SCAPHOPODA AND GASTROPODA
FROM DEPTHS EXCEEDING 6000 METERS

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The present paper contains descriptions of a single hadal scaphopod and five hadal gastropods, which all appear to be new species. A report on the abyssal and hadal bivalves is in preparation.

SCAPHOPODA

In the Sunda Trench at a depth of 6900-7000 m the *Galathea* Expedition obtained a single specimen of a *Siphonodentalium,* which is described below. It has been referred to as "Scaphopod" or "*Siphonodentalium* sp." by BRUUN (1957), WOLFF (1960) and CLARKE (1962). The deepest occurrence of a scaphopod hitherto recorded would seem to be *Dentalium leptoskeles,* described by WATSON (1886), from a depth of 2600 fathoms (about 4760 m) from *Challenger* St. 160, S. of Australia. The presence of soft parts in this species is mentioned, thus proving that it actually lived at great depth. BELJAEV & VINOGRADOVA (1961) recorded six specimens of a *Siphonodentalium* sp. from the Java (Sunda) Trench, *Vitjaz* St. 4535, depth: 6820-6850 m. The postiton of the station is very close to that of the *Galathea,* where the present specimen was dredged. BELJAEV and VINOGRADOVA, however, refer their specimens to the subgenus *Pulsellum,* which is distinguishable from *Siphonodentalium* s.s. through a finger-like tentacle in the centre of the pedal-disc. The *Galathea* specimen has no such tentacle and should accordingly be referred to *Siphonodentalium* s.s. The present specimen is the deepest record so far of a scaphopod mollusk.

Siphonodentalium galatheae n.sp.
(Figs. 1, 2)

Material:

St. 465, Sunda Trench (10°20'S, 109°55'E), 7000-6900 m, 5. September, 1951. Gear: ST 300. Bottom temperature: 1.5° C. – 1 specimen.

Diagnosis: *Siphonodentalium,* having a finely striated shell. The central tooth of the radula is narrow and tongue-shaped, the lateral tooth with a single denticle.

Description: The shell is slightly curved and opaque with a length of a little more than 7 mm. Both openings are circular. The oral opening has a diameter of 1.3 mm, while the shell diameter at the apical opening is 0.6 mm. The apical opening is smooth and without lobes. The lumen of the opening is 0.3 mm. The sculpture of the shell is very indistinct and consists of a fine longitudinal striation and irregular transverse growth lines. The thickness of the shell increases considerably from the oral to the apical opening. The foot is relatively large, the distal part forming a disc, the dorsal part having a deep sinuation. The edge of the disc has some 35 papillae of varying size. The captaculae would seem to be partly damaged so that their exact number can not be made out. The posterior mantle edge is deeply sinuated. There is a slight inflation of the posterior part of the body. The radula is characterized by a narrow tongue-shaped central tooth, the

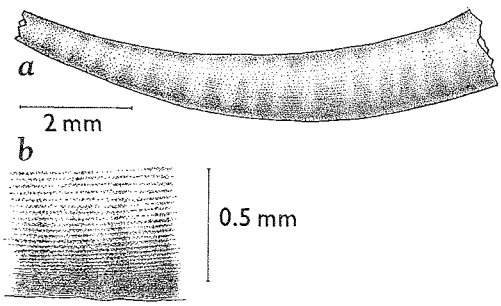

Fig. 1. *Siphonodentalium galatheae* n.sp., holotype; a, lateral view of the shell; b, details of the surface sculpture. H. LEMCHE del.

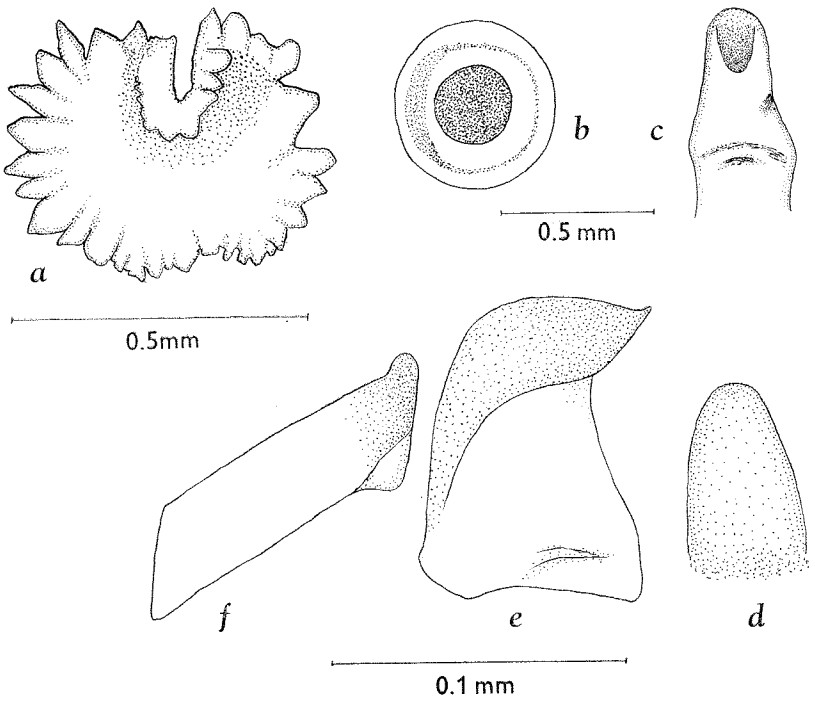

Fig. 2. *Siphonodentalium galatheae* n. sp.; holotype; a, frontal view of the foot; b, cross section of the posterior end of the shell; c, ventral view of the posterior end of the body; d, rachidian tooth; e, lateral tooth; f, marginal tooth.

lateral edges of which converge. The lateral tooth has a single well developed cusp. The marginal tooth has the approximate shape of a parallelogram, having a rounded cusp at the proximal median corner.

Remarks: The present species obviously belongs to the family Siphonodentaliidae. In this family the rachidian tooth of the radula is narrow as opposed to the family Dentaliidae, in which the rachidian tooth is broader than it is high. The smooth tapering shell having a circular section refers the species to the genus *Siphonodentalium*. Some 20 species have been referred to that genus. Only in a few of these has the radula been examined, most species having been described exclusively from shell characters. Since the shell is probably subject to some variation, both as to shape and sculpture, a comparison of the present species with those previously described is difficult. G. O. SARS (1878) figured the radulae of *S. vitreum* M. Sars (= *S. lobatum* (Sowerby)), and of *S. lofotense* M. Sars. The radula of the former is further figured by PILSBRY and SHARP (1897-98). BOISSEVAIN (1906) found, that the radula of *S. australasiae* Boissevain offered no difference to that of *S. vitreum* Sars, but no figure is given. HABE (1955) figures the radula of *S. okudai* (described by HABE 1953)[1]. The four species mentioned here would seem to be the only species of *Siphonodentalium*, in which the radula is known. In these species the rachidian tooth is approximately rectangular with parallel lateral edges. *S. galatheae* differs radically from this in that it has a tongue-shaped rachidian tooth with converging lateral edges. It is thus certain that it is different from any other species in which the radula is known. It is less certain, however, when comparison is made with species known from their shells only. PLATE (1908) described *Siphonodentalium minimum* from the Antarctic, 3423 m. The species is based on two empty shells, devoid of the soft parts. In the shape of the shell *S. minimum* is very close to *galatheae;* it seems, however, to have a more distinct longitudinal striation, which may constitute a specific difference. A comparison with shells of *Siphonodentalium* figured in PILSBRY and SHARP (1897-98), WATSON (1886), HENDERSON (1920), and other publications dealing with deep sea scaphopods, failed to refer *galatheae* with certainty to any of the species. Hence the author has preferred to describe it as new. The specimen is kept in the Zoological Museum of the University, Copenhagen.

Biology: The food of the Scaphopoda generally consists of various unicellular organisms and the microscopic larvae of bottom invertebrates. DELL (1957) found the buccal mass of *Dentalium zelandicum* Sowerby crammed with tests of Foraminifera, and MORTON (1959) in his detailed study of the

1. Not seen by the author.

feeding in *Dentalium entalis* L. found the same. The buccal mass of the present specimen has been examined but only a few sand grains were found.

Distribution of Siphonodentalium: The genus *Siphonodentalium* comprises some 20 species. About one third of these occurs in shallow water, mostly in boreal and subboreal waters, another third occur in the abyssal. Since most of the known species are recorded from one or a few localities and only from empty shells, it is at present not possible to discuss the distribution of the genus.

GASTROPODA

Gastropoda from hadal depths i.e. below 6000 m, have been briefly recorded by ZENKEVICH *et al.* (1955), BRUUN (1957), BELJAEV *et al.* (1958), WOLFF (1960) and CLARKE (1962). The two latter papers summarize all the records up to that time. It appears that the Soviet expeditions on the *Vitjaz* have obtained gastropods from depths below 10.000 m, proving that they are among the organisms which are able to adapt themselves to life at the greatest known depths. None of the papers already mentioned describe the specimens; they are just listed under preliminary generic or family names. In addition to the recording of the Gastropoda in the above mentioned papers WOLFF (l.c.) listed a number of gastropods from hadal depths shown at an exhibition in conjunction with the XVth International Congress of Zoology in London 1958, and of which so far no record exists in the literature. BELJAEV & VINOGRADOVA (1961) mention two species of *Philine* and one species of Lepetidae from the Sunda (Java) Trench, 6820-6850 m. None of these are described or figured. The *Galathea* obtained five species of gastropods, all from the Kermadec Trench; they are all considered as n.spp. and described below. The material, including the types, is kept in the Zoological Museum of the University, Copenhagen.

TROCHIDAE

Guttula galatheae n.sp.
(Figs. 3, 4)

Material:

St. 658, Kermadec Trench (35°51'S, 178°31'W), 6660-6770 m, 20. Febr. 1952. Gear: ST 600. Bottom: brown sand with clay and stones. Bottom temp. 1.3° C. – 8 specimens and 4 shells.

Diagnosis: A *Guttula,* having a circular aperture and a large cusp of the rachidian tooth of the radula.

Description: The shell is white and smooth and consists of 4-5 whorls, 41/2 in the type specimen. The spire is conical and forms 38 to 47% of the total height of the spire, about 44% in the type specimen. The apical angle is 82°-89°, 84° in the type specimen. The protoconch is preserved in all available specimens. It is slightly inflated, but not distinctly marked off from the teleoconch. The individual whorls are regularly curved in profile with a moderately deep suture. The aperture is nearly circular. The outer lip is simple, the collu-

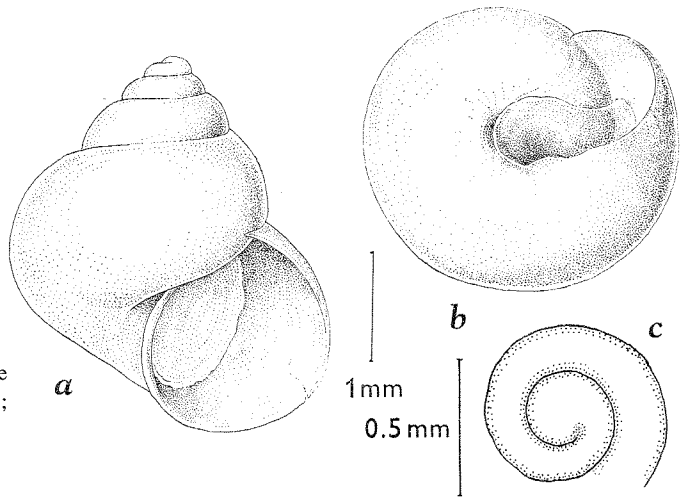

Fig. 3. *Guttula galatheae* n.sp.; a, apertural view of the holotype P.H.W.; b, basal view of the same P.H.W.; c, apical view of the protoconch.

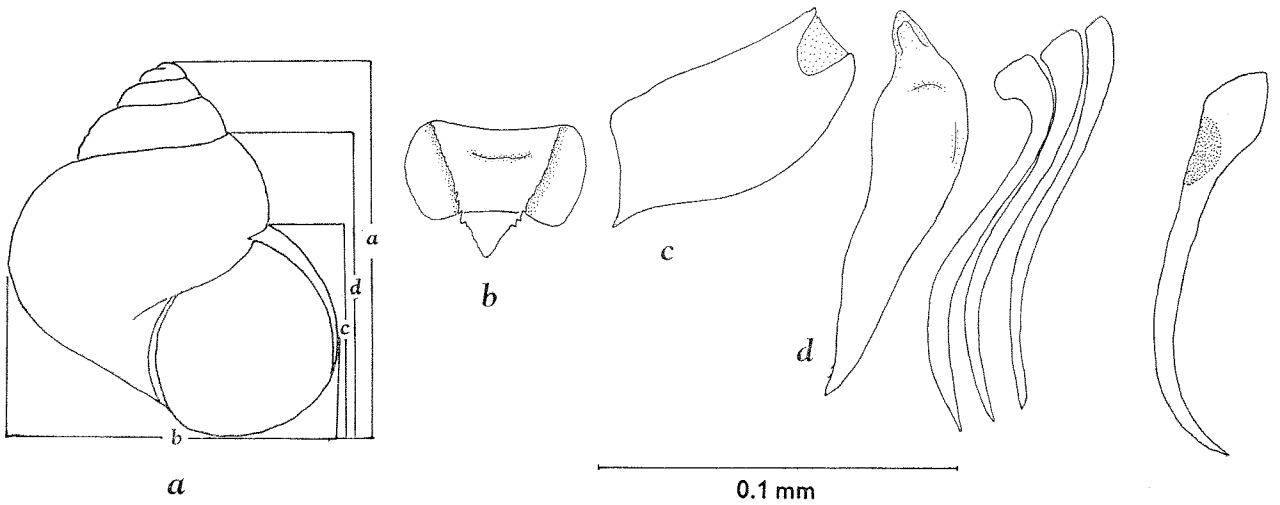

Fig. 4. *Guttula galatheae* n.sp.; a, outline of shell to show the dimensions measured; b, rachidian tooth; c, lateral tooth; d, five marginal teeth.

mellar edge is slightly reflected and a fine parietal callus is present. The umbilicus is visible as a fine slit. The operculum is horny and completely transparent with a very indistinct spiral sculpture. In shape it completely reflects the aperture. Soft parts: Some observations on the external morphology were made on a specimen in which the shell was dissolved. The foot is broad and has a distinct median ridge. A well developed propodium is present. The posterior part of the foot is rounded. An epipodium is present, having 3-4 tentacles. The cephalic tentacles are well developed, and pointed. No eyes could be observed. The mantle edge has a finger-shaped tentacle located on the right side. The anus is situated on a rounded lobe projecting from the extreme right side of the mantle edge. The penis is extremely well developed.

The radula: The rachidian tooth is relatively small. The lateral edges are convex, and the basal edge is slightly concave. The cusp is relatively large, extending beyond the basal edge. It is provided with 3-5 indistinct denticles located at some distance from the point. The single lateral tooth is approximately rhombic with a small median tooth, which is not distinctly marked off. The exact number of marginal teeth could not be counted. The median one differs in shape from the rest. It is broader and pointed at the base, and two very small denticles could be observed close to the distal end. The remaining lateral teeth are slender, curved and have broad bases.

Measurements and proportions: The measurements taken are shown on Fig. 4a and are given in millimeters. Specimen "A" is the holotype, while "E" and "F" refer to empty shells.

Specimen	A	B	C	D	E	F
Apical angle	84°	84°	85°	89°	82°	82°
a	3.58	4.25	3.92	2.83	4.00	3.83
b	3.08	3.92	3.80	3.67	3.58	3.33
c	2.00	2.25	2.42	2.17	2.17	2.17
d	2.83	3.25	3.33	3.08	3.17	3.08
b/a	0.86	0.92	0.97	0.96	0.90	0.87
c/a	0.58	0.53	0.62	0.57	0.54	0.57
d/a	0.79	0.76	0.85	0.80	0.79	0.80

Remarks: Both the shell and the radula would indicate that the present species should be referred to the family Trochidae, subfamily Margaritinae. In this subfamily one lateral tooth is found in the genera *Basilissa, Seguenzia* and *Guttula*. However, the two first-mentioned genera have shells, which are distinctly sculptured and of a shape different from the present one. The genus *Guttula* was erected by SCHEPMAN (1908) to contain a small trochid obtained by the *Siboga* Expedition at 2°40'S, 138° 37.5'E, 835 m depth. The shell of this species is small and without sculpture and in shape it is similar to *G. galatheae*. The same holds good with regard to the radula. Undoubtedly, *galatheae* should be referred to the genus *Guttula*. It differs, however, in several respects from *G. sibogae* Schepman, the hitherto only known species of the genus. The spire of the present species is lower than in *G. sibogae*. In the latter, the columellar edge of the aperture is straight, while in *galatheae* it is evenly curved. In the former, the rachidian tooth of the radula has a

much smaller cusp than in the latter. In addition, there are obvious differences in the shape of both the laterals and marginals.

The present species would seem to serve as a food item for at least two species of invertebrates living in the same locality. Thus MADSEN (1956) found a few specimens in the stomach of *Hymenaster blegvadi* Madsen (Asteroidea), and an operculum of what is undoubtedly the present species was found in the stomach of *Admete bruuni* n.sp. (see p. 133).

Trenchia n.gen.

Diagnosis: A genus belonging to the Trochidae, having a small conical shell, a relatively large aperture, a thin horny operculum and a rhipidoglos radula with two lateral teeth and numerous marginal teeth.

Remarks: The genus should obviously be placed in the family Trochidae. The shell of the single species known might indicate that it should be regarded as belonging to the Cyclostrematidae. THIELE (1935) separated the latter family from the Trochidae by the radula having only 1 lateral tooth in the Cyclostrematidae, while there are 1-5 laterals in the Trochidae. In the subfamily Skeneinae, which have shells of the same type as the present one, THIELE (l.c.) states, that the radula (which is known only in some of the genera of the subfamily) has four or five lateral teeth. In the subfamily Margaritinae (which also contains several genera in which the radula is unknown) the number of lateral teeth varies between one and five. Within this subfamily, however, no genus known so far has two lateral teeth. Hence the present author prefers to establish a new genus within the subfamily Margaritinae for the species described below.

Trenchia wolffi n.sp.

(Figs. 5, 6)

Material:

St. 650, Kermadec Trench (32°20'S, 176°54'W), 6620-6730 m, 15. February 1952. Gear: ST 600. Bottom: brown clay with pumice. Bottom temp.: 1.3°C. – 1 specimen.

St. 654, Kermadec Trench (32°10'S, 175°54'W), 5850-5900 m, 18. February 1952. Gear: HOT. Bottom: brown clay with pumice. Bottom temp.: 1.2°C. – 1 specimen.

The specimen from St. 650 has been selected as holotype. The whole apical part of the shell is heavily corroded and only the anterior three-fourths of the body whorl is undamaged. The specimen from St. 654 is badly damaged, since the anterior part of the shell and the majority of the soft parts are lacking. In this specimen, however, the apical part of the shell, including the protoconch, is well preserved (Fig. 5c). It is obvious from the shape and sculpture of the two shells that they belong to the same species.

Description: The shell is small with a very low spire. It is whitish, thin and, in some places, semi-transparent. From the preserved parts of the two shells present it is possible to estimate a specimen of the size of the type having about three whorls. The protoconch, present only in the paratype, is distinctly marked off and has a diameter across the aperture of about 350 μ. It is glassy and devoid of any sculpture. The apical angle is about 100°. The body whorl increases rapidly towards the aperture. The umbilicus is wide and deep. The spiral sculpture consists of two fine ribs. One starts at the border between the protoconch and the teleoconch, gradually fades, and is absent on the body whorl of

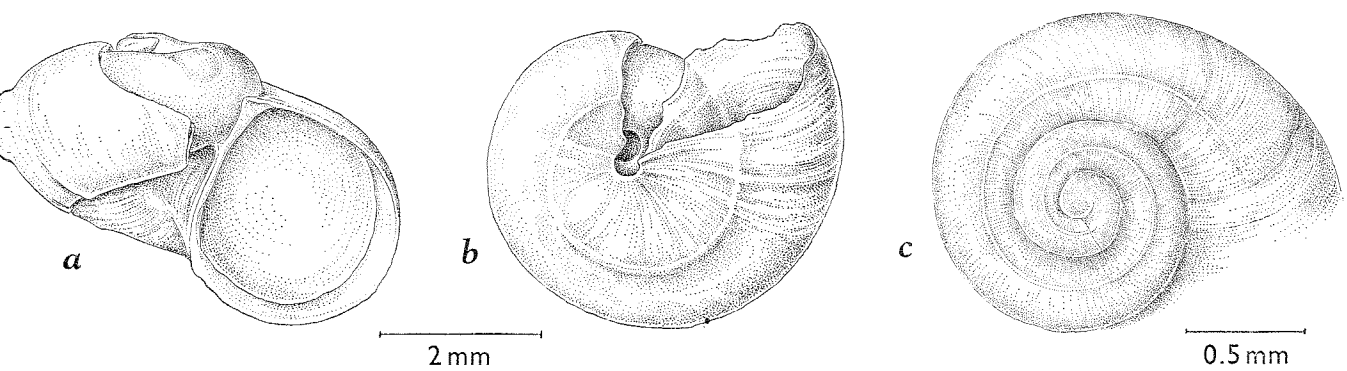

Fig. 5. *Trenchia wolffi* n.sp.; a, apertural view of the holotype; b, basal view of the same; c, apical view of the other specimen. P.H.W.

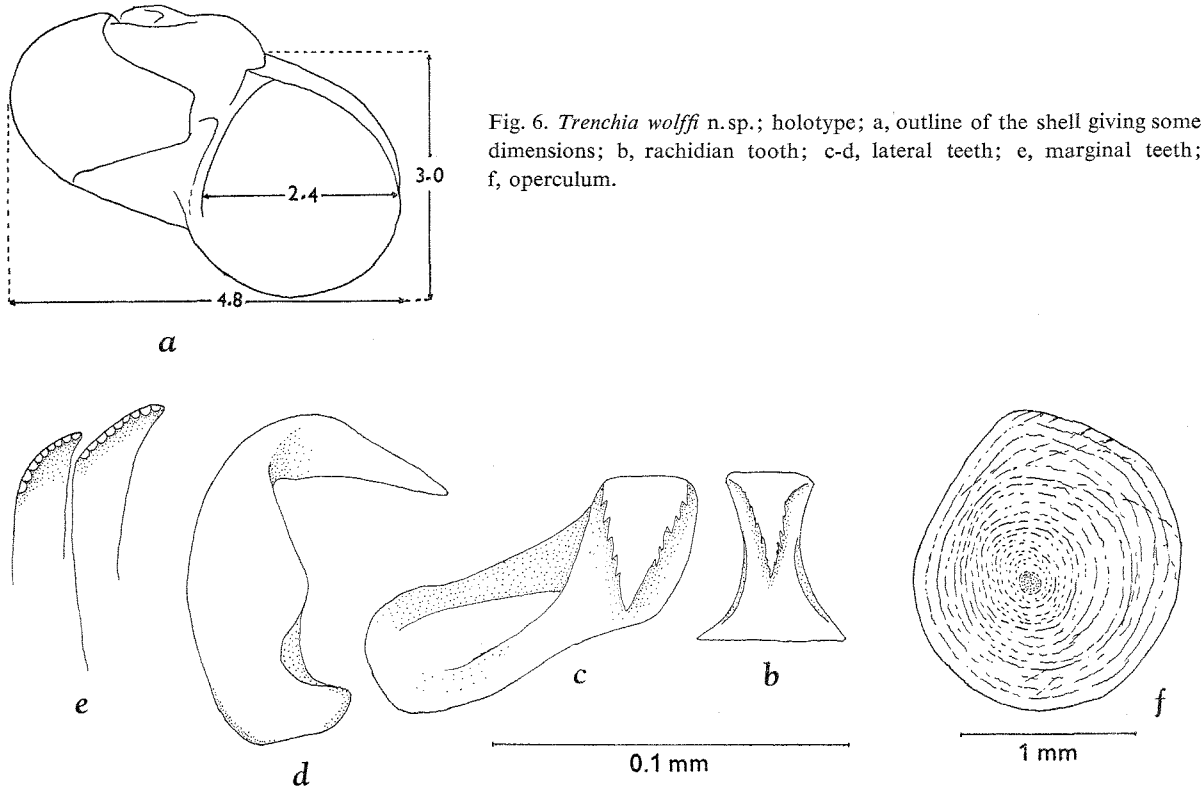

Fig. 6. *Trenchia wolffi* n.sp.; holotype; a, outline of the shell giving some dimensions; b, rachidian tooth; c-d, lateral teeth; e, marginal teeth; f, operculum.

the type. The distance of the spiral edge from the suture is slightly less than half the breadth of the whorl. A second more prominent spiral rib surrounds the umbilicus. The axial sculpture consists of fine, irregular growth lines. In the specimen from St. 654, one line is much more distinct than the remainder and is located where the subsutural spiral rib starts to fade away. The growth lines continue into the umbilicus as fine axial folds. The aperture is relatively large, and broadly egg-shaped. The outer lip is sharp and connected with the parietal wall posteriorly at an angle of about 90°. The dimensions of the type are shown in Fig. 6a.

The radula: the rachidian tooth is slender, having concave lateral edges. The cusp extends to a little more than half way to the basal edge of the tooth and is provided with a number of small, irregular denticles. Two lateral teeth are present. The first is broad, it has a rounded base and a large cusp provided with about 5 pairs of denticles located close to the rachidian tooth. The second lateral tooth has a very conspicuous cusp without denticles and bent at right angles to the rest of the tooth. The base is broad. Just above the base a median concavity is present. The marginal teeth are slender and obliquely pointed. The upper edge has about 9 rounded denticles. The number of marginal teeth could not be made out, but it seemed to be at least 20.

The operculum (Fig. 6f) is thin and transparent and has a nearly central nucleus.

Remarks: On account of the rhipidoglos radula and the shape of the shell, the present species should be referred to the Trochidae. A similar shell is found in Cyclostrematidae, but in that family only one lateral tooth is found, while a varying number of laterals have been found in the Trochidae.

ACLIDIDAE

Aclis kermadecensis n.sp.
(Fig. 7)

Material:

St. 649, Kermadec Trench (35°16'S, 178°40'W), 8210-8300 m, 14. February 1952. Gear ST 600. Bottom: grey clay with pumice. Bottom temp.: 1.5°C. – 1 specimen.

Diagnosis: A species of the genus *Aclis,* having a smooth shell with a relatively low spire, forming about 55% of the total length of the shell.

Description: The shell is white and very fragile and consists of about 5½ whorls. No sculpture is present. The spire forms about 55% of the total length of the shell and has a rounded apex. The protoconch is not distinctly marked off from the teleoconch. The apical angle is about 45°. The individual whorls are slightly convex in outline and separated by a moderately deep suture. The largest diameter of the body whorl, measured at right angles to the longitudinal axis is about 48% of the length of the shell. The aperture is ovoid in shape and its length is about 43% of the total length of the shell. The outer lip is sharp and regularly curved. The anterior part of the aperture is broad. The columellar edge is straight and slightly reflected. It forms an angle of about 137° with the slighlty convex parietal wall. No parietal callus is present. The umbilicus appears as a fine slit. The operculum is horny, very thin and transparent. It reflects completely the shape of the aperture. Owing to the delicacy of the single specimen available the soft parts could not be studied.

Measurements: Total length: 3,74 mm, maximum breadth at right angles to the longitudinal axis: 2.00 mm, length of the body whorl: 2.38 mm, length of the aperture: 1.62 mm.

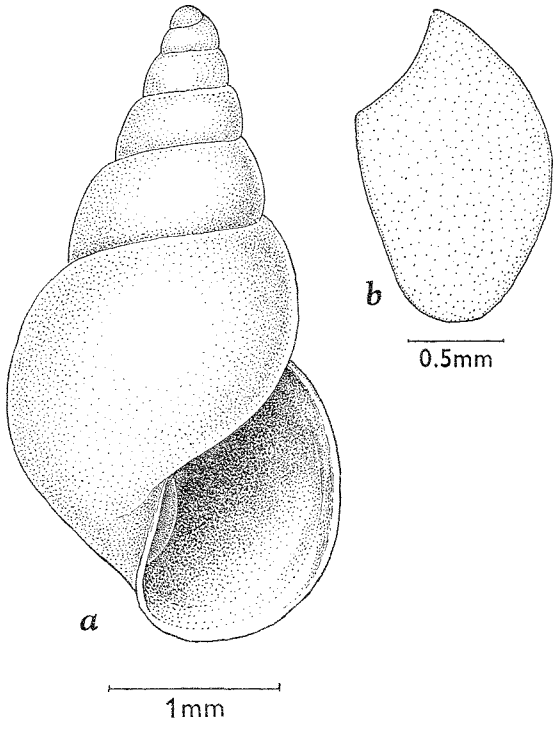

Fig. 7. *Aclis kermadecensis* n.sp. holotype; a, apertural view of the shell. P.H.W.; b, operculum.

Remarks: Provisionally, the present species has been referred to the family Aclididae, although the reference could not be corroborated by examination of the soft parts, since only one specimen was present. *A. kermadecensis* would seem to be closely related to *Aclis (Stilbe) acuta* Jeffreys – an abyssal species known from the Atlantic (JEFFREYS 1884). It differs from *A. acuta* in having a shorter spire with fewer whorls. The two species agree very well in the shape of the apertures.

The present species shows considerable similarity to *Stilifer brychius* Watson, of which a live specimen was obtained by the *Challenger* Expedition in the South Atlantic at about 5000 m depth (WATSON 1886). *S. brychius* has a higher spire and a more narrow aperture. The two species seem to differ widely in one respect: *A. kermadecensis* has an operculum. WATSON (l. c.) does not mention the presence of an operculum, although he describes both the shell and the anterior part of the body.

MELANELLIDAE

Melanella hadalis n.sp.
(Fig. 8)

Material:

St. 658, Kermadec Trench (35°51'S, 178°31'W), 6660-6770 m, 20. February 1952. Gear. ST 600. Bottom: brown sand with clay and stones. Bottom temp.: 1.3°C. – 1 specimen, the body whorl of the shell rather damaged.

Diagnosis: *Melanella* with a smooth shell, a low spire and a distinctly angulose body whorl.

Description: The shell is white and very fragile. It consists of about 5 whorls completely devoid of sculpture. The spire forms about 53% of the total length of the shell. The protoconch is slightly inflated and not distinctly marked off from the teleoconch. The apical angle is about 47°. The suture is very shallow. The whorls are nearly straight in profile. The periphery forms a rounded angle of about 110°. The largest diameter of the body whorl, measured at right angles to the longitudinal axis is about 50% of the total length of the shell. The aperture is ovoid with a straight outer lip, the anterior edge somewhat projecting. The columellar edge is straight and slightly reflected. It forms an angle of about 115° with the nearly straight parietal wall. The angle between the latter and the outer wall is about

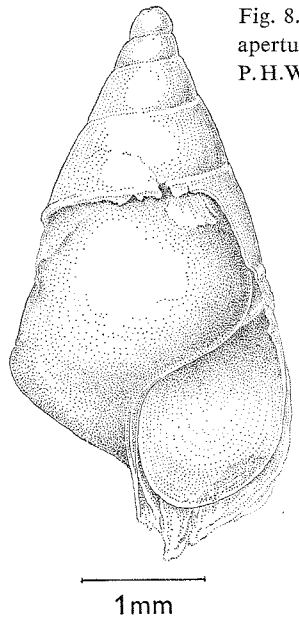

Fig. 8. *Melanella hadalis* n.sp.; apertural view of the holotype. P.H.W.

60°. No parietal callus is present. The umbilicus is not visible. The operculum is horny, very thin and transparent. The soft parts could not be studied because of the delicacy of the single specimen available.

Measurements: Total length: about 4.6 mm, maximum breadth at right angles to the longitudinal axis: 2.38 mm, length of the body whorl: 3.25 mm, length of the aperture: 2.00 mm.

Remarks: The reference of the present species to the Melanellidae is somewhat doubtful. Since, however, only a single damaged specimen showing few characteristic shell features is present, it is hardly, at the moment, possible to go into the systematic position of the present species in any detail. It would seem to resemble an *Odostomia* (Pyramidellidae) in the general shape of the shell. The absence of a columellar tooth indicates that it should not be referred to that genus. The present species would seem to have a lower spire and a broader aperture compared to other known species of the family.

CANCELLARIIDAE

Admete bruuni n.sp.
(Figs. 9, 10)

Material:

St. 658, Kermadec Trench (35°51'S, 178°31'W), 6660-6770 m, 20. February 1952. Gear: ST 600. Bottom: brown sand with clay and stones. Bottom temp.: 1.3°C. – 1 specimen.

Diagnosis: *Admete* having a large semitransparent shell with a faint spiral sculpture and a relative large aperture.

Description: The shell is white, thin and semitransparent with a comparatively short spire. The top whorls have disappeared, being replaced by a callus. The remaining part of the shell consists of about 4 whorls. The apical angle is about 65°. The total length of the shell is 22.2 mm (in an undamaged state the height would be about 24 mm), the body whorl 14.4 mm, the breadth 12.8 mm. The aperture is oblong, ovoid, with a short and wide siphonal canal. The outer lip is damaged, the parietal wall has no plicae. The whorls are slightly concave below the suture. There is a faint spiral sculpture consisting of about 15 close-set bands on each whorl of the spire, while about 50 bands are found on the body whorl. The latter has two opaque spiral bands below the periphery running from the parietal wall to the outer lip. The spiral sculpture is crossed by a very delicate axial sculpture, consisting of somewhat irregular fine lines which tend to be curved on the subsutural part of the whorls. Part of the body whorl shows traces of what may be the feeding tracks of a gastropod. No operculum is present. The soft parts: The anterior part of the foot forms a sausage shaped propodium, the lateral parts of which protrude beyond the lateral edges of the foot. The posterior end of the foot is rounded. There is

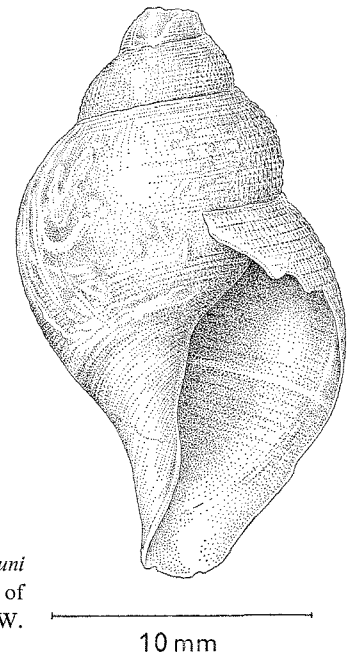

Fig. 9. *Admete bruuni* n.sp.; apertural view of the holotype. P.H.W.

a short, open siphon which has a median lappet. The mantle edge is thickened, except across the siphon. The snout is short and somewhat flattened. The tentacles are short, rounded, and circular in cross section, and no trace of eyes could be detected. No radula is present. The stomach contained a gastropod operculum, obviously belonging to *Guttula galatheae* n.sp. (p. 129).

Remarks: The genus *Admete* comprises some 45 species, of which the majority live in shallow water, particularly in antarctic and antiboreal waters. A few species are known to live in shallow water in the tropics, and a few others are known from the bathyal and abyssal region. VERRILL (1885) described *A. nodosa,* of which a live specimen was obtained in the N.W. Atlantic at a depth of 816 fathoms (1493 m). DALL (1889) described *Benthobia tryonii* from the W. Atlantic at a depth of 731 fathoms (1338 m); only the shell is known. DALL states his new genus, of which *tryonii* is the type, to be related to *Admete.* THIELE (1929) considers it as possibly = *Admete.* THIELE (1925) described *A. aethiopica* from the Indian Ocean, 693-1134 m, live specimens. Finally, BARNARD (1960) described *A. decapensis* from off S. Africa at a depth of 1500-1760 fathoms (2745-3221 m), based upon a single living specimen. DELL (1956) recorded two species of *Zeadmete* (which according to THIELE (1929) is possibly = *Admete)* from New Zealand waters at depths between 140 and 658 m. In addition, it is known that littoral species of *Admete* may occur in the upper part of the bathyal zone. This is for instance the case with the N. Atlantic species *A. viridula* (O. Fabricius) (THORSON 1944). The present species would seem to be different from any of the hitherto known species. *A. nodosa* Verrill has strongly developed axial ribs, whereas *B. tryonii* Dall has distinct ribs anterior to the suture and has a differently shaped aperture and siphon. *A. aethiopica* Thiele differs from *bruuni* in having well developed axial ribs which are nodulose anterior to the suture. It is also mentioned that eyes are present. *A. decapensis* Barnard differs in having a relatively smaller aperture, the parietal wall of which has a callus. There are 14 (18?) axial ribs having 7-8 tubercles, and eyes are present.

Most of the described species are known only from one or a few empty shells. Considering the extreme variation found in the shell of the well-known panarctic *Admete viridula* (O. Fabricius), reviewed by THORSON (1944), it would seem that the number of actual species is much smaller than hitherto supposed. This possibly applies to the numerous species described from the antarctic and antiboreal regions. Even taking this supposition into consideration, it is quite evident that the genus is essentially at home in shallow waters of cold regions; only a few species have been described from tropical seas. As mentioned above, three species are known to be bathyal and one is abyssal.

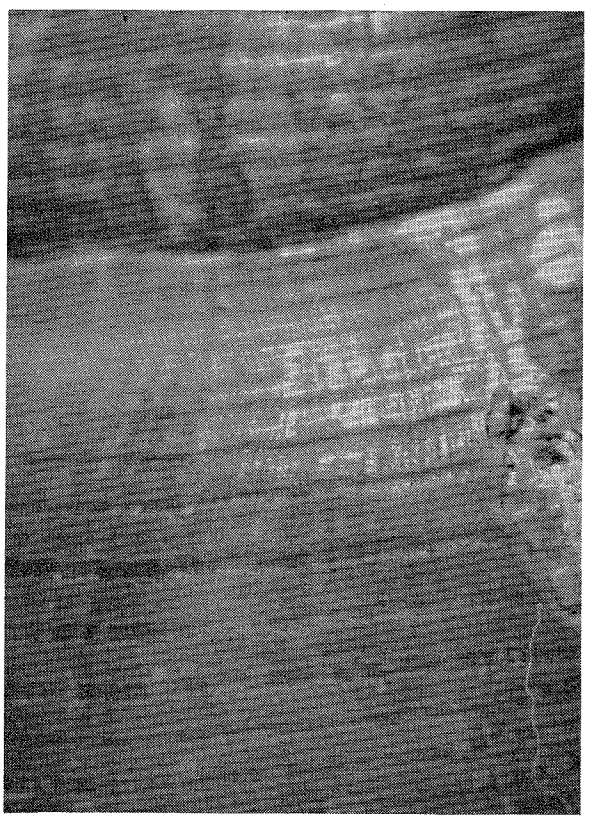

Fig. 10. *Admete bruuni* n.sp., holotype; details of shell sculpture; the suture separating the body whorl (below) is seen. About 12 ×.

The majority of the species of *Admete* have shell lengths of 10-15 mm, and several are even smaller. *Admete viridula* (O. Fabritius) may attain a length of nearly 20 mm (THORSON l.c.). The largest known species is probably *A. regina* Dall, of which a specimen from the Bering Sea, from about 48 m depth, had a shell length of 36 mm (DALL 1911). *A. bruuni* would thus seem to be among the largest known within the genus.

GENERAL REMARKS

Table 1 gives a survey of the identified hadal gastropods known until now. It appears that altogether 10-14 species are known so far. Gastropods are now recorded from the following trenches: The Kurile-Kamchatka Trench, the New Britain Trench, the Tonga Trench, the Kermadec Trench, and the Sunda (Java) Trench. Until now not a single species has been found to be common to two trenches or more. It should, however, be noted that several species appear in the literature only as "Prosobranchia" or under family name. Further, representatives of both Archaeogastropoda, Mesogastropoda and Stenoglossa are present in the hadal zone. It is, however, worth while to note the absence of species of members of the subfamily Turrinae (which are represented in the abyssal zone by a large number of species, often of a relatively considerable size). The deepest living species of this subfamily is *Pleurotoma (Pleurotomella) vayssierei* Dautzenberg, of which a single live specimen was obtained in the E. Atlantic (31°07'N, 24°03'W) at a depth of 5413 m (DAUTZENBERG 1927).

The Gastropoda so far recorded from hadal depths represent different types of feeding. Naticidae and *Admete* are definitely predators. As to the two Aclididae, FRETTER & GRAHAM (1962) state that nothing is known about the feeding in this group. The presence of a long proboscis and a radula with numerous needle-like teeth would indicate either a carnivorous or parasitic mode of life. The two species referred here to the Trochidae have radulae resembling those of shallow water members of the family, which are known to be »scrapers« i.e. living from the organisms of the surface film of rocks and stones etc. (FRETTER & GRAHAM l.c.). TURK (1963) showed, that some shallow water Trochidae may be necrophilous when opportunity occurs. Microscopical sections of *M. galatheae* seemed to show the presence of detritus in the stomach. This may indicate that the Trochidae are not exclusively »scrapers« but under certain conditions are able to utilize other sources of food.

Besides the gastropods mentioned above, WOLFF (1960) lists the following unidentified prosobranchs from depth exceeding 6000 m: Kurile-Kamtsjatka Trench, 7210-9050 m: 6-10 species; New Britain Trench, 8990-9043 m: 1 species; Tonga Trench, 10687-10415 m: 1-2 species; Kermadec Trench, 9995-10002 m: 1 species. They were all obtained by the Soviet *Vitjaz* Expeditions. The specimen from the Kermadec Trench was seen by the present author at the exhibition in London, 1958. It seemed to be different from any species described in the present paper.

All the five *Galathea* species have a thin and white shell without prominent sculpture. The three in which the soft parts were examined were without the slightest trace of eyes or eye stalks. It is impossible to point out any special adaptation or peculiarities which can be correlated with life at hadal depth. A survey of the bathyal and abyssal gastropods collected by the *Galathea* (and not yet studied in detail) revealed that none of the species described here actually occur in the collection. This may indicate that the species represent an endemic hadal fauna. Further collecting is, however, necessary before this conjecture can be considered to be well established.

WOLFF (1960) stated that there is little doubt that the hadal fauna is derived from the general abyssal fauna. The fauna of the Kermadec Trench has, in addition, elements obviously originating from the antarctic deep-sea. Thus GISLÉN (1956) reported *Bathycrinus australis* (Crinoidea) from the Kerma-

Table 1. List of identified Gastropoda from depths exceeding 6000 m.

Species	Trench	Depth (m)	Author
Lepetidae sp.....	Sunda (Java)	6820–6850	BELIAEV & VINOGRADOVA 1961
Guttula galatheae	Kermadec	6660–6770	present
Trenchia wolffi	Kermadec	5850–6730	present
Aclis kermadecensis ...	Kermadec	8210–8300	present
Melanella hadalis	Kermadec	6660–6770	present
Naticidae, 1-3 species .	Kurile-Kamtchatka	6860	ZENKEVICH *et. al.* 1955
Admete bruuni	Kermadec	6660–6770	present
Buccinidae, 1-3 species	Kurile-Kamchatka	6860	ZENKEVICH *et al.* 1955
Philine, 2 species.....	Sunda (Java)	6820–6850	BELIAEV & VINOGRADOVA 1961

dec Trench. The species has only been reported twice previously, both findings being from the abyssal Antarctic. According to MILLAR (1959), the tunicate *Cnemidocarpa bythia* Herdman was recorded from the Kermadec Trench (5850-7000 m), from two stations in the Tasman Sea (4400-4500 m) and from the area South of Australia (about 5000 m). WOLFF (1956) found that several species of *Storthyngura* and *Eurycope* (Isopoda) from the Kermadec Trench had their nearest relatives living in the bathyal and abyssal Antarctic. The above record of a hadal species of *Admete* would seem to present a similar case. A number of species of that genus are from the antarctic and antiboreal regions, while only a single species is known from the abyssal zone outside these regions. No doubt *A. bruuni* is derived from one of these species. The presence of an element of species from the antarctic zone is understandable, not only because of the proximity of the Kermadec Trench to the region mentioned, but also on account of the fact that the inflow of bottom water from the arctic to the Pacific takes place south of Tasmania and E. of New Zealand (WOOSTER & VOLKMANN 1960).

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