

FISHES

FROM DEPTHS EXCEEDING 6000 METERS

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During the *Galathea* Expedition fish were caught on two stations deeper than 6000 m: viz. in the Sunda Trench (St. No. 466, estimated depth 7160 m) and in the Kermadec Trench (St. No. 658, estimated fishing depths 6660-6770 m). A total of 6 specimens was taken, 5 of which belong to the liparid species, *Careproctus kermadecensis* n.sp. (all from the Kermadec Trench), and 1 specimen from the Sunda Trench, representing the brotulid species *Bassogigas profundissimus* (ROULE, 1913).

Prior to the *Galathea* Expedition the only known hadal fish was the holotype of *Bassogigas profundissimus* caught in 1901 (see Fig. 4) at a depth of 6035 m. (The hadal zone includes depths greater than 6000 m (BRUUN 1956)). At a later date, the *Vitjaz* Expeditions caught some additional hadal fishes, which all belong to the family Liparidae. In 1953, a new species, later described as *Careproctus amblystomopsis* Andriashev, 1955, was taken in the Kurile-Kamtschatka Trench at a depth of 7230 m. In 1957 five additional specimens of *C. amblystomopsis* were caught on two hadal stations in the Japan Trench, the deepest being caught at a depth of 7579 m (RASS 1958). At this deep station another *Careproctus* species was taken, but has not yet been identified.

Accordingly, all the hitherto known hadal species belong to the "Secondary deep-water species" (ANDRIASHEV 1935) or with another term to the "Littoral deep-sea species" (RASS 1954).

Survey of fishes caught at hadal depths

Brotulidae

- Bassogigas profundissimus* (Roule, 1913) – (see Fig. 4).
1 specimen from the Sunda Trench. 7160 m. *Galathea*. 1951.
1 specimen from the Moseley Trench. (Holotype). 6035 m. *Princesse-Alice*. 1901.
2 specimens from the Atlantic Ocean. 5600-5610 m

and 5850-5860 m. The Swedish Deep-Sea Expedition. 1948.

Liparidae

- Careproctus amblystomopsis* Andriashev, 1955
1 specimen from the Kurile-Kamtschatka Trench. (Holotype). 7230 m. *Vitjaz*. 1953.
5 specimens from the Japan Trench. 6156-7579 m. *Vitjaz*. 1957.
Careproctus sp.
1 specimen from the Japan Trench. 7579 m. *Vitjaz*. 1957.
Careproctus kermadecensis n.sp.
5 specimens from the Kermadec Trench. 6660-6770 m. *Galathea*. 1952.

WOLFF (1961) gave reasons to assume that a flatfish claimed to have been observed from the bathyscaphe *Trieste* at a depth of 10.912 m in the Mariana Trench and tentatively described as *Chascanopsetta lugubris* Alcock, 1894 was in reality probably not a fish.

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Bassogigas profundissimus (Roule, 1913)
(Figs. 1, 2, 3 and 4)

- Bassogigas* Goode and Bean, 1895.
Grimaldichthys profundissimus Roule, 1913.

Material:

- St. 466, Sunda Trench (10°21'S, 110°12'E), 7160 m, 6. September 1951. Bottom: bluish clay. Gear: Herring Otter Trawl. Temperature at bottom 1.5°. – 1 female.

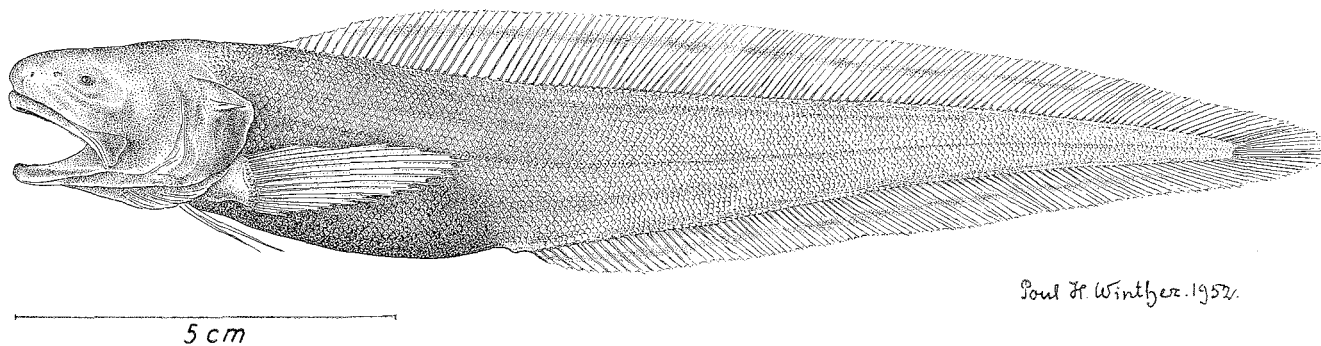


Fig. 1. *Bassogigas profundissimus* (Roule, 1913). *Galathea* St. 466.

As seen from the above data, the genus *Grimaldichthys* is considered synonymous to the genus *Bassogigas*. The reasons for this point of view are thoroughly discussed by NYBELIN (1957, pp. 295-298), who regards the number of the gill rakers and the dentition in the mouth cavity the most important characters. In Fig. 2 is shown the first branchial arch which differs from the holotype of *B. profundissimus* only by having 6 knots on the lower part instead of 8 knots (Table 1, columns 1 and 2). Fig. 3b shows the dentition on the praemaxillaries, vomer and palatines and Fig. 3a the dentition on dentale and the basibranchials. In order to avoid cutting up the mouth of the specimen the pattern of the dentigerous bones was transferred into plastilin, and from this the drawings were made. A comparison between Fig. 3 and the text figures 24-33 (NYBELIN 1957) shows that the present specimen is most closely related to *Bassogigas squamosus* (Roule, 1916), *B. pterotus* (Alcock, 1890) and *B. profundissimus*. Of these *B. squamosus* can at once be omitted, as i. a. the squamation is much heavier and the depth of body larger than found in the present specimen. *B. pterotus* differs less but is still different from the *Galathea* specimen. When ALCOCK (1890) described *B. pterotus* he based his description on one specimen only and, unfortunately, made no mention of the standard length. This means that a comparison of the morphometric characters with the present specimen is impossible. In Tables XV and XVI, NYBELIN (1957) gives the meristic and morphometric characters of what is called a paratype of

B. pterotus, a specimen borrowed from the Indian Museum, Calcutta. However, as the type material included one specimen only, the label "paratype" must be a mistake.

Table 1 shows the meristic and morphometric characters of the present specimen compared with the three other known specimens of *B. profundissimus*. Two of these were caught by the Swedish Deep-Sea Expedition and described by NYBELIN (1957); the characters of the holotype are mostly taken from ROULE (1913). However, some characters were not mentioned by ROULE; consequently these derive from NYBELIN (1957) who has examined the holotype. In these cases the characters are mentioned in the brackets (see Table 1, column 2); the same procedure has been adopted when NYBELIN's measurements of the holotype differ from those made by ROULE.

The number of rays in the vertical fins and the number of vertebrae were counted on an X-ray photograph, and thus give the most correct number possible. The only disagreement worth mentioning is that "Head in % of standard length" forms 21 in the present specimen, and 18 in the holotype. This discrepancy might be caused by different methods of measuring. (In the *Galathea* specimen the length of head was measured from tip of snout to the posterior edge of operculum membrane.) A swim-bladder 15 mm in length was found.

NYBELIN (1957, p. 302) mentions some characters which may be considered sexual differences: *a.* The distance between snout and anal fin is longer in the female, to allow more room for the ovaries. Consequently, the base of the anal fin is shorter in the female. *b.* The presence of a genital papilla in the male. *c.* The tip of the ventral fin-rays are flattened and have a longitudinal stripe of dark brown pigment at each border in the male, while in the female the tip is tapered. (The sex is indicated at the top of each column in Table 1). The sex of the holotype

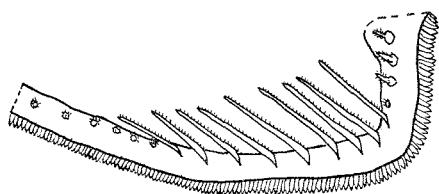
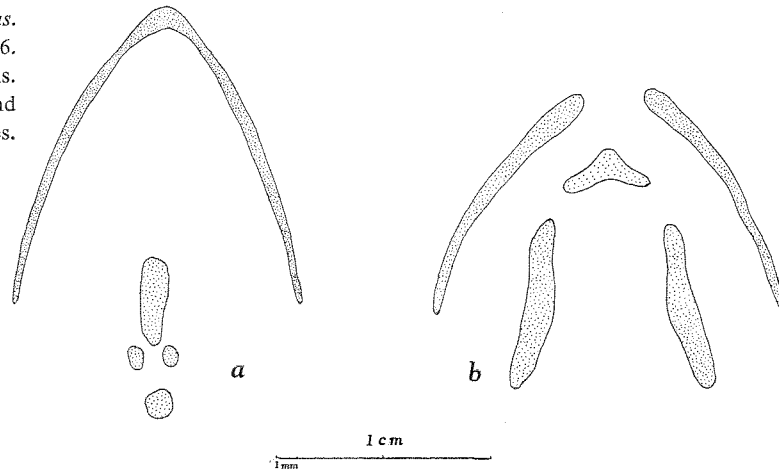


Fig. 2. First branchial arch of *B. profundissimus*. *Galathea* St. 466.

Fig. 3. Dentition of *B. profundissimus*.
Galathea St. 466.
a, Dentale and basibranchials.
b, Praemaxillaries, vomer and palatines.



was stated by NYBELIN. The sex of the present specimen, a female, was determined by cand. mag. O. MUNK, Institute for Comparative Anatomy and Zoological Technique, Copenhagen, by staining and cutting the gonad. The length of the ovaries was about 10 mm and they were placed caudodorsal to

the anus in the abdominal cavity. The ovaries were partly fused together. It should now be possible to ascertain, whether the above mentioned points (*a*, *b* and *c*) correspond to the present specimen. Naturally enough, material consisting of only 4 specimens cannot be used as a basis for any general considera-

Table 1.

	<i>Bassogigas profundissimus</i> (Roule, 1913)			
	<i>Galathea</i> specimen ♀	Holotype ♂	Swedish Deep-Sea Expedition	
			1 specimen ♂	1 specimen ♀
<i>Meristic characters</i>				
Standard length in mm	157	192	181	213
Rays in dorsal fin	118	ca. 120 (111)	107	110
Rays in caudal fin	8	8	8	8
Rays in anal fin	95	ca. 90	—	85
Rays in ventral fin	2	2	2	2
Rays in pectoral fin	16	15–16	—	—
Branchiostegal rays	8	8	—	—
Gill rakers on anterior arch	4 + 1 / 8 + 6	4 + 1 / 8 + 8	4 + 1 / 9 + 6	4 + 1 / 9 + 6
Vertebrae	71 (19 + 52)	—	—	—
Scales in lateral line	ca. 150	ca. 140	—	—
Scales in a transversal row	ca. 25	25–26	—	—
<i>Morphometric characters (all given in % of standard length)</i>				
Head	21	18 (19,53)	—	20,66
Depth at the anterior end of dorsal fin	15	16	14,92	15,49
Minimum depth	1,3	1,3	1,24	1,29
Snout	5,1	5,2	5,25	5,40
Upper jaw	11	11	11,05	10,80
Horizontal eyediameter	1,5	1,6	1,52	1,64
Interorbital	7,0	7,3 (7,92)	8,29	9,33
Snout – tip of opercular spine	20	— (18,93)	17,96	19,25
Snout – anus	41	41 (39,06)	40,88	44,13
Snout – anal fin	43	— (40,62)	42,54	45,54
Snout – dorsal fin	24	— (24,48)	23,76	23,94
Base of dorsal fin	78	79 (77,02)	76,80	76,53
Base of anal fin	59	60 (58,33)	59,12	54,46
Inner ventral ray	8,3	8,2 (7,29)	6,63	7,98
Outer ventral ray	11	11	8,84	10,33

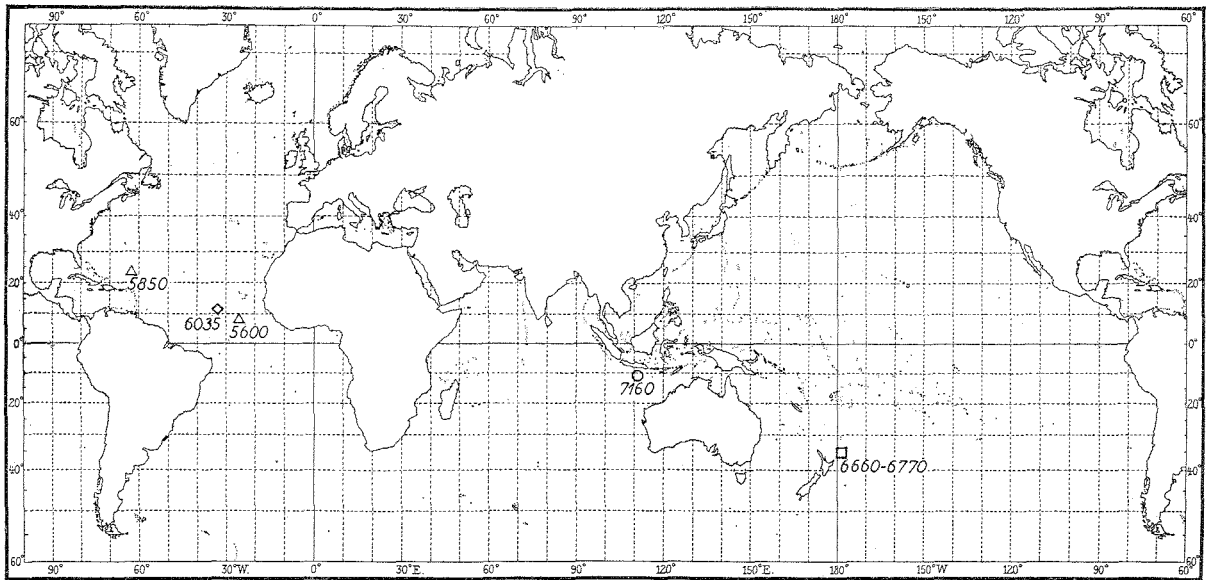


Fig. 4. Geographical and bathymetrical distribution of *Bassogigas profundissimus* (○, ◇, △) and *Careproctus kermadecensis* (□). ○ *Galathea* St. 466 (10°21'S, 110°12'E). ◇ *Princesse-Alice* St. 1173 (12°07'30"N, 33°32'45"W). △ Swedish Deep-Sea Expedition St. 329 and St. 371 (9°38'N, 26°20'W – 9°50'N, 26°30'W and 24°12'N, 63°23'W – 24°28'N, 63°18'W). □ *Galathea* St. 658 (35°51'S, 178°31'W).

tions, but it might give some clue as to the likelihood of the sexual differences, presumed by NYBELIN. Concerning point *a*, Table 1 shows that in the character "Snout – anal fin" the present specimen agrees slightly, while "Base of anal fin" is not substantiated by the *Galathea* specimen, as this character comprises 59% of the standard length, viz. the same as found in the two males. However, an agreement is found with both points *b* and *c*, as no genital papilla is present and the ventral rays are tapering. That the tips have not been broken, and in this way obscure the character, is rather evident from columns 1 and 2 where it can be seen that the rays form almost the same percentage of the standard length.

Stomach content:

The volume of the stomach content amounted to about 1 cm³ and consisted of 6 crustaceans and some indefinable material. The crustaceans included 1 amphipod (*Rhachotropis* sp., a demersal genus) and 5 isopods (length 4-6 mm) belonging to the genus *Eurycope*. According to Dr. T. WOLFF, who identified the isopods, almost all known species of *Eurycope* are benthic.

Bathymetrical distribution:

Fig. 4 shows the depths of the localities (varying from 5600 to 7160 m) on which the four known *B. profundissimus*-specimens were trawled. NYBELIN

(1951, p. 21) states that the present species has been caught in all three of the deepest North Atlantic hauls in which fish were captured at all, but only in those three. It can be added that the *Galathea* made no successful trawls in the North Atlantic at such great depths as those shown in Fig 4. This might indicate that *B. profundissimus* is restricted to the deep abyssal and hadal depths. If it does occur in shallower depths, it seems remarkable that no further specimens have been caught during the many trawls undertaken at abyssal depths in all oceans, especially during the last 15 years.

However, ANDRIASHEV (1955) makes the following comment to the *B. profundissimus*-specimen caught by the *Galathea* in the Sunda Trench: "Until supplementary information has been obtained it can not definitely be established that this fish was not caught during the inhaul of the trawl, i.e. on a lesser depth (than 7160 m), as has occurred with other representatives of this family." Naturally, it is impossible to prove that the present specimen was captured at the bottom, but some of the observations given below would indicate that this is feasible:

a. By the content of bottom material and some of the invertebrates in the trawl it has been ascertained that the gear actually did work at the bottom.

b. The presence of the isopod *Eurycope* sp. in the stomach content, a genus of which practically all species are benthic.

c. All the four known specimens derive from different localities, and it has been proved that in each case the trawl did reach the bottom. This means that the present species has never been captured in the numerous abysso- and hadopelagic hauls, i. a. in cases where the gear failed to reach the bottom.

Geographical distribution:

The holotype and the two Swedish specimens were all taken in the North Atlantic Ocean on both sides of the Transatlantic Ridge (Fig. 4). The catch of the present specimen in the Sunda Trench makes it reasonable to assume that *Bassogigas profundissimus* is distributed in all oceans.

Careproctus kermadecensis n. sp.
(Figs. 4, 5, 6, and 7)

Material:

St. 658, Kermadec Trench (35° 51'S, 178° 31'W), 6660-6770 m, 20. February 1952. Bottom: brown sand with clay and stones. Gear: sledge trawl, 6 m wide. - 5 specimens.

All the material is kept in the Zoological Museum, Copenhagen. The holotype (♀) has No. P 82217. The paratypes have Nos. P 82218-82221.

Condition of the material:

There is little doubt that all 5 specimens belong to the same species. However, it has only been possible to take measurements and make countings

on 2 of the 5 specimens as 2 individuals were preserved in bouin immediately after capture and as a result it is not now possible to state most of the meristic and morphometric characters, with any degree of certainty. The standard lengths of these specimens are approx. 19 cm (♂) and 5 cm. The third "useless" specimen is in a very bad condition. Apart from the fact that about half of the caudal is lost, the head is very damaged. The length of the remaining part of the fish is 42 mm. However, as in the case with the holotype (see below) this paratype (P 82219) was also drawn by P. H. WINTHER. By means of these drawings (Figs. 5c and 5d) one can obtain some impression of the original appearance of the specimen.

The only two employable specimens, standard length 255 mm and 258 mm, are also rather spoiled. Only very small portions of the skin are left and the abdominal organs are quite exposed. This means that distances involving the anus and the ventral disc can only be measured with great inaccuracy. Furthermore, the very soft snout has evidently been flattened as a result of the position of the fish while in the jar. Consequently, all measurements from the tip of snout to other parts of the fish are undoubtedly decreased by a few millimeters.

However, just after the completion of the *Galathea* Expedition drawings were made of some of the more remarkable animals, and fortunately two specimens of the present species were among these. The drawings (see Fig. 5), of which Figs. 5a and 5b were published by BRUUN (1955), were made in 1952 by the well-known artist Mr. P. H. WINTHER,

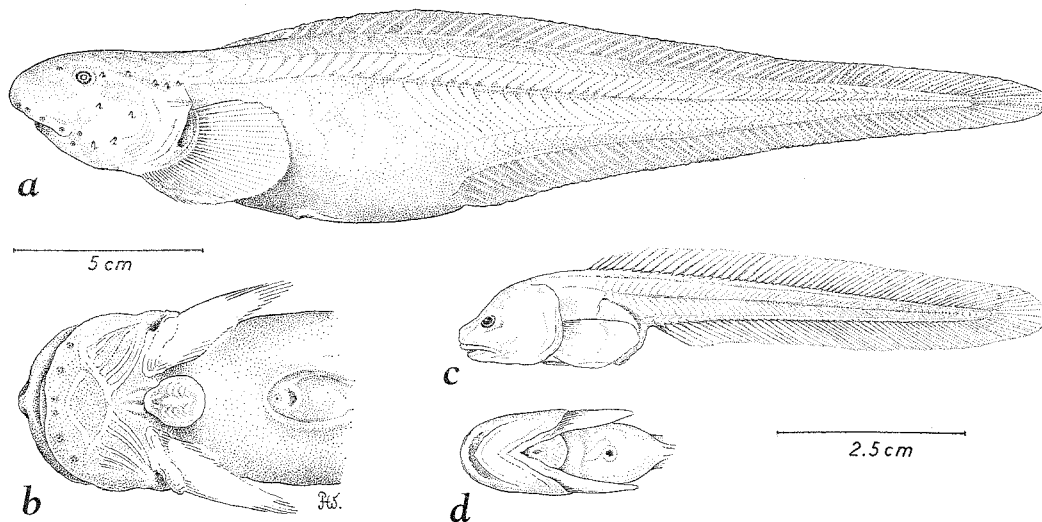


Fig. 5. *Careproctus kermadecensis* n. sp. *Galathea* St. 658. a, Lateral view of holotype. b, Ventral view of anterior part of holotype. c, Lateral view of paratype P 82219. d, Ventral view of anterior part of paratype P 82219.

Table 2.

	<i>Careproctus kermadecensis</i>				<i>Careproctus amblystomopsis</i> Andriashev, 1955
	Holotype P 82217		Paratypes		
	From the specimen	From Figs. 5 a and 5 b	P 82218	P 82219*	
<i>Meristic characters</i>					
Total length	—	275	—	78	238
Standard length	252	255	258	70	216
Dorsal fin	57	—	57	53	49
Caudal fin	14	—	14	—	11
Anal fin	53	—	53	53	43
Pectoral fin	32	—	33	—	30
Vertebrae	13+52	—	13+52	13+—	11+44
Branchiostegal rays	6	—	6	—	—
Gill rakers on lower arch	11	—	11	—	—
Pyloric coecae	7	—	7	7	7
Sex	♀	—	♀	♀	—
Suprabranchial pores (see text)	3	3	3	—	1
Maxillary pores	7	7	—	—	7
Mandibular pores	8	8	8	—	6
<i>Morphometric characters (all given in % of standard length)</i>					
Length of head	20	19	19	21	21,3
Breadth of head	18	19	19	—	19,9
Height of head	14	—	15	16	16,7
Diameter of eyeball	1,6	1,6	1,7	—	1,85
Snout	7,7	—	—	—	7,9
Interorbital	7,1	—	8,1	—	9,3
Gill slit	7,7	6,1	6,6	—	6,25
Longitudinal diameter of disc	6,0	6,5	5,4	7,1	7,4
From tip of lower jaw to anterior part of disc	16	—	17	—	17,6
From posterior part of disc to anus ..	—	7,6	7,8	7,1	5,8
Anus - anal fin	17	16	16	10	14,4
Predorsal length	21	22	21	29	24,1
Preanal length	45	48	45	37	38,4
Greatest height of body	—	20	19	—	20,4

* Most characters are taken from the drawings Figs. 5 c and 5 d. (Further explanation on p. 120).

whose work is known for its accuracy. Accordingly, several of the morphometric characters have been taken both from the holotype and from the drawings (see Table 2) in the belief that the drawings give a correct impression of the original appearance of the fish in contrast to the specimens in their present state.

Diagnosis:

This new species agrees in almost all respects with the description of the genus *Careproctus* Krøyer, 1862, and with the modified description given by BURKE (1930). *Careproctus* is i.a. characterized by having 1-2 suprabranchial pores, but this character is difficult to state in *C. kermadecensis*. Evidently,

5 pores are found between the gill slit and the eye (Fig. 5). The most anterior of these is, according to BURKE's terminology (1930, pp. 9-10), considered a maxillary pore, while it is not quite clear how many of the remaining 4 pores ought to be called suprabranchial.

Compared to the subgenus *Pseudoliparis* Andriashev, 1955, this new species only shows disagreement in one character, viz. in the number of suprabranchial pores; *Pseudoliparis* has only one of these pores.

Up to the present a total number of 47 species of *Careproctus* has been described. BURKE (1930, p. 98) writes in his description of the genus *Careproctus* that as it is rather difficult to obtain an

exact statement of the number of finrays he will not depend too much on these characters when separating the species. However, the condition of the two specimens of *C. kermadecensis* are, as mentioned above, such that only the meristic characters can be used with any degree of success. (By means of X-ray photographs it is easy to obtain accurate information on the number of finrays and vertebrae). By using BURKE's key to the genus *Careproctus*, which includes 38 species, the result is *C. ovigerum* (Gilbert, 1896). However, the fact that the present species and *C. ovigerum* are not identical is easily demonstrated by comparing some meristic characters of the latter, mentioned in brackets, (dorsal 43, anal 34, and pyloric coecae 19) and those of *C. kermadecensis*, from Table 2, column 1. Since BURKE's "Revision of the Liparidae" (1930) 9 more *Careproctus*-species are described. The characters of the most closely related of these species, *C. amblystomopsis*, are shown in Table 2, column 5. However, the differences in the meristic characters are significant enough to describe the *Galathea* material as a new species. The number of vertebrae in particular, shows a marked disagreement (65 ↔ 55).

Description:

Holotype. Most of the meristic and morphometric characters are shown in Table 2, columns 1 and 2.

The body is compressed and rather elongate. The skin is very loose and prickles are apparently not present. The dorsal fin starts over the median part of the pectorals. The anterior 5-6 rays are very short, being only $\frac{1}{4}$ - $\frac{1}{2}$ the length of the remaining dorsal rays. They are, furthermore, hidden in the loose skin and the spaces between the rays are longer than those found in the rest of the fin. Both the dorsal and anal fins are united with the caudal fin. In the present state of the specimen the shape of the pectorals is quite unrecognizable. The ventral disc is placed with its posterior edge vertically under the upper part of the pectoral base.

The head is, as in *Careproctus amblystomopsis*, wider than high; an unusual feature among *Careproctus* species. The skin on the head is so well preserved that the pores are quite distinctive. As indicated on Fig. 5 two types of pores exist: one ending in a tube and another in a slit. On page 118 the difficulty of stating the number of supra-branchial pores is mentioned. However, judging from Fig. 5 it seems reasonable to designate the 3 posterior of the 5 pores between the eye and the gill slit as supra-branchial pores. According to BURKE,

the pore just behind the eye belongs to the maxillary pores; 7 of these pores are found in the present specimen. The second pore posterior to the eye is here referred to the mandibular pore-row, which includes 8 pores. The pores on top of the head are less distinct, but apparently there is one pair of snout pores, one single pore between the nostrils and one pair between the eyes. One pair of nostrils.

Teeth are present on praemaxillare and dentale, none on maxillare, vomer and palatinum. Situated anteriorly in the jaws there are about 6 teeth-rows. This number diminish so that only 2-3 rows are found on the posterior part of dentale and praemaxillare. The pointed and slightly recurved teeth are simple; a character typical of the deep-occurring species of Liparidae (BURKE 1930, p. 11). When the mouth is closed the dentale-teeth-row is placed behind that of praemaxillare. Furthermore, two pairs of teeth-bearing plates are located posteriorly in the gill chamber. One oval plate (10 mm × 3 mm) on the last gill arch works upwards and presses against a circular one (diameter approx. 5 mm) in the roof of the branchial cavity. The strong, pointed, recurved teeth are especially developed on the dorsal plates.

In BURKE (1930) the length of the gill slit is considered an important character. This length can be measured only with great inaccuracy in the present specimen as the slits have been badly damaged. On Fig. 5 the slit ends opposite the 11th pectoral ray (beginning dorsally). Four gill arches; no hole behind the last arch. Gill rakers present as small blunt knots; 11 on the lower part of the anterior arch. No pseudobranchiae.

The intestine is rather short. 7 pyloric appendages; 3 on the left and 4 on the right side with lengths ranging from 10 mm to 30 mm. The ovaries with eggs of different sizes. (See p. 120 and Figs. 6 and 7).

After 10 years of preservation the colour of the skin is red brown, but is still so transparent that the myomeres are easily visible.

Variation:

The condition of the paratype, P 82218 (♀), mentioned in Table 2, column 3, is the same as the holotype, which means that the morphometric characters are very dubious. The meristic characters, however, vary only slightly from the holotype. The only disagreement is in the arrangement and in the number of some of the pores on top of the head. The nostril-pore is placed more posteriorly than in the holotype and 3 pores are found between the eyes. Two of these are situated to the left of the

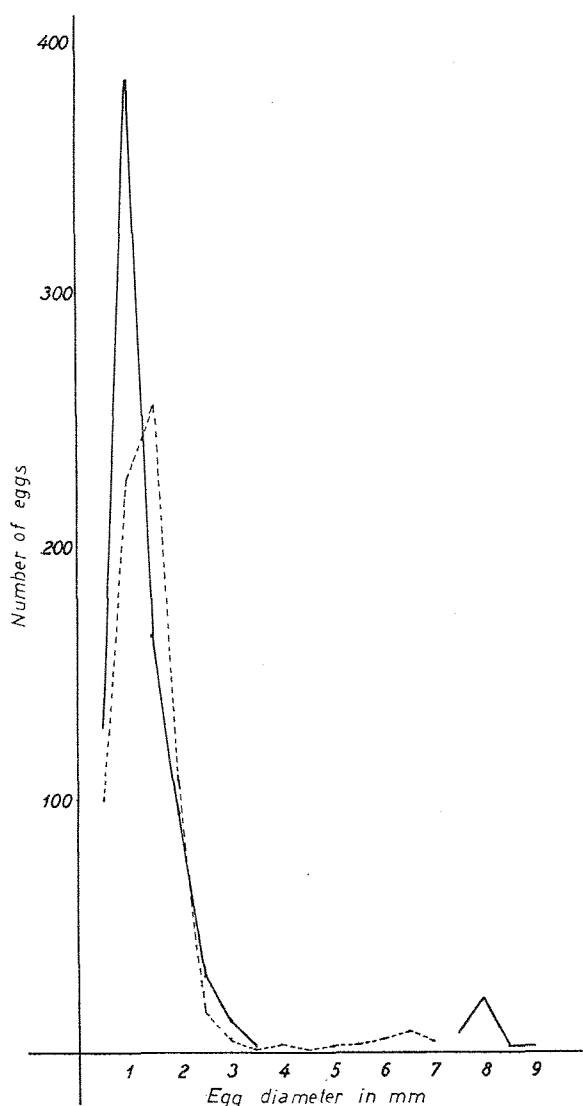


Fig. 6. Number and diameter of eggs from holotype (—) and paratype P 82218 (----) of *C. kermadecensis* n. sp.

median line (a fact indicating that there may, primarily, also have been two pores to the right; presuming that pores are either situated in the median line or as pairs symmetrical to this line).

The other paratype, P 82219 (♀), mentioned in Table 2, column 4 and shown in Figs. 5c and 5d is, with regard to the morphometric characters, rather different from the other two specimens described in columns 1-3. (As mentioned above the specimen is now in a very bad condition). Only three of the characters from column 4 derive from the specimen itself, viz. the number of abdominal vertebrae, the number of pyloric coecae and the sexual character. Information appertaining to the remaining characters originates from countings and measurements made on Figs. 5c and 5d. The most evident differ-

ences between Fig. 5a (the holotype, std. 1. 255 mm) and fig. 5c (a paratype no. 82219, std. 1. 70 mm) are as follows: the profile of the head is very different in the two specimens and also the form of the body (which in the paratype is constricted behind the anus). Furthermore, the pectoral fins end halfway between the anus and the anal fin in the paratype, while in the holotype they end very close to the anus.

It is obvious that the disagreements between P 82219 and P 82217-218 are caused by the differences in the standard lengths. Thus, the characters typical for the smaller paratype (P 82219) could possibly be regarded as juvenile features.

Remarks:

The two larger specimens of *C. kermadecensis* are females with ovaries filled with eggs, the diameter of the latter varying rather greatly. From both individuals the eggs were taken out and measured. Fig. 6 shows that the eggs from the holotype (with a total number of 849) separate into two well distinguished groups, one with a diameter of about 1 mm and the second group about 8 mm. The eggs from the paratype (with a total number of 737) are different, having a peak on the curve at 1.5 mm and another, slightly indicated, at 6.5 mm; furthermore, the curve is continuous. All the smaller eggs from both specimens are spherical with a smooth surface. Those with a diameter of 0.5-1.0 mm are almost all of a whitish colour, while most eggs measuring 1.5-4.0 mm are of a yellow brown colour. The larger eggs have a brown colour that becomes darker with increasing diameter. Furthermore, the larger eggs have a somewhat uneven surface which becomes more pronounced with the size of the egg. The last mentioned fact is probably caused by preservation.

Very little is written about the size of the eggs of the Liparidae. JORDAN and EVERMAN (1898, p. 2135) mention, in connection with *Careproctus gelatinosus* (Pallas, 1769), that the ovaries contained eggs the size of a pea. From the description of *Bathyphasma ovigerum* Gilbert, 1896 (later referred to the genus *Careproctus*) the following lines are cited: "The type (caught at a depth of 2900 m) is a male with well-developed testes, and contained in its mouth when captured a spherical mass of eggs evidently belonging to this species. The eggs measure $4\frac{1}{2}$ mm in diameter, and are well along in their development, the embryos distinctly visible through the very tough egg-membranes. The general form of head and body can be made out, and the long, continuous dorsal

and anal fins running backwards into the tail. It is probable that the male fish protects the eggs in this manner until after hatching". – BURKE (1930) gives the sex of the holotype for many species, but makes no comment on the condition of the ovary or the egg-size. The only other known hadal liparid, *C. amblystomopsis*, had according to the description, "the sexual organs but very slightly developed" and nothing else was mentioned. However, Dr. ANDRIASHEV informed me (*in litt.*) that from the additional *C. amblystomopsis* specimens caught in the Japan Trench Dr. TH. S. RASS had dissected a female (total length 203 mm). An examination of the left ovary showed that it was half-empty and contained only a few scattered eggs of two different sizes: 1.3-1.4 mm and 3.2-3.3 mm. A female of *C. reinhardtii* (Krøyer, 1862), caught off Greenland at a depth of 250 m, was examined by the present author. The ovaries proved to contain eggs of almost equal size (0.5-1.0 mm), a feature normally found among fish from shallow water.

This lack of homogeneity in the size of the eggs (see Figs. 6 and 7) is rather extraordinary. If all the eggs belong to the same clutch the smaller ones can be considered residual-eggs, and development continues only for the few larger ones. Presuming that the observation on the other deep-occurring liparid, *C. ovigerum* (see above) is correctly interpreted as a case of mouthbreeding, the same phenomenon could possibly take place in *C. kermadecensis*. In this way there is a reasonable explanation why this species develop so few eggs, as there is room for only a rather limited number in the mouth of the fish. Even if mouthbreeding does not take place there are still other reasons why not all the eggs in the ovary develop to full size; i.a. it would simply be impossible for the fish to hold about 800 eggs with a diameter of 8 mm. Furthermore, it would demand very large quantities of food to develop these enormous eggs.

There probably does not exist any seasonally conditioned breeding period at these depths, as temperature, oxygen-content and other physical factors are practically constant all year round.

MOSELEY (1880) writes that there might be environmental changes in the deep sea caused by the downfall of food from the upper layers, and this heavier rain of food should take place during a certain period of the year depending on the fluctuations of the plankton production in the upper zones. However, as MOSELEY indicates himself, this is merely an assumption. According to VINOGRADOV

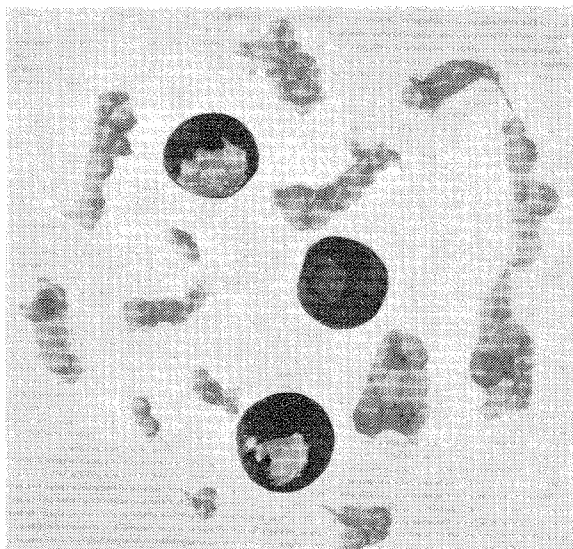


Fig. 7. Eggs of different sizes from the holotype of *C. kermadecensis* n.sp. (H. V. CHRISTENSEN fot.).

(1959) a typical season in the plankton production in the epipelagic zone in tropical and subtropical areas will show only slightly at hadal depths. The reason is, that deep-going currents transport plankton from higher latitudes and in this way blur the variation. However, even if a variation at greater depths is not induced directly by the plankton, an increase in the number of sinking, dead animals that feed on the plankton might take place during the plankton high season.

A figure from VINOGRADOV (1959) shows the amount of plankton biomass in i.a. the Kermadec Trench. At the surface 70 mg pr. m³ was found while 0.1 mg pr. m³ was found at the bottom. When considering the very scanty amount of food at the bottom it is surprising that 5 liparids were caught in a single haul. (The trawl, with an opening of 6 m, was towed for 2 hours with a speed of 1½ knots). However, as shown by the stomach content (p. 122) this species does not solely depend on plankton, as fish scales were found in all three specimens examined. However, it is most likely that these scales derive from dead fish eaten by the liparids. The form and position of the mouth (Fig. 5), in addition to the supposed bottom dwelling and slow swimming habit, makes it rather improbable that this species captures living fish. Furthermore, the size of some of the scales (12 mm in diameter) indicates that they derive from specimens quite impossible for the present liparids to capture. The scales might originate from dead fish that have sunk from upper layers.

By assuming the none existence of seasons at hadal depths the difference in the size of the eggs could be explained by considering that the eggs which form the two peaks on the curves in Fig. 6 belong to two clutches, and that most of the eggs from the eldest clutch have been resorbed. (Species with a yearly breeding period, have, generally, ovaries containing eggs of the same size). The fact that the eggs from the two females are not quite in the same stage of development (Fig. 6) also supports the "Two-clutch" point of view.

One of the reasons why most other fishes have a fixed breeding season is, that the larvae have to hatch in a period when there is a maximum of suitable food available. For instance, the breeding season for the bathypelagically-occurring Ceratioidea depends upon the amount of food in the upper layers, as their larvae live in the epipelagic zone (BERTELSEN 1951). Judging from the size of the eggs, the young of the present species apparently remain in hadal depths, and are thus independent of plankton in upper layers.

It is likely that no internal fertilization takes place, as these large eggs are apparently unfertilized, (at least no cleavage can be seen). In the chapter dealing with sexual dimorphism (BURKE 1930) no mention is made as to the presence of a genital papilla in any liparid species. However, in specimens of *Care-*

proctus reinhardti (Krøyer, 1862) from the collections in the Zoological Museum, Copenhagen, a genital papilla was found, both in males and females. It has been established that *C. kermadecensis* is not hermaphroditic. Cand. mag. O. MUNK (see p. 115) has examined the larger of the bouin-fixed specimens and found it to be a male, whereas with regard to the holo- and paratype (Table 2) he could not find any sperm-producing tissue.

It seems certain that the eggs are of the demersal type, as i. a. is indicated by their large size, but it is impossible to tell if they are adhesive or not. However, several of the dredge hauls made by the *Galathea* in the Kermadec Trench contained rather large pieces of pumice, to which eggs could have been fastened (Fig. 8). BURKE (1930, p. 21) writes that "the eggs of the deep-sea species must be endemic, as the larvae are unknown from the plankton".

Evidently, the eggs of the present species are larger than those of the few other liparids whose egg-size has been mentioned. The eggs from *Careproctus ovigerum* (p. 121) had a diameter of 4.5 mm. Among others, MARSHALL (1953, p. 329-330) gives information on some egg-sizes of arctic and antarctic Liparidae. In many respects species from these areas are reminiscent of deeply-occurring species in that they produce few and large, yolky eggs. The largest egg-size stated by MARSHALL was 4.6 mm.



Fig. 8. Pumice of different sizes trawled by *Galathea* in the Kermadec Trench. (M. HØYER fot).

Under hadal conditions it must certainly be an advantage for the newly hatched larva to be as well developed as possible. Among other authors MARSHALL (1953) mentions that the larger the larva the less the relative food requirement; a large larva is able to swim faster, which means that it can search a bigger area for food. Furthermore, larger larvae have fewer enemies than smaller ones. According to SUWOROW (1959, p. 446) larger eggs give relatively larger larvae, at least among trouts.

Stomach content:

Holotype: About 10 fish scales probably from more than one species. All are of the cycloid type, the largest with a diameter of 12 mm. – One specimen of an unidentifiable polychaet. – About 10 amphipods, including 5 *Hirondellea* sp. and 2 *Alicella* sp.; both genera belong to the preferably abysso-pelagic family Lysianassidae. In addition, several unidentifiable fragments. – A fragment of a large copepod. – About 2 cm³ undeterminable material.

Paratype: A 75 mm long and about 1 mm thick

section of the vertebral-column of a fish. – Two identical cycloid fish scales (7 mm). – Sixteen amphipods ranging from 4-10 mm in length: 8 *Hirondellea* sp., 6 *Alicella* sp., 1 *Orchomene* and a fragment of probably another species of Lysianassidae. – Fragments of legs of unknown crustaceans. – 1 cm³ undeterminable material.

The only recognizable stomach content of the larger of the bouin-fixed specimens were a few cycloid fish scales. Dr. J. L. BARNARD (California) examined the amphipods.

Bathymetrical distribution:

There seems no reason to doubt that this species is bentonic, judging from the ventral position of the mouth and the relatively well developed sucking disc. (The same arguments were used when ANDRIASHEV stated *C. amblystomopsis* to be bentonic). The recorded depth was 6660-6770 m.

Geographical distribution:

The species is known only from the type locality, the Kermadec Trench north of New Zealand (Fig. 4).

SUMMARY

The *Galathea* Expedition of 1950-52, caught 6 specimens of fishes from depths greater than 6000 m: viz. 1 *Bassogigas profundissimus* (Roule, 1913) (fam. Brotulidae) in the Sunda Trench, depth 7210 m, and 5 *Careproctus kermadecensis* n. sp. (fam. Liparidae) in the Kermadec Trench, depth 6660-6770 m.

A survey is given of the fishes hitherto caught at depths greater than 6000 m (hadal depths).

Only 3 specimens were previously known of *B. profundissimus*, all caught in the Atlantic Ocean. Proof is given that the *Galathea* specimen most likely was caught at the bottom.

C. kermadecensis is compared to *C. amblystomopsis* Andriashev, 1955, the only other known hadal liparid. The most remarkable feature is that the holotype and paratype no. P 82218 both have ovaries filled with eggs of very different sizes. The holotype contained about 850 eggs, of which 4% have a diameter varying from 7.5-9 mm (average 8 mm), while the rest of the eggs vary from 0.5-3.5 mm (average 1.0-1.5 mm). The eggs from the paratype show a somewhat similar dispersal, with a general variation from 0.5-7 mm in diameter.

An attempt has been made to explain this peculiar variation in the egg size. If all the eggs belong

to the same clutch the smaller ones might be considered residual-eggs. It seems reasonable enough that only a small number of eggs develop, since food is scarce at hadal depths. It is possible that these fish are mouth-breeders, and as there is room for only a few eggs in the mouth of the fish, this would give another explanation why so few eggs develop.

As it is most likely that there are no environmental changes at hadal depths, this fish probably does not have a seasonally conditioned breeding period. This is furthermore supported by the fact, that the eggs from the holotype and the paratype are not quite in the same stage of development.

The gonads of 4 specimens were examined and none were found to be hermaphroditic (3 ♀♀ and 1 ♂). Apparently no internal fertilization has taken place, since these large eggs are unfertilized (at least no cleavage can be seen). By producing few, and large, yolky eggs *C. kermadecensis* is reminiscent of many arctic and antarctic fishes. Because of the scarcity of food it must certainly be an advantage for the newly hatched larva to be as far developed as possible. The larger the larva the less the relative food requirement, and as a large larva is able to swim faster, it has a much larger area to search for food.

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