

THE FAUNA OF THE PORTRANE
LIMESTONE, III
THE CORALS



BY

DIMITRI KALJO

AND

EINAR KLAAMANN

(Institute of Geology, Academy of Sciences of Estonian S.S.R., Tallinn)

Pp. 413 - 434 ; 4 Plates ; 1 Text-figure

BULLETIN OF
THE BRITISH MUSEUM (NATURAL HISTORY)
GEOLOGY

Vol. 10 No. 11

LONDON : 1965

THE BULLETIN OF THE BRITISH MUSEUM
(NATURAL HISTORY), *instituted in 1949, is
issued in five series corresponding to the Departments
of the Museum, and an Historical series.*

*Parts will appear at irregular intervals as they become
ready. Volumes will contain about three or four
hundred pages, and will not necessarily be completed
within one calendar year.*

*In 1965 a separate Supplementary series of longer
papers was instituted, numbered serially for each
Department.*

*This paper is Vol. 10, No. 11 of the Geological
(Palaeontological) series. The abbreviated titles of
periodicals cited follow those of the World List of
Scientific Periodicals.*

© Trustees of the British Museum (Natural History) 1965

TRUSTEES OF
THE BRITISH MUSEUM (NATURAL HISTORY)

Issued December, 1965

Price Eighteen shillings

THE FAUNA OF THE PORTRANE LIMESTONE, III

THE CORALS

By D. KALJO AND E. KLAAMANN

CONTENTS

	<i>Page</i>
I INTRODUCTION	416
II SYSTEMATIC DESCRIPTIONS	416
RUGOSA BY D. KALJO	416
Family STREPTELASMATIDAE Nicholson	417
<i>Kenophyllum</i> sp.	417
<i>Kenophyllum</i> cf. <i>inflatum</i> (Dybowski)	417
<i>Streptelasma fragile</i> Wilson	418
<i>Streptelasma distinctum</i> Wilson	418
<i>Streptelasma</i> cf. <i>rusticum</i> (Billings)	419
<i>Grewingkia europaea</i> (Roemer)	420
<i>Grewingkia hibernica</i> sp. nov.	420
<i>Brachyelasma</i> cf. <i>duncani</i> (Dybowski)	421
<i>Dalmanophyllum subduplicatum</i> (M'Coy)	422
TABULATA BY E. KLAAMANN	422
Family Syringophyllidae Počta	422
<i>Sarcinula</i> sp.	422
Family Lyoporidae Kiaer	423
<i>Reuschia</i> sp.	423
<i>Reuschia</i> ? sp.	424
Family Halysitidae Edwards & Haime	424
<i>Catenipora tapaensis</i> (Sokolov)	425
<i>Catenipora wrighti</i> sp. nov.	427
HELIOLITOIDEA BY E. KLAAMANN	428
Family Coccoserididae Kiaer	428
Coccoserididae gen. et sp. indet.	428
<i>Esthonia asterisca</i> (Roemer)	429
<i>Pragnellia</i> cf. <i>arborescens</i> Leith	430
Family Heliolitidae Lindström	430
<i>Wormsipora hirsuta</i> (Lindström)	430
<i>Wormsipora portranensis</i> sp. nov.	431
Family Proheliolitidae Kiaer	432
<i>Proheliolites dubius</i> (Schmidt)	432
III REFERENCES	433

SYNOPSIS

The present work forms part of a series of papers dealing with the fauna of the Portrane Limestone and contains a description of 20 species of corals—Rugosa, Tabulata and Heliolitoidea—of which three are new. The corals from the Portrane Limestone have much in common with those of the Norwegian 5a and Estonian Pirgu Stages. For this reason it may be assumed that the Portrane Limestone is of early Ashgill age.

All the figured specimens are now in the British Museum (Natural History).

I INTRODUCTION

THE present work, representing a part of the study of the Portrane Limestone fauna, is based on a small collection of corals kindly put at the disposal of the authors by Dr. A. D. Wright of Queen's University, Belfast, to whom they wish to express their sincerest thanks.

The corals were etched out from the rock by chemical methods. As they are considerably silicified and rather fragile, it was not possible to apply the usual method of study by means of thin sections, and the examination was restricted to external observations, and, in the case of the *Rugosa*, to an examination of the visible part of the calice only. In a number of cases, in the course of preparation of the corals by the chemical methods, some skeletal elements were more dissolved than others, or even disappeared altogether, and, as a result, the natural structure had undergone alteration. Therefore the entire collection was not determinable to an equal degree of exactitude, and a large part of it had to be left aside.

However, it has been possible to define an interesting complex of corals, a description of which follows. For each species, the distribution outside Ireland is given. Here it is of interest to note that the majority of the fauna studied is known to occur in Norway and Estonia and some species in the Richmondian of North America. Among them are such typical Upper Ordovician species as *Grewingia europaea* (Roemer), *Catenipora tapaensis* (Sokolov), *Proheliolites dubius* (Schmidt) and others.

A detailed examination of the fauna of the Portrane Limestone proves it to have a great resemblance to that of the Norwegian 5a and Estonian Pirgu Stages. In the complex described, the typical species of the Norwegian 5b and Estonian Porkuni Stages are practically absent. Thus the Portrane Limestone clearly belongs to the early Ashgill.

Recently Kaljo, Klaamann & Nestor (1963) showed that the Ashgillian coral faunas of Estonia and Norway have many features in common. On this basis it may be briefly stated that, commencing with the Ashgillian, a uniform coral fauna was developed throughout the North European zoogeographical province and that it was distributed over a wide area.

II SYSTEMATIC DESCRIPTIONS

RUGOSA

By D. KALJO

The *Rugosa* of the Portrane Limestone are rather varied and numerous. Unfortunately the poor state of preservation does not allow all the details of their structure to be observed, the best preserved and most clearly seen parts being the calices. Whilst studying this material, the author came to the conclusion that the recent investigators of corals have paid too little attention to the calice. The details of its structure are features worthy of specific importance at least. However, the present state of knowledge of the *Rugosa* is such that, before the structure of the calice can be used in taxonomy, it will be necessary to study good material in order

to correlate the characteristic features of the calice with those internal features which are usually given taxonomic importance.

It is of interest to note in the Portrane specimens the presence of a varying scar of fixation which was observed in nearly all of the species examined. These scars may be narrow, slit-shaped (Pl. 1, fig. 6), of varying size, sole-shaped (Pl. 1, fig. 12), or burrow-shaped. Their frequent occurrence and rather considerable size (the scar in Pl. 1, fig. 12, being 32 mm. long and 16 mm. wide in a corallum only 55 mm. long) shows that these rugose corals lived in relatively mobile water where it was necessary to have a firm attachment. The varying shape of the scars points to the fact that fixation occurred either directly on to the rough detrital bottom or on to larger bodies of an elongate or flat shape.

Family **STREPTELASMATIDAE** Nicholson

Genus **KENOPHYLLUM** Dybowski 1873

Kenophyllum sp.

(Pl. 1, figs. 1, 2)

DESCRIPTION. The corallum is simple, medium-sized, horn-shaped, with the proximal part trochoid and the distal ceratoid; the incomplete length is 36 mm. and the diameter 22 mm. The septa are thick and fill the whole lumen in the proximal part, but distally they become slightly thinner, with narrow interseptal loculi between them. The exact number of major septa is not certain, but it approaches 36-38. They reach to the axis, but their axial parts are to some extent separated from the rest of the septa and anastomose with each other, forming a compact axial structure, the elements of which are mostly of an irregular, oblong shape. The peripheral stereozone is narrow. The tabulae are not seen.

REMARKS. The state of preservation of the specimen studied does not allow an exact identification, but it is obviously an undescribed species. The closest form seems to be *Kenophyllum canaliferum* Kaljo (Nabala Stage, Upper Ordovician, Estonia), which, however, differs from the Portrane specimen in external appearance, the number of septa and, probably, the shape of the calice. With respect to the number of septa and, to some extent, the external appearance, the form described also resembles *K. subcylindricum* (Dybowski) (Upper Ordovician, Nabala, Vormsi and Pirgu Stages, Estonia), although the latter has well-developed minor septa.

Kenophyllum cf. ***inflatum*** (Dybowski)

(Pl. 1, figs. 3-5)

DESCRIPTION. The corallum is simple, small, mostly trochoid, the proximal part slightly curved. A deep, saucer-shaped calice makes up about two-thirds of the length of the corallum. The largest specimen measured is 24 mm. in length and 20 mm. in diameter, but more commonly the length varies from 16-19 mm. with a

diameter of 12–16 mm. The septa in the calice are short, but in the proximal part the major septa reach the axis. The major septa vary in number with the growth of the calical diameter, as follows (diameter in mm.: the number of major septa):—12: 24; 13: 28; 15: 30; 20: 33. It may be noted that the increase of the septa distally slows down in comparison with the growth of the diameter—in other words, in the distal direction the intervals between the septa become larger. The minor septa are very short. The cardinal septum may be placed on either the convex or (though less frequently) the concave side of the corallum. The cardinal fossula is small and narrow. No tabulae were observed.

REMARKS. Dybowski (1873: 347) gave a very brief, unillustrated description of *Petraia inflata* of the Estonian Upper Ordovician, which is very closely related to the Portrane specimens, but which is larger, with a greater number of septa. Kaljo (1958: 24), pointing out that *P. inflata* differs from *Kenophyllum siluricum* (Dybowski) only in external appearance, treated both forms as one species. At present, however, the author attributes a greater taxonomic significance to the details of the calice and considers it necessary to revise this group of Rugosa; therefore for the time being he considers the Portrane forms as *K. cf. inflatum* (Dybowski).

In Estonia the corals of the *inflatum* type occur in the Upper Ordovician Vormsi Stage and are rather rare in the lower part of the Pirgu Stage.

Genus *STREPTELASMA* Hall 1847

Streptelasma fragile Wilson

(Pl. 1 figs. 6, 7)

1926 *Streptelasma fragile* Wilson: 11, pl. 1, figs. 1, 2

DESCRIPTION. The corallum is small, slender, ceratoid, the proximal part slightly curved. The largest specimen measured is 24 mm. in length and 9 mm. in diameter. The calice is funnel-like, deep. Septa thin, the cardinal septum placed on the convex side, generally off the plane of the greatest curvature. In the proximal part, the major septa reach the axis, their number being 16–20 in the case of a diameter of 5–6 mm. The minor septa are short, but distinctly visible. Walls thin; no tabulae have been observed.

REMARKS. This splendid, small Rugose coral was described by Wilson (1926) from the Richmondian of the Rocky Mountains. The Portrane specimens agree well with its description, the Canadian specimens differing only in possessing a somewhat deeper calice.

Streptelasma distinctum Wilson

(Pl. 1, figs. 8, 9)

1926 *Streptelasma distinctum* Wilson: 12, pl. 1, figs. 6, 7.

1958 *Streptelasma bystrowi* Reiman: 33, pl. 1, figs. 4–6.

DESCRIPTION. A small or medium-sized, horn-shaped, ceratoid or trochoid simple coral. Calice funnel-shaped with a wide bottom, one side of the calice being more sloping than is usual. The walls thin, the edge sharp. Major septa long, reaching the axis, where they may communicate with each other to some extent, or even intertwine. In the axial region some sparse pali-like structures may be observed. The number of major septa in the calice amounts to 43 (the diameter of the corallum at the bottom of the calice being 18–20 mm.). Minor septa are very short, the peripheral stereozone narrow. Tabulae are strongly convex at the periphery, and in the middle they are wavy.

REMARKS. This species belongs to the group of *Streptelasma corniculum* Hall, one of whose peculiar features is a simple axial complex. In the number of septa, it bears a similarity to *S. orientale* Kaljo (1958: 21, pl. 2, figs. 1–4—from the upper part of the Estonian Middle Ordovician), which, however, differs from it in the arrangement of the septa and the nature of the tabulae. *S. poulsenii* Cox (1937: 9, pl. 2, figs. 8a–c, 9a–b—Cape Calhoun formation, Greenland) is even more similar but differs mainly from it in size and in the flatter and more numerous tabulae.

It is obvious that this group of species requires a thorough revision, based on reliable material.

S. distinctum has been previously described from the Richmond formation of the Rocky Mountains, British Columbia, and from the Pirgu Stage of Estonia.

Streptelasma cf. *rusticum* (Billings)

(Pl. 1, fig. 10)

DESCRIPTION. Simple, medium-sized, ceratoid coral. The specimen is broken and its incomplete length is only 23 mm. The cup-shaped calice has thick vertical walls and a convex floor. The external diameter of the calice is 23–27 mm. and the internal diameter 15–17 mm. The depth of the calice is 12 mm. The major septa almost reach the axis but leave the axial area free, revealing an axial structure which consists of separate elements. The number of major septa at the bottom of the calice of a corallum with a diameter of 19–21 mm. is 41. Minor septa in the calice are rather short, but lengthen to some extent in the proximal direction. The calical edge is rather thin. Tabulae are convex in the peripheral part.

REMARKS. *Streptelasma rusticum* (Billings) has been described by Billings (1858)¹ and Lambe (1901) from the Hudson River formation of Canada, by Cox (1937) from the Richmondian of Canada and Ohio, by Wang (1948) from the Girvan Stinchar Limestone Group, and by Kaljo (1961) from the Estonian Pirgu Stage (Upper Ordovician). In these descriptions there is a considerable difference as to the axial structure: according to Lambe the major septa are “passing to the centre, where they are often considerably twisted”, and further, “Dissepiments . . . forming with the twisted inner ends of the primary septa the confused central structure charac-

¹The author has not been able to obtain this work. The reference is taken from Lambe (1901:110).

teristic of *Streptelasma*' (Lambe 1901: 111). The later authors, however, deal with the forms of *S. rusticum* whose major septa nearly reach the axis and whose axial structure is formed of the isolated inner ends of septa. Cox alone notes that the larger forms may have an anastomosing axial structure. The present author is of the opinion that in this instance two different species were dealt with, the larger forms coming from the Arctic being the genuine *rusticum* and representing the real *Grewingkia*, whereas the Ohio, Girvan and Estonian forms are nearer to *Streptelasma* and obviously form a new species. The final solution of this problem, however, requires better and more complete material than that currently at the author's disposal.

The Portrane form, by the number of its septa, shape of the calice and wide stereozone is very closely related to the Girvan form, differing to some extent from the Estonian specimens. It also resembles *S. craigense* (M'Coy), though the characteristic feature of the latter is the occurrence of long minor septa.

Genus **GREWINGKIA** Dybowski 1873

Grewingkia europaea (Roemer)

(Pl. I, fig. 11)

1861 *Streptelasma europaeum* Roemer: 16, pl. 4, figs. 1a-f.

1933 *Kiaerophyllum anguineum* Scheffen: 23, pl. 3, figs. 3, 4.

1948 *Streptelasma* (*Kiaerophyllum*) *europaeum* (Roemer) Wang: 103, pl. 7, figs. 1a-b, text-fig. 4.

1961 *Streptelasma* (*Grewingkia*) *europaeum europaeum* (Roemer) Kaljo: 57, pl. 2, figs. 2-9, text-fig. 3.

DESCRIPTION. Simple, conical, medium-sized corallum. The cup-shaped calice is of medium depth, with thin, almost vertical walls, and its floor convex. Septa somewhat thickened in ephebic stages. The major septa number 40 in the case of a diameter of 16 mm. and reach the axial structure, which is wide and consists of connected septal ends of different shapes. The peripheral stereozone is narrow, 1-1.5 mm. The minor septa project to some extent from the stereozone. The tabulae are abruptly convex at the periphery.

REMARKS. The Portrane specimens, though somewhat smaller, are very closely related to the Estonian and other forms in their general structure. *G. europaea* differs from the species of the *G. buceros* group in possessing a very narrow stereozone and an axial structure which is not compact.

The species is found in the Pirgu Stage of Estonia, in the Norwegian Stage 5a, and in the Stinchar Limestone Group of Girvan.

Grewingkia hibernica sp. nov.

(Pl. I, figs. 12-14)

DIAGNOSIS. *Grewingkia* of moderate size, straight or moderately curved, the

calice shallow. Septa short, but in the calice relatively long. The axial structure wide, about one-third of the diameter of the corallum.

HOLOTYPE. R.453I9.

FIGURED PARATYPES. R.453I8, R.455I2-I3.

DESCRIPTION. Mostly medium-sized, straight or moderately curved Rugose corals. The length of the corallum attains 70 mm., the greatest diameter 40 mm. The epitheca is covered with poorly preserved rugae and sometimes reveals horizontal growth-rings. The calice is shallow (9 mm. in the holotype), and, as a result of the axial structure penetrating to some extent into the calice, has a slightly convex floor. The septa in the calice are long at the base and only gradually shorten towards the upper rim of the calice. The septa are moderately thick. The major septa reach the axial structure where they may form compact groups connected by septal ends. The holotype has a diameter of 25–28 mm. and 50 major septa; in another specimen with the diameter of 33–38 mm. their number is 54. The minor septa are relatively long, about one-fifth to one-quarter of the length of the major septa. The stereozone is narrow (1–2 mm.) and segmented. The axial structure is wide, occupying approximately one-quarter of the diameter of the corallum, and consists of a complex of granular and oblong axial elements, intertwined with each other. The tabulae, which could be examined only in some fragments, showed a curvature at the periphery.

REMARKS. The Portrane form differs from all the other *Grewingkia* species in the peculiar structure of its calice.

Genus **BRACHYELASMA** Lang, Smith & Thomas 1940

Brachyelasma cf. *duncani* (Dybowski)

(Pl. 1, fig. 15)

DESCRIPTION. Corallum simple, ceratoid to cylindrical, somewhat compressed, medium-sized. The corallum is about 40 mm. in length and the maximum diameter 18–20 mm. The calice is cup-shaped, with thin vertical walls and flat floor. The stereozone is narrow. Septa thin and short, the axial area open, containing only some single "pali". Minor septa short. Tabulae rather curved at the periphery, flat or slightly wavy in the middle.

REMARKS. The form described from the Portrane Limestone is closest to *B. duncani* (Dybowski) (5a of Norway, Pirgu Stage of Estonia) in its general size and shape as well as in the width of the stereozone and number of septa. Owing to ignorance of some details of the structures (e.g. that of the stereozone and of the axial zone in ontogeny), it is impossible to give a precise identification of the Portrane specimens. *B. undulatum* (Scheffen), from Stage 5a of Norway, is also closely related, but the latter has a greater number of septa. The other species of *Brachyelasma* have either longer septa or a different axial structure and a wider stereozone.

Genus *DALMANOPHYLLUM* Lang & Smith 1939*Dalmanophyllum subduplicatum* (M'Coy)

(Pl. 1, figs. 16-18)

1850 *Petraia subduplicata* M'Coy: 279.1878 *Lindströmia subduplicata* (M'Coy) Nicholson & Etheridge: 86, pl. 6, figs. 2-2f, text-fig. 4.

DESCRIPTION. Corallum simple, small, ceratoid. Maximum dimensions: length 22 mm., diameter 15 mm. Epitheca covered with fine rugae. The funnel-shaped calice has a sharp rim. A strong axial column, consisting of a large central element surrounded by intertwined, separated, small septal ends, penetrates into the calice, below the floor of which it is rather wide, occupying about one-half of the diameter of the lumen. The number of major septa is 27-31 when the diameter of the calice is 12-15 mm. The minor septa are rather short. Between the major septa, particularly in the distal part of the coral, the interseptal loculi are wide. The peripheral stereozone is narrow. The tabulae are convex.

REMARKS. The Portrane Limestone specimens are very similar to those from Girvan described by Nicholson & Etheridge (1878), except that the septa in the proximal part of the former are less thickened by stereome than those of the latter. I am not altogether convinced that some of the interseptal loculi in the proximal part of the corallum have not become wider in the course of the chemical preparation.

D. subduplicatum has been described as occurring in the Craighead Limestone (Caradoc) and Upper Llandovery of Girvan, the Upper Ordovician of Wales, and in Stage 5a of Norway (Kiaer 1897).

TABULATA

By E. KLAAMANN

Order SARCINULIDA

Family SYRINGOPHYLLIDAE Počta 1902

Genus *SARCINULA* Lamarck 1816*Sarcinula* sp.

(Pl. 2, figs. 1-4)

DESCRIPTION. Corallum nodular, irregularly shaped, the maximum diameter being 40 mm. and the maximum height 35 mm. On account of the poor state of preservation at the surface of the colonies, only the rounded openings of the inner cavities can be observed there: their diameters are about 2.5-3.0 mm. and they are placed at intervals of 2.5-3.0 mm. from each other. In some cases it was possible to measure the true diameter of the corallites, namely, 3.5 to 3.7 mm. and in rare cases even 4.0 mm. The walls of the corallites are thick, 0.7-1.0 mm. The numerous pores penetrating the walls of the corallite in horizontal rows can be clearly seen. These rows of pores open between the plates connecting neighbouring corallites. The

connecting plates are very closely arranged, without plate-free intervals, and their average number is 6 in 5 mm. Thus the intercorallite tissue shows considerable resemblance to that of *Calapoecia*. The tabulae are badly preserved; they are slightly concave or curved and spaced at intervals of 0.5 to 3.5 (?) mm. The septal apparatus is represented by short laminar septa, whose number in a corallite exceeds 20 (probably amounts to 24). In a number of places thin ray-like "costae" are seen to diverge beyond the limits of the corallite forming a peculiar septal halo around it.

REMARKS. The relatively large distance between the corallites and the nature of the walls and of the septal apparatus show that, in spite of the intercorallite tissue resembling that of *Calapoecia*, we have here a typical representative of *Sarcinula*. Unfortunately, the unsatisfactory state of preservation of all the structural detail does not permit of an exact identification with any known species.

The Irish specimens bear the strongest resemblance to *S. luhai* Sokolov (1951: 92-94, pl. 16, figs. 6-7; pl. 17, figs. 1-2) of the Pirgu Stage of Estonia and Stage 5a of Norway. This species possesses corallites of almost the same diameter (most frequently 3.5-3.7 mm.), closely proximate rows of pores, and connecting plates without plate-free intervals between them. In the size of its corallites, the Irish species also resembles *S. latum* Sokolov (1951: 91-92, pl. 16, figs. 3-5), but the corallum of the latter always has a flat discoid shape, and between the connecting plates there are sharply outlined free intervals of 0.5-3.00 mm. in width. *S. latum* is also known from the Pirgu Stage of Estonia.

Until recently it was assumed that the only representative of *Sarcinula* was *S. organum* (Linné). However, the latest researches in the Baltic area reveal that, e.g., in the Upper Ordovician of Estonia, this species is represented very rarely and by only a very limited number of individuals, and that the main rôle is played by other species, and in particular by *S. luhai* and *S. latum*. *S. organum* differs from those species in the much smaller diameter of its corallites (2.5-3.0 mm.), and thus is but a rather distant relation to them as well as to the *Sarcinula* from the Portrane Limestone. It is possible that the forms from England described and illustrated by Milne-Edwards & Haime (1854: 295, pl. 71, figs. 3-3b) as *Syringophyllum organum* are very closely related to the Portrane *Sarcinula*.

Order LICHENARIIDA

Family LYOPORIDAE Kiaer 1930

Subfamily EOFLETCHERIINAE Sokolov 1955

Genus *REUSCHIA* Kiaer 1930

Reuschia sp.

(Pl. 2, fig. 5)

DESCRIPTION. The collection contains a small fragment (15 × 15 mm.) of a colony consisting of 17 thick-walled, tubular corallites, which now and then are in contact with each other along their whole length, or stand at a distance of 1-1.5 mm. from each other. The diameter of the corallites varies from 1.8 to 2.2 mm. compared

to which the thickness of the walls seems striking—0.6–0.8 mm. and in some cases even 1 mm. Hence the interior vacuity is very narrow (Pl. 2, fig. 5) and seldom exceeds 0.5–0.8 mm. in diameter. At the openings of the corallites the thick walls show a trabecular structure, but owing to the poor state of preservation, it was impossible to determine the number of trabeculae. Tabulae were not observed.

REMARKS. Up to the present time the only representatives of *Reuschia* which have been described are those of the Upper Ordovician of Norway (Kiaer 1930; Hill 1953) and China (Yü 1960). All these investigators define only one species, *R. aperta* Kiaer. The Portrane specimen differs from typical Norwegian representatives by having corallites of smaller diameter which are in closer contact. The Chinese *R. aperta*, however, has even larger corallites than the Norwegian form, and in addition has thicker walls; thus it seems that in this instance a new, separate species should be instituted.

Reuschia? sp.

(Pl. 2, fig. 6)

DESCRIPTION. The small bushy colony does not exceed 40 mm. in height. It is composed of cylindrical corallites budding like *Aulopora* and forming bunches of corallites, the central ones of which are orientated in a more or less vertical direction, whilst those at the outside bend slightly towards the periphery. The diameter of the corallites is constant throughout their whole length, mostly amounting to 2.5–3.0 mm. The calices are deep, with a circular cross-section and smooth rims. The better preserved corallites show a slight contraction at the opening, the calices developing a barrel-like shape. The thickness of the walls varies between 0.5 and 0.7 mm. They are composed of narrow trabeculae whose ends, in some corallites, extend inwards beyond the stereozone and, owing to their dense arrangement, form low vertical rugae. The latter are the only structures in the interior cavity of the corallites, since tabulae are missing altogether.

REMARKS. The mode of budding and the form of the corallites stress the great similarity of this species to *Eofletcheria*. However, the total absence of tabulae and the comparatively great thickness of the corallite walls indicate that we may consider the specimen to belong to *Reuschia*. Of the representatives of this genus, *R. aperta*, described by Yü (1960:97–98, pl. 9, figs. 4–5; pl. 10, figs. 5–8) from the Upper Ordovician of China, bears the greatest resemblance to the Portrane specimen, from a consideration of the size of the corallites, at least.

Order HALYSITIDA

Family HALYSITIDAE Edwards & Haime 1850

Subfamily CATENIPORINAE Hamada 1957

Genus *CATENIPORA* Lamarck 1816

The Halysitida are represented in the collection by more than 60 small irregular

colonies or parts of colonies. The specimens are, however, poorly preserved, so that in many instances it was impossible to examine the tabulae and the septal spinules and to establish the original thickness of the walls of the corallites. Accordingly, of the principal criteria that normally serve as a basis for taxonomic determination of the order, only the dimensions of the corallites and the form of the lacunae could be used. These two characters do, however, indicate two groups of forms, one of which is certainly identical with *Catenipora tapaensis* (Sokolov), a species of wide distribution in the Upper Ordovician of Baltoscandia.

***Catenipora tapaensis* (Sokolov)**

(Pl. 2, fig. 12)

1854. *Halysites catenularia* (part.); Edwards & Haime: 270–272.
 1858. *Catenipora labyrinthica* Fischer (part.); Schmidt: 229.
 1860. *Halysites escharoides* Lam. (part.); Eichwald: 507.
 1915. *Halysites escharoides* Fischer-Benzon; Yabe: 34 (10), pl. 6 (2), figs. 3, 4.
 1951. *Palaeohalysites tapaensis* Sokolov: 81–82, pl. 14, figs. 1, 2.
 1951. *Palaeohalysites piirsaluensis* Sokolov: 84–85, pl. 14, figs. 5–7.
 1951. *Palaeohalysites kuruensis* Sokolov: 85–86, pl. 15, figs. 3, 4.
 1955. *Palaeohalysites piirsaluensis* Sokolov; Sokolov, pl. 65, fig. 2.

DESCRIPTION. The corals have bushy, hemispheric or weakly cushion-shaped colonies whose diameter does not exceed 10 cm. The corallites form irregular nets on the sides of whose meshes are 1 to 6 corallites, in most cases 2 to 4. The lacunae are irregularly polygonal, mostly curved and oblong; their maximum diameter varies between 3 and 15 mm. Transversely the corallites are elliptical, the longer axis 1.3 to 1.7 mm., the shorter 0.9 to 1.2 mm. (Text-fig. 1, I)—there are almost no variations of these dimensions. The corallite walls are rather thick, 0.2–0.3 mm., and those between adjoining corallites are about twice as thick. The interval between the horizontal or slightly concave tabulae amounts to 0.5 to 0.8 mm. On account of the silicification, the septal spinules have been poorly preserved, occurring rarely; the corallites probably possessed twelve rows of spinules originally.

REMARKS. The Portrane forms reveal almost absolute similarity to Baltoscandian representatives of *C. tapaensis*, differing from them only in the somewhat lesser convex form of the corallite walls. This is expressed by the fact that the average long transverse diameter of the corallites of the former is approximately 0.1 mm. greater and the shorter diameter about 0.1 mm. less than the corresponding average measurements of the Estonian and Norwegian representatives of this species.

As seen in the synonymy, the conception of the species *C. tapaensis* in the present work is much wider than that of the author of the species who distinguished three separate species. This subdivision was based on small differences in the form of the corallites, in the thickness of their walls and in the development of septal spinules. The investigation of a great number of specimens of *Catenipora* from the Upper Ordovician of Estonia has shown that *C. tapaensis* (*sensu* Sokolov), *C. piirsaluensis* and *C. kuruensis*, established by Sokolov (1951) on the basis of limited material, are

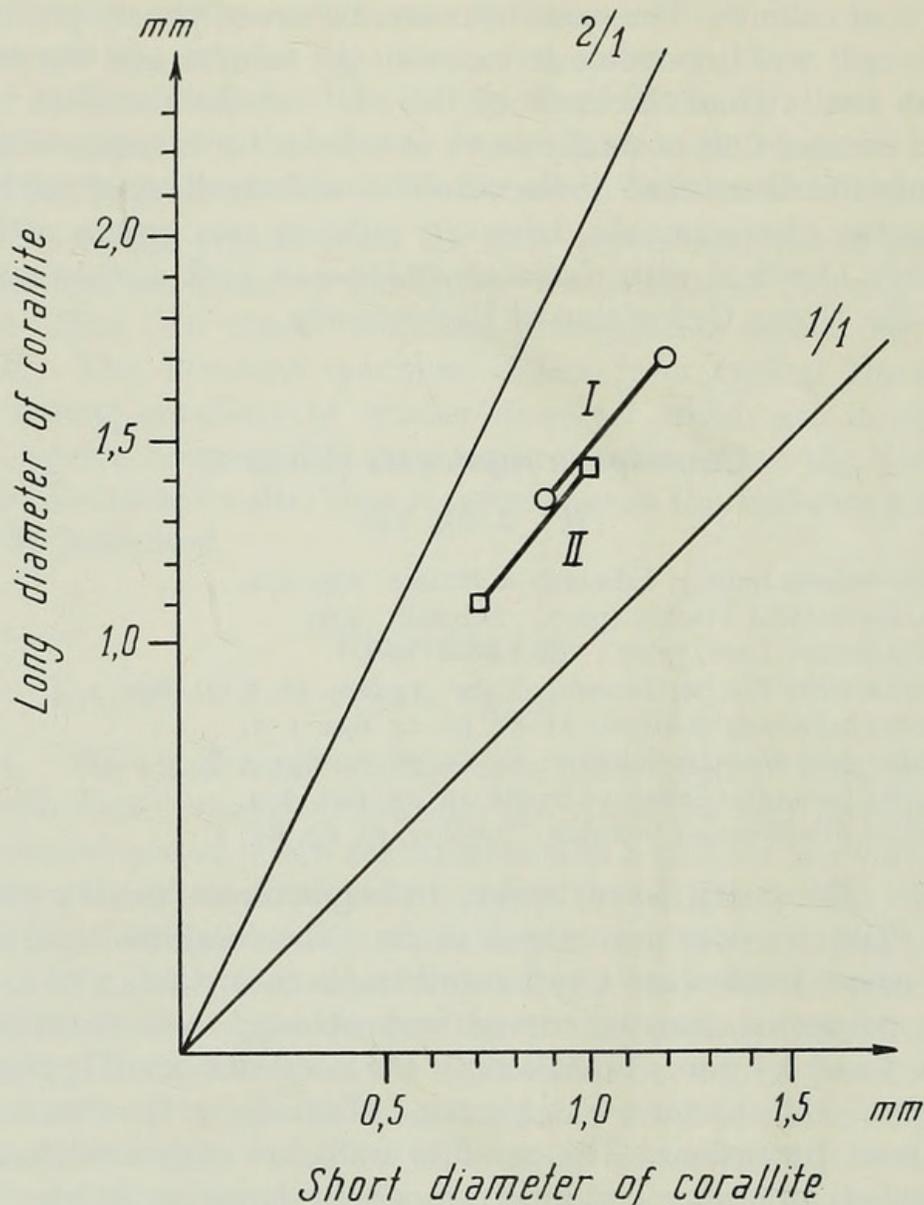


FIG. 1. Average dimensions of *Catenipora tapaensis* (Sokolov) (I) and *C. wrighti* sp. n. (II) computed from 22 and 9 colonies, respectively.

really connected with each other by a large number of transitional forms. Inasmuch as all the quoted forms have not only a morphological similarity but also equal stratigraphical distribution in Estonia, it can be concluded that they belong to one and the same species, which should be called *C. tapaensis* (Sokolov) according to page priority.

In all likelihood, a part of the Halysitids from Portrane described by Edwards & Haime (1854: 272) under the name *Halysites catenularia* belong to the species discussed.

DISTRIBUTION. Ireland, Portrane Limestone; Norway, Ringerike (Stavnaestangen), Upper Ordovician, Stage 5a; Estonia, Upper Ordovician, Vormsi and Pirgu Stages.

Catenipora wrighti sp. nov.

(Pl. 2, figs. 7-11)

DIAGNOSIS. Corallum bushy, diameter not exceeding 50 mm. Corallites connected into small irregular meshes, the sides of which are composed of 4 corallites or less: corallite diameter 0.7-1.0 × 1.1-1.5 mm. Tabulae and septal spinules present.

HOLOTYPE. R.45329, a small corallum, 20 mm. in diameter.

FIGURED PARATYPES. R.45330-33.

LOCALITY AND HORIZON. Ireland, Portrane; Upper Ordovician, Portrane Limestone.

DESCRIPTION. Corallum small, bushy, of irregular form, with a diameter ranging from 20 to 40 mm. The small elliptical corallites are joined into meshes, at the sides of which there are usually from 1 to 4 corallites, though the maximum is 8. As a result, the shape of the lacunae varies from the more common irregular polygon, with a diameter of 3-20 mm., to an elongated and meandering form. In single cases there is a locally dense disposition of the chains, so that the lacunal area is reduced to a minimum. The average diameter of the corallites is 0.9 × 1.3 mm., but it varies from 0.7-1.0 × 1.1-1.5 mm. The relation of the short diameter of the corallite to the long one is approximate 1:1.5 (Text-fig. I, II). The thickness of the exterior walls varies from 0.15 to 0.2 mm., the interior walls (those between the corallites) being somewhat thicker. Tabulae horizontal, their distance apart about 0.5-0.7 mm. Owing to the changes in the material as well as to the chemical processing, only the basal part of the septal spinules is preserved, which in places are represented by short blunt tubercles on the interior walls of the corallites.

REMARKS. Among the undisputed Ordovician Halysitid species known at present (whose number is less than 20), the dominant representatives belong to *Catenipora* and *Quepora*. These genera have an equal vertical range, and the only criterion for distinguishing them is the presence or absence of septal spinules in the visceral chamber of the corallites, a character depending to a great extent on the state of preservation. As observed by the author, the septal spinules of the Halysitids may be destroyed by minor diagenetic processes without any striking changes in the other elements of the skeleton. This circumstance renders a practical application of these characters extremely complicated. In my opinion, in the current systematics of the subfamilies Cateniporinae and Halysitinae, too great a significance has been attached to septal spinules, or, rather, to their absence.

For these reasons a comparison of the new species with the Ordovician species of *Quepora* as well as *Catenipora* is given.

Catenipora wrighti shows the greatest similarity (particularly in the size of corallites) to *C. tapaensis* (Sokolov) described above, as well as to *Quepora aequabilis* (Teichert) from the Trenton of Arctic Canada, *Q. quebecensis* (Lambe) from the Middle Ordovician of Quebec, and *Q. (?) parallela* (Schmidt) from the Ashgillian of Estonia (Pirgu and Porkuni Stages). *C. tapaensis* has larger colonies and thicker walls, in particular those between corallites, and a greater diameter of corallites

(cf. I and II, Text-fig. 1). The majority of the corallites of the new species have a diameter of 0.9×1.3 mm., whereas in *C. tapaensis* the dimensions $1.0-1.2 \times 1.6$ mm. are of most common occurrence.

Q. aequabilis is distinguished by very small lacunae and much narrower corallites—only 0.4–0.7 mm.

Q. quebecensis has larger and thicker-walled corallites from which no septal spinules are known.

The Baltic-species, *Catenipora parallela* Schmidt (1858: 229), attributed to *Quepora* by Hamada (1957), differs only slightly in the dimensions of the corallites ($0.75-0.9 \times 1.2-1.4$ mm.) and thickness of the walls (0.15–0.2 mm.). However, it is clearly distinguishable by the almost straight parallel walls of the corallites and the long, curved, commonly unconnected chains. It would appear from this last mentioned character that *Q. parallela* ought to be referred to *Eocatenipora*.

Such Ordovician species as *Q. (?) agglomeratiformis* (Whitfield), *Q. delicatula* (Wilson) (both from the Richmond of Canada), *Catenipora obliqua* (Fischer-Benzon) (Nabala Stage of Estonia) and *C. tractabilis* (Sokolov) (Vormsi Stage of Estonia) are very different, having considerably larger dimensions of the corallites than *C. wrighti*.

HELIOLITOIDEA

By E. KLAAMANN

Order PROTARAEIDA

Family COCCOSERIDIDAE Kiaer 1899

Gen. et sp. indet.

(Pl. 3, figs. 1–6)

DESCRIPTION. Colonies irregular, flat, with a thickness of 7–15 mm. and a diameter seemingly exceeding 50–60 mm. A number of specimens have fully or partly retained a somewhat wavy basal epitheca on the lower surface of the colony. The upper surface is poorly preserved, showing in single cases indefinite, low tubercles. The interior of the colony has been etched out; only some parts which border the lower and upper surfaces of the corallum are preserved. In the cross-sections of these parts a great number of quadrangular and hexagonal “tubules” are observed, the diameter of which keeps within the limits of 0.4–0.7 mm. The vertical sections, however, clearly reveal the pinnate microstructure of these “tubules”, a proof of their being, in reality, coenenchymal trabeculae which, as a result of secondary changes, have acquired a form of prismatic tubules of the type observed in *Heliolites*. No horizontal structures were discovered.

REMARKS. The laminar corallum, the presence of rough, vertical trabeculae and the absence of tabulae all indicate that the poorly preserved forms described above belong to the Coccoserididae. But as the structure of the corallites is unknown to

us, a more detailed definition of the material cannot be made. It is most probable that here we are confronted with representatives of *Protaræa*, a genus widely distributed in the Upper Ordovician of Baltoscandia, Great Britain and North America.

Subfamily **ACIDOLITINAE** Sokolov 1950

Genus **ESTHONIA** Sokolov 1955

Esthonia asterisca (Roemer)

(Pl. 3, figs. 9, 10)

1858. *Heliolites inordinata* (part.); Schmidt: 228.
 1861. *Heliolites interstincta* Linné; Roemer: 24, 25, pl. 4, figs. 4a, b.
 1880. *Heliolites intricatus* Lindström var. *lamellosus* (part.) Lindström: 32, 33, pl. 1, fig. 5.
 1883. *Heliolites asteriscus* (part.) Roemer: 505.
 1897. *Heliolites asteriscus* (part.) Roemer; Roemer: 505.
 1899. *Heliolites intricatus* var. *lamellosa* Lindström; Kiaer: 42-44, pl. 5, fig. 13; pl. 7, figs. 3-5; text-fig. 10.
 1899. *Acantholithus asteriscus* (Roemer) (part.) Lindström: 113, 114, pl. 11, figs. 31-35.
 1903. *Acantholithus asteriscus* (Roemer); Kiaer: 10-12.
 1955. *Esthonia asteriscus* (Roemer) Sokolov, pl. 71, figs. 1-6.
 1955. *Esthonia lamellosa* (Kiaer) Sokolov, pl. 71, fig. 7.
 1962a. *Esthonia asteriscus* (Roemer); Sokolov, pl. 2, figs. 1a-d.

DESCRIPTION. The material consists of fragments of irregular, wavy and laminar coralla with a thickness of only 1.5-4.5 mm. On the upper surface of the laminae are clearly discernible small, shallow calices placed at a distance of 0.5-1.5 mm. from each other. The diameter of the calices is 0.9-1.2 mm. They are clearly distinguished from the internal skeleton consisting of angular, thick-walled, intermediate tubules, about 0.15-0.2 mm. in cross-section. The twelve septa penetrate the interior chamber of the corallites to a depth of 0.2-0.25 mm. In the central part of the calice are what appear to be fine tubercles, but which are in reality formed by ends of axial trabeculae. No tabulae were detected either in the corallites or in the intermediate tubules.

REMARKS. The Portrane specimens discussed doubtless belong to typical representatives of *Esthonia asterisca* (Roemer), a form frequently described from the Upper Ordovician of Baltoscandia and most commonly referred to as *Heliolites intricatus* var. *lamellosa* Lindström and *Acantholithus asteriscus* (Roemer) (see synonymy). As indicated by Lindström himself (1899), the first-mentioned name is not correct, since at the time of the establishment of the variety the author erroneously connected under this name two different species of Roemer—*Heliolites parvistellus* and *H. asteriscus*. For these reasons it cannot be considered correct to restore the name *lamellosa*, as was done by Sokolov (1955, pl. 71, fig. 7), for designating the forms of *Esthonia asterisca* which have a very thin encrusting colony.

In the course of time the species *Esthonia asterisca* (Roemer) was defined with greater precision. In order to avoid possible misunderstandings concerning this

species it would be advisable first of all to establish its type; if Roemer's original collection is lost, we recommend that the specimen from the Vormsi Stage of Estonia depicted by Sokolov (1955, pl. 71, figs. 1, 2) be used as neotype. Further, it is imperative to determine with greater precision the date of the establishing of the species discussed. The year usually quoted—1861—is incorrect, since the name *H. asteriscus* was first proposed by Roemer (1883) in his comment on the species *Heliolites inordinata*.

DISTRIBUTION. Ireland, Portrane Limestone; Norway, 5a in Åsker and Ringerike; Estonia, Vormsi and Pirgu (?) Stages.

Genus **PRAGNELLIA** Leith 1952

Pragnellia* cf. *arborescens Leith

(Pl. 3, figs. 7, 8)

DESCRIPTION. The coralla have a curved, branching form, but at the base of the colony they swell out and encrust. The diameter of the branches varies from 3 to 8 mm., the length is about 30 mm. Corallites small, rounded, with a diameter mostly about 1.0 mm., the maximum being 1.2 mm. Calices very low, with short septa which have a considerably thickened base. The central part of the calice often slightly bulges and, when in a good state of preservation, reveals a fine punctuation caused by the ends of septal trabeculae. The coenenchyme on the surface of the colony is represented by small tubercles (0.1 mm. in diameter). The cross-sections of colonies also reveal a trabecular structure, the trabeculae being in radial arrangement. The rest of the details of the structure of the corallum have been destroyed.

REMARKS. *Pragnellia* is a rare representative of the Heliolitoidea of which only two species are known at present. The Portrane form resembles most of all *P. arborescens* Leith (1952: 795, pl. 11b, figs. 1-8) from the Upper Ordovician of North America, differing from it by greater intervals between calices on the surface of the colony and by a lesser forking of branches.

Sokolov (1962, 1962a) gave the following data on the distribution of *Pragnellia*: Upper Middle Ordovician—Upper Ordovician of the Urals, Altai, North America; Pirgu Stage of Estonia.

Family **HELIOLITIDAE** Lindström 1873

Genus **WORMSIPORA** Sokolov 1955

Wormsipora hirsuta (Lindström)

(Pl. 4, figs. 1-3)

1899. *Nicholsonia megastoma* M'Coy; Kiaer: 37-39, pl. 6, figs. 8, 9; pl. 7, figs. 1, 2.

1899. *Heliolites hirsutus* Lindström: 64, pl. 11, figs. 18-22.

1903. *Propora hirsuta* (Lindström) Kiaer: 9, 12, 39-42.

1955. *Wormsipora hirsuta* (Lindström) Sokolov, pl. 74, figs. 1-3; pl. 81, figs. 3, 4.

1962. *Wormsipora hirsuta* (Lindström); Sokolov, pl. 4, fig. 2.

DESCRIPTION. Corallum irregular, slightly elongated in the vertical direction, varying from 15–30 mm. in width, 20–40 mm. in height; composed of uniform, star-shaped corallites which often touch each other and whose diameter is 1.7–2.0 mm. The corallites have clear contours, since their walls are considerably thicker than those of the coenenchymal tubules, which, in addition, have broken contours in cross-section. The septal apparatus serves as the most important character of the present species. It consists of numerous coarse spinules bent upwards and penetrating the corallites to a depth of 0.6 mm. The ends of the spinules are sometimes cleft. The spinules are arranged in distinct, vertical rows and placed close to each other, creating the impression not of spinules, but of 12 septal ribs indentated at the rim. Fine septal growths are to be noticed in places on other septal elements as well. The cavities of the corallites and coenenchymal tubules are dissected by convex tabulae and diaphragms. The average distance between tabulae in corallites is 0.4–0.7 mm.

REMARKS. Judging by the good figures of the lectotype and exhaustive descriptions presented by Lindström (1899) and Sokolov (1955, 1962), the Portrane specimens discussed are identical in minutest details with *Wormsipora hirsuta* (Lindström) of Estonia.

DISTRIBUTION. Portrane Limestone, Ireland; Vormsi Stage, Estonia.

Wormsipora portranensis sp. nov.

(Pl. 4, figs. 4–9)

DIAGNOSIS. Corallum small, hemispheric or irregular in shape. Diameter of corallites 2.5–3.0 mm. Coenenchyme of thick-walled tubules with interrupted contours in tangential section. Septal spinules, joined at their bases, form 12 coarse ribs. Tabulae of corallites and tubulae horizontal or gently curved.

HOLOTYPE. No. R.45344, an irregular colony, 25 × 35 mm.

FIGURED PARATYPES. R.45345–47.

LOCALITY AND HORIZON. Ireland, Portrane; Upper Ordovician, Portrane Limestone.

DESCRIPTION. Hemispheric or oblong coralla with a diameter of 15–30 mm., on the surfaces of which open deep star-shaped calices of corallites, which may be at a distance of about 2 mm. from each other or may touch each other with their rims. The rims of the calices are somewhat raised in respect to the coarse-grained surface of the coenenchymal tissue filling the narrow intervals between the corallites. The diameter of the corallites keeps within the limits of 2.5–3.0 mm. Longitudinal sections reveal that the coenenchymal tubules are rather thick-walled with regularly distributed horizontal diaphragms. The latter are placed more densely than the tabulae in the corallites. The septal apparatus is represented by 12 coarse ribs, formed as a result of the union of the thick bases of spinules. Spinules long (0.5–0.7 mm.), diverging upwards at a sharp angle from the ribs and frequently penetrating the overlying tabulae. Interval between the tabulae varying from 0.3 to 1.2 mm.

REMARKS. In its structure, the new species is strikingly similar to *Wormsipora hirsuta* (Lindström), from which it differs in the greater diameter of the corallites and in the joined bases of the spinules, leading to the formation of coarse, spinose septal ribs.

In its external appearance, the colony is extremely like the form described by Lindström (1880, pl. 1, fig. 6) as *Plasmopora conferta* Edwards & Haime. In all likelihood this form is also *Wormsipora*, having, however, even larger corallites of 4 mm. diameter.

Order PROPORIDA

Family PROHELIOLITIDAE Kiaer 1899

Genus PROHELIOLITES Kiaer 1897

Proheliolites dubius (Schmidt)

(Pl. 4, figs. 10-12)

1858. *Heliolites dubia* Schmidt: 226.
 1861. *Heliolites dubia* Schmidt; Roemer: 26-27, pl. 4, figs. 5a-5b.
 1880. *Heliolites dubius* Schmidt (part.); Lindström: 32, pl. 1, figs. 3, 4 (only).
 1883. *Heliolites dubius* Schmidt; Roemer: 505-506.
 1897. *Heliolites dubius* Schmidt; Roemer: 505-506.
 1897. *Proheliolites dubius* (Schmidt) Kiaer: 10.
 1899. *Proheliolites dubius* (Schmidt) (part.); Kiaer: 21-26, pl. 3, figs. 5, 6; pl. 6, fig. 5.
 1899. *Proheliolites dubius* (Schmidt) (part.); Lindström: 70-71, pl. 11, figs. 13-17.
 1903. *Proheliolites dubius* (Schmidt); Kiaer: 6, 12.
 1955. *Proheliolites dubius* (Schmidt); Sokolov: pl. 75, figs. 6, 7.
 1956. *Proheliolites dubius* (Schmidt); Hill & Stumm: F461, text-fig. 348, 6a-6b.
 1962a. *Proheliolites dubius* (Schmidt); Sokolov, pl. 6, figs. 4a-b.

DESCRIPTION. Corallum irregular, hemispheric or elongated, the maximum diameter not exceeding 40 mm. Corallites with compact walls, rounded, but owing to their very dense arrangement, often assuming a polygonal form. They are surrounded by fine and sparse, mostly triangular or quadrangular coenenchymal tubulae, whose maximum number around one corallite is four. Corallites with a diameter of 0.9 mm. predominate, others varying within the limits of 0.8-1.0 mm. The diameter of the tubulae is about 0.3-0.5 mm. The septal apparatus is very peculiar, being arranged in 12 rows of short, unconnected spinules which, unlike those of the other Heliolitoidea, bend downwards. In cross-sections the spinules are seen as 12 points connected to the inner wall of the corallites. Tabulae horizontal, in the tubulae rather dense (0.2-0.3 mm. apart) and in the corallites sparser (0.5-1 mm. apart).

REMARKS. The only difference between the forms described and those from the Baltic consists in the smaller colonies. However, this character is typical of all the

Tabulata and Heliolitoidea of Portrane discussed and may have been caused by ecological factors.

DISTRIBUTION. Portrane Limestone, Ireland; 5a and 5b, Ringerike (Stavnaestangen) and Asker, Norway; Boda Limestone of Dalarne, Sweden; Pirgu-Stage, Estonia.

III REFERENCES

- BILLINGS, E. 1858. Report for the Year 1857 of E. Billings, Esq., Palaeontologist. *Geol. Surv. Canada Rep. Progr.*, **1857**: 147-192.
- COX, I. 1937. Arctic and Some Other Species of *Streptelasma*. *Geol. Mag.*, London, **74**: 1-19, pls. 1, 2.
- DAVIS, W. J. 1887. Kentucky Fossil Corals—a Monograph of the Fossil Corals of the Silurian and Devonian Rocks of Kentucky, Pt. II. *Kentucky Geol. Surv.* [4] + i-xiii, 139 pls. Frankfort.
- DYBOWSKI, W. 1873. Monographie der Zoantharia sclerodermata rugosa aus der Silurformation Estlands, Nord-Livlands und der Insel Gotland. *Arch. Naturk. Liv-, Ehst- u. Kurl.*, Dorpat (1) **5**: 257-414, pls. 1, 2.
- EDWARDS, H. M. & HAIME, J. 1854 [1855]. A Monograph of the British Fossil Corals. Pt. 5. Corals from the Silurian formation. *Palaeontogr. Soc. [Monogr.]*, London: 245-299, pls. 57-72.
- EICHWALD, C. E. VON. 1860. *Lethaea Rossica ou Paléontologie de la Russie*, I. 1657 pp., atlas 38 pls. Stuttgart.
- HAMADA, T. 1957. On the classification of the Halysitidae I, II. *J. Fac. Sci. Tokyo Univ.*, **10**, 3: 393-430.
- HILL, D. 1953. The Middle Ordovician of the Oslo Region, Norway. 2. Some Rugose and Tabulate Corals. *Norsk geol. Tidsskr.*, Bergen, **31**: 143-168, 5 pls.
- HILL, D. & STUMM, E. C. 1956. Tabulata in *Treatise on Invertebrate Paleontology. Part F. Coelenterata*: F444-F477, text-figs. 340-357. (Editor R. C. Moore). Geol. Soc. Amer. and Univ. Kansas Press, Lawrence.
- KALJO, D. L. 1958. On the taxonomy of the genus *Streptelasma* Hall and a description of some new Rugose corals. *Geologia Inst. Uurim.*, Tallinn, **2**: 19-26, pls. 1, 2 (In Russian with English summary).
- 1961. Some additional data on the study of Ordovician streptelasmids in Estonia. *Geologia Inst. Uurim.*, Tallinn, **6**: 51-67, pls. 1-4 (In Russian with English summary).
- , KLAAMANN, E. R. & NESTOR, H. E. 1963. Features in common in the Ashgillian coral and stromatoporoid fauna of Estonia and Norway. *Geologia Inst. Uurim.*, Tallinn, **13**: 75-81 (In Russian with English summary).
- KIAER, J. 1897. Faunistische Uebersicht der Etage 5 des norwegischen Silursystems. *Skr. VidenskSelsk. Christiania* (1) **3**: iv + 76.
- 1899. Die Korallenfaunen der Etage 5 des norwegischen Silursystems. *Palaeontographica*, Stuttgart, **46**: 1-60, pls. 1-7.
- 1903. Revision der mittelsilurischen Heliolitiden und neue Beiträge zur Stammesgeschichte derselben. *Skr. VidenskSelsk. Christiania*, **10**: 1-58, 14 figs.
- 1930. Den fossilførende ordovicisk-siluriske lagrekke på Stord og bemerkninger om de øvrige fossilfunn i Bergensfeltet. *Bergens Mus. Aarb.*, **1929**, 11: 1-75, pls. 1-5.
- 1932. The Coral Fauna of the Kalstad Limestone in Meldalen. *Skr. norske VidenskAkad.*, Oslo (1) **1932**, 4: 103-113, pls. 12-17.
- LAMBE, L. M. 1901. A revision of the genera and species of Canadian Palaeozoic Corals. The Madreporaria Aporosa and the Madreporaria Rugosa. *Cont. Can. Palaeont.*, Ottawa, **4**, 2: 97-197, pls. 6-18.
- LEITH, E. I. 1952. *Schizocoralla* from the Ordovician of Manitoba. *J. Paleont.*, Tulsa, **26**: 789-796, pls. 114-116.
- LINDSTRÖM, G. 1880. *Fragmenta Silurica*. 59 pp., 30 pls. Holmiae.

- LINDSTRÖM, G. 1899. Remarks on the Heliolitidae. *K. svenska VetenskAkad. Handl.*, Stockholm, **32**: 1-140, pls. 1-12.
- M'COY, F. 1850. On some new genera and species of Silurian Radiata in the Collection in the University of Cambridge. *Ann. Mag. Nat. Hist.*, London (2) **6**: 270-290.
- NICHOLSON, H. A. & ETHERIDGE, R. 1878. *A Monograph of the Silurian Fossils of the Girvan District in Ayrshire*, **1**. ix + 135 pp., 9 pls. Edinburgh & London.
- REIMAN, V. M. 1958. Neue Tetrakorallen des baltischen Oberordoviziums und des Llandovery. *Geologia Inst. Uurim*, Tallinn, **2**: 33-47, pls. 1, 2. (In Russian with German summary).
- ROEMER, F. 1861. *Die fossile Fauna der silurischen Diluvial-Geschiebe von Sadevitz bei Oels in Nieder-Schlesien*. xvi + 82 pp., 8 pls. Breslau.
- 1883. *Lethaea geognostica*, 1. *Lethaea palaeozoica*, **1**. 688 pp., 2 pls. Stuttgart.
- 1897. *Lethaea geognostica*, 1. *Lethaea palaeozoica*, **1**, 3. vi + 688 pp., 2 pls. Stuttgart.
- SCHEFFEN, W. 1933. Die Zoantharia Rugosa des Silurs auf Ringerike im Oslogebiet. *Skr. norske VidenskAkad.*, Oslo (1) **1932**, 5: 1-64, pls. 1-11.
- SCHMIDT, FR. 1858. Untersuchungen über die Silurische Formation von Ehstland, Nord-Livland und Oesel. *Arch. Naturk. Liv-, Ehst- u. Kurl.*, Dorpat (1) **2**: 1-248.
- SOKOLOV, B. S. 1951. Tabuljaty paleozoja Evropeiskoi chasti SSR. I. Ordovik Zapadno Urala i Pribaltiki. *Trud. vsesoyuz. neft. geol. -razy. Inst.*, Moscow-Leningrad (n.s.) **48**: 1-132, pls. 1-18.
- 1955. Tabuljaty paleozoja Evropeiskoi chasti SSR. Vvedeniye. Obchije voprosy sistematiki i istorii razvitija tabuljat. *Trud. vsesoyuz. neft. geol. -razy. Inst.*, Moscow-Leningrad (n.s.) **85**: 1-328, pls. 1-90.
- 1962. Subclass Tabulata in *Osnovy paleontologii; Gubki, arheociaty, kischechnopolostnye, chervi*: 192-265, pls. 1-18. Moscow. [Ed. B. S. Sokolov.]
- 1962a. Subclass Heliolitoidea in *Osnovy paleontologii; Gubki, arheociaty, kischechnopolostnye, chervi*: 266-285, pls. 1-6. Moscow. [Ed. B. S. Sokolov.]
- 1962b. Biostratigraficheski i biogeograficheski obzor tabuljatomorfnih korallor paleozoja SSSR. *Geol. geofis.*, Novosibirsk, **10**: 53-67.
- WANG, H. C. 1948. Notes on Some Rugose Corals in the Gray Collection from Girvan, Scotland. *Geol. Mag.*, London, **85**: 97-106, pl. 7.
- WILSON, A. E. 1926. An Upper Ordovician fauna from the Rocky Mountains, British Columbia. *Mus. Bull. Can. geol. Surv.*, Ottawa, **44**: 1-34, pls. 1-8.
- YABE, H. 1915. Einige Bemerkungen über die Halysites-Arten. *Sci. Rep. Tôhoku Imp. Univ.*, Tokyo (2) **4**: 25-38, pls. 5-9.
- YU, CH. 1960. Pozdneordovikskije korally Kitaja. *Acta palaeont. sin.*, Peking, **8**, 2: 65-132, pls. 1-15.

PLATE I

Kenophyllum sp. p. 47

FIGS. 1, 2. Two views of the corallum showing the axial structure. R.45309. × 1.25.

Kenophyllum cf. *inflatum* (Dybowski) p. 417

FIG. 3. Corallum. R.45310. × 2.

FIGS. 4, 5. Calice and corallum. R.45311. × 2.

Streptelasma fragile Wilson p. 418

FIG. 6. Corallum showing a slit-shaped scar of fixation. R.45312. × 2.

FIG. 7. Two small corals fixed on the bottom with curved sides of the apex. R.45313. × 2.

Streptelasma distinctum Wilson p. 418

FIG. 8. Bottom of calice. R.45314. × 1.3.

FIG. 9. Longitudinal section. R.45315. × 2.

Streptelasma cf. *rusticum* (Billings) p. 419

FIG. 10. Calice. R.45316. × 1.3.

Grewingkia europaea (Roemer) p. 420

FIG. 11. Calice. R.45317. × 1.2.

Grewingkia hibernica sp. nov. p. 420

FIG. 12. Corallum with very wide proximal part and large scar of fixation. R.45318. × 1.2.

FIGS. 13, 14. Calice and cross-section of holotype. R.45319. × 1.2.

Brachyelasma cf. *duncani* (Dybowski) p. 421

FIG. 15. Corallum. R.45320. × 1.25.

Dalmanophyllum subduplicatum (M'Coy) p. 422

FIG. 16. Corallum with wide scar of fixation near the apex. R.45321. × 2.

FIG. 17. Specimen showing the axial structure. R.45322. × 2.

FIG. 18. Calice with axial structure. R.45323. × 2.

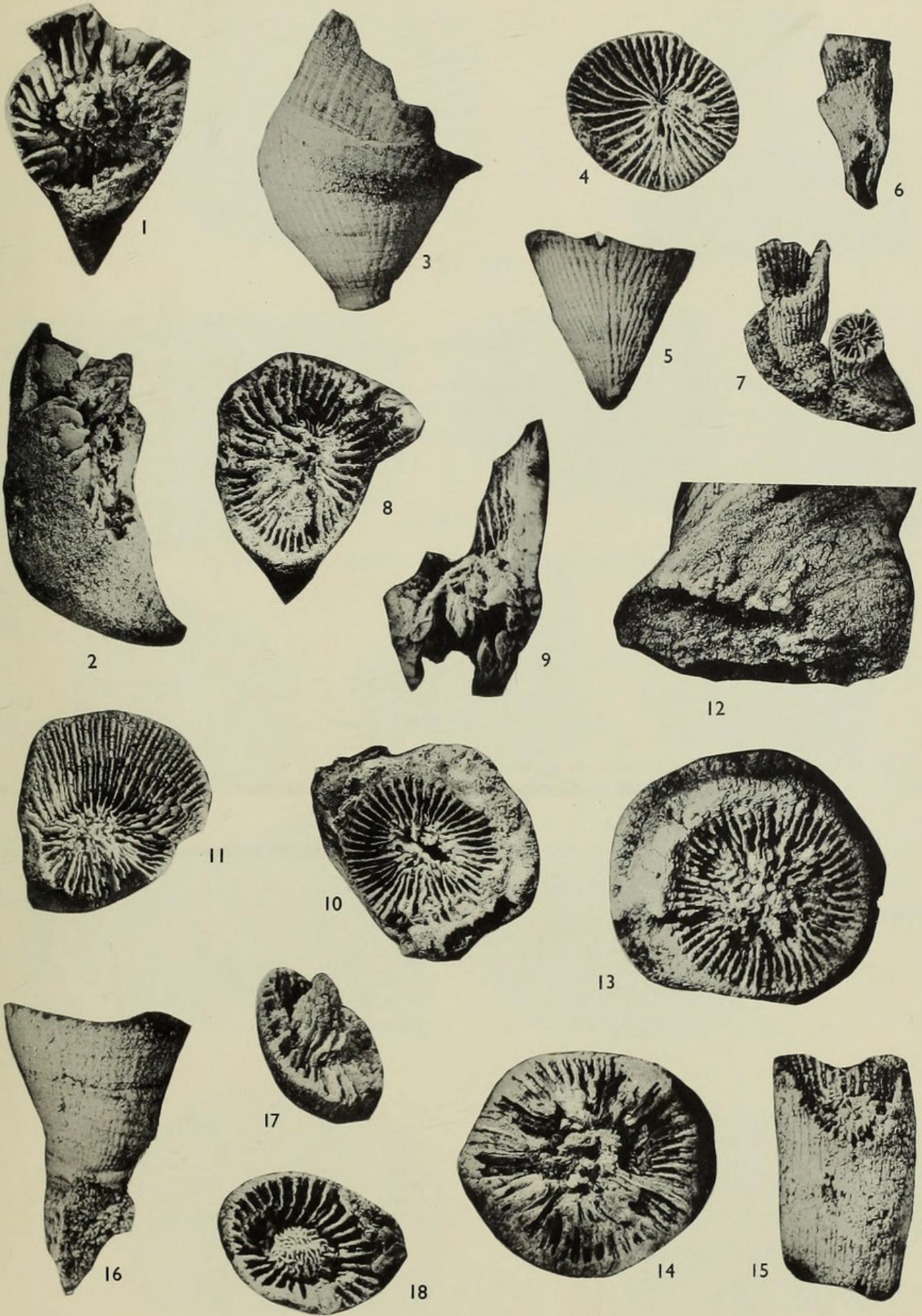


PLATE 2

Sarcinula sp. p. 422

- FIGS. 1, 2. Transverse and longitudinal sections of an etched corallum. R.45324. × 2.
FIG. 3. Interior of an etched corallum. R.45325. × 2.
FIG. 4. Fragment of a corallum showing horizontal rows of pores and laminated structure of intercorallite tissue. R.45326. × 2.

Reuschia sp. p. 423

- FIG. 5. A small corallum formed by thick-walled cylindrical corallites. R.45327. × 2.

Reuschia ? sp. p. 424

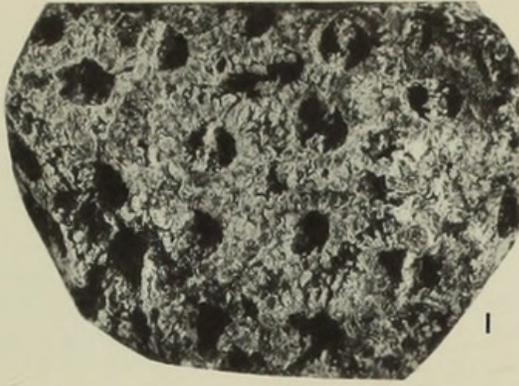
- FIG. 6. An irregular bushy corallum. R.45328. × 2.

Catenipora wrighti sp. nov. p. 427

- FIG. 7. Holotype. R.45329. × 2.
FIGS. 8-11. Surface views of small colonies. R.45330-33. × 2.

Catenipora tapaensis (Sokolov) p. 425

- FIG. 12. Surface view of an etched corallum showing the varying form and diameter of lacunae. R.45334. × 2.



1



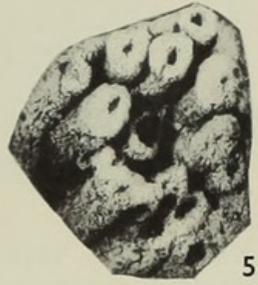
2



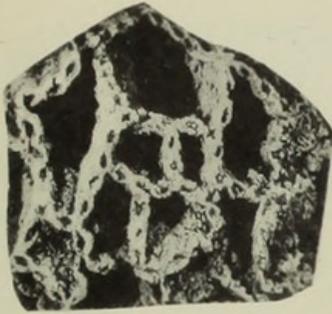
3



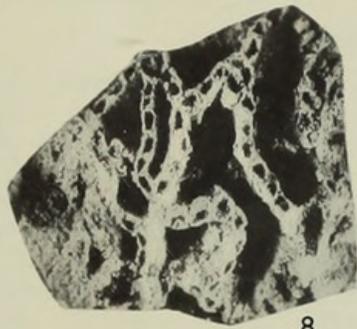
4



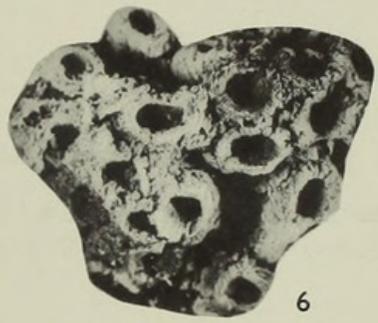
5



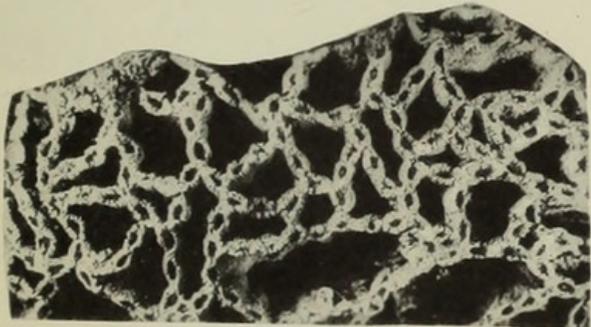
7



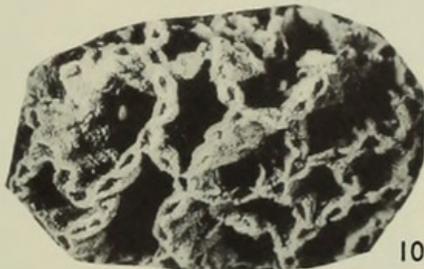
8



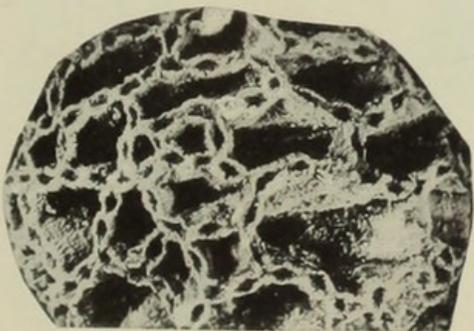
6



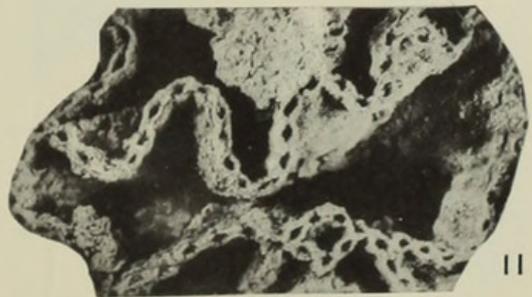
9



10



12



11

PLATE 3

Coccoserididae gen. et sp. indet. p. 428

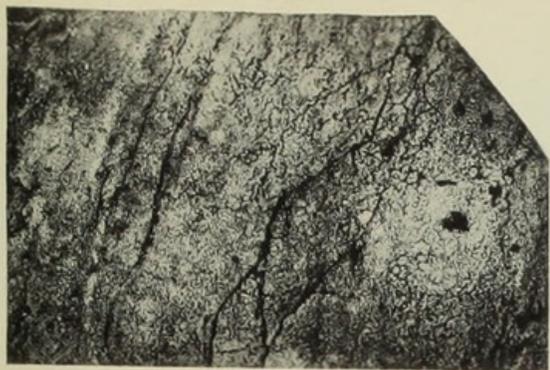
- FIG. 1. Basal epitheca of a laminar corallum. R.45335. × 2.
FIG. 2. The same specimen. Part of the upper surface showing *Protaraea*-like structure. × 8.
FIG. 3. An etched laminar corallum. R.45336. × 2.
FIG. 4. Part of the same specimen showing vertical sections of coenenchymal trabeculae.
× 8.
FIGS. 5, 6. Typical surface views of a laminar colony. R.45337. × 2 and × 8.

Pragnellia cf. *arborescens* Leith p. 430

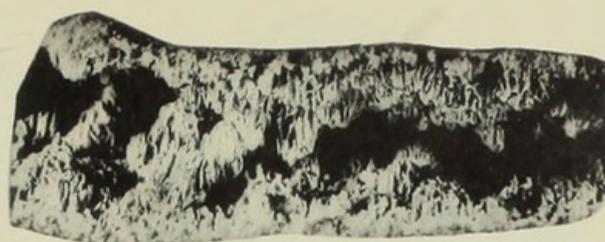
- FIGS. 7, 8. Irregular cylindrical colonies. R.45338 and R.45339. × 2.

Esthonia asterisca (Roemer) p. 429

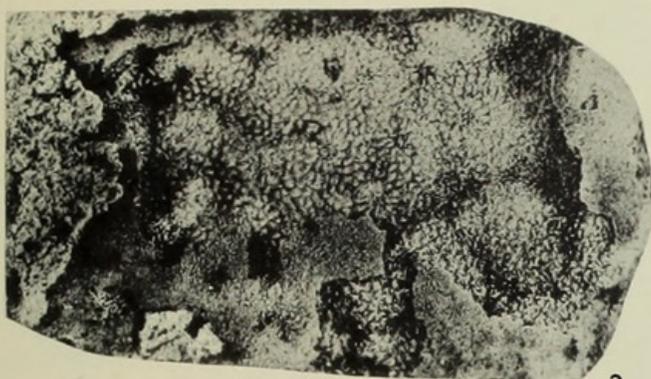
- FIG. 9. Surface view of a thin lamellar corallum. R.45340. × 2.
FIG. 10. Fragment of a lamellar corallum. R.45341. × 8.



1



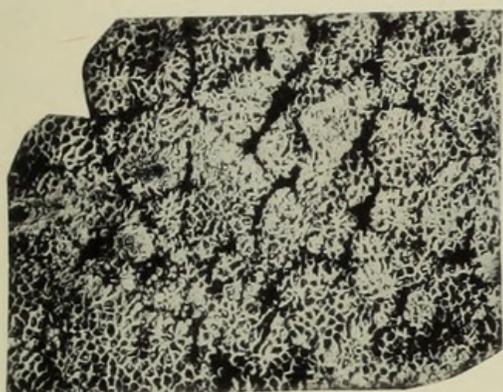
3



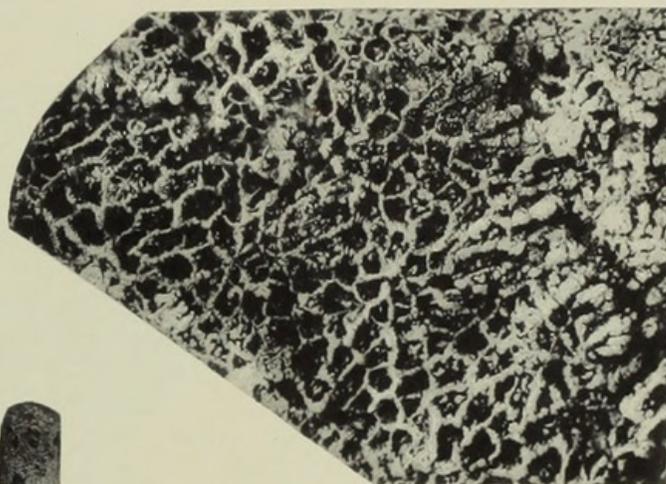
2



4



5



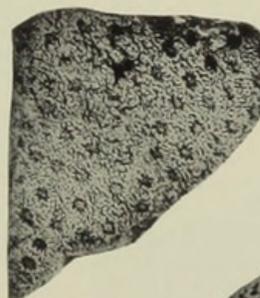
6



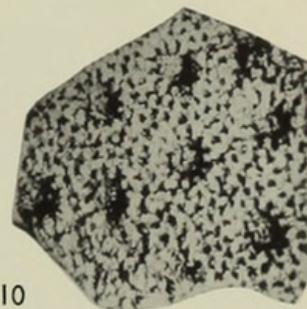
7



8



9



10

PLATE 4

Wormsipora hirsuta (Lindström) p. 43^o

FIGS. 1, 2. Upper surface and interior view respectively of a small hemispherical corallum. R.45342. × 2.

FIG. 3. Longitudinal section of corallites showing rugae-like rows of septal spinules. R.45343 × 2.

Wormsipora portranensis sp. nov. p. 43^I

FIGS. 4, 5. Vertical section and upper surface of holotype. R.45344. × 2.

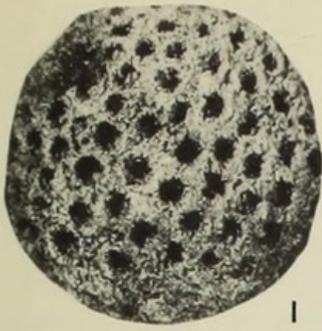
FIGS. 6, 7. Surface views of two cylindrical coralla showing the interrupted structure of the coenenchymal tissue and 12 rows of septal spinules. R.45345, R.45346. × 2.

FIGS. 8, 9. Two longitudinal sections of corallites showing massive septal spines directed upwards. R.45347. × 7 and × 4, respectively.

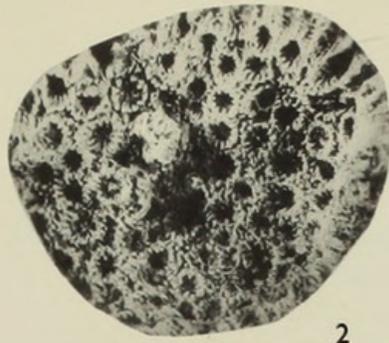
Proheliolites dubius (Schmidt) p. 43²

FIGS. 10, 11. Upper surface and interior view respectively of an etched corallum. Vertical section shows horizontal tabulae in the corallites and coenenchymal tubes. R.45348. × 2.

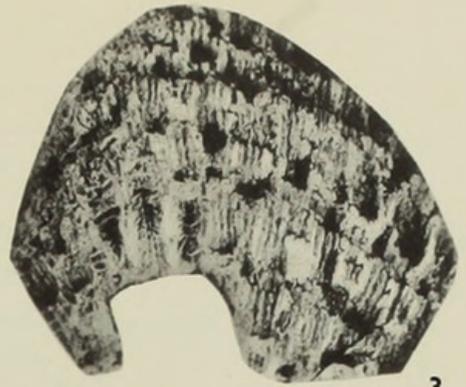
FIG. 12. The same specimen. Between the corallites rare polygonal coenenchymal tubes can be observed. × 8.



1



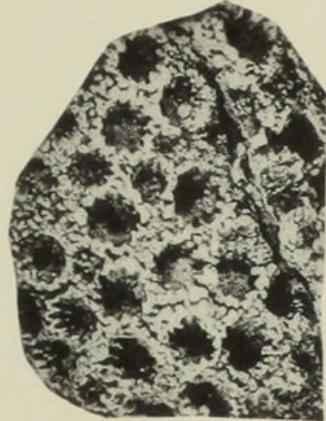
2



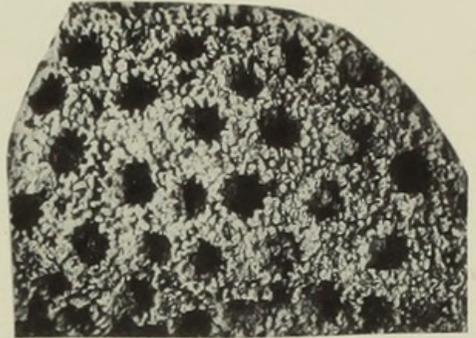
3



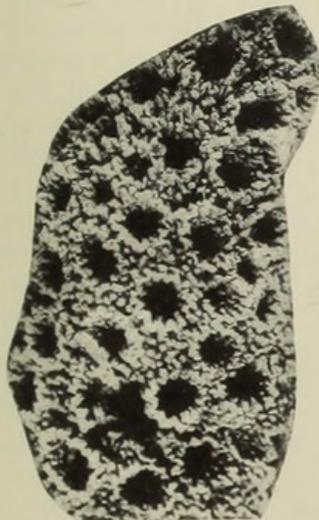
4



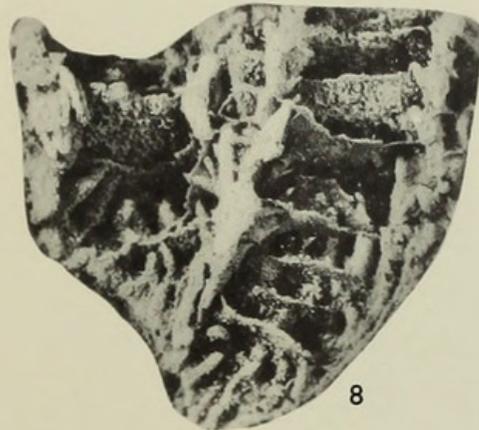
5



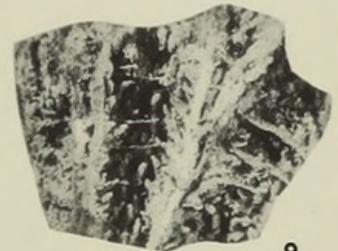
6



7



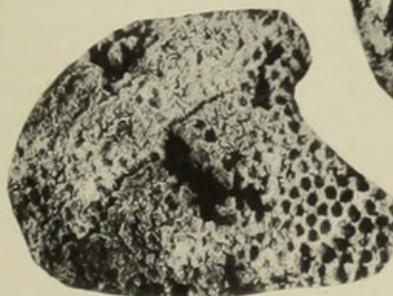
8



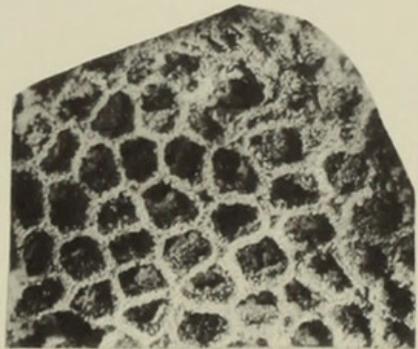
9



10



11



12



Kaljo, Dimitri and Klaamann, Einar. 1965. "The fauna of the Portrane Limestone. III. The corals." *Bulletin of the British Museum (Natural History) Geology* 10, 413–434.

View This Item Online: <https://www.biodiversitylibrary.org/item/112052>

Permalink: <https://www.biodiversitylibrary.org/partpdf/83499>

Holding Institution

Natural History Museum Library, London

Sponsored by

Natural History Museum Library, London

Copyright & Reuse

Copyright Status: In copyright. Digitized with the permission of the rights holder

Rights Holder: The Trustees of the Natural History Museum, London

License: <http://creativecommons.org/licenses/by-nc-sa/4.0/>

Rights: <http://biodiversitylibrary.org/permissions>

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.