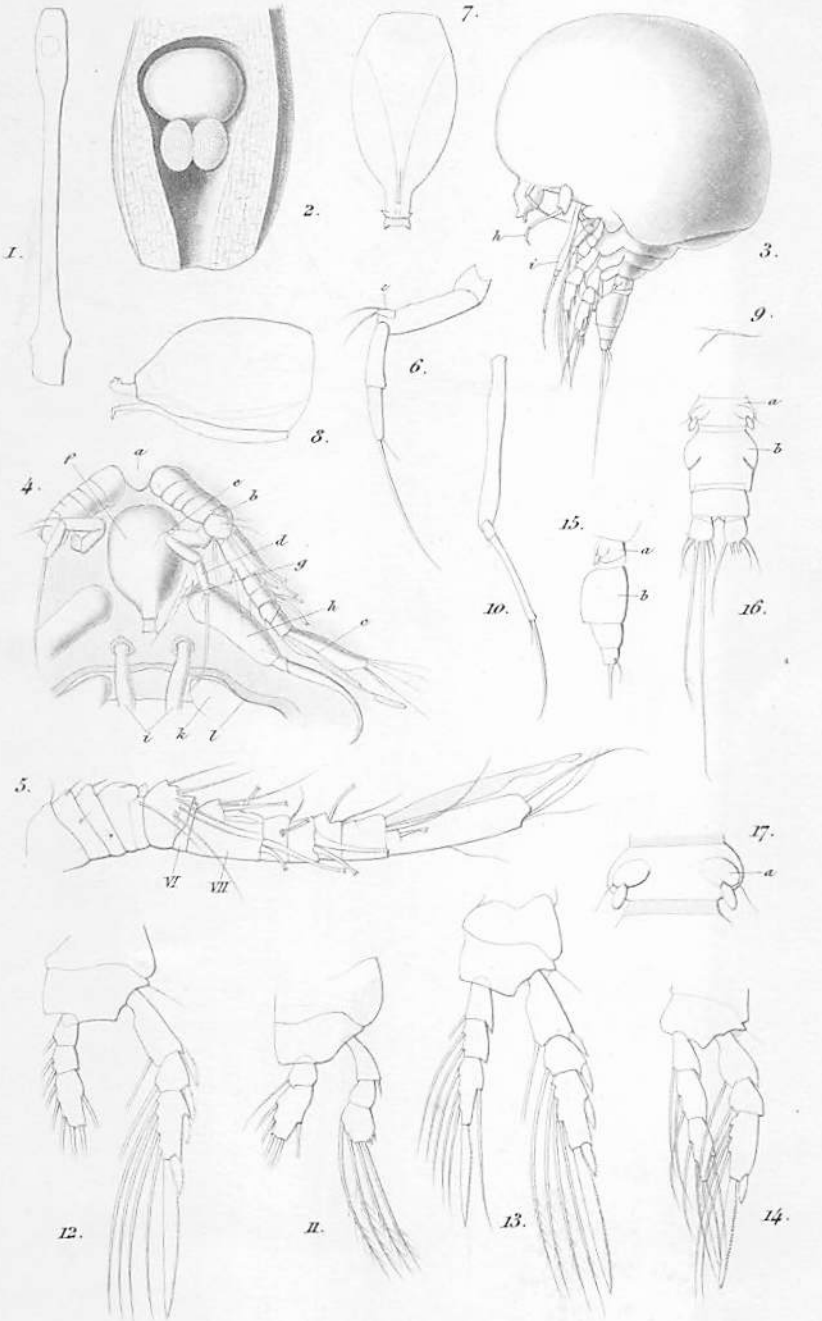

Echinocheres globosus, n. gen., n. sp.

T. N. Möller sc.

H. J. Hansen del.