THE CALVOCHERIDAE, A FAMILY OF COPEPODS INDUCING GALLS IN SEA-URCHIN SPINES

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INTRODUCTION

Misshapen spines in sea-urchins of the family Echinothuridae were observed several times by the famous Danish echinoderm specialist, the late Dr. Th. Mortensen. The swellings were caused, he discovered, by a small crustacean inhabiting a cavity in the swelling. He entrusted his material to H. J. HANSEN, who published a detailed study on the phenomenon in 1902, whereas new samples discovered later on were studied by K. STEPHENSEN (1935). Apart from these two publications, no new observations concerning these galls in sea-urchin spines have been published.

HANSEN gives an illustration of the transformed spine (1902, pl. XV fig. 1); this illustration, copied in the present paper (fig. 1a) gives the impression that the parasite inhabits a thickened part at the top of the host's spines. Hansen must have dealt with a spine whose distal part was broken off or he figured one of the club-shaped spines that normally, thus

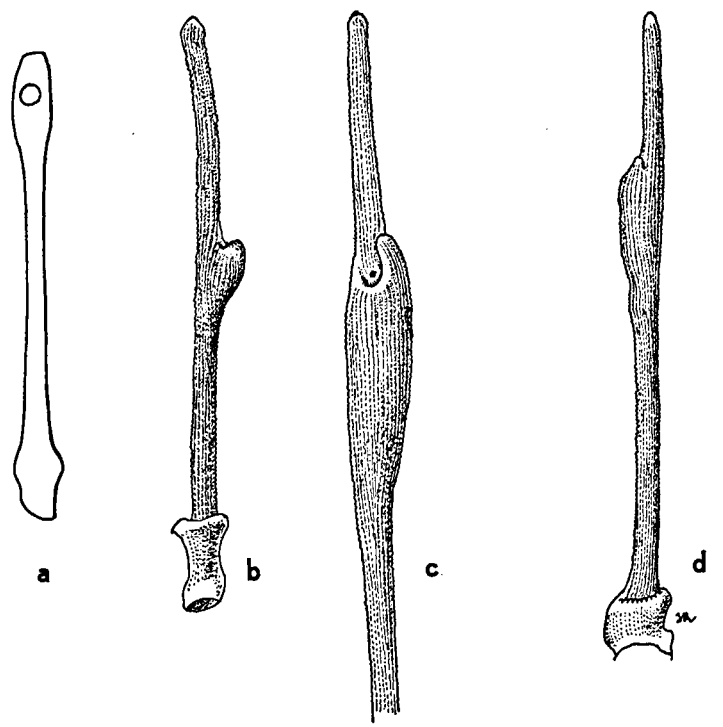

Fig. 1. Spines of sea-urchins transformed through the action of Calvocheridae.

a, spine of *Calveriosoma gracile* (A. Agassiz) with gall caused by *Calvocheres globosus* (Hansen) (after HANSEN, 1902); b, same, after a specimen from Siboga Stat. 161; c, d, galls in spines of *Hygrosoma hoplacantha* (Wyv. Thomson), caused by *Calvocheres engeli* n.sp.; the spines have been illustrated from different sides; Siboga Stat. 122 (b-d, original drawings by Mr. Jos Ruting).

without interference of a parasite, occur in Echinothuridae. The galls caused by copepods occur always halfway the spine (our figures 1 b-d); they are not unlike birdnests glued against a stem. The swelling illustrated by Hansen is a symmetrical one, the galls actually found are asymmetrical.

In the swelling, which consists of loose calcareous material, an ampulla with a soft, strongly pigmented wall is found. Inside this ampulla, the copepod lives, always a single female, the head orientated to the base of the spine. A narrow duct (the "neck" of the ampulla) leads to the pore in the gall; this pore is always situated at the distal end of the swelling. The duct is so narrow that the adult copepod cannot leave the gall. The ovisacs are fixed to the genital segment of the female; each ovisac contains but a single egg. Since every gall is inhabited by one specimen only, it can be taken for granted that the nauplii hatching from these eggs, leave the gall through the pore. Since the hosts are deep-sea echinoids, nothing more is known about the biology of the parasites.

Hansen proposed the name *Echinocheres globosus* for the species first discovered, but since the generic name *Echinocheres* proved to be preoccupied (CLAUS, 1889) for a different genus of copepods, WILSON (1932) substituted it by *Calvocheres*. The genus comprises actually two species, *C. globosus* (Hansen, 1902), the type-species by monotypy, and *C. oblongus* Stephensen, 1935, an incompletely known form. For the present study, fresh material of *C. globosus* was used, whereas also a new species was discovered, described below as *C. engeli*.

The new species is dedicated to Professor Dr. H. Engel, on the occasion of his 70th birthday, and in recognition of his human qualities of which the author benefited so often.

C. globosus and *C. engeli* differ in so many points – such as the armature of the anterior maxilla, the transformed maxilliped claw, the segmentation of the endopod of the 2nd to 4th leg – that it would seem justifiable to attribute them to different genera. I have refrained from doing so, since what is known of *C. oblongus* seems to bridge the gap between *C. globosus* and *C. engeli* to a certain degree.

The three species can be distinguished as follows:

	globosus	*oblongus*	*engeli*
mx_1	short, with 1 seta	long, with 1 seta	long, with 2 setae
P_2, endopod	3-segmented	2-segmented	2-segmented
P_3, P_4, endopod	3-segmented	3-segmented	2-segmented
mxp claw	thin	thin	flattened
P_1, exopod	with rudimentary lateral spines	with lateral spines	without lateral spines
P_2, second exopod segment	with lateral spine	without lateral spine	without lateral spine
host	*Calveriosoma gracile* *Sperosoma quincunciale*	*Hygrosoma petersi*	*Hygrosoma hoplacantha*
distribution	East Indies	N. Atlantic	East Indies

FAMILY CALVOCHERIDAE

Hansen described his gallicole species under the name of *Echinocheres globosus* and attributed it to a new subfamily, the Echinocherinae. WILSON (1932) replaced *Echinocheres* by *Calvocheres*. The subfamily-name was not changed, but the Code of Nomenclature (art. 39) leaves no doubt that this should be done as well. Hansen adhered Giesbrecht's view according to which all siphonostome cyclopoids were unified in one family (the Asterocheridae) with a number of subfamilies. Present day views go in the direction of several closely related families within the suborder Cyclopoida siphonostoma. The rise to family rank, and the nomenclatural change of the type genus are reflected by the proposed name, Calvocheridae (new name, new rank).

The family can be diagnosed as follows: Cephalosome greatly enlarged. Caudal rami present. Only one postgenital segment. Anterior antennae with many (14) segments, aesthete on penultimate segment. Posterior antenna fundamentally as in the Asterocheridae (s.str.). Siphon well developed. Mandibles (both "palp" and "stylet") entirely absent. Anterior maxilla in reduction: only one lobe (the inner) well-develop-

ed; terminal armature reduced to 1 or 2 setae. Posterior maxilla as in the Asterocheridae (s.str.). Maxilliped fundamentally as in the Asterocheridae (s.str.). Legs 1 to 4 biramous. Leg 5 in reduction but present. Number of eggs small.

The chief differences with the Asterocheridae (s.str.) lie in the number of postgenital segments, in the absence of mandibles, and in the reduction of the anterior maxilla.

DESCRIPTIVE PART

Calvocheres globosus (Hansen, 1902).

Echinocheres (preoccupied name) *globosus* Hansen, 1902: 437, pl. XV.
Calvocheres globosus Stephensen, 1933:207; Stephensen, 1935:225.

MATERIAL EXAMINED. — 5 ♀♀, in swellings of the spines on the adoral side of the sea-urchin, *Calveriosoma* (= *Calveria*, preoccupied) *gracile* (A. Agassiz, 1881). Siboga Stat. 161:01° 10'5 S, 130° 09' E. 798 m, Aug. 17, 1899. (ZMA Co. 101.033).

REMARKS. — The present material (from the Halmaheira Sea, Indonesia) comes from the same geographical region as the type-specimens (collected in the Philippines), and makes galls in the spines of the same sea-urchin, *Calveriosoma gracile*. There can be little doubt, therefore, that the Siboga material is identical with Hansen's species, although there are several discrepancies in the morphology of the actual specimens and the original description. STEPHENSEN (1935) recorded *C. globosus* from S.E. Japan, in spines of *Sperosoma quincunciale* de Meyere, at a depth of 437-505 fathoms.

I have dissected a female (length 596 μ, greatest width 515 μ) and compared the exoskeleton structures with Hansen's observations.

I hold a view different from Hansen's concerning the interpretation of the number of segments in the A_1 (fig. 2a). The basal portion is very similar to that of *C. engeli* (described below). Segment 8 is free in *C. engeli*, entirely fused with segment 7 in *C. globosus*. Segments 8, 9, and 10 of *globosus* are homologous with segments 9, 10, and 11 of *engeli*. Segments 11 and 12 of *globosus* are fused to a single segment (12) in *engeli*. Segments 13 and 14 of both species are homologous again.

The 2nd antenna resembles that of *C. engeli*, though its terminal, ciliated claw is slightly longer (as in Hansen's figure 6).

Mandible (both stylet and palp) are absent. I failed to find any trace of a mandibular stylet; Han-

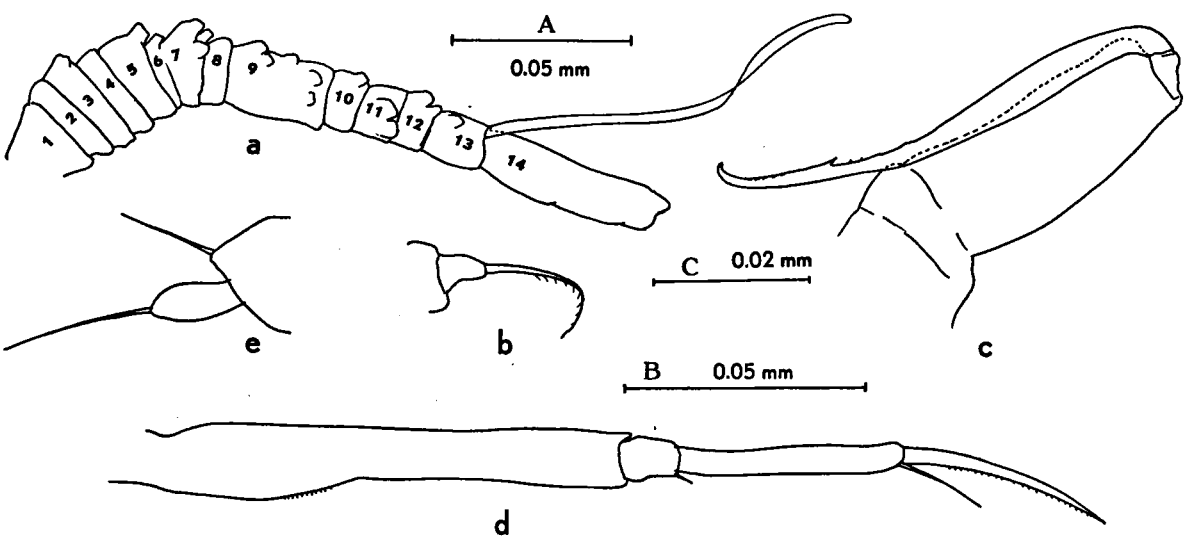

Fig. 2. *Calvocheres globosus* (Hansen), ♀.
a, anterior antenna (setae omitted) (scale A); b, anterior maxilla (B); c, posterior maxilla (B); d, maxilliped (B); e, fifth leg (C).

sen also is very vague about the structure of the mandible.

Hansen's description of the first maxilla is erroneous. It consists of one lobe only, and not of two lobes of unequal length as supposed in the original description. Hansen's fig. 9, and our fig. 2 b, represent the mx_1. The entire appendage is in a rudimentary condition; it is inserted near the base of the mx_2.

The 2nd maxilla (fig. 2c) has a slender, curved claw, distally armed with a recurved hook and several denticles.

The maxilliped (fig. 2d) corresponds well with Hansen's description; it is an exceedingly slender appendage.

The legs correspond closely with Hansen's figures 11 to 14. Their chaetotaxis formula is as follows (elements reduced in length are placed in parentheses):

	coxopod	*basipod*	*endopod*	*exopod*
P_1	0-0	1-0	0-1; 1-3-2	(I)-0; 0-0; (I)-4
P_2	0-0	1-0	0-1; 0-2; 1-2-3	(I)-1; I-1; II-I-4
P_3	0-0	1-0	0-(1); 0-2; 1-I-3	(I)-1; I-1; II-I-3
P_4	0-0	1-0	0-1; 0-2; 1-I-2	0-1; 0-1; I-I-3

The 5th leg is rudimentary (fig. 2e), but still consists of a basal segment, which is for the greater part fused with the first urosome segment, armed with a lateral seta, and of an elongately oval distal segment provided with a long, thin seta.

The number of urosome segments is reduced to the effect that there is only one postgenital segment. The caudal ramus is as Hansen described.

Calvocheres engeli nov. spec.

MATERIAL EXAMINED. — 6 ♀♀ (1 holotype, 5 paratypes). In galls of spines at the adoral side of the sea-urchin, *Hygrosoma hoplacantha* (Wyv. Thomson, 1877). Siboga Stat. 122, off Menado (Celebes), 01° 58'5 N, 125° 00' S.E., 1264-1165 m, Aug. 17, 1899. (ZMA Co. 101.034).

3 ♀♀. Same host, same position on host. Siboga Stat. 300, Timor Sea, off Rotti Island, 10° 48'6 S, 123° 23'1 E, 918 m, Jan. 30, 1900. (ZMA Co. 101.035).

DESCRIPTION. — Female: Length of two specimens measured 725 and 741 μ, greatest width of cephalosome 545 and 547 μ. Several females carry eggs: one egg on each side of the urosome; diameter of the egg 209 × 290 μ.

The globular cephalosome has a large excavation at the posterior side, into which the pedigerous segments 1, 2, and 3 are retracted. The 4th pedigerous segment, and the urosome (consisting of the 5th pedigerous segment, the genital segment and the anal segment) are projecting from the hollow posterior cephalosomal end. Anteriorly, the cephalic segment shows an enormous swelling; as a result, the cephalic appendages are implanted in the posterior half of the somite. They are all orientated in a sense parallel to the urosome (fig. 3a).

The anterior antenna (fig. 3d) is 14-segmented. Several of the basal segments are apparently devoid of setae. The setae on the segments 5 to 14 are placed on a kind of socle. When seen under a certain angle (fig. 3e) these socles give the appendage a very peculiar toothed aspect. The penultimate segment is provided with a broad aesthete.

The posterior antenna (fig. 3f) has a 2-segmented protopod. The exopod is rudimentary, provided with 2 very unequal setae. The endopod is 2-segmented; the distal segment is armed with a very long, nearly straight claw.

No mandibular stylet, nor a mandibular palp.

The siphon consists of a swollen basal portion, whereas the distal fourth is produced into a tubiform portion. Two triangular projections mark the end of the siphon (fig. 3b).

The anterior maxilla (fig. 3g) is a unimerous, slender, finger-shaped lobe, distally armed with 2 unequal, plumose setae; the outer lobe is probably represented by a triangular, naked rudiment. The posterior maxilla (fig. 3h) consists of the usual basal segment and a much longer, distally strongly curved, claw. This claw is ornamented with 3 rows of fine spinules only.

The maxilliped (fig. 3i) has a 2-segmented, unarmed, basal portion, and a 3-segmented distal portion transformed into a claw. The 2nd claw segment bears distally a plumose seta; the 3rd claw segment is flattened, not unlike the blade of a knife, and densely ciliated.

Legs 1 to 4 (figs. 3j-m) have 3-segmented exopods, and 2-segmented endopods. The protopod is 2-segmented, the basipod bears a lateral setule in all legs. Intercoxal plates are present. The chaetotaxis formula is shown in the table on page 90 (elements reduced in size are placed in parentheses).

The 5th leg (fig. 3n) is composed of a basal pro-

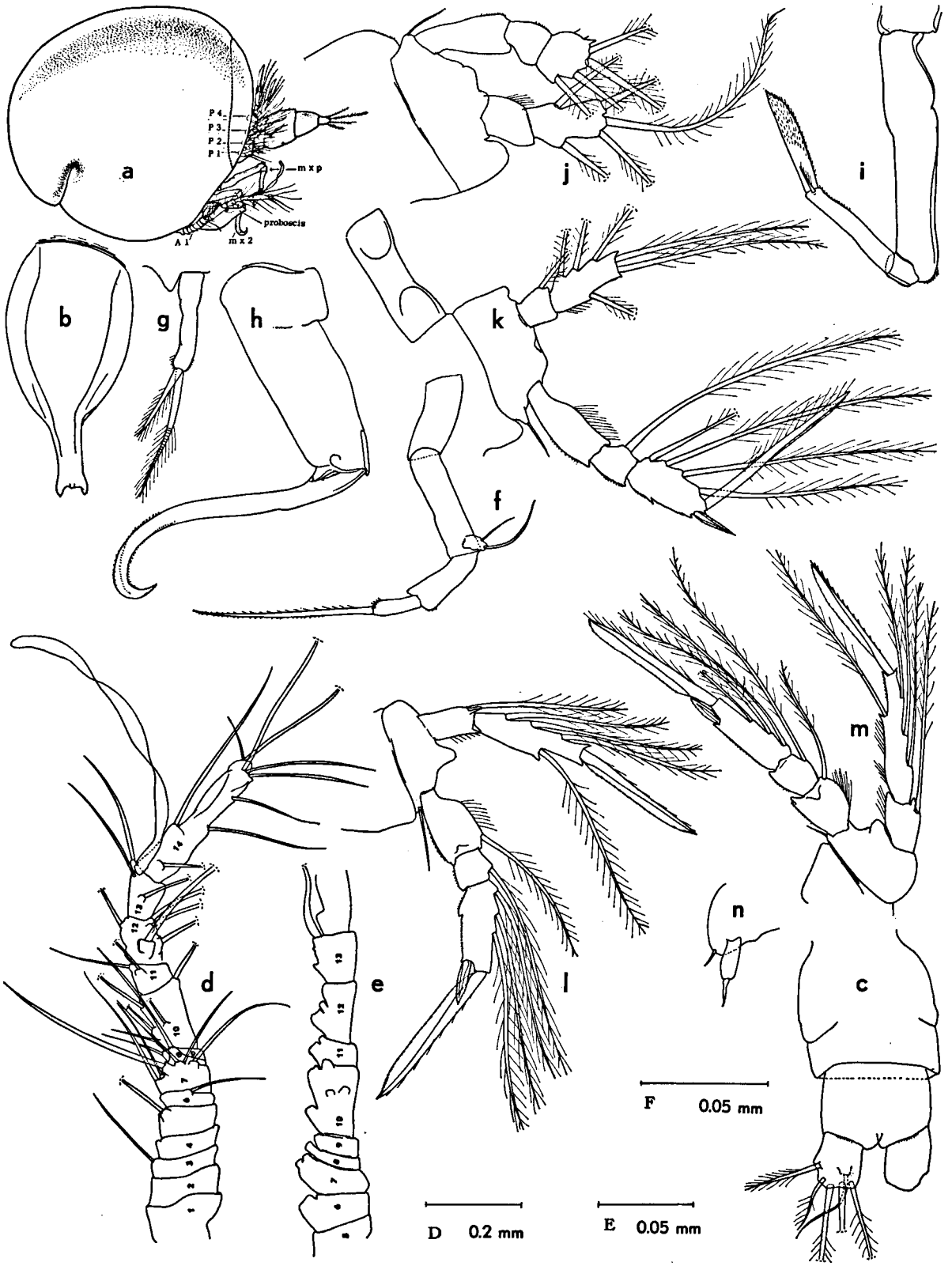

Fig. 3. *Calvocheres engeli* n.sp., ♀.
a, entire animal, from the left (scale D); b, proboscis, in ventral view (E); c, urosome (F); d, anterior antenna (F); e, segments 5 to 13 of A1, seen from a different angle, setae omitted (F); f, posterior antenna (F); g, anterior maxilla (F); h, posterior maxilla (F); i, maxilliped (F); j, first leg (F); k, second leg (E); l, third leg (E); m, fourth leg (E); n, fifth leg (F).

	coxopod	*basipod*	*endopod*	*exopod*
P_1	0-0	1-0	0-0; 1-3-1	0-0; 0-0; (2) -4
P_2	0-0	1-0	0-1; 1-2-3	0-0; 0-1; I-I-4
P_3	0-0	1-0	0-1; 1-I-3	0-1; 0-1; I-I-3
P_4	0-0	1-0	0-1; 1-I-3	0-1; 0-1; I-I-3

tuberance with 1 short lateral setule, and a slender distal segment, with 1 short terminal spine.

There is only one postgenital segment (fig. 3c), which is armed posteriorly, on the ventral surface, with a row of fine spinules. The caudal ramus is hardly longer than wide, armed with 1 lateral, 4 terminal, and 1 dorsal setae.

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