

RECENT DEEP-SEA BRACHIOPODA FROM THE WESTERN PACIFIC

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ABSTRACT

Four new species are described: *Crania indonesiensis*, *Sphenarina ezogremena*, *Septicollarina hemiechinata*, and *Phaneropora galathea*, the last two being the types of new genera. *Phaneropora* has become the type genus of a new family, Phaneroporidae, to which the deep-sea genus *Leptothyrella* of formerly uncertain systematic position has also been referred. The new family shows a good example of homeomorphy with a rhynchonelloid deep-sea family Cryptoporidae.

The morphology of the crura of *Rhynchonella doederleini* has been restudied, and the species has been made the type of a new genus, *Acanthobasiliola*, and transferred to the family Basiliolidae, where it forms the new subfamily Acanthobasilioninae.

The western Pacific species *Grammetaria bartschi*, *Gryphus davidsoni*, *Terebratulina reevi*, ?*T. callinome*, *Campages furcifera* and *Jolonica hedleyi* have been found in the Indian Ocean (south of Bali) for the first time, but all these occurrences are represented by empty shells. A new pattern of the geographical dis-

tribution, an "Atlantic-Southern Ocean pattern", is described for *Cryptopora gnomon*. This pattern and the "Pacific-Southern Ocean pattern" of distribution of another brachiopod deep-sea species, *Abyssothyris wyvillei*, seem to indicate different centres of origin for these deep-sea species. The rising of deep-sea fauna at the Malayan Archipelago and at the West Indies, as shown by the distribution of *Pelagodiscus atlanticus*, can be considered as evidence that the tropical shallow-water fauna penetrates to the abyss at least in these two regions of the world ocean.

Two ancient elements have been recorded: 1) a new species of *Sphenarina* which has previously been known only as a Pliocene fossil from the Mediterranean region; 2) *Septicollarina hemiechinata*, n. gen., n. sp., which has some similarity to the Triassic genus *Aulacothyropsis* from the Alps, the Balkans, Crimea, the Caucasus and the Pamirs. Therefore the recent brachiopod fauna of the continental slopes of the western Pacific reveals a relationship to the fauna of the ancient Tethys Sea.

INTRODUCTION

This paper is based on material collected at depths greater than 200 m in the western Pacific. It treats collections taken by the Galathea Expedition in 1951, by Dr. Th. Mortensen's Expeditions in 1913-16 and 1929, and by the Great Northern Telegraph Company in 1933. The material was sent to me for identification by the Zoological Museum of the University of Copenhagen and consists of 21 species from 13 stations. Three "Galathea" stations under consideration (St. 477 and St. 488 south of Bali, and also

St. 554 in Great Australian Bight) are outside the Pacific, but are characterised by the same species as the West Pacific region.

In order to more precisely describe the distributional pattern of the species treated, I have included some data obtained from the collections gathered in the same part of the Pacific by the P. P. Shirshov Institute of Oceanology. These data add new information to our knowledge of Recent Brachiopoda from this biogeographically important

region and are based on material collected during expeditions of the research vessels "Vitiáz" (1958), "Ob" (1956-58) and "Dmitry Mendeleev" (1975-76).

The Danish collection is preserved in the Zoological Museum in Copenhagen, the Russian collection in the P. P. Shirshov Institute of Oceanology, U.S.S.R. Academy of Sciences, Moscow.

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SYSTEMATIC PART

Family DISCINIDAE Gray, 1840

Pelagodiscus atlanticus (King, 1868)

Discina atlantica King, 1868: 170-173; Jeffreys 1876: 252; Davidson 1880: 62.

Discinisca atlantica, Davidson 1888: 200, pl. 26, 18-22.

Pelagodiscus atlanticus, Dall 1908: 400, Thomson 1927: 130, fig. 37; Wesenberg-Lund 1941: 3; Hertlein & Grant 1944: 21, pl. 2, 1-5; Odhner 1960: 403; Zezina 1965: 354; 1975: 903; Cooper 1973b: 10, pl. 5, 36; 1975: 915, pl. 2, 1-2.

Material:

"Galathea" St. 99. 11 Dec. 1950. 8°40'S, 11°10'E, off Angola, 2690 m. Trawl. Yellowish clay. - 6 specimens, on whales' ear bones, concretions and a scaphopod shell.¹

St. 408. 4 July 1951. 12°47'N, 116°24'E, South China Sea, 4330 m. Sledge trawl. Volcanic stones on globigerina ooze. - 2 specimens.

"Vitiáz" St. 3839. 19 Jan. 1958. 36°47'S, 172°30'E, Tasman Sea, 1750 m. Grab. - 1 brachial valve.

St. 3996. 17 May 1958. 5°00'N, 135°31'E, N. of New Guinea, 4600 m. Sigsbee trawl. Fe-Mn nodules on mud. - 2 specimens.

"Ob" St. 82. 14 Apr. 1956. 38°03'S, 165°32'E, Tasman Sea, 1795 m. Grab. Carbonate mud. - 1 brachial valve.

St. 83. 15 Apr. 1956. 37°31.2'S, 163°59'E, Tasman Sea, 1329 m. Grab. Carbonate mud. - Fragment of a brachial valve.

St. 358. 20 Mar. 1958. 54°01'S, 166°10'E, S. of New Zealand Plateau, 1370 m. Grab. Globigerina ooze. - 11 brachial valves.

St. 371. 28 Mar. 1958. 68°16'S, 165°16'E, near Balleni Is., 2678 m. Grab. Clay. - 1 brachial valve.

St. 376. 31 Mar. 1958. 67°21'S, 174°19'E, 3370 m. Grab. Clay with gravel. - 1 specimen.

St. 385. 5 Apr. 1958. 62°39'S, 159°51'W, South Pacific Rise, 2320 m. Grab. Mud with nodules. - 1 brachial valve.

"Dmitry Mendeleev" St. 1237. 26 Dec. 1975. 32°41'S, 155°11'E, Tasman Basin, 4850 m. Galathea trawl. - 1 specimen.

St. 1254. 1 Jan. 1976. 30°00'S, 169°03'E, at Bounty Basin, 2970-3020 m. Galathea trawl. - 8 specimens on pumice stones and on Bivalvia.

St. 1314. 2 Feb. 1976. 59°59'S, 158°08'E, slope of Hjort Trench, 3010-3030 m. Sigsbee trawl. - 1 specimen.

St. 1315. 3 Feb. 1976. 59°56.4'S, 158°46.2'E, slope of Hjort Trench, 2030-2190 m. Sigsbee trawl. - 3 specimens.

Remarks: The "Galathea" specimens from St. 408 are 3.5 and 3.8 mm long, 3.1 and 4.0 mm wide, respectively. They are similar to the specimens found on the floor of the Northern Atlantic Basin, where this species has a lower rate of growth than on the continental slopes (Zezina 1975). Almost all West Pacific occurrences are deep-sea. An exception is "Challenger" St. 194 near the Sulu Is. (4°33'S, 120°58'E) at 366-658 m, where the species was collected at the uppermost limit of its vertical distribution. This occurrence reflects a phenomenon of deep-sea fauna rising at the slopes of the Malayan Archipelago. The same phenomenon is known for *P. atlanticus* in the Atlantic West Indies (Zezina 1965). The rising of deep-sea faunas at the western tropical approaches in the Pacific and in the Atlantic can be considered as evidence that the tropical shallow-water fauna penetrates to abyssal depths in (at least) these two regions.

1. This species was found in the same region by "Valdivia" on various biological substrates lying on the surface of soft sediments (Jaekel 1953).

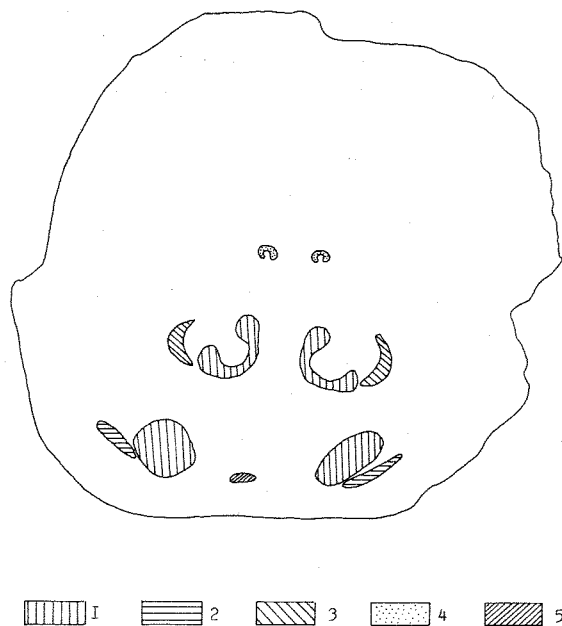


Fig. 1. *Crania indonesiensis* n.sp. Muscle scars on the interior surface of the upper valve. The five signatures represent scars of the following muscles: 1, anterior adductors and posterior deductors; 2, superior oblique muscles; 3, lophophore elevators; 4, lophophore protractors; 5, unpaired median muscle.

Family CRANIIDAE Gray, 1840

Crania indonesiensis n. sp.

Text-fig. 1, Pl. 1, Figs 1-3

Material:

St. 15, Th. Mortensen Java - S. African Exp. 10 Apr. 1929. 7°29'S, 114°49'E, 240 m. Sigsbee trawl. Sand and mud with concretions. - 1 specimen (holotype, female) without lower valve.

Description: Upper valve subquadrate with straight posterior margin and rounded angles. Apex of posterior valve situated near posterior margin of valve (at 1/16 of length of valve). Posterior slope of valve very steep, almost vertical. Upper surface of valve without any lamella, ribs or striation but covered by large and small irregular cavities. Concentric lines of growth noticeable only near the margins of valve. Inner surface of upper valve smooth and shining. Shell thin, with largest cavities of the upper surface visible interiorly as large smooth bulges. Inner surface of upper valve with 220 pores per mm². Muscular impressions weakly elevated, resembling dull white spots. For arrangement of the muscle scars see Fig. 1. Ripe eggs in the coelomic

cavities of the dorsal mantle up the bases of the lophophore branches (7 eggs in the right cavity and 10 eggs in the left). The shell is 6.6 mm long, 6.9 mm wide, 2.0 mm high longitudinally and 3.0 mm high transversely, the lateral margins being lower than the anterior and the posterior margins.

Comparison: The new species differs from *Crania japonica* Adams, 1863, in the absence of elevated ridges and septum in the upper valve, features which allow the transfer of *C. japonica* to another recent craniid genus *Craniscus* Dall, 1871. *Crania indonesiensis* is also well distinguishable from the species of *Crania* known in the Pacific and Indian Ocean. It differs from the Australian species *C. suessi* Reeve, 1862, in having a thin subquadrate shell without orange-red ornamentation, and from the New Zealand species *C. huttoni* Thomson, 1916, in its smaller size, in the absence of radial ribs on the upper valve and in the more posterior position of the apex. It differs from *C. philippinensis* Dall, 1920, in that the upper surface is without lamellae or radiation, the inner surface is nongranular and is only half as large as *C. philippinensis*. It differs from *C. hawaiiensis* Dall, 1920, in having a nonflexible calcareous shell and from *C. californica* Berry, 1921, in having a nongranular inner surface and a more posterior position of the apex of the upper shell. From *C. valdiviae* Helmcke, 1940, described from St. Paul Island, it differs in lacking spines on the upper valve, and from *Crania* sp., described by Cooper (1954a) from Bikini Atoll (Marshall Islands) it differs by its larger size, by the more posterior position of the apex and by the more steep posterior slope of the upper valve. Finally, *Crania indonesiensis* differs from all other known *Crania* by the very posterior position of the apex and by the almost vertical posterior slope of the upper valve with its straight posterior margin.

Family CRYPTOPORIDAE Muir-Wood, 1955

Cryptopora gnomon Jeffreys, 1869

Text-fig. 2

Cryptopora gnomon Jeffreys, 1869a: 136; Helmcke 1940: 72, figs 34, 35d; Wesenberg-Lund 1941: 14-15, chart 9; Cooper 1954b: 364; 1959: 22, pl. 5, 16, pl. 21, 7-14; 1973b: 11, pl. 8, 14-16; Muir-Wood 1959: 292, pl. 5, 2; Zezina 1975: 909-910, figs 8-9. *Atretia gnomon*, Jeffreys 1869b: 421; 1876: 251; 1878: 412, pl. 23, 4a-c; Davidson 1887: 173, pl. 25, 6-14; Dall 1920: 293.

Neatretia gnomon, Fischer & Oehlert 1891: 122, fig. 11; Wesenberg-Lund 1939: 201.

Material:

“Galathea” St. 626. 20 Jan. 1952. 42°10'S, 170°10'E, Tasman Sea, 610 m. Sigsbee trawl. Globigerina ooze. - 1 pedicle valve.

“Dmitry Mendeleev” St. 1300. 28 Jan. 1976. Hjort Trench, 5950 m. Grab. Siliceous mud. - 1 empty shell.

Remarks: Both examined specimens differ from the Australian *Cryptopora brazieri* Crane, 1886, in the absence of lateral ridges on the beak and are identical to North Atlantic specimens. The pedicle valve (St.

626) is 3.8 mm long. The specimen from St. 1300 is smaller (2.1 mm long and 1.6 mm wide), but adult.

The pedicle valve is the first occurrence of cryptopod Brachiopoda near New Zealand. The empty shell is the most southern occurrence of the Cryptoporidae and the deepest occurrence of the order Rhynchonellida, but unfortunately we cannot guess how deep the specimen originally lived. The two examined specimens together with the specimen collected by the Vema Expedition in the South Atlantic northeast of the Falkland Islands (Cooper 1973b) form a very interesting pattern of geographical distribution (Fig. 2), which can be called an “Atlantic - Southern Ocean pattern” as compared with a “Pacific - Southern Ocean pattern”

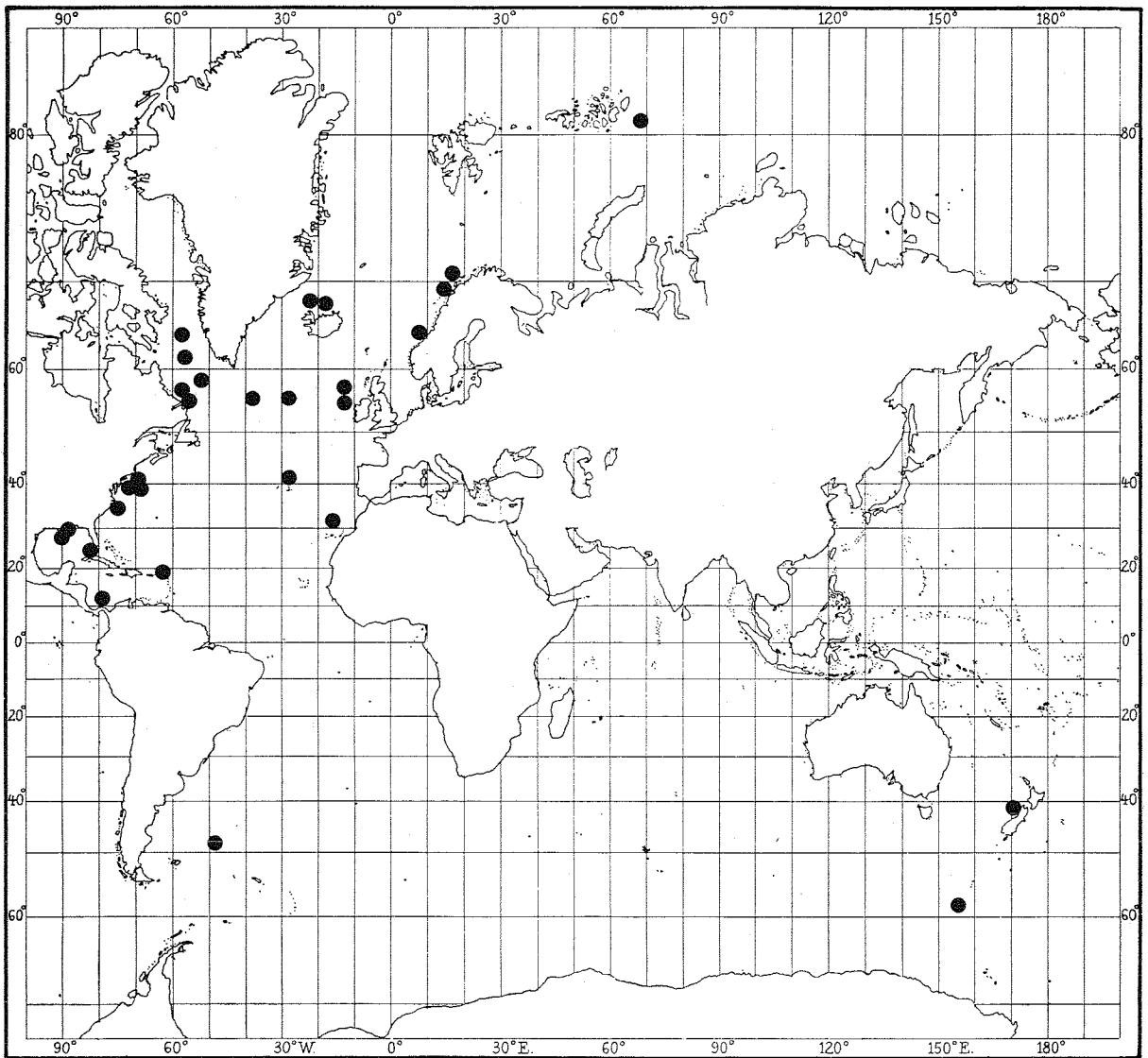


Fig. 2. Geographical distribution of *Cryptopora gnomon* Jeffreys. “Atlantic-Southern Ocean pattern” of distribution.

(Zezina 1976: 91, fig. 19), known for the deep-sea brachiopod species *Abyssothyris wyvillei* (Davidson). Differences between Atlantic-Southern Ocean and Pacific-Southern Ocean patterns of geographical distribution suggest different centres of origin for these deep-sea species, among which *C. gnomon* is eurybathic, living specimens being known from 300 m to 4060 m.

Family BASILIOLIDAE Cooper, 1959

Subfamily BASILIOLINAE Cooper, 1959

Basiliola pompholyx Dall, 1920

Basiliola pompholyx Dall, 1920: 291; Jackson & Stiasny 1937: 10, pl. 1, 6-9; Cooper 1959: 27, pl. 12, 1-15.

Material:

Th. Mortensen Pacific Exp. 3 Mar. 1914. 25 miles E. by S. of Zamboanga, the Philippines, 300-370 m. Sigsbee trawl. Hard bottom. - 1 specimen.

Remarks: The shape and the size (22.1 mm long, 21.7 mm wide, 19.2 mm high) is typical for *B. pompholyx*, but the long, weakly diverging crura of the specimen are more characteristic for two other species, also known near the Philippines: *B. beecheri* (Dall, 1895) and *B. elongata* Cooper, 1959, both of which, however, have more elongate and smaller shells. It is probable that the large and wide *B. pompholyx*, known from the Philippines, Borneo, Celebes and Kei Islands, and the small and elongate *B. elongata*, known from the Philippines and Kei Islands, are the extreme variants of the medium-sized *B. beecheri* from Hawaii. Thus *B. beecheri* s. l. has a rather wide geographical distribution in the tropical western Pacific from the Philippines to the Kei Islands and from Borneo to Hawaii. The present specimen is the most shallow occurrence of *B. pompholyx*, which has previously been known from 558 to 1070 m and from 2021 m (empty shell). However, the depth of the present specimen is typical for *B. beecheri* (262-573 m) and for *B. elongata* (280-487 m).

Eohemithyris colurnus (Hedley, 1905)

Hemithyris colurnus Hedley, 1905: 44, figs 7-8; Dall 1920: 288.

Aetheia colurna, Thomson 1927: 157.

Eohemithyris colurnus, Cooper 1959: 23, pl. 15, 12-26.

Material:

Th. Mortensen Pacific Exp., R/S "Endeavour". 16 Sep. 1914. 38°12'S, 149°40'E, eastern Bass Strait, 200-300 m. Ring trawl. Mixed bottom. - 1 specimen.

Remarks: This is the most southern occurrence of the species, which has previously been known off the eastern shores of Australia from Cape Byron (28°S) to Gabo Island (37°35'S), at 188-203 m.

ACANTHOBASILIOLINAE n. subfam.

Diagnosis: Basiliolidae with crura attached to narrow outer hinge plates; thick median ridge present in brachial valve; outer surface of the shell covered by spines.

Type genus: *Acanthobasiliola* nov. gen.

Comparison: This subfamily differs from Basiliolinae Cooper, 1959, in the presence of a median ridge in the brachial valve; from Aphelesiinae Cooper, 1959, in the presence of narrow outer hinge plates; from Aetheiinae Cooper, 1959, in the absence of inner hinge plates; from Lacunosellinae Smirnova, 1963, in the absence of broad dorsal crural plates. Furthermore, the subfamily differs from all these subfamilies in having spines on the outer surface of the shell.

Acanthobasiliola n. gen.

Diagnosis: Shell transversely oval, inflated, with uniplacate frontal commissure. The shell resembles *Basiliola* in shape, but differs in that its outer surface is covered with spines. Beak small and erect, with complete foramen, strong pedicle collar and weak dental plates. Crura short, falcifer, with small festoons at anterior margins. Outer hinge plates narrow, inner hinge plates absent. Brachial valve with a thick median ridge.

Type species: *Rhynchonella doederleini* Davidson, 1886.

Comparison: *Acanthobasiliola* is the only genus in the subfamily, and it differs from all other basiliolid genera by the same features as the new subfamily differs from the other subfamilies (see above). *Acanthobasiliola* resembles *Tegulorhynchia* Chapman

& Crespin, 1923, in having spines at the outer surface and in having the median ridge in the brachial valve, but differs in the morphology of the crura, which is a character at the family level (see remarks to *A. doederleini*).

Acanthobasiliola doederleini (Davidson, 1886)

Pl. 2, Figs 1-3

Rhynchonella doederleini Davidson, 1886a: 1; 1887: 172-173, fig. 19, pl. 25, 14-15.

Rhynchonella doederleini, Leidhold 1922: 423-470, pl. 11-15.

Hemithyris doederleini, Dall 1920: 287.

Tegulorhynchia doederleini, Jackson & Stiasny 1937: 9-10, pl. 2, 28-33; Hatai 1940: 214-215, pl. 8, 57, 58, 70, 71; Cooper 1957: 6-7, pl. 1, 34-51.

Material:

St. 15, Th. Mortensen Java-S. Africa Exp. 10 Apr. 1929. 7°29'S, 114°49'E, 240 m. Sigsbee trawl. Sand and mud with concretions. - 11 specimens.

Remarks: The species has previously been reported from near Borneo and the Philippines and also in Sagami Bay (Japan) at 293-635 m. The present specimens possess falcifer crura with festoons at anterior margins. This feature is characteristic on both old and young specimens. The crura of *Rhynchonella doederleini* were not figured in the original description of the species, but they were described as "short curved lamellae". A more precise description is given by Leidhold (1922: 426): "Am Hinterrand der inneren Zahngrubenwände beginnen die beiden kurzen, gekrümmten Crura, deren Innenfläche flach ausgehöhlt und längsgestreift, während ihre freie Endigung, der vordere Rand, gezähnt ist". Thus, the crura are falcifer, but later this feature was overlooked. In Thomson's monograph (1927) we find the species in the genus *Tegulorhynchia* Chapman & Crespin, 1923, without any note on the form of the crura. In more recent surveys (Cooper 1959; Ager 1965) *R. (T.) doederleini*, together with other species of the genus *Tegulorhynchia*, is considered as a member of the family Hemithyrididae Rzhonsnitskaya, 1956, possessing radulifer crura. It is now clear that since *doederleini* possesses falcifer (not radulifer) crura it cannot belong to the family Hemithyrididae, but must be referred to a new genus in the family Basiliolidae. The new genus *Acanthobasiliola* is valid, if the type species of the genus *Tegulorhynchia* (the

tertiary *Rhynchonella squamosa* Hutton, 1873, from New Zealand) actually has radulifer crura. However, "curved crura" can be interpreted either as meaning radulifer or falcifer ones. Thus, if *Rh. squamosa* also has falcifer crura, i. e., if it is similar to *Rh. doederleini*, the new genus *Acanthobasiliola* should be considered as a synonym of *Tegulorhynchia*, which should form a new subfamily Tegulorhynchiinae in the family Basiliolidae.

Family FRIELEIIDAE Cooper, 1959

Grammetaria bartschi (Dall, 1920)

Hemithyris bartschi Dall, 1920: 289.

Grammetaria bartschi, Cooper 1959: 58-59, pl. 4, 4-5, pl. 9, 1-12.

Material:

"Galathea" St. 477. 11 Sep. 1951. 9°01'S, 114°48'E, S. of Bali, 780 m. Grab. Sandy clay. - Fragment of a shell with the cardinalia.

Remarks: The fragment has a broken crura but shows inner hinge plates joined with the septum, strong dental plates and well-preserved deltidial plates which are joined together anteriorly and folded back posteriorly near the apex of the beak. All features of the fragment are in accordance with Dall's description and Cooper's illustrations. The "Galathea" specimen is the deepest and the most eastern occurrence of the species, which was previously known from near the Philippines (off Jolo) and in the Molucca Pass (off Makyan Island), at 295-545 m. Unfortunately, only empty shells of the species are known.

Sphenarina ezogremena n. sp.

Pl. 2, Figs 4-7

Material:

St. 15, Th. Mortensen Java - S. Africa Exp. 10 Apr. 1929. 7°29'S, 114°49'E, 240 m. Sigsbee trawl. Sand and mud with concretions. - 1 young specimen.

Description: Shell small and smooth, 4.8 mm long and 3.9 mm wide, with rounded anterior margin and rectimarginate commissure. Foramen triangular, open; deltidial plates auriculate. Pedicle valve with dental plates and pedicle collar. Dentalia and dental sockets marked with transverse ribs. Crura broad an-

teriorly and flattened laterally. Inner hinge plates very narrow. Crural bases attach the floor of the valve at their posterior part. There is a median groove in the brachial valve with a low ridge on either side of the groove.

Comparison: The specimen resembles the Pliocene Mediterranean *Sphenarina* in having a rectimarginate anterior commissure, auriculate deltidial plates, flattened crura, and in lacking the septum or median ridge in the brachial valve. The specimen differs from the type species of the genus, *S. sicula* (Seguenza), in having a rounded shell, an open foramen, and narrow hinge plates and by lacking radial striation on the surface of the shell. The first and the second differences may be features which change during growth of the shell. Very narrow inner hinge plates can be seen in the specimen with soft parts (as in the one in Dr. Mortensen's collection), and may be overlooked in fossils. The absence of radial striation on the shell must be considered a specific feature.

Remarks: This is the first Recent occurrence of the genus *Sphenarina*. The specific name means "that which survived" from the Greek word *ezogreménos*.

Family TEREBRATULIDAE Gray, 1840

Gryphus davidsoni (Adams, 1867)

Terebratula davidsoni Adams, 1867: 314, pl. 19, 30 (see Dall, 1920).

Terebratula minor Davidson, 1871: 302, pl. 30, 10.

Liothyris vitrea var. *davidsoni*, Davidson 1886b: 9-10, pl. 1, 14-16.

Gryphus davidsoni, Dall 1920: 319; Hatai 1940: 261, pl. 1, 5, 6, 11, 12, 14, 17.

Material:

"Galathea" St. 477. 11 Sep. 1951. 9°01'S, 114°48'E, South of Bali, 780 m. Grab. Sandy clay. - 1 brachial valve.

Remarks: The brachial valve of the empty shell with a broken loop and broken anterior margin is slightly more than 14 mm long. There is a fanlike low cardinal process in the valve. Four low septal ridges separate the muscular depressions anterior to the cardinal process and form a design agreeing with that of the grooves in *G. vitrea* (Born, 1778). The specimen is the deepest and the most southern known occurrence of the species, which has

previously been found near the southern and southeastern shores of Japan from the Korea Strait to Tiba, at 101-223 m. Although the "Galathea" specimen is imperfect, there is no doubt as to its identification.

Gryphus borneoensis Dall, 1920

Pl. 3, Figs 1-2

Gryphus borneoensis Dall, 1920: 314; Jackson & Stiasny 1937: 13, pl. 2, 19-23.

Material:

St. 15, Th. Mortensen Java-S. Africa Exp. 10 Apr. 1929. 7°29'S, 114°49'E, 240 m. Sigsbee trawl. Sand and mud with concretions. - 1 damaged specimen.

Remarks: The specimen is represented by the posterior part of the shell with a well-preserved loop, body wall and part of the lophophore and also by some fragments of the pedicle valve. The length of the shell, reconstructed with the fragments of the pedicle valve, is about 55 mm. The outer surface is covered with a light brown periostracum. The loop is not broad, but has sharp lateral angles. The cardinal process is shelflike. There are large elongated starlike spicules in the dorsal body wall. Spicules in lophophore do not form cirri socles, but there is a broken chain of thin sticklike spicules in every cirrus (or tentacle). The species was known before in the seas of the western Pacific, at 275-930 m, and (?) 1300-1633 m. The new occurrence is the most shallow-water and the most southern one.

Dallithyris sp.

Pl. 3, Figs 3-6

Material:

St. 15, Th. Mortensen Java-S. Africa Exp. 10 Apr. 1929. 7°29'S, 114°49'E, 240 m. Sigsbee trawl. Sand and mud with concretions. - 1 young specimen.

"Galathea" St. 500. 25 Sep. 1951. 7°34'S, 132°44'E, Arafura Sea, 390 m. Dredge. Coral sand and stones. - 1 adult damaged specimen.

Remarks: The young specimen is 6.8 mm long and 5.9 mm wide. The loop is rounded and occupies one fourth of the length of the valve. The crura are almost parallel, and the transverse band is rather broad, with a somewhat narrower middle part. The cardinal process is absent or broken. The deltidial

plates are conjunct. There are three rows of starlike perforated spicules in the dorsal body wall. Spicules in lophophore form cirri socles at the dorsal part of the lateral lobes, but the socles become slighter anteriorly and disappear ventrally.

The adult specimen from the "Galathea" is badly damaged. Only the posterior part is preserved. The shell is glasslike, almost translucent. There is a smooth well-developed symphytium. The loop with parallel crura and very broad transverse band is typical for the genus *Dallithyris* Muir-Wood, 1959. The spicules in the dorsal body wall look like strongly perforated stars. Spicules in the tentacles are echinate and numerous, especially near the base, but do not form cirri socles.

The two specimens look like a species of *Dallithyris* at different stages of its development. They resemble *Terebratulina sternsi* Dall & Pilsbry, 1891, which has been transferred to the genus *Gryphus* by Hatai (1940), but which possesses all the features of the genus *Dallithyris*. However, *T. sternsi* seems to have different spicules in the body wall (Hatai 1940, pl. 12, 1) than these two specimens. Unfortunately, the specimens under consideration are not suitable for describing a new species of *Dallithyris*.

Family CANCELLOTHYRIDIDAE

Thomson, 1926

Terebratulina callinome Dall, 1920

Terebratulina callinome Dall, 1920: 303-304; Jackson & Stiasny 1937: 13, pl. 1, 10, 10a, 11; Hatai 1940: 233-234; Cooper 1973a: 375-376, pl. 44, 18-28.

Material:

Th. Mortensen Pacific Exp. 3 Mar. 1914. E. by S. of Zamboanga, the Philippines, 370-300 m. Sigsbee trawl. - 1 young specimen.

? "Galathea" St. 488. 12 Sep. 1951. 8°49'S, 115°19'E, S. of Bali, 202 m. Grab. Corals, shells and gravel. - 1 pedicle valve of empty shell.

Remarks: The Mortensen Exp. specimen is 18.1 mm long, 14.8 mm wide and 7.6 mm high. This is small for the species, and the condition of gonads shows that the specimen is not adult. Perhaps this is the reason why it possesses a small rounded loop similar to that of the specimen shown by Jackson & Stiasny (1937, pl. 1, 11), and differing from that of the holotype (Cooper 1973a, pl. 44, 28). The loop of the

Mortensen specimen is similar also to the loop of *T. hataiana* Cooper (1973a, pl. 43, 14-15). However, the attachment of the crura and the form of the posterior part of the brachial valve in *T. hataiana* and in the Mortensen specimen are different. Spicules in the dorsal body wall are starlike, with long rays, and are elongated dorso-ventrally. There is one main row of spicules and two additional ones at the base of the lophophore and near the brachial shell.

The shell collected by the "Galathea" is 23.1 mm long. It is the most southern occurrence of the species, which has previously been known from Hondo Island, the Philippines and Borneo, at 124-635 m. Unfortunately, the empty pedicle valve can not be identified with full confidence.

Terebratulina reevi Dall, 1920

Terebratulina reevi Dall, 1920: 305-306 (part); Cooper 1973a: 379, pl. 42, 19-33.

Material:

Th. Mortensen Java-S.Africa Exp. St. 15, 10 Apr. 1929. 7°29'S, 114°49'E, 240 m. Sigsbee trawl. Sand and mud with concretions. - 11 specimens.

"Galathea" St. 488. 12 Sep. 1951. 8°49'S, 115°19'E, S. of Bali, 202 m. Grab. Corals, shells and gravel. - 1 empty shell.

"Galathea" St. 500. 25 Sep. 1951. 7°34'S, 132°44'E, Arafura Sea, 390 m. Rectangular dredge. Coral sand and stones. - 4 specimens.

Remarks: All the present specimens have the features typical for the species in spite of their larger size. Three largest Mortensen specimens have the following shell dimensions (mm):

Specimen no.:	Length	Width	Height
1	23.0	17.0	8.5
2	20.0	14.5	10.5
3	17.6	14.0	6.5

All new occurrences are more southern than those previously known for the species, viz. from near the Philippines and Borneo, at 18-969 m depth.

Terebratulina pacifica Yabe & Hatai, 1934

Terebratulina pacifica Yabe & Hatai, 1934: 661, figs 22-24, 29; Hatai 1940: 230-232, pl. 6, 28-30, 32-35, 41-44, 47, 71, 102-105.

Material:

Great Northern Telegraph Co. 25 June 1933.
32°26'N, 128°37'E, east of Kyusyu Island, 250 m. -
1 specimen.

Remarks:

The species is common off the southern and southeastern shores of Japan from Kyushu to Yokohama at 102-820 m. The present specimen is 16.6 mm long, 13.4 mm wide and 8.3 mm high. There are two rows of starlike, almost round, spicules with short rays in the dorsal body wall. The net of spicules in the lophophore is very dense. The form of the loop is similar to that of *T. callinome*, collected by the Mortensen Expedition.

Terebratulina ?valdiviae Blochmann, 1908

Terebratulina valdiviae Blochmann, 1908: 601, 639, pl. 36, 5-6.

Material:

"Galathea" St. 212. 24 Feb. 1951. 20°08'S, 35°33'E, off Beira, Mozambique, 200 m. Grab. Gravel with many shells and blocks of coral. - 1 empty shell and 2 pedicle valves.

Remarks: The shell most closely approaches *T. valdiviae* which is well known in the Indo-Malayan Archipelago at 73-1264 m. The two pedicle valves are from another species of *Terebratulina* which cannot be identified precisely because of the polished condition of the valves.

Family DALLINIDAE Beecher, 1893

Campages furcifera Hedley, 1905

Campages furcifera Hedley, 1905: 43-44, figs 5-6; Dall 1920: 364; Thomson 1927: 249-251, fig. 81.

? *Campages asthenia* Dall, 1920: 365; Jackson & Stiasny 1937: 15, pl. 1, 1-3.

Material:

"Galathea" St. 488. 12 Sep. 1951. 8°49'S, 115°19'E, S. of Bali, 202 m. Grab. Corals, shells and gravel. - Fragment of an empty brachial valve.

Remarks: The brachial valve is 21.5 mm long and comprises the posterior part with inner and outer hinge plates and with the septum, which almost

reaches the anterior margin. The place where the loop has been attached to the septum is visible. The shape of the valve is more rectangular than triangular and conforms to Hedley's figure, repeated by Thomson. The fold of the anterior commissure is deep.

The "Galathea" specimen is the northernmost occurrence of the species, which has previously been known from the eastern shelf of Australia from Cape Byron to Gabo Island, at 203-265 m.

The differences between *C. furcifera* and *C. asthenia*, pointed out by Dall (1920: 365), are not sufficient for a definite separation of these two species. Dall's notes are: "This agrees in its characters with *C. furcifera*, but is less arcuate, has a much feebler fold, and the anterior part of the loop is less elevated". These differences can be caused by variation in age, or by ecological variation, related to the depth of the habitat. The specimens collected by the "Siboga" Expedition near Timor (390-1224 m) and in the Celebes Sea (1165-1264 m) were identified by Jackson & Stiasny (1937: 15) as *C. asthenia*, in spite of their sharply triangular shape, although according to Dall (1920), *C. asthenia* has a subrectangular shape. Apparently this feature can also be a subject of intraspecific variation. If *C. asthenia* is a synonym of *C. furcifera*, the species is distributed in the western Pacific from the Philippines to Gabo Island (New South Wales), at 202-1264 m.

Campages (?) sp.

Material:

"Galathea" St. 500. 25 Sep. 1951. 7°34'S, 132°44'E, Arafura Sea, 390 m. Rectangular dredge. Coral sand. - Fragment of a brachial valve with loop and lophophore.

Remarks: The brachial valve, 23 mm wide and more than 20 mm long (broken anteriorly), possesses the septum, which extends anteriorly to the middle of the valve and posteriorly joins the interior hinge-plates. The exterior hinge plates are concave. The loop joins the septum near the middle of its length. The anterior part of the valve is broken, but it can be seen that the anterior commissure was sulcate. The exterior surface, covered with yellowish brown periostracum, is smooth except for concentric lines of growth. All these features resemble those of *Campages basilanica* Dall, 1920; this, however, is smaller (14 mm long) than the "Galathea" specimen, which has no cardinal

process and possesses spicules in the body wall. In these two features the specimen differs from all known species of *Campages*, but the fragment is not suitable for the description of a new species.

Jolonica hedleyi Dall, 1920

Campages (Jolonica) hedleyi Dall, 1920: 366-367.

Jolonica hedleyi, Thomson 1927: 248; Jackson & Stiasny 1937: 16, pl. 2, 24-27.

Material:

"Galathea" St. 488. 12 Sep. 1951. 8°49'S, 115°19'E, S. of Bali, 202 m. Grab. Corals, shells and gravel. - Brachial valve of empty shell.

Remarks: The valve is 28.9 mm long and 24.5 mm wide. It is larger than the type specimen from the Philippines (18 mm long) and than the largest Siboga specimen from near the Sulu Islands (26.4 mm long). The "Galathea" valve is more elongated than that of other known specimens. The ventral part of the loop is broken. The septum extends one-third of the length of the valve. The anterior part of the valve shows a broadly sulcate rectangular commissure.

The "Galathea" specimen is the most southern and the most shallow-water occurrence of the species, which has previously been known from near the Philippines and the Sulu Islands, at 275-562 m.

Septicollarina n. gen.

Diagnosis: Dallinid brachiopods with a campagiform loop, a long septum in brachial valve and a short one in pedicle valve. With straight strong parallel dental plates forming two large side pockets. Pedicle collar as wide as the dental plates. Septum in pedicle valve as long as width of pedicle collar and divides the space under the collar into two equal rooms. Anterior commissure slightly sulcate. Pedicle valve covered by few low spines, brachial valve smooth.

Type species: *Septicollarina hemiechinata* n. sp.

Comparison: The genus differs from *Campages* Hedley, 1905, in having strong dental plates. From all other dallinid genera it differs in having a short septum, which supports the pedicle collar in the pedicle valve, and in having spines on the exterior surface of the pedicle valve, while the brachial valve is smooth.

Septicollarina is similar to *Aulacothyropsis* Dagys,

1959 (from upper Triassic of the Alps, the Balkan Mts., Crimea, the Caucasus and the Pamirs), in having strong parallel dental plates, a well-developed pedicle collar, a short median septum in the beak of the pedicle valve (Dagys 1974: 204, fig. 149) and a campagiform loop. As in *Aulacothyropsis*, the loop of *Septicollarina* joins the median septum at the early stages, but right and left parts of the loop in *Septicollarina* are conjunct, while in *Aulacothyropsis* they are disjunct. Dagys (1974: 204) considers the disjunction of the right and left parts of the loop as a feature of the family Aulacothyropsidae Dagys, 1972. *Septicollarina* differs from all other genera of Aulacothyropsidae in its beak characters. In spite of similarity of *Septicollarina* to the type genus of the Triassic family, I place the new genus in the family Dallinidae because of the conjunct right and left parts of the loop.

Septicollarina hemiechinata n. sp.

Text-fig. 3, Pl. 1, Figs 4-7

Material:

St. 15, Th. Mortensen Java-S.Africa Exp. 10 Apr. 1929. 7°29'S, 114°49'E, 240 m. Sigsbee trawl. Sand and mud with concretions. - 1 specimen.

Description: Shell transversely oval, almost round, with a straight low beak whose height is about one-

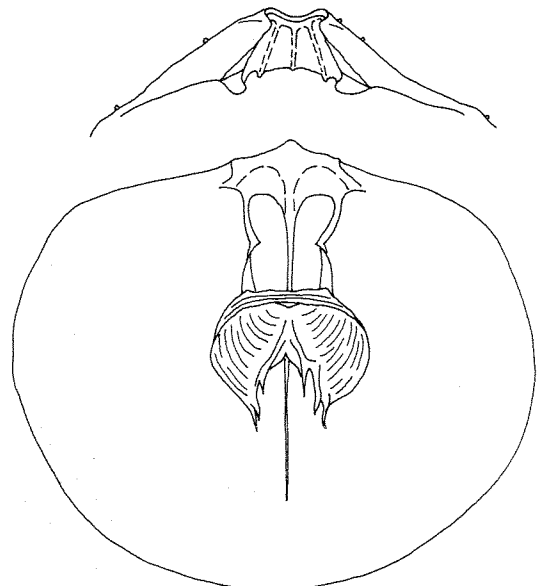


Fig. 3. *Septicollarina hemiechinata* n. gen., n. sp. Interior views of the pedicle valve with the pedicle collar, and of the brachial valve with the loop and cardinalia.

seventh of the length of the pedicle valve. Valves thin and semitranslucent. Pedicle valve covered exteriorly by few low spines. Brachial valve smooth, without spines. Anterior commissure of the valves slightly sulcate. Foramen permesothyrid, open; deltidial plates narrow, elongated triangular. Dentalia rounded and slightly hooked. Straight and strong dental plates forming two large side pockets. A short median septum present in posterior part of pedicle valve, supporting the pedicle collar and dividing the space under it into two equal chambers. Length of the septum equal to width of the pedicle collar. Cardinal process lacking. Interior hinge plates joining a median septum which extends three-fourths of the length of the brachial valve. Loop campagiform with large thorns anteriorly, where the descending branches bend over to become the ascending branches. Length of loop (which is not adult) about half the length of the valve.

The specimen is young; its gonads are not developed and look like double-branched white objects under the crural bases and near the dental plates. The pedicle valve is 6.9 mm long, the brachial valve is 6.0 mm long, and the shell is 7.0 mm wide and 3.4 mm high.

Family LAQUEIDAE Thomson, 1927

Laqueus rubellus (Sowerby, 1846)

Terebratula rubella Sowerby, 1846: 94; 1847: 350, pl. 69, (see Dall 1920).

Laqueus rubellus, Davidson 1887: 113, pl. 19, 1-5; Dall 1920: 352; Hatai 1940: 345, pl. 3, 37-38, pl. 5, 31-32, 39-45, 57-58, pl. 7, 30-32; Okaeda 1960: 26, pl. 13, 13.

Material:

Th. Mortensen Pacific Exp. 29 June 1914. Okinose, Sagami Bay, Japan, 550 m. Dredge. Hard bottom. - 2 specimens.

30 June 1914. Off Misaki, Japan, 370 m. Dredge. Sand. - 3 specimens.

Remarks: The species is common around Japan, at 42-499 m.

Family TEREBRATELLIDAE King, 1850

Jaffaia jaffaensis (Blochmann, 1910)

Magasella jaffaensis Blochmann, 1910 (in Verco) 1910: 92, pl. 27, 6-9.

Campages jaffaensis, Hedley 1911: 114, pl. 20, 41-42; Dall 1920: 367.

Jaffaia jaffaensis, Thomson 1927: 254-255.

Material:

Th. Mortensen Pacific Exp., R/V "Endeavour". 15 Sep. 1914. 39°10'S, 149°55'E, Bass Strait, 350-450 m. Ring trawl. Soft bottom. - 1 young broken specimen on Coelenterata.

16 Sep. 1914. 38°12'S, 149°40'E, 180-300 m. Ring trawl. Mixed bottom. - 1 young specimen.

Remarks: Two specimens are 2 mm and 9 mm long. The species is known from Australia (Cape Borda to Sydney) and the Tasmanian shelf, at 73-549 m.

PHANEROPORIDAE n. fam.

Diagnosis: Terebrateloid brachiopods with entire umbo in brachial valve and a high septum, reaching the bottom of pedicle valve. Descending branches of loop attach the septum immediately or are replaced anteriorly by spicules which fill the lophophore. Ascending branches of loop absent. Dental plates more or less developed.

Type genus: *Phaneropora* n. gen.

Comparison: Phaneroporidae differs from most terebrateloid families (Kraussinidae, Dallinidae, Terebratellidae) in lacking ascending branches in the loop. It differs from Platidiidae in having an entire umbo in the brachial valve and from Megathyrididae in having dental plates and a zigolophous lophophore.

The new family resembles the rhynchonelloid family Cryptoporidae Muir-Wood, 1955, in the shape of the shells and in the morphology of the cardinalia. These two families represent a good example of homeomorphy in recent brachiopods. It is easy to distinguish the shells of Phaneroporidae from the shells of Cryptoporidae by the poriferous valves of the former.

Remarks: Besides *Phaneropora* the new family includes the genus *Leptothyrella* Muir-Wood, 1965 (nom. subst. pro *Leptothyris* Muir-Wood, 1959), which was not included in any family by Muir-Wood. Therefore three species are now known in the Phaneroporidae: *Phaneropora galathea* n.sp. from the S. W. Pacific and Great Australian Bight, (240 m), 390-755 m and (1320-1640 m)¹; *P. incerta* (Da-

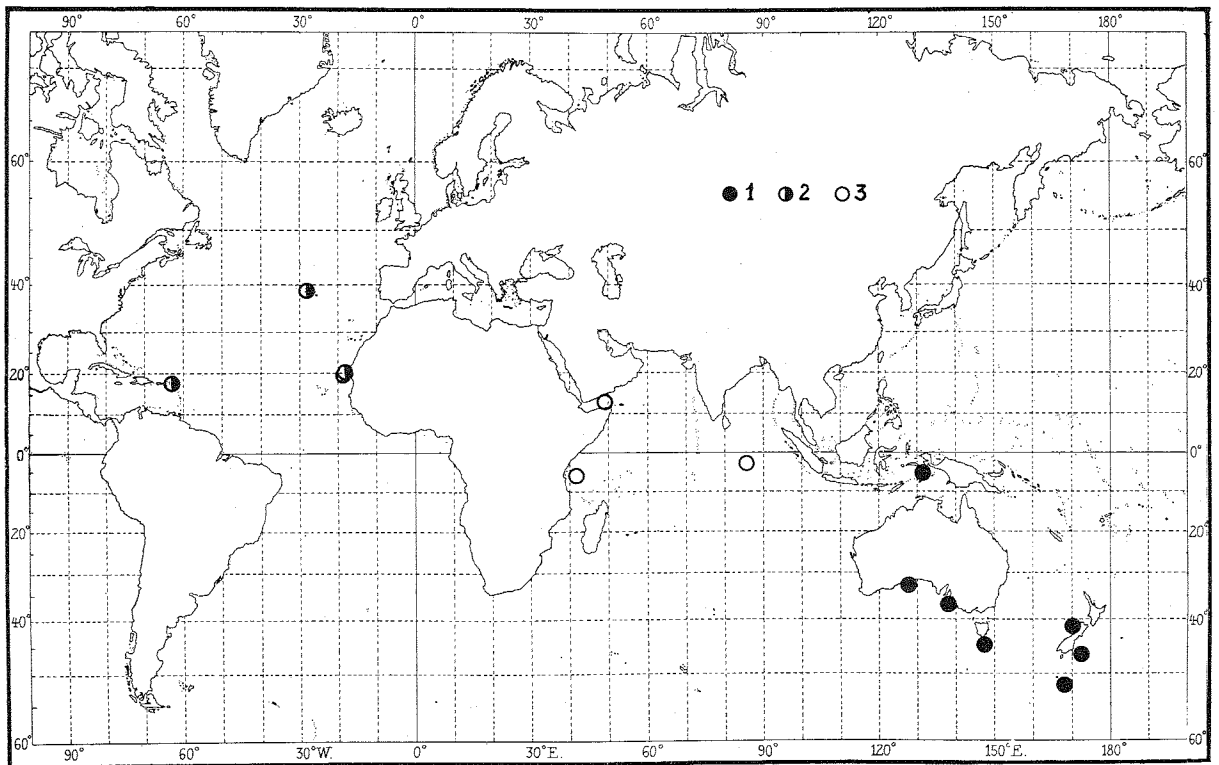


Fig. 4. Geographical distribution of the family Phaneroporidae n. fam. 1, *Phaneropora galathea* n. sp.; 2, *P. incerta* (Davidson); 3, *Leptothyrella ignota* Muir-Wood.

vidson, 1878) from the Atlantic, 713-2995 m; and *Leptothyrella ignota* (Muir-Wood, 1959) from the Indian Ocean, 2000-4737 m. The geographical distribution of the family is shown in Fig. 4.

***Phaneropora* n. gen.**

Diagnosis: Shell droplike. Valves equally convex, smooth, punctate. Sides of beak more or less regularly tuberculate. Dental plates well developed. No hinge plates or cardinal process. Descending branches of a loop attach to a high septum by narrow ribbons or are replaced anteriorly by spicules which fill the lophophore. Septum platelike at its base and sticklike at its top. Ascending branches of loop absent. Lophophore zigolophous.

Type species: *Phaneropora galathea* n. sp.

Comparison: *Phaneropora* is distinct from *Leptothyrella* in having a sticklike top of septum, strong dental plates, and a zigolophous lophophore and in lacking a cardinal process. Differences between the

spirolophous lophophore of *Leptothyrella* and the zigolophous one of *Phaneropora* are problematic because both patterns of lophophore are similar at early stages of development.

Remarks: Besides the type species, *Phaneropora* includes the rare species *Magasella incerta* Davidson, 1878, which was considered by Davidson (1880: 47, 48; 1887: 101) and by Thomson (1927: 268) as a young stage of some unknown terebratulacean species and was included by Fisher & Oehlert (1891: 128) in the genus *Platidia* Costa, 1852, with some hesitation. However, *M. incerta* differs essentially from all previously known terebratellacean genera as well as from *Platidia*. Muir-Wood (1959: 309) had found some differences between *L. ignota* and *M. incerta*, but these differences must be studied more precisely. Most of known features of *M. incerta* resemble the features of *P. galathea*.

1. Depths of empty shells occurrences are given in brackets.

Phaneropora galathea n. sp.

Pl. 4, Figs 1-7

Material:

"Galathea" St. 500. 25 Sep. 1951. 7°34'S, 132°44'E, Arafura Sea, 390 m. Rectangular dredge. Coral sand. - 1 specimen.

St. 554. 5 Dec. 1951. 37°28'S, 138°55'E, Great Australian Bight, 1320-1340 m. Sigsbee trawl. Globigerina ooze. - 1 shell, holotype.

St. 626. 20 Jan. 1952. 42°10'S, 170°10'E, Tasman Sea, 610 m. Sigsbee trawl. Globigerina ooze. - 3 shells.

"Dmitry Mendeleev" St. 1275. 13 Jan. 1976. 46°16.0'S, 173°10.8'E, New Zealand Plateau, 1640 m. Grab. Foraminifera ooze. - 1 shell.

St. 1278. 15 Jan. 1976. 51°47.0'S, 169°32.2'E, New Zealand Plateau, 240 m. Grab. Foraminifera sand. - 1 fragment of a pedicle valve.

St. 1345. 20 Feb. 1976. 43°48'S, 147°51'E, near Tasmania, 755 m. Sigsbee trawl. - 37 specimens on gastropod shells.

St. 1371. 27 Feb. 1976. 33°33'S, 127°17'E, Great Australian Bight, 730 m. Mini-trawl. Foraminifera ooze with spicules of sponges and volcanic glass. - 1 shell.

Description: Shell droplike. Valves equally convex, smooth, punctate (170-225 pores per 1 mm² in middle part of brachial valve). Each side of beak with a row of tubercles. With well-developed dental plates. Cardinal process and hinge plates absent. Straight posterior margin of brachial valve formed by inner socket ridges. Descending branches are solid in

their posterior parts and form an obtuse angle with crura, but in their anterior parts they are replaced by numerous spicules of lophophore, which attach to the high septum in the brachial valve. Septum platelike at the base and sticklike at the top. Ascending branches absent. Lophophore zigolophous.

Comparison: The new species differs from *P. incerta* (Davidson) in that the descending branches do not attach to the septum immediately, but through the spicules of the lophophore.

Remarks: *P. galathea* varies in the height of the beak and in regularity of tuberculation at the sides of the beak. All Australian and New Zealand specimens have regular tubercles, but their number on each side varies from 5 to 8, and a beak height constitutes from 17 to 22% of the length of a pedicle valve. The beak height in the specimen from "Galathea" St. 500 constitutes 26% of the length of the pedicle valve, and only three tubercles are present on one side of the beak, the other side being smooth.

Dimensions (in mm) of the "Galathea" specimens:

Stations and no. of specimens	Length of pedicle valve	Length of brachial valve	Width of shell	Height of shell
St. 500	3.4	2.5	2.6	-
St. 554 (holotype)	3.6	3.0	3.1	1.0
St. 626 (No. 1)	4.2	3.5	3.5	-
St. 626 (No. 2)	3.7	2.9	3.2	1.1
St. 626 (No. 3)	3.0	2.4	2.4	-

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PLATE 1

- Figs 1-3. *Crania indonesiensis* n. sp., $\times 8$; 1, exterior view of the dorsal valve; 2, lateral view of the dorsal valve; 3, interior view of the dorsal valve.
- Figs 4-7. *Septicollarina hemiechinata* n. gen., n. sp., $\times 8$; 4, exterior view of the brachial valve; 5, exterior view of the pedicle valve; 6, interior view of the brachial valve with soft parts; 7, interior view of the pedicle valve.