COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

BULLETIN No. 34.

PERMIAN BRYOZOA FROM THE FITZROY BASIN, WESTERN AUSTRALIA

BY

JOAN CROCKFORD.

Issued under the Authority of Senator the Hon. W. H. Spooner, Minister for National Development
1957.

By Authority:
A. J. ARTHUR, Commonwealth Government Printer, Canberra.
(Printed in Australia.)

1907/56.

BULLETIN 34

CORRIGENDA AND ERRATA.

p. 12, 1.12 - insert 'a shallow' befor 'water habitat'

p. 29, para. 2, 1.6 - for 'eventually' read 'evidently'.

p. 38 - synonymy of R.ambrosoides: should be 'Crockford, 1944b.

p. 40 - for 'figs. 2 - 4' read 'figs. 3 - 5'.

p. 43 - for 'figs. 5 - 7' read 'figs. 6 - 8'.

p. 57 - for 5B (1102C) read 5B (1186C).

p. 69 - Occurrence 1. 1 - for '1367' read '1267'.

Description, 1.4 -for 'jointed', read 'jointed'.

p. 73 - 'for 12 (1113A)' read '11 (1113A)'

p. 88 - locality 18 - for 'some', read 'same'.

Plate 6, caption - 1.5 - for 'near the', read 'near end'.

Plate 8, caption - E.porosa var. minor,1.1 - fig.5 should be fig. 6.

Plate 9, caption - for '1073H', read '1073G'.

Plate 14, caption - L.globosa: 1.1 - for 'the holotype' read 'specimen 1294';
1.4 - for 'a specimen from locality 3 (1138)', read ' the holotype'.

Plate 17, fig. 3 - for 'sp. indet' read 'sp.nov.'

Plate 21, caption - for 'Holotype', read 'Specimen 1203'.

Table I ; for 'Formation and Locality', read 'Nura Nura Member;
for' Liveringa Group' , read 'Liveringa Formation'.

COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

BULLETIN No. 34.

PERMIAN BRYOZOA FROM THE FITZROY BASIN, WESTERN AUSTRALIA

BY

JOAN CROCKFORD.

Issued under the Authority of Senator the Hon. W. H. Spooner, Minister for National Development

1957.

By Authority:
A. J. ARTHUR, Commonwealth Government Printer, Canberra.
(Printed in Australia.)

1907/*56*.

COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

Minister : SENATOR THE HON. W. H. SPOONER, M.M.

Secretary : H. G. RAGGATT, C.B.E.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

Director : P. B. NYE, O.B.E.

Deputy Director : J. M. RAYNER.

This publication was prepared for the Geological Section.

Chief Geologist : N. H. FISHER.

Issued 31st July, 1957.

CONTENTS.

SUMMARY.

The Bulletin describes and figures Bryozoa collected from three Permian formations in the West Kimberley district of Western Australia: the Nura Nura member of the Poole Sandstone, the Noonkanbah Formation, and the lower part of the Liveringa Group.

Seventy-nine species are recorded. Forty-two of them are new species; and three new genera (*Evactinostella, Etherella,* and *Liguloclema*) and a new family have been erected in the Cyclostomata.

The facies relationships of the species show that habitat is an important factor in correlation. Ramose zoaria appear to be more adaptable than other forms, and some species are almost ubiquitous.

The Nura Nura fauna may be correlated with the Callytharra Limestone of the Carnarvon Basin and possibly with the Lower Productus Limestone of the Salt Range of India. Many of the Nura Nura species are long-ranging. The Noonkanbah species are, on the whole, more restricted: they can be correlated, within Australia, with the Wandagee Formation and Baker Formation of the Carnarvon Basin. Outside Australia, the fauna shows resemblances to those of the Bitaoeni and Basleo Beds of Timor and an Artinskian fauna from Vancouver Island; some Fenestellidae resemble Lower Permian species described from the Urals.

INTRODUCTION.

The specimens here described were collected mainly by field parties of the Bureau of Mineral Resources, Geology and Geophysics in 1951 and 1952 from the Nura Nura Member of the Poole Sandstone, the Noonkanbah Formation, and the Liveringa Group. Specimens collected earlier by Dr. A. Wade, Dr. C. Teichert, and Caltex (Aust.) Oil Development Pty. Ltd., and now in the University of Western Australia collection, are also described.

Dr. G. A. Cooper, of the United States National Museum, sent me some specimens of North American late Palaeozoic Bryozoa for comparison, and Miss Helen Duncan, of the United States Geological Survey, provided notes on fistuliporoid genera similar to those in Western Australia.

The faunas described vary both vertically—in time—and laterally by facies variation. The distribution is summarized in Table I. and discussed on pp. 80-87.

They are largely endemic; but a number of species have been found in other basins of deposition in Western Australia and a few in overseas faunas. Many of the new species are generally similar to forms of similar age elsewhere. The probable correlations of the faunas are discussed on pp. 80-87.

Catalogue numbers of specimens refer to specimens in the Commonwealth Palaeontological Collection of the Bureau of Mineral Resources, except those otherwise stated.

GLOSSARY OF MORPHOLOGICAL TERMS.*

Acanthopore: Fine tube occurring in the walls between the zooecial tubes, and parallel to the tubes in growth; projecting at the surface to form a spine. Acanthopores of two sizes (megacanthopores and micracanthopores) are developed commonly.

Ancestrula: The first-formed zooid of a colony, derived by metamorphosis of a free-swimming larva.

Aperture: The outermost opening of the zooecium. In Cryptostomata, the aperture is the mouth of the vestibule, which extends from the aperture to the orifice near the inner boundary of the mature zone.

Bifoliate: Consisting of two layers of zooecia growing back to back with a double-walled mesotheca between the layers.

Carina: The median ridge on the obverse side of the branch in some Cryptostomata.

Celluliferous: Side of the zoarium bearing the zooecial apertures (syn., Obverse).

Diaphragm: A transverse calcareous plate, complete or with a central or eccentric perforation, extending across a zooecial tube or a mesopore.

Dissepiment: Crossbar connecting the branches of fenestrate zoaria, usually but not invariably non-celluliferous.

Distal: Direction of growth away from the ancestrula.

Epitheca: Basal lamina of zoarium from which zooecia arise.

Fenestrule: The open space in a fenestrate zoarium, enclosed by the branches and dissepiments, or by the anastomosing branches of a reticulate zoarium.

Hemiseptum: A plate, extending partially across the zooecial tube in some Cryptostomata; either one or two hemisepta may occur in an individual tube, being placed near the orifice at the base of the vestibule; they are designated as superior hemiseptum (on proximal wall of tube) and inferior hemiseptum (on distal wall).

Immature region: The basal, or the internal, part of a zoarium; characterized by thin-walled zooecial tubes, and by the usual absence of structures which are developed in the mature region, such as acanthopores and mesopores; and usually differentiated from the mature zone also by less numerous diaphragms, or by lesser development of moniliform walls; or in some Cyclostomata by some difference in the development of lunaria, or in the nature of the tissue infilling the interspaces between the zooecial tubes.

Interspace: The part of the zoarium between adjacent zooecia or their apertures.

---

* The following definitions have either been taken from, or adapted from, those given in a "Glossary of Morphological Terms" by Bassler, 1953, G 7-G 16.

Longitudinal section: Section parallel to the direction of growth of the zooecial tubes.

Lunarium: Hood-like overarching projection of the peristome on the proximal side of the zooecial tube; in sections, the lunarium generally is thickened, and commonly is curved more strongly than the remainder of the circumference of the tube. Lunaria commonly are developed more strongly within, or around, maculae or monticules than over the remaining surface of the zoarium; and they may be developed more strongly at and near the surface than in the immature region.

Macula: A small area, flat or slightly depressed at the surface of the zoarium; in the Cyclostomata, commonly bordered by enlarged zooecia, and composed of an aggregation of vesicles, or of vesicular tissue in the immature part of the zoarium, but of stereom or of stereom with occasional layers of vesicular tissue at and near the surface; or in the Trepostomata, a similar area in which the zooecia are usually smaller in size than usual, and mesopores and acanthopores are more commonly developed than over the remainder of the surface. In either Order, maculae when developed are usually regularly spaced upon the zooecial surface.

Marginal spines: A series of small sharp projections surrounding the aperture.

Mature region: The outer part of the zoarium, within which the zooecial walls may be thickened, either evenly or unevenly; and in which vesicular tissue or dense stereom, or acanthopores and mesopores, commonly occur between the zooecial tubes; and in which diaphragms become relatively more abundant within the zooecial tubes.

Megacanthopore: Acanthopores of conspicuously large size, usually fewer in number, but originating deeper within the zoarium, than the micracanthopores.

Mesopores: Small tubes (being, like the acanthopores, kenozooecia—modified zooecia without polypides) occurring between the zooecial tubes in the mature region, and typically developed in the Trepostomata.

Mesotheca: The double lamina within a bifoliate zoarium, produced by the back-to-back growth of two unilamellar series of zooecia.

Micracanthopore: Small acanthopores.

Monilae: The bead-like expansions of the zooecial walls in some Stenoporidae.

Moniliform walls: The beads walls developed in some Stenoporidae.

Monticules: Clusters of enlarged zooecia, or of enlarged zooecia associated with numerous and enlarged acanthopores and mesopores, forming regularly spaced slight prominences on the zooecial surface in some Trepostomata; or similar prominences in the Cyclostomata composed of enlarged zooecia with more strongly developed lunaria than occur over the remainder of the surface.

Multilamellar: Growth in successive layers of zooecia, each layer growing over and covering the older layers.

Node: In the Fenestellidae and Acanthocladiidae, the small spines (representing acanthopores) which occur either very regularly and characteristically spaced along the carina, or are regularly or irregularly developed between the apertures on the obverse surface where no carina occurs.

Non-celluliferous surface: That surface of a fenestrate or pinnate zoarium which lacks apertures (syn., Reverse).

Obverse surface: That surface of a fenestrate or pinnate zoarium on which the zooecial apertures are placed.

Orifice: The primary opening of the zooecium for extrusion of the polypide.

Peristome: The rim surrounding either the orifice or the aperture.

Polypide: The soft parts of the zooid.

Proximal: Direction towards origin of growth.

Reverse surface: Non-celluliferous surface.

Stereom: Dense calcareous tissue.

Tangential section: Section cut parallel to the surface of the zoarium.

Transverse section: Section at right angles to the direction of growth of the colony.

Vesicular tissue: Irregular small arched plates filling the zooecial interspaces in Cyclostomata and some Cryptostomata; commonly replaced partly or entirely by stereom near the surface.

Vestibule: A circular or oval shaft extending inwards from the zooecial apertures to the orifice in Cryptostomata; limited at its base by hemisepta or by the passage from the mature to the immature part of the zooecial tube.

Zoarium: An entire bryozoan colony; the growth form being generally constant for a species, but not necessarily constant within a genus.

Zooecium, zooecial tube: The tube which contained the polypide.

SYSTEMATIC DESCRIPTIONS.

Order CYCLOSTOMATA Busk, 1852.

Suborder CERAMOPOROIDEA Bassler, 1913.

Family FISTULIPORIDAE Ulrich, 1882.

Genus FISTULIPORA* M'Coy, 1850.

FISTULIPORA VACUOLATA Crockford, 1944.

Fistulipora vacuolata Crockford, 1944a, 143, pl. iv, fig. 1, text-figs. 7, 8.

Occurrences: Noonkanbah Formation, localities 5B (1292) and 13 (1053).†

The holotype was from the highest fossil horizon of the Noonkanbah at Mt. Marmion; locality 5B is similar in horizon, but locality 13 is in the lower middle part of the Formation. The heavy massive zoarium probably favoured water habitat; the vertical distance between its occurrences is rather surprising and suggests that its presence should indicate the existence of a favorable habitat rather than any specific horizon within the Formation.

FISTULIPORA NURA sp. nov.

Pl. 1, figs. 1-3.

Occurrence: Nura Nura member of Poole Sandstone, locality 1.

Holotype: 1054.

Diagnosis: Encrusting, multilamellar Fistulipora; zooecial tubes large, with inconspicuous, unthickened lunaria, and separated by one or two rows of fine vesicles, rarely aggregated into small maculae.

Description: The zoarium is lamellar, arising from an encrusting base. The holotype envelops a coarse *Polypora* and is about ·7 x 5 cm. in area, and reaches a thickness of about 2 cm. above the encrusted *Polypora*; there are two lamellae varying from 6 to 13 mm. in thickness, and their upper surfaces are undulating.

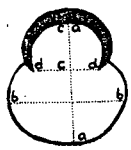


Fig. 1.

The zooecia are comparatively large and are rounded; inconspicuous, slightly thickened (0.4 to 0.7 mm.) lunaria are developed around about a third of the circumference of the tubes, but do not indent them; the size of individual tubes‡ is A: 0.28 to 0.38 mm.; B: 0.24 to 0.36 mm.; C: 0.7 to 0.95 mm.; D: 0.21 to 0.26 mm. Sixteen to 19 zooecia lie in a field of 4 sq. mm., or 4 to 5½ in a length of 2 mm. Thin, complete, straight or oblique diaphragms are developed rather infrequently, usually 3 or 4 in 2 mm. in each tube. The zooecia are separated

* An application by H. Duncan, A. Loeblich and R. C. Moore to retain *Fistulipora* as a *nomen conservandum* is under consideration by the I.C.Z.N.

† Localities are referred to by number in the text for ease of reading. A list of localities is given on p. 88.

‡ The method of measurement used for species in which the zooecial tubes are surrounded by distinct lunaria is shown in Text-fig. 1.

by one or two rows of thin-walled fine vesicles; these are aggregated into inconspicuous maculae, 1 mm. in diameter, at intervals of 5 or 6 mm.; the vesicles extend to the upper surface of each lamella and are not replaced by stereom, but near the surface they are usually rather smaller and more flattened than earlier.

Discussion: The growth form and the continuance of vesicular tissue to the upper surface differentiate this form from any other so far known from the Western Australian Permian. Lamellar zoaria are developed in several species described from the Timor Permian: of these forms, *F. basleoensis* Bassler (Basleo Beds) shows some similarity in internal structure, but consists of much thinner lamellae, and has much larger and more widely spaced zooecia.

FISTULIPORA STEREOS sp. nov.

Pl. 1, figs. 4, 5.

Occurrences: Noonkanbah Formation, localities 5 J (Holotype); 18 (1059); and 34 (22343, Univ. W.A. Colln.).

Holotype: 1058.

Diagnosis: Lobate or coarse ramose *Fistulipora*; zooecial apertures exceptionally large, tubes separated by stereom with only occasional vesicles; lunaria heavily thickened, diaphragms closely spaced.

Description: The specimens were fragments of lobate, or possibly coarse ramose, zoaria; the largest is 2.5 cm. in height and 2 x 1.3 cm. in diameter. The zooecial apertures are exceptionally large, and small spot-like areas of enlarged zooecia and thicker stereom form inconspicuous monticules spaced 4 to 8 mm. apart. The zooecial apertures are separated by heavy deposits of stereom at and near the surface. The sectioned specimen (holotype) is hollow at the centre, where a circular area about 1.5 mm. diameter is filled by matrix; although this space is probably fortuitous, it is possible that this species possessed a hollow ramose zoarium.

The large zooecial tubes noticeably radiate from the centre of the zoarium. Heavy lunaria, 0.12 to 0.2 mm. thick, usually surround about half the circumference of each tube, but at times extend around two-thirds of a tube; although these lunaria normally only slightly indent the tubes. those which surround two-thirds of a tube may quite strongly indent it. Measurements of the tubes are: A: 0.4 to 0.52 mm.; B: 0.26 to 0.48, but usually 0.36 to 0.43 mm.; C: 0.17 to 0.36, usually about 0.2 mm.; D: 0.26 to 0.4 mm. There are about 13 tubes in 4 sq. mm., and 3½ to nearly 4 in a length of 2 mm. The zooecia, both at the surface and internally, are separated by thick stereom, and only occasionally are coarse angular vesicles developed within this stereom. Thin complete diaphragms are commonly developed, 5 to 9 in each tube in 2 mm. The tube wall on the side on which the heavily thickened lunarium occurs is usually quite straight, but the opposite tube wall is generally quite irregular in outline.

Discussion: This species, which is unlike any form previously described in its internal structure, is here referred to *Fistulipora*, rather than *Dybowskiella*, because the ends of the lunaria only occasionally indent the zooecial tubes, and

no pseudosepta are developed; like several other species occurring in both the Western Australian and Timor Permian, this form is intermediate between these two genera. Although this group of species is not clearly enough defined from either genus to form at present a separate generic group, the characteristics which these species have in common occur typically within the Lower Permian.

FISTULIPORA LIVERINGA sp. nov.

Pl. 2, figs. 5, 6.

Occurrence: Liveringa Formation, locality 37.

Holotype: 1057.

Diagnosis: Small massive *Fistulipora;* zooecial tubes irregular in shape, enlarged and with heavily thickened lunaria in maculae; diaphragms numerous; vesicles coarse, walls thick but often incomplete adjacent to anterior tube walls.

Description: The holotype (3.8 cm. high and 2.8 cm. in diameter) is part of a small massive zoarium; the zooecial apertures are noticeably large, especially in the small maculae spaced about 7 mm. apart.

In tangential section, the zooecial tubes between the maculae are oval, and measure A: 0.36 to 0.43 mm.; B: 0.24 to 0.4 mm.; C: 0.12 to 0.17 mm.; D: 0.24 to 0.26 mm. Lunaria 0.07 to 0.12 mm. wide surround one-third to half the circumference of the tubes, but do not indent them, nor do the ends of these lunaria project to form pseudosepta. In the maculae, the tubes are much enlarged, measuring up to A: 0.69 mm.; B: 0.36 mm.; C: 0.36 mm.; D: 0.24 mm.; here the lunaria reach a thickness of 0.26 mm., and extend around half or more of the circumference of each tube; commonly, in the maculae the tubes are indented by the lunaria. Normally, there are about 13 tubes in 4 sq. mm., and 4 in a length of 2 mm., but within the maculae there are only 7 tubes in 4 sq. mm., and slightly over 2 in 2 mm. Thick diaphragms, slightly concave or occasionally strongly curved, occur frequently, with up to 7 in 2 mm. in individual tubes. Large thick-walled vesicles, usually in a single row, separate the enlarged tubes in the maculae; elsewhere, a single row of smaller vesicles may separate the tubes, but often the tubes are touching, with vesicles restricted to their angles. No stereom is developed, even at the surface.

In vertical sections, only when the section passes on each side through the lunarium are both walls of a tube straight and strongly formed; mostly, either the anterior wall is irregular in outline, following the jagged shape of the walls of the vesicles, or else a vertical series of vesicles is gradually replaced by short thick processes projecting from the apparent tube wall, and these also give the tubes an irregular outline in transverse section. These vesicles with incompletely calcified walls appear to be quite characteristic of the species; the walls of both vesicles and tubes are normally quite thick, and although the projections of the incomplete vesicles into the tubes end abruptly the original calcification is completely preserved—that is, the central lamina of each vesicle wall is terminally covered by the outer layer of the wall, so that the free end of the wall is a completed structure, and not a broken end.

Discussion: This species is from a bed high in the marine Permian sequence, and its structures, which are unlike those of any previously described species, indicate that it is a senescent form within this long-ranged genus; similar, but less marked, incomplete calcification of the tube walls is shown in *F. stereos* sp. nov., from a lower bed, within the Noonkanbah.

Genus DYBOWSKIELLA Waagen and Wentzel, 1886.

Dybowskiella Waagen and Wentzel, 1886, 910, 916;

Dybowskiella Waagen and Wentzel, Crockford, 1947, 5; Bassler, 1953, G 84.

Synonym: *Triphyllotrypa* Moore and Dudley, 1944, 260, 291.

Diagnosis: Laminar, massive, lobate or coarsely ramose fistuliporoids, with very strongly developed lunaria, whose ends project into the zooecial tubes to form pseudosepta, the tubes therefore being bilobate or trilobate in transverse section.

Genotype: Dybowskiella grandis Waagen and Wentzel, 1886, 919: pls. CII; CIII; CIV, figs. 1-4, CVI, fig. 7; and CXV, fig. 6. Range: Devonian (?) to Permian.

Bassler (1953) lists the range of this genus as Permian, and there is a well-marked group of fistuliporoids typical of the Permian in North America, India, and Western Australia possessing these generic characters. But *Dybowskiella* cannot be regarded as restricted to the Permian, since earlier fistuliporoids which do not seem to differ generically from these Permian species have been described from the Lower Carboniferous of eastern Australia.

DYBOWSKIELLA CRESCENS (Crockford), 1944.

Fistulipora crescens Crockford, 1944a, 143, pl. iv, fig. 1, text-figs. 7, 8.

Occurrences: Noonkanbah Formation, localities 26 (1282 A); 29 (1060: topotype); and 35 (22336B Univ. W.A. Colln.).

This species has been found only in beds near the top of the Noonkanbah. Because of its very strong lunaria, it is here referred to *Dybowskiella* rather than *Fistulipora*.

DYBOWSKIELLA ARBORESCENS sp. nov.

Pl. 2, figs. 1-4.

Occurrences: Noonkanbah Formation, localities 12 (1055); 21 (Holotype); and 29A (22332, Univ. W.A. Colln.). Baker Formation, West side of Wandagee Hill, on fence between Shed and Mungadan Paddocks, 60½ Ch. N. of S.E. corner of Shed Paddock (22333, Univ. W.A. Colln.).

Holotype: 1056.

Diagnosis: Coarse, ramose *Dybowskiella;* zooecial tubes with heavily thickened lunaria, indenting the tubes in the mature zone; vesicles thin-walled and very coarse near the centre, but flattened and with thickened walls near the surface.

Description: The zoarium is coarse ramose, with main branches about 2.5 cm. in diameter, thickening and then dividing commonly into two or three smaller branches or lobes between 0.7 and 2.3 cm. in diameter. Although the variation in size of the main stem and branches gives a wider range of appearance to both large and fragmental specimens than is found in most ramose Bryozoa, they retain the general appearance of a coarse ramose stem irregularly dividing into finer lobes and branches. Enlarged zooecia and clusters of vesicles form small monticules, about 2.5 mm. in diameter and spaced 7 to 8 mm. apart, on the surface of the zoarium, but these are readily made inconspicuous by weathering.

The zooecial tubes are vertical in the axial zone, from which they curve outwards gradually to meet the surface almost perpendicularly. At and near the surface the tubes are surrounded for two-thirds their circumference by heavily thickened lunaria, which strongly indent the tubes in tangential sections near the surface. The normal size of the tubes is A: about 0.32 mm.; B: 0.24 to 0.28 mm.; C: 0.17 mm.; D: 0.21 mm., but the tubes in the monticules are appreciably larger—about 0.4 mm. in their two longer measurements. The lunarium becomes heavily thickened towards the surface (0.1 to 0.17 mm. at its widest part), and this thickness is much exaggerated if the sections are slightly oblique; well-preserved parts of the surface show the rather hooded appearance of typical fistuliporoid lunaria. In the axial zone, where lunaria are inconspicuous or virtually absent, the tubes are round in normal sections, and about 0.31 mm. in diameter. Diaphragms are closely spaced in the axial zone, up to 6 in 2 mm.; they are rather more widely spaced near the surface. In the axial zone the tubes are separated by exceptionally large thin-walled vesicles, nearly as large as the tubes; in the outer 3 mm., these vesicles gradually become smaller, flatter, and slightly thicker-walled, and there are usually one or two rows of vesicles separating adjacent tubes, with additional rows in the monticules. Stereom is not developed near the surface, but the differential weathering of the finer vesicles near the surface gives the superficial appearance of a zone of stereom.

Discussion: No ramose fistuliporoids have previously been described from the Western Australian Permian, but collections from the higher parts of the sequence in the Carnarvon Basin contain species generally similar to the present form. The Timor Permian faunas contain several ramose species with branches up to 12 mm. diameter, but none is specifically identical with the present form, although several are generally similar and clearly indicate a comparable evolutionary stage. The massive zoaria of *Fistulipora vacuolata,* an associated Noonkanbah species, most closely resemble this form in general internal structure; but as well as the difference in growth form, the regular development of monticules in the present species, and distinct differences in lunarial development, separate these two forms.

This species is referred to *Dybowskiella* rather than to *Fistulipora* because the zooecial tubes are generally strongly indented by lunaria in the mature zone, although lunaria are only poorly developed in the axial zone; but in

typical ramose species of *Dybowskiella,* as in the genotype *D. grandis* Waagen and Wentzel, lunaria are strongly developed and indent the tubes, with the formation of pseudosepta, even in the central part of the axial zone. It is probable, therefore, that *D. arborescens* is a slightly earlier species than *D. grandis,* which occurs at the top of the Middle Productus Limestone and in the Upper Productus Limestone.

Genus ERIDOPORA Ulrich, 1882.

Eridopora Ulrich, 1882;

Eridopora Ulrich, Bassler, 1929, 52; Bassler, 1953, G85.

Diagnosis: Thin encrusting or partially attached lamellae with fistuliporoid internal structure; apertures oblique and sub-triangular, with strongly developed lunaria.

Genotype: Eridopora macrostoma Ulrich, 1882, 137, pl. 6, figs. 2, 2a.

Range: Devonian to Permian.

Eridopora has not previously been recorded from the Australian Permian, although two species occur in Timor. The genus occurs in the Callytharra as well as in the Noonkanbah (F 6908, from the Callytharra at Jacob's Gully, 15 m. West of Gascoyne Junction, is an *Eridopora* generally resembling *E. major* Bassler, 1929, but not specifically identical).

ERIDOPORA PERMIANA sp. nov.

Pl. 3, figs. 1-4; Text-fig. 2.

Occurrences: Noonkanbah Formation, localities 5 A (Holotype); 15 (1063 A); 17 (1062); 19 (1064 A); and 21 (1061 A).

Holotype: 1065.

Diagnosis: Very thin *Eridopora,* with zooecial apertures of sub-triangular appearance where perfectly preserved; vesicles in two rows between the zooecia; tubes not enlarged around the maculae.

Description: The zoarium is extremely thin, generally about 0.5 mm.; it forms a loosely attached lamella over the surface of either a fenestellid—the holotype being attached to a coarse *Polypora*—or other organic remains;

Fig. 2.—*Eridopora permiana* sp. nov. Weathered vertical section through the thin encrusting zoarium of the holotype, x 20.

occasionally the *Eridopora* extends beyond the margins of the encrusted fossil and so becomes partly free. The holotype is some 3.5 x 2.8 cm. in area. The surface is fairly flat or may, if the encrusted organism has a coarse growth, follow the irregularities of the underlying surface. Inconspicuous small spot-like maculae, 1 to 1.5 mm. in diameter, are level with the general surface of the

zoarium or very slightly depressed below it; these maculae are composed of clusters of small vesicles, and the zooecia adjoining them are of normal size: the centres of the maculae are 5 to 7 mm. apart.

The zooecial apertures meet the surface very obliquely, and strongly developed lunaria overarch the posterior sides of the apertures where the surface is well preserved; these lunaria generally surround the posterior third of the tube wall, and from their arched forward edge they extend backwards as the zooecium passes beneath the surrounding vesicles, so that well preserved lunaria have an apparent thickness of 0.26 mm. at the surface; slight weathering reduces this to the true width of about 0.09 mm. The size of the apertures is A: 0.28 to 0.33 mm.; B: 0.24 to 0.31 mm.; C: 0.09 to 0.12 mm.; D: 0.19 to 0.24 mm.; 4½ to 5 apertures occur in 2 mm., or about 13 to 16 in a field of 4 sq. mm. The zooecia are separated by small angular vesicles, which are most commonly in two rows between adjacent tubes. These vesicles extend right to the surface, and are exposed by the slightest weathering; no stereom is developed. Weathered surfaces giving vertical sections through the zoarium show the oblique tubes, without diaphragms, separated by regular rows of small compact vesicles.

The triangular shape of the zooecial apertures characteristic of *Eridopora* is here shown mainly when the surface of the zoarium is well preserved and the arching of the lunarium over the aperture is shown; weathering rapidly gives the apertures an apparent circular shape, and in section also, the degree to which a triangular outline is produced depends largely upon the angle at which the tube is cut. Despite this, this form appears to be a typical *Eridopora*.

Discussion: *E. permiana* bears a strong general resemblance to the previously described Permian species of *Eridopora*, *E. major* Bassler and *E. oculata* Bassler from Timor, and to *Fistulipora parasitica* Waagen and Wentzel from the Middle Productus Limestone, but differs from each of these in details of its structure.

Family Hexagonellidae Crockford, 1947.

The Hexagonellidae in the Upper Palaeozoic of Australia include, as well as the species here separated as *Evactinostella* gen. nov., two groups of species at present unsatisfactorily classified within any defined genus.

Firstly, amongst the species from Western Australia at present included in *Hexagonella* are several forms which have broad frond-like zoaria, in contrast to the narrow ribbon-like zoaria of the genotype and other typical species of Hexagonella. Whereas the ribbon-like zoaria generally, though not invariably, birfurcate in the plane of the mesotheca, the broad frond-like species (which seem to appear on a rather higher horizon within the Permian) commonly divide in planes at or near right angles to the mesotheca, and fragmentary zoaria of some of these species indicate that they arise as erect, irregularly dividing, broad flattened laminae from a spreading and encrusting base. No specimens yet collected give sufficient information about the structure of a complete zoarium to enable these forms to be satisfactorily separated as a new genus, but eventually such differentiation should be possible. In internal and

surface structures these species appear identical with *Hexagonella,* their relationship to which resembles but does not precisely parallel that between *Meekopora* Ulrich and *Meekoporella* Moore and Dudley in the late Pennsylvanian and Permian of North America.

The second group of species whose present classification is unsatisfactory comprises a large number of erect attached forms whose zoaria are composed of three or more bifoliate rays, arising from a spreading base and joined to each other along a vertical line in the centre of the zoarium, but with each ray free for the greatest part of its lateral extent; there is generally no sign of any secondary division of these rays. Two forms previously regarded as primitive species of *Evactinopora* in the Lower Carboniferous of eastern Australia (Crockford, 1947, 8, 27) show strong general resemblances to this group of species occurring in the Permian of Western Australia. Two such forms described in this paper are tentatively referred to *Prismopora,* since, although a new generic name is necessary for these and similar species, it does not seem desirable to propose such a name until zoaria more complete than the present rather fragmentary material can be used as the basis for definition of a new genus. It is presumably from such species that the distinctive free zoaria here separated as *Evactinostella* gen. nov. (which superficially resembles *Evactinopora* Meek and Worthen, from the Mississippian of the United States) were derived. One species of *Prismopora* described here (*P. digitata* sp. nov.) appears, however, to be a typical *Prismopora.*

Genus HEXAGONELLA Waagen and Wentzel, 1886.

HEXAGONELLA AUSTRALIS (Bretnall), 1926.

Coscinium (?) *australe* Bretnall, 1926, 25, pl. i, fig. 5, pl. ii, fig. 2;

Hexagonella australe (Bretnall), Crockford, 1944a, 149, pl. iv, fig. 3, text-figs. 13-16.

Occurrences: Nura Nura member of Poole Sandstone, locality 2 (1071 B); Noonkanbah Formation, localities 17 (1066, 1067 A); 22 (1068 A); and 27 (1290 G).

This species, originally described from Fossil Hill, Wyndham R., is common in the Callytharra Formation. The Noonkanbah specimens are identical with the holotype, except that the branches divide occasionally in more than one plane. Although the holotype shows branching in one plane only, otherwise identical specimens from Jacob's Gully, a Callytharra locality, resemble the present Noonkanbah specimens in showing subordinate division of the branches at an angle to the original frond, and no differentiation appears possible between the Callytharra and Nura Nura, and the Noonkanbah, specimens.

HEXAGONELLA BIFIDA Crockford, 1944.

Hexagonella bifida Crockford, 1944a, 154, text-figs. 19-20 a.

Occurrences: Noonkanbah Formation, localities 10 (1069) and 19 (1070) (the holotype was from the Noonkanbah Formation, locality 33).

HEXAGONELLA HUDLESTONI sp. nov.

Pl. 4, figs. 1-5.

Occurrences: Callytharra Formation, Belung Pool, Wooramel R., area (F 6539 A, B) and Wooramel R. (F 6546, 6552); Nura Nura member of Poole Sandstone, locality 2 (1071 A); and Noonkanbah Formation, localities 5 J (1073 A); 5 C (Holotype and 1075); 5 A (1076); and 10 (1072).

Holotype: 1074.

Diagnosis: Hexagonella with narrow flattened fronds of uniform width; hexagonellid ridges poorly developed; solid maculae regular and distinctive in their arrangement.

Description: The zoarium is bifoliate, with usually flattened but rarely oval branches which, except where they are branching, maintain a fairly uniform width of 1.8 cm.; their thickness is 5 to 8 mm. Bifurcation is usually in the plane of the mesotheca, but occasionally at an angle to it, so that the mesotheca may temporarily become triradiate; occasionally the branches anastomose slightly, as in F 6546, a Callytharra specimen. The arrangement and spacing of the maculae is one of the most constant and characteristic features of this form; these are prominent areas of stereom, rounded in the centre of the branches and elongate and curved outwards near the edges, and are from 2 x 2 mm. to 3 x 1 mm. in size, being spaced some 7 to 8 mm. apart in the central rows and 4 to 5 mm. apart near the edges. Hexagonellid ridges, arising about 4 to 6 mm. apart near the lateral margins of the branches, divide the surface into irregular polygonal areas, but these ridges are only faintly developed and have almost invariably been removed by weathering.

The zooecial apertures are generally circular and are enlarged by weathering at the surface; there are about 4 apertures in 2 mm., and 18 to 20 in a field of 4 sq. mm. The zooecia are separated near the mesotheca by fine vesicular tissue, and within this zone, where both zooecia and vesicles are thin-walled, slightly thickened lunaria surround and slightly indent the posterior third of the tube walls. The vesicular tissue is, within about 0.5 mm. of the mesotheca, almost completely replaced by stereom, which continues to separate the tubes (except for occasional thin layers of vesicles) until the surface is reached; within this stereom, the tubes are rounded, about 0.24 to 0.28 x 0.21 mm. in diameter, and no lunaria are shown. The tubes are recumbent for about 1 mm. along the mesotheca, and in this section two or three thin complete diaphragms usually occur; occasional diaphragms are also developed in the longer vertical section of the tubes.

Discussion: This species falls within the group usually classified as *H. dendroidea* (Hudleston). The figures given by Hudleston (1883) and also by Hinde (1890) of *H. dendroidea* are of a much coarser form, with a different arrangement of maculae and of hexagonellid ridges; *H. dendroidea* can be separately recognized in Callytharra collections. *H. hudlestoni* is a common form in the Western Australian Permian; it maintains a very constant growth form, and free specimens, or weathered sections in matrix, from the Callytharra

and the Noonkanbah show no appreciable variations in their structure; overgrowths commonly thicken and slightly broaden the zoarium, but both in these and in occasional narrower branches the characteristic shape and arrangement of the maculae is retained.

Two species of *Meekopora* from the Permian of Kansas, *M. parilis* and *M. opima* (Moore and Dudley, 1944, 302, 303, pls. 37-46) show a strong general resemblance to this form, but differ in details of their structure. Generic differentiation between *Meekopora,* in which no hexagonellid ridges are developed, and forms such as the present one, in which these ridges, characteristic of *Hexagonella,* are developed only very faintly (and are in fact rarely preserved except along the edges of the zoarium) is based upon a rather minor characteristic despite its constancy of occurrence. The genotype of *Hexagonella* possesses these ridges in a strongly developed and regular pattern; except in *H. dendroidea* and *H.? lineata,* none of the Western Australian species referred to *Hexagonella* possess particularly strongly developed ridges, but in each species so classified hexagonellid ridges are definitely present. Evidently these ridges are not developed at all in any of the numerous species of *Meekopora* described by Moore and Dudley from the Pennsylvanian and Permian of North America, but, apart from this one characteristic, the Western Australian forms both superficially and in details of their structure show a very strong general resemblance to the North American species.

HEXAGONELLA? LINEATA (Crockford), 1944.

Hexagonella lineata Crockford, 1944a, 154, pl. iv, fig. 4, text-figs. 23, 24.

Topotypes of this species (a broad frond-like form whose zoarial growth varies from that of typical *Hexagonella*) are quite common in material from locality 29 (1284-6).

Genus FISTULAMINA Crockford, 1947.

FISTULAMINA LATA *sp. nov.*

Pl. 4, figs. 6, 7; Text-fig. 3.

Occurrences: Noonkanbah Formation, localities 5 A (116); 12 (Holotype, and 1077 A, B); 15 (1063 C, 1079 A, and 1230 B); 19 (1078 A); and 30 (22337, Univ. W.A. Colln.).

Holotype: 1077 C.

Diagnosis: Fistulamina with broad flattened branches; margins faintly lobate; zooecial apertures in 8 to 11 rows, small and widely spaced; lunaria inconspicuous; maculae, as distinct from the non-celluliferous margins of the branches, absent.

Description: The zoarium is flattened, bifoliate, and strap-like, and is usually 5 to 6 mm. (occasionally 4 mm.) wide, increasing to 8 mm. before bifurcation, which occurs in the plane of the mesotheca and at intervals of 1 to 2 cm.; the branches are about 2 mm. in thickness. The margins of the branches are very slightly lobed, with slight clusterings of zooecia (which are

more closely spaced in the lateral than in the central rows) separated by inconspicuous widening of the non-celluliferous lateral margins; these lobes are spaced about 5 mm. apart, and the width of the non-celluliferous margin between the lobes does not exceed 1 mm. The surface between the apertures is granular in well-preserved specimens; no maculae, as distinct from the very narrow non-poriferous margins of the branches, are developed, but, at the point of bifurcation, the junction of these margins extends backwards to form a narrow solid area of stereom for some 3 mm. before division.

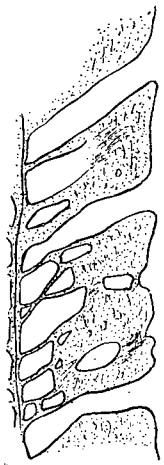


Fig. 3.—*Fistulamina lata* **sp. nov. Weathered oblique longitudinal section through part of the bifoliate zoarium of specimen (22337, Univ. W.A. Colln.), x 20.**

The zooecial apertures are oval, from 0.21 x 0.17 mm. to 0.26 x 0.19 mm. in size, but frequently are rounded and enlarged by weathering; they are in 8 to 11 rows, arranged fairly regularly in the centre of each surface but less regularly near the margins; the apertures are usually between 0.59 and 0.95 mm. apart, being a little closer spaced in the lateral than in the central rows. Lunaria cannot usually be distinguished; occasionally on weathered surfaces they can be differentiated as an arc of denser tissue around the posterior third of an aperture, not indenting the tube.

The zooecia are long, narrow, and tubular; they lie parallel to the mesotheca for about 2.5 mm., and then curve upwards rather sharply to meet the surface almost perpendicularly; the most common tube width is 0.24 mm. Two or three thin complete diaphragms may be developed in the recumbent part of the tube. A few small thin-walled vesicles occur between and just above the tubes while they are recumbent tubes; they are separated after they curve upwards to the surface by stereom.

Discussion: The larger size, and the internal structure, of this form separate it from associated species of *Etherella,* to which it shows a general external resemblance; the zoarium is finer than in any described species of *Hexagonella,* from which it is differentiated by the lack of maculae and of surface ridges; *Fistulamina* is differentiated from *Meekopora* by the absence of maculae, which are prominent in species of *Meekopora* of similar form.

Genus PRISMOPORA Hall, 1883.

Prismopora Hall, 1883, 159.

Prismopora Hall, Ulrich, 1890, 386, 505; Warthin, 1930, 43.

Diagnosis: Zoaria erect, arising as three bifoliate rays from an encrusting base; rays typically very short, zoarium in transverse section triangular, with the sides of the triangle slightly concave; branches dividing into secondary branches, also of triradiate structure but at times of smaller size as the zoarium extends upwards. Internal structure fistuliporoid, with maculae well developed and stereom replacing vesicular tissue away from the mesothecae.

Genotype: Prismopora triquetra Hall, 1883, 159.

Range: Devonian to Permian.

Prismopora has previously been described only from North America, the genotype being a Devonian species. The genus occurs also in the Chester of the Mississippi Valley region, and then in the Lower Pennsylvanian of the mid-continent and Rocky Mountain regions, but appears to be absent or extremely scarce in rocks of the same age farther west; and it may also occur in later rocks in the Glass House Mtns. of Texas (H. Duncan, in litt.). *Prismopora* has also been described (Warthin, 1930) from the Upper Pennsylvanian of Oklahoma.

PRISMOPORA DIGITATA sp. nov.

Pl. 5, figs. 1-4.

Occurrences: Noonkanbah Formation, localities 5 J (Holotype, and 1073 C, 1081 A, 1082, 1083 A-C, 1086, 1150 A); 5 N (1084 A); and 18 (1085 A).

Holotype: 1073 B.

Diagnosis: Prismopora in which a solid triangular zoarium arises from an encrusting base, dividing once above into three blunt, thinner, triradiate branches; maculae solid, regularly arranged, and conspicuous.

Description: The triradiate zoarium arises from a sub-circular encrusting base, covered by a thin epitheca; usually a single erect branch arises from the centre of a base 9 to 13 mm. in diameter, but in one specimen the base is extended laterally, being 17 x 10 mm. in its greatest diameters, and two branches arise from it. The width of the three sides of these erect branches near the base varies with the age of the zoarium. Usually the sides are unequal in width and vary from 6, 6, and 8 mm. to 8, 9, and 11 mm. In young zoaria, the longest side is flat, and the two shorter sides slightly concave, but all three sides of older and more thickened zoaria may be flattened; in cross section the three rays of the mesotheca pass outwards from the centre of the zoarium to the sharply angular edges of the rays. Each erect branch divides some 18 mm. above the base; the three branches then formed are smaller than the original stem, being about 6 to 8 mm. on their widest side near their origin, and tapering, in 2 cm., to about 2.5 mm. wide. Each secondary branch, although originally derived from a single mesotheca, develops three rays close to its origin.

Solid maculae are very prominent and distinctive; they originate near the centre of each surface, and curve upwards and outwards to the edges of each side, where they are usually 1 to 1.5 mm. wide, and are spaced with their centres 2.5 to 3.5 mm. apart; they are slightly depressed, and their edges slightly indent the margins of the branches. The development of maculae is usually restricted to these regularly placed and shaped areas, but older zoaria may show in addition a single long thin area of stereom running up the centre of each surface of the branch, up to 14 mm. long and 1 to 2 mm. wide.

The zooecial apertures are crowded on the surface between the maculae: 4 to 7 rows of apertures occur between adjacent maculae. They are oval, and usually much enlarged by weathering; unweathered apertures are normally 0.19 to 0.24 mm. long and about 0.18 mm. wide, with 4½ to 5½ apertures in 2 mm. or 17 to 22 in 4 sq. mm., excluding maculae. Where they are well-preserved the apertures show lunaria, usually on the side of the aperture directed towards the nearest macula or towards the centre of the surface; these surround, and very slightly indent, the tubes for almost half their circumference. The surface between the apertures is flat and finely granular.

Internally, the zooecial tubes are recumbent for a short distance, and then bend upwards abruptly and pass to the surface almost perpendicularly; diaphragms are occasionally developed. Near the mesotheca, the tubes are separated by rather thick-walled vesicles, which are replaced within a short distance by stereom with only occasional tiny vesicles, in places aggregated into layers in the outer part of the zoarium.

Discussion: This species appears to be a typical *Prismopora,* and in its general appearance is not unlike the much smaller zoaria of *P. triangulata* (White), from the Pennsylvanian of Texas and Missouri; *P. lobata* Warthin, from the Upper Pennsylvanian of Oklahoma, is another similar but much finer species.

PRISMOPORA? TRIRADIATA sp. nov.

Pl. 6, figs. 1-4.

Occurrences: Noonkanbah Formation, localities 7 A (1092); 8 (Holotype); 9 (1093 A, B); 10 (1091); 13 (1090); 16 (1094 A); 17 (1095); and 19 (1089 A).

Holotype: 1088.

Diagnosis: Prismopora (?) with three broad bifoliate rays arising from a slightly spreading base; surface with prominent, elongate, solid maculae.

Description: The zoarium is attached; the base spreads slightly where the angles between the rays in the lower part of the colony have been filled in by additional layers of vesicles and stereom as the colony grew upwards. The three rays gradually extend laterally above the base. All the zoaria collected are fragmentary, but the rays preserved extend up to 3 cm. from the junction of the rays

to their outer margins, and are up to 6 cm. in height; they are usually between 4.5 and 7 mm. thick, and, except near the base of the colony, there is very little thickening of the rays near their junction. Although weathering in some zoaria has given the appearance of rays attached along the central junction of the mesothecae in the lower part of the zoarium, and diverging from this junction to be free above, this seems always to be the result of oblique weathering across the upper surface of the colony; there is no real indication that the rays were not originally attached to each other throughout their full height, and no secondary branching of the rays is shown.

Elongate solid maculae, 4 to 7 mm. long and 1 to 2 mm. wide, are arranged in rows radiating from the base and centre of the zoarium, and are especially prominent on weathered surfaces; commonly a long, narrow macula, 5 cm. or more in length and 2 or 3 mm. wide, runs vertically up the junction of the rays and may weather to give the appearance of a solid axis. No hexagonellid ridges are shown.

The zooecial apertures are usually greatly enlarged by weathering, but where well preserved they are indented by lunaria, usually but not always directed towards the nearest macula; these lunaria surround about half of each tube, and are visible but not prominent in sections. Unweathered apertures measure about 0.2 to 0.24 x 0.14 to 0.17 mm.; 4½ to 5 occur in 2 mm. and 18 to 22 in 4 sq. mm., excluding maculae. Near the mesotheca, the zooecia are recumbent for about 1 mm.; they then bend upwards sharply and pass perpendicularly to the surface. Near the mesotheca the tubes are separated by fine vesicles; these are quickly replaced by stereom with only occasional vesicles, and subsequently narrow layers of vesicles alternate with layers of stereom to the surface. Two or three thin complete diaphragms occur in most zooecial tubes. The rays of some zoaria are thickened by rejuvenation and overgrowths, as is common in bifoliate fistuliporoids.

Of the specimens used in this description, all are of large size except 1095, which is a small broken specimen 1.2 cm. high, of the base of the three rays of a young zoarium, and which has the attached base, with its concentrically wrinkled epitheca, well preserved.

Discussion: This species is only doubtfully referred to *Prismopora*; the size of the zoarium is far greater than that of any described *Prismopora* (although species of giant size do commonly occur in the late stages of bryozoan genera), and none of the rays show any evidence of division at the upper edge to form further triradiate branches. On the other hand, the zoarium is attached, and this, apart from other characters, clearly differentiates this species from *Evactinostella* (p. 27). *Meekoporella* Moore and Dudley, 1944, does not possess the regular growth form developed in the present and similar species in the Western Australian Permian; and, although fragments of *Meekoporella* may be triradiate, the present form shows no evidence of the development of cup-shaped areas at the base of the colony with branching bifoliate fronds arising from them, as in *Meekoporella*, but consists simply of three large, flat, erect rays

arising from a slightly spreading base and joined throughout their height. At present, this (and the following) species seem best tentatively referred to *Prismopora.*

P.? triradiata is common in several facies in the middle part of the Noonkanbah; it does not appear to extend into the higher parts of the Formation.

PRISMOPORA? ATTENUATA sp. nov.

Pl. 5, figs. 6, 7.

Occurrence: Noonkanbah Formation, locality 5 C.

Holotype: 1087.

Diagnosis: Prismopora? with extremely thin rays; apertures crowded in bands between prominent solid maculae.

Description: The zoarium is erect and triradiate; the base is not shown. The rays are extremely thin, being about 1.4 mm. thick through the bands of zooecia, and 0.9 mm. through the maculae; no thickening of the zoarium has occurred near the junction of the rays. Of the two rays shown, one reaches a maximum width of 9 mm., and the other of 6 mm.; the third ray is broken off close to its origin. Solid depressed maculae are very prominent; they commonly originate in the angle formed by the junction of the rays, and, after passing up vertically for about 2 mm., they curve outwards, gradually broadening, and meet the margin of the ray at almost 90°; but extra maculae are often interpolated near the outer margin, originating some 5 mm. from the centre. The sharp outer margin of each ray is sinuous, being slightly indented by the maculae, and a paper-thin non-celluliferous border about 1 mm. wide originally extended up this margin. The width of the maculae near the outer margin of the rays is generally 2 mm., and their centres are there spaced from 2.5 to, more often, 4 mm. apart.

The zooecial apertures are clustered into bands, each containing 5 to 8 rows of crowded apertures between adjacent maculae. Originally these apertures were oval, about 0.25 x 0.17 mm., and they are separated near the surface by a layer of stereom some 0.33 mm. thick; because of the extreme thinness of the rays, weathering rapidly reaches the inner part of the zoarium, and most of the apertures are very much enlarged. There are 5 to almost 7 apertures in 2 mm., and about 29 to 32 in 4 sq. mm.; no lunaria are visible, and the surface between the apertures is finely granular. Fractured surfaces show typical fistuliporoid internal structure; the tubes are parallel to the mesotheca for a very short distance, and then pass upwards to the surface; near the mesotheca, the tubes are separated by tiny, vertically elongate, thin-walled vesicles.

Discussion: Although only a single specimen is present in the Noonkanbah collections, it is well preserved and is a very distinctive form; it is generally similar in the shape of the zoarium and arrangement of the maculae to

P. digitata sp. nov., which occurs rather commonly on earlier horizons in the Noonkanbah; the much thinner, but more extended, rays and other measurements clearly differentiate *P.? attenuata* from this earlier form.

Genus Evactinostella nov.

Zoarium free, with bifoliate flattened branches which diverge from a central vertical line and do not subsequently divide; internal structure fistuliporoid; rudimentary hexagonellid ridges developed.

Genotype: Evactinopora crucialis Hudleston, 1883, 593, pl. XXIII, figs. 2 a-c.

Evactinopora crucialis has been referred by Hudleston (1883, 593) and Etheridge (1914, 16) to *Evactinopora* Meek and Worthen; by Hinde (1890, 200) to *Hexagonella* Waagen and Wentzel; and by Moore and Dudley (1944, 305) to their new genus *Meekoporella*. Comparison with each of these forms and with other bifoliate fistuliporoid genera indicates that *E. crucialis* and related forms in the Western Australian Permian should be placed in a new genus.

In common with *Evactinopora, Evactinostella* possesses a free zoarium, and consists of flattened bifoliate rays which are here joined in the centre of the zoarium along a vertical "axis" (formed only by the junction of the mesothecae and of the rays, and not a separate structure). *Evactinopora* occurs only in the Mississippian of the United States; the Permian forms occurring in Western Australia differ in lacking the characteristic heavily calcified marginal supports of the folia developed in *Evactinopora*, and are also, in their general structure, more closely related to the bifoliate fistuliporoids of this and other Permian faunas than to the earlier *Evactinopora*.

The free zoarium and different growth-form clearly differentiate *Evactinostella* from both *Hexagonella* and *Meekoporella;* in addition, the surface ridges characteristic of *Hexagonella* are quite rudimentary in their development in this form. *Meekoporella* "consists of bifoliate sheets that join at angles of about 120° to the planes of the median lamellae. The sheets diverge and coalesce so as to form steep-sided, deep polygonal chambers having an inverted pyramidal form" (Moore and Dudley, 1944, 304); they also state that "a typical representative of this new genus that occurs in Permian rocks of Australia was erroneously identified as a gigantic, remarkably elevated *Evactinopora* (Hudleston, 1883 . . .)". None of the many specimens of *E. crucialis* used for the following description gives any indication of division or of coalescence of the rays, and also, so far, no bifoliate fistuliporoid with the growth form of *Meekoporella* has yet been found in these Western Australian faunas.

In addition to the type species, at least one other, undescribed, species of *Evactinostella* occurs in the Western Australian Permian; this second is a smaller species, in which the rays proceed outwards horizontally from their central junction, and do not curve upwards as in the type species; no specimens of this second form were included in the present collections.

EVACTINOSTELLA CRUCIALIS (Hudleston), 1883.

Pl. 7, figs. 1-5.

Evactinopora crucialis Hudleston, 1883, 593, pl. xxiii, figs. 2 a-c;

Hexagonella crucialis (Hudleston), Hinde, 1890, 200,;

Evactinopora crucialis Hudleston, Etheridge, 1914, 18, pl. ii, fig. 7; pl. v, figs. 1-2;

Meekoporella crucialis (Hudleston), Moore and Dudley, 1944, 305.

Occurrences: Callytharra Formation, 33 m. N. of Gascoyne Junction (F 6817, 6919); 4 m. W. of Mt. Sandiman Stn., Gascoyne area (F 1647); and Baracooda Pool, Arthur R., Gascoyne area (F 9036, Aust. Mus. Colln.). Nalbia Sandstone, about 30 ch. S.W. of S. W. corner of Wandagee Hill (Upper part of Schizodus Stage of Wandagee Series of Teichert) (22340, Univ. W.A. Colln.). Baker Siltstone, Mundagan Paddock, about 8 ch. S.W. from where road from Wandagee Woolshed passes through fence between Mungadan and Nalbia Paddocks (Lowest part—zone 10—of Linoproductus Stage of Wandagee of Teichert) (22341, Univ. W.A. Colln.). Nura Nura member of Poole Sandstone, locality 1 (1096 A-D); Noonkanbah Formation, localities 11 (1097 A-C); 15 (1063 B, 1230 A); 29 (1295); 29 A (22339 A, B, Univ. W.A. Colln.); 18 A (1098 A, B, 1099 A, B, 1100 A, B, and 1101 A); and 33 (22338. Univ. W.A. Colln.).

Holotype: The holotype of this form was the single specimen in the collections described by Hudleston; this specimen is not now with material used by Hudleston and now in the British Museum Collections, nor is it in any other museum in England in which collections which Hudleston used at varous times are now known to be lodged; it is therefore reasonable to assume that the holotype is lost. No neotype is selected here, however, as no suitable topotype is included in the present collections (the holotype was "believed to be derived from the 'Fossil Range' north of the Lyons River", presumably from the Callytharra).

Diagnosis: Evactinostella with usually four, rarely five, strong broad rays, which curve upwards and outwards from their central junction; surface with small, rounded, solid maculae.

Description: The zoarium is free; four bifoliate rays typically diverge from the centre of the zoarium, but in two specimens (22335, Univ. W.A. Colln., the locality of which is unknown, and 1099 B, from the Noonkanbah Formation, locality 18 A) five rays are developed, with apparently no other appreciable differences in structure. The zoarium is cruciform in cross section, the individual rays curvng upwards and outwards from the centre at the base, and being themselves of flattened oval cross sections; these rays are joined obliquely across their full width at the centre of the zoarium. The height of the zoarium, and the width and thickness of the rays, varies with age; in a mature specimen, where the rays have been thickened by stereom and later by surface overgrowths, typical measurements are:—width of ray, at right angles to its length: 2.0 to

2.8 cm.; height of zoarium at junction of rays: 2.5 to 3.3 cm.; thickness of rays: usually about 1 cm., but slightly greater near their junction, and tapering considerably near their extremities; length of rays: the longest observed (1096 A) extend for 13.5 cm. from their junction, and reach a height of about 6 cm., although incomplete. The apical angle between opposite rays is generally about 135°, but is occasionally sharper, about 90°, and may vary in the two pairs of rays of one specimen; differences in apical angle (within this range) are shown in specimens from one locality, and seem unaccompanied by any variation in internal structure. The rays, though slightly thickened near their junction, retain their flattened oval transverse section right to the centre of the zoarium; no central disc or extra deposits of stereom develop on the under surface of the zoarium, as they do in *Evactinopora*. One Callytharra specimen (F 6919) has slightly flexuous rays. In transverse section, the angle separating the rays is somewhat variable; in each Noonkanbah specimen listed, and in the two specimens from the higher horizons in the Carnarvon Basin, this angle is close to 90°, whereas in the Callytharra and Nura Nura specimens the rays typically intersect to give two noticeably acute and two obtuse angles. This difference is probably of no real stratigraphical significance (firstly, because there seems to be no accompanying variation in internal structure, and secondly, because the original specimen described by Hudleston—which was almost certainly from a Callytharra locality—is figured with rays intersecting at right angles), but in future collections such differences in angle might be found useful. The four rays of a specimen seem invariably of almost exactly equal size; previous descriptions have referred to unequal development of rays, but this apparent inequality is due either to the angle at which the zoarium is exposed and weathered, or to fracturing of one or more rays. In a free zoarium, symmetrical development would assist stability—one Noonkanbah specimen (22339 A, Univ. W.A. Colln.) shows a fractured ray which appears to have been rejoined during growth, which has then proceeded in the original direction.

Solid maculae, about 3 x 2 mm. in size, and spaced about 8 mm. apart, occur on the surface; though normally inconspicuous, they are prominent on some weathered specimens. The surface between the apertures is solid; hexagonellid ridges are only developed on the lower surface of the rays near the base of the zoarium, where the surface is commonly thrown up into slight folds, 6 to 8 mm. long—eventually incipient ridges; in specimens weathered obliquely these may give a frilled appearance to one margin of a ray. Slight weathering usually exposes some of the vesicular tissue. Lunaria, slightly raised around more than half of each aperture but not indenting the tubes, are poorly developed.

The internal structure is that typical of bifoliate fistuliporoids. The mesotheca is well defined; it is thrown up into numerous tiny folds so that, in sections parallel and close to it, it appears as numerous fine striae; the zooecial tubes are at first recumbent, then bend sharply outwards and pass, a little obliquely, to the surface. Lunaria are poorly developed in a few tubes, and are especially noticeable near the mesotheca; here they usually surround half

or a little less of the tube wall, but do not noticeably indent the tubes, which are oval in cross section, 0.2 to 0.24 x 0.17 to 0.2 mm.; 16 to 21 occur in 4 sq. mm., and 4½ to 5 in 2 mm.; commonly several zooecia immediately adjoining a macula are considerably enlarged, measuring up to 0.28 x 0.21 mm., but these tubes do not show any stronger development of lunaria. Normally three thin complete diaphragms occur in each tube. Near the mesotheca, the tubes are separated by fine rectangular vesicles, which are here flattened on their lower and arched on their upper surfaces. As is usual in many bifoliate species, thin overgrowths of the surface commonly occur in mature specimens; these overgrowths retain the characteristics of the earlier part of the colony but are separate layers with new growths of zooecia, as distinct from the layers formed by successive alternations of vesicles and stereom.

Discussion: The unusual form of the zoarium, the variations in size with the age of the colony, and the many possible differences in shape according to the angle at which a zoarium is exposed by weathering, give much variety to the appearance of this species, but despite this *E. crucialis* is one of the most characteristic and readily recognised members of these Permian faunas. Etheridge (1914, 18, pl. ii, fig. 7, and pl. v, figs. 1-2) has referred to asymmetrical development of the rays of some zoaria; these rays were broken, rather than asymmetrical, but it has probably been these observations which led Moore and Dudley (1944) to place this species in *Meekoporella;* it seems likely that a free zoarium with this growth form would have little chance of survival unless growth was symmetrical. The actual ancestrula area of no specimen is clearly shown, as the tiny area at the base has been weathered away in each specimen; but this area of weathering is so small, being usually only 1 to 2 mm. in diameter, that there is no doubt that the zoarium was free. The scarcity of free zoaria makes their habitat of some interest. In modern faunas, small free lunulitiform zoaria are characteristically found in sandy areas, below 15 fathoms, and in strong currents. *Evactinopora* in the Mississippian of the United States occurs (H. Duncan, in litt.) either in a shaly facies or, in the larger species, in a coarse crinoidal limestone. In the present collections, *E. crucialis,* through its comparatively long range in the Permian, seems associated with shallow-water deposits in which wave action has been rather strong; in such an environment its peculiar growth form would be fairly stable and the distribution of the zooecial apertures would be well suited for food collection. The matrix is commonly either a coarse friable sandstone or a sandy limestone. Although too long-ranged to be useful stratigraphically, unless minor variations are found to be significant in a larger series of specimens, *E. crucialis* would probably be of use in indicating a near-littoral or shallow-water facies.

Family Etherellidae nov.

Diagnosis: Cribrose or strap-like bifoliate Bryozoa with substantially fistuliporoid internal structure, but differing from other bifoliate fistuliporoids in the shape of the zooecial tubes, the recumbent portion of which is much

longer, and the perpendicular portion very much shorter, than in most Hexagonellidae; the recumbent part of the zooecia is recurved so that, in sections near the mesotheca, the tubes are hook-shaped. Zooecial tubes separated for most of the thickness of the zoarium by heavy deposits of stereom, with occasional vesicles developed only near the mesotheca; lunaria absent or very poorly developed; diaphragms and hemisepta absent; no vertical plates developed between adjoining rows of zooecia; maculae restricted to the narrow non-celluliferous margins of the branches.

Discussion: The group of Bryozoa for which this new family is proposed is so far known only from the Permian of Western Australia, and the species assigned to it are placed in two new genera, *Etherella,* the zoaria of which are cribrose, and *Liguloclema,* in which the zoaria are straplike. Both genera are comparatively abundant forms in these Permian faunas, and both seem quite distinct in their internal structure from any genus previously described; they are presumably derived from an earlier bifoliate fistuliporoid genus such as the associated *Fistulamina,* which first appears in the Lower Carboniferous Burindi Series in New South Wales, and is fairly common throughout the Carboniferous in eastern Australia. *Fistulamina* is not known to occur in the Permian in eastern states, but one described species occurs (p. 21) in the Noonkanbah faunas, and is, in its external appearance, very similar to the forms here separated as *Liguloclema.*

The distinctive tube-shape in these new genera seems fundamentally different from that developed in other Ceramoporoidea and implies some modification of the living organism, and so appears an adequate basis for the separation of these forms as a new family. Subordinate differences between each of these new genera and other bifoliate fistuliporoids, especially those of similar zoarial form, include the reduction of vesicular tissue (which is usually strongly developed in bifoliate fistuliporoids) to a very few tiny vesicles near the mesotheca; the consequent much greater development of stereom; and the reduction of maculae to the narrow non-celluliferous margins of the branches.

Only one specimen shows the base of a zoarium; this specimen is figured and described with the description of the variety (*Etherella porosa* var. *minor*) to which it is referred (p. 33, pl. 8, fig. 5); it shows a close general similarity to the base of a colony of *Hexagonella turgida* Bassler (Bassler, 1929, 51, pl. CCXXXII (8), fig. 9) described from the Timor Permian.

In their general structure, reduction of maculae, and in particular in the comparatively long recumbent and short perpendicular portions of the zooecial tubes in most species, it is possible that these genera might be considered as Cryptostomata. They are here classified with the Cyclostomata, however, as both this family and the Goniocladiidae, in which maculae are similarly restricted and the recumbent and perpendicular portions of the tubes are similarly proportioned, seem quite definitely to be phylogenetically related to the bifoliate fistuliporoids, rather than to any group of Cryptostomata.

Genus ETHERELLA nov.

Zoarium a bifoliate, flattened, cribrose expansion; zooecial tubes generally parallel to the mesotheca for the greater part of their length, and curved backwards in this recumbent portion to appear hook-shaped in sections near the mesotheca, but later bending upwards to meet the surface perpendicularly; zooecial tubes usually separated by stereom, but occasional small vesicles developed, especially near the mesotheca.

Genotype (here designated): *Etherella porosa* sp. nov.

Bifoliate cribrose zoaria are developed in several Palaeozoic bryozoan families, as in *Coscinotrypa* Hall and Simpson, 1887 (*Coscinium* Keyserling, 1846, *non* Endlicher, 1836), which is now referred to the Hexagonellidae, and in the early Palaeozoic genera *Clathropora* Hall (Ptilodictyonidae) and *Coscinella* Hall and Simpson (Stictoporellidae).

Of these genera, the present form is most similar in structure to *Coscinotrypa,* which ranges from the Ordovician to the Permian, the genotype being a North American Devonian species; several species of *Coscinotrypa* have been described from the Mississippian of North America, and the genus occurs in Russia from the Middle Carboniferous to the Lower Permian (Shulga-Nesterenko, 1952, table 2). Although in their external appearance the Western Australian species described here closely resemble species of *Coscinotrypa,* and in particular some of those described from the Lower Permian of Russia, they differ from any described species in their distinctive internal structure.

ETHERELLA POROSA sp. nov.

Pl. 8, figs. 1-3.

Occurrences: Noonkanbah Formation, localities 5 A (1104); 5 B (Holotype); 5 C (1103 A); and 22 (1068 B). Liveringa Formation, locality 37 (1105 A).

Holotype: 1102 A.

Diagnosis: Zoarium bifoliate, cribrose; fenestrules oval and large; zooecial tubes hook-shaped, separated by a few comparatively coarse vesicles near the mesotheca and by stereom near the surface.

The zoarium is cribrose, with regularly anastomosing bifoliate flattened branches; the largest incomplete zoaria measure 5 x 4 cm. The fenestrules are oval, 5 to 7 mm. long and 3 to 5 mm. wide, and are regularly placed; usually the centres of two adjacent fenestrules are 9 to 11 mm. apart measured diagonally, or about 15 to 18 mm. measured along their longer diameters. The branches are between 4 and 5.5 mm. wide and average 1.3 mm. in thickness at the centre; they are oval in cross-section and taper laterally to a sharp narrow non-celluliferous margin about 0.5 mm. wide, bordering the fenestrules.

The apertures are placed in curving diagonal rows, each containing 10 or 11 apertures, on each surface of the branches; these apertures are oval, 0.2 to 0.25 mm. long and 0.13 to 0.16 mm. wide; the centres of successive apertures

in one longitudinal row are 0.5 to 0.7 mm. apart; almost 4 occur in 2 mm., and 16 to 19 in 4 sq. mm. Lunaria do not appear to be developed. The surface in well-preserved specimens is smooth and solid between the apertures, but slight weathering may form peaks, superficially resembling acanthopores, between the apertures.

Internally, the zooecia are at first recumbent on the mesotheca, and then bend up sharply to meet the surface at right angles. The recumbent part of each tube is hook-shaped, each being sub-divided by a strong vertical plate which passes diagonally backwards across each tube, so that the origin of each tube is immediately adjacent to the point at which the tube bends upwards to the surface. The tubes are 0.5 to 0.8 mm. long, and about 0.19 mm. wide, on either side of the dividing plate, which projects some 0.26 to 0.35 mm. diagonally backwards into each tube, and leaves a tube width also of about 0.19 mm. beyond its extremity. This dividing plate about equals in thickness, and

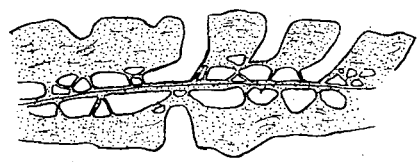


Fig. 4.—*Etherella porosa* gen. et sp. nov. Transverse section of the bifoliate zoarium, polished surface of the holotype, x 20.

resembles in structure, the normal wall between two adjacent tubes, and is usually slightly thickened at its free end; a small vesicle occasionally occurs within it, and this appears to indicate that the plate represents one side of the tube wall, doubled back upon itself, rather than any other type of structure, and this impression is still more strongly given by etched specimens; in its position it has no analogy with a hemiseptum, or with a hemiphragm. The tubes in adjacent rows are generally, but not always, bent in opposite directions. The unusual shape of the tubes in this and related forms is clearly shown both in sections and upon weathered surfaces. No diaphragms are developed within the tubes, and no hemisepta are present. Vesicular tissue occurs between and immediately above the tubes in their recumbent portion (which measures some 0.17 mm. in height above the mesotheca); for the remaining distance to the surface (a further 0.4 to 0.55 mm.) stereom separates the tubes. The mesotheca is thrown into numerous tiny folds and so appears as a series of fine striations in sections parallel to it.

Overgrowths of the surface are not uncommon; these add slightly to the thickness of the zoarium, and, where they are weathered, show clearly that the tubes here also are hook-shaped, and repeat the characteristics developed near the mesotheca.

ETHERELLA POROSA var. MINOR nov.

Pl. 8, figs. 4-6.

Occurrences: Noonkanbah Formation, localities 5 J (Holotype, and 1073 E, F) and 18 (1085 B).

Holotype: 1073 D.

Diagnosis: Zoarium as in *E. porosa,* but of smaller size; base of zoarium encrusting a crinoid stem; vesicular tissue almost completely replaced by stereom.

Description: The zoarium is cribrose, and in one specimen (1073 E) the base of the colony is preserved; this consists of an encrustation around a weathered circular fragment of, apparently, a crinoid stem, and the two bifoliate branches which arise from the portion exposed at once commence to bifurcate to form a cribrose colony; this base bears a strong general resemblance to that figured by Bassler (1929) for *Hexagonella turgida* Bassler.

The dimensions of the zoarium in this variety are finer than in *E. porosa;* the width of the flattened branches is 2 to 3.3 mm., usually between 2.8 and 3 mm.; their thickness is about 1.3 mm.; and the size of the fenestrules is from 2.5 x 2 mm. to 3.5 x 2 mm., with the centres of adjacent fenestrules some 5 to 7 mm. apart diagonally, or 6 to 9 mm. along their longer diameters. The branches are of similar flattened oval cross-section, and the fenestrules are bordered by a sharp non-celluliferous margin about 0.3 to 0.5 mm. wide, which often extends backwards to form a short V-shaped solid area at the base of a fenestrule.

The zooecial apertures are in rather irregular diagonal rows each of 7 to 11 apertures on each surface; the apertures are more crowded than in *E. porosa,* for although they are from 0.52 to 0.83 mm. apart in the irregular longitudinal rows which they form, the lateral crowding of these rows gives from 24 to 30 apertures in 4 sq. mm. Individual apertures are oval, 0.21 x 0.14 mm. in diameter, and lunaria are absent. The surface between the apertures is smooth and solid.

Internally, the zooecial tubes are the same shape as in *E. porosa;* the recumbent part of the tubes is 0.36 to 0.6 mm. long, and their width 0.14 to 0.21 mm. Vesicular tissue is reduced to a few tiny, vertically elongate vesicles between the tubes near the mesotheca.

Discussion: Although very similar in its general appearance and structure to *E. porosa,* this form is separated as a distinct variety because of its smaller size, more crowded apertures, and lesser development of vesicular tissue, and because these differences are found in a group of specimens from an earlier stratigraphical horizon within the Noonkanbah than *E. porosa* s. str.

Etherella irregularis sp. nov.

Pl. 9, figs. 1-3.

Occurrence: Noonkanbah Formation, locality 5 J (Holotype, and 1073 G).

Holotype: 1073 H.

Diagnosis: Zoarium irregularly cribrose; branches rounded, bifoliate, dividing usually but not always in the plane of the mesotheca; zooecia hook-shaped near the mesotheca, vesicular tissue almost absent.

Description: The zoarium consists of bifoliate rounded branches, bifurcating frequently in the plane of the mesotheca, and anastomosing so that an irregularly cribrose colony is formed; rarely, branches bifurcate at right angles to the mesotheca, but the branches so formed appear abortive; an incomplete zoarium measures 5 x 3 cm. The width and size of branches and fenestrules is far less regular than in the two preceding forms; usually the branches are 3.5 to 4.5 mm. wide, but the lateral connexions between the branches are usually narrower and occasionally very thin; normal branches are 2 to 3 mm. thick, being most strongly thickened and rounded along the centre of each surface, and the curve from this central broad ridge out to the rounded margins of the branch is quite concave. The fenestrules also are less regular in shape and size; they usually measure between 2.5 x 1.8 mm. and 5.5 x 3.5 mm.

The zooecial apertures are oval, 0.2 to 0.23 x 0.14 to 0.17 mm.; 9 to 14 occur in somewhat erratic diagonal rows across each surface, and they are quite irregularly spaced longitudinally; there are about 25 apertures in 4 sq. mm. The recumbent portion of the tubes is short and hook-shaped, the two sides of this hook being in this species of very unequal length—from the origin to the bend is only about 0.25 mm., while the second side is about 0.65 mm. long; both these lengths are short compared with the length of the vertical portion of the tubes along the centres of the branches (up to 1.7 mm.); the height of the recumbent portion is 0.25 mm. Neither diaphragms, hemisepta, nor lunaria are developed. Vesicular tissue is restricted to a few angular vesicles between the tubes near the mesotheca and to an occasional small rounded or angular vesicle, up to 0.7 mm. across, isolated in stereom in the outer part of the branch.

Discussion: Although much less regular in its growth form, this species closely resembles the two preceding forms in internal structure and appears congeneric with them; there is no described form with which it could be confused.

Genus LIGULOCLEMA nov.

Diagnosis: Zoarium bifoliate, with narrow, flattened, strap-like (ligulate) branches; maculae, as distinct from the narrow non-celluliferous margins of the branches, not developed; internal structure as for family.

Genotype (here designated): *Liguloclema typicalis* sp. nov.

Zoaria referred to this new genus externally resemble *Sulcoretepora* d'Orbigny, to which Etheridge doubtfully referred one species, but they differ from *Sulcoretepora* and other Bryozoa of similar zoarial form in their distinctive internal structure.

Strap-like Bryozoa are very common in the Noonkanbah, and of all the Bryozoa in this fauna they form the most unsatisfactory group with which to deal. At least four quite distinct generic groups possessing this zoarial form are present; of these, the broader forms, which possess maculae and species of which are described as *Hexagonella,* can be quite satisfactorily

separated from the narrower zoaria (i.e., those which are generally 5 mm. or less in width), in which non-celluliferous tissue is restricted to the narrow lateral margins of the branches or to short ingrowths from these margins, mainly at the point of bifurcation of a branch. However, three generic groups are included in these latter narrow strap-like forms, which may possess either long straight zooecial tubes (*Fistulamina*, p. 21) or the distinctive hook-shaped tubes here separated as *Liguloclema,* or again, they may have short zooecial tubes with distinct vestibules, and belong apparently to an undescribed genus of Cryptostomata, insufficiently represented for description. It appears quite impossible to differentiate between these last three genera externally, although either sectioning or etching of the surface is sufficient to reveal the very different types of internal structure developed. Species belonging to these different genera are very similar in the details of external structure, and it is possible to find two zoaria almost identical externally, and lying side by side on the one specimen, yet quite distinct from each other in internal structure. Many specimens in the fauna are unsatisfactorily preserved for identification, and there are probably several undescribed species; their use for any stratigraphical purpose at present seems likely to be quite misleading.

A species described from the Upper Carboniferous of the Himalayas (*Taeniodictya darbandensis* Reed, 1924, 97, pl. x, figs. 10 a, b) externally resembles these narrow strap-like genera, and it seems possible, although Reed makes no reference to its internal structure, that it would be a form related to one of them; *Taeniodictya* elsewhere ranges from the Ordovician to the Mississippian.

LIGULOCLEMA TYPICALIS sp. nov.

Pl. 9, fig. 4, Text-fig. 5.

Occurrences: Noonkanbah Formation, localities 16 (1094 C); 23 (1279); and 29 (Holotype, and 1107 A, 1287 A).

Holotype: 1106 A.

Diagnosis: Zoarium bifoliate; branches flattened, strap-like with 8 to 11 rows of apertures on each surface; zooecial tubes hook-shaped, separated by vesicular tissue near the mesotheca and by stereom near the surface.

Description: The zoarium consists of bifoliate branches some 3.3 to 5 mm. wide (comparatively broad for a species without maculae) and about 1.2 mm. thick; the holotype shows frequent bifurcations, spaced about 8 mm. apart, but no subsequent anastomosis of the branches. The margins of the branches are sharp and are edged by a narrow non-celluliferous border; at each angle of branching this border is extended backwards as a narrow tapering area of solid tissue up to 2.5 mm. long and about 0.5 mm. wide, but maculae as distinct from these areas are not developed.

The zooecial apertures are usually in 8 to 11 longitudinal rows, with rapid increase in the number of rows before bifurcation; individual apertures are

oval, 0.15 to 0.17 x 0.12 to 0.14 mm. A slight lunarium surrounds the posterior third of each aperture, and this posterior margin is, where the surface is not weathered, distinctly raised; apart from this the surface between the apertures is quite smooth and unornamented. The centres of successive apertures in one row are 0.43 to 0.55 mm. apart, with about 20 in 10 mm. The recumbent portion of the zooecial tubes is hook-shaped, the longer side of the tube being 0.48 to 0.6 mm., and the shorter side only about half this length; the height of the recumbent part of the tubes is up to 0.2 mm., and for this distance on each side of the mesotheca the tubes are separated by small, narrow, elongate vesicles; once the tubes have bent upwards to the surface they are separated by stereom.

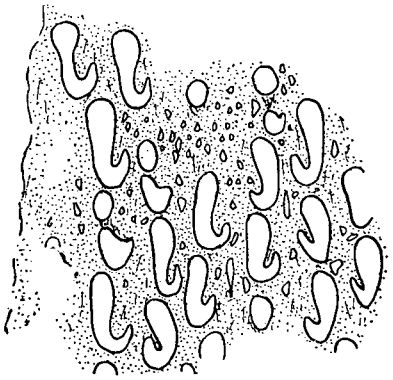


Fig. 5.—*Liguloclema typicalis* gen. et sp. nov. Internal structure shown on an etched surface passing obliquely through the holotype; variation in the apparent shape of the hook-like zooecial tubes, and in the relative abundance of vesicles and development of stereom, occurs as different depths within the zoarium are shown: x 20.

Discussion: The different dimensions of the zoarium and the internal structure of this species separate it from *Fistulamina lata* sp. nov., but other species of *Fistulamina,* fragmentary material of one of which occurs associated with the present species in the fauna at Mt. Marmion, closely resemble this form in their external dimensions but differ clearly from it in internal structure. The coarser zoarial form separates *L. typicalis* from *L. meridianus* (Etheridge), typical zoaria of which have branches less than 1.8 mm. wide.

LIGULOCLEMA MERIDIANUS (Etheridge), 1926.

Sulcoretepora (?) *meridianus* Etheridge, 1926, in Bretnall, 19, pl. i, fig. 9;
"*Sulcoretepora*" *meridianus* (Etheridge), Crockford, 1944a, 156, pl. iv, fig. 6, text-figs. 29, 30.

Occurrences: Noonkanbah Formation, localities 6 (1109 B); 11 (1108 A, B); 18 (1085 C); 19 (1179 A; 1179 B is a much larger undescribed species of this genus with branches about 8 mm. wide); 29 A (Holotype).

The internal structure of this species, as previously figured (Crockford, 1944a, text-figs. 29, 30). indicates that this form is congeneric with *Liguloclema typicalis* sp. nov., and that its resemblance to species of the Cryptostomatous genus *Sulcoretepora* is superficial.

Family GONIOCLADIIDAE Nikiforova, 1938.

The group of genera included in this family has been previously discussed in the description of Lower Carboniferous faunas from eastern Australia (Crockford, 1947, 11, 29); they were there regarded as a sub-family of the Fistuliporidae, but are here considered as a separate family within the Cyclostomata, in order to agree with the taxonomy adopted by Bassler (1953, G89).

Genus GONIOCLADIA Etheridge, 1876.

GONIOCLADIA TIMORENSIS Bassler, 1929.

Goniocladia timorensis Bassler, 1929, 89 pl. ccxlvii (23), figs. 8-15;
G. timorensis Bassler, Crockford, 1944a, 157, pl. v, fig. 8.

Occurrences: Noonkanbah Formation, localities 5 A (1212); 6 (1109 A); 17 (1111 A); 18 A (1101 B); and 28 (1280).

This species, the holotype of which came from the Basleo Beds of Timor, has previously been recorded from the Noonkanbah (locality 31).

GONIOCLADIA INDICA Waagen and Pichl, 1885.

Goniocladia indica Waagen and Pichl, 1885, 805, pl. 93, fig. 3.
G. indica Waagen and Pichl, Bassler, 1929, 88.

Occurrences: Noonkanbah Formation, localities 12 (1077 E); 19 (1078 B); and 35 (22336C, Univ. W.A. Colln.).

The original description of this species was based upon material from the Middle Productus Limestone, and specimens later recorded by Bassler were from the Basleo Beds. The present specimens agree well with those originally described and figured by Waagen and Pichl, *G. indica* being a coarser-meshed species than the associated *G. timorensis*.

Genus RAMIPORA Toula, 1875.

RAMIPORA AMBROSOIDES (Bretnall), 1926.

Aetomocladia ambrosoides Bretnall, 1926, 21, pl. i, fig. 4;
Acanthocladia acuticostata Bassler, 1929, 85, pl. ccxliv (20), fig. 13;
Aetomocladia ambrosoides Bretnall, Hosking, 1931, 12, pl. iv, figs. 5-6;
Ramipora ambrosoides (Bretnall), Crockford, 194b, 193, pl. i, figs. 3-5, pl. ii, figs. C-F.

Occurrences: Noonkanbah Formation, localities 5 C (1115 A, B); 5 N (1084 B); 8 (1158); 11 (1113 B); 12 (1077 G); 17 (1112 A); 19 (1064 C, 1078 C); 21 (1114); 22 (1068 C); 23 (1278); 25 (1283 A, B); 27 (1290 A); and 29A (20948 B, Univ. W.A. Colln.).

R. ambrosoides was originally described from "between the top of the Lyons Series and the top of the Byro Series, Gascoyne River District", and is one of the commonest forms from the Callytharra upwards into the higher beds

of the Western Australian Permian; in the present collection it does not seem to occur in the Nura Nura, but is one of the most widespread species in the Noonkanbah.

Order TREPOSTOMATA Ulrich, 1882.

Suborder AMALGAMATA Ulrich and Bassler, 1904.

Family STENOPORIDAE Waagen and Wentzel, 1886.

Genus STENOPORA Lonsdale, 1884.

STENOPORA HEMISPHERICA Waagen and Wentzel, 1886.

Pl. 10, figs. 1, 2.

Stenopora hemispherica Waagen and Wentzel, 1886, 891, pl. CVI, fig. 2.

Occurrences: Nura Nura member of Poole Sandstone, localities 2 (1119 A-D), and 2 A (1291 A-E).

These specimens are fragments of small massive rounded but slightly lobate zoaria, up to 2.6 cm. high and 2.5 cm. in diameter. The long zooecia diverge quite gradually from the base of the colony, those near the sides of the zoarium being bent outwards, about 5 mm. from the surface, so that they meet the surface at right angles; and the tubes, which are thin-walled and polygonal in the central part of the zoarium, become very slightly thicker walled, and are more rounded, in this outer mature zone. The zooecia are up to 0.31 x 0.26 mm. in diameter, and 6 or 7 tubes occur in 2 mm. On broken surfaces arcuate rows of tiny monilae are seen to cross the central part of the zoarium; a more prominent band, formed by a group of two or three close-spaced monilae, generally crosses the zoarium at intervals of 1.8 to 3 mm., but less noticeable variations in wall thickness occur between these bands; the monilae are more crowded in the mature zone, especially in the outermost 3 mm., where there may be 6 to 11 rows of thickening within 2 mm. Quite commonly the zoarium has fractured across one of the arcuate zones of thickening to give a smooth arched false surface. A very occasional diaphragm is developed, and occasionally a small angular mesopore occurs between the tubes near the surface. Acanthopores appear to be restricted to the angles of the tubes, where a single comparatively large one is commonly developed.

Although the original description of this species is brief, and its illustration rather inadequate, the strong similarity between the characters described by Waagen and Wentzel and those shown by these numerous small and distinctive zoaria occurring in the Nura Nura makes it improbable that the Western Australian specimens are a different species from *S. hemispherica*, the monotype of which was from the base of the Lower Productus Limestone at Amb.

This form also superficially resembles the common *S. crinita* Lonsdale of the higher stages of the eastern Australian Permian, but the present species is a much smaller form, with far finer zooecial tubes.

STENOPORA SPICATA (Bassler), 1929, var. OBTUSA nov.

Pl. 10, figs. 2-4.

Occurrences: Noonkanbah Formation, localities 5 A (1122 A, 1123 A-E); 5 C (Holotype); 5 J (1125 A); 10 (1072 B); 16 (1120 A); 21 (1124 A, B); and 23 (1126 A, B).

Holotype: 1121.

Diagnosis: Zoarium erect and club-shaped; surface with small monticules of enlarged thick-walled zooecia and clustered mesopores; acanthopores extremely large and distinctive; moniliform wall structure only slightly developed.

Description: The zoarium is erect and club-shaped, arising from a small slightly spreading base as a single thick stem, which characteristically is swollen and a little lobate towards its upper extremity; but no subsidiary branching has been noted in any specimen. The size of the zoarium is probably of stratigraphical importance; zoaria from the earlier horizons on which it occurs are of small size (1072 B—from locality 10—and 1125 A—from 5 J—are only 7 or 8 mm. high), but on higher horizons larger zoaria occur, ranging from a common height of about 3 cm. to a maximum of over 5 cm. A typical specimen 3 cm. high rises from a spreading base 1.5 mm. across and 1 to 2 mm. thick, giving off a single stem at first 8 mm. but later expanding to 11 mm. in diameter; the holotype is 5 cm. high, with an incomplete base 2 cm. wide and 1 to 3 mm. thick, the erect part of the zoarium being at first 14 x 17 mm., and later 30 x 25 mm., in diameter. No appreciable change in zooecial structure accompanies the difference in size of the zoarium; perhaps the smaller specimens from the earlier horizons are immature zoaria, but it seems more probable that small zoaria are characteristic of the earlier part of the Formation (in the New South Wales Permian similar variations in zoarial size within *S. crinita* Lonsdale occur on different horizons—Crockford, 1945, 11).

The small spot-like monticules, 5 to 6.5 mm. apart, are formed by larger and much thicker-walled zooecia than usual, and mesopores, which are few in number on the surface between the monticules, are comparatively crowded within them. Normally there are 26 to 29 apertures in 2 mm.; in the monticules there are only about 14 apertures, but an equal number of mesopores, in 4 sq. mm. The apertures are rounded, or are at times indented by the acanthopores; normally they are 0.26 x 0.21 to 0.31 x 0.27 mm. in diameter, and the walls between adjacent apertures are 0.12 to 0.21 mm. thick; in the monticules the apertures are up to 0.4 x 0.33 mm., and the walls up to 0.45 mm. thick. Mesopores occur very occasionally over most of the surface of the zoarium; but within the monticules large round or oval mesopores, up to 0.24 x 0.18 mm. across, occur commonly. Acanthopores are of two sizes, the larger being comparatively enormous, measuring up to 0.26 x 0.21 mm., and extremely prominent, with successive rings or layers of different densities of tissue surrounding a very tiny central tube, in both tangential and vertical sections; their large size persists in sections passing through the central part of the zoarium. Usually 4 or 5 of

these megacanthopores surround each aperture, but they are very much more crowded in the thicker walls within the monticules; their blunt ends slightly project on well-preserved parts of the surface. The micracanthopores are very much less noticeable; usually few occur but they are crowded in the monticules.

In vertical section, moniliform thickening of the walls is not strongly developed, although the thickening is a little uneven and in the outer part of the zoarium tends to give a serrated appearance to the wall edges; occasionally wall thickness differs more sharply. Diaphragms are virtually absent, although a very occasional thin complete one may occur. The tubes are vertical in the axial zone (about a third of the total diameter) then bend outwards rather sharply to meet the surface perpendicularly.

Discussion: The very distinctive internal structure of these specimens is so similar, in both tangential and vertical sections, to that described and figured by Bassler (1929, 56, pl. CCXXXIII (9), figs. 6-8) for the monotype of *S. spicata,* from the Amarassi Beds of Timor, that it is not possible to consider the two forms separate species; but differences in zoarial form (the Amarassi specimen was a "small, smooth, rounded mass about 3 mm. high and 5 mm. wide growing parasitically upon foreign objects") make it impossible to identify these Noonkanbah specimens fully with *S. spicata,* and for this reason they are described as a new variety. At the same time, Bassler's description would apply to a broken portion of the base of one of these zoaria, although it is of course not possible to assume, especially in view of the different geographical localities, that this is so; Bassler does not refer specifically either to micracanthopores or to the presence of monticules, but micracanthopores are shown in this figure and a monticule would not necessarily be included in the area of his specimen.

STENOPORA PUNCTATA sp. nov.

Pl. 11, figs. 6, 7.

Occurrences: Noonkanbah Formation, localities 9 (1131); 13 (1132); and 19 (Holotype).

Holotype: 1130.

Diagnosis: Frondescent *Stenopora,* arising from an encrusting base; small apertures separated by very numerous mesopores; acanthopores moderately developed.

Description: The zoarium is formed by flattened frondescent branches above an encrusting base; one specimen envelops another stenoporid, and in another, the branches are to some extent fused and superficially resemble a rayed zoarium. The branches are 4 to 8 mm. thick; there is no mesotheca, but the zooecial tubes curve outwards quite abruptly from the axial zone to meet the surface perpendicularly on each side of the flattened branches. The surface is smooth, with sporadic maculae composed of aggregations of mesopores and a few tubes larger than average.

The apertures are small, rounded, and crowded, with 6 or 7 in 2 mm. and about 40 in 4 sq. mm. Normal apertures are 0.19 to 0.25 mm. x about 0.18 mm. across; but in section their apparent size, especially in oblique sections passing through the thin-walled innermost part of the mature zone, is often greater. Mesopores are small, rounded, and very numerous; generally one row occurs between adjacent tubes, and usually 6 to 10 around each aperture; a group of 6 or 8 is commonly clustered at the angles of the tubes; they are larger, angular, and less abundant in the inner part of the mature zone. Three or four acanthopores, of uniform size, occur around each tube. No diaphragms are seen. The tube walls are comparatively thin in the mature zone, mainly because of the numerous intercalated mesopores; in this zone, they are slightly moniliform, and well-marked arcuate rows of monilae also cross the axial zone. The width of the mature zone is about 2.5 mm., and within this width discontinuous overgrowths occasionally occur.

Discussion: Of described species of *Stenopora, S. magnopora* (Bassler), from the Bitaoeni Beds of Timor, generally resembles this species in its internal structure, but has far larger zooecial tubes (0.6 mm. in diameter), and differs also in zoarial form. The lack of diaphragms in both zooecia and mesopores distinguishes *S. punctata* from species of *Stenodiscus* and *Leioclema* of otherwise similar structure.

STENOPORA BELLA sp. nov.

Pl. 11, figs. 1-5.

Occurrence: Noonkanbah Formation, locality 5 J (Holotype, and 1128 B-D).

Holotype: 1128 A.

Diagnosis: Zoarium small, ramose; apertures rounded, separated by abundant mesopores at the surface but fewer internally, and with very numerous tiny acanthopores; inconspicuous at the surface; arcuate rows of monilae in the axial zone; monticules formed by thicker-walled zooecia surrounded by more abundant mesopores.

Description: The zoarium arises as a single erect stem from a very slightly spreading base; this stem is distinctly oval, and in unweathered specimens measures about 9 x 7 mm. just above the base; it bifurcates at intervals of 12 to 15 mm. into branches of smaller and unequal size. Monticules are developed as transverse ridges, spaced 3 to 4 mm. apart, on the narrower rounded surface of the branches, gradually becoming less conspicuous as they cross the broader flattened surface; they are composed of zooecia whose walls are thicker, and carry a greater aggregation of mesopores, than usual.

The apertures are small and rounded; they are typically about 0.19 to 0.26 x 0.15 to 0.2 mm. in diameter at and near the surface, but in sections close to the inner side of the mature zone they appear larger, and the walls between them are thinner; there are 7 or 8 apertures in 2 mm., or about 32 to 38, with very numerous mesopores, in 4 sq. mm. The mesopores range in size from tiny spots up to, occasionally, 0.14 x 0.19 mm. On the surface, these mesopores are extremely numerous and commonly almost completely separate

the apertures. Nine to 12 usually occur around each aperture, and they may be crowded into two or three rows at the corners; but in sections they rapidly become less numerous inwards from the surface, and commonly there may be only one or two around each aperture in sections slightly beneath the surface; the number of mesopores decreases correspondingly in even slightly weathered specimens. Acanthopores, although extremely numerous in sections, are usually very tiny and thus are usually quite inconspicuous at the surface. They are crowded in one, or occasionally two or three, rows between the apertures but an occasional one, especially at the corners of the apertures, may be larger than usual and visible at the surface.

The width of the axial zone in unweathered specimens is less than a third of the radius; the mature zone may be made up of successive discontinuous layers over part of the zoarium (Pl. 11, fig. 4), while a single series of zooecia elsewhere continues uninterrupted from the axial zone to the surface. Arcuate rows of monilae cross the axial zone, and are irregularly spaced, with 2 to 5 in 2 mm.; in the mature zone the moniliform structure of the walls is moderately marked. Although a single diaphragm may very rarely be seen they are typically absent.

Discussion: This form generally resembles, both in surface and internal structure, *S. ramulosa* (Bassler), "common" from the Bitaoeni to the Amarassi in Timor; *S. ramulosa* is, however, a finer form with decidedly larger zooecial apertures.

Stenopora lineata sp. nov.

Pl. 10, figs. 5-7.

Occurrence: Noonkanbah Formation, locality 5 C.

Holotype: 1127.

Diagnosis: Zoarium ramose, base spreading; apertures irregular in size and shape, arranged in discontinuous rows, and with numerous acanthopores in short longitudinal rows between them; mesopores few in number; small monticules developed.

Description: The holotype is a cylindrical branching zoarium arising from a spreading base; this incomplete base is 3.8 mm. wide, and thickens from a fine edge up to 9 mm. thick; the single erect branch, about 15 mm. wide, divides 3.5 cm. above the base into two secondary branches, 8 to 10 mm. thick. Small monticules are spaced 6 to 8 mm. apart.

This species is unusual in the irregularity, both in size and arrangement, of the apertures, which, over most of the surface, are arranged in short discontinuous rows of three or four; they are quite irregular both in size and shape, varying from fairly rounded, about 0.36 x 0.24 mm., to elongate and narrow, ranging from 0.4 x 0.12 to 0.76 x 0.2 mm.; usually 3½ or 4 apertures occur in 2 mm., and 18 to 20, with one or two mesopores, in 4 sq. mm. The mesopores also vary from small and oval, about 0.21 x 0.12 mm., to elongate and narrow, up to 0.25 mm. long x 0.05 to 0.12 mm. wide. This already irregular arrangement of apertures and mesopores does not vary appreciably

in the monticules, but over part but not all the outer edges of the base of the colony the apertures are much smaller and usually rounded, about double the usual number occurring in 4 sq. mm. Acanthopores are numerous and are fairly regular in their arrangement; they are of two sizes, the smaller and more abundant being arranged in discontinuous lines and generally placed on short longitudinal ridges between the rows of apertures, or sometimes on shorter ridges beneath an aperture; usually one, but occasionally two, such lines of micracanthopores occur between two adjacent rows of apertures, with 5 to 9 in each row between the ends of successive apertures; and in the interspace beneath each aperture, there is either a single megacanthopore, or a short row of two or three micracanthopores.

The mature zone occupies about two-thirds and the axial zone one-third of the radius. In the axial zone, the tubes are very thin-walled, and in this specimen these walls in the centre of the zoarium have been partly broken down and the centre infilled by sediment; the inner ends of the tube walls are irregularly broken and there is no sign of any axial tube, the space appearing fortuitous. The tube walls are strongly thickened throughout the mature zone; a marked row of monilae occurs around the inner edge of this zone and slight irregularities in thickening continue until the surface is reached; broken surfaces near the base show rather more marked monilae. No diaphragms occur.

Discussion: Although represented by only one specimen, this form is quite different in internal structure from other species to which it bears some external resemblance, and with which it could superficially be confused; its internal structure does not closely resemble any described stenoporid.

Genus TABULIPORA Young, 1883.

Tabulipora Young, 1883, 154.

Tabulipora Young, Bassler, 1929, 60; Bassler, 1953, G 105.

Diagnosis: As *Stenopora,* but zooecial tubes with centrally perforate diaphragms.

Genotype: **Tabulipora scotica* Lee, 1912, 162, pl. 14, figs. 4A-D, pl. 15, figs. 12, 13, 17, 18 (*Stenopora urei* Young, *partim*). Range: Mississippian to Permian.

TABULIPORA SCISSA sp. nov.

Pl. 12, fig. 7; text-fig. 6.

Occurrences: Noonkanbah Formation, localities 17 (Holotype) and 22 (1134 A).

Holotype: 1133.

Diagnosis: Fine ramose *Tabulipora*; apertures small, mesopores occasionally developed; acanthopores numerous, of two sizes; several perforate and a few complete diaphragms developed near the surface in each tube; mature zone very narrow.

* *Tabulipora* is here used as defined by Bassler, 1953; but it appears doubtful whether *Tabulipora scotica* Lee could be accepted as genotype, or *Tabulipora* recognized as a valid genus, without application to the I.C.Z.N. for suspension of the relevant Rules of Zoological Nomenclature.

Description: The specimens are fragments of ramose zoaria with branches about 5 mm. in diameter, the axial zone occupying by far the greater part, and the mature zone being restricted to the outermost 0.35 to 0.9 mm. The zooecial apertures are rounded; usually they are about 0.24 to 0.26 x 0.2 mm. in diameter at the surface, but their apparent size is rapidly increased where weathering has removed the mature zone; and extensive, irregular areas of larger zooecia (up to 0.4 x 0.25 mm. in size), probably representing maculae, also occur. Small mesopores are occasionally developed, and a single megacanthopore usually occurs beneath each aperture, with more numerous micracanthopores also surrounding the tubes. The apertures are arranged in rough longitudinal rows, usually with about 6 apertures in 2 mm., but with only 4 or 4½ in 2 mm. where the apertures are larger. In the mature zone, there are one or two well-marked rows of monilae; the tubes are angular and thin-walled in the axial zone, except where it is crossed by short arcuate rows of monilae. Diaphragms occur mainly quite close to the surface, and there are commonly three or four in each tube; although some appear complete, they frequently show a large perforation, up to half the tube width in diameter, around which the free edges of the diaphragm are bent slightly downwards.

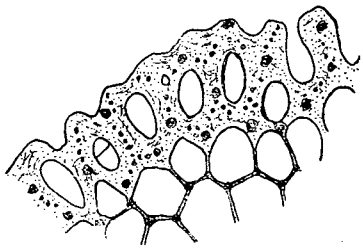


Fig. 6.—*Tabulipora scissa* sp. nov. Part of a section of the holotype, passing obliquely through the narrow peripheral zone, and showing the development of acanthopores and of an occasional mesopore, x 20.

Discussion: This genus, which is closely related to *Stenopora* and is common in the Upper Palaeozoic elsewhere, has not previously been recorded from Australia. A second, coarser, species occurs in the Noonkanbah at locality 11 (1135), but the material was unsuitable for description.

T. scissa very closely resembles *T. sustutensis* Fritz, 1946, from the Lower Permian of British Columbia, in size, relative width of axial and mature zones, and in the nature and development of diaphragms, but differs in the generally smaller size of its apertures and in the presence of areas of enlarged zooecia.

Genus STENODISCUS Crockford, 1944.

STENODISCUS VARIABILIS sp. nov.

Pl. 12, figs. 1-3.

Occurrence: Noonkanbah Formation, localities 5 H (1143); 10 (1144 A); 17 (1141); 19 (1235 A); 21 (1142); 29 (Holotype, and 1147). Base of Liveringa Formation, locality 37 (1146 A).

Holotype: 1145.

Diagnosis: Ramose *Stenodiscus* with branches of variable and gradually diminishing thickness; zooecial tubes angular and polygonal in the wide axial zone, and with about three rows of strongly thickened and distinct monilae in the narrow mature zone; acanthopores of two sizes, distinctively arranged near the surface; thin complete diaphragms frequently developed.

Description: The zoarium is ramose, and the branches range in size from about 2.5 cm. near the base of the zoarium, dividing into two smaller branches each about 1.5 cm. thick, down to thin branches about 1.2 cm. before and 6 mm. after bifurcation; most specimens were branches about 1 cm. thick. The apertures are sufficiently large to be distinct on weathered surfaces, and the interspaces between them are broad; although the surface is typically smooth, small and erratically spaced areas of larger apertures and more abundant mesopores, although only very slightly raised above the surface, probably represent monticules. The mature zone, which is about 1 mm. wide in the thinnest specimens, is only about 2 mm. wide in the thickest branches, and fractured surfaces show the broad axial zone, composed of thin-walled polygonal tubes, bending outwards near the surface into the very narrow mature zone.

The apertures are usually 0.22 to 0.32 mm. long and 0.18 to 0.26 mm. wide, with 5 or 6 in 2 mm., but the enlarged apertures in the monticules are up to 0.4 x 0.3 mm. Mesopores, measuring up to 0.18 x 0.15 mm., are normally about half as numerous as the apertures; around the base of the colony, and also in the monticules, they are more numerous than the apertures. The interspaces between the apertures are rather broad and flattened, usually 0.14 to 0.2 mm. wide, and the arrangement of the apertures is quite haphazard. The numerous acanthopores are of two sizes, and are distinctive in their arrangement; there are one to (rarely) four megacanthopores around each aperture, and between them there is a single row of very much smaller and more numerous micracanthopores—up to 16 around each aperture—especially well developed close to the surface; the megacanthopores are made up of concentric rings of solid tissue around a tiny central tube, whereas the micracanthopores are rather granular in structure. The thin-walled axial portion of the zoarium is crossed by widely spaced arcuate rows of monilae, along which the tubes at times fracture; in the mature zone, there are about three rows of rather long, strongly thickened monilae, separated by short lengths of very thin wall; in many specimens the outer surface of the zoarium has been broken off around part of its circumference beneath the outermost layer of monilae. Thin complete diaphragms are not uncommon, and two or three may occur in individual tubes within the mature zone.

One specimen referred to this species (1144 A) is largely encrusting; a thin layer composed mainly of the mature zone surrounds a specimen of *Rhabdomeson grande* Bassler, and agrees in its internal structure with the present form except in the probable absence of diaphragms, apparently not developed in the short length of tube formed.

Discussion: In tangential section, this form closely resembles *Tabulipora tenuinervis* Bassler, from the Bitaoeni Beds of Timor, but it differs in its appearance in vertical section, and especially in possessing complete, not perforate, diaphragms.

STENODISCUS HARDMANI sp. nov.

Pl. 12, figs. 4-6.

Occurrences: Noonkanbah Formation, localities 24 (1140 A) and 26 (1282 B). Liveringa Formation, localities 36 (1293 A) and 38 (Holotype, and 1139 B-L).

Holotype: 1139 A.

Diagnosis: Fine ramose *Stenodiscus,* with moniliform wall structure only slightly developed, and diaphragms occurring mainly in the mature zone; mesopores not numerous; acanthopores comparatively large, numerous, and distinctively arranged.

Description: The zoarium is ramose, with individual branches 2 to 6 mm., but usually about 4 mm., in diameter, frequently and irregularly dividing into two or more branches, usually about the same size as the parent stem, but occasionally finer; some branches are short and blunt; the base of the zoarium is very slightly spreading. The surface is usually smooth, but occasional spot-like areas with more abundant mesopores form small maculae, and in some specimens, generally those whose surfaces are slightly weathered, these areas are a little raised to form irregularly spaced monticules; mesopores are usually more abundant also in the angles of branching, or sometimes along one surface of a branch.

The zooecial tubes are angular and thin-walled in the axial zone, from which they bend outwards fairly sharply into the mature zone; in the finer branches, this mature zone extends for about a third, or rarely almost half, the radius, whereas in the thicker zoaria its actual width remains about the same, occupying a proportionately smaller part of the radius. The apertures are oval, and are irregularly arranged; there are typically 5 or 6 in 2 mm., and usually they measure about 0.21 to 0.26 x 0.14 to 0.17 mm., although groups of larger apertures, up to 0.31 x 0.21 mm., are seen in places. At the surface, the apertures are enlarged rapidly by weathering, and the interspaces between them are then ridge-like and the acanthopores indistinctly shown, and the mesopores and monticules are more apparent. Where the surface is well preserved, or in tangential sections passing just beneath the surface, acanthopores are distinctive and well developed; they do not vary much in their size, but of the 12 or 15 around each aperture close to the surface, usually four or five are a little larger than the remainder and originate deeper within the zoarium. They are arranged in a single row around each aperture, with a denser grouping where a mesopore occurs between the apertures. The mesopores are small and rounded, up to 0.17 x 0.12 mm. in diameter, and normally are a little less numerous than the apertures. Thin complete diaphragms, although by no means numerous,

are developed quite commonly in both mature and axial zones; one specimen (1140 A) has rather more numerous diaphragms in the mature zone than the remainder, but appears otherwise identical. The thickening of the walls in the mature zone is slightly moniliform, and an occasional arcuate row of small monilae arises from the inner surfaces of this zone, but usually does not persist across the axial zone.

Discussion: This species somewhat resembles *Dyscritella spinigera* (Bassler), which is common in the earlier parts of the Permian sequence, but is larger in size; and thin sections or weathered oblique sections clearly bring out differences in internal structure (in the relative widths of mature and axial zones, in the type of wall thickening, and especially the readily recognizable and quite distinctive differences in the development of acanthopores).

Among the large group of specimens described by Waagen and Wentzel (1886, 882) under *Geinitzella columnaris* Schlotheim, one specimen figured as *G. columnaris* var. *ramosa multigemmata* Waagen and Wentzel resembles, at least in the arrangement of acanthopores, these Western Australian specimens; this figured specimen (pl. CXII, figs. 2 a-d) was from the Lower Zechstein of Germany, and is dissimilar to the Indian specimens figured under the same name; but despite the similarity between the tangential sections of these two forms, their vertical sections are not very similar (especially in the apparently much wider mature zone in the German specimens, and their lack of diaphragms), and the rather doubtful magnifications given for the figures make closer comparison, unfortunately, impossible.

Genus MEGACANTHOPORA Moore, 1929.

Megacanthopora Moore, 1929, 10;

Megacanthopora Moore, Bassler, 1953, G 133.

Diagnosis: Ramose Stenoporids (?), with megacanthopores enlarged to simulate mesopores and zooecia at the surface.

Genotype: Megacanthopora fallacis Moore, 1929, 13, pl. 2, figs. 1-4, text-figs. 2, 3. Range: Pennsylvanian to ? Permian.

MEGACANTHOPORA? SCALARIFORMIS sp. nov.

Pl. 15, figs. 3-6.

Occurrence: Noonkanbah Formation, locality 5 J.

Holotype: 1129.

Diagnosis: Fine, ramose *Megacanthopora?* with apparent mesopores abundant between the zooecial apertures at the surface, and clustered into transversely elongate prominent maculae; acanthopores abundant, not prominent at the surface but more numerous in sections than the mesopores, some of which they appear to replace within the zoarium.

Description: The holotype is a thin cylindrical branch of a ramose zoarium, 5 mm. in diameter and, before sectioning, over 2 cm. long; the surface is

smooth, and the maculae which occur on it are most distinctive, being elongate across the branches—about 1 mm. deep and 2.5 mm. across—and occurring about every 2.5 mm. up the surface in irregular linear series: they are composed of closely spaced aggregations of apparent mesopores, and are very slightly depressed below the normal surface. Between the maculae, these mesopores are rather more numerous than the zooecial apertures, which the larger ones approach in size; both apertures and mesopores are generally enlarged by weathering, and acanthopores, though a few are shown on the surface, are not particularly noticeable.

In tangential section, the general appearance of these structures alters as the section passes from near the surface to deeper levels within the zoarium. Almost all the mesopores disappear just below the surface, and therefore the zooecial tube walls appear much thicker in tangential sections through the outermost part of the zoarium than they do at the surface; at the same time the acanthopores become far more numerous. Maculae remain readily distinguishable in tangential section as transverse bands of almost solid stereom, with occasional small mesopores and very numerous large acanthopores, but no zooecial tubes, occurring in them. Probably, although some mesopores do occur, many of the apparent mesopores at the surface are actually enlarged acanthopores, as in *Megacanthopora fallacis* Moore. In section, normal zooecia measure about 0.21 to 0.26 x 0.13 to 0.16 mm., and, though usually oval, many zooecia are rather distorted in shape; and in sections the width of the walls between adjacent apertures is normally 0.14 to 0.33 mm., but this width is much less at the surface where the numerous "mesopores" have been intercalated between the tubes. The mesopores in section range from tiny tubes only slightly larger than the acanthopores to about half the size of the zooecial tubes; near the surface there are about 20 apertures and rather fewer mesopores in 4 sq. mm., excluding maculae. Acanthopores are comparatively large and of uniform size, and are fairly numerous in usually two, sometimes more, rows between adjacent apertures, 9 or 10 surrounding any individual aperture; in the maculae especially they seem to be arranged in rows of three or four on short discontinuous ridges. A few zooecia contain thin complete diaphragms. The axial zone occupies only about one-quarter of the radius; the thickening of the walls in the mature zone is slightly irregular.

Discussion: This single small specimen is quite unlike any described stenoporid in both its external appearance and internal structure. Unfortunately lack of material prevents the making of serial sections to confirm its reference to *Megacanthopora,* but the striking difference between its appearance on the surface and in sections and the apparent enlargement of the megacanthopores to simulate mesopores suggests relationship with the genotype, *M. fallacis* Moore. Moore does not refer to any occurrence of maculae in *M. fallacis*; but *M. fallacis* is a finer ramose species, with branches 2 to 3.5 mm. in diameter, and maculae are uncommon in fine zoaria even in genera of which they are otherwise characteristic.

Moore originally considered this genus a trepostome and referred it to the Batostomellidae; but Bassler (1953) placed it in the Cryptostomata (Rhabdomesontidae). *M.? scalariformis* certainly belongs within the Trepostomata. The genotype and one other species which Moore referred to *Megacanthopora* (*Batostomella greeniana* Girty) are from the Pennsylvanian of the United States.

Genus DYSCRITELLA Girty, 1911.

Dyscritella Girty, 1911, 193;

Dyscritella Girty, Bassler, 1929, 62; 1941, 178.

Diagnosis: Encrusting or ramose Stenoporidae, with mesopores and acanthopores (usually of two sizes) well developed; walls evenly thickened in the mature zone, not moniliform; diaphragms typically absent in both zooecia and mesopores, though a single complete diaphragm may occur in an occasional zooecial tube.

Genotype: Dyscritella robusta Girty, 1911, 193. *Range:* Mississippian to Permian.

Dyscritella as redefined here includes species previously referred to *Batostomella* as well as to *Dyscritella,* the genotype of *Batostomella* (Crockford, 1947, 33; Bassler, 1953, G 99) being an Ordovician form of different affinity: species hitherto referred to *Batostomella* generally differed from those placed in *Dyscritella* chiefly in the occurrence of diaphragms, but in such species only an occasional diaphragm is usually present, and Bassler (1941, 178) states that "an occasional one may be noted" in the genotype of *Dyscritella.*

DYSCRITELLA ADNASCENS Bassler, 1929.

Dyscritella adnascens Bassler, 1929, 62, pl. CCXXXVI (12), figs. 3-5.

Occurrences: Callytharra Formation, Wooramel R., below Callytharra (F 6592 A). Noonkanbah Formation, localities 5 J (1172, 1174 A) and 17 (1173 A, B).

These small zoaria agree precisely with Bassler's description and figures of specimens of this species from the ?Bitaoeni and the Amarassi Beds of Timor. One zoarium (1172) encrusts a crinoid stem, as does one of the original specimens figured from Timor; and the specimen from the Callytharra, and one from the Noonkanbah, encrust coarse species of *Polypora.*

DYSCRITELLA cf. SPINULOSA Bassler, 1929.

Dyscritella spinulosa Bassler, 1929, 62, pl. CCXXXVI (12), figs. 1, 2.

Occurrence: Noonkanbah Formation, locality 22 (1068 D).

This single specimen closely resembles, but is not identical with, *D. spinulosa* Bassler, from the Bitaoeni Beds of Timor. The Noonkanbah specimen is identical with that described from Timor in its small encrusting zoarium, the

size of the apertures, and the distribution of mesopores, but differs in having very numerous crowded acanthopores in one or two rows on the ridges between the apertures, instead of only 5 or 6 large prominent acanthopores around each aperture, as in the Timor specimens.

DYSCRITELLA SPINIGERA (Bassler), 1929.

Batostomella spinigera Bassler, 1929, 61, pl. CCXXXVI (12), figs. 6-11.

Occurrences: Nura Nura Member of Poole Sandstone, locality 1 (1148). Noonkanbah Formation, localities 5 C (1155); 5 J (1081 B); 5 R (1157 A, B); 8 (1156 A); 14 (1149 A); 15 (1079 B); 17 (1110 B, 1151 A, 1152 B, 1153 A. 1154 A); 19 (1064 C, 1166 A, 1167 A); 27 (1290 B); and 29 A (22342 A, Univ. W.A. Colln.).

Typical specimens of this form, originally described by Bassler from the ? Basleo Beds of Rotti, are common in the present collection; specimens also occur in material from the Callytharra Formation of the Carnarvon Basin. The species bears a general resemblance to the single specimen of *Orbipora ambiensis* Waagen and Wentzel (1886, 878, pl. CXV, fig. 2, and fig. 32), from the Lower Productus Limestone at Amb; Fig. 32 is very similar to *D. spinigera,* but the rather diagrammatic sections of the same specimen figured on pl. CXV show less resemblance—especially since they show no acanthopores, although the presence of these is mentioned in the text; this form may, therefore, extend into the Salt Range.

DYSCRITELLA MACROSTOMA sp. nov.

Pl. 13, figs. 5-8.

Occurrences: Noonkanbah Formation, localities 5 A (Holotype); 5 C (1115 C); 5 J (1251 A); 5 S (1178); 17 (1111 B); 20 (1177); and 21 (1176 A, 1185 C).

Holotype: 1116 C.

Diagnosis: Ramose *Dyscritella,* with large circular apertures and abundant angular mesopores; acanthopores numerous and of two sizes.

Description: The zoarium is ramose, ranging in different specimens from 2 to about 3.6 mm.; the apertures are rounded, and are typically large and prominent, usually 0.26 to 0.33 x 0.25 mm. in diameter, and with 5 or slightly more in 2 mm. Angular mesopores, also of large size, up to 0.2 x 0.12 mm., are commonly fairly abundant between the apertures; single rows of 3 or 4 of these mesopores occur in the angles between adjacent apertures, or curved rows of 6 or more partly surround individual apertures. The interspaces between the apertures and mesopores at the surface usually appear narrow in contrast to the size of the apertures, particularly where these have been infilled by matrix. In section, acanthopores are numerous, occurring in one or sometimes two rows between the apertures, and with about 12 to 18 around each aperture; of this

number, two or three are usually distinctly larger than the remainder, and these megacanthopores, but only occasionally the micracanthopores, are noticeable at the surface. The thickening of the zooecial walls in the mature zone, which constitutes less than a third of the radius, is even; no diaphragms are shown.

Of the specimens grouped here, one, from locality 17, is a thick zoarium, about 3.6 mm., but its apertures are distinctly smaller (about 0.21 x 0.17 mm.), the interspaces between them broader, and their spacing also closer (about 7 in 2 mm.), than in the remaining specimens, to which it is otherwise similar in structure.

Discussion: Among the Bryozoa in this collection, *D. macrostoma* most resembles in the general appearance of its surface *D. adnascens* Bassler, the zoaria of which are, however, encrusting, and which has smaller apertures and far fewer acanthopores; and *Stenopora punctata* sp. nov., in which the mesopores are much more numerous and the acanthopores fewer, and which differs also in the form of the zoarium and in internal structure. Of the fine ramose stenoporids described here, the present species is one of the most distinctive forms.

Dyscritella tenuirama sp. nov.

Pl. 13, figs. 1, 2.

Occurrences: Noonkanbah Formation, localities 7 B (1163 A, B); 8 (1165 A); 15 (1160); 17 (Holotype, and 1162 A); and 27 (1290 D). Liveringa Formation, locality 38 (1159 A, B).

Holotype: 1161.

Diagnosis: Fine ramose *Dyscritella,* with small apertures from which the zooecial tubes slope gradually and directly backwards into the axial zone; acanthopores comparatively large, four or five around each aperture; mesopores few in number, occasionally clustered to form tiny maculae; a diaphragm occasionally developed.

Description: The specimens are fragments of fine ramose zoaria, with branches usually 1.5 to 1.8 mm., but occasionally to 2.4 mm., in diameter. The zooecial apertures are small, usually between 0.17 and 0.21 mm. long (but up to 0.28 mm. long in the specimens from locality 38), and about 0.12 to 0.15 mm. wide; there are 6 to 8 in 2 mm. longitudinally, typically irregularly arranged, but occasionally forming alternating longitudinal series for some distance. Small mesopores, ranging from tiny spots up to rounded openings 0.1 mm. in diameter, approximately equal the apertures in number. The acanthopores are comparatively large and prominent; they are all of about the same size, and four or five usually surround each zooecial aperture. Occasionally, the tiny mesopores occur in a cluster of ten or so, thus forming very small maculae. The axial zone is much wider than the mature zone, which occupies only about a third to a quarter of the radius. The zooecial tubes slope directly backwards from the surface towards the axial zone, and so meet the surface quite obliquely; this is very noticeable on weathered surfaces, where also an occasional diaphragm within a tube may be shown.

Discussion: This small form is not unlike the associated *D. spinigera* (Bassler) in general appearance, but differs quite distinctly in size and internal structure, especially in the relative width of axial and mature zones; in *D. spinigera* the zooecial tubes bend sharply from the narrow axial zone into the broad and more heavily thickened mature zone, and meet the surface at right angles, whereas in this species the tubes slope gradually out to the surface and the mature zone is very much narrower; in *D. spinigera,* also, both acanthopores and mesopores are distinctly more abundant.

DYSCRITELLA BRUTENI sp. nov.

Pl. 13, figs. 3, 4.

Occurrences: Noonkanbah Formation, localities 5 N (Holotype, and 1084 C); 5 J (1150 B, 1170 A); and 19 (1169 B).

Holotype: 1168 A.

Diagnosis: Ramose *Dyscritella,* with oval apertures arranged in generally regular longitudinal rows, and mesopores occurring very infrequently; acanthopores, of one size, numerous in one to three distinct rows between adjacent lines of apertures; a diaphragm occasionally developed.

Description: The zoarium is ramose, with frequently dividing cylindrical branches of fairly constant diameter, about 4 mm. The apertures are oval, comparatively large, and distinct, and are generally arranged in fairly regular longitudinal rows, although their spacing within these rows (with their centres 0.48 to 0.75 mm. apart) is rather erratic; 4.5 to 5 apertures usually occur in each row in 2 mm.; at times, especially near the bifurcation of a branch, the arrangement of the apertures becomes quite irregular. Individual apertures are oval, 0.28 to 0.33 mm. long and 0.17 to 0.21 mm. wide. They are surrounded by numerous acanthopores, usually in a single row but sometimes crowded into two or occasionally three rows in the spaces laterally between adjacent apertures; 7 or 8 acanthopores occur in these rows on each side of an aperture, with an additional one, or more, beneath each aperture. The acanthopores are all of about equal size, but some originate deeper in the zoarium than others, hence they are more numerous at the surface than in the inner part of the mature zone. Mesopores, tiny spot-like rounded pits, up to 0.08 mm. in diameter, occur very infrequently. No maculae are shown.

In section, the mature zone extends for about half the radius; in the portion sectioned the axial zone had largely been broken down and infilled by matrix. The zooecial tubes bend gradually from the axial into the mature zone, which they cross at an angle of about 45°, so that they meet the surface obliquely; an occasional thin complete diaphragm occurs. The thickening of the walls in the mature zone is even, except that a certain amount of discontinuous overgrowth occurs over part of the surface; this overgrowth serves to maintain, rather than to increase, the normal thickness of the zoarium, and is not noticeable at the surface.

Discussion: The generally regular arrangement of the zooecial apertures and acanthopores give this species a stronger external resemblance to *Rhombopora* than to *Dyscritella,* but the occurrence of mesopores, even though they are only occasionally developed, indicate that it belongs within the Trepostomata.

DYSCRITELLA LIVERINGA sp. nov.

Pl. 14, fig. 1; text-figs. 7, 8.

Occurrence: Liveringa Formation, locality 38.

Holotype: 1181.

Diagnosis: Thin encrusting *Dyscritella;* zooecial apertures very small, surrounded by numerous tiny mesopores and by large, blunt acanthopores; small monticules closely spaced.

Description: The zoarium is encrusting; the holotype covers about 5 x 3 cm. on the surface of a brachiopod, but is only about 0.6 mm. in maximum thickness; small, slightly raised monticules are spaced 2.5 to 4 mm. apart. The zooecial apertures are very tiny, normally measuring about 0.17 x 0.13 mm. with 10 or 11 in 2 mm.; those within the monticules are slightly larger, up to 0.26 x 0.22 mm. Angular, or occasionally rounded, mesopores are comparatively numerous, and vary from tiny spots up to about half the area of the apertures; they partly but not completely separate the apertures, around each of which

Fig. 7.

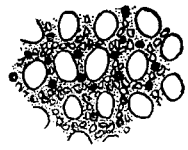


Fig. 8.

Figs. 7, 8.—*Dyscritella liveringa* sp. nov. 7, weathered vertical section through the thin encrusting zoarium of the holotype, x 20. 8, weathered surface of the holotype in an area between monticules, showing the relative abundance of zooecia, mesopores, and acanthopores, x 20.

6 to 10 commonly occur; they are occasionally more crowded at the angle of an aperture, and in the monticules they are rather more numerous than over the general surface. The acanthopores are relatively very large; they all appear similar in size, and 4 or 5 occur around each aperture; individual acanthopores measure up to 0.12 x 0.1 mm., larger than the majority of the mesopores, and they project as thick blunt spines for about 0.08 mm. above the surface. In the monticules the zooecia are thicker walled, and the acanthopores and mesopores are larger, than usual. The specimen was not sectioned, but a weathered section shows internal structure typical for *Dyscritella.*

Discussion: This species generally resembles *D. spinulosa* Bassler, 1929, especially in the development and arrangement of the acanthopores, but is a very much finer form, having 10 or more, instead of about 4, apertures in 2 mm.

Genus LEIOCLEMA Ulrich, 1882.

LEIOCLEMA GLOBOSA sp. nov.

Pl. 14, figs. 2-4.

Occurrences: Nura Nura Member of Poole Sandstone, locality 3 (Holotype). ? Noonkanbah Formation, locality 11 (1137). Permian, 9 m. E.S.E. from Cuncudgerie Hill, Canning Basin (1294).

Holotype: 1138.

Diagnosis: Zoarium massive; zooecial tubes with numerous complete diaphragms; mesopores fewer in number than zooecia; acanthopores of one size, about five to each tube.

Description: The zoarium is rounded and massive, up to 4 cm. high and 7 cm. in diameter. The zooecial tubes pass vertically or with a slight outward curve from the base to the upper surface of the colony; areas of enlarged and thicker-walled tubes and slightly more numerous mesopores indicate the presence of monticules spaced about 4 to 6 mm. apart. Normal tubes are about 0.24 to 0.28 x 0.2 to 0.24 mm. in diameter, and about 37 to 41 of such tubes, and some 10 to 13 mesopores, normally occur in 4 sq. mm. The enlarged tubes are up to 0.38 x 0.33 mm., and about 22 of these larger tubes, and about 19 mesopores, occur in the same area in the monticules. Acanthopores are of one size, comparatively large, and usually 5 surround each aperture. Diaphragms are very closely spaced in the tubes and apparently even closer spaced in the mesopores; they are thin, complete, and straight or slightly concave, and 10 to 16 occur in each tube in 2 mm. The normal thickness of the tube walls is about 0.05 mm., or about twice this thickness in the monticules; in vertical section, it can be seen that no monilae are developed.

The specimen from the Noonkanbah Formation (1137) doubtfully referred here is a tiny rounded fragment, 10 mm. wide and 3 mm. high, possibly the base of a zoarium of this species. A vertical section for which the specimen was used shows straight zooecial tubes with comparatively thin walls, no monilae, but with closely spaced diaphragms; the tubes appear finer than in the holotype. No tangential section could be made to check its identification.

Discussion: The absence of beading in the tube walls differentiates this form from *Stenodiscus;* it is therefore referred to *Leioclema,* although mesopores are here less abundant than in typical species of *Leioclema.*

Genus CALLOCLADIA Girty, 1911.

Callocladia Girty, 1911, 212;

Callocladia Girty, Bassler, 1941, 176; 1953, G 102.

Diagnosis: Hollow ramose Stenoporids; mesopores, acanthopores, and perforated diaphragms developed; walls evenly thickened in the mature zone.

Genotype: Callocladia elegans Girty, 1911, 212.

Range: Mississippian to ? Permian.

CALLOCLADIA (?) RAMOSA sp. nov.

Pl. 15, figs. 1, 2; text-fig. 9.

Occurrence: Noonkanbah Formation, locality 17.

Holotype: 1180.

Diagnosis: Callocladia? with large rhomboid zooecial apertures and very occasional mesopores; acanthopores of two sizes numerous; epithecate axial tube well defined.

Description: The holotype is a fragment of a ramose zoarium, about 2.8 mm. in diameter, with noticeably large rhomboid zooecial apertures, and with a well-defined axial tube, so that in general appearance it is not unlike a *Rhabdomeson.* The zooecial apertures are, however, very variable in size.

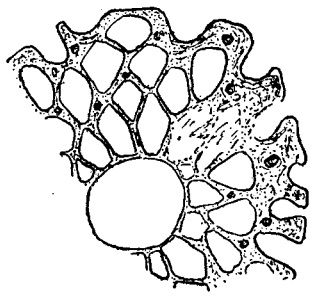


Fig. 9.—*Callocladia? ramosa* **sp. nov. Weathered end surface of the holotype, showing the epithecate axial tube, x 20.**

Usually they measure about 0.25 x 0.2 mm., but over irregular areas, slightly raised above the normal level of the surface and apparently representing monticules, the apertures are considerably larger, up to 0.38 x 0.33 mm.; these areas of larger apertures are irregularly but in places quite closely spaced, two such areas occurring in one place within about 3 mm., and the variation in size of the zooecial apertures is readily noticeable. Mesopores do not occur over the general surface of the branch, but within each monticule there are one or two mesopores, up to 0.21 x 0.12 mm. Acanthopores are prominent and are at times sufficiently large to indent the apertures; four or five megacanthopores occur around each aperture, commonly but not invariably at the angles of the apertures; micracanthopores are more numerous. The specimen was not sectioned, but on its end surfaces the epithecate axial tube, about 0.52 x 0.45 mm. in diameter, is clearly shown; the zooecial tubes are thin-walled near this axial tube, and pass outwards to meet the surface obliquely. The tube walls are thickened for about 0.35 mm. in the outer part of the zoarium; an occasional diaphragm appears to occur on these weathered surfaces.

Discussion: This form belongs either to *Callocladia,* described from the Mississippian of the United States, or to the related and associated *Coeloclemis* Girty, each of these genera being stenoporids possessing hollow ramose zoaria;

Coeloclemis typically has neither diaphragms nor mesopores, whereas in *Callocladia* mesopores, and also centrally perforated diaphragms, are developed. Although diaphragms are developed in this specimen, it is not possible to determine whether any central perforation occurs, hence it is referred only tentatively to *Callocladia*. Both genera are uncommon and seem to occur, elsewhere, only in the Mississippian of the United States.

The irregular size of the zooecial apertures in this species, and the occurrence of mesopores and monticules, differentiate it from species of *Rhabdomeson*, *R. mammillatum* (Bretnall) and *R. bretnalli* sp. nov., to which it otherwise bears a very marked superficial resemblance.

Order CRYPTOSTOMATA Vine, 1883.

Family FENESTELLIDAE King, 1850.

Genus FENESTELLA Lonsdale, 1839.

FENESTELLA HOROLOGIA Bretnall, 1926.

Fenestella horologia Bretnall, 1926, 15, pl. i, fig. 6;

Fenestrellina horologia (Bretnall), Crockford, 1943, 266; 1944 a, 158; 1944 b, 167, pl. 1, figs. 3, 6; 1944 c, 189, pl. i, fig. 1, pl. ii, fig. A;

Fenestella pectinis Moore (*partim*), Chapman, in Raggatt, 1936, 128; (non) *F. pectinis* Moore, 1929, 18, pl. ii, figs. 8-10;

Fenestella parviuscula Bassler, 1929, 76, pl. CCXLI (17), figs. 8-13;

F. parviuscula Bassler, Fritz, 1932, 99.

Occurrences: Nura Nura member of Poole Sandstone, localities 2 (1220); 2 A (1291 F); and 4 (1221). Noonkanbah Formation, localities 5 A (1102 C); 5 B (1102 C); 5 C (1232); 5 J (1073 I); 5 N (1084 D); 6 (1224 A); 13 (1216 B); 15 (1188 C); 17 (1213 E); 19 (1078 F); 21 (1185 G); 22 (1187 N); 27 (1290 O); and 29 (1285).

Fenestella subornata Shulga-Nesterenko, 1952 (40, Table 5, pl. vi, fig. 3), from the Lower Permian—Upper Part of *Pseudoschwagerina* Zone—of the Urals, shows a very marked resemblance to this common species, which occurs in the Bitaoeni and Basleo Beds of Timor, the Lower Permian of Vancouver Island, and in Queensland and the Northern Territory, as well as almost throughout the Permian in Western Australia. *F. subornata* is a slightly coarser species than *F. horologia*, having 14, instead of 16 to 18, apertures in 10 mm., and since it has a similar spacing of apertures, 36 in 10 mm., these apertures are less regularly placed in regard to the fenestrules; nodes occur in a single row on the carina in each form, but are slightly more closely spaced in *F. horologia*. Several other species of *Fenestella* from the Lower Permian of the Urals generally resemble *F. horologia*, but differ in similar details of their structure and micrometric measurements; these resemblances suggest similarity in age.

FENESTELLA BASLEOENSIS Bassler, 1929.

Fenestella basleoensis Bassler, 1929, 74, pl. CCXL (16), figs. 5-9.

Occurrences: Noonkanbah Formation, localities 16 (? 1225 A); 5 A (1065 B, 1208); 23 (1276 A); 29 A (22342 B, Univ. W.A. Colln.); and 32 (20952 E, Univ. W.A. Colln.).

The original specimens of this form were from the Basleo Beds of Timor. Of several varieties of this species recorded from the Lower Permian of the Urals, one—*F. basleoensis* var. *limatula* Trizna, 1939—seems very similar in size, general appearance, and arrangement of zooecia and nodes, both to Bassler's figured specimens and to those recorded here from Western Australia; Trizna notes that these Russian specimens are a little finer, but had thinner branches and dissepiments, and thus larger fenestrules, than the holotype, but these differences are quite slight; *F. basleoensis* var. *limatula* occurs in the *Hexagonella ischimbaica* beds (*Schwagerina* ("*Parafusulina*") *lutugini* Zone) of the Artinskian.

FENESTELLA VALENTIS (Crockford), 1944.

Fenestrellina valentis Crockford, 1944b, 169, pl. i, fig. 4.

Occurrences: Noonkanbah Formation, localities 17 (1213 A, 1239—topotypes) and 26 (1297 A).

FENESTELLA COLUMNARIS (Crockford), 1944.

Fenestrellina columnaris Crockford, 1944b, 170, pl. ii, fig. 3, text-fig. 1 F, G.

Occurrences: Noonkanbah Formation, localities 5 A (1186 B); 5 C (1217); 5 J (1174 B); 6 (1214); 11 (1216 A); 17 (1210 A); 19 (1215 A); 21 (1185 F); 22 (1068 K); and 31 (2757 M, Univ. W.A. Colln.). Holotype, from the lower part of the Wandagee Formation in the Carnarvon Basin.

FENESTELLA CACUMINATIS (Crockford), 1944.

Fenestrellina cacuminatis Crockford, 1944b, 171, text-fig. 1 B.

Occurrence: Noonkanbah Formation, locality 17 (1213 B—topotype).

FENESTELLA DISJECTA (Crockford), 1944.

Fenestrellina disjecta Crockford, 1944b, 168, pl. i, fig. 2, text-fig. 1 E.

Occurrences: Noonkanbah Formation, localities 5 A (1209 A); 17 (1238 A, B—topotypes); 21 (1196 B, 1237); 22 (1068 L); and 23 (1278 B). (Previously recorded from the base of Teichert's (1950) Coolkilya Sandstone, in the Carnarvon Basin.)

FENESTELLA HINDEI sp. nov.

Pl. 16, fig. 1; text-fig. 10.

Occurrences: Noonkanbah Formation, localities 11 (1216 C); 12 (1077 L); 19 (1078 E, G); and 31 (Holotype and 2757 L, Univ. W. A. Colln.).

Holotype: 2792, Univ. W.A. Colln.

Diagnosis: *Fenestella* with a coarse-meshed zoarium; thin branches with usually six to eight apertures to a fenestrule; nodes in a single row spaced farther apart than the apertures; zooecial cells pyriform.

Description: There are 3 to 4½ elongate narrow fenestrules and 9 or 10 thin straight branches in 10 mm. The branches are between 0.43 and 0.6 mm. in width, and frequently bifurcate; they bear two rows of alternating zooecial apertures, with increase to three rows occurring only immediately before bifurcation. A slight median carina separates these rows of apertures; there is a

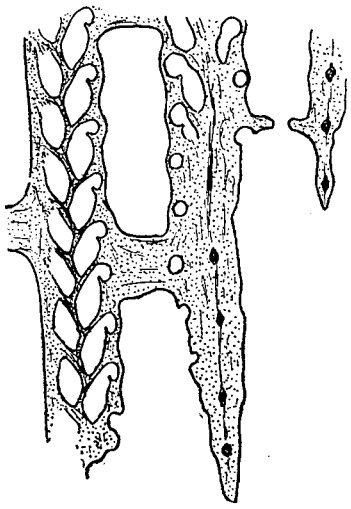


Fig. 10.—*Fenestella hindei* **sp. nov. Polished surface of the holotype, showing the shape of the zooecia and the spacing of nodes, x 20.**

single row of blunt, rather thick nodes spaced 0.4 to 0.55 mm. apart. There are 6 to 8, occasionally 10, zooecial apertures in the length of one fenestrule and one dissepiment; these apertures are slightly oval, 0.17 x 0.14 mm., and their centres are spaced 0.24 to 0.38 mm. apart; in 10 mm. there are about 32 apertures. The fenestrules, which are rectangular to oval in shape, are rather variable in length, measuring between 1.6 and 3.4 mm. but most commonly between 1.9 and 2.6 mm.; their width is 0.3 to 0.8 mm. The dissepiments are usually between 0.25 and 0.5 mm. in width. The zooecial tubes are pyriform, with the vestibules directed outwards towards the margins of the branches; strongly developed superior hemisepta are shown in weathered specimens. On the reverse surface, both branches and dissepiments are evenly rounded, the dissepiments being much thinner than the branches; on unweathered parts of a specimen, both branches and dissepiments are finely granular on this surface, but very slight weathering exposes first a series of fine longitudinal striae along the branches, and then the outline of the zooecial cells.

Discussion: Several coarse-meshed species of *Fenestella* occur in the Upper Carboniferous and Permian of Australia and in the Permian of Timor, but these species differ from any described form in the details of their measurements; *Fenestella chapmani* (Crockford), a species of similar dimensions described from the Callytharra Formation of the Carnarvon Basin (Crockford, 1944a, 158, pl. iv, fig. 5), differs from *F. hindei* sp. nov. in having larger and more widely spaced zooecial apertures and particularly in the very much wider spacing of nodes upon the carina.

FENESTELLA sp. nov.

Text-fig. 11.

Occurrence: Noonkanbah Formation, locality 19 (1201 B).

A single poorly preserved specimen of a coarse-meshed species of *Fenestella* of generally similar size to *F. hindei* sp. nov., but showing a different shape and arrangement of the zooecial cells, occurs associated with *F. hindei* at locality 19. The branches are fine, about 0.33 mm. wide, and bear broadly triangular

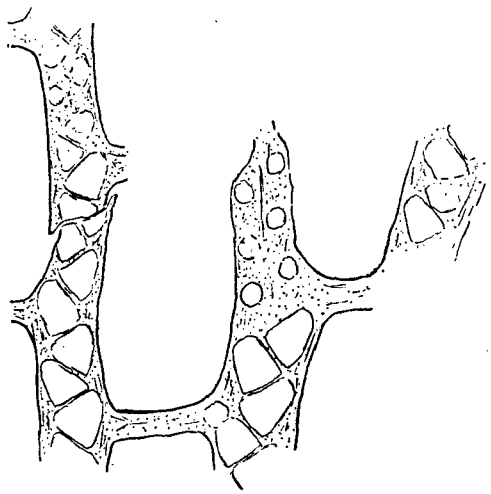


Fig. 11.—*Fenestella* sp. nov. Portion of the obliquely weathered obverse surface of *Fenestella* sp. nov. (specimen 1201 B) showing triangular zooecial cells; x 20.

zooecial cells crowded along the branches and appearing, where weathered to near the basal plate, to form almost a single row. The apertures are comparatively large, about 0.17 mm. in diameter, and their centres are spaced 0.33 to 0.4 mm. apart, with about 27 in 10 mm., and 5 or 6 to a fenestrule. There is a slight carina but no nodes are shown. The fenestrules are about 1.65 mm. long and 0.9 mm. wide, and the dissepiments 0.17 to 0.25 mm. wide. Slight superior hemisepta occur within the cells.

Discussion: Species of *Fenestella* with markedly triangular zooecial cells are very uncommon in the Australian Permian, although some fenestrate species bearing two rows of nodes on the carina (*Minilya* spp.) do possess this cell

shape; and triangular zooecial cells occur commonly in eastern Australian Lower Carboniferous Fenestellidae. Shulga-Nesterenko (1952, 46 et seq.) has described several species with triangular zooecial cells from the Lower Permian of the Urals, and this fragment from the Noonkanbah is very similar to two of these species: *Fenestella sublonga* Shulga-Nesterenko (Shulga-Nesterenko, 1952, 55, pl. X, fig. 4, Text-fig. 4, and Table 6), described from the *Pseudoschwagerina* Zone at Sterlitamak, a form with longer fenestrules (2.0 to 2.75 mm.) but with a similar spacing of zooecial apertures; and especially to *F. unica* Shulga-Nesterenko (Shulga-Nesterenko, 1952, 55, pl. X, fig. 5, and Table 6), from the Burtsev Horizon of the southern Urals, in which the fenestrules are similar in length (1.58 to 1.75 mm.), but which has smaller and more closely spaced apertures (36 in 10 mm., and 7 to each fenestrule) than this Western Australian specimen.

Genus Polypora M'Coy, 1844.

Polypora megastoma de Koninck, 1863.

Pl. 16, figs. 2, 3.

Polypora megastoma de Koninck, 1863, 5, pl. ii, fig. 3;
P. megastoma de Koninck, Waagen and Pichl, 1885, 785, pl. lxxxviii, figs. 3, 5, 6, 7, pl. lxxxix, fig. 3.

Occurrences: Noonkanbah Formation, localities 5 A (1207); 5 J (1082 B); 7 B (1218); 15 (1226); 16 (1219); 17 A (on 2793 C Univ. W.A. Colln.); and 32 (20952 B, C, Univ. W.A. Colln.).

This species was originally described by de Koninck from the western end of the Salt Range, and the figure accompanying his description illustrates only the reverse of the zoarium; a later collection of specimens, from several localities within the Middle Productus Limestone, were identified with this form and described and figured by Waagen and Pichl, and the specimens here recorded agree very closely with their figured specimens.

Polypora woodsi (Etheridge), 1892.

Protoretepora ampla var. *woodsi* Etheridge 1892, 222, pl. 8, fig. 12;
Polypora woodsi (Etheridge), Crockford, 1941a, 414, pl. xviii, fig. 1, pl. xix, fig. 1; Crockford, 1944b, 177, pl. 3, fig. 2;
Polypora tumula Laseron, 1918, 191, pl. vii, fig. 3, pl. ix;
Polypora tripliseriata Bassler, 1929, 79, pl. ccxlii (18), figs. 14-16.

Occurrences: Noonkanbah Formation, localities 5 C (1231); 17 (1153 B, 1238); 19 (1234 B); 22 (1187 E); 27 (1290 M); and 31 (2757 J, Univ. W.A. Colln.). (This widespread and characteristically Lower Permian species occurs in the Callytharra as well as in the Noonkanbah, and has previously been recorded from both Formations.)

POLYPORA MULTIPORIFERA Crockford, 1944.

Polypora multiporifera Crockford, 1944b, 177, pl. 3, fig. 4.

Occurrences: Noonkanbah Formation, localities 5 A (1268) and 31 (2757 K, Univ. W.A. Colln.). (Holotype from the Wandagee Formation.)

POLYPORA FOVEA Crockford, 1944.

Polypora fovea Crockford, 1944b, 175, pl. 3, figs. 1, 3.

Occurrences: Noonkanbah Formation, localities 6 (1229 A); 16 (1227); 17 (1211-topotype); and 19 (1228). (Also recorded from the Wandagee.)

POLYPORA KIMBERLEYENSIS sp. nov.

Pl. 17, figs. 1, 2.

Occurrences: Noonkanbah Formation, localities 5 A (1288); 5 C (1184 C, 1115 D); 5 J (1073 J); 5 N (1171 C); 6 (1224 C, 1245); 10 (1243); 11 (1216 D, 1240); 12 (1241); 13 (1242); 17 (Holotype, and 1191 B, 1210 B, 1213 F, G, 1238 D, 1244 A, 1246 A); and 22 (1068 M, 1187 O).

Holotype: 1173.

Diagnosis: Coarse-meshed *Polypora* with flabellate growth-form; elongate oval fenestrules and thin straight branches with normally 5 or 6 rows of small apertures, 7 to 10 to a fenestrule; small nodes occasionally developed on the obverse surface, reverse surface smooth.

Description: The zoarium is flabellate, with an attached base about 10 mm. across, from which narrow, straight, rapidly bifurcating branches arise. Near the base of the colony some of the lateral branches and dissepiments are commonly modified to form supporting rootlets, up to about 7 mm. long, which are themselves expanded at their distal ends to give greater support to the colony. The largest zoarium measures 5 x 4 cm. Usually, there are 3 fenestrules and about 6 branches in 10 mm. The branches are straight and bifurcate rapidly near the base of the colony, but less frequently in more mature specimens; there are 4 rows of apertures just after, and 7 to 8 immediately before, bifurcation, with normally either 5 or 6 rows. The apertures are round and very small, only 0.1 to 0.13 mm. in diameter; the obverse surface of the branches is convex, and the lateral rows of apertures are slightly raised and project into the fenestrules, but the remaining rows of apertures are either level with the obverse surface, and without peristomes, or are at times a little recessed; the lateral rows of apertures also encroach slightly on the dissepiments, and occasionally cells may extend for some way along a dissepiment which is wider than usual, apparently where there has been abortive branching. Seven to 10 apertures occur in the length of one fenestrule and one dissepiment, the centres of

successive apertures being 0.33 to 0.5, but usually about 0.45, mm. apart; there are about 23 apertures in 10 mm. The surface between the apertures is finely granular, and where it is slightly weathered longitudinal striae curving around the apertures are faintly shown, and in places these weather to give the appearance of a hexagonal ridge surrounding the slightly recessed apertures; an occasional inconspicuous node may occur between apertures. In one weathered specimen (1246) rounded surface cells, resembling the ovicells of Cheilostomata, are commonly developed immediately behind the zooecial apertures, and occasionally one of these cells is shown in other specimens.

The fenestrules are elongate, and are oval on the obverse but usually appear rectangular on the reverse surface; usually their length is between 2.5 and 4.0 mm., most commonly around 3 mm., and their width from 0.5 to 1.3 mm. The width of the dissepiments, which are on the obverse slightly depressed below the level of the branches, is 0.65 to 0.85 mm.; in specimens from a more calcareous facies than the holotype, the dissepiments may be much broader and the fenestrules correspondingly shorter, but their total length remains the same. The width of the branches is 0.65 to 0.8 mm. where there are four, 0.88 to 1.1 mm. where there are five, and about 1.8 mm. where there are six rows of apertures.

On the reverse surface, both branches and dissepiments are sharply convex, and the dissepiments are almost level with the branches; both are finely granular and are without any development of tubercles; where the branches are slightly weathered, fine longitudinal striae are shown. The zooecial cells are short, and are rhomboidal in outline on the basal plate, their length only slightly exceeding their width; the vestibules slope upwards rather gradually to the obverse surface.

Discussion: This species seems to be one of the most common and characteristic Bryozoa of the facies in which it occurs in the Noonkanbah; although it bears a distinct general resemblance to several coarse species of *Polypora,* it differs in the details of its structure from any described form. *P. multiporifera* Crockford, which occurs in both the Wandagee and Noonkanbah Formations, is a coarser species, with fenestrules of much more variable length, although these species have the same number of rows of apertures, and the apertures are of similarly small size and spacing. *P. linea* Crockford, from the Lower Marine of New South Wales, is of similar size, but differs in the much larger diameter, and the spacing, of its apertures, in the shape of the cells, and in possessing occasional very large nodes along the midline of the branches. Although several species from the Timor, Salt Range, and Russian Permian are of similar size and appearance this form does not seem specifically identical with any described species. It shows a particularly marked resemblance to *Polypora remota* Condra var. *grandis* Trizna, 1939, from the *Fenestella* Beds (*Schwagerina anderssoni—lutugini* Zone) of the Artinskian; but this variety has fenestrules of more regular length (3.33 to 3.38 mm.) and larger, more closely spaced apertures (26 to 28, rarely 30, in 10 mm.), and consequently more apertures to a fenestrule, than these Western Australian specimens.

POLYPORA NATALIS sp. nov.

Pl. 18, figs. 1, 2; text-fig. 12.

Polypora sp. nov. indet., Crockford, 1944b, 178, pl. 2, fig. 5.

Occurrences: Noonkanbah Formation, localities 5 C (1195 E, 1248, 1249); 5 N (1084 F); 8 B (Holotype); 12 (1077 E); and 22 (1068 D, N, O); (previously recorded from locality 32).

Holotype: 1289.

Diagnosis: Very coarse, flabellate *Polypora,* with very small zooecial apertures in 7 or 8 rows, and with 9 to 15 apertures to a fenestrule; fenestrules polygonal from reverse surface, on which both branches and dissepiments are sharply convex.

Description: The zoarium is erect and flabellate, arising from a spreading base about 1 cm. wide in a small zoarium; the branches bifurcate to form a spreading colony much less frequently than in the preceding species; there are 1.5 to 2 fenestrules in 10 mm. vertically, and 3 to almost 4 branches in 10 mm. laterally. The branches vary in width from about 1.3 mm. immediately after, to about 3.2 mm. just before, bifurcation; normally there are 7 to 9 rows of zooecial apertures, with up to 12 before and 6 just after bifurcation. The apertures are small (about 0.12 mm.), and are surrounded by a comparatively broad peristome, composed in well preserved specimens of about eight tiny projecting spines; the centres of successive apertures in the one row are 0.33 to 0.6 mm. apart, averaging about 0.41 mm., so that there are about 24 apertures in 10 mm., and 9 to 15 in the length of one fenestrule and one dissepiment. The obverse surface of the branches is rather flattened, although

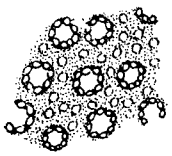


Fig. 12.—*Polypora natalis* sp. nov. Portion of the obverse surface of the holotype, near a bifurcation where the zooecia are not regularly arranged, but showing the ornamentation of an unweathered surface, x 20.

the lateral rows of apertures usually open on the rounded margins of the branches, and the apertures in these lateral rows are commonly a little farther apart than in the central rows, and are arranged so that they fan out towards the fenestrules. The surface between the apertures is slightly excavated, and ornamented by clusters of coarse granules; where weathered, it appears either ornamented by short longitudinal striae, or smooth. The fenestrules are oval on the obverse surface, varying in length from 3 to 7 mm., and are 0.86 to 2.5 mm. wide; the dissepiments, which are slightly depressed on the obverse surface, and are, where unweathered, ornamented by coarse transverse striae, are 1.2 to 2 mm. wide. On the reverse surface, both branches and dissepiments are rounded, but appear sharply convex after slight weathering; both are smooth and finely granular, and on this surface the fenestrules appear polygonal rather than oval.

Discussion: Of bryozoans occurring in the Noonkanbah, *Goniocladia timorensis* Bassler shows the strongest superficial resemblance to the present species, and although their structure is quite different, specimens of *P. natalis* weathered from the reverse could be confused with *G. timorensis.*

Amongst described species of *Polypora* from other Permian faunas, *P. gigantea* Waagen and Pichl, from the Middle Productus Limestone, shows a general similarity to *P. natalis,* but appears from its description and figures to be a coarser species and to have a very much less regular growth form. *P. magnidicus* Bassler, from the Bitaoeni Beds of Timor, is a somewhat finer species of quite different appearance from the reverse, and has only 5 to 6 rows of zooecia; and *P. brouweri* Bassler, another Timor species of similar size, also has only 5 or 6 rows of zooecia, with larger and much more widely spaced apertures. *P. supraornamentata* Novikova (Shulga-Nesterenko, 1952), from the Sterlitamak and Burtsev Horizons in the Urals, is generally similar in size and has 8 to 9 rows of small apertures (20 to 22 in 10 mm.), but has much thinner dissepiments, and fenestrules of more regular size; a figured tangential section of the obverse surface of this species shows a slight similarity to *P. natalis,* having coarse granules between the apertures and two or three tiny hollow spines around each aperture; a number of fenestellids, belonging to several genera, from the Russian Lower Permian, have apertures surrounded by a ring of tiny tubes, and in some the similarity to the ornamentation around the apertures in *P. natalis* is quite marked.

POLYPORA WADEI sp. nov.

Pl. 17, fig. 4.

Occurrences: Noonkanbah Formation, localities 5 A (1247 A, 1116 E); 6 (1254); 12 (1080 B); 17 (1252); and 19 (1253).

Holotype: 1080 B.

Diagnosis: Moderately coarse *Polypora,* with straight branches and oval to rectangular fenestrules; 5 to 6 rows of apertures, and 6 to 7 apertures to a fenestrule.

Description: The zoarium is fenestrate and rather coarse, having 4 to 4.5 fenestrules and about 8 branches in 10 mm.; no specimen shows the base of the colony, but the zoarium appears to have been flabellate, with straight branches which bifurcate frequently near the base, but infrequently later. Normally there are five or six rows of apertures on branches 0.6 to 0.8 mm. wide; there are four rows of apertures just after bifurcation, where the branches are 0.55 to 0.7 mm. wide, and eight rows on branches 1.7 mm. wide immediately before bifurcation. The obverse surface is flattened, and the apertures are oval, 0.17 x 0.12 mm., and are spaced with their centres 0.28 to 0.38 mm. apart; there are six to seven apertures to a fenestrule. The surface ornamentation—short longitudinal granular ridges and pitted grooves—is not well shown; no nodes appear to have been developed. The fenestrules are rectangular to oval, 1.4 to 1.8 mm. long and 0.48 to 0.85 mm. wide; the dissepiments are 0.4 to 0.7 mm. wide. On the reverse surface both branches and dissepiments are smooth,

finely granular, and evenly rounded, and they are of about the same thickness. The central rows of cells are small and crowded, and are rhomboidal in outline on the basal plate, but the lateral rows, the vestibules of which diverge outwards towards the margins of the branches, are generally broader and larger.

Discussion: This form is differentiated from the finer *P. fovea* Crockford, with which it is associated, both by its larger measurements and by the different number of rows of zooecia and of apertures to a fenestrule. *P. timorensis* Bassler is very similar in size and appearance, but has only four rows of apertures, and five to six tiny apertures to a fenestrule. Measurements are generally similar to those of *P. koninckiana* Waagen and Pichl, from the upper part of the Middle Productus Limestone, but the two forms do not appear to be identical.

POLYPORA sp. nov.

Pl. 17, fig. 3.

Occurrences: Noonkanbah Formation, localities 6 (1229 B); 5 J (1250); and 19 (1078 H).

Diagnosis: Fine *Polypora,* with 5 rows of zooecia and 4½ zooecia to a fenestrule; fenestrules short and rounded, and dissepiments very broad.

Description: The zoarium is fine-meshed, with about seven fenestrules and eight branches in 10 mm. The fine appearance of the colony is made more noticeable by the very small size of the fenestrules, which are very little longer than the dissepiments, and are rounded; they are usually about 0.8 mm. (ranging from 0.6 to 1.25 mm.) long, and are about 0.65 mm. wide, while the dissepiments are usually about 0.6 mm. wide (ranging from 0.55 to 0.8 mm.). The branches are 0.5 mm. wide just after, and up to 1.25 mm. just before, bifurcation, with the number of rows of zooecia increasing from three or four to six or eight; usually there are five rows, and the normal branch width is about 0.8 mm. The apertures are small and circular, 0.12 mm. in diameter, and their centres are 0.31 to 0.45 mm. apart, with about 27 in 10 mm. and 4½ to a fenestrule. The obverse surface between the apertures is smooth and flat, but occasional small nodes are indistinctly shown on weathered surfaces; the reverse surface appears to have been smooth and finely granular, with the dissepiments a little depressed below the branches.

Discussion: Amongst the associated species of *Polypora,* this form is most similar in its measurements to *P. fovea,* but is slightly finer and very different in general appearance. *P. macrops* Bassler, 1929, from the Bitaoeni Beds of Timor, is very similar to this species; it is a slightly finer form but otherwise the only significant difference between these species is that the Noonkanbah specimens very constantly show five rows of zooecia, while Bassler's description and figures of *P. macrops* show that only four rows of zooecia occur. Other forms similar in size, but possessing only 3 to 4 rows of apertures, are *P. biarmica* Keyserling, 1846, as recorded from the Upper Productus Limestone by Waagen and Pichl, and the form recorded by Reed (1930, 16, pl. i, fig. 13) from the Upper Carboniferous of Tibet as *P.* cf. *bifurcata* Keyserling.

POLYPORA OBESA sp. nov.

Pl. 19, fig. 4.

Occurrences: Noonkanbah Formation, localities 5 A (1247 B); 6 (1229 C, 1255); and 17 (1111 D).

Holotype: 1255.

Diagnosis: Coarse flabellate *Polypora,* with broad branches and dissepiments and very narrow oval fenestrules; 5 to 9 rows of zooecia and usually 7 apertures to a fenestrule; obverse surface finely granular with occasional tiny nodes.

Description: The zoarium is flabellate and coarse-meshed, having four or slightly more fenestrules and 5 to 5½ branches in 10 mm. The branches are broad and flattened on the obverse surface, and have usually five to seven rows of zooecial apertures, but with eight or nine rows developed just before bifurcation; the usual width of the branches is about 1.75 mm., but they vary from 1.3 mm. just after, to about 2.6 mm. before, bifurcation. The apertures are small and oval, 0.12 x 0.09 mm. in diameter, and are rather closely spaced, the distance between the centres of successive apertures being 0.28 to 0.4 mm., with about 27 in 10 mm. There are five to nine (most frequently seven) apertures in the length of one fenestrule and one dissepiment; the surface between the apertures is smooth and finely granular, with an occasional very small node. Although the dissepiments are not celluliferous, an occasional aperture encroaches on the dissepiments, and one or two extra zooecia may be developed. The fenestrules are oval, about 1.1 to 2.6 mm. long and comparatively very narrow, usually only 0.6 to 0.7 mm. wide. The dissepiments, which are on the obverse surface very slightly depressed below the level of the branches, are very broad, 0.65 to 1.65 mm. wide. On the reverse surface, both branches and dissepiments are rather sharply convex, so that from this side the fenestrules appear much more rounded than on the obverse; both are smooth and finely granular, the dissepiments being a little thinner than the branches. Weathering from the reverse at times shows the zooecial cells, which are rhomboidal and comparatively very small, about equalling in length the spacing of the apertures.

Genus MINILYA Crockford, 1944.

MINILYA DUPLARIS Crockford, 1944.

Minilya duplaris Crockford, 1944b, 173, pl. i, figs. 5, 7, text-fig. 1 C, D.

Occurrences: Noonkanbah Formation, localities 5 A (1233); 5 B (1102 E); 5 C (1195 C, D, 1236 C); 5 N (1171 B); 17 (1210 C, 1213 C, D; topotypes); 28 (1281 A, B); 29 (1287 C). Liveringa Formation, locality 37 (1209 B).

Species belonging within this generic group, separated from *Fenestella* by the occurrence of a double row of nodes on the carina, are common in the top of the Pennsylvanian in the United States, and in the Permian of Timor, the Salt Range, and Russia. This species is very similar to *Fenestella magnispinata* Shulga-Nesterenko, 1941, from the *Pseudoschwagerina* Zone; comparison of the

measurements of these forms indicating that *M. duplaris* possesses a slightly coarser mesh, with broader dissepiments, and that the nodes in *F. magnispinata* are larger, and very slightly closer spaced. *Fenestella bispinulata* Moore, 1930, from the Upper Pennsylvanian of Kansas, is again a finer species, and the form recorded from the Middle Productus Limestone by Waagen and Pichl as *F. perelegans* Meek is also very similar in appearance to *M. duplaris,* but was described as having a very slightly finer zoarium.

Elias (1937) has suggested that in the evolution of various races within the fenestellids, series of species can be traced in which forms of identical appearance, but gradually increasing dimensions, indicate successively younger horizons within the late Palaeozoic; *M. duplaris* could thus be regarded as the early Artinskian representative of a group including *F. bispinulata* (Upper Pennsylvanian) and *F. magnispinata* (Sakmarian), but the relationships of other similar species require study before this could be assumed. *Fenestella horologia* (as *F. parviuscula* Bassler) and *Polypora woodsi* (as *P. tripliseriata* Bassler) were included in Elias's discussion as Artinskian representatives of similar races.

MINILYA PRINCEPS Crockford, 1944.

Minilya princeps Crockford, 1944b, 174, pl. 1, fig. 1.

Occurrences: Noonkanbah Formation, localities 5 A (1206 A); 17 (1112 B, 1246; topotypes); and 27 (1290 L).

Genus PROTORETEPORA de Koninck, 1876.

PROTORETEPORA AMPLA (Lonsdale), 1844.

Fenestella ampla Lonsdale, 1844, 163;

Fenestella ampla Lonsdale, Lonsdale, 1845, 268, pl. 9, fig. 3b, *not* figs. 3, 3a, 3c;

Protoretepora ampla (Lonsdale), Crockford, 1941a, 406, pl. xix, fig. 4, text-fig. 2 A; 1944a, 160.

Occurrence: Noonkanbah Formation, locality 17 (1259). (Previously recorded from locality 32.)

PROTORETEPORA ROBUSTA (Bassler), 1929.

Phyllopora? robusta Bassler, 1929, 82, pl. CCXLVI (22), figs. 3-6.

Occurrence: Noonkanbah Formation, locality 5 A (1116 D, 1260).

The holotype of this species was from the Bitaoeni Beds of Timor; it is here referred to *Protoretepora,* since Bassler (1953, G 125) considers *Phyllopora* King, 1849 (*non* Ehrenberg, 1834) equivalent to this genus, although not all species referred to *Phyllopora* are similar to *Protoretepora.*

PROTORETEPORA FLEXUOSA sp. nov.

Pl. 18, figs. 4, 5.

Occurrences: Noonkanbah Formation, localities 5 A (1265, 1367); 5 C (Holotype, and 1263, 1264); 5 J (1174 C, 1262 A, B); 5 N (1168 D); and 7 B (1269).

Holotype: 1261.

Diagnosis: Protoretepora with narrow, flexuous branches and broad celluliferous dissepiments, so arranged that the dissepiments do not always fall into distinct linear series; apertures usually in 5 rows, with seven or eight to a fenestrule; branches and dissepiments rounded and fenestrules small and circular on the reverse surface.

Description: The zoarium is fenestrate, and one specimen showing the base indicates that it was a flattened infundibuliform colony with the celluliferous surface internal; there are about 4½ fenestrules and 6½ branches in 10 mm. The branches are very flexuous and are jointed by broad celluliferous dissepiments; in places the division into branches and dissepiments becomes indistinct, so that the fenestrules do not always form definite linear series. Normally the branches are about 0.95 mm. wide, and bear five rows of apertures; their width is about 0.85 mm. just after branching, where there are four or sometimes five rows of apertures, and increases just before branching to about 1.8 mm. with a corresponding increase to nine rows. Four or five apertures are opposite each fenestrule, and an additional three, occasionally four, opposite the end of a dissepiment; these apertures are slightly oval, about 0.13 mm. in their longer diameter, and are surrounded by thin distinct peristomes; the distance between the centres of successive apertures is 0.28 to 0.41 mm. Because of the flexuous branches, the number of rows of zooecia, and their spacing, are less regular than in a *Polypora*. Additional zooecial apertures, about the same distance apart as those on the branches, cover the obverse surface of the dissepiments also, and where specimens are weathered from the reverse the dissepiments are seen to be completely occupied by zooecial cells; some of these dissepiments are quite short laterally, where two branches may be bent so close together that there is little or no space between them. The surface is smooth and without nodes between the apertures, although weathering tends to give it a pitted appearance. The fenestrules are oval on the obverse surface, and are 0.9 to 1.1 mm. long and 0.7 mm. wide; the width of the dissepiments is usually 1.0 to 1.2 mm., sometimes wider. On the reverse surface the fenestrules appear small and circular, and the branches and dissepiments are usually quite indistinguishable but form a regularly perforated mesh of quite distinctive and characteristic appearance. The zooecial tubes form short rhomboidal cells only about 0.38 mm. long on the basal plate.

Discussion: This species is slightly coarser than the genotype, *P. ampla,* and differs quite distinctly in appearance, particularly in the very flexuous branches. It is distinguished by the lack of prominent and numerous nodes

on the obverse surface from the slightly coarser *P. jabiensis* (Waagen and Pichl), from the Upper Productus Limestone. *P. cribellum* (de Koninck), as revised by Waagen and Pichl (1885) from material which also came from the Upper Productus Limestone, is finer than the present form, and has much larger cell apertures, and the dissepiments are strongly depressed below the surface of the branches.

Genus LYROPORA Hall, 1857.

Bassler (1953) now regards as valid genera both *Lyropora* Hall (fenestrate zoaria, the branches bearing 3 or more rows of zooecia, and with heavily calcified U- or V-shaped lateral supports bordering the fenestrate area), and *Lyroporella* Simpson, 1895 (in which the zoarium is generally similar but the branches bear only 2 rows of zooecia; and the genotype of which was previously regarded as unrecognizable). One species, *Lyropora*(?) *erkosoides* Etheridge, 1926, has been described from the Callytharra; this species should now be referred to *Lyroporella*, but at least one species of *Lyropora* s. str., occurs in the Callytharra; no specimens of either genus are yet known to occur on higher horizons in Western Australia.

LYROPORA JOSELINA sp. nov.

Pl. 19, figs. 1-3.

Occurrences: Nura Nura member of Poole Sandstone, localities 1 (1222, 1247, 1258) and 1 A (Holotype, and 1256 B).

Holotype: 1256 A.

Diagnosis: Lyropora with a coarse fenestrate mesh, the branches having five rows of zooecia, and about 6 zooecia to a fenestrule; lateral supports asymmetrical and fenestrate area very flexuous.

Description: The zoarium consists of a very flexuous fenestrate mesh extending between two calcified lateral supports of asymmetrical shape, which arise from a thick pendunculate base. This base appears to have been circular in outline, and is unusually large for the genus, being about 1.5 cm. in diameter on its lower surface; above this it contracts to about 1 cm., before expanding to form the diverging lateral supports. The supports extend upwards for about 2.5 cm., but the fenestrate mesh, which is much folded in its upper portion, forms a large colony—one specimen weathered at right angles to the surface of the mesh shows the truncated ends of the branches covering an area of 12 x 7 cm. The specimens are all imbedded in matrix and the shape of the supports is not clearly shown, but they appear to have been quite asymmetrical, one spreading laterally and one more upright, and in the lower part of the colony the branches are much thickened and the fenestrules are partly or wholly infilled by successive films of stereom which obscure both obverse and reverse surfaces. The thickness of the supports is shown in the illustrated specimens.

There are five fenestrules and five to six branches in 10 mm.; these branches are straight but bifurcate rapidly, and are broad and flattened on the obverse surface. There are normally five rows of zooecial apertures, with eight before and four just after branching; the branches vary from about 0.75 mm. wide just after, to 1.55 mm. just before, bifurcation, with a normal width of about 1.0 mm., much increased by thickening near the base. The apertures are round, 0.11 mm. where unweathered, and are very closely spaced, the distance between the centres of successive apertures being usually 0.24 to 0.31 mm. (occasionally 0.38 mm.), and about 39 occur in 10 mm. The rows of apertures are not regularly alternating, as is usual, but are rather irregularly arranged; the surface between the apertures is smooth; a few very small nodes are shown. The fenestrules are short, narrow, and oval, and the dissepiments very broad; the total length of one fenestrule and one dissepiment is from 1.55 to 2.15 mm., usually about 1.8 mm.; normal fenestrules measure 0.8 to 1.2 mm., and the dissepiments are usually 0.6 to 1.15 mm. wide, but the relative measurements of each vary, especially where secondary thickening has filled in the fenestrules. On both obverse and reverse surfaces the fenestrules and dissepiments are of about the same thickness, and on the reverse both are rather sharply rounded, so that from this surface the fenestrules are round when infilled by matrix. The zooecial cells are rhomboidal in outline on the basal plate and are very small, only about 0.24 mm. long; in the more heavily calcified parts of the zoarium and within those parts of the lateral supports into which the branches originally extended, the vestibules of the cells are greatly elongated as they extend upwards to successive levels of the surface before being obscured.

Discussion: The lateral supports, although asymmetrical, are quite strongly developed, and differentiate this species from flabellate species of *Polypora,* although it is by no means such a typical *Lyropora* as forms occurring in collections from the Callytharra; it could not be closely compared to any described species.

" Genus SPHRAGIOPORA " Ulrich, 1890.

Sphragiopora Ulrich, 1890, 398, 638;

Sphragiopora Ulrich, Bassler, 1929, 83.

Many small rounded parasitic zoaria, some generally resembling the form described by Bassler as *S. crateriformis* (1929, 83, pl. CCXLIII (19), fig. 11), and larger but similar zoaria, occur at some localities in the Noonkanbah, particularly at locality 17, where the matrix is shale. No description of these forms is given here, as it appears far more probable that they represent the early stages of the zoaria of various fenestellids, as Bassler (1953, G 126) tentatively regards them, rather than separate species in the fauna; their abundance on individual horizons suggests the very sudden development of some unfavorable condition—probably, from the matrix in which they usually occur, of muddy water.

Family ACANTHOCLADIIDAE Zittel, 1880.

Genus ACANTHOCLADIA King, 1849.

ACANTHOCLADIA sp. indet.

Occurrence: Noonkanbah Formation, locality 17 (1162 B).

This single small specifically indeterminate fragment of an *Acanthocladia* is recorded because, although *Acanthocladia* and the closely related *Penniretepora* are common in the Timor Permian, and *Penniretepora* occurs frequently also in the earlier Callytharra Formation, no other recognizable specimens of either genus have been found in collections from the Noonkanbah.

Genus SYNOCLADIA King, 1849.

SYNOCLADIA TEICHERTI sp. nov.

Pl. 17, fig. 5, pl. 18, fig. 3.

Occurrences: Noonkanbah Formation, localities 5 A (1205); 12 (1077 K); 19 (1215 B, 1234 A); 29 (Holotype); and 32 (20952 D, Univ. W.A. Colln.).

Holotype: 1274.

Diagnosis: Coarse *Synocladia,* branches with usually 4 rows of zooecia, and 7 apertures to a fenestrule; dissepiments broad, not strongly arched, having 3 additional transverse rows of apertures, with up to 5 apertures in each row; small nodes fairly numerous on the obverse surface, and occasional "accessory cells" on both obverse and reverse.

Description: The zoarium is fenestrate, usually forming quite flat expansions, but the form of the colony is not shown; there are five fenestrules and usually slightly over five, sometimes up to seven, branches in 10 mm. The branches are straight, and usually bear four rows of zooecia, with six rows before and three just after branching; increase in the number of rows occurs gradually, and there may be five rows for about three fenestrules before branching; the usual width of the branches is 0.95 to 1.3 mm., varying from 0.8 mm. just after, to 1.9 mm. just before, branching. The apertures are large, measuring where unweathered 0.19 x 0.16 mm., and no carinae are developed between the rows of apertures, the obverse surface being flattened and smooth; the distance between the centres of successive apertures is 0.24 to 0.38 mm., and there are about seven apertures in the length of one fenestrule and one dissepiment, or about 32 in 10 mm.

Generally there are three transverse rows of apertures on the dissepiments; there are up to five in the central row, and three or four in the outer rows; when a dissepiment is shorter than usual the number of apertures is correspondingly smaller. Nodes occur on the obverse surface, but are not well shown; they seem to have been small and blunt, and about equal to the number of apertures along the centre of the branch, where up to 3 or 4 may occur around an individual aperture; but they were apparently less numerous near the lateral margins of the branches and across the dissepiments. The scars of small "accessory cells", about half the size of the apertures, occur occasionally

on the obverse surface, and are sometimes developed on the reverse surface also, being there up to 0.18 mm. in diameter. The fenestrules are oval to slightly crescentic in shape, and are 1.0 to 1.6 mm. long and from 0.6 to 1.4 mm. wide; the dissepiments are not so noticeably arched as is usual in this genus, and their width is 0.55 to 1.0 mm. On the obverse surface the dissepiments are level with the surface of the branches, but they are slightly depressed on the reverse; the non-celluliferous tissue of the reverse is very thin and easily removed by weathering, and the outline of the cells, which are coarse and rhomboidal, with the additional cells of the dissepiments curving distinctly outwards on each side from the branches, is usually shown. The branches are not, as in some species of *Synocladia,* differentiated into two series of different thickness.

Discussion: This species is not very different in its measurements from the common and stratigraphically restricted *Synocladia spinosa* of the Cundlego Sandstone of the Carnarvon Basin, but in its detailed structure, such as the number of rows of apertures, and the development of nodes and of "accessory cells", it clearly differs from *S. spinosa.* Both forms show greater similarity to the genotype, *S. virgulacea* (Phillips), from the Permian of England, Germany, and the Salt Range, than to any other described species; Waagen and Pichl describe the genotype as the commonest bryozoan in the Middle and Upper Productus Limestone faunas. Shulga-Nesterenko (1952, Table 2) indicates that the genus occurs from a point within the Lower Permian upwards to the top of the Permian in Russia, but no descriptions of Russian Permian species have been available for comparison. Bassler (1953, G 128) lists the range of the genus as Mississippian to Permian, but many of the Carboniferous species have been referred to the related genus *Septopora,* and *Synocladia* seems, from described forms, to be one of the most characteristic Permian genera, and is very widespread within the Permian.

A second species of *Synocladia* probably occurs within the Noonkanbah; this form (1271 –3, from localities 5 A and 5 J) has more rows of apertures and smaller zooecia than the present species, but the available material is unsuitable for description.

Family RHABDOMESIDAE Vine, 1883
(*as* Rhabdomesontidae).

Genus RHABDOMESON Young and Young, 1874.

RHABDOMESON MAMMILLATUM (Bretnall), 1926.

Rhombopora mammillata Bretnall, 1926, 24, pl. 1, fig. 2;

Rhabdomeson mammillata (Bretnall), Crockford, 1944a, 166, pl. v, fig. 14, text-figs. 39-41.

Rhabdomeson shanse Reed, 1933, 113, pl. ii, fig. 3.

Occurrences: Noonkanbah Formation, localities 12 (1113 A); 13 (1077 H); 19 (1078 D, 1182); 23 (1126 C); 25 (1283 C); and 31 (2757 I, Univ. W.A. Colln.) (Holotype, probably from the Noonkanbah Formation, locality 29.)

RHABDOMESON MAMMILLATUM var. nov.?

Pl. 20, figs. 1-3.

Occurrences: Noonkanbah Formation, localities 5 A (1186 A); 5 C (1184 A); 21 (1176 B, 1185 A); 22 (1183 A); 23 (1277); 31 (2757 G, H, Univ. W.A. Colln.); and 35 (22336 D-G, Univ. W.A. Colln.). Base of Liveringa Formation, locality 37 (1146 B).

Description: This group of specimens, of which those figured (1176 B and 22336 D, Univ. W.A. Colln.) are the most typical, are portions of ramose zoaria, with cylindrical branches about 3.5 mm. thick, dividing at an acute angle to form two branches each maintaining this thickness; the surface is smooth, with large rhombic zooecial apertures arranged in regular longitudinal and diagonal rows, giving a distinctive appearance to the branches even without enlargement; only immediately adjacent to bifurcation is this regular arrangement disturbed. There are from about 25 to, more frequently, 35 longitudinal rows of apertures, and 4½ to slightly over 5 apertures in each row in 2 mm., with the centres of successive apertures 0.38 to 0.52 mm. apart; individual apertures measure 0.26 to 0.31, occasionally 0.36, mm. x 0.2 to 0.31 mm. The interspaces between the apertures are rounded and are, as in *R. mammillatum* s. str., arranged to form diagonal ridges, at each intersection of which a single megacanthopore forms a blunt spine above the surface; no micracanthopores are developed.

The axial tube is about 0.6 mm. in diameter, and is constricted at intervals of about 0.8 mm. The tubes pass obliquely outwards from the axial tube through the thin-walled axial zone, about 0.85 mm. wide on either side, and then bend sharply to the mature zone, which is normally 0.6 mm. wide, but which widens where bifurcation of the branch occurs; no hemisepta or diaphragms are shown.

Discussion: It is possible that these specimens are all fragments from near the base of zoaria of *R. mammillatum*; and for this reason they are not given a varietal name, although the two types of zoaria are readily differentiated from fragments and it is only occasionally that both types occur at one locality. They are here grouped separately because their branch size is sharply distinguishable from typical zoaria of *R. mammillatum,* and in each group bifurcation (as is typical in the Rhabdomesidae) gives two branches each of substantially the same size as the parent stem; because the spacing of the apertures, although similar in each form, averages farther apart in the larger zoaria, in which the apertures are also longer and in particular much broader than in finer zoaria; and especially because the occurrence of coarser specimens seems limited stratigraphically to the higher parts of the Noonkanbah and early part of the Liveringa, while finer zoaria are more widely distributed throughout the Noonkanbah Formation.

RHABDOMESON GRANDE Bassler, 1929.

Pl. 19, fig. 5.

Occurrence: Noonkanbah Formation, locality 10 (1144 B).

This zoarium, which is almost completely encrusted by a stenoporid, shows in section the characteristics of this exceptionally large species, originally described from the Bitaoeni Beds of Timor.

RHABDOMESON BISPINOSUM Crockford, 1944.

Rhabdomeson bispinosa Crockford, 1944a, 167, text-fig. 47.

Occurrences: Noonkanbah Formation, localities 12 (1077 I) and 33 (22132 B, Univ. W.A. Colln.).

These two small fragments, although neither is very well preserved, appear identical with the holotype, which was from the Callytharra Formation.

RHABDOMESON BRETNALLI sp. nov.

Pl. 20, figs. 4-7.

Occurrences: Noonkanbah Formation, localities 5 R (1190); 15 (1188 A); 17 (Holotype); 19 (1167 B); and 22 (1187 B, C).

Holotype: 1189 A.

Diagnosis: Rhabdomeson with thick ramose branches; small zooecial apertures in fairly regular longitudinal and diagonal rows; megacanthopores at the angles of the apertures, 4 to 6 to each aperture, micracanthopores slightly more numerous.

Description: The zoarium is formed by cylindrical ramose branches about 2.8 mm. in thickness, with lateral branches of the same size given off at right angles. The surface is smooth, with small zooecial apertures and comparatively broad flattened interspaces. There are about 30 to 35 rows of apertures, each with 5½ to 6 apertures in 10 mm., the centres of successive apertures being usually 0.45 to 0.6, sometimes 0.75, mm. apart; the apertures are 0.21 to 0.26 mm. long and 0.13 to 0.19 mm. wide. Megacanthopores are placed usually but not regularly at the angles of the apertures, and there are usually four but quite commonly five or six of these megacanthopores around each aperture; micracanthopores are rather more numerous, up to eight occurring in a single row around each aperture.

The axial tube is slightly oval, 0.6 x 0.45 to 0.5 mm. in diameter; from its outer margin the zooecial tubes pass obliquely upwards and outwards through the comparatively narrow immature zone, 0.33 to 0.43 mm. wide, into the thick-walled mature zone, 0.65 to 0.85 mm. wide; the bend from the axial to the mature zone is sharp but no hemisepta are shown.

Discussion: *R. bretnalli* is differentiated from *R. mammillatum* by its smaller and less regularly arranged apertures, by the different proportions of the axial and mature zones, and particularly by the less regular arrangement of megacanthopores and by the development of micracanthopores.

Genus SAFFORDOTAXIS Bassler, 1952.

Saffordotaxis Bassler, 1952, 385.

Diagnosis: "Like *Rhombopora,* but a row of megacanthopores surrounds each aperture" (Bassler, 1953, G. 134).

Genotype: *Rhombopora incrassata* Ulrich, 1890, 652, pl. LXX, figs. 12-12d.

Range: Mississippian-Permian.

Bassler has separated from *Rhombopora* species formerly assigned to that genus, but which either possess only megacanthopores (*Saffordotaxis*) or micracanthopores (*Nicklesopora*), whereas the genotype of *Rhombopora* and typical species of that genus have "micracanthopores around each aperture and a megacanthopore at the distal end of each" (Bassler, 1953, G. 134). Several species occurring in the Australian Permian acanthopores of one size only, and thus apparently require reclassification; in the group of species here referred to *Saffordotaxis* these acanthopores, although small, are clearly defined and distinct, and are therefore regarded as megacanthopores, rather than as the very much smaller micracanthopores illustrated as characteristic of the genotype of *Nicklesopora.*

SAFFORDOTAXIS MULTIGRANULATA (Bretnall), 1926.

Rhombopora multigranulata Bretnall, 1926, 25, pl. i, fig. 3;

Rhombopora multigranulata Bretnall, Crockford, 1944a, 167, pl. v, fig. 13, text-figs. 35, 36.

Occurrences: Noonkanbah Formation, localities 5 R (1193); 8 (1156 D, 1192); 17 (1191 A); 21 (1266); and 31 (2757 P, Univ. W.A. Colln.) (Holotype, probably from the Noonkanbah Formation, locality 29).

A very fine ramose *Dyscritella* similar in general appearance to this form occurs at locality 5 R (1194 A), and differs in the development of a few tiny mesopores, placed usually so that a single one occurs beneath each aperture.

SAFFORDOTAXIS cf. WANNERI (Bassler), 1929.

Rhombopora wanneri Bassler, 1929, 64, pl. CCXLV (21), figs. 7-9.

Occurrence: Noonkanbah Formation, locality 5 A (1204).

This single small specimen closely resembles Bassler's description of the holotype, from the Basleo Beds of Timor. Like the holotype, it has small

zooecial apertures separated by broad interspaces, with numerous, rather small, irregularly arranged acanthopores, and is similar in the relative widths of the axial and mature zones (the mature zone in each specimen occupying more than half the radius); but in this Noonkanbah specimen the spacing of the zooecial apertures is rather irregular, and although over part of the surface it is similar to the spacing shown in figures of the holotype, the apertures are at times more closely spaced, with 3 to 5 in 2 mm.

SAFFORDOTAXIS ELEGANS sp. nov.

Pl. 21, figs. 1-4.

Occurrences: Noonkanbah Formation, localities 5 A (1122 B); 5 C (1103 C, D, 1184 B, 1195 A, B); 12 (1077 J); 14 (1149 B-F); 16 (1094 D, and section); 19 (1169 D, E); 21 (Holotype, and 1061 B, 1199 A); 22 (1068 F-J, 1118 B-E, 1134 B, 1183 B, D, 1187 I-M); and 23 (1276 B). Base of Liveringa Formation, locality 37 (1146 C).

Holotype: 1185 E.

Diagnosis: Very fine ramose zoaria, with about 10 rows of large, oval, widely separated zooecial apertures; numerous small acanthopores usually in a single flexuous line between adjacent rows of apertures.

Description: The zoarium is ramose and very fine, usually 0.5 to 0.6 mm., and reaching a maximum width of 0.7 to 0.9 mm. immediately before branching, which occurs repeatedly and gives rise to two branches of the same diameter as the parent stem, diverging from each other at an acute angle. The zooecial apertures are in about ten longitudinal rows, and are usually widely spaced, although they vary considerably in their spacing even in single specimens; the centres of successive apertures are 0.55 to 0.9 mm. apart, and there are from 2 to 3½ apertures in 2 mm. The apertures are elongate, and meet the surface very obliquely, so that their apparent size is largely dependent on weathering or the extent to which they are infilled by matrix; usually they are 0.28 to, more often, about 0.4 mm. long and 0.17 mm. wide. A single flexuous row of small, closely spaced, but distinct acanthopores occurs directly beneath each aperture. Internally, the tubes are short, without diaphragms or hemisepta, and pass obliquely outwards from the centre of the zoarium to the surface, with the mature zone occupying about half the radius.

Discussion: This species is a much finer form than the associated *S. multigranulata,* from which it differs also in the spacing and arrangement of the zooecia, and in the more regular arrangement of acanthopores, which in *S. multigranulata* occur sometimes in one, sometimes in two, rows between the apertures. The tiny zoaria of this form, and frequent oblique or transverse weathered sections through them, are common in the higher parts of the Noon-

kanbah, except in specimens from the shallow-water facies; because of their distinctive appearance, and because they seem to be quite absent from favorable facies in the earlier part of the Formation, this species seems of probable stratigraphical value in indicating the higher part of the Noonkanbah and the early part of the Liveringa.

A specimen from the Fusulina Limestone of the Carnic Alps figured by Johnsen (1906, 141, taf. x, fig. 3) as *Rhombopora nicklesi* Ulrich, 1890 (but apparently not conspecific with this American species) closely resembles *S. elegans* but has smaller and more closely spaced zooecial apertures.

Saffordotaxis castanea sp. nov.

Pl. 21, figs. 5, 6; text-fig. 13.

Occurrences: Noonkanbah Formation, localities 5 A (1203); 5 J (Holotype); 16 (1202 A); and 22 (1187 D).

Holotype: 1073 K.

Diagnosis: Moderately coarse ramose zoaria with about 24 rows of zooecia regularly arranged in longitudinal and diagonal series; large acanthopores in a single flexuous line between adjacent rows of apertures, with 8 to 10 along each side of each aperture.

Description: The zoarium is composed of ramose branches 2 to 2.5 mm. thick with large apertures placed in about 24 to 28 longitudinal and in diagonal rows; there are $2\frac{1}{2}$ to $3\frac{1}{2}$ apertures in 2 mm., the centres of successive apertures being 0.59 to 0.72 mm. apart. Individual apertures are oval, and vary considerably in their apparent size with the degree of infilling or weathering, as

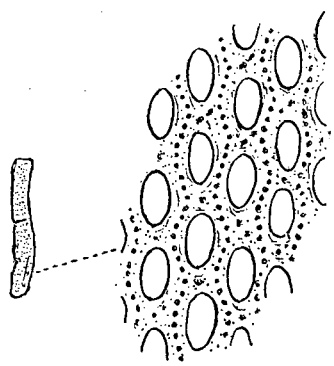


Fig. 13.—*Saffordotaxis castanea* **sp. nov. Zoarium of the holotype, natural size, and portion of the surface of the ramose zoarium of the holotype, showing the elongate zooecial apertures and the arrangement of the acanthopores, x 20.**

the zooecial tubes meet the surface very obliquely; typical apertures are 0.36 to 0.48 mm. long and 0.17 to 0.24 mm. wide. A short shallow groove occurs beneath each aperture, and a single row of acanthopores, placed on a slight flexuous longitudinal ridge, occurs between adjacent rows of apertures. The acanthopores are quite large, and about 8 or 10 occur along each side of each aperture, with an occasional additional acanthopore of the same size in the

space beneath an aperture. The mature zone occupies about one-third of the radius of the zoarium, and the tubes diverge very gradually from the axial to the mature zone and pass obliquely to the surface.

Discussion: This species differs from *S. multigranulata* (Bretnall), an associated species of similar size, in the arrangement of acanthopores.

Genus RHOMBOCLADIA Rogers, 1900.

RHOMBOCLADIA SPINULIFERA Crockford, 1944.

Pl. 16, fig. 4.

Rhombocladia spinulifera Crockford, 1944a, 171, text-fig. 48.

Occurrence: Noonkanbah Formation, localities 29 (1275) and 31 (2757 N. Univ. W.A. Coiln.) (Holotype from locality 17.)

Genus STREBLOTRYPA Ulrich, 1890.

STREBLOTRYPA MINUTULA Bassler, 1929.

Streblotrypa minutula Bassler, 1929, 67, pl. CCXXXIX (15), figs. 11-15.

Occurrences: Noonkanbah Formation, localities 5 A (1116 E); 5 C (1200 A); 19 (1169 A, 1201 A); 21 (1185 D, 1197 A); and 22 (1068 E, 1183 C).

These specimens agree with the description of this species, the original specimens of which were from three localities in the Amarassi of Timor, except that the zooecial apertures, which Bassler stated are "0.1 mm. and 0.075 mm. in length and width respectively" are here very slightly larger, being on unweathered surfaces 0.12 to 0.14 mm. long and 0.07 mm. wide; the fine zoaria of this form are themselves only 0.35 to 0.5 mm. thick, and bifurcate to form two branches, diverging at right angles, of this same size. Sections and weathered surfaces of this form indicate that it belongs to *Streblotrypa* s. str., rather than to *Streblascopora,* as it lacks the distinct central bundle of fine tubes characteristic of *Streblascopora.*

Genus STREBLASCOPORA Bassler, 1952.

Streblascopora Bassler, 1952, 385.

Diagnosis: "Like *Streblotrypa,* but with a central bundle of parallel immature tubes as in *Ascopora*". (Bassler, loc. cit.)

Genotype: Streblotrypa fasciculata Bassler, 1929, 66, pl. CCXXXIX (15), figs. 4, 5.

Range: Permian.

STREBLASCOPORA MARMIONESIS (Etheridge), 1926.

Streblotrypa marmionensis Etheridge, 1926, in Bretnall, 22, pl. i, fig. 1, and pl. ii, fig. 3;

Streblotrypa marmionensis Etheridge, Crockford, 1944a, 168, pl. v, figs. 10, 11, text-figs. 31-34.

(?)*Streblotrypa germana* Bassler, 1929, 67, pl. CCXXXIX (15), figs. 6-10.

Neotype: F 17551, Australian Museum Colln. (The holotype of this species was burnt; the neotype is therefore selected from the specimens which Etheridge used as paratypes; it has previously been figured as typical of this species (Crockford, 1944a, pl. v, fig. 10) and is a topotype.)

Occurrences: Nura Nura member of Poole Sandstone, locality 1 (1223 A, B). Noonkanbah Formation common throughout. Base of Liveringa Formation, localities 36 (1293 B, C) and 37 (1146).

THE AFFINITIES AND CORRELATION OF THE NURA NURA, NOONKANBAH, AND LIVERINGA BRYOZOAN FAUNAS.

The distribution of bryozoan faunas within the Permian of the Fitzroy Basin is shown in Table 1, the species recorded being arranged in order of their appearance in the fauna; where any species is known either to occur, or to be very closely related to a form which occurs, in other Permian areas, reference to this occurrence also is made in Table 1. The stratigraphy of the Fitzroy Basin and the correlation of formations occurring within it have been discussed by Teichert (1941), Guppy, Lindner, Rattigan, and Casey (1952), and Thomas and Dickins (1954); their conclusions regarding individual formations are summarized before the bryozoan faunas of each formation are discussed.

Nura Nura Member of the Poole Sandstone.

Stratigraphy and Correlation: The Poole Sandstone, which overlies the Grant Formation at the base of the Permian sequence in the Fitzroy Basin, has a total thickness of 205 feet to 1,305 feet (Thomas and Dickins, 1954, fig. 1). The Nura Nura member, which occurs near the base of the Poole Sandstone, is about 20 feet thick and contains the ammonites *Metalegoceras clarkei* Miller, *M. striatum* Teichert, and *Thalassoceras wadei* Miller, indicating an Artinskian age (Teichert, 1941, 387). Thomas and Dickins (1954, 219 and 221-2) have also discussed the affinities of the brachiopod, cephalopod, and pelecypod faunas, showing that the brachiopods resemble those described from the Lower Productus Limestone, and recording the occurrence in the Nura Nura of a cephalopod closely related to *Popanoceras indo-australicum* Haniel from the Bitaoeni beds of Timor. Within Western Australia, the Callytharra Formation of the Carnarvon Basin and the Fossil Cliff Formation of the Irwin Basin are correlated with the Nura Nura (Teichert, 1941, 389; Condon, 1954, 52-3).

Bryozoan Fauna: Ten species of Bryozoa are recorded from six localities within the Nura Nura; as well, the fauna examined contained several specimens of Polypora too poorly preserved for specific identification, and a single specimen of a primitive undescribed species of *Hexagonella.*

Of the Nura Nura fauna, six species—*Hexagonella australis* (Bretnall), *H. hudlestoni* sp. nov., *Evactinostella crucialis* (Hudleston), *Dyscritella spinigera* (Bassler), *Fenestella horologia* Bretnall, and *Streblascopora marmionensis* (Etheridge)—are recorded in this paper from the later Noonkanbah Formation as well as from the Nura Nura. These six species occur also in the Callytharra Formation of the Carnarvon Basin (Bretnall, 1926, 15, 22, 25; Crockford, 1944a, 149, 158, 168; and this paper, pp. 19, 35-79); and *Evactinostella crucialis, Fenestella horologia,* and *Streblascopora marmionensis* have been recorded also from the Baker Formation and the Coolkilya Greywacke of the Carnarvon Basin (Crockford, 1944a, 168; 1944b, Table 1; and this paper, p. 35).

Three of the species which occur in the Nura Nura, the Callytharra, and the Noonkanbah, are also present in the Timor Permian. *Dyscritella spinigera* was originally described from a ?Basleo* locality in Timor (Bassler, 1929, 61). *Streblascopora marmionensis* appears identical with *S. germana* (Bassler), from the Basleo and Amarassi beds of Timor (Crockford, 1944a, 168); the genus *Streblascopora,* differentiated by advance in internal structure from the related genus *Streblotrypa,* has not so far been recorded from any formation older than Lower Permian. *Fenestella horologia* has been recorded, as *F. parviuscula* Bassler, from the Bitaoeni and Basleo beds of Timor (Bassler, 1929, 76; Crockford, 1944c, 167) and also from the Lower Permian of Vancouver Island (Fritz, 1942, 99); this species occurs also in the Dilly Stage at Springsure in Queensland (Crockford, 1943, 266).

Of the four remaining Bryozoa in the Nura Nura fauna, *Fistulipora nura* sp. nov. has been found only in the Nura Nura, and is simpler in internal structure than species of *Fistulipora* described from the later Noonkanbah Formation. *Stenopora hemispherica* Waagen and Wentzel was originally described from the base of the Lower Productus Limestone (Waagen and Wentzel, 1886, 891) and is also a species of simpler type than those occurring in the Noonkanbah. *Leioclema globosa* sp. nov. occurs both in the Nura Nura and at a locality in the Canning Basin of Western Australia whose position within the Permian is unknown, but is probably equivalent to that of the Nura Nura (Thomas and Dickins, personal communication); this form is also doubtfully recorded from the Noonkanbah (p. 55), and no closely similar species has been described from any other Permian area. The occurrence of *Lyropora* suggests affinity with the Callytharra Formation of the Carnarvon Basin, in which both *Lyropora* and *Lyroporella* occur fairly commonly

* Bassler (1929) recorded only the localities from which the bryozoan fauna he described from the Timor Permian was collected; the beds within which individual species occur have been listed by Martin (1932, 391), upon whose paper reference made here to the occurrence of Bryozoa in the various formations of the Timor Permian is based.

(Etheridge, in Bretnall, 1926, 11; Crockford, 1944c, 190; and this paper, p. 113); neither genus is so far known to occur in any later beds in Western Australia.

Conclusions: Of the Bryozoa described from the Nura Nura, two species appear of stratigraphical value, *Stenopora hemispherica* Waagen and Wentzel, which indicates correlation of the Nura Nura with the base of the Lower Productus Limestone, and *Lyropora joselini* sp. nov., which indicates correlation with the Callytharra Formation of the Carnarvon Basin; and this is in agreement with previous correlations based on the cephalopod and brachiopod faunas and referred to above. Two genera present (*Hexagonella* Waagen and Wentzel and *Streblascopora* Bassler) are not known to occur before the Lower Permian.

Noonkanbah Formation.

Stratigraphy and Correlation: The Noonkanbah Formation overlies the Poole Sandstone; Teichert (1941, 386) and Thomas and Dickins (1954, fig. 1) give the total thickness of this Formation as about 1,200 feet. Thomas and Dickins (1954, 219-222) have found that the brachiopod and pelecypod faunas of the upper part of the Noonkanbah resemble the faunas of the Baker Formation and the Norton Greywacke of the Carnarvon Basin, and that the brachiopod fauna of the upper part of the Noonkanbah, like that of the Nura Nura, is closely related to the brachiopod fauna of the Lower Productus Limestone; and they have found also that some of the pelecypods are related closely to species from the Permian of Timor. Prendergast (1944, 13 et seq.) also found close relationships between the brachiopods of the Wandagee Formation of the Carnarvon Basin and those of the Lower Productus Limestone. The upper part of the Noonkanbah Formation of the Fitzroy Basin is correlated with the Wandagee Formation and Norton Greywacke of the Carnarvon Basin, and with the Lower Productus Limestone of the Salt Range, and is regarded as Artinskian in age (Condon, 1954, 82, 85).

Bryozoa are listed in Table 1 from forty-one localities within the Noonkanbah Formation. Of these localities, eleven lie within, or are very near, measured sections of the Noonkanbah at Bruten's Yard, and the approximate position of these localities within the section (given in feet above the base of the Formation) is shown beneath Table 1. The remaining localities, numbered 6, and 8 to 29 A, are interspersed in Table 1 in their approximate stratigraphical position within the Noonkanbah Formation with reference to the Bruten's Yard section, and according to information supplied by J. N. Casey, J. M. Dickins, and G. A. Thomas; of these localities, the majority are believed to be placed with reasonable accuracy in their correct stratigraphical position, but localities 11, 14, 19, and 20 may be lower or higher in the sequence than they are shown; additional information regarding each locality is given in the List of Localities on p 88. Specimens from localities 30 to 35 belong to collections made prior to 1940 and from localities from which no later collections have been made;

the probable position of these localities within the sequence is not known so accurately as are the later collections, these localities, therefore, could only be placed in Table 1 in the position indicated as probable by their geographical positions and their faunas.

Bryozoan Fauna: Individual species in the Noonkanbah Formation that are related to forms previously described have been compared above under the systematic description of species. Comparisons with the faunas of other Permian areas may be made as follows:—

1. Carnarvon Basin, Western Australia.

Callytharra Formation: Nine species recorded from the Noonkanbah Formation occur also in the Callytharra Formation; these forms are *Hexagonella australis* (Bretnall), *H. hudlestoni* sp. nov., *Dyscritella adnascens* Bassler, *Rhabdomeson bispinosum* Crockford, and *Polypora woodsi* (Etheridge), all of which have not so far been recorded from any horizon except the Callytharra in the Carnarvon Basin (records of their occurrence in the Callytharra having been given by Bretnall, 1926, 25; Crockford, 1944a, 149, 167; 1944b, Table 1; and this paper, pp. 19, 50); and *Evactinostella crucialis* (Hudleston), *Ramipora ambrosoides* (Bretnall), *Fenestella horologia* Bretnall, and *Streblascopora marmionensis* (Etheridge), forms which persist until the Coolkilya Greywacke (Bretnall, 1926, 15, 21; Crockford, 1944a, 149, 158, 168; 1944b, Table 1; and this paper, pp. 28, 38). The Callytharra Formation, however, contains several species of Bryozoa—particularly forms amongst the Fenestellidae, Acanthocladiidae, and Rhabdomesidae described by Bretnall (1926) and Crockford (1944a, 1944c)—quite distinct from those occurring in the Noonkanbah, and some genera, such as *Lyropora, Lyroporella, Septopora, Pennireiepora,* and *Streblocladia,* are very common in the Callytharra but are not known to occur in the Noonkanbah. The fistuliporoids and stenoporids of the Callytharra are virtually undescribed, but collections which have been examined for comparison with the Noonkanbah fauna described in this paper indicate that stenoporids, except thin ramose or encrusting species of *Dyscritella,* are uncommon in the Callytharra, and that the fistuliporoids differ distinctly from those of the Noonkanbah.

Byro and Kennedy Groups: Comparing the Noonkanbah Bryozoa with Permian formations later than the Callytharra in the Carnarvon Basin, *Synocladia teicherti* sp. nov. resembles *S. spinosa* Crockford (Crockford, 1944a 165), a common form in the lower part of the Cundlego Formation; the genus *Synocladia* is not known to occur within any other formation in the Permian sequence in the Carnarvon Basin. *Ramipora ambrosoides* (Bretnall), *Fenestella horologia* Bretnall, *F. columnaris* (Crockford), *Polypora multiporifera* Crockford, *P. fovea* Crockford, and *Streblascopora marmionensis* (Etheridge) occur in the Wandagee Formation* (Crockford, 1944a, 168; 1944b, Table 1;

* The horizons within the Wandagee Series of Teichert (1941, 381–4 and Fig. 5) from which these and other species were originally described or recorded by Crockford (1944a, b, and c) have been re-defined by Condon (1954, 78–96 and Table 2); these records are altered and discussed here in accordance with Condon's terminology.

and this paper, p. 38). *Dybowskiella arborescens* sp. nov., *Evactinostella crucialis* (Hudleston), *Ramipora ambrosoides* (Bretnall), *Fenestella horologia* Bretnall, and *Streblascopora marmionensis* (Etheridge) occur in the Baker Formation (Crockford, 1944a, 168; 1944b, Table 1; and this paper, pp. 15, 28 and 38). *Evactinostella crucialis* (Hudleston), *Ramipora ambrosoides* (Bretnall), *Fenestella disjecta* (Crockford), and *Streblascopora marmionensis* (Etheridge) occur in the lower part of the Coolkilya Greywacke (Crockford, 1944a, 168; 1944b, Table 1; and this paper, pp. 28, 38). In addition, species of *Fistulipora* and particularly broad, flattened species of *Hexagonella* described from the Wandagee and Baker Formations and the Coolkilya Greywacke (Crockford, 1944a, 145, 147, and 153-4) show a marked similarity to species occurring in the Noonkanbah. No stenoporids have been described from the Wandagee and Baker Formations and from the Coolkilya Greywacke, but thin ramose zoaria of *Dyscritella* and coarser ramose zoaria of *Stenopora* are common in collections from these formations.

Of the species listed as common to formations within the Byro and Kennedy Groups of the Carnarvon Basin and the Noonkanbah Formation of the Fitzroy Basin, the stratigraphical ranges of *Dybowskiella arborescens* sp. nov., *Fenestella columnaris* (Crockford), *F. disjecta* (Crockford), *Polypora multiporifera* Crockford, and *P. fovea* Crockford so far appear limited, and the occurrences of these species are in general agreement with the correlation by Condon (1954, 82, 85) of the upper part of the Noonkanbah Formation with the Wandagee Formation and the Norton Greywacke.

2. Eastern Australian Permian sequence.

Four species of Bryozoa recorded from the Noonkanbah appear identical with forms occurring in the Permian of eastern Australia. *Fenestella horologia* Bretnall, *Polypora woodsi* (Etheridge) and *Minilya duplaris* Crockford occur in the Dilly Stage in the Springsure district of Queensland (Crockford, 1943, 266; 1944b, 174, 177); *Polypora woodsi* and *Minilya duplaris* also occur at Lake's Creek Quarry, near Rockhampton (Crockford, 1945, 132, 133). *Polypora woodsi* and *Protoretepora ampla* (Lonsdale) occur at horizons in Tasmania and also in the Maitland Group (former Upper Marine Series) in New South Wales (Lonsdale, 1844, 163; Crockford, 1941a, 406, 414).

3. Timor Permian sequence.

Bitaoeni beds: Fenestella horologia Bretnall (as *F. parviuscula* Bassler, 1929) and *Polypora woodsi* (Etheridge) (as *P. tripliseriata* Bassler, 1929), both species which have been recorded from the Callytharra as well as the Noonkanbah, occur also in the Bitaoeni beds of Timor (Bassler, 1929, 76, 79; Martin, 1932, 391), *F. horologia* being present also in the Basleo beds; Elias (1937, 314, 327), discussing phylogenetic development within fenestrate genera, considered these two species, both widespread forms, distinctive of the Artinskian. *Protoretepora robusta* (Bassler) and *Rhabdomeson grande* Bassler were described originally from the Bitaoeni,

and *Dyscritella adnascens* Bassler from a ?Bitaoeni and an Amarassi locality; and the form recorded and figured from the Noonkanbah in this paper as *Polypora* sp. nov., very closely resembles *P. macrops* Bassler, a Bitaoeni form.

Basleo beds: Of species common to the Noonkanbah Formation and the Basleo beds, *Ramipora ambrosoides* (Bretnall) (recorded from Timor as *Acanthocladia acuticostata* Bassler), *Dyscritella spinigera* (Bassler), *Fenestella horologia* Bretnall, and *Streblascopora marmionensis* (Etheridge) (*Streblotrypa germana* Bassler, 1929) occur through too long a time range in either Western Australia or Timor to indicate more than general similarity in age. Species restricted in Timor to the Basleo beds and occurring also in the Noonkanbah are *Goniocladia indica* Waagen and Pichl, *G. timorensis* Bassler, and *Fenestella basleoensis* Bassler (Bassler, 1929, 74, 88, 89; Martin, 1932, 392); and the species recorded from the Noonkanbah as *Dyscritella* cf. *spinulosa* Bassler and *Saffordotaxis* cf. *wanneri* (Bassler) each very closely resemble the Basleo species to which they are compared. *Goniocladia* is not known to occur in the earlier part, including the Callytharra, of the Carnarvon Basin Permian sequence, but specimens of this genus are present in undescribed collections from the Wandagee Formation.

Amarassi beds: Streblotrypa minutula Bassler occurs in the Amarassi beds (Bassler, 1929, 67) and in the later part of the Noonkanbah, and *Stenopora spicata* (Bassler) var. *obtusa* var. nov. is described as a variety of an Amarassi species. *Streblascopora marmionensis* (Etheridge) (*Streblotrypa germana* Bassler) is present in the Amarassi as well as in the Basleo beds.

It is noticeable that the specialized genera *Fistulotrypa* Bassler, *Fistulocladia* Bassler, and *Clausotrypa* Bassler, which occur in the Basleo and Amarassi beds of Timor (Bassler, 1929, 48, 49, and 70), have not been found in any collections from the Noonkanbah; *Fistulotrypa* and *Fistulocladia* have been recorded only from the Timor Permian, but *Clausotrypa*, common in the Basleo, has also been recorded as one of the most common genera in the Lower Permian bryozoan faunas of Vancouver Island (Fritz, 1932, 93, 97).

The Noonkanbah faunas therefore show some resemblance to faunas from the Bitaoeni, Basleo, and Amarassi beds of Timor, resemblances to the Bitaoeni and Basleo beds being more marked than to the Amarassi.

4. Productus Limestone sequence.

Lower Productus Limestone: The accepted correlation of the Noonkanbah is with the upper part of the Artinskian, and with the Lower Productus Limestone; this correlation and resemblances shown by brachiopods occurring in the Noonkanbah to those of the Lower Productus Limestone have been referred to above (p. 82). The Bryozoa so far recorded from the Lower Productus Limestone are four species described as *Monotrypa mastoidea* Waagen and Wentzel, *Orbipora ambiensis* Waagen and Wentzel, *Stenopora hemispherica* Waagen and Wentzel (Waagen and Wentzel, 1886, 876, 878, and 891), and *Polypora vermicicularis* Waagen and Pichl (Waagen and Pichl, 1885, 793), all described from near the base of the Lower Productus Limestone. Of these forms, *Stenopora hemispherica* has

been recorded in this paper from the Nura Nura member of the Poole Sandstone, and it is possible that *Dyscritella spinigera* (Bassler), recorded in this paper from the Callytharra, Nura Nura, and Noonkanbah, may be identical with *Orbipora ambiensis* Waagen and Wentzel (p. 51). No comparison of any significance can be made between the Bryozoa occurring in the Noonkanbah and the small bryozoan fauna so far described from the Lower Productus Limestone.

Middle and Upper Productus Limestone: The bryozoan faunas described from the Middle and Upper Productus Limestone are larger and are much more varied than those known from the Lower Productus Limestone. Two species of Bryozoa—*Goniocladia indica* Waagen and Pichl and *Polypora megastoma* de Koninck—occur both in the Middle Productus Limestone (Waagen and Pichl, 1885, 785, 805) and in the Noonkanbah; in addition, *Minilya duplaris* Crockford very closely resembles the form recorded as *Fenestella perelegans* Meek from the Middle Productus Limestone by Waagen and Pichl (1885, 777). The distribution of the genera *Hexagonella* (which has been recorded outside Western Australia only in the Basleo and Amarassi beds of Timor, the Middle and occasionally the Upper Productus Limestone, and the Artinskian of the Urals), *Synocladia,* and *Protoretepora* s. str. suggest some affinity between the Noonkanbah fauna and that of the later Middle Productus Limestone.

5. Lower Permian of the Urals.

Several fenestellids occurring in the Noonkanbah resemble species described from the Sakmarian and Artinskian of the Urals. *Fenestella horologia* Bretnall closely resembles *F. subornata Shulga-Nesterenko* (Shulga-Nesterenko, 1952, 40) from the upper part of the Artinskian of the Urals; *Fenestella basleoensis* Bassler, var. *limatula* Trizna (Trizna, 1939, 108, 131, and Table 1), an Artinskian form, is almost identical with *F. basleoensis* Bassler, which occurs at several localities in the Noonkanbah as well as in the Basleo beds of Timor; and the form recorded in this paper from the Noonkanbah as *Fenestella,* sp. nov., resembles *F. sublonga* Shulga-Nesterenko (Shulga-Nesterenko, 1952, 55), a Sakmarian species, and *F. unica* Shulga-Nesterenko (Shulga-Nesterenko, 1952, 55), an Artinskian form. *Polypora kimberleyensis* sp. nov. shows resemblances to *P. remota* Condra var. *grandis* Trizna (Trizna, 1939, 116, 134, and Table 2), from the Artinskian of the Urals; *P. natalis* sp. nov. resembles *P. supraornamentata* Novikova (in Shulga-Nesterenko, 1952, 76), another Artinskian species; and *P. natalis* also has surface ornamentation resembling that developed in several Russian Artinskian fenestellids. *Minilya duplaris* Crockford is also closely similar to species occurring in the Sakmarian and Artinskian of the Urals in which this genus occurs commonly.

No very noticeable resemblances are shown between the Stenoporidae and Rhabdomesidae occurring in the Noonkanbah and those described, and whose descriptions are available, from the Permian of the Urals; a number of specialized genera were developed in each of these families in Russia during

the Lower Permian; none of these specialized forms can be identified in the Noonkanbah fauna. Very few descriptions of Cyclostomata from the Russian Permian have been available for comparison, and no marked similarity can be shown to exist between individual species of Cyclostomata from the Noonkanbah and those occurring in the Urals.

6. North American faunas.

Three species occurring in the Noonkanbah—*Fenestella basleoensis* Bassler, *F. horologia* Bretnall (recorded as *F. parviuscula* Bassler), and *Polypora megastoma* de Koninck—occur also in a Lower Permian (Artinskian) fauna from Vancouver Island (Fritz, 1932, 99, 101), and *Tabulipora scissa* sp. nov. is very similar to *T. sustutensis* Fritz (1946, 86), also from Vancouver Island. The bryozoan fauna described by Fritz from Vancouver Island was stated to show strong similarity to that of the Timor Permian, and to the Middle Productus Limestone faunas.

The Cyclostomata occurring in the Noonkanbah show general similarity to those described by Moore and Dudley (1944) from the late Pennsylvanian and Permian of mid-continent North America.

Conclusions: The bryozoan faunas occurring in the Noonkanbah Formation show resemblances to faunas in the Carnarvon Basin of Western Australia which agree with the correlation of the top of the Noonkanbah with the Wandagee Formation and the Norton Greywacke by Condon (1954, 82, 85). Distinct resemblances can also be shown to faunas from the Timor Permian, particularly to the Bitaoeni and Basleo beds, to the Sakmarian and Artinskian of the Urals, and to an Artinskian fauna from Vancouver Island.

Liveringa Formation.

Stratigraphy and Correlation: The Liveringa Formation overlies the Noonkanbah Formation, and is 2,420 feet in thickness. The pelecypod, gastropod, and branchiopod fauna of the marine basal beds of the Liveringa indicate correlation with the Baker Siltstone and Coolkilya Greywacke of the Carnarvon Basin, and are considered to be Upper Artinskian to Lower Kungurian in age (Thomas and Dickins, 1954, pp. 220, 222, and fig. 1). A marine horizon at the top of the Liveringa Formation contains a brachiopod fauna with species closely resembling Middle and Upper Productus Limestone forms, and this bed is believed to be Tartarian in age (Thomas and Dickins, 1954, 221-3 and fig. 2).

Bryozoan Fauna and Conclusions: Bryozoan faunas are recorded from two localities within the marine basal beds of the Liveringa Formation (localities 37 and 38); these small faunas are very similar to those of the topmost beds of the Noonkanbah.

Two species of Bryozoa are recorded from Mt. Hardman (locality 39), within the marine horizon at the top of the Liveringa Formation; one of these species, *Stenodiscus hardmani* sp. nov., occurs also near the top of the Noonkanbah Formation and in the basal beds of the Liveringa. Neither of these forms show any distinctive resemblance to any previously described species, and their occurrence therefore adds nothing to the evidence regarding the age of the fauna given by the associated brachiopods.

LIST OF LOCALITIES.

NURA NURA MEMBER OF POOLE SANDSTONE.

1.—N. end of Lake Joseline, Mt. Wynne area (W 42 B, C).

1A.—¼ m. W. from "2" (W 40).

2.—1 m. N.E. from Lake Joseline, 4 m. at 290° from Mt. Wynne (W 44 C).

2A.—4½ m. W. of Mt. Wynne Trig. Point (K. Nura 1).

3.—¼ m. N. from "2" (W 35).

4.—2 m. at 40° from Lake Joseline at fence junction (W 34 B).

NOONKANBAH FORMATION.

5A.—S.—5 A, 4 m. due W. from Chestnut Bore, Christmas Creek Stn.; section A-S extending over a distance of 3 miles in a 170° direction from 5 A, the horizon of which is near the top of the Noonkanbah (PR 284 A-S; NH 17 A-S).

6.—4 m. S. from Chestnut Bore, Christmas Creek Stn. (PR 136).

7A, B.—7 A, 3 m. at 235° from Brutens Yard; B, 200 yards N.E. from "A" (PR 137 G, H).

7C.—Approx. 2 m. at 260° from Brutens Yard and 750 feet above base of Noonkanbah (KNF 73).

8A.—8 A, 2 m. at 260° from Brutens Yard (PR 288, NK 20).

9.—Probably near Blue Bush Bore, Cherrabun Stn. (PR 126).

10.—3½ m. at 110° from Christmas Creek Stn. (R 478).

11.—1 m. S. from Melon Waterhole, Gogo Stn. (GG 2).

12.—2 m. at 120° from Tank Bore, Cherrabun Stn. (PR 291).

13.—3 m. at 285° from Brutens Yard, Cherrabun Stn. (PR 302A).

14.—½ m. E. from Noonkanbah Stn. (NK 32).

15.—9 m. W. from Liveringa Stn., and ¾ m. N. of Mt. Anderson-Liveringa road (G 51).

16.—2 m. S.S.W. from Bohemia Downs Stn., on a fault line (R 422).

17, 17A.—Keevie's Well, 8 m. N. from Mt. Anderson Homestead.

18, 18A.—Probably in vicinity of the Fenton Fault, near Barnes Flow (FL 145). 18A. Locality unknown but probably in some area (FL 96).

19.—3 m. at 100° from Woods Bore, Christmas Creek Stn. (PR 256).

20.—1½ m. at 220° from Brutens Yard (PR 113).

21.—1½ m. S.W. from "5 A" (NK 15).

22.—7 m. due W. from Chestnut Bore, Christmas Creek Stn. (NK 12).

23.—On track, 6 m. E. of Ellendale Stn., on Bell's Creek (SP 49).

24.—6 m. S.E. from Bucknall's Pinnacle (SR 84).

25.—6 m. at 335° from Pilot's Camp, on track to Barnett's Tank from Ellendale (SP 37).

26.—On track, 1 m. at 200° from Barnett's Tank on Sixty-Seven Mile Creek (SP 26).

27.—Little Flow.

28.—On track as it crosses a ridge (base of Liveringa or top of Noonkanbah) 2 m. at 200° from Barnett's Tank (SP 25 B).

29, 29A.—Mt. Marmion, Base: Top of Noonkanbah.

30.—.65 m. S. from Trig. 248, Meeda Stn.

31.—9 m. E.N.E. from Trig. Stn. G 2, St. George's Range.

32.—Scarp 2 m. E. from Christmas Creek Stn.

33.—Just North of Hill C, Grant Range.

34.—5½ m. S. by E. from Nerrima Homestead.

35.—½ m. E. of Fence, Duchess Ridge.

LIVERINGA FORMATION.

36.—6 m. at 140° from Surprise Bore, Cherrabun Stn. (SR 6).

37.—8 m. S. from Donkey Gorge Bore, Christmas Creek Stn.; base of Liveringa (PR 261).

38.—Mt. Hardman.

(Specimens from localities 1 to 29—except 17A—and 36 to 38 belong to the Commonwealth Palaeontological Collection; 17A, and 29A to 35, are in the University of Western Australia Collection.)

REFERENCES.

BASSLER, R. S., 1920.—The Permian Bryozoa of Timor. *Paläont. Timor*, xvi Lief., xxviii.

————, 1941.—Generic Descriptions of Upper Paleozoic Bryozoa. *J. Wash. Acad. Sci.*, 31 (5), 173.

————, 1952.—Taxonomic Notes on Genera of Fossil and Recent Bryozoa. *J. Wash Acad. Sci.*, 42 (12), 381.

————, 1953.—TREATISE ON INVERTEBRATE PALAEONTOLOGY. G: BRYOZOA. Kansas, Univ. Kansas Press.

BRETNALL, R., 1926.—Palaeontological Contributions to the Geology of Western Australia, Series vii, No. xiii: Descriptions of some Western Australian Fossil Polyzoa. *Geol. Surv. W. Aust., Bull.* 88.

BROWN, D. A., 1952.—THE TERTIARY CHEILOSTOMATOUS POLYZOA OF NEW ZEALAND. London, British Museum.

CHAPMAN, F., in RAGGATT, H. G., 1936.—The Geology of the North-West Basin, Western Australia, with Particular Reference to the Stratigraphy of the Permo-Carboniferous. *J. Roy. Soc. N.S.W.*, 70, 100.

CONDON, M. A., 1954.—Progress Report on the Stratigraphy and Structure of the Carnarvon Basin, Western Australia. *Bur. Min. Resour. Aust., Rep.* 15.

CROCKFORD, JOAN, 1941a.—Permian Bryozoa of Eastern Australia, Part i: A Revision of Some Previously-named Species of Fenestrellinidae (Fenestellidae). *J. Roy. Soc. N.S.W.*, 74 (for 1940), 397.

————, 1941b.—Permian Bryozoa from Eastern Australia, Part ii: New Species from the Upper Marine Series of New South Wales. *Ibid.*, 74 (for 1940), 502.

————, 1943.—Permian Bryozoa from Eastern Australia, Part iii: Batostomellidae and Fenestrellinidae from Queensland, New South Wales, and Tasmania. *Ibid.*, 76 (for 1942): 258.

————, 1944a.—Bryozoa from the Permian of Western Australia, Part i: Cyclostomata and Cryptostomata from the North-West Basin and Kimberley District. *Proc. Linn. Soc. N.S.W.*, 69, 139.

————, 1944b.—Bryozoa from the Wandagee and Noonkanbah Series (Permian) of Western Australia, Part i. *J. Roy. Soc. W.A.*, 28 (for 1941-2), 165.

————, 1944c.—A Revision of Some Previously Described Species of Bryozoa from the Upper Palaeozoic of Western Australia. *Ibid.*, 28 (for 1941-2), 187.

————1945.—Stenoporids from the Permian of New South Wales and Tasmania. *Proc. Linn. Soc. N.S.W.*, 70, 9.

————, 1947.—Bryozoa from the Lower Carboniferous of New South Wales and Queensland. *Ibid.*, 72, 1.

————, 1949.—Bryozoa from the Upper Carboniferous of Queensland and New South Wales. *Ibid.*, 73 (for 1948), 419.

————, 1951.—The Development of Bryozoan Faunas in the Upper Palaeozoic of Australia. *Ibid.*, 76, 105.

DUNCAN, HELEN, LOEBLICH, A. R., and MOORE, R. C., 1955.—Proposed Validation under the Plenary Powers of "Fistulipora" McCoy, 1849 (Class Bryozoa, Order Cyclostomata, Family Fistuliporidae) *Bull. zool. Nomencl.*, 11 (5), 155.

ELIAS, M. K., 1947.—Stratigraphic Significance of Some Late Palaeozoic Fenestrate Bryozoa. *J. Paleont.*, 11 (4), 306.

ETHERIDGE, R., jnr., 1892.—*In* Jack, R., and Etheridge, R., GEOLOGY AND PALAEONTOLOGY OF QUEENSLAND AND NEW GUINEA.

————, 1914.—Palaeontological Contributions to the Geology of Western Australia, Series V, No. 10. Western Australian Carboniferous Fossils, chiefly from Mount Marmion, Lennard River, West Kimberley. *Geol. Surv. W. Aust., Bull.* 58.

————, 1926.—*In* Bretnall, R. W., 1926.

FRITZ, MADELEINE A., 1932.—Permian Bryozoa from Vancouver Island. *Trans. Roy. Soc. Can.* (3), 26 (4), 93.

————, 1946.—Permian (?) Bryozoa from Sustut Lake, British Columbia. *J. Paleont.*, 20 (1), 86.

GIRTY, G. H., 1911.—New Genera and Species from the Fayetteville Shale of Arkansas. *Ann. N.Y. Acad. Sci.*, 20 (for 1910), 189.

HALL, J., 1887.—Bryozoans of the Upper Helderberg and Hamilton Groups. *Trans. Albany Inst.*, 10, 145.

HINDE, G. J., 1890.—Notes on the Palaeontology of Western Australia, Corals and Polyzoa *Geol. Mag.*, N.S., Dec. 3, 7, 194.

HOSKING, LUCY F. V., 1931.—Fossils from the Wooramel District, Western Australia. *J. Roy. Soc. W. Aust.* 27, 7.

HUDLESTON, W. H., 1883.—Notes on a Collection of Fossils and Rock Specimens from West Australia, North of the Gascoyne River. *Quart. J. geol. Soc. Lond.*, 39, 582.

JOHNSEN, A., 1906.—Bryozoen aus dem karnischen Fusulinenkalk. *Neues Jb. Min. Geol. Paläont.*, 2 (1906), 135.

KING, W., 1849.—On Some Families and Genera of Corals. *Ann. Mag. nat. Hist.*, (2) 2, 388.

KONINCK, L. G. DE, 1863.—Descriptions of Some Fossils from India, discovered by Dr. A. Fleming, of Edinburgh. *Quart. J. geol. Soc. Lond.*, 19, 1.

————, 1877 (1898).—Récherches sur les Fossiles Paléozoiques de la Nouvelle Galle de Sud. *Mém. Soc. Roy. Sci. Liège*, 2, 8. (Reprinted as Descriptions of the Palaeozoic Fossils of New South Wales. *Mem. geol. Surv. N.S.W., Palaeont.*, 6.)

LASERON, C. F., 1918.—Notes on Some Permo-Carboniferous Fenestellidae, with Descriptions of New Species. *J. Roy. Soc. N.S.W.*, 52, 81.

LEE, G. W., 1912.—The British Carboniferous Trepostomata. *Mem. geol. Surv. U.K., Palaeont.*, 1 (3), 135.

LONSDALE, W., 1844.—*In* DARWIN, Geological Observations on Volcanic Islands.

————, 1845.—*In* STRZELECKI, Physical Descriptions of New South Wales and Van Diemen's Land.

MARTIN, R., 1932.—De Palaontologie en Stratigraphie van Nederlandsch Oost-Indie, Bryozoa. *Leid. geol. Meded.*, V, 390.

MOORE, R. C., 1929.—A Bryozoan Faunule from the Upper Graham Formation, Pennsylvanian, North-Central Texas. *J. Paleont.*, 2 (1), 1, and 3 (2), 121.

————, 1930.—New Species of Bryozoa from the Pennsylvanian of Texas. *J. Sci. Labs Denison Univ.*, 25, 147.

————, and DUDLEY, RUTH M., 1944.—Cheilotrypid Bryozoa from Pennsylvanian and Permian Rocks of the Midcontinent Region. *Bull. geol. Surv. Kans.*, 52 (6), 229.

NIKIFOROVA, A. I., 1939.—New Species of Upper Palaeozoic Bryozoa from the Bashkirian Urals. *Trans. Geol. Oil Inst. U.S.S.R.*, Ser. A, Fasc. 115, 70.

PRENDERGAST, K. L., 1944.—Permian Productinae and Strophalosiinae of Western Australia. *J. Roy. Soc. W. Aust.*, 28, 1.

REED, F. R. C., 1924.—Upper Carboniferous Fossils from Chitral and the Pamirs. *Palaeont. Indica*, N.S., 6 (4).

————, 1930.—Upper Carboniferous Fossils from Tibet. *Ibid.*, N.S., 16.

————, 1933.—Anthracolithic Faunas of the Southern Shan States. *Rec. geol. Surv. India*, 67, 83.

SHULGA-NESTERENKO, M. I., 1941.—Lower Permian Bryozoa of the Urals. *Palaeont. U.S.S.R.*, 5, (5), fasc. 1.

————, 1952.—New Lower Permian Bryozoa from the Southern Urals. *Trans. Palaeont. Inst., Acad. Sci. U.S.S.R.*, 37.

SIMPSON, G. B., 1895.—A Discussion of the Different Genera of the Fenestellidae. *13th Annual Report of the State Geologist (of New York) for the year* 1893, Albany, 1894 (1895), 687.

STACH, L. W., 1937.—The Application of the Bryozoa in Cainozoic Stratigraphy. *Rep. Aust. Assoc. Adv. Sci.* (Auckland), 80.

TEICHERT, C., 1941.—Upper Paleozoic of Western Australia: Correlation and Paleogeography. *Bull. Amer. Ass. Petrol. Geol.*, 25, 371.

THOMAS, G. A., and DICKINS, J. M., 1954.—Correlation and Age of Marine Permian Formations in Western Australia. *Aust. J. Sci.*, 16 (6), 219.

TOULA, F., 1875.—Permo-Carbon-Fossilien von der Westkuste von Spitzbergen. *Leonhard und Bonn's Neues Jb. Miner.* 1875, 225.

TRIZNA, V. B., 1939.—New Species of Bryozoa belonging to the Fenestellidae and Acanthocladiidae from the Bashkirian Foothills. *Trans. Geol. Oil Inst. U.S.S.R.*, Ser. A, Fasc. 115, 102.

ULRICH, E. O., 1882.—American Paleozoic Bryozoa. *J. Cincinn. Soc. nat. Hist.*, 5, 121.
————, 1890.—Paleozoic Bryozoa. *Geol. Surv. Ill.*, Vol. 8.

WAAGEN, W., and PICHL, J., 1885.—Salt Range Fossils, 1. Productus Limestone Fossils, 5. Bryozoa-Annelida-Echinodermata. *Palaeont. Indica*, Ser. 13.
————, and WENTZEL, J., 1886.—Salt Range Fossils, 1. Productus Limestone Fossils, 6. Coelenterata. *Ibid.*, Ser. 13.

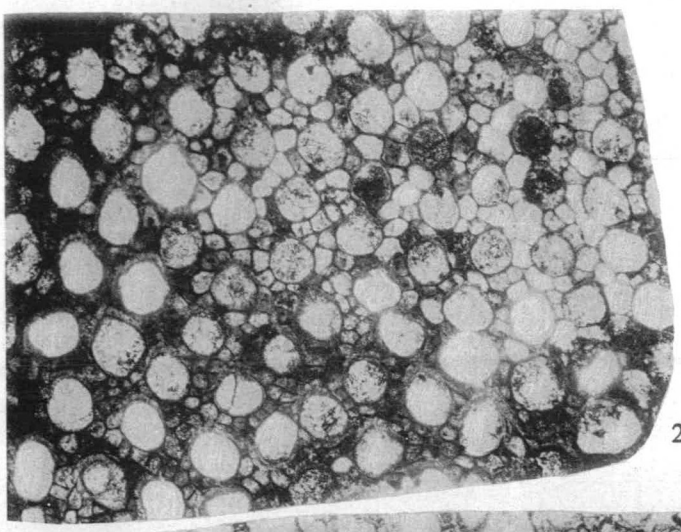
WARTHIN, A., 1930.—Micropaleontology of the Wetumka, Wewoka, and Holdenville Formations. *Oklahoma geol. Surv. Bull.* 53.

YOUNG, J., and YOUNG, J., 1874.—On a New Genus of Carboniferous Polyzoa. *Ann. Mag. nat. Hist.*, (4), 13, 335.
————, 1883.—On Ure's "Millepore" *Tabulipora* (*Cellepora*) *Urii* Flem. *Ann. Mag. nat. Hist.*, (5), 12, 154.

Plate 1.

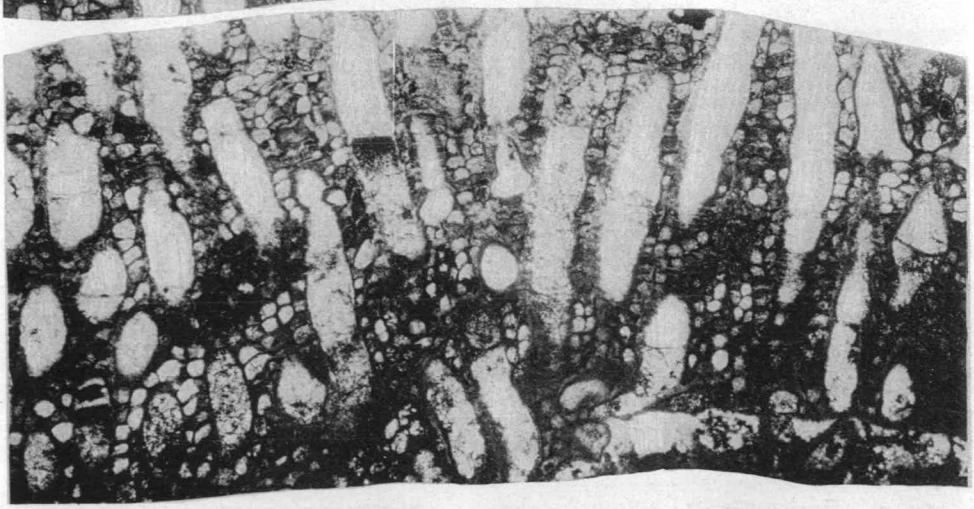
1-3. *Fistulipora nura* sp. nov. 1. Part of the holotype, encrusting a coarse *Polypora*, x 1. 2. Tangential section of the holotype, x 20. 3. Longitudinal section of the holotype, x 20.

4, 5. *Fistulipora stereos* sp. nov. 4. Tangential section of the holotype, passing through part of a macula, with enlarged zooecial tubes and greatly thickened lunaria, in the upper right-hand portion of the photograph, x 20. 5. Longitudinal section of the holotype, x 20.



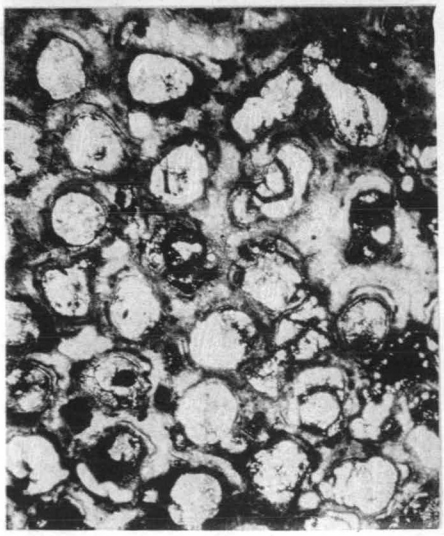
2

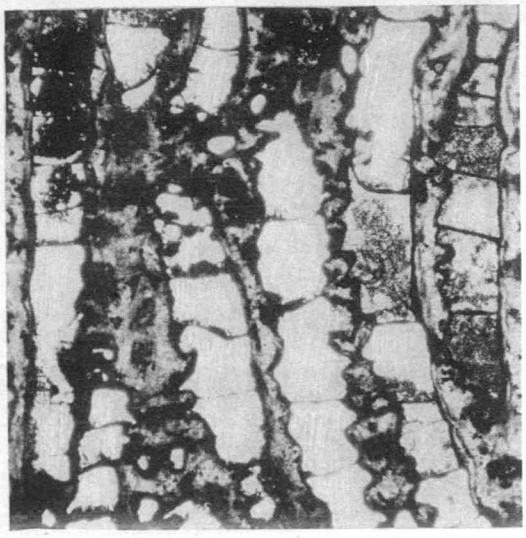
1



3

4





5

PLATE 2.

1-4. *Dybowskiella arborescens* sp. nov. 1. Holotype, showing slightly raised monticules on the surface of the zoarium, x 1. 2-4. Thin sections of a specimen from locality 12 (1055). 2. Vertical section passing through the outer part of the axial zone and through the peripheral zone, and showing the differences in the shape of the vesicles, and in the thickness of the walls of the zooecial tubes, in these zones, x 20. 3, 4. Tangential sections, fig. 3 being within the axial zone, where the vesicles are large and the lunaria are poorly developed, and fig. 4 passing obliquely through the peripheral zone, with smaller flattened vesicles and thickened lunaria, frequently but not invariably indenting the zooecial tubes; the lunaria become progressively more thickened, and more strongly indent the tubes, as the surface is approached: x 20.

5, 6. *Fistulipora liveringa* sp. nov. 5. Tangential section of the holotype, the section passing into a macula in the upper left hand corner, x 20. 6. Longitudinal section of the holotype, x 20.

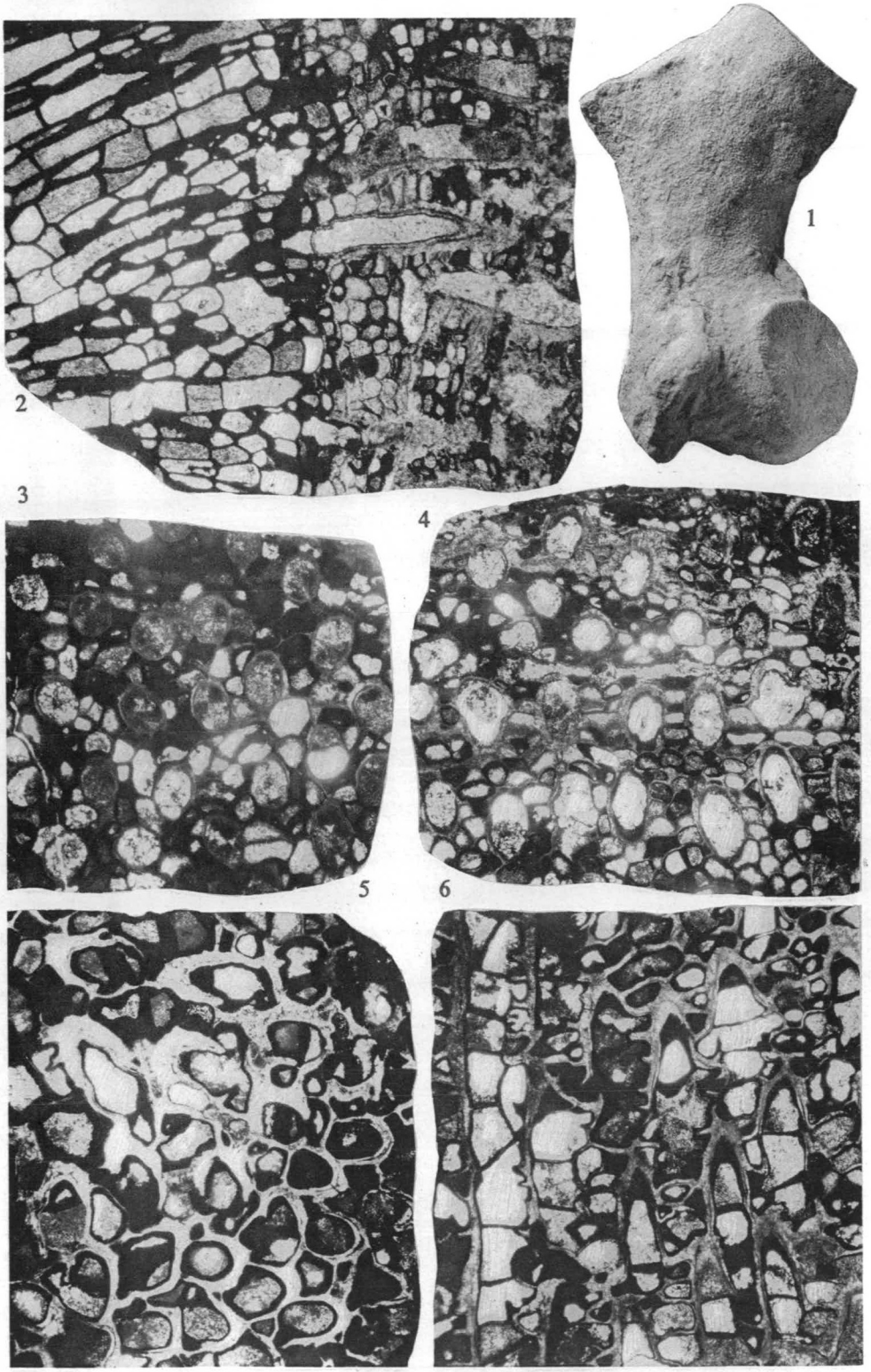
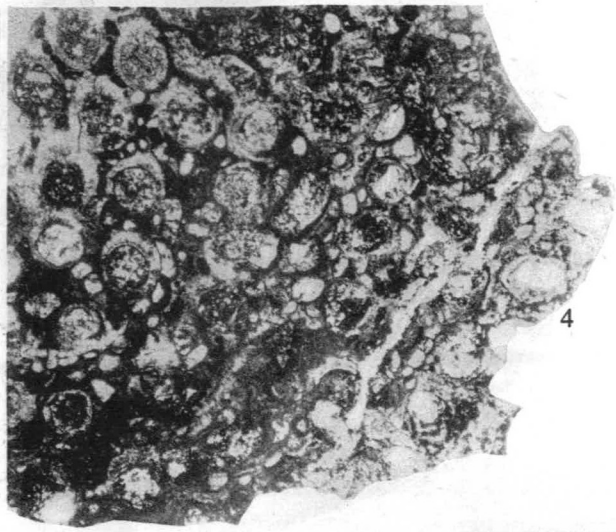
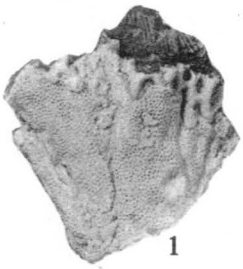
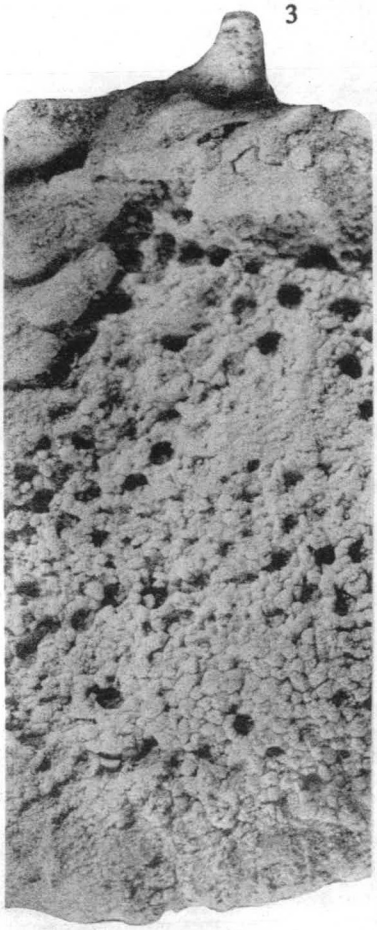

1
2
3
4
5
6

PLATE 3.

1-4. *Eridopora permiana* sp. nov. 1. Holotype, a thin zoarium encrusting a coarse *Polypora*, with the obverse surface of a specimen of *Fenestella basleoensis* Bassler shown at the top of the photograph, x 1. 2. Surface of the holotype; the vesicles between the zooecia are partly exposed by weathering, and are clustered into small maculae in the areas indicated by arrows; prominent overarching lunaria are shown in the lower right of the photograph, but have been partly removed by weathering over most of the surface: x 10. 3. Weathered surface of a specimen from locality 17 (1062), showing maculae: x 10. 4. Thin section of a specimen from locality 15 (1063 A), x 20.


4


1


3

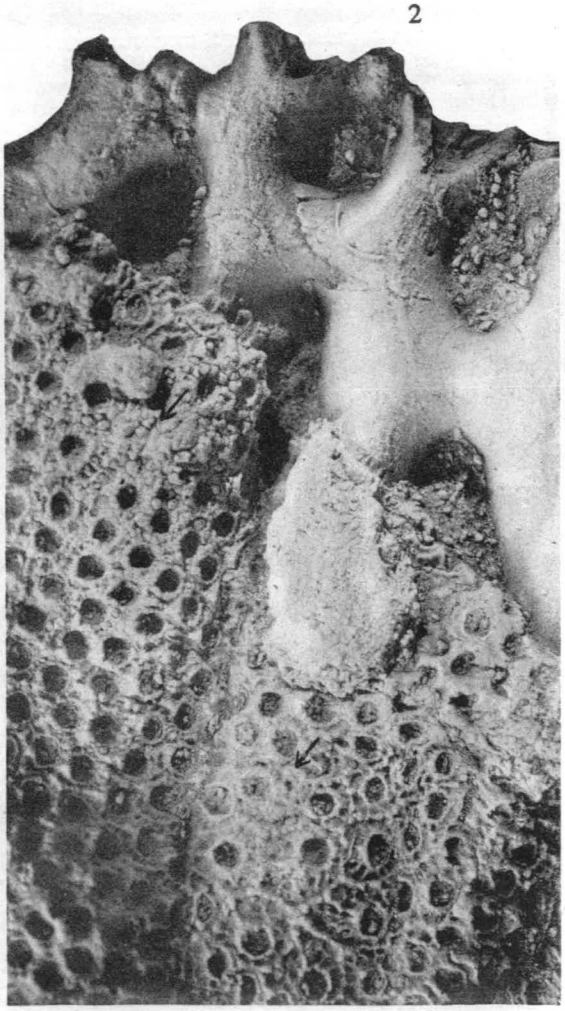

2

PLATE 4.

1-5. *Hexagonella hudlestoni* sp. nov. 1. Holotype, x 1. 2, 3. Two specimens from the Callytharra Formation of the Carnarvon Basin (F 6539 A, F 6546), x 1; fig. 2, showing arrangement of maculae indistinguishable from that of several Noonkanbah specimens, and fig. 3, showing branching of the zoarium and some slight anastomosis of the branches, with consequently less regular arrangement of the maculae. 4. Tangential section of a specimen from the Nura Nura member of the Poole Sandstone (1071 A), passing from near the mesotheca in the upper part of the photograph, to near the surface, where many vesicles are replaced by stereom, in the lower part; portion of a macula is cut in the lower right corner: x 20. 5. Tangential section of a topotype (1075), passing more rapidly than the adjoining section from near the mesotheca to near the surface of the zoarium, portion of two maculae being here represented by almost solid stereom: x 20.

6, 7. *Fistulamina lata* sp. nov. 6. Holotype, x 1. 7. Weathered surface of a topotype (1077 B), showing the long straight zooecial tubes near the mesotheca, and stereom separating the zooecial apertures near the surface: x 10.

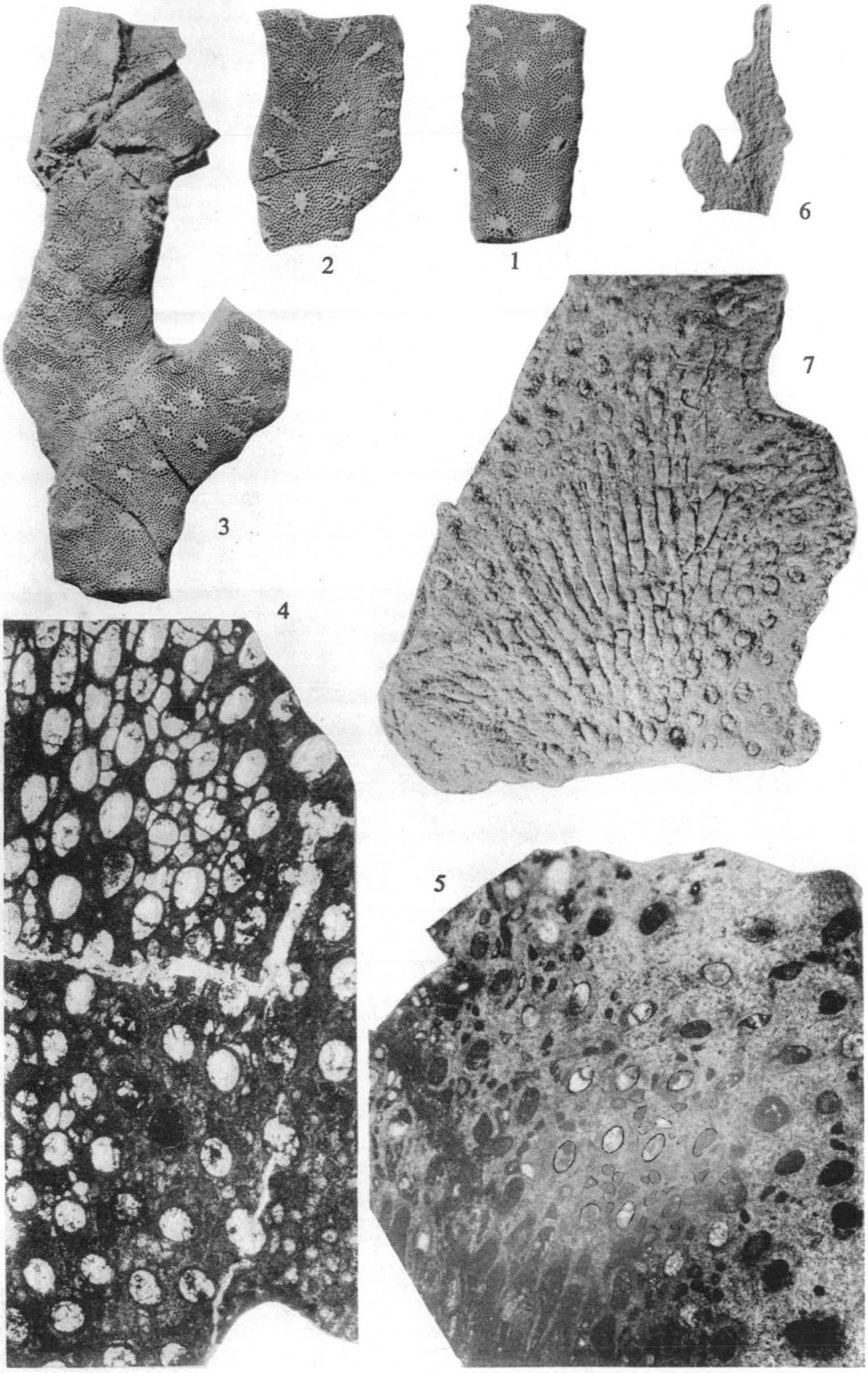

1
2
3
4
5
6
7

PLATE 5.

1-4. *Prismopora digitata* sp. nov. 1. Holotype, x 1. 2. Encrusting base of the zoarium of a topotype (1073 C), x 5. 3. Tangential section of a topotype (1086), passing through the outer part of the zoarium, where stereom has largely replaced the vesicles initially separating the zooecial tubes and composing the maculae: x 20. 4. Transverse section of a topotype (1086), x 20.

5. Gen. et sp. indet. Thin bifoliate zoarium of a bryozoan from locality 5 C (1184), which closely resembles *Prismopora digitata* sp. nov. in external appearance, but whose internal structure is cryptostomatous.

6, 7. *Prismopora? attenuata* sp. nov. 6. Holotype, x 1. 7. Surface of one ray of the holotype, with a second very thin bifoliate ray shown in vertical section, passing through both a group of zooecia and through one of the paper-thin maculae, at the left of the photograph: x 5.

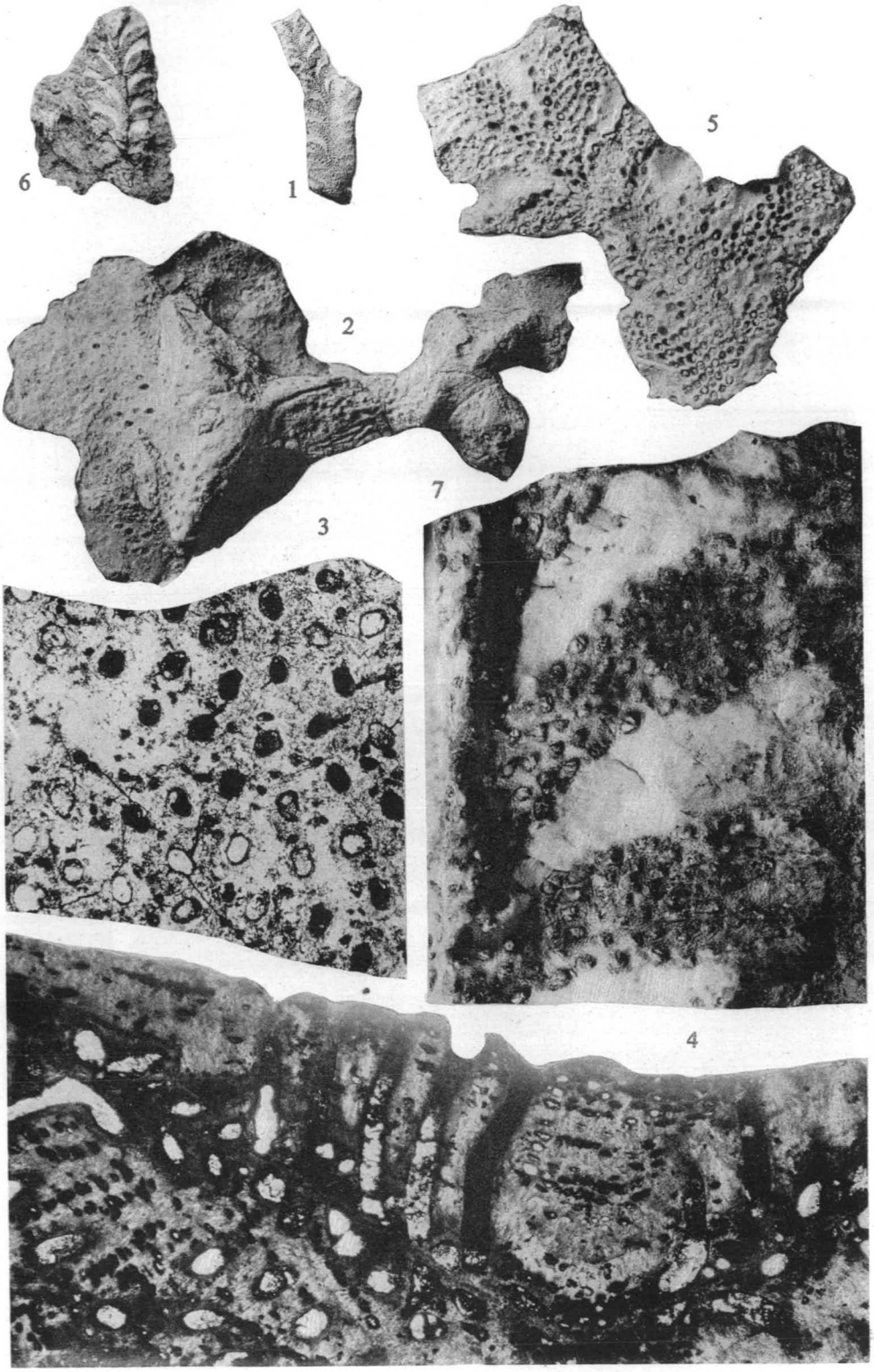

6
1
5
2
7
3
4

PLATE 6.

1-4. *Prismopora? triradiata* sp. nov. 1. Portion of a specimen from locality 10 (1089 A), x 1. 2-4. Thin sections of the holotype, x 20. 2, 3. Tangential sections, fig. 2 passing from near the surface, where stereom separates the zooecial tubes, inwards to a level on which the spaces between the zooecial tubes, and the maculae, are occupied mainly by vesicles; and fig. 3 near the slightly oblique to the mesotheca, which is shown in section near the top of the photograph; the recumbent portion of the zooecial tubes, separated by coarse angular vesicles, occupies the central part of the photograph, while in the lower portion the tubes have become erect and the vesicles between them smaller and less angular. 4. Transverse section of the zoarium, showing the 3-rayed mesotheca, and the layering of vesicles and stereom between the tubes, which occurs in many Western Australian Hexagonellidae, and which gives a characteristic appearance to their weathered surfaces, a partial overgrowth of the surface is shown at the top of the photograph, and the large area of vesicles radiating outwards from the junction of the rays appears on the surface as a single large elongate macula.

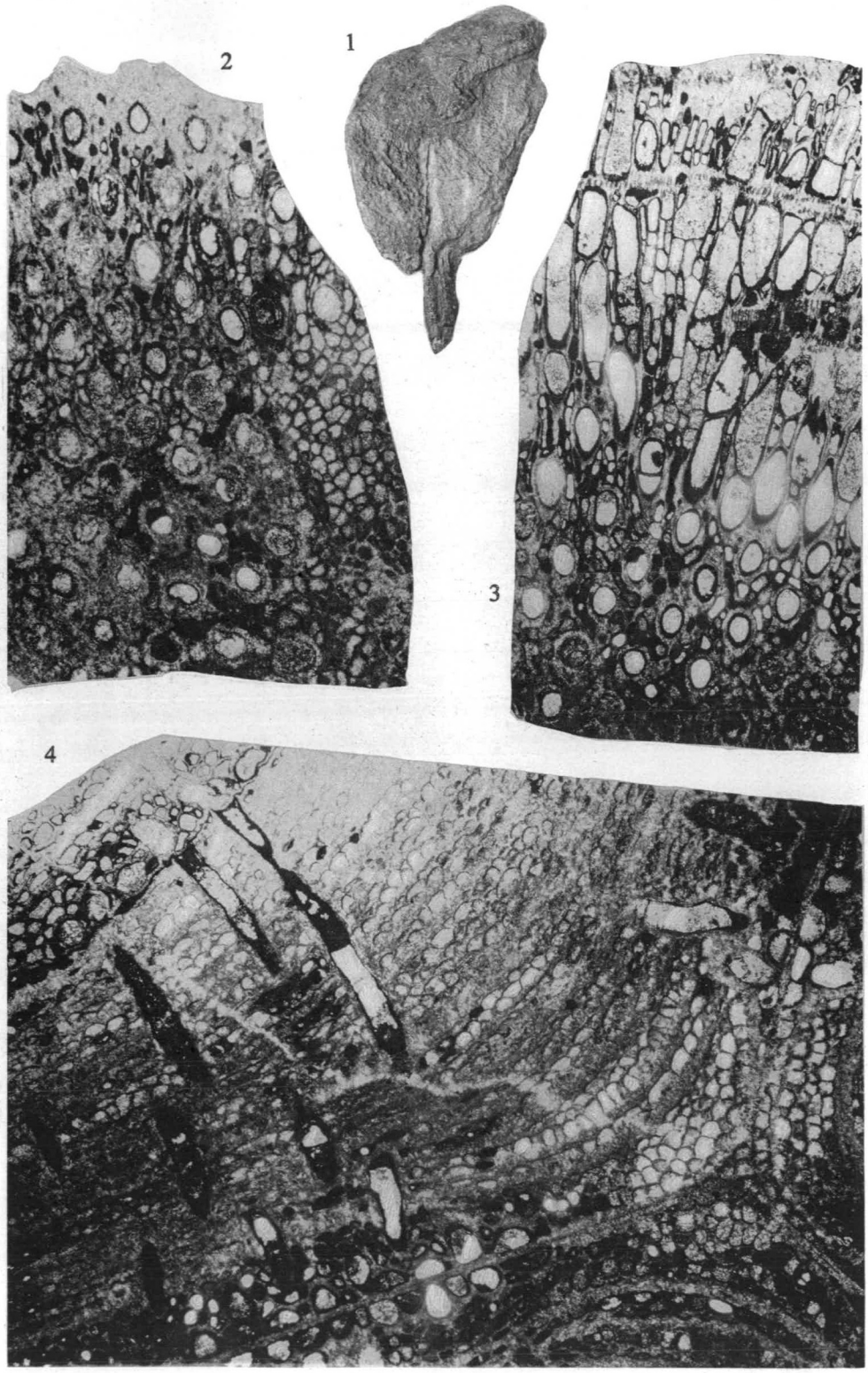
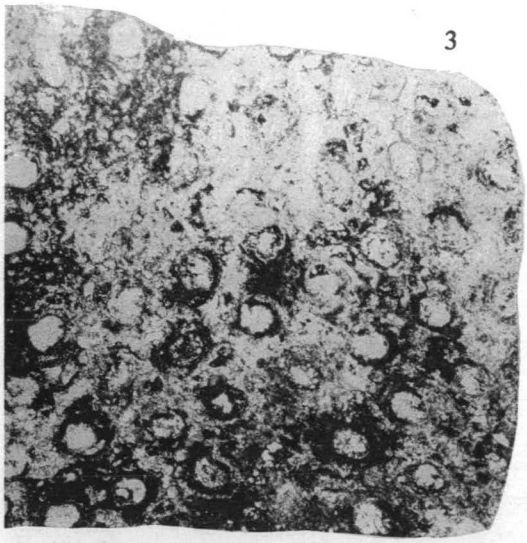

1
2
3
4

PLATE 7.

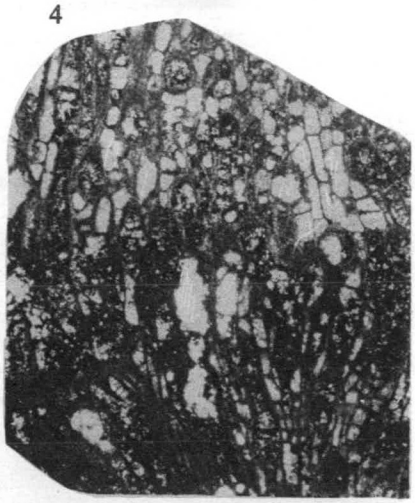
1-5. *Evactinostella crucialis* (Hudleston). 1, 2. An incomplete zoarium from the top of the Noonkanbah Formation at Mt. Marmion, locality 29 A (22339 B, Univ. W.A. Colln.), x 1. 1. Zoarium viewed from one side, with the four rays arching upwards and outwards from the base, and showing the maculae, slightly raised by weathering, and the incipient hexagonellid ridges which occur near the base. 2. Base of the zoarium. 3-5. Thin sections of two zoaria from Mt. Marmion (3, 4: 22339 A, and 5: 22339 B, Univ. W.A. Colln.), x 20. 3. Tangential section of the outer part of the zoarium, with one of the small rounded maculae cut in section on the upper left. 4. Section parallel and close to the mesotheca, cutting through the recumbent and early part of the erect portion of the zooecial tubes, which are here separated by coarse vesicles. 5. Longitudinal section of part of one bifoliate ray, with partial surface overgrowth.

1

2



3



4

5

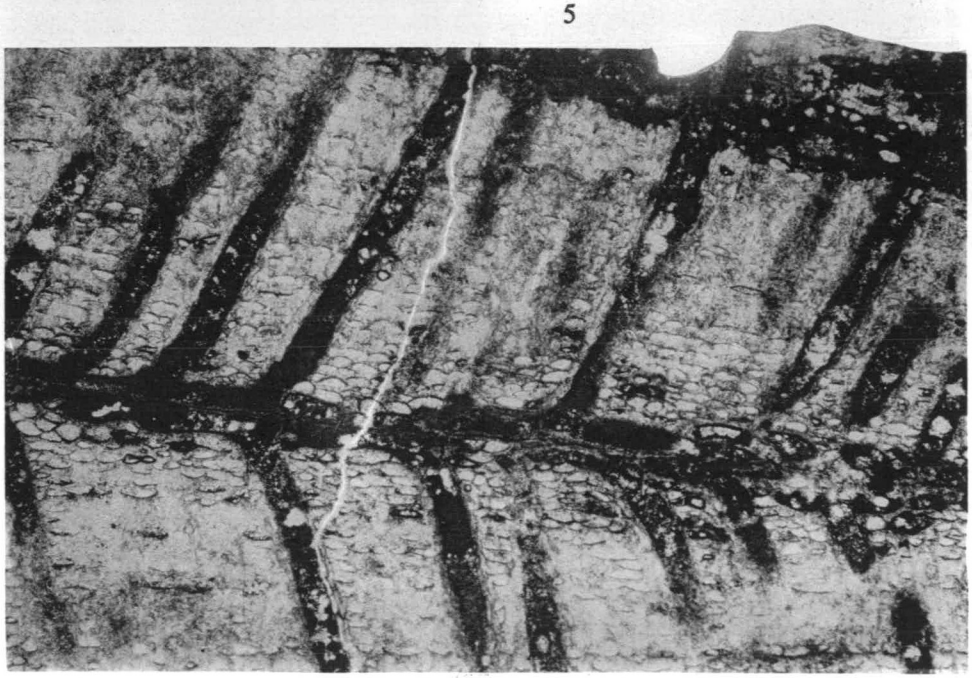


PLATE 8.

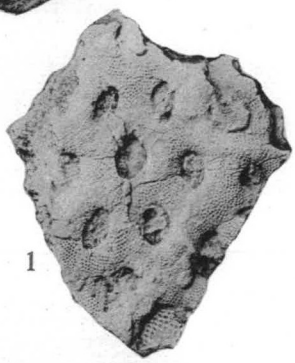
1-3. *Etherella porosa* gen. et sp. nov. 1. Holotype, x 1. 2. Part of the exposed surface of the bifoliate zoarium of the holotype; a very thin surface overgrowth occurs over a portion of the zoarium, and where this is weathered the recumbent portion of the zooecial tubes is shown to repeat the hook shape found in the initial portion of the tubes adjacent to the mesotheca: x 5. 3. Thin section of the holotype: an oblique tangential section passing across the mesotheca in the lower part of the photograph, and showing the hook-shaped portion of the zooecial tubes adjacent to the mesotheca on each side; above, and to the left, the section passes through the zone immediately above the recumbent portion of the tubes, where a few rounded vesicles occur between the tubes, into the zone closer to the surface where the tubes are separated by stereom: x 20.

4-6. *Etherella porosa* var. *minor* var. nov. 4. Holotype, x 1. 5. Part of the surface of the holotype; a small portion of the surface in the lower corner has been etched and shows the hook-shaped tubes just above the mesotheca: x 10. 5. Base of the zoarium of a topotype (1073 E), initially encircling another organism and immediately commencing to bifurcate to form a mesh-like zoarium; the bifoliate nature of the zoarium is shown on the fractured surface, and the margin of the mesotheca is marked by a weathered line around the edge of a fenestrule: x 5.

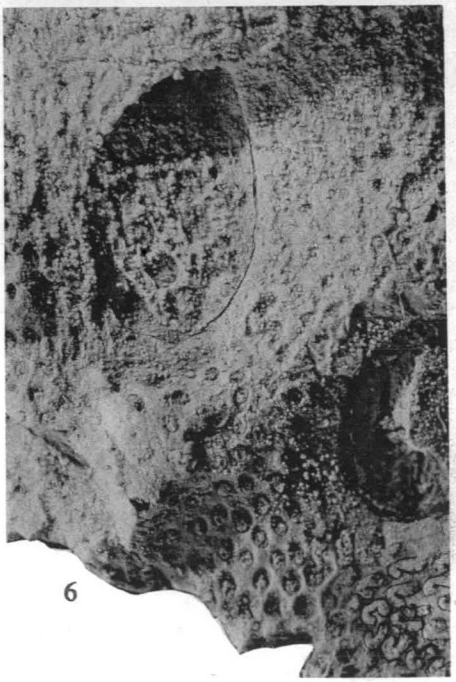
2

5

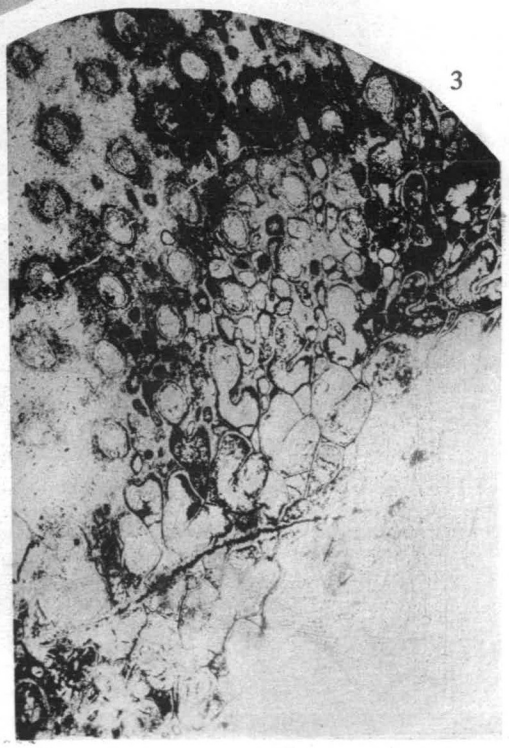
4



1



6



3

PLATE 9.

1-3. *Etherella irregularis* sp. nov. 1. Holotype, x 1. 2. Surface of a topotype (1073 H) etched to near the level of the mesotheca to show the characteristic shape of the initial portion of the zooecial tubes; occasional small vesicles are shown within the stereom where the tubes have become erect: x 10. 3. Transverse section of the holotype, with two tubes showing partial division corresponding to the hook-shape shown in tangential section: x 20.

4. *Liguloclema typicalis* gen. et sp. nov. Holotype, etched in the upper portion to show the internal structure (area shown also in Text-fig. 5): x 5.

5. Gen. et sp. indet. Bifoliate cryptostomatous bryozoan, congeneric with the form shown in Pl. 5, fig. 5, and externally closely resembling *L. typicalis* and the previously described *L. meridianus* (Etheridge): specimen from locality 5 B (1102 B), x 10.

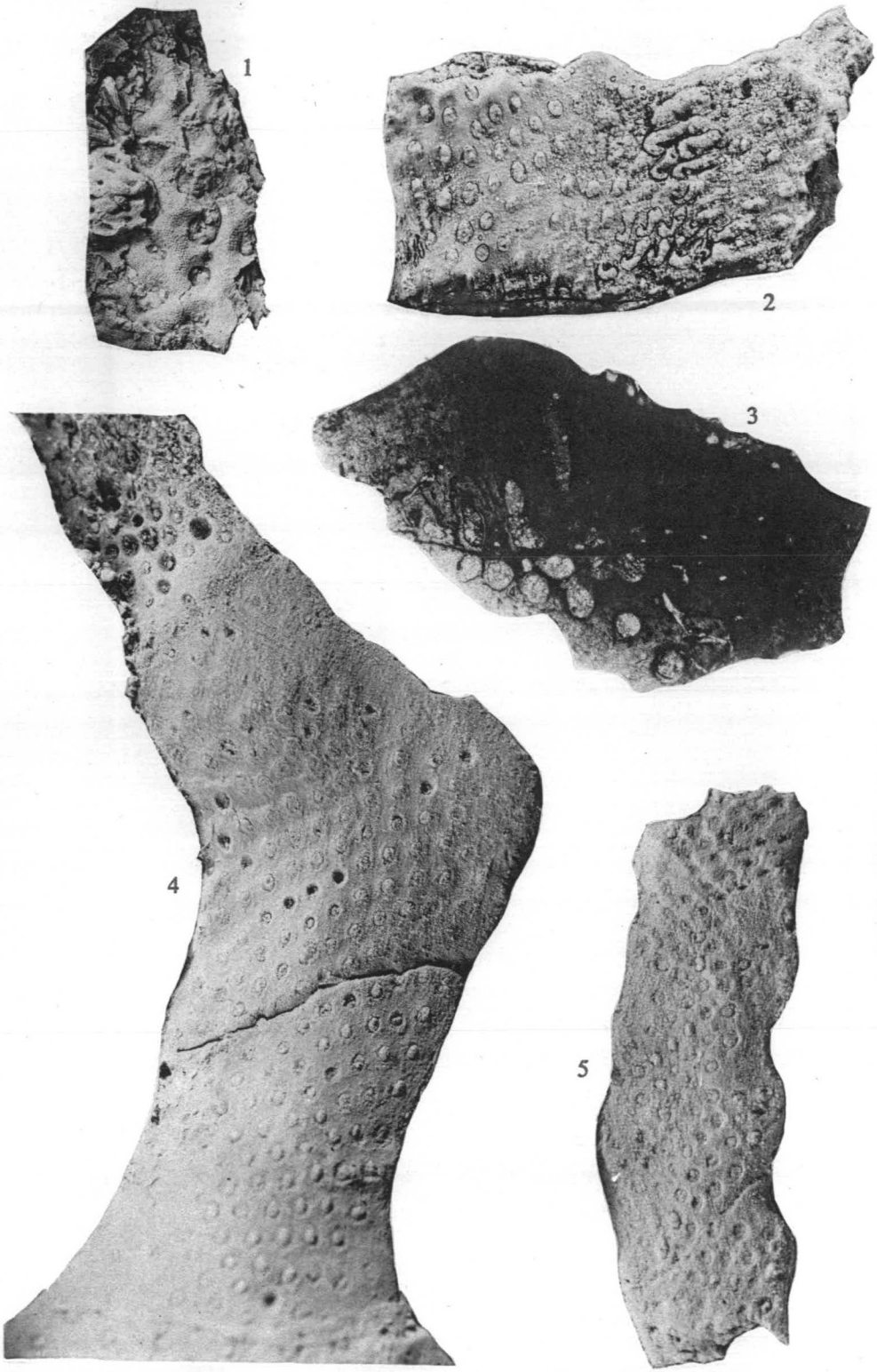

1
2
3
4
5

PLATE 10.

1, 2. *Stenopora hemispherica* Waagen and Wentzel. 1. Zoarium from locality 2 A (1291 A), x 1. 2. Portion of the same zoarium; the angular tubes, with an occasional row of fine monilae, within the axial zone pass outward into the thicker-walled and more rounded tubes of the peripheral zone, where the monilae are closely crowded: x 10.

3-5. *Stenopora spicata* (Bassler) var. *obtusa* var. nov. 3. Holotype, x 1. 4, 5. Thin sections of the holotype, x 20. 4. Tangential section, showing the normal arrangement of zooecia, mesopores and acanthopores on the right, and the variation and enlargement of these structures within a monticule on the left. 5. Part of a transverse section, the tube walls, as in several species here described, showing only indistinctly moniliform structure in the peripheral zone, and with acanthopores prominently shown.

6-8. *Stenopora lineata* sp. nov. 6. Part of the holotype, x 1. 7, 8. Thin sections of the holotype, x 20. 7. Tangential section. 8. Transverse section.

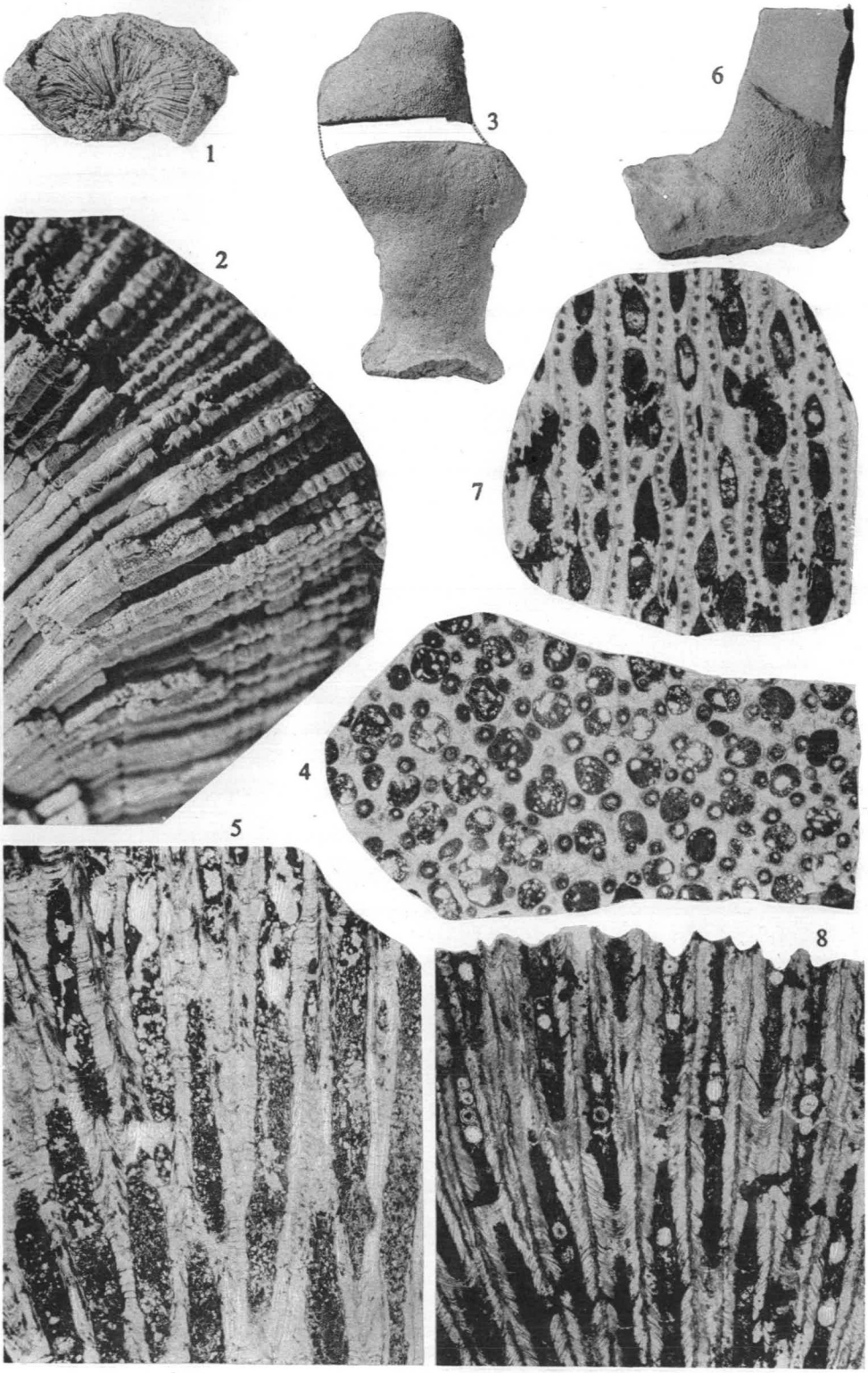

1
2
3
4
5
6
7
8

PLATE 11.

1-5. *Stenopora bella* sp. nov. 1. Holotype, showing prominent but easily eroded monticules of unusual shape: x 2.5. 2. Part of the surface of the holotype, showing the small zooecial apertures and numerous mesopores: x 10. 3-5. Thin sections of a topotype (1128 B), x 20. 3. Transverse section. 4. Longitudinal section, showing partial overgrowth; in this section and in fig. 3, moniliform wall structure is only slightly developed in the peripheral zone, but prominent arcuate rows of monilae cross the thin-walled axial zone. 5. Tangential section, with numerous micracanthopores and fairly abundant mesopores shown in the walls between the zooecial tubes.

6, 7. *Stenopora punctata* sp. nov. Thin sections of the holotype, x 20. 6. Longitudinal section. 7. Tangential section near the surface of the zoarium, with numerous mesopores, and with acanthopores of two sizes, the megacanthopores frequently approximating to or exceeding the size of the mesopores.

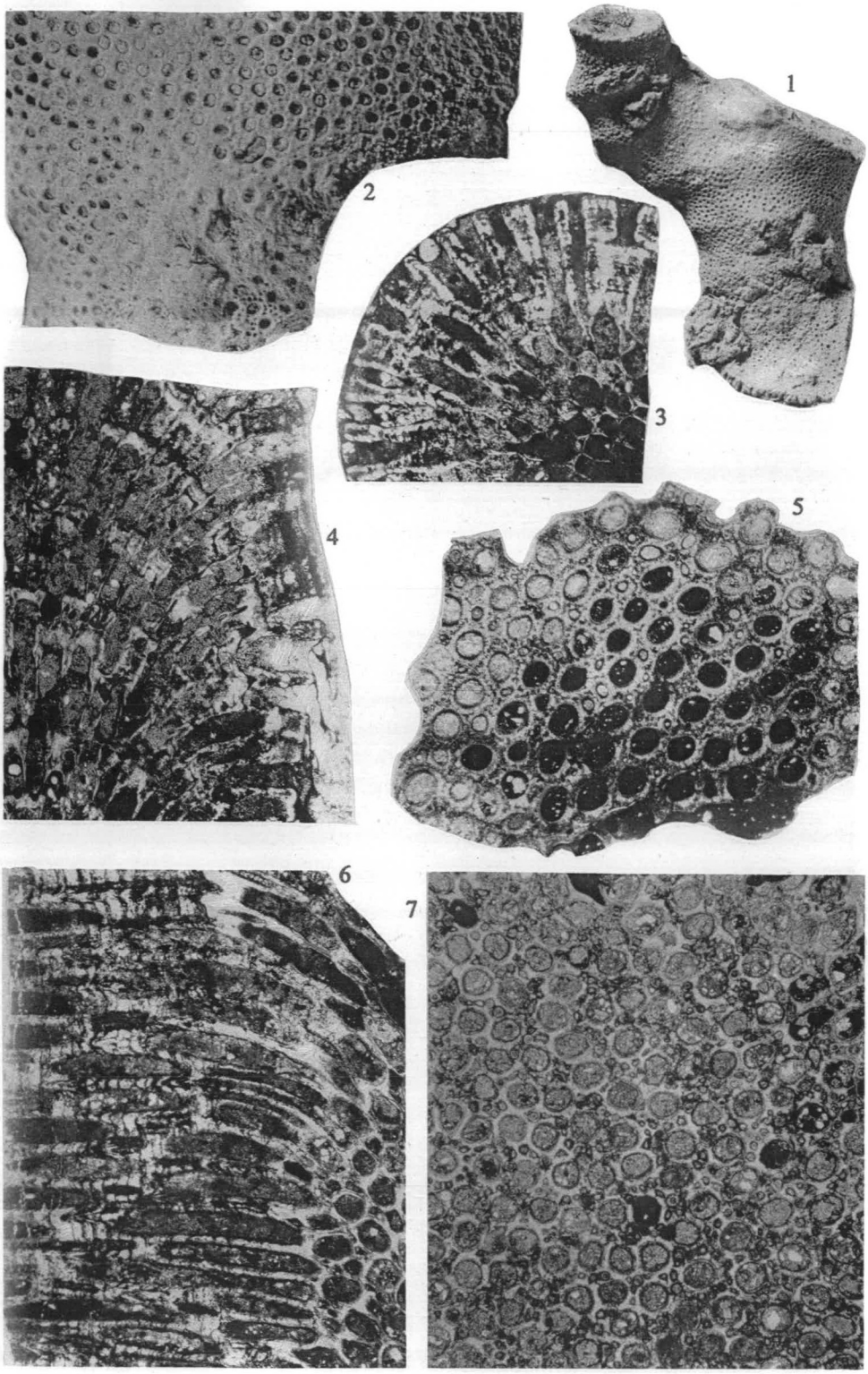

1
2
3
4
5
6
7

Plate 12.

1-3. *Stenodiscus variabilis* sp. nov. 1. Holotype; the fractured surface shows the relatively very broad axial and narrow peripheral zone, and a curved fracture in the centre of the zoarium is along one of the arcuate rows of monilae. 2, 3. Thin sections of a specimen from Keevie's Well (1141), x 20. 2. Transverse section, passing through the peripheral zone, with a few distinct elongate zones of moniliform thickening, into the outer part of the axial zone; an occasional diaphragm is shown. 3. Tangential section, the acanthopores being distinctly of two sizes, and mesopores only occasionally developed.

4-6. *Stenodiscus hardmani* sp. nov. 4. Surface of the holotype, x 5. 5, 6. Thin sections of a topotype (1139 E), x 20. 5. Tangential section, close to the surface, showing the numerous acanthopores, of which only a small number are usually visible at the surface or in sections passing deeper within the zoarium. 6. Transverse section, showing only slightly moniliform tube walls; arcuate zones of thickening commonly cross the peripheral zone at frequent intervals.

7. *Tabulipora scissa* sp. nov. Oblique transverse section of the holotype, x 20; showing the very narrow peripheral zone, and the occasional diaphragms, some of which appear complete in sections, but others, noticeably in several tubes in the upper part of the section, showing a distinct central perforation, the edges of which turn slightly downwards.

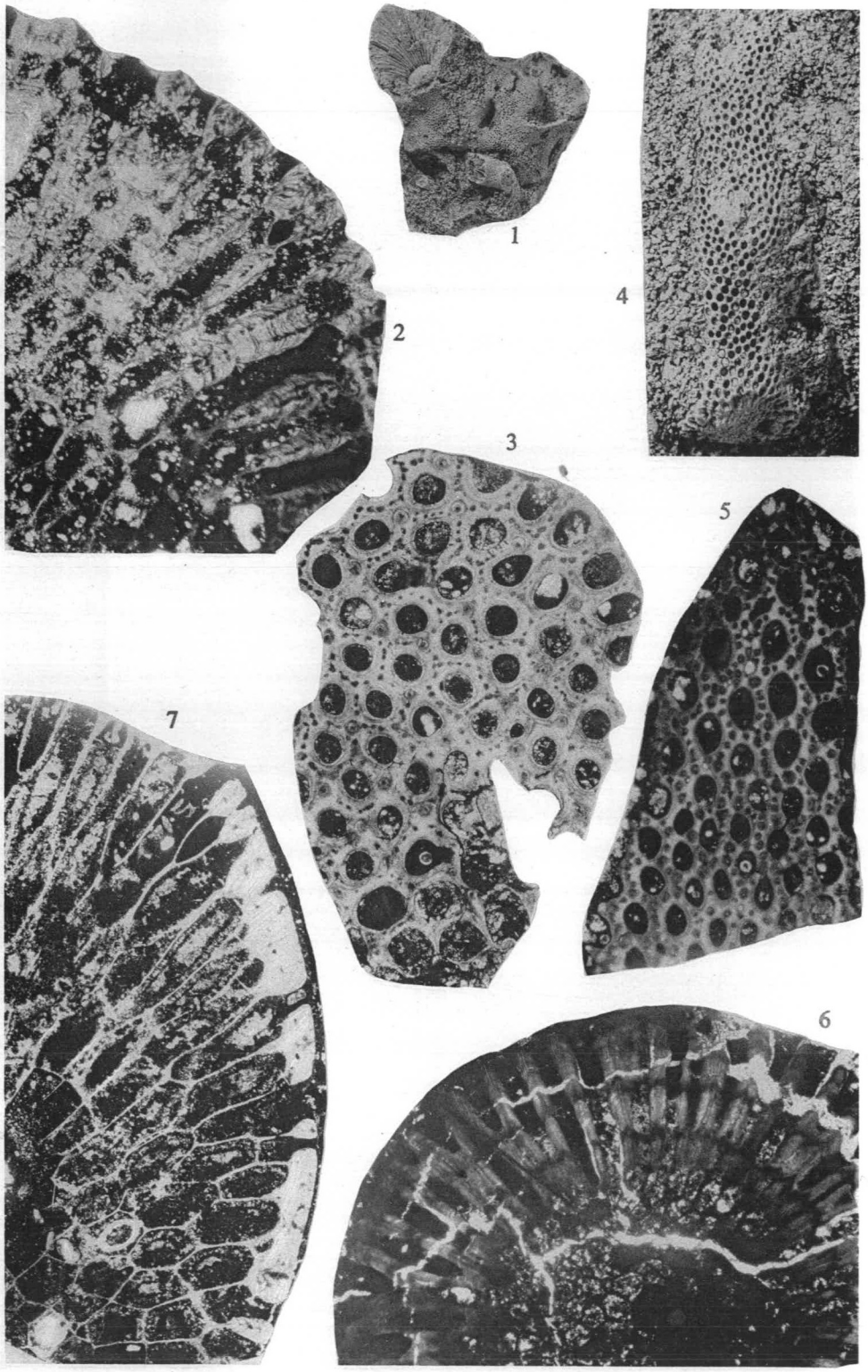

1
2
3
4
5
6
7

PLATE 13.

1, 2. *Dyscritella tenuirama* sp. nov. 1. Holotype, x 10. 2. Oblique transverse section of a specimen from locality 8 (1165 A), x 20.

3, 4. *Dyscritella bruteni* sp. nov. 3. Part of the holotype, x 5. 4. Thin section of the holotype, x 20.

5-8. *Dryscritella macrostoma* sp. nov. 5, 6. Surface of the holotype, x 5 and x 10. 7, 8. Two portions of a thin section of a specimen from locality 5 S (1178), passing obliquely through the zoarium at an angle of branching: x 20.

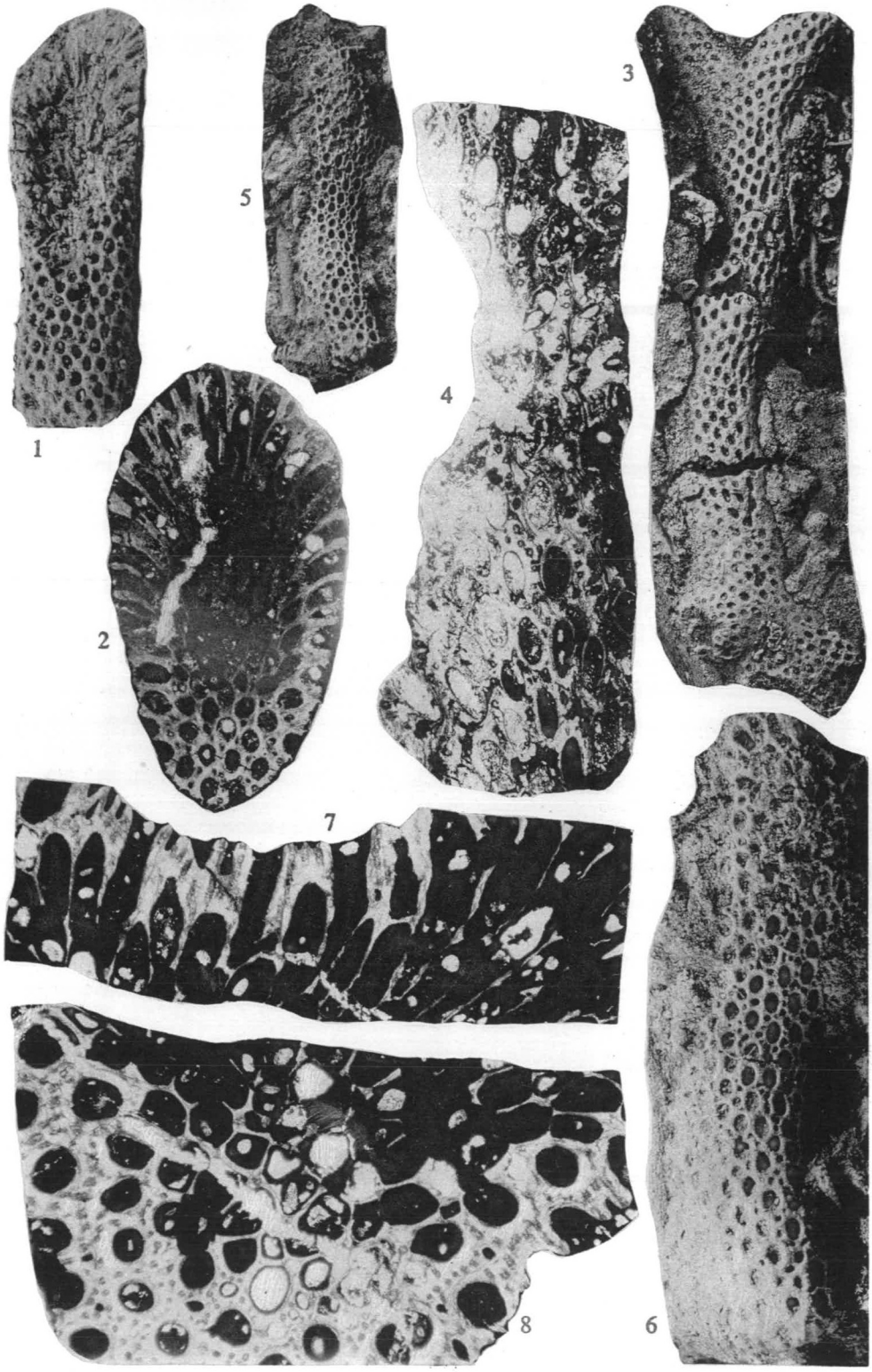
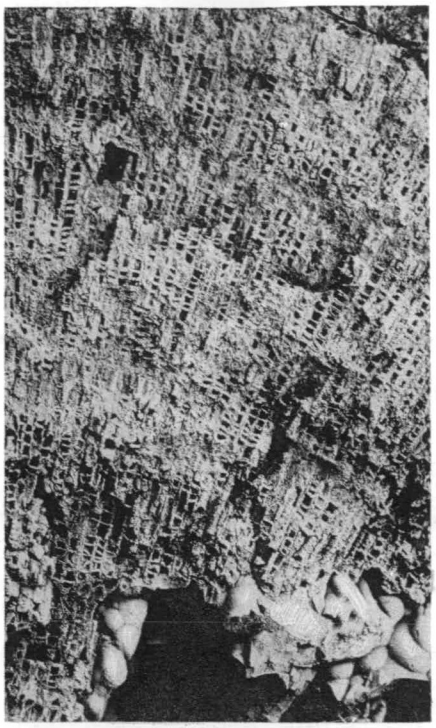

1
2
3
4
5
6
7
8

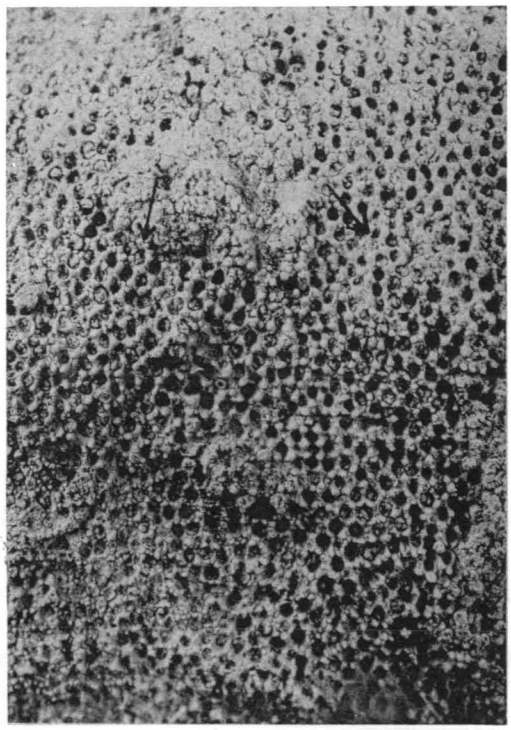
PLATE 14.

1. *Dyscritella liveringa* sp. nov. Surface of the holotype, a thin encrusting zoarium attached to the surface of a brachiopod; arrows indicate the position of two of the rounded monticules, in which the zooecia are noticeably thicker walled, and the acanthopores far larger, than on the intervening surface; the numerous small mesopores are shown in a weathered area in the lower part of the photograph: x 10.

2-4. *Leioclema globosa* sp. nov. 2. Portion of a fractured surface of the holotype, weathered to show the prominent, closely spaced diaphragms, and the thin, evenly thickened zooecial walls extending without modification to the upper surface of the zoarium: x 5. 3, 4. Thin sections of a specimen from locality 3 (1138), x 20. 3. Longitudinal section; apparent variation in the thickness of the tube walls is due to the somewhat oblique section; no monilae appear to be developed. 4. Tangential section; the enlarged tubes at the top left are part of a monticule.

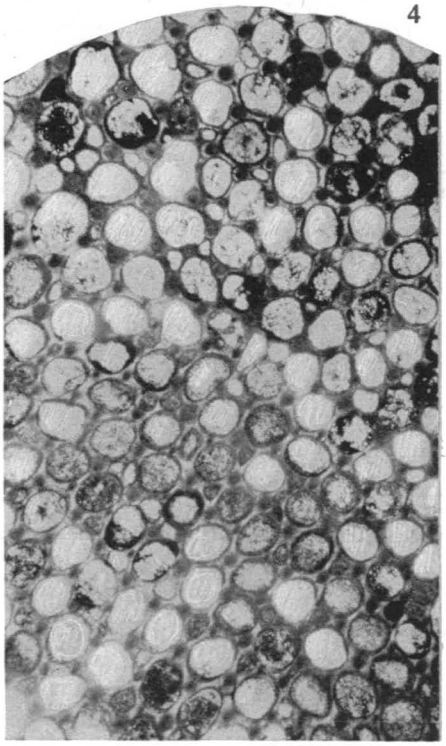


2



1

3



4

PLATE 15.

1, 2. *Callocaladia? ramosa* sp. nov. 1. Holotype, x 5. 2. Part of the surface of the holotype, with the position of megacanthopores, micracanthopores, and the occasional mesopores indicated over portion of the photograph: x 10.

3-6. *Megacanthopora? scalariformis* sp. nov. 3, 4. Holotype, x 2.5, and portion of the surface, x 10. 5, 6. Thin sections of the holotype, x 20. 5. Transverse section, crossing the wide peripheral zone and portion of the narrow axial zone. 6. Tangential section; mesopores are more numerous in the part of the section approaching the surface (on the left) and are shown only occasionally in the deeper part of the section, even within the maculae where they are crowded at the surface.

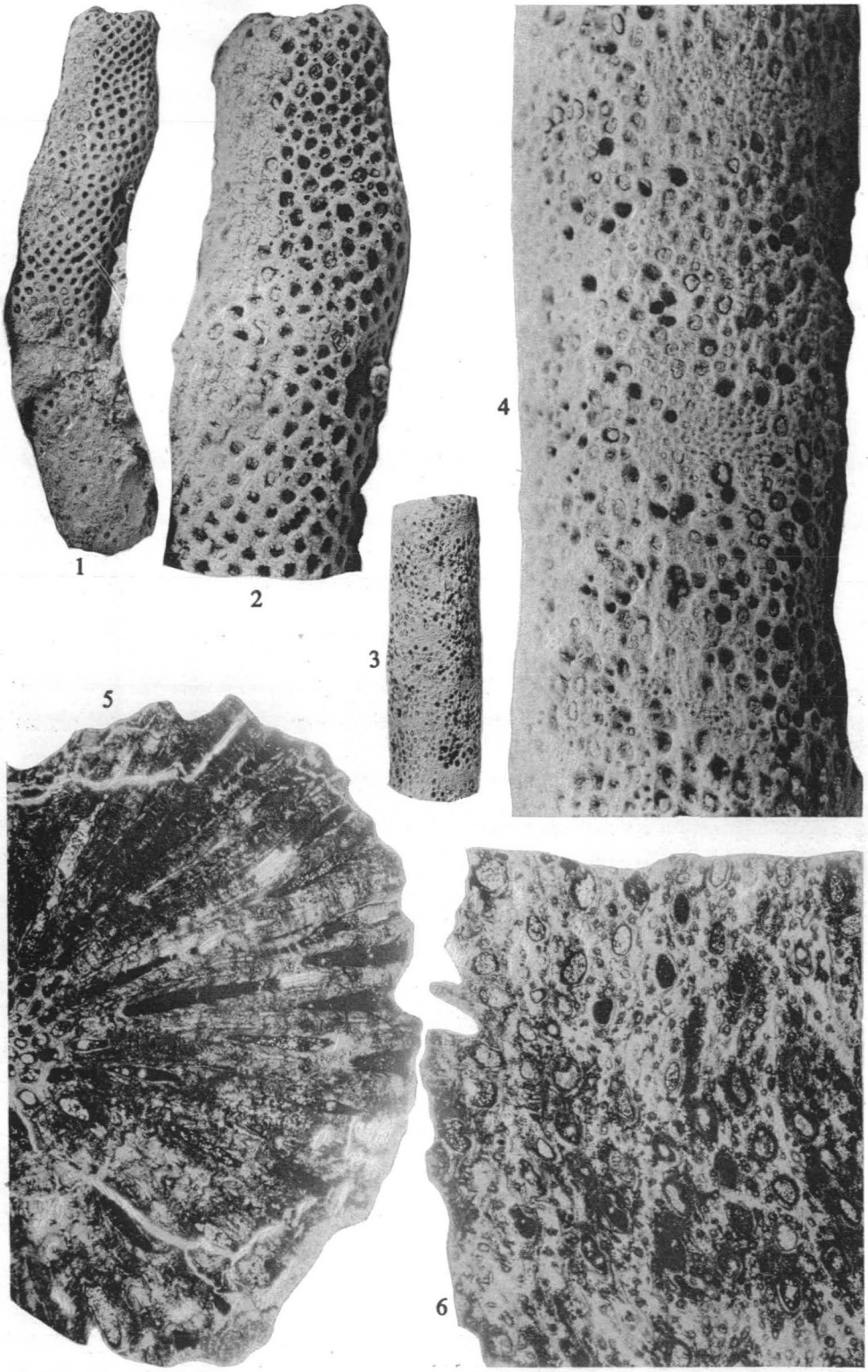
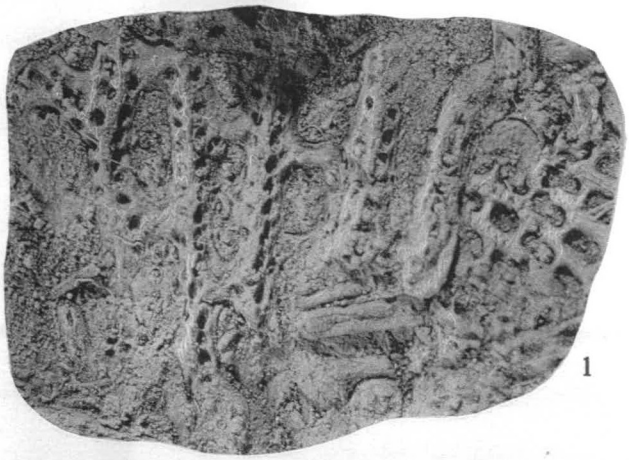

1
2
3
4
5
6

PLATE 16.

1. *Fenestella hindei* sp. nov. Weathered obverse surface of a specimen from locality 19 (1078 E), x 10.

2, 3. *Polypora megastoma* de Koninck. A typical zoarium, from locality 5 A (1207), x 1, and part of the same zoarium, weathered from the reverse surface, x 10.

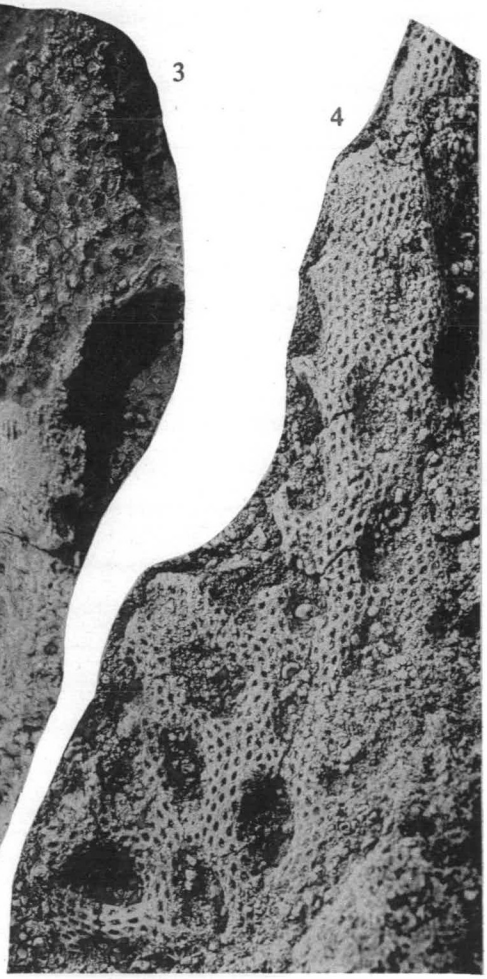
4. *Rhombocladia spinulifera* Crockford. Growth form of a zoarium from locality 29, Mt. Marmion (1275), x 5.



1

2

3



4

PLATE 17.

1, 2. *Polypora kimberleyensis* sp. nov. Holotype, x 1, and portion of the obverse surface of the holotype, x 10.

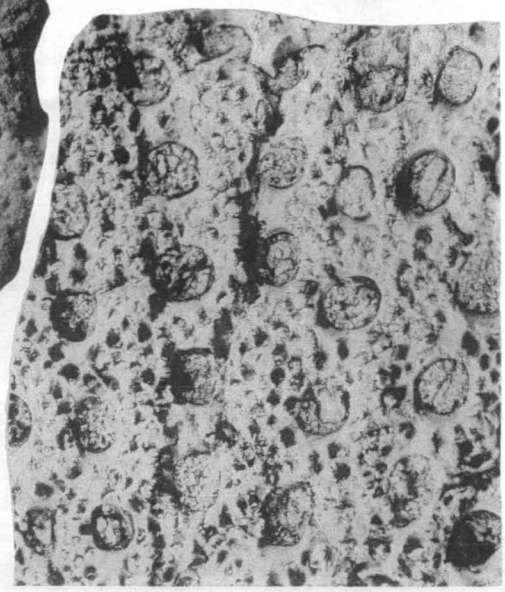
3. *Polypora*, sp. indet. Specimen from locality 5 J (1250), deeply weathered from the obverse surface: x 10.

4. *Polypora wadei* sp. nov. Surface of the holotype, a specimen weathered from the obverse surface, x 10.

5. *Synocladia teicherti* sp. nov. Obverse surface of the holotype, x 10.


2


1


3


4

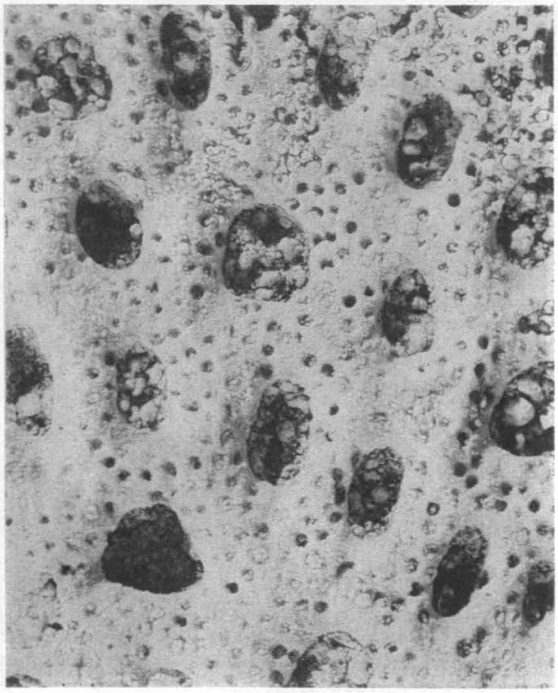
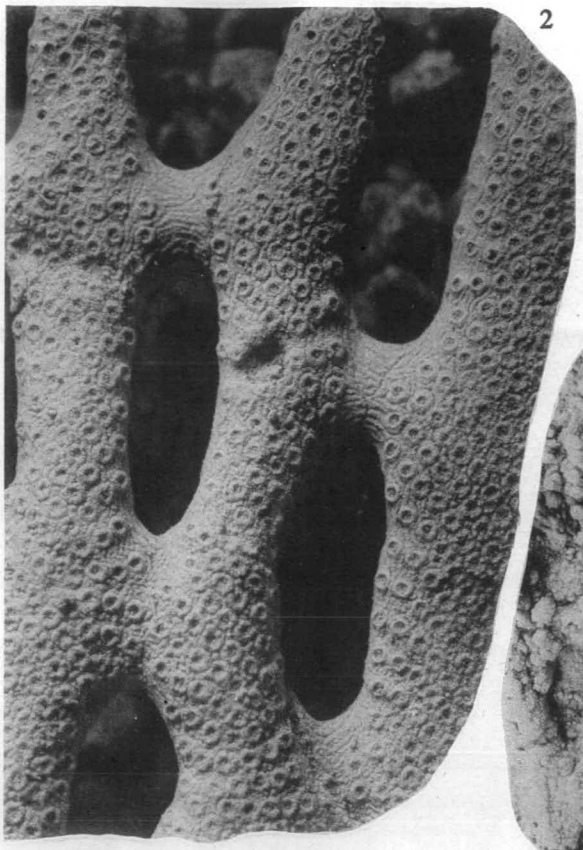

5

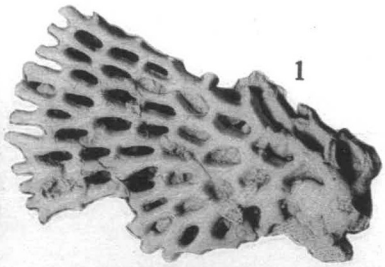
PLATE 18.

1, 2. *Polypora natalis* sp. nov. 1. Portion of the holotype, near the base of a large flabellate zoarium, x 1. 2. Part of the obverse surface of the holotype, x 10.

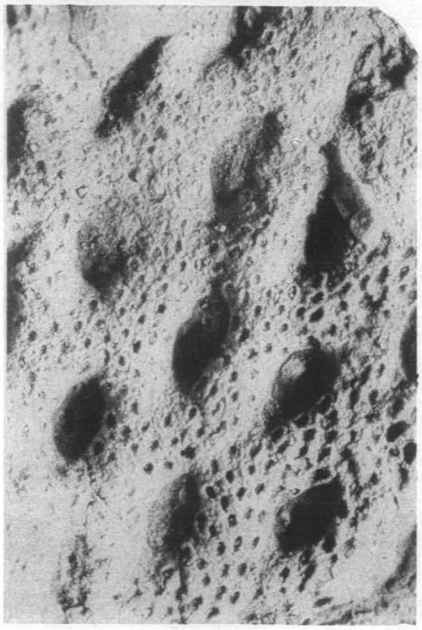
3. *Synocladia teicherti* sp. nov. A specimen from locality 5 A (1205), weathered from the reverse surface, and showing arrangement of the zooecial cells characteristic of this genus: x 10.

4, 5. *Protoretepora flexuosa* sp. nov. 4. Obverse surface of the holotype, x 10. 5. A specimen from locality 5 A (1265), weathered from the reverse surface and showing characteristic arrangement of the zooecial cells.


2


1


3


4

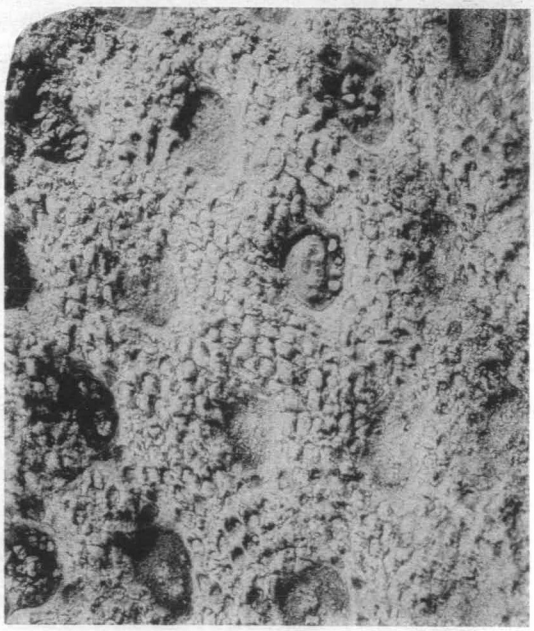

5

Plate 19.

1-3. *Lyropora joselini* sp. nov. 1. Holotype, a small specimen weathered from the reverse surface, and showing near the base of the zoarium portion of the lateral supports, the greater part of these supports being firmly embedded in matrix: x 1. 2. A specimen from locality 1 (1222) weathered to show part of the lateral supports; oblique sections through branches of the fenestrate meshwork, the lateral margins of which are partly enveloped by the supports, are shown on one weathered surface: x 1. 3. Weathered obverse surface of a topotype (1256 B), showing the arrangement of the zooecial apertures, an occasional small node, and the shape of the weathered zooecial cells.

4. *Polypora obesa* sp. nov. Part of the obverse surface of the holotype, x 10.

5. *Rhabdomeson grande* Bassler. Thin section of a specimen from locality 10 (1144 B), the zoarium being completely surrounded and masked at the surface by an encrusting stenoporid: x 10.

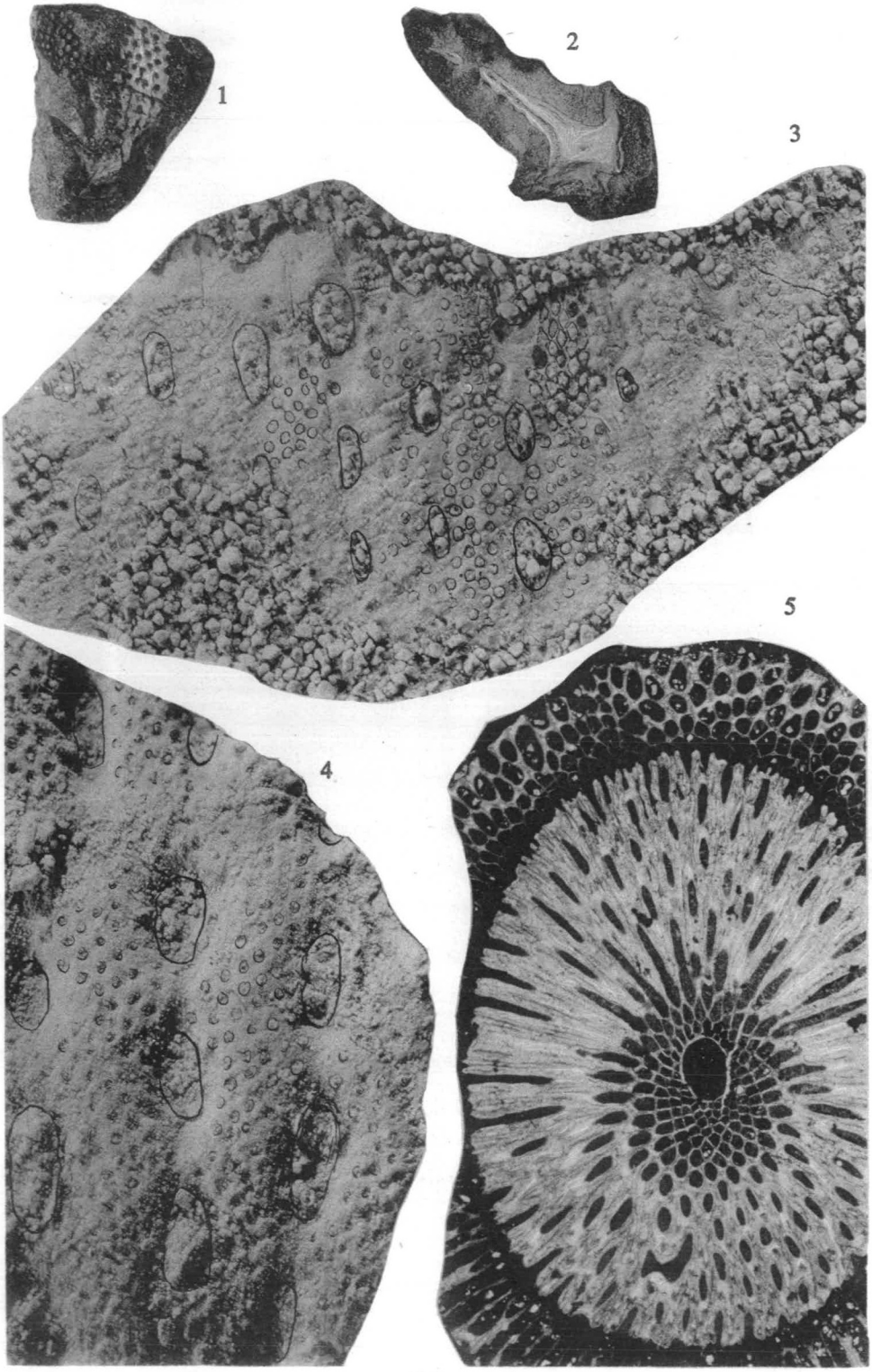

1
2
3
4
5

PLATE 20.

1-3. *Rhabdomeson mammillatum* (Bretnall) var. nov.? 1. Surface of a typical zoarium (1176 B) from locality 21, with the position of the megacanthopores indicated over part of the surface: x 10. 2. A specimen from locality 35 (22336 E, Univ. W.A. Colln.), weathered to show the shape of the zooecial tubes, and the axial tube: x 10. 3. A second specimen from the same locality (22336 D, Univ. W.A. Colln.), obliquely weathered and showing the internal structure: x 5.

4-7. *Rhabdomeson bretnalli* sp. nov. 4. Holotype, x 5. 5. Part of the surface of the holotype; the arrangement and size of megacanthopores and micracanthopores is indicated over part of the photograph: x 10. 6. Part of a thin section of a specimen from locality 22 (1187 B), showing arrangement of the zooecia and of the megacanthopores, which are rather more numerous and less regularly arranged than in *R. mammillatum* (Bretnall); on the right, a small number of micracanthopores are shown in section, their absence in the remainder of the section being due to their shallow origin: x 20. 7. End surfaces of the holotype, showing the axial tube and the axial and peripheral zones, x 10.

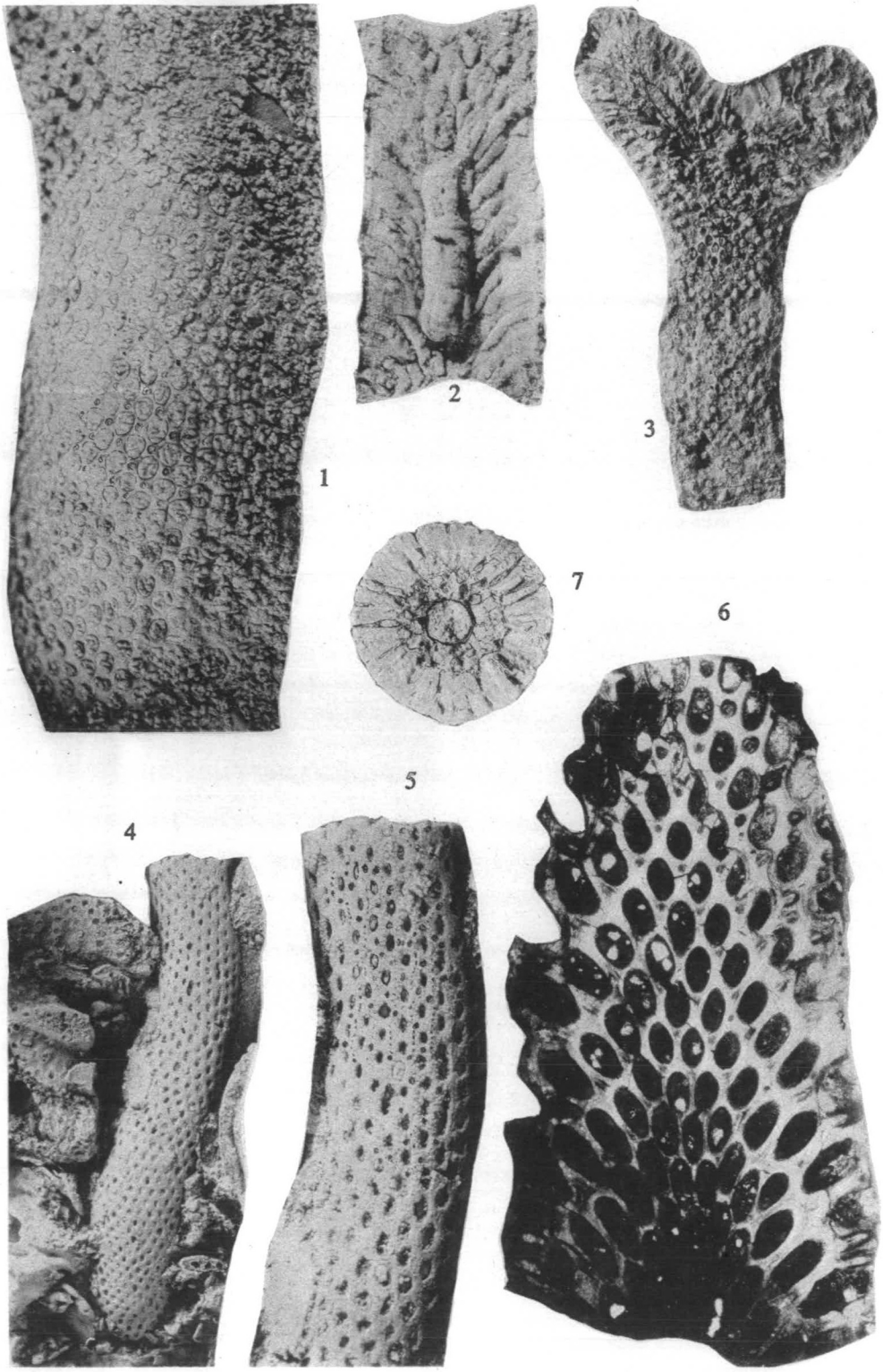
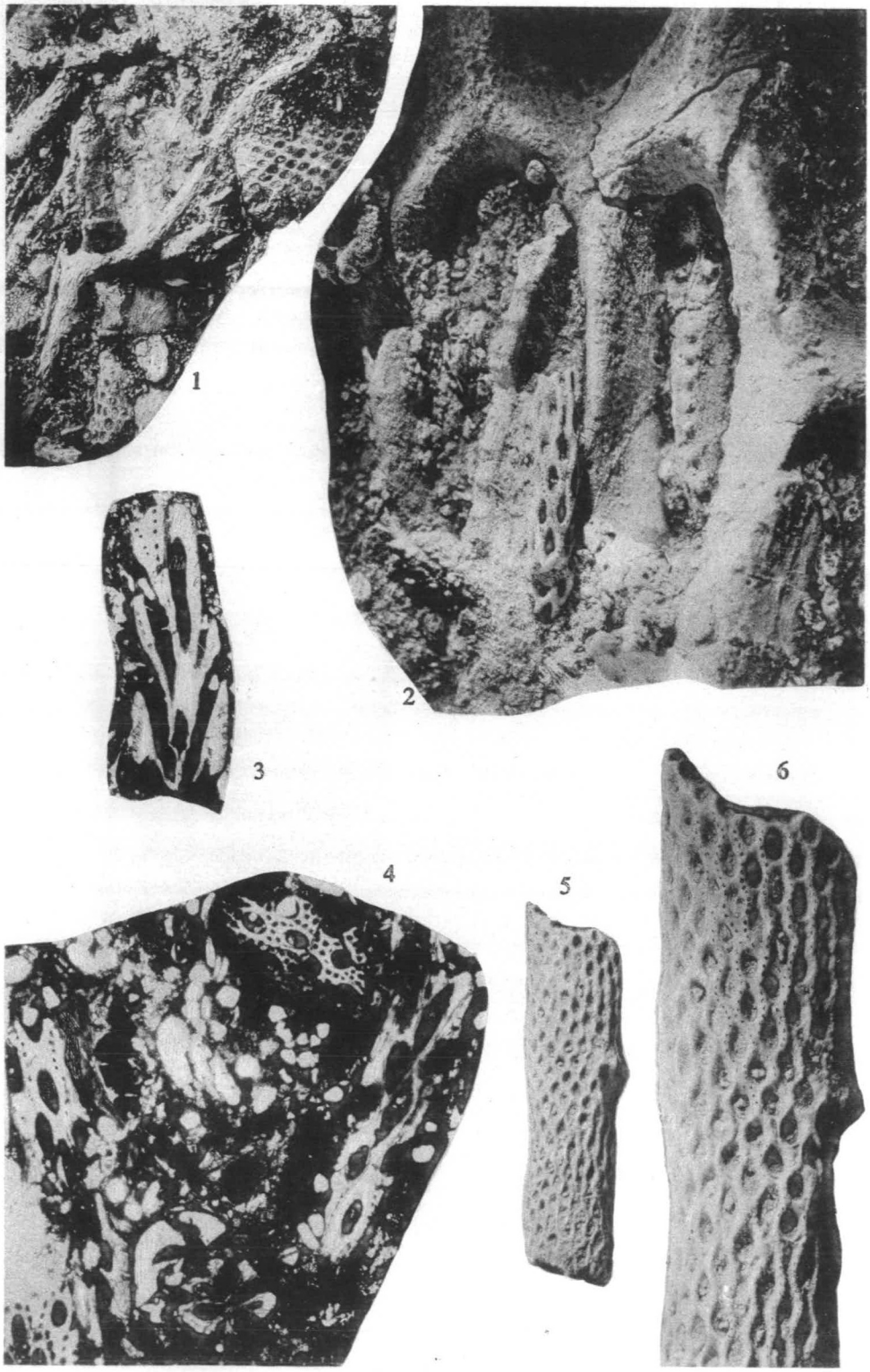

1
2
3
4
5
6
7

PLATE 21.

1-4. *Saffordotaxis elegans* sp. nov. 1. Holotype; part of a zoarium of *Rhabdomeson mammillatum* (Bretnall) var. nov.? is shown on the right: x 5. 2. A small zoarium from locality 5 C (1195 B), showing acanthopores and the oblique zooecial apertures; the reverse surface of a zoarium of *Polypora natalis* sp. nov. is also shown: x 10. 3, 4. Thin sections of specimens from locality 16 (1094), x 20. 3. Longitudinal section of a single zoarium, showing hemisepta. 4. Slide showing portions of a tangential and of an oblique section, both showing acanthopores, and below the centre a transverse section of this small species; two fragments of *Streblascopora marmionensis* (Etheridge) are also shown.

5, 6. *Saffordotaxis castanea* sp. nov. Holotype, x 5, and a part of the surface, x 10.


1
2
3
4
5
6

All photographs were taken by G. T. Reid at the Photographic Laboratories of the Bureau of Mineral Resources, Geology, and Geophysics, Acton, A.C.T.

TABLE I.—DISTRIBUTION OF BRYOZOA OCCURRING IN THE PERMIAN OF THE FITZROY BASIN, WESTERN AUSTRALIA.

Species.	Formation and Locality.						Noonkanbah Formation.																																													Liveringa Group.			Occurrences Elsewhere.
	1	1A	2	2A	3	4	7A	7B	6	8	9	10	11	12	5S	7C	5R	13	14	15	16	19	20	5N	23	25	27	5J	17, 17A	18	18A	30	31	32	33	34	5H	21	22	5C	5B	5A	35	24	26	28	29, 29A	36	37	38	
Fistulipora nura sp. nov.	x																																																				
Evactinostella crucialis (Hudleston)	x												x							x											x				x												x				Callytharra Formation, Norton Greywacke, and Baker Formation, Carnarvon Basin
Dyscritella spinigera (Bassler)	x									x							x		x	x		x					x	x	x										x							x				?Basleo Beds, Timor; and Callytharra Formation, Carnarvon Basin
Lyropora joselini sp. nov.	x	x																																																			
Streblascopora marmionensis (Etheridge)	x						x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x		x	x	x	x	x		x	x	x		x	x	x	x		x				Callytharra Formation to Coolkilya Greywacke, Carnarvon Basin; ?Basleo and Amarassi Beds, Timor
Hexagonella australis (Bretnall)			x																								x		x										x												Callytharra Formation, Carnarvon Basin
Hexagonella hudlestoni sp. nov.			x									x																x												x		x								Callytharra Formation, Carnarvon Basin
Stenopora hemispherica Waagen & Wentzel			x	x																																															Lower Productus Limestone, Salt Range
Fenestella horologia Bretnall			x	x		x			x				x							x		x		x			x	x	x									x	x	x	x	x					x				Callytharra to Wandagee, Carnarvon Basin; Bitaoeni to Basleo Beds, Timor; Lower Permian, Vancouver Is.; Dilly Stage, Qld.
Leioclema globosa sp. nov.					x								?																																							Permian, Canning Basin, W.A.
Prismopora? triradiata sp. nov.							x			x	x	x						x			x	x							x																						
Polypora megastoma de Koninck								x												x	x						x	x	x					x								x									Middle Productus Limestone
Protoretepora flexuosa sp. nov.								x																x				x												x		x									
Liguloclema meridianus (Etheridge)									x				x									x								x																	x				
Goniocladia timorensis Bassler									x																				x		x		x																		Basleo Beds, Timor
Fenestella columnaris (Crockford)									x				x									x						x					x					x	x	x		x					x				Lower Part of Wandagee Formation
Polypora f ivea Crockford									x												x	x							x																						Wandagee Formation
Polypora kimberleyensis sp. nov.									x			x	x	x				x						x				x	x										x	x		x									
Polypora wadei sp. nov.									x					x								x							x													x									
Polypora sp. nov.									x													x						x																							
Polypora obesa sp. nov.									x																				x													x									
Ramipora ambrosoides (Bretnall)										x			x	x								x		x	x	x	x		x									x	x	x							x				Callytharra Formation to Coolkilya Grewacke, Carnarvon Basin; Basleo Beds, Timor
Dyscritella tenuirama sp. nov.										x										x							x		x																						
Saffordotaxis multigranulata (Bretnall)										x							x												x				x					x									x				
Stenopora punctata sp. nov.											x							x				x																													
Hexagonella bifida Crockford												x										x													x																
Stenopora spicata (Bassler) var. *obtusa* var. nov.												x									x				x			x									x		x		x									Species from Amarassi Beds, Timor
Stenodiscus variabilis sp. nov.												x										x							x								x	x									x				
Rhabdomeson grande Bassler												x																																							Bitaoeni Beds, Timor
Fenestella hindei sp. nov.													x	x								x											x																		
Rhabdomeson mammillatum (Bretnall)													x	x								x			x								x														x				Anthracolithic Series, Shan States
Dybowskiella arborescens sp. nov.														x																								x													Baker Siltstone, Carnarvon Basin
Fistulamina lata sp. nov.														x						x		x										x										x									
Goniocladia indica Waagen and Pichl														x								x																					x								Middle Productus Limestone, Salt Range, and Basleo Beds, Timor
Polypora natalis sp. nov.														x		x								x										x				x	x												
Synocladia teicherti sp. nov.														x								x												x								x					x				
Rhabdomeson bispinosum Crockford														x																					x																Callytharra Formation, Carnarvon Basin
Saffordotaxis elegans sp. nov.														x					x		x	x			x													x	x	x		x							x		
Dyscritella macrostoma sp. nov.																x							x					x	x									x		x		x									
Rhabdomeson bretnalli sp. nov.																	x			x		x							x										x												
Fistulipora vacuolata Crockford																		x																						x							x				
Eridopora permiana sp. nov.																				x		x							x									x				x									
Liguloclema typicalis sp. nov.																					x				x																						x				
Fenestella basleoensis Bassler																					?				x									x								x					x				
Saffordotaxis castanea sp. nov.																					x							x											x			x									
Dyscritella bruteni sp. nov.																						x		x				x																							
Fenestella sp. nov.																						x																													
Polypora woodsi (Etheridge)																						x							x				x					x	x												Callytharra Formation, Carnarvon Basin; Bitaoeni Beds, Timor; Dilly Stage and Lake's Creek, Qld.; Maitland Group, N.S.W.; Granton, Tas.
Streblotrypa minutula Bassler																						x															x	x	x		x									Amarassi Beds, Timor
Prismopora digitata sp. nov.																								x				x			x																				
Minilya duplaris Crockford																								x					x										x	x	x		x	x		x		x		Dilly Stage and Lake's Creek, Qld.
Fenestella disjecta (Crockford)																									x				x									x	x			x									Base of Coolkilya Greywacke
Rhabdomeson mammillatum (Bretnall) var. nov.			?																						x								x					x	x	x		x	x						x		
Minilya princeps Crockford																													x																					
Fistulipora stereos sp. nov.																												x		x						x														
Etherella porosa var. *minor* var. nov.																												x		x																				
Etherella irregularis sp. nov.																												x																						
Stenopora bella sp. nov.																												x																						
Megacanthopora? scalariformis sp. nov.																												x																						
Dyscritella adnascens Bassler																												x	x																					Bitaoeni and Amarassi Beds, Timor; Callytharra Formation, Carnarvon Basin
Tabulipora scissa sp. nov.																													x										x											
Fenestella valentis (Crockford)																													x															x						
Protoretepora ampla (Lonsdale)																													x					x																Muree Stage, N.S.W.; Permian, Tas.
Callocladia? ramosa sp. nov.																													x																					
Fenestella cacuminatis (Crockford)																													x																					
Acanthocladia sp. indet.																													x																					
Rhombocladia spinulifera Crockford																													x				x													x				
**Fenestella ruidacarinata* (Crockford)																																	x																	
Polypora multiporifera Crockford																																	x									x									Wandagee Formation
Etherella porosa sp. nov.																																						x	x	x		x						x		
Dyscritella cf. *spinulosa* Bassler																																						x												Species, Bitaoeni Beds, Timor
Prismopora? attenuata sp. nov.																																							x											
Stenopora lineata sp. nov.																																							x											
Protoretepora robusta (Bassler)																																									x									Bitaoeni Beds, Timor
Saffordotaxis cf. *wanneri* (Bassler)																																									x									Species, from Basleo Beds, Timor
Dybowskiella crescens (Crockford)																																										x		x		x				
**Streblascopora etheridgei* (Bretnall)																																										x				x				
Stenodiscus hardmani sp. nov.																																											x	x			x		x	
Fitsulipora wadei (Crockford)																																														x				
Hexagonella? lineata (Crockford)																																														x				
**Hexagonella? plana* (Crockford)																																														x				
**Fenestella lennardi* (Crockford)																																														x				
Fistulipora liveringa sp. nov.																																																x		
Dyscritella liveringa sp. nov.																																																	x	

NOTE.—The following localities lie within, or a very close to, measured sections of the Noonkanbah Formation at Bruten's Yard, and their positions within the section (given in feet above the base of the Noonkanbah) are as follows:—

7A:	Between 430′ and 480′	5J:	Between 910′ and 970′
7B:	Between 500′ and 560′	5H:	Between 975′ and 1,000′
5S:	Between 620′ and 725′	5C:	Between 1,125′ and 1,160′
5R:	Between 740′ and 780′	5B:	Between 1,160′ and 1,190′
7C:	About 750′	5A:	Between 1,210′ and 1,260′
5N:	Between 820′ and 860′		

The remaining localities within the Noonkanbah Formation are interspersed with these localities in their probable stratigraphical position, as discussed on p. 82.

* Previously described species of which no additional records are made in the present paper.

By Authority: A. J. ARTHUR, Commonwealth Government Printer, Canberra.