

# THE DEEPEST LIVING FISH *ABYSSOBROTULA GALATHEAE*

A NEW GENUS AND SPECIES OF OVIPAROUS OPHIDIIDS  
(PISCES, BROTLIDAE)

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## ABSTRACT

*Abyssobrotula galathea* n. gen., n. sp., belonging to the oviparous ophidioids, is described based on 11 specimens caught at nine localities from all oceans. It is characterized by a low pectoral fin-ray count (10-11), elongate pectoral fins, a weak opercular spine, and two median and a pair of basibranchial tooth patches. *Abyssobrotula* seems related to other small-eyed, elongate genera such as *Bassogigas* and *Holcomycteronus*. It is the deepest living species of fish known and at the bottom it is restricted to abyssal and hadal depths (c. 3100-8370 m).

## INTRODUCTION

For some years a number of ophidioid fishes caught in deep water, often in very poor condition, have been accumulating in my collection of unidentified specimens. However, within the last 1-2 years Daniel M. Cohen and I have intensified our work on a revision of the ophidioid genera so that now a set of relevant, generic diagnostic characters is available for the majority of the genera. Consequently, the present material, which consists of 11 specimens from six different deep sea cruises covering all world oceans, is herein described and related to other genera.

**Acknowledgments.** The following persons most kindly provided material or data: R. L. Haedrich, Woods Hole, J.-C. Hureau, Paris, T. S. Rass, Moscow, B. H. Robison, Santa Barbara, and J. C. Staiger, Miami. Special thanks are given to Daniel

M. Cohen, Washington, D. C., for fruitful discussions and suggestions on the manuscript. My colleagues, J. B. Kirkegaard and T. Wolff, most kindly identified the intestinal contents.

**Abbreviations.** CAS (California Academy of Sciences), MNHN (Museum National d'Histoire Naturelle, Paris), UMML (University of Miami, School of Marine and Atmospheric Sciences), ZIL (Zoological Institute, Leningrad), ZMUC (Zoological Museum, University of Copenhagen).

## *Abyssobrotula* n. gen.

Type species: *Abyssobrotula galathea* n. sp.

**Diagnosis:** An oviparous, ophidioid fish with a short head, a slightly inferior mouth, and a swollen snout. The scale pockets indicate a coarse squamation on the abdomen. Small eyes, a poorly developed opercular spine, 8-11 long rakers on the anterior gill arch, two median and one pair of basibranchial tooth patches, 7-8 branchiostegal rays, and a ^ - formed vomer. Pectoral fin elongated with 10-11 rays, two ventral fin-rays in each fin, eight caudal fin-rays, 97-116 dorsal and 76-96 anal fin-rays.

**Relationships:** In Table 1 some of the diagnostic characters of *Abyssobrotula* are compared to those from a number of other elongate, small-eyed, oviparous ophidioids. It differs from all the tabulated genera in the elongate pectoral fin, the few pectoral fin-rays, and the poorly developed opercular spine. If

Table 1. Comparison between *Abyssobrotula* and related genera

	<i>Abyssobrotula</i> n. gen.	1)	1)	<i>Barathrites</i> Zugmayer, 1911	<i>Barathrodemus</i> Goode & Bean, 1883	<i>Parabassogigas</i> Nybelin, 1957
		<i>Bassogigas</i> Goode & Bean, 1896	<i>Holcomycteronus</i> Garman, 1899			
Mouth	inferior	terminal	terminal	inferior	inferior	inferior
Opercular spine	weak	strong	strong	strong	strong	strong
Pectoral fin	elongate	short	long; lower rays free	short	short	short
Pectoral fin-rays	10-11	27-31	15-21	22	20-25	21-27
Long gill rakers	8-11	7- 9	7-10	5- 7	12-15	7- 8
Branchiostegal rays	7- 8	8	8	7	8	8
Median basibranchial tooth patches	2	2	2	1	2	2
Paired basibranchial tooth patches	1	± 1	1	0	1	0
Form of dentigerous vomer	^	^	^	◇	△	◇

1) *Bassogigas* includes *gillii* Goode & Bean, 1896 only. The remaining *Bassogigas* spp. are all referred to *Holcomycteronus* Garman, 1899 (Nielsen MS).

most attention is paid to the form of the vomer combined with the pattern of the basibranchial tooth patches the closest relatives are *Bassogigas* and *Holcomycteronus*, while the inferior mouth relates it to *Barathrites*, *Barathrodemus*, and partly to *Parabassogigas*.

Name: *Abyssobrotula* is chosen for this genus, as it contains the hitherto deepest recorded ophidioid species.

*Abyssobrotula galathea* n. sp.

*Bassogigas profundissimus*, Staiger 1972: 26; not of Roule 1913.

The deepest living fish ever caught was identified by Staiger as *Bassogigas profundissimus* (Roule, 1913)

and his publication has often been cited in deep-sea literature. I have reexamined Staiger's specimen and find that it is not *B. profundissimus* but instead should be referred to *A. galathea*, which is therefore the deepest living fish species.

Diagnosis: See the generic diagnosis.

Name: Named for the R/V "Galathea" which caught the first specimens of this species.

Material examined (11 specimens):

*Holotype*: "Galathea" St. 661, Kermadec Trench (36°07'S, 178°32'W), 5230-5340 m, bottom temp. 1.1°C., sledge trawl (6 m wide), 23 Feb. 1952. ZMUC P77599. (SL 130, ♀).

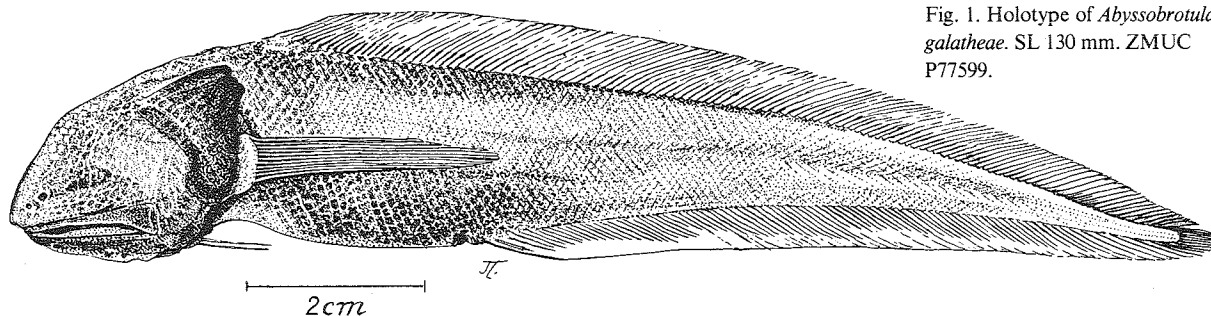


Fig. 1. Holotype of *Abyssobrotula galathea*. SL 130 mm. ZMUC P77599.

*Paratypes*: "Galathea" St. 654 (32°10'S, 175°54'W), 5850-5900 m, 1.2°C., herring otter trawl, 18 Feb. 1952. ZMUC P77600. (SL 123, ♀). - "Galathea" St. 664 (36°34'S, 178°57'W), 4540 m, 1.1°C., herring otter trawl, 24 Feb. 1952. ZMUC P77601. Alizarin-stained. (SL 110, ♀). - Same data. ZMUC P77602. Bouin-fixed. (SL c. 100, ♀).

*Additional material*: "Vitiaz" Cr. 31 St. 4555, E. Indian Ocean (15°41'S, 104°57'E), 5750-5940 m, sledge trawl, 26 Nov. 1959. ZIL 43250. (SL 125). - "Te Vega" St. XXD-56, E. Pacific (1°19'N - 1°12'N, 84°07'W-83°56'W), fishing depth 0-2500 m, sounding 2926-3292 m, 6' Tucker midwater trawl, 6 Oct. 1968. CAS 36574. (SL 133, ♀). - "Pillsbury" St. P-1168, Puerto Rico Trench (19°43'N, 67°05'W), 8370 m, 41' otter trawl, 21 Jan. 1970. UMML 29070. (SL 140, ♀). - "Jean Charcot" Campagne Walda St. 1, E. Atlantic (0°23.2'N, 3°42.4'W), 4975 m, beam trawl, 28 May 1971. MNHN 1976-45. (SL 156, ♀). - "Jean Charcot" Campagne Walda St. 3, SE. Atlantic (18°52.1'S, 7°23.1'E), 5048 m, beam trawl, 6 June 1971. MNHN 1976-43, 1976-44. (2 specimens, SL 67-132, juv. and ♀). - "Chain" 124 St. 523, NW. Atlantic (38°39.5'N, 69°58.1'W to 38°37.8'N, 70°01'W), 3111-3115 m, 41' shrimp trawl, 11 July 1975. ZMUC P77676. (SL 75, juv.).

#### Description:

As *A. galathea* is variable in certain characters and is found in all oceans, subsequent studies may indicate the existence of more than one species.

**Holotype**: The meristic and morphometric characters are shown in Table 2. The body is rather soft with a tapering tail and a ventrally flexed head. The caudal part of the body comprises about 60 % of the SL. The loose, transparent skin was covered with scales both on body and head. The head pores are mentioned below. The scales continued out on the proximal part of the dorsal and anal fin-rays. No scales remain, but the empty scale pockets are distinct, especially on the abdomen. The lateral line is visible only on the anteriormost part of the body and no pores are developed. The vertical fins are confluent. The dorsal fin originates above vertebra No. 7 and above the base of the pectoral fin. The anal fin originates below vertebra No. 23 and dorsal fin-ray No. 30. The elongate pectoral fin equals 23 % of the SL, but the tips of the fin-rays clearly show that they have been broken. The ventral fins insert rather far for-

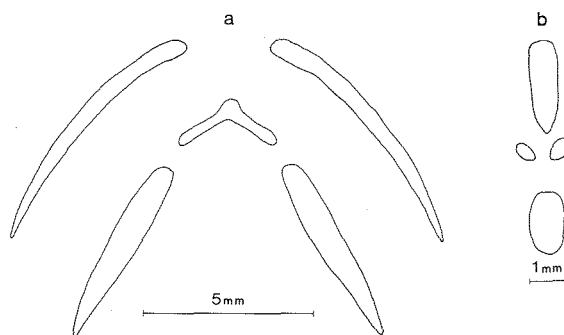


Fig. 2. Holotype of *A. galathea*; a, dentigerous part of premaxillaries, vomer and palatines; b, basibranchial tooth patches.

ward slightly posterior to the angle of the gape. The outer ray is longer than the inner, but here also the tips of the rays seem to be missing. The snout and dorsal part of the head are swollen; the position of the mouth is inferior. The eyes are minute, less than 1 % of the SL, deep-set, and difficult to locate. The anterior nostril is closer to the posterior nostril than to the edge of the upper lip. The maxillary is expanded posteriorly ending well behind the eye. The opercular spine is flat and poorly developed. The colour of the body is yellowish as the muscles can be seen through the transparent skin. The branchial cavity is black and the peritoneum darkbrown.

**Dentition**. The small, pointed teeth are arranged in irregular rows. The dentigerous parts of the premaxillaries and dentaries are rather narrow (Fig. 2a) and the teeth are small. The palatine tooth patch is broad and consists of larger teeth. The vomerine teeth are of the same size as those on the palatines. The upper jaw symphysis is edentate; the dentigerous parts of the dentaries meet in the lower jaw symphysis. The basibranchial tooth patches (Fig. 2b) have teeth of the same size as the vomerine teeth. The anterior median patch is narrow, rounded anteriorly and pointed posteriorly. The posterior median patch is shorter, broader, and rounded at both ends. The paired patches are oval and arranged with the longer axis at a 45° angle to the median patches. There are wide interspaces between the four patches.

**Gill cavity**. The upper branch of the anterior gill arch has 3 short rakers, there is 1 long raker in the angle between the branches, and the lower branch has 9-10 long and 6 short rakers. The second arch has 4+12, the third 1+10-11, the fourth 8, and the fifth 5 small rakers. The length of the gill filaments on the anterior arch is only half the length of the filaments

Table 2. Meristic and morphometric characters of *A. galathea*.

	Holotype	Paratypes			Additional material							
	ZMUC P77599	ZMUC P77600	ZMUC P77601	ZMUC P77602	ZIL 43250	CAS 36574	UMML 29070	MNHN 1976-45	MNHN 1976-44	MNHN 1976-43	ZMUC P77676	ZMUC P77685-687
Standard length in mm	130	123	110	c.100	125	133	140	156	132	67	75	142-157
<i>Meristic characters</i>												
Dorsal fin-rays	113	109	97	.	116	99	104	108	103	100	109	101-108
Caudal fin-rays	8	8	8	8	8	8	8	8	8	8	8	8
Anal fin-rays	84	83	76	.	96	79	81	83	83	83	85	78-86
Ventral fin-rays	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2
Pectoral fin-rays	11-11	10-10	11-11	10-10	10-10	10-10	10-10	10-10	10-10	10-10	10-10	10-10
Gill rakers on anterior arch	3+10-11+6	4+9+5-6	3-4+9-10+7	3+9+3	4+9-10+7-8	4+8-9+6	5+9+7	3+9-10+4-5	3-4+8+5	3+9+5	4+10+5	3-5+8-10+5-7
Branchiostegal rays	8-8	8-8	8-	.	8-	7-7	8-8	8-8	-8	.	.	7-8
Vertebra (incl. ural centra)	19+53	18+50	19+52	.	19+56	18+53	17+50	18+51	18+50	18+51	19+49	18-19+50-53
Ant. anal ray below vertebra No.	23	21	21	.	23	22	21	22	21	21	21	21-22
Ant. anal ray below dorsal ray No.	30	25	25	.	28	23	24	27	26	23	26	25-27
Ant. dorsal ray above vertebra No.	7	7	8	.	7	7	8	7	6	7	7	6-7
Pseudobranchial filaments	2-2	2-2	2-2	.	.	2-2	2-2	2-2	3-2	2-2	-2	2-2
<i>Morphometric characters as % of SL</i>												
Head	18.0	18.0	.	.	.	19.0	19.5	18.0	18.0	18.5	19.5	18.0-19.0
Depth at ant. anal ray	14.0	12.5	12.0	.	.	14.5	15.0	14.5	13.0	11.0	.	14.0-15.5
Upper jaw	11.0	10.5	10.5	.	.	10.5	12.0	10.5	11.0	10.5	.	10.0-11.0
Lower jaw	11.0	12.0	12.0	.	.	.	.	.	11.0	12.0	.	10.5-12.5
Diameter of pigmented eye	0.8	0.7	.	.	.	0.9	0.9	.	0.8	0.8	.	.
Postorbital	13.0	11.5	.	.	.	12.5	13.0	12.0	12.5	12.5	.	11.5-13.0
From base of ventral fins to ant. anal ray	28.5	27.0	27.5	.	.	26.5	29.0	25.0	29.0	24.5	26.5	26.5-29.5
Preanal	40.0	39.0	37.0	.	.	38.0	41.5	39.5	39.0	35.0	39.5	38.5-40.0
Predorsal	21.0	22.5	22.0	.	.	23.0	25.5	20.5	21.0	21.5	.	20.5-22.0
Preventral	11.5	10.5	11.0	.	.	12.5	12.0	.	11.0	11.5	12.0	12.0-13.0
Length of ventral fin-rays	8.8-4.6	8.5-7.2	10.0-6.4	.	10.5-8.0	9.8-6.8	11.5-8.6	9.3-7.0	11.0-9.1	10.0-6.7	.	.
Max. length of pectoral fin	23.0	21.0	23.5	.	22.5	36.0	51	29.5	40.0	19.5	.	28.0-36.0

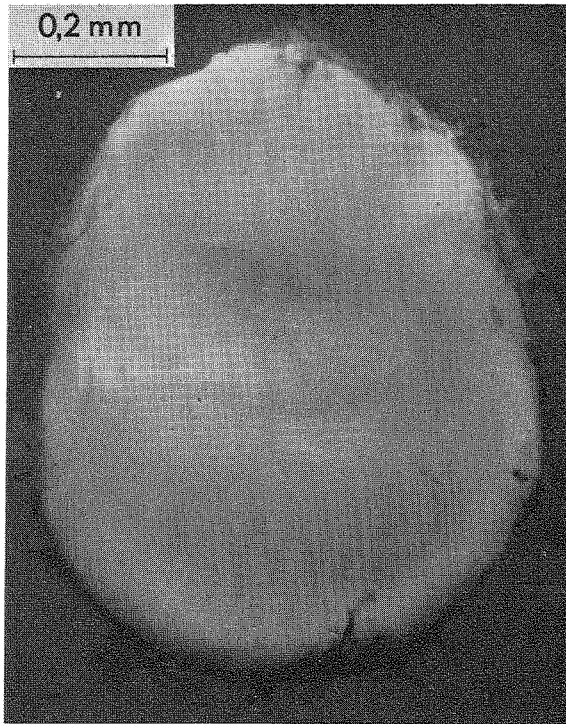


Fig. 3. Median side of right sagitta from *A. galathea*. ZIL 43250.

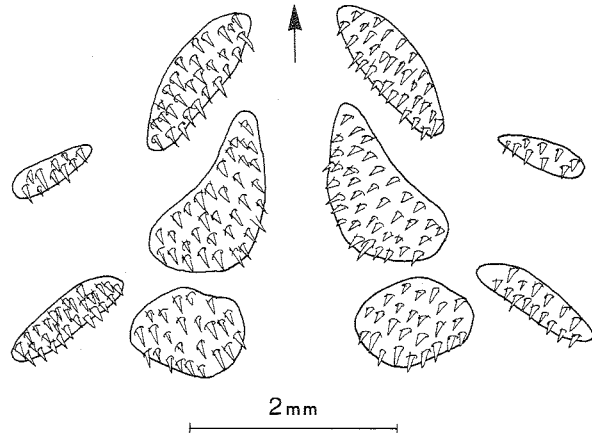


Fig. 4. Upper pharyngeal tooth patches from *A. galathea*. ZIL 43250. The arrow points anteriorad.

#### Variation:

Table 2 shows high variability in dorsal and anal fin-ray counts, 97-116 and 76-96, respectively. However, when the vast geographical range is taken into account it seems reasonable to consider the variation as intraspecific. Other characters in Table 2 show little variation except for the lengths of the pectoral and ventral fins which is due to breakage of the fin-rays. Two pairs of small otoliths are present in some of the specimens, judging from the radiographs; the diameter of the sagitta is about 1 mm. The right sagitta (Fig. 3) shows a medial sulcus, but it is not possible to see whether the colliculi are fused or separated. Compared with most other ophidioid genera the otoliths of *Abyssobrotula* are small. The paired basibranchial tooth patches are not developed in one specimen (MNHN 1976-44) and in another (ZMUC P77676) only the right patch is present. All the remaining specimens have a basibranchial tooth pattern like that of the holotype (Fig. 2b). The lengths of the median patches vary, but the posterior end

on the 2nd to 4th arches. Two small pseudobranchial filaments are found on each side.

*Axial skeleton.* Information from radiographs of the holotype agrees with the description of the alizarin-stained paratype (see variation).

*Viscera.* The thick-walled oesophagus and stomach are black. Pyloric caeca are not developed. The pale, broad intestine is almost straight with a coil anteriorly. The yellowish liver is small. The short, thick ovaries are fused and contain numerous yellow eggs which vary in diameter from 0.3 to 0.5 mm. The swim bladder is small and thin-walled.

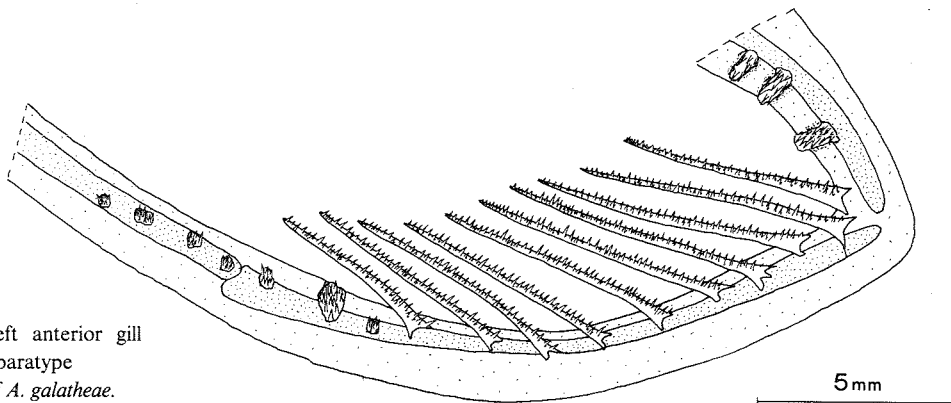


Fig. 5. Left anterior gill arch from paratype (P77601) of *A. galathea*.

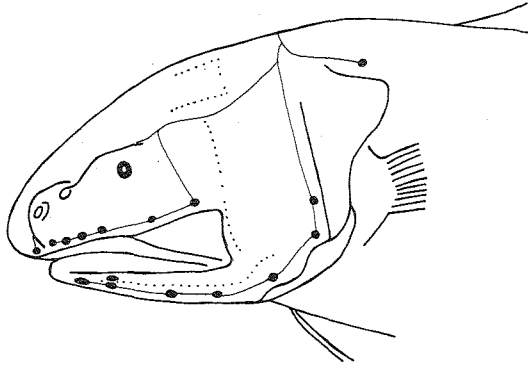


Fig. 6. Head pores of *A. galathea*. UMML 29070.  
(From Staiger 1972).

of the anterior and the anterior end of the posterior patch never reach the paired tooth patches. The upper pharyngeal tooth pattern is shown in Fig. 4. All five patches in each side have rather strong, pointed, retrorse teeth. The lower pharyngeal tooth pattern consists of one patch in each side. The number of long rakers on the anterior gill arches varies between 8 and 11 (Fig. 5).

**Head pores.** The head pore system is described in detail by Staiger (1972: 27-28) based on the "Pillsbury" specimen (Fig. 6). The lateral canal has a single pore at the anterior end, the infraorbital canal opens in six pores, the preoperculo-mandibular canal has eight pores, and the supraorbital one near the tip of the snout. Pores are absent in the supra-temporal canal. It is only in the "Pillsbury" specimen that the pores are well preserved, but those remaining in the other specimens seem to fit the above description.

**Axial skeleton.** The description below is mainly based on a cleared and alizarin-stained paratype (P77601). The anterior neural arch and spine are poorly developed, reaching only half the height of the following spines. Also the anterior vertebral centrum is relatively small. The anterior precaudal vertebrae have broad, neural arches and hardly any spines (Fig. 7a); the posterior ones have smaller arches and long, slender spines (Fig. 7b). There are neither parapophyses nor ribs on the anterior two vertebrae. From the third vertebra the parapophyses become larger posteriorad. Long, thin pleural ribs are attached to vertebrae Nos. 3-12 (in a few specimens on Nos. 3-13) and epipleural ribs are found on vertebrae Nos. 3-9. The caudal skeleton (Fig. 8) has two well separated hypural plates. The lower plate has a thin, flat process ventrally, supporting the ventral caudal fin-ray. Epural elements are not developed. A pair of large uroneurals is

seen dorsal to the coalescent ural and first preural centra. The haemal arch and spine belonging to the first preural centrum are large while the neural arch and spine apparently are absent. The second preural centrum is provided with a normal, ventrally directed process, but the dorsal process is atypical. The dorsal process on the second preural vertebra appears to be normally developed in most other specimens. The third preural vertebra is shaped like the preceding caudal vertebra.

Radiographs of the other specimens have been compared with the stained paratype and variations are mentioned. In the two smaller specimens (SL 67-75 mm) the vertebral centra are much less strongly constricted than in the remaining specimens (SL 110-156 mm).

**Viscera.** One of the paratypes (P77600) differs from the rest of the material by having a longer intestine. Also the liver is larger, which may only indicate that the specimen is in a better condition. Eight of the 10 specimens are females. The ovaries contain numerous eggs with diameters varying from 0.1-0.5 mm. Two specimens are juveniles.

**Swim bladder.** A histological examination was made of the apparently intact, hollow, ellipsoidal swim bladder from the "Vitiaz" specimen of which the longer axis is 6 mm. The rete mirabile penetrates the swim bladder wall anteriorly on the ventral part. Inside the swim bladder is found a spherical body within which the rete terminates. It appears as if this sphere somehow comprises a built-in gas gland.

#### Biology:

This oviparous fish is the deepest caught species ever recorded. As mentioned above no specimens were

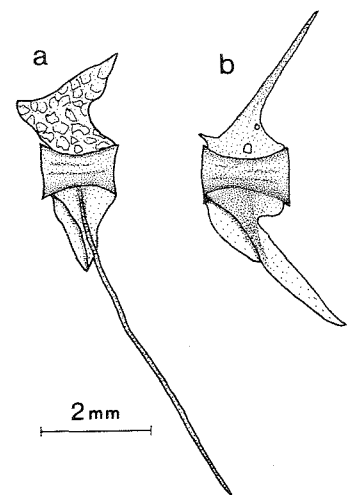
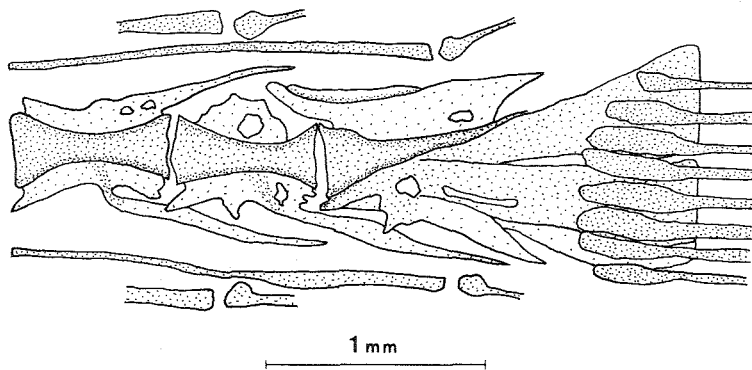


Fig. 7. Vertebrae from paratype (P77601) of *A. galathea*; a, precaudal vertebra No. 7; b, last precaudal vertebra.

Fig. 8. Caudal skeleton from paratype (P77601) of *A. galathea*.



taken in gear provided with closing devices, but the intestinal contents strongly indicate that all except one were feeding at the bottom. The exception is the only specimen (CAS 36574) caught in a pelagic gear. Although most of the gut contents are unidentifiable fragments, the following items, all of which are benthic animals or parts of them, can be listed: dorsal filit from the polychaete family Aphroditidae, represented by two *Macellicephal* spp.; crustaceans belonging to the Isopoda Asellota: *Eurycope* sp. (from 2 fish), Eurycopidae (from 5 fish), *Acanthocope* sp. (from 1 fish), Ischnomesidae (from 1 fish). Also a 2-3 mm amphipod was found. Contents from the oesophagus and stomach are not included in this analysis, as other material from the net might have been ingested during the trawling and hauling up of the net. Also indicating a benthic or near-bottom rather than a deep-pelagic occurrence is the well ossified skeleton.

It is very doubtful that the extremely small, hidden

eyes are functional. The sensory pores on the head are well developed; those on the body apparently are absent.

#### Distribution:

*A. galathea* is known from nine localities distributed within the tropical and subtropical areas of all oceans (Fig. 9). Regarding vertical distribution no specimen was caught with a closing gear so no exact data are available. On eight of nine stations the gear had worked on the bottom at depths varying between 3111 and 8370 m, which strongly indicates a deep benthic occurrence. However, at one locality, the Gulf of Panama, a specimen was taken in a pelagic trawl fishing between 2500 m and the surface over bottom depths between 2926 and 3292 m. This is a disturbing specimen, but it is known from other supposedly benthic species that they can occasionally occur pelagically. If pelagic occurrence was common for *A. gala-*

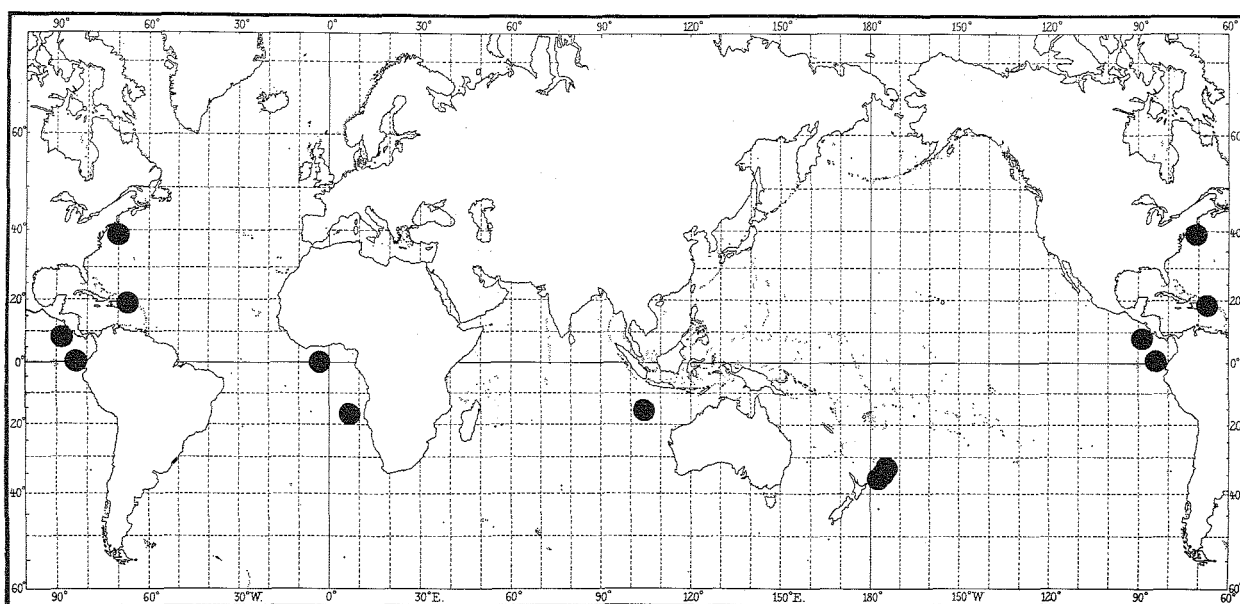


Fig. 9. Records of *A. galathea*.

*theae* one would have expected records from many more shallower pelagic hauls.

This is the fifth known hadally occurring species of fish, in addition to *Bassogigas profundissimus* (Roule, 1913), *Leucicorus atlanticus* Nielsen, 1975, *Careproctus amblystomopsis* Andriashev, 1955, and *Careproctus kermadecensis* Nielsen, 1964.

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