COMMONWEALTH OF AUSTRALIA
DEPARTMENT OF NATIONAL DEVELOPMENT
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

BULLETIN No. 90

PERMIAN POLYZOA FROM THE BOWEN BASIN

by

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University of Sydney

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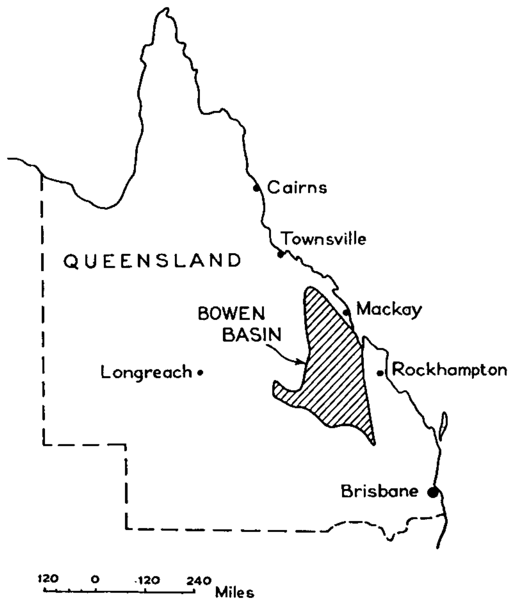
SUMMARY

Permian Polyzoa of the Bowen Basin belong to over 30 species and 16 genera of the Orders Cyclostomata, Trepostomata, and Cryptostomata. Four species, *Fenestella bowenensis, F. springsurensis, Fenestella* sp. nov., and *Saffordotaxis multinodata,* are regarded as being new. Twelve of the genera have been recorded previously from the Permian of Western Australia, and most of them are not known from the Permian of New South Wales and Tasmania. Thus a short-lived marine connexion with Western Australia is envisaged in the northern part of the continent.

Previous taxonomic work has established the identity of *Minilya duplaris* Crockford and *Fenestella horologia* Bretnall, and consequently the genus *Minilya,* with *M. duplaris* as type species, is regarded as synonymous with *Fenestella. Parafenestella* Miller is reduced to subgeneric status, but *Levifenestella* Miller is considered to be of generic rank. Type localities of some species based on Australian material are revised.

The application of statistical methods to species of *Fenestella* is discussed. A punched card system facilitated comparison of fenestrate species. Two keys were constructed for most of the Permian and Carboniferous species of *Fenestella* known from Australia.



Text-fig. 1.—Locality map of the Bowen Basin.

INTRODUCTION

The Bowen Basin is a large triangular synclinal structure 350 miles long, occupying an area of about 20,000 square miles in eastern Queensland (Text-fig. 1). It is composed of Permian and Triassic sediments and volcanics resting unconformably on Upper Carboniferous or older rocks. To the southeast and southwest, the sediments dip under the Mesozoic strata of the Great Artesian Basin.

The abundance of the faunas in the Basin has been known since last century, but the Polyzoa have remained almost unstudied. The regional mapping programme undertaken by the Bureau of Mineral Resources and the Geological Survey of Queensland in the Basin has prompted the present study, which has revealed many new faunas and elucidated some of the stratigraphic problems. Other Bowen Basin faunas are being studied by J. M. Dickins, K. S. W. Campbell, and J. F. Dear (brachiopods), J. M. Dickins and B. N. Runnegar (pelecypods and gastropods), and Professor D. Hill (corals).

The Permian volcanics and sediments of the Bowen Basin contain four distinct faunas, first recognized by Dickins et al. (1964). One object of the present work was to study the Polyzoa in the light of the four successive faunas and to investigate their biostratigraphy.

Various epochal and stage subdivisions of the Permian are in use: I follow the normal Russian practice of dividing the period into two epochs, of which the Lower Permian encompasses the Sakmarian, Artinskian, and Kungurian Stages, and the Upper Permian the Kazanian and Tatarian Stages. Because of changing concepts in Permian stratigraphy in the USSR and because many of the Soviet publications dealing with Polyzoa were compiled more than fifteen years ago, no attempt has been made to cite specific stages for the Russian species mentioned in the comparative work.

The abundance of fusulinids and ammonoids in some standard sequences overseas and their absence from most Australian deposits make it difficult to gauge the age of an Australian fauna. In this work, the ages of the faunas are related to the standard Ural sequence, having been deduced previously using brachiopods and molluscs.

Permian Polyzoa can be traced from Eastern Australia through Western Australia, Timor, the Salt Range, and Turkestan to the Urals. Accurate species comparisons can be made with all these areas except the Salt Range, where Polyzoa are inadequately described and figured. If this can be remedied quite accurate comparisons of polyzoan faunas may be made between Eastern Australia and the Ural sequence, and the age of the Australian fauna thus deduced.

Previous Investigations

Geological work in the Bowen Basin has been concentrated mainly in three areas: the Collinsville, Springsure, and Cracow areas. Interest in Collinsville and Cracow was accentuated by the discovery of economic deposits of coal and gold respectively, and the Springsure area was studied mainly because of the faunas and the associated structure.

Jack (1879) and Jack & Etheridge (1892) are the two important references to work in the Basin during the last century. Jensen (1926), Reid (1930b), and Denmead (1938) in the southern portion of the Basin, and Reid (1924, 1929) in the Collinsville area, add to the knowledge of the geology of the Basin during this century. Reid (1930a) discusses the Upper Palaeozoic succession.

References to the occurrence of Polyzoa in the Bowen Basin are few. Nicholson & Etheridge (1879) described three species of *Stenopora* from the Bowen River Coalfield. Jack & Etheridge (1892) described three fenestrate forms from this area.

Whitehouse (in Reid, 1929) lists the fauna of the Bowen River Coalfield, including a few previously recorded Polyzoa.

From the Springsure area, Crockford (1943, 1946, 1951) records *Fenestella dispersa* (Crockford), *F. fossula* Lonsdale, *F. horologia* Bretnall, *Minilya duplaris* Crockford, and *Fenestella canthariformis* (Crockford).

Hill (1957) adds *Dyscritella* sp. to the species from the Springsure area.

Acknowledgments

I wish to thank members of the Department of Geology and Geophysics, University of Sydney, who have assisted me in this work. In particular, appreciation is due to Professor C. E. Marshall, who permitted me to use Departmental facilities and provided funds enabling me to study the major outcrops of Permian sediments in Eastern Australia.

The study has been aided by the loan of material or assistance from the Department of Geology, University of Queensland; the Geological Survey of Queensland; the Australian Museum; the Bureau of Mineral Resources; the Department of Geology, University of New England; the Geological Survey of Western Australia; the Department of Geology, University of Western Australia; the Department of Palaeontology, British Museum (Natural History); and the Division of Invertebrate Paleontology, United States National Museum. To the heads of these institutions, I express my sincere thanks.

I am indebted to Professor D. Hill, FRS, Department of Geology, University of Queensland, who first introduced me to the study of the Polyzoa, and to Dr J. M. Dickins, Bureau of Mineral Resources, who suggested that I undertake the study.

To Dr J. R. P. Ross, Western Washington State College, Bellingham, USA, Dr R. Tavener-Smith, Queen's University, Northern Ireland, and Dr J. M. Beattie, I express my appreciation for advice on taxonomic problems and criticism of the manuscript.

For discussion on the stratigraphy of the Bowen Basin, I wish to thank Dr J. M. Dickins, Mr A. R. Jensen, and Mr E. J. Malone of the Bureau of Mineral Resources, Canberra.

I offer my thanks to Mrs H. Gantman, Librarian, Department of Geology and Geophysics, University of Sydney, and to the Interlibrary Loan Section of Fisher Library, University of Sydney, for their assistance in purchasing and obtaining on loan many important and obscure publications, especially by Russian authors, which otherwise would not have been available.

For his aid with photographic reproductions I would like to thank Mr G. Z. Foldvary, Department of Geology and Geophysics, University of Sydney.

This work was carried out as partial fulfilment of the requirements for the degree of Doctor of Philosophy while I was a Teaching Fellow within the Department of Geology and Geophysics, University of Sydney (1963-1965), and was assisted by annual allocations from the University of Sydney Research grant.

Abbreviations of Repositories

AM	Australian Museum Palaeontological Collection, Sydney.
BM	British Museum (Natural History), London.
CPC	Commonwealth Palaeontological Collection, Bureau of Mineral Resources, Canberra.
GSQ	Geological Survey of Queensland, Brisbane.
GSWA	Geological Survey of Western Australia, Perth.
SUGD	Department of Geology and Geophysics, University of Sydney, Sydney.
UQGD	Department of Geology, University of Queensland, Brisbane.
UTGD	Department of Geology, University of Tasmania, Hobart.
UWA	Department of Geology, University of Western Australia, Perth.

PERMIAN STRATIGRAPHY OF THE BOWEN BASIN

The following summary is based mainly on the results obtained by the Bureau of Mineral Resources and the Geological Survey of Queensland, who have recently completed the first systematic regional mapping programme covering the entire Bowen Basin.

Jack (1879) and Jack & Etheridge (1892) used a threefold division of the Permian sequence into Lower Bowen Volcanics, Middle Bowen Beds, and Upper Bowen Coal Measures. These divisions have been recognized in the recent combined mapping programme, but have been renamed and subdivided.

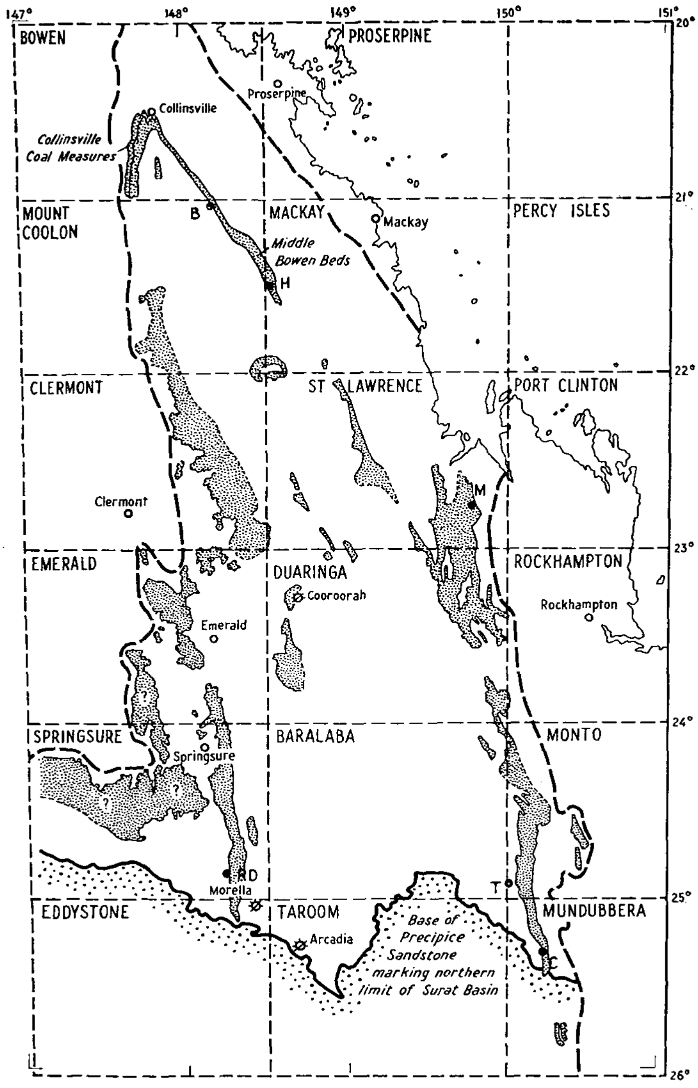
The 'Lower Bowen Volcanics', now formally named the Lizzie Creek Volcanics (Malone, Olgers, & Kirkegaard, 1968) are composed predominantly of agglomerates and tuffs of andesitic composition, together with andesites and dacites. Interbedded in the volcanics are sandstone and shale containing *Glossopteris,* indicating a Permian age. A small marine fauna has been found in the upper part of the Lizzie Creek Volcanics in the northern part of the Basin. This fauna is designated Fauna I. The volcanics crop out only on the eastern side of the Basin.

The distribution of 'Middle Bowen Beds', now named Back Creek Group, is shown in Text-figure 2. The group is held to range from the lower Artinskian to the lower Kazanian (Dickins, Malone & Jensen, 1964). It contains a wide and varied fauna. The combined mapping programme enabled the Back Creek Group to be divided into three lithologically and palaeontologically distinctive units which were recognized first in the northern part of the Basin. These units, first referred to informally as Units A, B & C (see Dickins, et al., 1964) were formally named the Tiverton, Gebbie, and Blenheim Formations by Malone, Jensen, Gregory, & Forbes (1966), and raised to the rank of Subgroups by Malone et al. (1968). They contain Faunas II, III, and IV respectively. Brachiopods and pelecypods form the main basis for the palaeontological division. The Gebbie Subgroup has been divided further into three units containing Faunas IIIA, IIIB, and IIIC respectively (see Dickins et al., 1964). The distribution of the Back Creek Group and its divisions will be discussed later.

The 'Upper Bowen Coal Measures' (Blackwater Group, Malone et al., 1968) are nonmarine or lacustrine and contain a *Glossopteris* flora. They are composed of lithic sandstone, carbonaceous shale and sandstone, conglomerate, and coal. The group can be traced in outcrop along the eastern and western flanks of the Basin.

As most of the fauna studied here comes from the Back Creek Group in the Blenheim, Springsure, and Cracow areas, stratigraphic columns for these areas are shown in Text-figure 3, along with their characteristic polyzoan faunas.

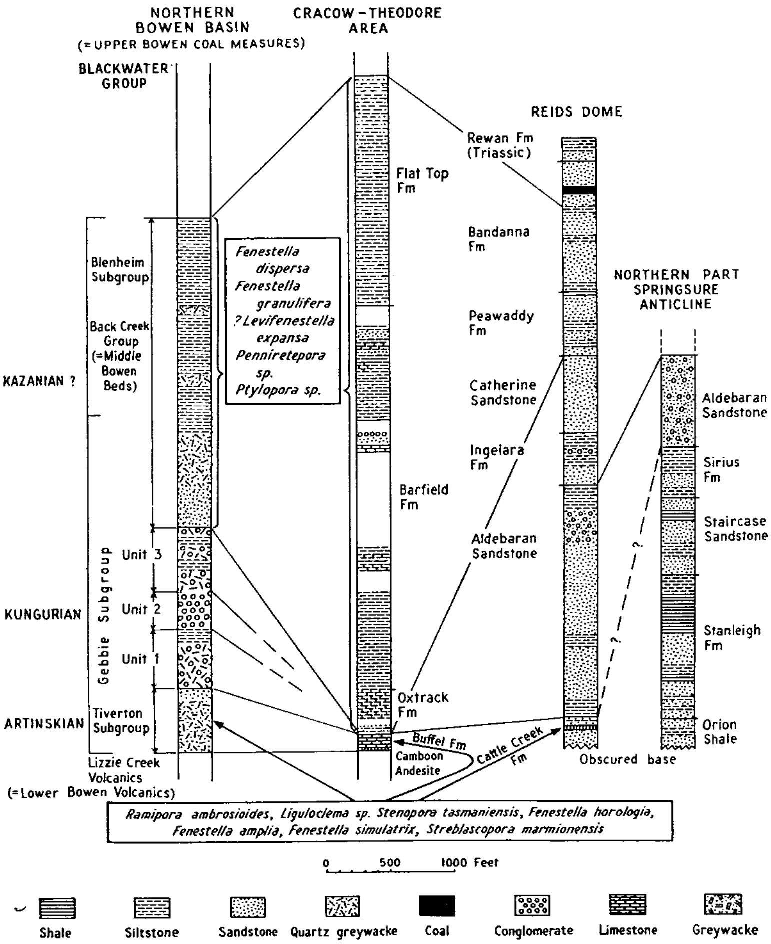
In the Blenheim area the Tiverton Subgroup disconformably overlies the Lizzie Creek Volcanics. Such a disconformity is found also in the Cracow area, where the Buffel Formation disconformably overlies the Camboon Andesite, regarded as being equivalent to the Lizzie Creek Volcanics. In the Tiverton Subgroup a dominant Western Australian element is found in the polyzoan



Text-fig. 2.—BOWEN, MOUNT COOLON, etc. are names of 1:250,000 Sheet areas, the boundaries of which are shown. B = Blenheim; H = Homevale; RD = Reids Dome; M = Marlborough; T = Theodore; C = Cracow.
Map after Dickins, Malone, & Jensen (1964). The dark dashed line indicates the limit of the Bowen Basin and is taken mainly from Malone (1964).

faunas. The unit can be traced south of Blenheim to Homevale, where it disappears under alluvium, reappearing west of Marlborough and again in the Cracow-Theodore area. In the northern part of the Basin, the Tiverton Subgroup is found only on the eastern limb. South of Collinsville on the western limb, the Gebbie Subgroup unconformably overlies Permian or older volcanics.

The Gebbie Subgroup can be recognized in the northern part of the Basin, and on the eastern limb it overlies the Tiverton Group as far south as Blenheim. In the Cracow area, the Tiverton Subgroup is disconformably overlain by the Blenheim Subgroup, of which the basal formation is the Oxtrack Formation, containing a characteristic Fauna IV. The disconformity is interpreted as being



Text-fig. 3.—Stratigraphic columns for the Blenheim, Cracow-Theodore, and Springsure areas shown in Text-fig. 2. Characteristic elements of the polyzoan fauna are placed in their appropriate position.

due to a general shallowing of the Basin caused by epeirogenic movement. Movement in some areas, for instance Cracow, was sufficient to produce emergence from the sea, but in the northern part of the Basin around Collinsville development of lacustrine conditions and formation of coal measure sequences indicate that emergence was probably not complete. The Gebbie Subgroup in this area is represented by the Collinsville Coal Measures, with a marine incursion in the middle, containing Fauna IIIB. Polyzoa are rare in the Gebbie Subgroup.

The start of Blenheim Subgroup time is represented by a transgressive phase, and the eastern limb of the Basin was again submerged. Polyzoan faunas are profuse, especially in the Cracow area, where the Subgroup is represented by the Oxtrack, Barfield, and Flat Top Formations. The Subgroup can be traced north from here along the complete eastern side of the Basin. The return of the polyzoan faunas is probably due to climatic conditions, but may be related to the occurrence of sediments similar to those found in the Tiverton Subgroup. However, the fauna does not contain a dominant Western Australian element and its origin is not known.

After Blenheim Subgroup time, the eastern side of the Basin returned to nonmarine conditions. In the northern part the Blackwater Group crops out and can be traced southwards to the Cracow-Theodore area, where it is represented by the Gyranda Formation and the Baralaba Coal Measures.

In the Reids Dome area, the Cattle Creek Formation containing Fauna II represents the Tiverton Subgroup. In the northern part of the Springsure Anticline the Subgroup is represented by the Stanleigh Formation, the Staircase Sandstone, and the Sirius Formation.

The Aldebaran Sandstone is the lowest formation of the Gebbie Subgroup. It is overlain by the marine Ingelara Formation containing Fauna III. The relation of this fauna and the fauna found in the overlying Catherine Sandstone to the marine incursion with Fauna IIIB in the northern part of the Basin is not precisely known. Polyzoa are virtually absent from the Gebbie Subgroup in the Reids Dome Area, and therefore do not throw any light on the problem. The Catherine Sandstone of Hill (1957) has been divided into the Catherine Sandstone, as used herein, and the Peawaddy Formation.

The Peawaddy Formation contains the Mantuan *Productus* Bed near the top. In this is found Fauna IV, and the Peawaddy Formation is regarded as being part of the Blenheim Subgroup. Overlying the Peawaddy Formation is the Black Alley Shale, previously called the lower part of the Bandanna Formation, and the Blackwater Group, previously called the upper part of the Bandanna Formation.

In the Clermont area only the Blenheim Subgroup crops out; it unconformably overlies Lower Carboniferous volcanic rocks. In the Emerald area, outcrops of the Back Creek Group are discontinuous, but all three Subgroups can be recognized in isolated outcrops.

Relevant references are: Dickins, Malone, & Jensen, 1964; Jensen, Gregory, & Forbes, 1966; Malone, 1964; Malone, Jensen, Gregory, & Forbes, 1966; Malone, Olgers, & Kirkegaard, 1968; Malone, Corbett, & Jensen, 1964; Mollan, 1967; Mollan, Exon, & Kirkegaard, 1968; Olgers, Webb, Smit, & Coxhead, 1966; Veevers, Mollan, Olgers, & Kirkegaard, 1964; Veevers, Randal, Mollan, & Paten, 1964; Wass, 1962; Wass, 1965.

Localities

BMR Localities†

B 628 Kazanian-Kungurian, Blenheim Subgroup, approximately 20.5 miles south-southwest of Collinsville, Queensland; Lat. 20°49'S., Long. 147°43'E., Bowen* Sheet (south part), 7.3 miles at 255° from 'Havilah'.
Leioclema sp.

B 1570 Kungurian-Kazanian, Big *Strophalosia* Zone of Blenheim Subgroup, approximately 22 miles south-southwest of Collinsville, Queensland; Lat. 20°50'S., Long. 147°42'E., Bowen Sheet (south part), 8 miles at 250° from 'Havilah'.
Leioclema sp.

B 1570a as for B 1570 but 101 to 117 feet above the base.
B 1570b as for B 1570 but 32 to 43 feet above the base.
B 1570c as for B 1570 but 0 to 16 feet above the base.

CL 12/1 Kungurian-Kazanian, Blenheim Subgroup, north-northwest of Clermont, Queensland; Lat. 22°16'S., Long. 147°57'E., Clermont Sheet in Cherwell Creek, 2.8 miles at 180° from 'Mount Lebanon'.
Stenopora crinita

MC 293 Kungurian-Kazanian, Blenheim Subgroup, Lat. 21°04'S., Long. 148°13'E., Mount Coolon Sheet, 400 yards down the creek from 'Blenheim'.
Polypora keppelensis

MC 957 Kungurian-Kazanian, Blenheim Subgroup, Lat. 21°20'S., Long. 148°25'E., Mount Coolon Sheet, 3.4 miles at 65° from 'The Springs'.
Fenestella fossula

SL 643 Artinskian, Tiverton Subgroup, 10 miles north-northeast of 'Yatton'; Lat. 22°32'S., Long. 149°13'E., Saint Lawrence Sheet, 0.7 miles east of the Bruce Highway, hill on south side of Yatton Creek.
Penniretepora sp.
Polypora magnafenestrata

Du 179 Sakmarian, Lizzie Creek Volcanics, approximately 16 miles north of Marlborough; Lat. 22°35'S., Long. 149°52'E., Saint Lawrence Sheet, 6.7 miles at 50° from 'Stoodleigh'.
Fenestella granulifera

The following localities lie within the Springsure Sheet area.

SP 132 Artinskian, Stanleigh Formation, Tiverton Subgroup, Lat. 24°02'S., Long. 148°07'E., on the Emerald Road, 6.7 miles north of Springsure.
Polypora pertinax

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* All map Sheets cited are in 1:250,000 Geological Series.
† Not all BMR specimens have been catalogued.

SP 451 Artinskian, Stanleigh Formation, Tiverton Subgroup, Lat 24°02'S., Long. 148°07'E., on the Emerald Road, 6.9 miles north of Springsure.
Protoretepora ampla

SP 720 Artinskian, *Eurydesma* Limestone of the Cattle Creek Formation, Tiverton Subgroup, at Reids Dome, southwest of Rolleston; Lat. 24°51'S., Long. 148°19'E., 0.3 miles at 320° from AOE No. 2 well.
Liguloclema sp., *Ramipora ambrosioides, Stenopora crinita, Rhombopora* sp., *Streblascopora marmionensis, Penniretepora* sp., *P. triporosa, Polypora woodsi, Protoretepora ampla, Fenestella amplia, F. canthariformis, F. fossula, F. horologia, F.* cf. *simulatrix, F. bowenensis* sp. nov., *F. springsurensis* sp. nov., *Fenestella* (*Parafenestella*) sp.

SP 732 as above but Lat. 24°51'S., Long. 148°20'E., 0.3 miles at 55° from AOE No. 2 well.
Ramipora ambrosioides, Fenestella horologia, F. cf. *columnaris, F. spinifera, F. bowenensis* sp. nov.

SP 748 Artinskian, Cattle Creek Formation, Tiverton Subgroup, approximately 5 miles northwest of 'Rewan' Lat. 24°55'S., Long. 148°18'E., 5.4 miles at 183° from AOE No. 2 well.
Polypora virga, P. woodsi, Fenestella spinifera

UQGD Localities

L. 896 Kungurian-Kazanian, Mantuan *Productus* Bed of the Peawaddy Formation, Lat. 24°38'S., Long. 148°27'E., Springsure Sheet 1.2 miles at 300° from 'Consuelo'.
Fenestella cf. *dispersa*

L. 997 Artinskian, Cattle Creek Formation, Lat. 24°53'S., Long. 148°20'E., Springsure Sheet in Cattle Creek, 5.4 miles at 255° from 'Serocold'.
Polypora woodsi, Protoretepora ampla, Fenestella affluensa, F. cf. *columnaris, F. dispersa, F.* cf. *dispersa, F. fossula, F. horologia, F. simulatrix.*

L. 1363 Kungurian-Kazanian, Blenheim Subgroup, Lat. 20°50'S., Long. 147°51'E., Bowen Sheet (south part), in Rosella Creek, 2.7 miles at 135° from 'Havilah'.
Fenestella fossula

L. 1554 Artinskian, Cattle Creek Formation, Lat. 24°51'S., Long. 148°18'E., Springsure Sheet, 1.3 miles east-southeast of Mount Serocold.
Diploporaria sp., *Polypora pertinax, P. woodsi, Fenestella horologia*

L. 2487 Kungurian-Kazanian, Oxtrack Formation, west of Cracow; Lat. 25°18'S., Long. 150°16'E., Mundubbera Sheet (western part), 1800 feet due south of a point 2.6 miles west of Cracow on the Theodore Road.
Stenopora tasmaniensis

L. 2575 Artinskian, Buffel Formation, 6 miles south of Cracow; Lat. 25°22'S., Long. 150°17'E., Mundubbera Sheet (western part), 0.8 miles at 290° from 'Cracow'.
Fistulipora sp., *Stenopora tasmaniensis, S. ovata, Saffordotaxis multinodata* sp. nov., *Penniretepora* sp., *Fenestella horologia, F. bowenensis* sp. nov.

L. 2580 Kungurian-Kazanian, Oxtrack Formation, west of Cracow; Lat. 25°18'S., Long. 150°16'E., Mundubbera Sheet (western part), immediately west of Orange Creek road crossing of Theodore-Cracow Road.
Stenopora tasmaniensis, Saffordotaxis multinodata sp. nov., *Penniretepora* sp., *P. triporosa, Ptylopora* sp., *Polypora magnafenestrata, Levifenestella?, expansa, Fenestella granulifera, F.* cf. *spinifera, Fenestella* sp. nov.

Other localities

Y 1 CPA 21, 10 chains north of No. 3 camp, Bowen River Coalfield.
Stenodiscus sp.

Y 2 Pelican Creek, Bowen River Coalfield.
Stenodiscus sp.

PALAEONTOLOGY

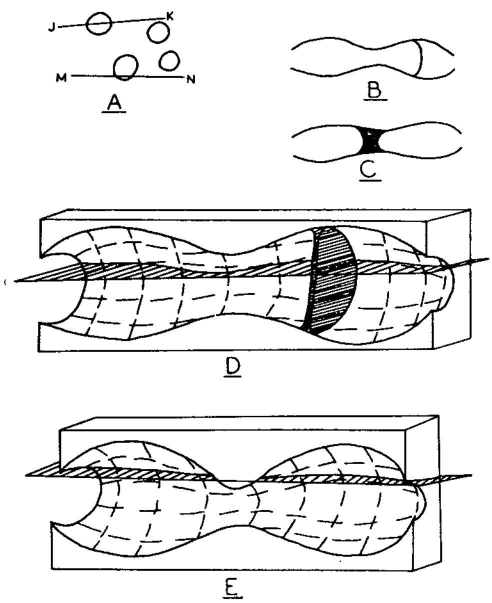
Scope of the work

More than 70 localities in the Bowen Basin have yielded Polyzoa, in various states of preservation. The main source of fossils has been the Bureau of Mineral Resources collection; it has been supplemented by collections borrowed from the University of Queensland and the Geological Survey of Queensland, and collections made by myself. Locality numbers prefixed by 'L' are from the UQGD catalogue; the others are Bureau localities.

Three orders of the Phylum Polyzoa are represented: Cyclostomata, Trepostomata, and Cryptostomata.

Morphological Terms

Most of the morphological terms used here are those defined by Bassler (1953) and Crockford (1957). However, some terms need clarification or are used in a sense slightly different from that of Bassler and Crockford.



Text-fig. 4.

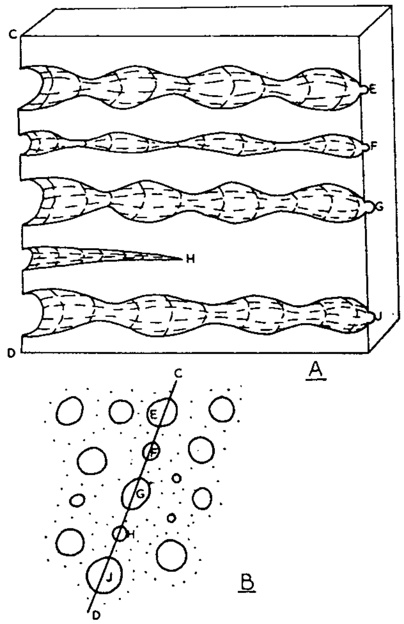
A. **Tangential section showing zooecial orifices.**
B. **Ideal longitudinal section along JK showing a diaphragm.**
C. **Section along MN showing a 'diaphragm' formed by laminae extending from zooecium to zooecium in the zooecial walls and not across the zooecial tube.**
D, E. **Three-dimensional drawings comparing B and C. D shows section JK through a diaphragm and E shows section MN intersecting part of the zooecial wall. Minute structure of the walls is not shown.**

Annulation: the structure of walls in the mature zone of Trepostomata, which gives the walls a beaded or moniliform appearance in section. Annulations extend from zooecium to zooecium through the zoarium. The term 'monilae' is not used because it is considered to be misleading, being related to the section shape only of the annulation.

Carina: used in the sense of Bassler (1953); but carinae may be present also on the dissepiments and parallel their length.

Diaphragm: a partition developed across a zooecial tube or mesopore; it may or may not be perforated. Some authors have confused laminae extending from zooecium to zooecium in the zooecial wall with a diaphragm (see Text-fig. 4).

Median plate: the structure that meanders along the length of a branch and separates the two rows of zooecia from each other in the genus *Fenestella*. Upward growth of the structure forms the carina and nodes on the obverse surface.



Text-fig. 5

A. Ideal section through midplane of four zooecia E, F, G, J. F is an immature or aborted zooecium. H is a mesopore.

B. Tangential section through zoarium showing relation of E, F, G, H, J to one another and showing how F is indistinguishable from H. Walls are annulated; minute structure is not shown.

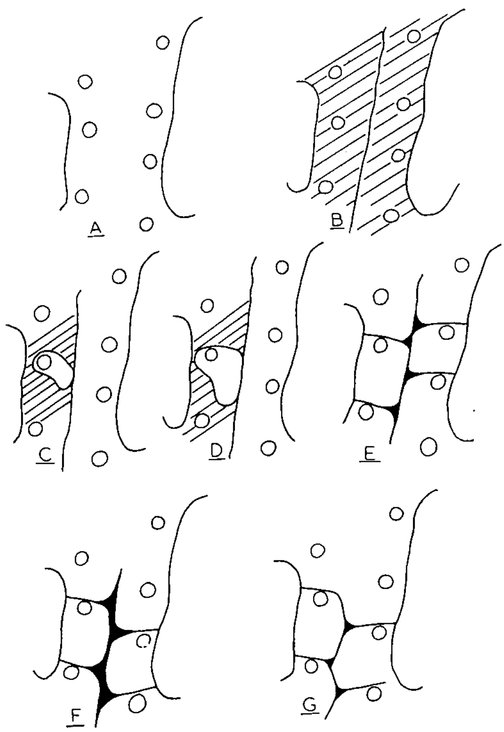
Mesopore: used in the sense of Bassler (1953); but a mesopore may be confused with an aborted or immature zooecium. Their structure in tangential section is similar and unless an ideal longitudinal section can be obtained the two structures can be differentiated satisfactorily only from serial sections (see Text-fig. 5).

Node: used in the sense of Crockford (1957), but nodes have been observed surmounting carinae on the dissepiments. Their significance in this position is not known.

Zooecial Base Shape: the shape of the zooecial chamber at its base. The shape of the chamber, in transverse section, varies according to the level of the section studied (see Text-fig. 6).

Sectioning

The orientation of the longitudinal, transverse, and tangential sections used in this study are shown with respect to three growth forms in Text-figures 7 and 8.



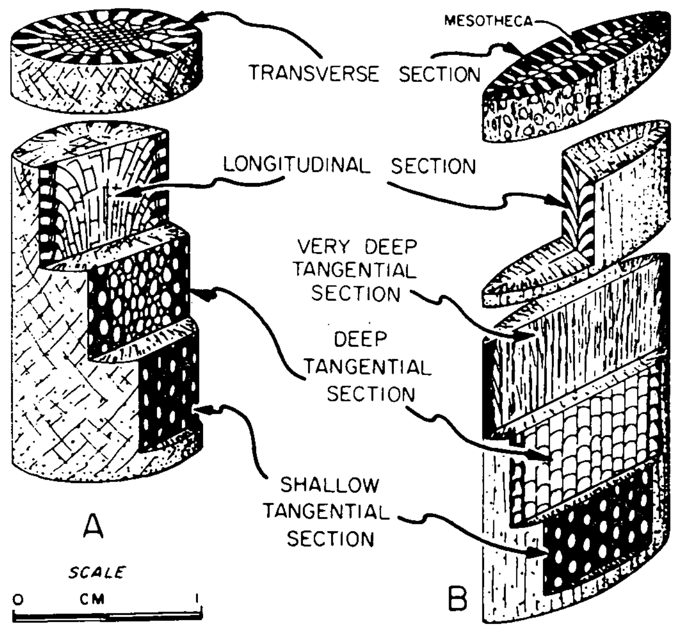
Text-fig. 6.—Sections through a zoarium of *Fenestella quinquecella* (Crockford) showing variation in shape of zooecial chamber. Sclerenchymatous material associated with the obverse is indicated by shading. Zooecial orifices are shown in all sketches. Approx. x 40.

In Cyclostomata longitudinal and transverse sections were used. In Trepostomata, the use of the three sections showed the presence in some species of structures which may be mesopores or aborted or immature zooecia. Idealized sections figured in Text-figure 5 cannot be obtained easily, and to differentiate between mesopores and aborted zooecia, serial sections were cut through the zoaria.

The sections were ground on a machine similar to that described by Hendry, Rowell, & Stanley (1963, p. 145). The machine can produce sections 0.01 mm apart. Replicas of the sectioned surfaces, using dry acetate peels, were produced at close intervals (0.1 mm), and when the mature zone had been completely sectioned serially the replicas were studied to ascertain the nature of any structures present.

Acetate peels and thin sections were used to study the internal structure of the species.

The procedure for sectioning outlined for the Trepostomata was applied to the ramose Cryptostomata. With the fenestrate Cryptostomata, actual skeletons were studied and very few moulds were used. With the species described here and those entered in the keys to Australian Permian and Carboniferous species



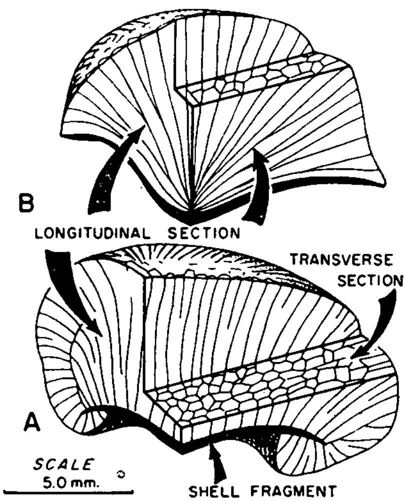
Text-fig. 7.—Sketches of colonies with (A) radial construction and (B) bifoliate construction. (After Ross, 1964).

of *Fenestella,* the zooecial base shape was revealed by etching the zoarium with dilute hydrochloric acid or by serially sectioning the zoarium. Before sectioning, specimens were embedded in polylite, a synthetic resin, to preserve them from mechanical damage.

Statistical Treatment

For species of *Fenestella* considered to be new, the arithmetic mean, standard deviation, number of measurements made, and number of specimens are quoted for the following features: fenestrule length and width, dissepiment and branch width, zooecial apertures per fenestrule and, where possible, zooecia and nodes per 5mm. Use of statistics in conjunction with branches and fenestrules per 10mm (Malone & Perry, 1965, p. 42) is not applied because, to be statistically correct and consistent, the measurements would all have to be made over a particular distance, preferably 10mm, or a particular number of branches measured each time. This may be difficult with fragmentary material; in the literature the number of branches and fenestrules per 10mm has commonly been calculated by extrapolation from a lower measurement. Statistics applied to features such as fenestrule length and width will enable the reader to obtain a more quantitative concept of the species.

In this study the method of measurement was consistent and followed Tavener-Smith (1965a).



Text-fig. 8.—Sketches of colonies with laminate construction. (After Mannil, 1961).

Statistical analyses are conducted only on specimens of new species occurring at the type locality. With this information statistical analyses of specimens from different areas and stratigraphic horizons can be compared with the type analysis and a more rigorous quantitative concept of the species can be obtained. Adequate numbers of specimens from the type localities of previously described species were not available and these species are not treated statistically.

SYSTEMATIC DESCRIPTIONS

Phylum POLYZOA Thompson, 1830

Subphylum ECTOPROCTA Nitsche, 1869

Class GYMNOLAEMATA Allman, 1856

Order CYCLOSTOMATA Busk, 1852

Suborder CERAMOPOROIDEA Bassler, 1913

Family FISTULIPORIDAE Ulrich, 1882

Remarks: As in the Family Stenoporidae, genera may be represented by two modes of growth, and each mode may give rise to a different external form. These may be of specific value, although in *Stenopora* they were found to be conspecific (Smith, in press). Moore & Dudley (1944) considered each genus to be characterized by a particular mode of growth.

Genera of the Fistuliporidae may have maculae. At present these are considered to be of use only at a specific level.

The many inconsistencies of some genera placed in the family have been reviewed by Ross (1961, p. 60). Her discussion on *Fistulipora, Buskopora, Cheilotrypa, Coelocaulis, Dybowskiella, Fistuliporella,* and *Lichenotrypa* shows that there is much need for the revision of type species of these genera.

Genus FISTULIPORA M'Coy, 1849; emend. Nicholson & Foord, 1885

1831 (non) *Fistulipora* Rafinesque, p. 5.

1849 *Fistulipora* M'Coy, p. 130, figs a, b.
1851 *Fistulipora* M'Coy; Milne-Edwards & Haime, p. 11.
1882 *Didymopora* Ulrich, p. 156.
1885 *Fistulipora* McCoy; Nicholson & Foord, p. 500.
1890 *Fistulipora* McCoy; Ulrich, p. 474.
1896 *Cyclotrypa* Ulrich, p. 269.
1944 *Cyclotrypa* Moore and Dudley, p. 266.
1947 *Fistulipora* McCoy; Crockford, p. 4.

Type species (by subsequent designation of Milne-Edwards & Haime, 1850, p. lix): *Fistulipora minor* M'Coy, 1849, p. 130, figs a, b, from the Lower Carboniferous Limestone, Derbyshire, England.

Diagnosis: Zoarium ramose, encrusting or laminate; zooecial apertures with poorly developed lunaria which do not indent the zooecial wall; diaphragms present; vesicular tissue abundant in interzooecial spaces.

Remarks: M'Coy (1849) described two species of *Fistulipora, F. major* and *F. minor,* without designating a type species. He stated that some generic characteristics cannot be observed on *F. minor* and that additional information may be gained from a study of *F. major.* Bassler (1929, p. CCXXX, fig. 5) examined and figured paratype material from the Sedgwick Museum without describing it. The original specimens described by M'Coy are presumed lost. Revision of the type species may yield pertinent information.

Moore & Dudley (1944) regarded lunarial development as being of generic significance and erected *Cyclotrypa* Moore & Dudley for the forms in which the lunaria are poorly developed. However, from the figures of M'Coy and Bassler it can be seen that the lunaria are poorly developed on *Fistulipora.* Perry & Hattin (1955) erected six species of *Fistulipora* on the degree of prominence of the lunaria; but additional work has shown that the six species are identical (Perry & Hattin, 1960).

Dybowskiella Waagen & Wentzel, 1886, is a genus characterized by bilobate or trilobate zooecial tubes caused by the projection of strongly developed lunaria. Trilobate zooecial tubes have been found also in species of *Fistulipora* such as *F. foordi* Ulrich, 1890, and *F. triloba* Hall & Simpson, 1887.

I do not consider the degree of development of the lunaria to be of taxonomic importance.

Range and Distribution: Ordovician to Permian; cosmopolitan.

FISTULIPORA sp.
(Pl. 1, figs 1, 2)

Description of Bowen Basin Material: Zooecial tubes are 0.08mm wide in cross-section. The nature of the walls and zooecial apertures cannot be determined. Vesicles are coarse and angular. From one to four rows of vesicular tissue separate adjacent zooecia. There are areas where vesicles have been flattened, some of them being replaced by dense tissue.

Remarks: The occurrence of fragments in oblique longitudinal sections made the generic identification difficult. Dr J. M. Beattie (née Crockford) has confirmed the presence of *Fistulipora* sp. in the sections.

The species described has minute dimensions and in this way can be separated from species in the Permian of Western Australia.

Range and Distribution: Cyclostomatous Polyzoa related to *Fistulipora* are common in the Permian of Western Australia. This is the first record of the genus from the Permian of Eastern Australia. In the Bowen Basin, *Fistulipora* sp. has been recorded only from the Artinskian Buffel Formation in the Cracow District.

Specimens 16401 and 16402 SUGD are recorded from L2575.

Family ETHERELLIDAE Crockford, 1957

Remarks: The Etherellidae may be distinguished from the Fistuliporidae and Hexagonellidae by the reduction in the amount of vesicular tissue and the greater development of stereom. Diaphragms are absent. The hook-shaped nature of zooecia near the mesotheca is important, but the ratio of the length of the recumbent portion to that of the perpendicular portion of zooecia varies with the orientation of the section.

Genus LIGULOCLEMA Crockford, 1957

1957 *Liguloclema* Crockford, p. 35.

Type species (by original designation): *Liguloclema typicalis* Crockford, 1957, p. 35, pl. 9, fig. 4, text-fig. 5 from the Artinskian Noonkanbah Formation.

Remarks: The genus *Liguloclema* can be distinguished from *Etherella* by the different external form of the zoarium: *Liguloclema* is strap-shaped and *Etherella* cribrose.

Range and Distribution: Permian; Western Australia and Queensland.

LIGULOCLEMA sp.
(Pl. 1, fig. 3; Text-fig. 9)

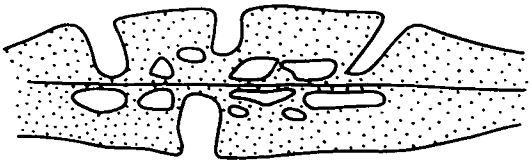
Description of Bowen Basin Material: Externally the main branch is strap-like in appearance. It is 2.5mm wide and 1.5mm thick. Thickness and width proximal to bifurcation increase only slightly. Distal to bifurcation the main branch is 2.1mm wide and the secondary branch 1.8mm wide. Measurements of branch thickness at the only bifurcation cannot be made because of partial crushing.

Lateral margins of the branch are marked by sharp carinae.

Zooecial apertures are arranged in diagonal rows across the branch. There is some resemblance in portions of the branch to seven longitudinal rows. This is true also of the diagonal rows proximal to bifurcation, where there is an increase in the number of zooecial apertures per unit area.

The zooecial apertures range in diameter from 0.16mm to 0.3mm. They are slightly oval, with the upper and lower limits varying by about 0.03mm from the diametric measurements. Lunaria are present in various states of development and occupy one-half to one-third of the apertural circumference. Centres of successive apertures are separated by 0.8mm to 1.3mm and 6 or 7 apertures are found in 5mm in the growth direction.

Internally the zooecial tubes show their hook-shaped condition near the mesotheca. Only in this area is vesicular tissue developed, the vesicles being replaced by dense stereom near the surface.



Text-fig. 9.—*Liguloclema* sp., camera lucida drawing of a polished transverse section. CPC 7016 from SP 720. Approx. x25.

Remarks: *Liguloclema* sp. shows more resemblance to *L. meridianus* (Bretnall, 1926) than to the type species. The latter is much broader with more rows of zooecial apertures and a more regular longitudinal arrangement of the apertures. *L. meridianus* is of similar dimensions to *L.* sp., but the apertures are more regularly arranged and more closely spaced.

Range and Distribution: This is the first record of *Liguloclema* from Eastern Australia. In the Bowen Basin it is recorded from the Artinskian Cattle Creek Formation at Reids Dome.

Specimens referred to the species are CPC 7015 and 7016 from locality SP 720.

Family GONIOCLADIIDAE Nikiforova, 1938

Waagen & Wentzel (1886, p. 775) erected the Subfamily Goniocladinae and placed it in the Family Fenestellidae, Suborder Cryptostomata. They included *Ramipora* Toula and *Goniocladia* Etheridge Snr in this subfamily. Shulga-Nesterenko (1933) placed the genera in the Family Cystodictyonidae, Order Cryptostomata, and Nikiforova (1938) placed the Family Goniocladiidae in the Order Cryptostomata. However, the lack of hemisepta and the absence of vertical double plates between zooecia separate the genera from the sulcoreteporid Cryptostomata.

I follow Crockford (1947, p. 11) and Bassler (1953, p. G89) in including the genera and family in the Order Cyclostomata, rather than Shulga-Nesterenko (1955, p. 177) and Morozova (1955, p. 71), who place them in the Cryptostomata.

Genus RAMIPORA Toula, 1875

1875 *Ramipora* Toula, p. 230, pl. X, figs 1, 1a.
1926 *Aetomacladia* Bretnall, p. 21.
1933 *Ramipora* Toula; Shulga-Nesterenko, p. 35, 54.
1938 *Ramiporidra* Nikiforova, p. 197.

Type species (by monotypy): *Ramipora hochstetteri* Toula, 1875, p. 230, pl. X, figs 1, 1a, from the Permian (Artinskian) *Spirifer* Limestone at Kapp Starostin, Bellsund or Nordfjorden, Spitzbergen.

Diagnosis: Zoarium dendroid, composed of a first-order branch bearing paired and opposed second-order branches from which paired and opposed third-order branches may arise. These may bear fourth-order branches, end bluntly, or fuse with a neighbouring branch. Branches are bifoliate, with zooecia on either side of a mesotheca which is represented on both obverse and reverse surfaces by median carinae. Zooecial apertures are on obverse surface and may be variably oriented; zooecia without hemisepta; lunaria and peristomes variably developed; diaphragms rare. Vesicular tissue developed internally but not externally, the spaces between the apertures being solid.

Remarks: During studies on species of *Ramipora* from Pechora Land, Shulga-Nesterenko (1933, p. 55) found that some forms could not be referred to *Ramipora* because of variation in the mode of growth and the distinct configuration of the colony. Certain peculiarities in the internal structure were also noted. Because of these differences, the subgenera *Ramiporella, Ramiporina,* and *Ramiporalia* were erected. Nikiforova (1938) erected the subgenus *Ramiporidra* with *Ramipora uralica* Stuckenberg as the type species.

Bassler (1953, p. G89) considers *Ramiporina* as a synonym of *Volgia* Stuckenberg, 1905. He also regards *Aetomacladia* Bretnall, 1926, as a subgenus of *Ramipora* and states that the number of rows of zooecial apertures is diagnostic, whereas in all other subgenera form of the colony is the diagnostic feature.

If *Ramipora* Toula, *Ramiporidra* Nikiforova, and *Aetomacladia* Bretnall are studied from Toula (1875, p. 230, pl. X, figs 1, 1a), Morozova (1955, p. 73) and Crockford (1944a, p. 193, pl. 1, figs 4, 5) the diagnoses are the same.

Range and Distribution: Mississippian to Permian; Europe (Spitzbergen, Russia), Asia (Japan), Australia (Western Australia and Queensland).

RAMIPORA AMBROSIOIDES (Bretnall), 1926

(Pl. 1, figs 4, 5; pl. 2, figs 1, 2)

1926	*Aetomacladia ambrosioides* Bretnall, p. 21.
1926	*Aetomacladia ambrosiodes* (sic) Bretnall, pl. 1, fig. 4.
1929	*?Acanthocladia acuticosta* Bassler, p. 85, pl. CCXLIV, fig. 13.
1931	*Aetomacladia ambrosoides* (sic) Bretnall; Hosking, p. 12, pl. IV, fig. 4.
1936	*Aetomacladia ambrosoides* (sic) Bretnall; Chapman, in Raggatt, p. 106.
1936	*Aetomacladia ambrosioides* Bretnall; Chapman, in Raggatt, p. 128.
1936	*Aetomacladia ambronis* (sic) Bretnall; Chapman, in Raggatt, p. 148.
1937	*Aetomacladia ambrosioides* (sic) Bretnall; Raggatt & Fletcher, p. 169.
1937	*Aetomacladia ambrosioides* Bretnall; Raggatt & Fletcher, p. 173.
1944a	*Ramipora ambrosoides* (sic) (Bretnall); Crockford, p. 193, pl. 1, figs 3-5; pl. 2, figs C-F.
1957	*Ramipora ambrosoides* (sic) (Bretnall); Crockford, p. 38.
1961	*?Ramipora ambigua* Sakagami, p. 24, pl. 9, figs 1, 2.
1964	*Aetomacladia ambrosoides* (sic) (Bretnall); Crespin, p. 50.
1964	*Ramipora ambrosoides* (sic) (Bretnall); Crespin, p. 56.

Lectotype (chosen Crockford, 1944a, p. 193): GSWA 2/2405B from the ?Sakmarian Callytharra Formation, east of the Gascoyne-Wyndham River Junction, Western Australia; Lat. 25°03'S, Long. 115°33'E, Glenburgh Sheet, at Fossil Hill, Fossil Hill station, Western Australia.

Diagnosis: Fine *Ramipora* with three to five rows of zooecial apertures on each side of the mesotheca and six to eight apertures between the lateral branches.

Remarks: The lectotype of *Ramipora ambrosioides* has been located on the slab figured by Bretnall (1926, pl. III). There are three specimens labelled '12'. In one, the label has the correct orientation, in another it is upside down and in the third, the lectotype, it is lying on its right side. Part of the '12' can be seen in Crockford's figure of the lectotype (1944a, pl. 1, fig. 4).

Discussion of the type locality has been presented by Wass (1966b).

Bowen Basin Material: Fragmentary zoaria are similar to those described and figured by Crockford (1944a, p. 197, pl. 1, fig. 3).

Remarks: *Ramipora ambigua* Sakagami and *Acanthocladia acuticosta* Bassler are inadequately known and in this work are considered to be possibly identical with *R. ambrosioides*. Bassler states that in *A. acuticostata* two rows of zooecial apertures are developed; but in the lower left hand side of his figure three rows showing oblique orientation to the carina are clearly visible.

Range and Distribution: *Ramipora ambrosioides* has been recorded previously from Western Australia, in the Callytharra, Wandagee, and Noonkanbah Formations of Artinskian age. The upper limit of the Noonkanbah Formation may be Lower Kungurian (Crockford, 1951).

This is the first record of the species from Eastern Australia. In the Bowen Basin, it has been found in the Artinskian Cattle Creek Formation at Reids Dome. Specimens and their localities are: CPC 7017-7021, SP 720; CPC 7022-7024, SP 732.

Family STENOPORIDAE Waagen & Wentzel, 1886

(ex Stenoporinae Waagen & Wentzel, 1886, rev. and emend. Duncan, 1949)

Diagnosis: Zoaria of variable habit: ramose, encrusting, frondescent, bifoliate, or a combination of types; zooecia angular; walls may be annulated, thickened intermittently or uniformly; mesopores may occur; acanthopores present, usually very conspicuous and numerous; diaphragms generally present, complete, perforate, or incomplete.

Genus STENOPORA Lonsdale, 1844

1844 *Stenopora* Lonsdale, p. 178.
1845 *Stenopora* Lonsdale; Lonsdale, in Strzelecki, p. 262.
1886 *Stenopora* Lonsdale; Nicholson & Etheridge, p. 173.
1891 *Stenopora* (partim) Lonsdale; Etheridge, p. 32.
1912 *Stenopora* (partim) Lonsdale; Lee, p. 147.
1929 (non) *Stenopora* Lonsdale; Bassler, p. 54.
1929 *Ulrichotrypa* Bassler, p. 55.
1939 *Stenopora* Lonsdale; Duncan, p. 242.
1941 *Stenopora* Lonsdale; Bassler, p. 173.

Type species (by subsequent designation of Ulrich, 1890, p. 375): *Stenopora tasmaniensis* Lonsdale, 1844, p. 178, from the 'Palaeozoic Formation of Van Diemen's Land' (Tasmania).

Diagnosis: Zoarium ramose, massive, encrusting, bilaminar, frondescent; zooecial tubes thin-walled in immature region and distinctly annulated in the mature region; diaphragms absent; apertures oval or rounded; mesopores present; maculae or monticules may be developed; acanthopores present.

Remarks: Generic diagnoses for *Stenopora* have varied from author to author. Many have included diaphragms of a varying nature in the diagnoses. Diaphragms are not present in *Stenopora;* structures called diaphragms by some authors are formed by wall laminae passing from one zooecium to the next in the wall, not across the zooecial tube (see Text-fig. 4).

Sections made by Smith (in press) and the writer using topotype material show the presence of mesopores, an identification hitherto in doubt.

STENOPORA TASMANIENSIS Lonsdale, 1844

(Pl. 2, figs 3, 4; Pl. 3, figs 1-3; Pl. 4, figs 1, 2)

1844 *Stenopora tasmaniensis* Lonsdale, in Darwin, p. 178.
1845 *Stenopora tasmaniensis* Lonsdale; Lonsdale, in Strzelecki, p. 262, pl. 8, figs 2-2e.
1886 *Stenopora tasmaniensis* Lonsdale; Nicholson & Etheridge, p. 178, pl. 3, figs 9-12.
1888 *Stenopora tasmaniensis* Lonsdale; Johnston, pl. 21, figs 3-3b.

1891 *Stenopora tasmaniensis* Lonsdale; Etheridge, p. 60, pl. 4, figs 3-4; pl. 5, figs 7-8.
1891 *Stenopora johnstoni* Etheridge, p. 59, pl. 7, fig. 7.
1915 *Stenopora johnstoni* Etheridge; Hummel, p. 74, pl. 8, figs 4a-b.
1941 *Stenopora tasmaniensis* Lonsdale; Bassler, p. 173, figs 5, 6.
1945 *Stenopora johnstoni* Etheridge; Crockford, p. 20, text-figs 24, 25.

Holotype: Lost.

Neotype (chosen Smith, in press): UTGD 53639 from the Artinskian Golden Valley Group (Bundella Mudstone), on the shore below Porter Hill, Lower Sandy Bay, Hobart, Tasmania.

Diagnosis: Zoarium ramose; zooecia arising from an imaginary axis or from a mesotheca; mesopores present; acanthopores well developed, encircling the zooecia; annulations present, often overlapping to such an extent that the walls appear evenly thickened.

Remarks: Smith (in press) has observed a zoarium of *Stenopora tasmaniensis* arising from a zoarium of *S. johnstoni;* and I have collected material from the north shore of Maria Island, Tasmania, in which this feature can be observed even though the specimen is weathered where the two 'species' meet. Previously, the two species had been differentiated solely on their growth form, *S. tasmaniensis* being ramose and *S. johnstoni* bilaminar.

Description of Bowen Basin Material: The zoaria are ramose, from 4mm to 10mm in diameter. Surface features exhibited by monticules are absent.

Zooecial tubes diverge from an imaginary axis at 20°-30° and on reaching the mature zone curve outwards to intersect the periphery at 80°-90°. Zooecial walls in the immature zone are thin and slightly crenulate; in the mature zone they become annulated. Annulations are separated from one another in the inner portion of the mature zone, but towards the periphery they begin to overlap, giving the wall an evenly thickened appearance.

In transverse section, the zooecial tubes are polygonal in the midportion of the immature zone. In the mature zone, the tubes are circular (0.23-0.3mm) or oval (0.19-0.25 x 0.28-0.39mm).

Zooecial apertures are not oriented and are separated by mesopores. Mesopores are of two sizes, the larger having a diameter of 0.12mm and the smaller a diameter of 0.05mm. The two sizes may be found together in clusters of two or three. If in clusters, the mesopores are usually separated by acanthopores.

From 10 to 16 acanthopores surround each aperture, in a single row. They cannot be divided into micro- and megacanthopores because of continuous variation between the upper and lower limits of size.

The variation in width of the mature zone can be shown best by figures: in a zoarium of radius 2.2mm the mature zone is 0.9mm wide, and in a zoarium of radius 4.2mm the mature zone is 2.8mm wide.

Remarks: Acanthopores in *S. ovata* and *S. crinita* are more widely spaced than in *S. tasmaniensis*. In all sections studied of the three species, the annulated walls of *S. tasmaniensis* have shown features described previously and the annulations are more closely spaced than in *S. ovata* and *S. crinita.*

S. ovata had previously been distinguished from *S. tasmaniensis* by its larger zoaria; but I found the sizes to overlap.

Range and Distribution: Crockford (1951) lists the species from the Artinskian Berriedale Limestone in Tasmania. Smith (in press) gives a list of localities in Tasmania. As *S. johnstoni,* Crockford (1951) records the species from the Sakmarian Allandale and Rutherford Formations in New South Wales and from the Artinskian Golden Valley Group at Maria Island and Porter Hill, Tasmania.

Hill & Woods (1964) refer a specimen to *S.* cf. *tasmaniensis* from the 'Upper Oxtrack Formation', now the Oxtrack Formation, at Cracow, Queensland. The specimens from this horizon are definitely *S. tasmaniensis,* and this extends the stratigraphic range of the species to Kungurian — Kazanian.

Specimens recorded as *S. tasmaniensis* and their localities in the Bowen Basin are: UQGD F44293-4 and F44299-44301, L2575; UQGD F43416, SUGD 16403-4, L2580; UQGD F43417-8, L2487.

STENOPORA OVATA Lonsdale, 1844

(Pl. 4, figs 3, 4; Pl. 5, figs 1, 4)

1844 *Stenopora ovata* Lonsdale, in Darwin, p. 179.
1845 *Stenopora ovata* Lonsdale; Lonsdale, in Strzelecki, p. 263, pl. 8, figs 3-3b.
1886 *Stenopora ovata* Lonsdale; Nicholson & Etheridge, p. 173, pl. 3, figs 1-4.
1945 *Stenopora ovata* Lonsdale; Crockford, p. 15.
1945 *Stenopora pustulosa* Crockford, p. 16, pl. 2, figs 2, 3; text-figs 22, 23.

Holotype: Lost, from the 'Palaeozoic Formation of Van Diemen's Land' (Tasmania).

?Neotype: (chosen Nicholson & Etheridge, 1886, pp. 174-5) BM PD4604, collected by Strzelecki, probably from an unknown locality in Tasmania; figured in Strzelecki (1845, pl. 8, figs 3-3b) and Nicholson & Etheridge (1886, pl. 3, figs 1-4).

Diagnosis: *Stenopora* with ramose or encrusting zoarium; zooecia arise from an imaginary axis if ramose; mesopores present, especially in monticules, which are well developed; acanthopores restricted to the junctions of zooecial walls; annulations usually separate, easily distinguished.

Remarks: Crockford (1945) tentatively erected *S. pustulosa* because the characters of *S. ovata* were imperfectly known and because monticules had not been observed on *S. ovata* whereas they were characteristic of *S. pustulosa*. A study of the Tasmanian material of *S. ovata* and the type specimens of *S. pustulosa* has revealed that they are identical. Smith (in press) reaches a similar conclusion. Smith has concluded that the type locality of the species is Gray, near St Marys, Tasmania. Strzelecki (1845) does not list this as a locality but collected from the district (1845, p. 94, Locality 7).

Description of Bowen Basin Material: The zoaria have a diameter of 8mm to 30mm if ramose, and if encrusting, the thickness of the zoarium is usually greater than 10mm. Monticules are irregularly distributed over the surface.

Zooecial tubes are polygonal in the central portion of the immature zone. They have crenulate walls and diverge from the imaginary axis of growth at an angle of 20°-35°. The zooecial tubes curve outwards in the mature zone and intersect the periphery at 80°-90°. Zooecial walls are annulated in the mature zone, with the annulations usually separate from one another. A slight oblique section shows them as being crowded.

Zooecial apertures are oval, having a short axis of 0.25mm to 0.34mm and a long axis of 0.32mm to 0.48mm. They lack any arrangement.

Monticules are from 10mm to 15mm apart. They are not well developed on the surface, but are readily observable in thin section. The zooecia are as large as 0.44mm x 0.58mm in the monticules, but, in the main, they are not greatly enlarged in the monticules, and mesopores, which are not abundant on the ordinary surface, are abundant in the monticules. Mesopores may be separated by acanthopores.

Acanthopores are usually developed only at the junctions of the zooecial walls, but in a monticule there may be more between the junctions. From five to ten surround each zooecium.

The mature zone occupies about one-half the radius of the zoarium.

Remarks: Distinctions between *S. ovata* and *S. tasmaniensis* have been discussed under *S. tasmaniensis*. *S. ovata* stock may have evolved from *tasmaniensis* stock by the suppression, in places, of smaller acanthopores between the zooecia. At the same time, acanthopores at the junctions of zooecial walls have become larger and generally more persistent.

Range and Distribution: Etheridge (1891) records *S. ovata* from the Hunter River railway bridge at Singleton, New South Wales. Walkom (1913) records the species from the railway cutting east of Allandale. Crockford (1951) lists the species from the Artinskian Berriedale Limestone in Tasmania; Smith (in press) has a concise list of the Tasmanian localities.

Hill & Woods (1964) refer a specimen to *S.* cf. *ovata* from the Lower Oxtrack Formation, now the Buffel Formation, at Cracow, Queensland.

The range of the species may be regarded as Sakmarian to Kazanian.

Specimens from the Bowen Basin are: CPC 7126, 7129, 7130, 7153, 7154, all from locality L.2575.

STENOPORA CRINITA Lonsdale, 1845

(Pl. 5, figs 2, 3; Pl. 6, fig. 1)

1845 *Stenopora crinita* Lonsdale, in Strzelecki, p. 265, pl. 8, figs 5, 5a.
1849 *Chaetetes crinitus* (Lonsdale); Dana, p. 711, pl. 11, fig. 7.
1886 *Stenopora crinita* Lonsdale; Nicholson & Etheridge, p. 182, pl. 4, figs 1-5; text-figs 2A, B.
1891 *Stenopora crinita* Lonsdale: Etheridge, p. 49, pl. 2, fig. 3; pl. 4, fig. 2; pl. 5, figs 1-4; pl. 6, figs 3-6; pl. 7, figs 1-2.
1945 *Stenopora crinita* Lonsdale; Crockford, p. 11, text-figs 3, 4.

Lectotype: (chosen Nicholson & Etheridge, 1886, p. 183) BM PD4603 from 'Illawarra, New South Wales'.

Diagnosis: Large, massive, ramose and encrusting species of *Stenopora;* if ramose, zooecia arise from an imaginary axis; zooecia thin-walled in immature zone, the walls in the mature zone exhibiting well spaced annulations; mesopores present, more so in the monticules; acanthopores usually restricted to the junctions of the zooecial walls, but may be more profuse in the monticules.

Remarks: Unfortunately, because of lack of matrix on the lectotype, direct comparisons with rock types on the south coast of New South Wales in the Illawarra area could not be made. Within this region, *S. crinita* is most abundant at Black Head, Gerroa. This locality is easily accessible and is probably the type locality.

Description of Bowen Basin Material: The zoaria have a diameter of 35mm to 65 mm if ramose. Distal to branching, the secondary branches may be only 21mm in diameter. If the zoaria are encrusting, their thickness varies from 15mm to 30mm.

In the centre of the immature zone, zooecial tubes are polygonal, and have thin crenulate walls. The tubes diverge from an imaginary axis at 15°-30°, and because of the relatively small width of the immature zone they bend sharply outwards into the mature zone and intersect the periphery at 80°-90°. Zooecial walls are annulated in the mature zone; annulations are small and pyriform in section and separate from one another.

Zooecial apertures are polygonal, with a short axis of 0.27mm to 0.47mm and a long axis of 0.33mm to 0.57mm. They exhibit no orientation.

Monticules 10-15mm apart are present on encrusting and ramose forms. They are well developed on the surface of the zoarium, and in a shallow tangential section it is difficult to find a large area not affected by a monticule. Zooecia in monticules are not greatly enlarged or reduced from those of an ordinary surface. Zooecial walls are generally wider in monticules than those on an ordinary surface. Mesopores are not abundant in any portion of the zoarium.

From five to fourteen acanthopores surround each aperture; the smaller number is found outside a monticule where the acanthopores occur at junctions of zooecial walls. Thickening of walls in the monticules is due to introduction of acanthopores between junctions of zooecial walls.

The mature zone occupies from one-half to three-quarters the radius of the zoarium.

Remarks: *Stenopora crinita* can be easily distinguished from *S. ovata* by the wall structure and from *S. tasmaniensis* by the arrangement of acanthopores on an ordinary surface.

Range and Distribution: Etheridge (1891) lists the species from a number of localities in the Hunter Valley and on the South Coast of New South Wales. These are throughout the Maitland Group. Crockford (1951) records *S. crinita* from the Malbina Formation (Member E) at Eaglehawk Neck, Tasmania.

Whitehouse (in Reid, 1930b) lists the species from the Dilly Stage of the Springsure District, Queensland. Crockford (1945) has examined one of the specimens and does not regard this as a true record of *S. crinita* because of the larger number of acanthopores. Whether this was due to the development of monticules is not known. The range of the species is Artinskian to Kungurian: the specimen recorded here from the Cattle Creek Formation is the earliest known occurrence of the species.

Specimens catalogued from the Bowen Basin and their localities are CPC 7127, CL 121; CPC 7128, SP 720.

Genus STENODISCUS Crockford, 1945

1844 (non) *Stenopora* Lonsdale, p. 178.
1891 *Stenopora* (partim) Lonsdale; Etheridge, p. 32.
1912 *Stenopora* (partim) Lonsdale; Lee, p. 147.
1929 *Stenopora* Lonsdale; Bassler, p. 54.
1945 *Stenodiscus* Crockford, p. 21.

Type species (by original designation): *Stenodiscus moniliformis* Crockford, 1945, from the Artinskian Berriedale Limestone, Cascades Group, in the Collinsvale Quarry, northwest of Hobart, Tasmania (Crockford, 1945, p. 21, pl. 1, figs 1-3, text-figs 20, 21).

Diagnosis: Zoaria ramose; zooecia arising from a central, imaginary axis, are thin-walled in immature zone and slowly curve outwards to a lateral, thick walled, annulated mature zone; diaphragms present; zooecial apertures oval or circular, randomly arranged; mesopores present; acanthopores surround each aperture; monticules developed.

Range and Distribution: Lower Carboniferous-Permian; Western Australia, Eastern Australia, Timor, China.

STENODISCUS sp.

(Pl. 6, figs 2-5)

Description: The zoaria are ramose, ranging in diameter from 6.0mm to 13.0mm in a stable portion. Proximal to bifurcation, the diameter of zoaria may increase to approximately 30.0mm.

Zooecial apertures do not show any orientation. They have an irregular shape: their long axis is 0.3mm to 0.4mm, and their short axis 0.11mm to 0.24mm.

Mesopores are not abundant, but acanthopores are found at the junctions of zooecial walls; five or six surround each aperture.

Zooecial tubes in the immature zone possess thin crenulate walls and are crossed by diaphragms at widely spaced intervals. Before reaching the mature zone the tubes begin to bend gradually from an imaginary axis and reach the mature zone at an angle of 70°-75° to this axis. Walls of zooecial tubes in the mature zone have pear-shaped annulations. Only in outer portions of the mature zone do annulations exhibit any tendency to overlap. Zooecial tubes are crossed by a diaphragm at the boundary between the mature and immature zones; in some cases there may be another in the outer portion of the mature zone. Zooecial tubes in the outer portion of the mature zone are normal to the axis of growth and intersect the periphery at right angles.

The mature zone occupies a small portion of the zoarial diameter and may be 1.2mm to 2.9mm wide.

Remarks: *Stenodiscus* sp. has fewer diaphragms, different wall structure, and fewer acanthopores per zooecium than the type species. The last two features enable it to be differentiated from *Stenodiscus variabilis* Crockford, 1957, and *S. hardmani* Crockford, 1957. Duncan (1949) stated that in stenoporoids diaphragms were generally complete in primitive forms and annulations were developed in advanced forms. However, in *Stenodiscus,* both features are developed in the one genus.

Specimens found in the Bowen Basin and their localities are: GSQ F6003, Y1; GSQ F6009 and F6010, Y2.

Genus LEIOCLEMA Ulrich, 1882

1882 *Leioclema* Ulrich, p. 141.
1883 *Thallostigma* Hall, p. 154.
1890 *Leioclema* Ulrich; Ulrich, pp. 376, 425.
1905 *Lioclema* (sic) Ulrich; Ulrich & Bassler, p. 38.
1920 *Leioclemina* Vinassa de Regny, p. 227 (*fide* Bassler, 1935, p. 237).
1929 *Lioclema* (sic) Ulrich; Bassler, p. 54.
1939 *Lioclema* (sic) Ulrich; Duncan, p. 248.
1961 *Paralioclema* Morozova, p. 93.

Type species (by original designation): *Callopora punctata* Hall, 1858, p. 653, from the Lower Mississippian Meramec Group, Warsaw Formation, near Warsaw, on the eastern bank of the Mississippi River, Illinois, USA (Ulrich, 1882, p. 141, pl. 6, figs 1, 1a; for clearer figures, see Ulrich & Bassler, 1905, p. 38, pl. 9, figs 7-9).

Diagnosis: See Nickles & Bassler, 1900, p. 33.

Range and Distribution: Ordovician-Permian; cosmopolitan.

LEIOCLEMA sp.

(Pl. 7, figs 1, 2; Pl. 8, fig. 4)

Description: The zoaria are encrusting. Their surfaces possess monticules.

Zooecia are subcircular to quadrangular in outline, with a diameter of 0.1mm to 0.38mm. The zooecial apertures are not oriented. Zooecia contain diaphragms which are concave inwards and spaced from 0.24mm to 0.32mm apart, but occasionally they may be separated by 0.48mm. There is no relation between the spacing and the position of the diaphragm in the tube. Walls of zooecia are slightly crenulate and from 0.04mm to 0.12mm wide. At the upper limit a mesopore usually separates the zooecia. In a monticule the zooecial walls are up to 0.2mm in width.

Mesopores contain diaphragms of similar spacing to those in zooecia. The diameter of the mesopores is 0.05-0.08mm. If found in clusters an acanthopore separates them from zooecia.

Acanthopores have a diameter of 0.04mm to 0.08mm. Those in an area affected by a monticule are usually larger than those on the ordinary surface. They are circular, and their walls are composed of granular calcite. If there are three or four junctions of zooecial walls around a zooecium, an acanthopore may be found at each intersection. If there are five or six junctions, only rarely are there five or six acanthopores around the zooecium. In some areas there are only one or two acanthopores per zooecium.

Remarks: *Leioclema* sp. can be distinguished from *L. porosa* Crockford, 1947, from the Lower Carboniferous Lion Creek Limestone, near Rockhampton, Queensland, and *L. globosa* Crockford, 1957, from the Permian of Western Australia, by its lack of mesopores and the wider spacing of diaphragms.

Range and Distribution: This is the first record of *Leioclema* from the Permian of Eastern Australia. *Leioclema globosa* occurs in Western Australia from the Sakmarian Nura Nura Member of the Poole Sandstone to the Artinskian Noonkanbah Formation (Crockford, 1957).

In the Bowen Basin, the species has a range of Kungurian-Kazanian. Specimens assigned to the species, with their localities are: CPC 7040, B 628; CPC 7041, B 1570c.

Order CRYPTOSTOMATA Shrubsole & Vine, 1882

Family RHABDOMESIDAE Vine, 1883

Genus Saffordotaxis Bassler, 1952

1890 *Rhombopora* Meek (partim), Ulrich, p. 652.
1952 *Saffordotaxis* Bassler, p. 385.

Type species (by original designation): *Rhombopora incrassata* Ulrich (1890, p. 652, pl. LXX, figs 12-12d) from the Lower Mississippian, Osagian, Keokuk Formation, at Kings Mountain, near Louisville, Kentucky, USA (Bassler, 1952, p. 385).

Diagnosis: Zoarium slender, ramose; zooecia tubular, diverging from a central axis, thin-walled in immature zone, thick-walled in mature zone; diaphragms may be developed; apertures oval, in longitudinal and diagonal rows; megacanthopores, sometimes in two rows, surround each aperture; mesopores absent.

Remarks: The generic status of *Saffordotaxis* is doubtful. Bassler (1952) related it to *Nicklesopora* Bassler, 1952, which, in turn, is related to *Rhombopora* Meek, 1872. *Saffordotaxis* differs from *Nicklesopora* in possessing one or two rows of megacanthopores around each zooecium (Bassler, 1952) and from *Rhombopora* in having one row of megacanthopores around each zooecium.

I consider the number of rows of megacanthopores to be of specific not generic significance. *Rhombopora* has a row of micracanthopores around each zooecium with a megacanthopore at the distal end; *Saffordotaxis* has megacanthopores only around zooecia.

Use of the terms megacanthopore and micracanthopore varies with the individual worker. They are relative terms and differentiation of acanthopores into one or the other is made difficult because of gradation from one to the other. Diaphragms have been found in both genera. However, *Rhombopora lepidodendroides,* the type species of *Rhombopora,* seems to have a different growth pattern from *R. incrassata,* the type species of *Saffordotaxis,* if the figures of Ulrich (1884, pl. 1, figs 1a, 1b) and Bassler (1953, pl. 95, fig. 5c) are compared. Additional photographs of the two type species forwarded to me by the United States National Museum also show some difference in growth pattern. Whereas in *Rhombopora* the zooecial tubes diverge from a central imaginary axis, in *Saffordotaxis* they diverge from a central axis. Difference in growth form seems to be the only feature which may be of generic significance. I know of no rhabdomesid genus in which both growth forms are present.

Nicklesopora elegantula (Ulrich), the type species of *Nicklesopora,* as figured by Ulrich (1884, pl. 1, figs 3-3b), also has zooecial tubes diverging from an imaginary axis, as in *Rhombopora,* but does not seem to have the preferred orientation of the apertures evident in *Rhombopora.* Diaphragms are absent in *Nicklesopora.*

All three genera are related; but the relation cannot be determined until their type species are restudied.

Range and Distribution: Devonian-Permian; Russia, Japan, Timor, North America, Australia (Western Australia and Queensland).

SAFFORDOTAXIS MULTINODATA sp. nov.

(Pl. 7, figs 3, 4; Pl. 8, figs 1-3; Pl. 9, figs 1-4)

Holotype: UQGD F43419, from the Kungurian-Kazanian Oxtrack Formation, west of Cracow, Queensland; L2487, Lat. 25°18'S., Long. 150°16'E., Mundubbera Sheet 1800 feet due south of a point 2.6 miles west of Cracow on the Theodore Road.

Diagnosis: Species of *Saffordotaxis* with acanthopores arranged in three or four rows; diaphragms lacking.

Description: Zoaria are ramose or massive with a diameter which varies from 1.2mm to 2.1mm, in a stable region, but may approach 2.5mm proximal to bifurcation. The angle between branches ranges from 55° to 70°. In hand specimen diagonal rows of zooecial apertures are more prominent than longitudinal rows, but in thin section the reverse is true. Apertures are oval, having a short axis of 0.16-0.24mm and a long axis of 0.36-0.44mm. In longitudinal rows, three apertures may be found in 1.6-1.8mm, with their centres 0.52-0.58mm apart. In diagonal rows, three apertures may be found in an interval of 0.98-1.12mm, with their centres separated by 0.36-0.44mm. Apertures are separated by rows of acanthopores.

Acanthopores are about 0.03mm in diameter. Three or four rows separate zooecia in longitudinal rows. Around one zooecial tube there may be 19 to 24 acanthopores. The outer two rows of acanthopores seem to continue around the zooecia, but the inner one or two rows are discontinuous as the row abuts against the ends of zooecial tubes.

Zooecial tubes are thin-walled and crenulate in the immature zone, where they diverge from the central axis at 20° to 25°. At the abrupt junction between the mature and immature zones the walls thicken rapidly, and continue to thicken gradually towards the periphery. The walls are so thickened at the junction that they appear to form a superior hemiseptum. Zooecia meet the periphery at 80°. The mature zone occupies less than one-half the radius of the zoarium. In a zoarium of diameter 1.96mm the mature zone is 0.42mm wide.

In transverse section, zooecial tubes of the immature zone are lozenge-shaped, with their elongate ends pointing towards the axis of growth. Immediately proximal to the mature zone tubes become rhomboid, and in the mature zone they are cylindrical.

Remarks: *Saffordotaxis multinodata* sp. nov. can be distinguished from all other species of the genus by the number of rows of acanthopores around the zooecia.

Range and Distribution: *Saffordotaxis* has been recorded previously from Western Australia, but this is the first record of the genus in Eastern Australia.

The range of *S. multinodata* sp. nov. is Artinskian to Kungurian-Kazanian.

The following specimens of *Saffordotaxis multinodata* sp. nov. are recorded from the Bowen Basin localities: UQGD F43657-8, L2580; UQGD F44295-7, L2575; SUGD 16405-16410, L2575.

Genus RHOMBOPORA Meek, 1872

1872 *Rhombopora* Meek, p. 141.
1911 *Rhombopora* Meek; Bassler, p. 162.
1929 *Rhombopora* Meek; Bassler, p. 63.
1929 *Rhombopora* Meek; Moore, p. 133.
1957 *Rhombopora* Meek; Elias, p. 401.

Type species (by original designation): *Rhombopora lepidodendroides* Meek, 1872, p. 141, pl. 7, figs 2a-g, from the Pennsylvanian at Nebraska City, Nebraska, USA.

Diagnosis: Zoarium cylindrical, ramose, with zooecia diverging from a central imaginary axis; zooecia thin-walled in mature zone, may be with hemisepta and diaphragms; zooecial apertures in diagonal rows and less prominent longitudinal rows; apertures within regular sloping vestibule, surrounded by micracanthopores with one of large size being placed distal to each aperture; mesopores absent.

Remarks: Specimens catalogued as AM F44675 are *Rhombopora lepidodendroides* from the Nebraska City area. Information from the University of Nebraska reveals that Meek's original locality is inaccessible. Stratigraphic studies have shown that Meek's original material was collected from the same horizon as the above-mentioned specimens. This is in the Tarkio Limestone, 4 feet above the Willard Shale, Nemaha Subgroup, Wabaunsee Group of the Pennsylvanian.

Sections cut through the material reveal the absence of hemisepta, diaphragms, and a true vestibulum. Acanthopores are abundant. From this it appears that orientation of zooecial apertures is the only morphological feature which is possessed by *Rhombopora* in common with Rhabdomesidae.

Range and Distribution: Devonian-Permian; Russia, Japan, Timor, North America, India, China and Australia (Western Australia, New South Wales, and Queensland).

RHOMBOPORA sp.

(Pl. 10, fig. 1; Text-figs 10-12)

Description: Fragments may be ramose or massive. The stable zoarial diameter ranges from 1.3mm to 1.7mm. Proximal to bifurcation the diameter may increase to 1.92mm and distal to bifurcation it may be 1.12mm. Distal to bifurcation the angle between the branches cannot be measured. In hand specimen, longitudinal and diagonal rows of zooecial apertures are well developed. Apertures are oval, having a long axis of 0.18-0.26mm and a short axis of 0.08-0.13mm. In a longitudinal row three apertures may be found in 1.3-1.92mm, with their centres separated by 0.36-0.9mm. In a diagonal row three apertures may be found in an interval of 0.8-0.96mm, with their centres 0.26-0.4mm apart. Acanthopores separate the apertures (Text-fig. 10).

Apertures are surrounded by one row of seven to nine acanthopores. Only in one or two specimens does the acanthopore distal to the zooecial aperture seem larger than the others.

Zooecial tubes are thin-walled in the immature zone, where they diverge from the imaginary axis at about 35°. On reaching the mature zone the tubes bend abruptly, their walls thicken rapidly, and the angle at which they reach the periphery varies from 80° to 90° (see Text-fig. 11). The width of the mature zone is a little less than one-half the radius of the zoarium. In a zoarium of diameter 1.6mm, the mature zone is 0.34mm wide.

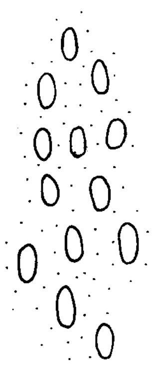


FIG. 10

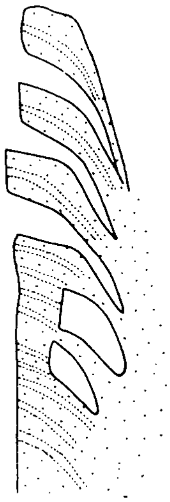


FIG. 11

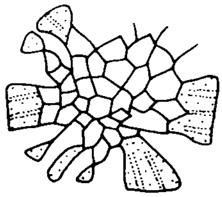


FIG. 12

Text-fig. 10.—*Rhombopora* sp., drawing from a polished surface of a tangential section. Loss of orientation of apertures is due to slight oblique nature of section. CPC 7025 from SP 720. x20.

Text-fig. 11.—*Rhombopora* sp., drawing from a photograph of a longitudinal section. CPC 7025 from SP 720. x20.

Text-fig. 12.—*Rhombopora* sp., drawing from a polished surface of a transverse section. CPC 7025 from SP 720. x20.

Diaphragms can be observed in the immature zone.

In transverse section, zooecial tubes are polygonal in the centre of the immature zone. Near the boundary between the zones they become elongate oval before assuming the cylindrical habit of the mature zone (see Text-fig. 12).

Range and Distribution: *Rhombopora* has been recorded previously from Eastern Australia. *R. filiformis* Crockford, 1941b, occurs in the Artinskian Conjola Formation in New South Wales, and *R. laxa* (Etheridge) is found in the Permian (?Artinskian) sequence at Gympie.

The present record is the first of the genus from the Bowen Basin. Specimens (CPC 7025) have been found at only one locality, SP 720, Artinskian in age.

Genus STREBLASCOPORA Bassler, 1952

1929 *Streblotrypa* Vine (partim); Bassler, p. 66.
1944b *Streblotrypa* Vine (partim); Crockford, p. 168.
1952 *Streblascopora* Bassler, p. 385.

Type species (by original designation): *Streblotrypa fasciculata* Bassler, 1929, p. 66, pl. CCXXXIX, figs 4, 5, from the Artinskian Bitaoeni Beds of Timor, on the path from Manoema to Soefa (Bassler, 1952, p. 385).

Diagnosis: Zoarium ramose with an axial bundle of parallel tubes; zooecia tubular, thin-walled in immature region, thick-walled in mature region, often with hemisepta. Apertures arranged in longitudinal and diagonal rows with mesopores separating apertures in longitudinal rows; small acanthopores may be present near apertures.

Remarks: *Streblascopora* differs from *Streblotrypa* in possessing an axial bundle of tubes, from which the zooecia diverge. In *Streblotrypa* the zooecial tubes diverge from an imaginary axis. The genus of several described forms is in doubt because only external features have been studied.

Range and Distribution: Lower Carboniferous-Permian; Russia, North America, Japan, Timor, Australia (Western Australia and Queensland), ?South America.

STREBLASCOPORA MARMIONENSIS (Bretnall, 1926)*

(Pl. 10, figs 2-7)

1926 *Streblotrypa marmionensis* Etheridge, Bretnall, p. 22, pl. 1, figs 1, 7, pl. 2, fig. 3.
1929 cf. *Streblotrypa germana* Bassler, p. 67, pl. CCXXXIX, figs 6-10.
1931 *Streblotrypa marmionensis* Etheridge; Hosking, p. 14, pl. 4, fig. 1, text-fig. 1.
1944b *Streblotrypa marmionensis* Etheridge; Crockford, p. 168, pl. 5, figs 10, 11, text-figs 31-34.
1957 *Streblascopora marmionesis* (sic) (Etheridge); Crockford p. 80.

Holotype: AM F17548, from the Artinskian Noonkanbah Formation, near Mount Marmion, Western Australia; Lat. 17°23'S., Long. 124°21'E., Derby Sheet at the base of Mount Marmion, Kimberley Downs station, east of Derby, Western Australia (Crockford, 1944b, p. 168, pl. 5, fig. 11).

Neotype (chosen Crockford, 1957, p. 80): AM F17551 from the same locality (Crockford, 1944b, pl. 5, fig. 10).

The holotype number stated in previous papers is incorrect. Museum records show that the holotype is lost.

* Ascribed by Bretnall (1926, p. 7) to 'Eth. fil. MS': but Bretnall was the first to publish the description.

Diagnosis: Ramose *Streblascopora* with cylindrical branches having usually 16 to 20 longitudinal rows of apertures and with distinct areas of pits marked off by longitudinal ridges; each area contains 4 to 14 mesopore pits.

Description of Bowen Basin Material: Zoarial fragments may be ramose; no base of a colony is preserved. Diameter of the zoaria varies from 1.05-1.48mm and at bifurcation there may be an increase from 1.31mm proximal to 1.72mm during bifurcation. Distal to bifurcation the secondary branch is 1.48mm wide. Zooecial apertures are arranged in longitudinal and diagonal rows with the former more obvious and flanked by longitudinal ridges. Diagonal rows make an angle of 45° with the branch periphery.

Zooecial apertures are elliptical, their length is 0.12-0.16mm and their width 0.08-0.16mm. The apertures are truncated slightly at their distal end. In a longitudinal row there are 19 to 23 zooecial apertures in 10mm; centres of successive apertures are separated by 0.42-0.71mm. In longitudinal rows the apertures are separated by mesopores.

The number of mesopores between the apertures varies from 4 to 14. They are arranged in two or three longitudinal rows. If both are developed, the three-row condition is distal to the two. Rows are separated by ridges, which are lower and wider where there are three rows of mesopores.

Internally, the central bundle of tubes is 0.24mm wide. Zooecia diverge from the central bundle at 25°-30° towards periphery, which they meet at right angles. The width of the mature zone is 0.21mm.

Remarks: Bretnall (1926, pl. 1, figs 1, 7) refers figure 1 to *S. marmionensis* (Bretnall) and figure 7 to *S. etheridgei* (Bretnall). I consider both to be referable to *S. marmionensis* (Bretnall), which can be distinguished from *etheridgei* by its smaller size, the presence of longitudinal ridges separating the zooecial apertures in unweathered specimens, and the absence of the large crescentic mesopore pit placed distal to each aperture.

Streblascopora germana (Bassler) from Timor is poorly known, but appears to differ from *S. marmionensis* in dimensions of the central bundle of tubes and the immature zone.

Range and Distribution: In Western Australia, *S. marmionensis* has been recorded from the ?Sakmarian Callytharra Formation to the Artinskian Noonkanbah Formation (Crockford, 1951, 1957), and the Artinskian Berriedale Limestone in Tasmania (Banks, in Hill, 1955). This is the first record of the species in Queensland, but its range is not affected. Specimens CPC 7028-33 were collected from locality SP720.

Family ACANTHOCLADIIDAE Zittel, 1880

Fenestrate Polyzoa of the Bowen Basin belong to two families: Fenestellidae King and Acanthocladiidae Zittel. The artificiality of the classification of genera into these two families was discussed by Vine (1884). Since then many workers, especially Nekhoroshev (1932), Shulga-Nesterenko (1951), Astrova & Morozova (1956), and Morozova (1962, 1964), have discussed the scheme of classification of fenestrate Polyzoa.

Much of the information contained in Morozova (1962, 1964) seems to be correct, but there are a number of inconsistencies. Morozova mentions important features of fenestrate Polyzoa which can be used in a classificatory scheme at familial level, but their importance is reduced at generic level. Criticisms of the genera *Levifenestella* Miller and *Parafenestella* Miller are based on preservation of the carina and other features such as zooecial arrangement.

The Family Fenestellidae King as it appears in Bassler (1953) is divided into three families—Fenestellidae, Septoporidae, and Polyporidae—by Morozova (1964), and the Acanthocladiidae is reduced in content. In the Polyporidae and Septoporidae, the structure of the carina varies from genus to genus; and the arrangement of zooecia in the colony varies from genus to genus in all three families. These variations seem to make Morozova's scheme even more artificial than that of Bassler; and because no better scheme has yet been devised, Bassler's classification is used here.

Genus DIPLOPORARIA Nickles & Bassler, 1900

1875 *Diplopora* Young & Young, p. 326.
1890 *Diplopora* Young & Young; Ulrich, p. 636.
1900 *Diploporaria* Nickles & Bassler, p. 233.

Type species (by monotypy): *Glauconome* (*Diplopora*) *marginalis* Young & Young (1875, p. 326, pl. 3, figs 14-21), from the Lower Carboniferous Limestone of West Scotland.

Diagnosis: Zoarium consisting of main branch; secondary branches few in number arising obliquely from main branch at wide intervals; secondary branches not joined by dissepiments; zooecia in two rows on main and secondary branches separated by a nodose carina.

Range and Distribution: Carboniferous-Permian; Great Britain, Russia, USA, and Australia.

DIPLOPORARIA sp.

(Pl. 11, fig. 1)

Description: The zoarium is presumed to be pinnate, but its complete shape has not yet been observed. The incomplete length of the main branch is

11.3mm, and in this distance there are two secondary branches. They arise from opposite sides of the main branch at points 3.4mm apart. The more proximally placed secondary branch makes an angle of about 40° with the main branch, whereas the other has an angle of departure with the main branch of about 80°.

The main branch is 0.56mm wide except proximal to bifurcation, where it may be as wide as 0.64mm. Immediately distal to bifurcation the width is reduced to 0.48mm, but it soon resumes the usual proportions. Secondary branches are 0.6mm wide. Both main and secondary branches have two rows of zooecia.

Apertures in one row alternate with those in the other. There are 14 to 16 apertures in 5mm, and the centres of successive apertures are separated by 0.32-0.48mm. The more closely spaced apertures are those on the side of bifurcation. Apertures have a diameter of 0.1-0.16mm and are lipped by a thick peristome. This is very evident on the side of the apertures opposite the carina. In some apertures this peristomal lip is developed into short sharp spines. Apertures on both main and secondary branches are separated by a nodose carina.

There is one row of nodes; 13 to 15 nodes are developed in 5mm. They are elongated parallel to the branch length and if unweathered have a diameter of 0.02-0.04mm at their upper extremity. The last node on the carina proximal to bifurcation is larger than usual. Centres of successive nodes are separated by 0.4-0.48mm. Proximal to bifurcation, the carina converges towards the side of the branch from which the secondary branch will arise; otherwise the carina is in the middle of the branch.

Distal to bifurcation of the main branch is an area of instability on the more proximal secondary branch. In this unstable region zooecial apertures are arranged spirally around the branch.

The obverse surface is covered by minute granules which show a tendency to be oriented parallel to the growth direction.

The reverse surface is ornamented by longitudinal striae and grooves.

Remarks: Comparison with other known species of *Diploporaria* is made difficult because the zoarium is fragmentary. However, spiralling of zooecial apertures has been observed on *D. bifurcata* (Ulrich, 1890, pl. LXII, fig. 12a).

The wide intervals between the secondary branches serve to distinguish this genus from *Penniretepora* d'Orbigny. The species *P. fragilis* Crockford may have one secondary branch every 3.2mm on one side of the main branch.

This is the widest interval in any Australian species of *Penniretepora* and is much less than the one branch every 11.3mm found on *Diploporaria* sp.

Range and Distribution: This is the first record of the genus from Australia and it is found only in Artinskian strata. One specimen has been found, UQGD F48387 from L 1554.

Genus PENNIRETEPORA d'Orbigny, 1849

1849 *Penniretepora* d'Orbigny, p. 501.
1850 *Penniretepora* d'Orbigny, p. 153.
1850 (non) *Penniretepora* d'Orbigny, p. 45.
1875 *Acanthocladia* Young & Young, p. 327.
1883 *Pinnatopora* Vine, p. 191.
Glauconome auctt. (*non* Goldfuss, 1826).

Type species (by original designation): *Retepora pluma* Phillips, 1836, p. 199, pl. 1, figs 13-15, from the Carboniferous (Visean) of Yorkshire, England.

Diagnosis: Zoarium consisting of main branch with secondary branches arising obliquely from it at intervals; no dissepiments between secondary branches; zooecia in two rows on main and secondary branches with apertures usually separated by a nodose carina; zooecia simple, rhomboidal.

Remarks: d'Orbigny erected the genus *Penniretepora* in 1849 with *Retepora pluma* as the type species (1849, p. 501). Miller (1961a, p. 225) stated that the type species was selected by Bassler (1953). Only one reference to *Penniretepora* by d'Orbigny (1850) is in accord with the original description of 1849. This is the second reference (1850, p. 153).

Range and Distribution: Silurian-Permian; cosmopolitan.

PENNIRETEPORA TRIPOROSA Crockford, 1944

(Pl. 11, fig. 2)

1929 (non) *Pinnatopora trilineata* var. *texana* Moore, p. 126, pl. 15, figs 6-9.
1936 *Pinnatopora trilineata* var. *texana* Moore; Chapman, in Raggatt, p. 128 (*fide* Crockford, 1944b, p. 161).
1944b *Penniretepora triporosa* Crockford, p. 161, pl. 161, pl. 5, fig. 4, text-fig. 49.
1961 *Penniretepora akagii* Sakagami, p. 49, pl. 24, fig. 9.
1963 *Penniretepora higashiyamensis* Sakagami, p. 16, pl. 3, fig. 3, text-fig. 2.

Holotype: CPC 305 from the ?Sakmarian Callytharra Formation, west of Callytharra Springs, Western Australia; Lat. 25°53'S., Long. 115°29'E., Wooramel Sheet (Crockford, 1944b, p. 161, pl. 5, fig. 4, text-fig. 49).

Diagnosis: See Crockford, 1944b, p. 161.

Remarks: Crockford (1944b) quotes F795, CPC as the number of the holotype. The renumbering indicates that the specimen is lodged in the type collection.

Description of Bowen Basin Material: The specimens are fragmentary.

The zoarium is pinnate. The main branch is 0.72mm to 0.9mm wide; there may be some small increase proximal to bifurcation. Secondary branches arise at intervals of 0.9-1.12mm and the angle they make with the main branch ranges from 55° to 65°. Secondary branches range in width from 0.36mm to 0.62mm. Carinae on successive secondary branches on the same side of the main branch are separated by 1.36-1.8mm. Both main and secondary branches have two rows of apertures.

The diameter of the apertures on both branches is from 0.16mm to 0.26mm. Some apertures are elongate, 0.3mm x 0.2mm. On the main branch there are 11 to 12 apertures in 5mm, and on secondary branches immediately distal to bifurcation there are 13 in 5mm. Successive zooecial apertures are separated by 0.4mm to 0.54mm. Between successive secondary branches on one side of the main branch there are two or three apertures. Rows of apertures on both main secondary branches are separated by a nodose carina.

The carina is more prominent on the main branch, where nodes are separated by 1.12-1.4mm; on the secondary branches they are much closer spaced, 0.7mm to 0.98mm apart.

The obverse surface is covered by minute granules, arranged in rows on the carinae and distal to the zooecial apertures, and random elsewhere.

The reverse surface is ornamented by longitudinal grooves which may be either parallel to the growth direction or of random orientation. In some places, small nodose projections are found between the grooves.

Remarks: The material assigned to *Penniretepora triporosa* Crockford differs from the type material in possessing a slightly narrower main branch. This is not considered to be of sufficient taxonomic importance alone to warrant separation of the material into a new species.

The Japanese Permian species *P. decora* Sakagami, 1962a, has smaller dimensions than *P. triporosa.* Sakagami (1963, p. 17) states that *P. higashi-yamensis,* which I consider to be conspecific with *P. triporosa,* is identical with *P.* cf. *irregularis* (Nekhoroshev, 1948). If one studies the plates of Sakagami (1963, text-figs 1, 2) the two species seem to be markedly different.

Penniretepora invisa (Trizna, 1939) from Russia has similar dimensions, but can be readily distinguished by its greater angle between secondary branches and the main branch and width of the main branch.

Range and Distribution: In Queensland this is the first record of the genus *Penniretepora* from the Permian. Previously the genus had been recorded from the Carboniferous at Glen William, New South Wales, and at Mundubbera, Rockhampton, and Stanwell, Queensland (Crockford, 1951). Voisey (1936) recorded the genus from the Permian at Drake.

Penniretepora triporosa was recorded from the Permian of Western Australia by Crockford (1951). There it is found in the ?Sakmarian Callytharra Formation.

In the Bowen Basin the species is found in strata which range in age from Artinskian to Kungurian-Kazanian. Specimens and localities are: UQGD F48383-48385, L 2580; CPC 7027, SP 720.

PENNIRETEPORA sp.

(Pl. 11, fig. 3)

Description of Bowen Basin Material: The specimens are fragmentary.

The zoarium is pinnate. The main branch is 0.6mm to 0.9mm wide. Secondary branches, which make an angle of 50° to 60° with the main branch, are separated by 2.0mm to 2.3mm. They are from 0.5mm to 0.64mm wide. Carinae on successive branches on the same side of the main branch are separated by 2.2mm to 3.0mm. The number of secondary branches in 10mm cannot be estimated because of the fragmentary nature of the material. Both main and secondary branches have two rows of apertures.

The diameter of the apertures on both branches is 0.16mm to 0.3mm. On the main branch there are 10 to 13 apertures in 5mm, and the centres of successive apertures are separated by 0.42-0.52mm. Four or five apertures are found between successive secondary branches on the same side of the main branch. Rows of apertures on main and secondary branches are separated by a nodose carina. Apertures encroach on the carina between secondary branches and where a node is found.

The carina seems to be more prominent on the main branch, where nodes are 1.64mm to 2.08mm apart.

The obverse surface is ornamented by fine rows of granules, which splay out around the nodes and make them seem larger than they are.

Remarks: Many of the measurements of *Penniretepora* sp. are similar to those made on *Penniretepora triporosa.* The two species can be readily distinguished by the greater spacing of the secondary branches, greater spacing of the nodes, and the greater number of zooecial apertures between successive secondary branches on *Penniretepora* sp.

Range and Distribution: Artinskian to Kungurian-Kazanian: specimens referable to *Penniretepora* sp. and their localities are: CPC 7039, 7103, SL 643; CPC 7104, SP 720; CPC 7105, L 2580; CPC 7106, L 2575.

Genus PTYLOPORA M'Coy, 1844

1844 *Ptylopora* M'Coy, p. 200.
1846 *Ptylopora* Agassiz (fide Bassler, 1953, p. G128).
1884 *Ptylopora* M'Coy; Vine, p. 189.
1949 *Ptylopora* M'Coy; Duncan, p. 132.

Type species (by subsequent designation of Vine, 1884, pp. 189, 190): *Ptylopora pluma* M'Coy, 1844, p. 200, pl. XXVIII, fig. 6, from the Lower Carboniferous of Ireland.

Diagnosis: Zoarium pinnate, composed of a main branch which bears oblique secondary branches; secondary branches may bifurcate; main and secondary branches have two rows of zooecial apertures separated by a nodose carina; secondary branches connected by dissepiments, usually non-celluliferous.

Remarks: Nickles & Bassler (1900, p. 382) and Bassler (1935, p. 179, 1953, p. G128) regard *Dendricopora* de Koninck, 1877, as being a synonym of *Ptylopora*: but the original description of *Dendricopora* states that there are three rows of zooecial apertures and no median carina, whereas *Ptylopora* has two rows of zooecial apertures separated by a median carina. The zoarial form also differs from *Ptylopora*. In *Dendricopora,* there is a main branch of the first order which bears paired and not necessarily opposite branches of the second order. These, in turn, give rise to paired and and not necessarily opposite branches of the fourth order. Branches of a different order may be connected by dissepiments. (See de Koninck, 1877, pl. VIII, fig. 4). Figured specimens of *Ptylopora* show that branches of the second order do not give rise to paired third-order branches, and only two examples can be found in which a branch of the second order bifurcates. In a figure of the type species (M'Coy, 1844, pl. XVIII, fig. 6, left hand side) bifurcation of branches of the second order in the distal portion of the zoarium can be observed. Ulrich (1890, pl. LXV, fig. 3b) figures the same characteristic on *P. prouti* Hall.

Range and Distribution: Devonian-Permian; cosmopolitan.

PTYLOPORA sp.

(Pl. 12, fig. 1)

Description: The zoarium is 10.5mm long and is composed of a main branch 0.72-1.02mm wide, from which secondary branches diverge at angles of 45° to 60°. They have a width of 0.41mm to 0.6mm.

Secondary branches on opposite sides of the main branch are displaced by about 0.4mm between the centres of successive branches. From four to five lateral branches occur in 5mm. Adjacent sides of successive secondary branches on the same side of the main branch are separated by 0.6-0.8mm.

Two rows of zooecial apertures are developed on secondary and main branches. The apertures of the secondary branches are too poorly preserved to be described. From 14 to 16 apertures are found in 5mm on the main branch. Apertures have a diameter of 0.16mm, and the centres of successive apertures are separated by 0.32-0.44mm. Peristomes are weakly developed on the side of the apertures adjacent to the carina.

A carina separates the apertures on the main and secondary branches. It is nodose and not well preserved.

The reverse of the zoarium cannot be studied.

Remarks: In Australia *Ptylopora* has a range of Lower Carboniferous to Upper Permian and has been recorded from Queensland and New South Wales (Crockford, 1941b, 1947; Maxwell, 1964). *P. carinata* Crockford, 1941b, from the Permian at Shoalhaven Heads, near Nowra, New South Wales, has narrower main and secondary branches than *Ptylopora* sp., but has fewer secondary branches in 5mm, and secondary branches are more widely separated, as are the zooecial apertures.

If more specimens of both species are found they may prove to be identical: the present discrepancy in measurements may be caused by the fragments belonging to different portions of the zoaria.

Range and Distribution: One specimen of *Ptylopora* sp. has been found in the Bowen Basin. It occurs in strata of Kungurian-Kazanian age at L 2580 and is catalogued as UQGD F 48386.

Family FENESTELLIDAE King, 1849

Genus LEVIFENESTELLA Miller, 1961

1961b *Levifenestella* Miller, p. 493, pl. XXVI, fig. 1, text-fig. 1a.

Type species (by original designation): *Levifenestella maeve* Miller, 1961b, p. 493, pl. XXVI, fig. 1, text-fig. 1, from the Lower Carboniferous (Tournaisian) limestone of Pollarone-Lackavarne shore, 3 miles east-southeast of Easky, Co. Sligo, Ireland.

Diagnosis: See Miller, 1961b, p. 493.

Remarks: The genus *Levifenestella* was erected by Miller for species of *Fenestella* possessing a nodeless carina.

No specimen has been described in the literature with both a nodeless and a nodose carina; so the criterion appears valid.

Range and Distribution: Lower Carboniferous-Lower Permian; Great Britain, USA, Russia, Timor, Australia (Queensland and New South Wales).

LEVIFENESTELLA? EXPANSA (Crockford, 1946)

(Pl. 12, fig. 3)

1946 *Fenestrellina expansa* Crockford, p. 130, text-fig. 11.

Holotype: UQGD F7956A, from the Artinskian Lakes Creek Beds, east of Rockhampton, Queensland; L.29, 354087 Rockhampton 1:253,440 military map, 1.3 miles southeast of Lakes Creek Railway Station, Queensland (Crockford, 1946, p. 130, text-fig. 11).

Diagnosis: Species of *Levifenestella* having a coarse meshwork; branches may be straight and parallel or of no definite orientation; fenestrules very variable in shape; four to ten zooecia per fenestrule; carina high.

Description of Bowen Basin Material

Micrometric Formula (1)

B/10	D/10	Z/5	N/5	Bw	Zd	Zb
7-9	2-4	10-12	0	0.64-0.8	0.24	P

Branches may be straight and parallel or of no definite orientation. In a portion of the zoarium where there is little bifurcation the branches do not vary

(1) In the following descriptions of fenestellid species, abbreviations used are:

B/10 .... branches in 10mm.
Bw .... branch width.
F/10 .... fenestrules in 10mm.
Fl .... fenestrule length.
Fw .... fenestrule width.
D/10 .... dissepiments in 10mm.
Dw .... dissepiment width.
Z/5 .... zooecia in 5mm.
Zd .... zooecial diameter.
Z/F .... zooecia per fenestrule.
Zb .... zooecial base shape.
Z-Z .... separation of centres of successive zooecial apertures.
N/5 .... nodes in 5mm.
N-N .... separation of centres of successive nodes.
R/B .... rows of zooecia on branch.

greatly in width. If bifurcation is frequent the branches may increase to 1.44mm in width proximal to bifurcation, but distal to bifurcation they resume their usual dimensions. The lateral slopes are steep and the apertures open sideways.

Zooecia are in two rows with centres of successive apertures separated by 0.42-0.6mm. From six to ten zooecial apertures are found in the space of one fenestrule.

Fenestrule length varies from 0.8mm to 4.2mm, and width from 0.36mm to 1.12mm. If the branches are straight and parallel the fenestrules are rectangular. If not, the shape of the fenestrules is very varied and the variation is increased by dissepiments' not being perpendicular to the branches.

Dissepiments attain a width of 0.16-0.52mm. The widest dissepiments are associated with bifurcation, and it is mostly in this region that they are found oblique to branches.

No trace of nodes or node axes can be found on the weathered carina. The carina would have been high because of the steep lateral slopes of the branches.

Zooecial base shape is pentagonal.

The reverse of the zoarium cannot be observed.

Remarks: The zooecial base-shape cannot be observed in Crockford's specimens; but Bowen Basin specimens have a pentagonal base, like the form described by Crockford (1946) as *Fenestrellina expansa* var. *nodulifera.*

No species of *Levifenestella* with similar meshwork formula could be found. *Fenestella regina* Bassler, 1929, *F. chapmani* (Crockford, 1944b), *F. octonicellata* Shulga-Nesterenko, 1952, and *F. japonica* (Sakagami, 1962a) have the first three dimensions of the meshwork formula similar to *L. expansa,* but in *japonica, regina,* and *octonicellata* nodes are poorly known and in *chapmani* the nodes are large and widely spaced.

Range and Distribution: *Levifenestella expansa* has been recorded previously only from the Artinskian Lakes Creek Beds of Queensland (Crockford, 1946).

In the Bowen Basin the species (specimens UQGD F48381-2) has been recorded from locality L2580, which extends its range to Kungurian-Kazanian.

Genus POLYPORA M'Coy, 1844

1844 *Polypora* M'Coy, p. 206.
1852 *Polypora* M'Coy; Hall, p. 167.
1884 *Polypora* M'Coy; Vine, p. 194.
1890 *Polypora* M'Coy; Ulrich, pp. 396, 585.
1963 *Polypora* M'Coy; Miller, p. 166.

Type species (by subsequent designation of Vine, 1884, p. 194): *Polypora dendroides* M'Coy, 1844, p. 206, pl. 29, fig. 9, from the Tournaisian of Ireland.

Diagnosis: See Miller, 1963, p. 166.

Range and Distribution: Ordovician-Permian; cosmopolitan.

POLYPORA KEPPELENSIS Crockford, 1946

(Pl. 12, fig. 2)

1932 (non) *Polypora minuta* Deiss, p. 261 (*fide* Crockford, 1962).
1946 *Polypora minuta* Crockford, p. 133.
1962 *Polypora keppelensis* Crockford, p. 840.

Holotype: UQGD F7974A, from the Artinskian Lakes Creek Beds, east of Rockhampton, Queensland; L. 144, 354087 Rockhampton 1:253,440 military map, behind Lakes Creek Quarry, 1.3 miles southeast of Lakes Creek Railway Station, Queensland (Crockford, 1946, p. 133, text-fig. 9).

Diagnosis: See Crockford, 1946, p. 133.

Description of Bowen Basin Material

Micrometric Formula

R/B	B/10	D/10	Z/5	N/5	Bw	Zd
4 3 2	8-12	10-11	12-15	—	0.42-0.56	0.16-0.21

The branches are straight and non-nodose. Proximal to bifurcation the width of the branch increases to 0.84mm and distal to bifurcation it is reduced to 0.26mm, but gradually resumes the usual proportions. Branches are of similar width to the fenestrules.

The width of the fenestrules ranges from 0.34mm to 0.52mm, and length from 0.78mm to 1.08mm. The fenestrules tend to be rectangular, but some are oval because of thickening of dissepiments where they join the branches.

Dissepiments are from 0.19mm to 0.34 wide. They are perpendicular to the branch, except for some, associated with bifurcation, which are oblique. The encroaching of some apertures on dissepiments results in thickening of the dissepiments at the branch junction.

Apertures are in three rows on the branches, but some branches have four proximal to bifurcation and two distal to bifurcation.

From two to three zooecial apertures border a fenestrule, with the peristomes indenting the fenestrules in places. Centres of successive apertures are separated by 0.31-0.48mm.

The reverse surface on the branches has not been studied.

Remarks: Because the name *Polypora minuta* was preoccupied by Deiss, Crockford (1962) selected the new name *P. keppelensis.*

Polypora volgensis Shulga-Nesterenko, 1951, has a similar meshwork formula to *P. keppelensis,* but can be distinguished because of its smaller fenestrule dimensions and zooecial diameter.

Range and Distribution: The only previous record of *P. keppelensis* is by Crockford (1946). The Bowen Basin collection extends its range to Kungurian-Kazanian (CPC 7112-7115 from MC 293).

POLYPORA MAGNAFENESTRATA Crockford, 1941

(Pl. 12, fig. 4; Pl. 13, fig. 1)

1941b *Polypora magnafenestrata* Crockford, p. 513, pl. XX, fig. 5, pl. XXI, fig. 5.

Holotype: SUGD 1418 from the Artinskian *Fenestella* Shale of the Branxton Formation, Maitland Group, west of Branxton, New South Wales (Crockford, 1941b, p. 513, pl. XX, fig. 5).

Diagnosis: Large species of *Polypora,* characterized by six to eleven zooecial apertures per fenestrule; zooecia occur in up to seven rows across the branch; fenestrules irregular in shape and size; nodes absent.

Description of Bowen Basin Material

Micrometric Formula

R/B	B/10	D/10	Z/5	N/5	Bw	Zd
7 4-5 3	4-6	2-4	8-10	0	1.12-1.74	0.21-0.32

The branches are straight and non-nodose. Proximal to bifurcation, the branch width may increase to 2.48mm, immediately distal to bifurcation the width is 0.78mm, gradually increasing until the branch resumes the usual proportions. Bifurcation, where it can be observed, occurs at intervals of 10.5mm. Distal to bifurcation and before the branch resumes the usual proportions, a dissepiment departs to an adjacent branch. The branch width may be smaller or larger than the fenestrule width.

Fenestrules have a width of 0.82mm to 2.56mm. They are narrowest where two adjacent branches are joined by a dissepiment immediately distal to bifurcation. Between bifurcation length ranges from 4.2mm to 6.2mm; immediately distal to bifurcation this may decrease to 3.1mm. The fenestrules are of varied shape, but most are more or less rectangular.

Throughout the zoarium outside the branches formed by a bifurcation, there may be fenestrules very much smaller than average. They are about 1.2mm wide and 0.8mm long: this shortening is due to the increased width of the dissepiment on the proximal side of the fenestrule. Dissepiments in this region may be 0.82mm wide; in the main, they are 0.4mm to 0.62mm wide. Not all dissepiments are perpendicular to branches. Where dissepiments join the branches there is not much increase in width, but in one dissepiment the width increases to 1.24mm.

Immediately proximal to bifurcation, zooecial apertures are in seven rows; immediately distal, in three; and in the stable portion, in four or five. Centres of successive zooecial apertures are 0.42-0.7mm apart. Six to eleven apertures border a fenestrule and in some places they are indented by peristomes. The reverse surface has not been observed.

Remarks: The micrometric formula of the holotype is 3 5 7// 4-7/ 2-4// 8-12/ 0// 0.9-2.56/ 0.18-0.28.

No mention is made of paratypes by Crockford (1941b), but in the SUGD catalogue two specimens of this species are labelled paratypes. One of them, 3439, is too poorly preserved to give a micrometric formula and the other, 3445, is not to be found.

Polypora linea Crockford, 1941b, possesses more nodes and fewer zooecial apertures per fenestrule than *P. magnafenestrata*. It is not as irregular an expanse as the described species. *P. multiporifera* Crockford, 1944c, with its characteristic nodose branches and closer spacing of the zooecia, can be distinguished readily from *P. magnafenestrata*.

Of the overseas species, *P. ogbinensis* Nikiforova, 1933a, is somewhat similar to the described species but has fewer B/10, more Z/5 and wider dissepiments.

Range and Distribution: The species has been recorded previously from the Sakmarian Allandale Formation, the Artinskian *Fenestella* Shale of the Branxton Formation, and the Artinskian Conjola Formation in New South Wales; in Tasmania, it occurs in the Artinskian Berriedale Limestone (Crockford, 1951).

The occurrence in the Bowen Basin is the first record of the species from Queensland; it increases the range. Specimens and their localities are: UQGD F48375-6, L. 2580; UQGD F48377-8, SL 643.

POLYPORA PERTINAX Laseron, 1918

(Pl. 13, fig. 5)

1918	*Polypora pertinax* Laseron, p. 190, pl. V, figs 1, 2, pl. VI, figs 1, 2, pl. VIII, fig. 1, pl. X, fig. 1.
1941a	*Polypora pertinax* Laseron; Crockford, p. 412, pl. XVIII, fig. 5.
1964	*Polypora pertinax* Laseron; Maxwell, p. 40.

Lectotype (chosen Crockford, 1941a, p. 412): AMF20188, from the Sakmarian Allandale Formation, east of Allandale Railway Station, New South Wales (Crockford, 1941a, p. 412; Laseron, 1918, pl. V, fig. 2, pl. VI, figs 1, 2, pl. VIII, fig. 1).

Diagnosis: Species of *Polypora* with three to six rows of zooecia and three zooecia per fenestrule; nodes poorly developed.

Description of Bowen Basin Material

Micrometric Formula

R/B	B/10	D/10	Z/5	N/5	Bw	Zd
3-6	8-10	7-9	13-15	?	0.72-0.96	0.14-0.16

Branches are wide and do not show a great deal of variation in relation to the number of rows of apertures, which ranges from three to six (only one specimen had three rows of apertures, and crushing in the zoarium renders the width there indeterminate). Branches are wider than the fenestrules.

Fenestrules range in width from 0.35mm to 0.58mm, and in length from 0.76mm to 1.08mm. Their oval shape is accentuated by thickening of dissepiments where they join the branches.

Dissepiments are 0.32-0.5mm wide. They are not regarded as being celluliferous, although zooecial apertures do encroach on them in some places.

There are generally four to six rows of zooecia. Centres of successive zooecial apertures are separated by 0.29mm to 0.4mm, and are surrounded by peristomes which indent the fenestrules. Apertures on the lateral portions of the branches open sideways because of the steep lateral branch slope. There are three or four zooecial apertures per fenestrule.

No nodes have been observed and the reverse surface has not been studied.

Remarks: If the descriptions of Crockford and Laseron were used as a guide, the species described could not be referred to *P. pertinax* because it possesses more rows of zooecial apertures. However, study of the types has revealed that four to six rows of apertures are usually developed, and in some cases seven can be found across the branch.

Polypora ovaticellata Shulga-Nesterenko, 1952, possesses fewer rows of zooecia and narrower branches than *P. pertinax,* and *P. michalevensis* Shulga-Nesterenko, 1955, has narrower branches and dissepiments. *Polypora varsoviensis* Ulrich, 1890, has different branch and fenestrule dimensions from *P. pertinax.*

Range and Distribution: *Polypora pertinax* has been recorded from the Sakmarian Allandale and Rutherford Formations of New South Wales (Crockford, 1951), and the ?Artinskian Yarrol Formation in the Yarrol Basin of Queensland (Maxwell, 1964).

This is the first record of the species from the Bowen Basin, and its range is confirmed in the Artinskian. The specimens recorded with their localities are: UQGD F40290, L. 1554; UQGD F48387, SP 132.

POLYPORA VIRGA Laseron, 1918

(Pl. 13, fig. 2)

1918 *Polypora virga* Laseron, p. 192, pl. VII, fig. 4, pl. VIII, fig. 2.
1941a *Polypora virga* Laseron; Crockford, p. 410, pl. XIX, fig. 3.
1964 *Polypora virga* Laseron; Maxwell, p. 40, pl. 13, fig. 6.

Holotype: Lost. From the Branxton Formation, Maitland Group, in the railway cutting, immediately west of Branxton, New South Wales (See Laseron, 1918, pp. 183, 193).

Neotype (chosen Crockford, 1941a, p. 411): SUGD 1407 from the Artinskian *Fenestella* Shale of the Branxton Formation, Maitland Group, west of Branxton, New South Wales (Crockford, 1941a, p. 411, pl. XIX, fig. 3).

Diagnosis: *Polypora* with three or four rows of zooecia and four zooecia per fenestrule; fenestrules indented by peristomes; nodes large, infrequently developed.

Description of Bowen Basin Material

Micrometric Formula

R/B	B/10	D/10	Z/5	N/5	Bw	Zd
3-4	7-9	6-7	10-11	?	0.72-1.42	0.22-0.33

The width of the branches depends on the number of rows of zooecia. If there are three rows, the branch width ranges from 0.72mm to 0.84mm; if four, the branch width ranges from 0.9mm to 1.21mm. In the only instance where five rows of apertures were found the branch width was 1.42mm. Bifurcation cannot be observed. The change from three to four rows of zooecia may occur within the length of one fenestrule.

Fenestrules range in shape from oval to narrow and elongate. Their width ranges from 0.38mm to 0.84mm and their length from 1.32mm to 1.84mm. They may be indented by peristomes.

Dissepiments are perpendicular to the branches. Measurements of width taken in the middle of dissepiments range from 0.22mm to 0.5mm, but at the end of a narrow fenestrule near the junction with a branch the width may increase to 0.65mm.

There are three to five rows of apertures across the branch: commonly three or four. There are usually four apertures per fenestrule, but in some places, owing to the arrangement of apertures across a branch, there may be five. One of the five is farther removed from the lateral edge of the fenestrule than the other four. Centres of successive apertures are separated by 0.32mm to 0.56mm. In the main, apertures are arranged in diagonal rows across the branch. They are ringed by peristomes. Irregular raising of peristomal junctions can form a node.

The reverse surface cannot be observed.

Remarks: The specimen designated by Crockford as the neotype has the following micrometric formula:
3-5// 6-9/ 6-7// 10-11/ ?// 0.64-1.440/ 0.18-0.26

Some portions of the specimen are difficult to study because it comprises a reverse surface partly weathered through to an obverse surface. In places where weathering is deeper, indentation of the fenestrules by zooecial peristomes can be observed. Laseron (1918, pl. VIII, fig. 2) shows this feature to be developed on the original specimen of the species.

Polypora dichotoma Crockford, 1941b, and *P. triseriata* Crockford, 1941b, are similar to *P. virga,* but they have different fenestrule dimensions. *P. multinodata* Crockford, 1941b, has more regularly spaced nodes than *P. virga.*

The Russian species *P. soshkinae* Shulga-Nesterenko, 1952, has different fenestrule and dissepiment dimensions from *P. virga*.

Range and Distribution: *Polypora virga* has been recorded from the Artinskian *Fenestella* Shale of the Branxton Formation and from the Artinskian Conjola Formation in New South Wales; in Tasmania, the Artinskian Berriedale Limestone has yielded specimens of the species.

In Queensland, the species has been recorded from the Lakes Creek Beds and possibly from the Yarrol Formation (Crockford, 1951; Maxwell, 1964).

Only one specimen of *Polypora virga,* CPC 7110 from SP 748, has been found in the Bowen Basin; it does not extend the range of the species.

POLYPORA WOODSI (Etheridge, 1892)

(Pl. 13, fig. 3)

1877	*Protoretepora ampla* (Lonsdale); de Koninck, p. 42, pl. 8, figs 5a-c.
1880	*Protoretepora* sp. indet. Etheridge, p. 278.
1892	*Protoretepora ampla* var. *woodsi* Etheridge, p. 222, pl. 8, fig. 12.
1918	*Polypora tumula* Laseron, p. 191, pl. 7, fig. 3, pl. 9, figs 1, 2.
1929	*Polypora tripliseriata* Bassler, p. 79, pl. CCXLII, fig. 14-16.
1937	*Polypora tripliseriata* Bassler; Elias, p. 331.
1941a	*Polypora woodsi* (Etheridge); Crockford, p. 414, pl. 18, fig. 1, pl. 19, fig. 1.
1944c	*Polypora woodsi* (Etheridge); Crockford, p. 177, pl. 3, fig. 2.
1946	*Polypora woodsi* (Etheridge); Crockford, p. 133.
1957	*Polypora woodsi* (Etheridge); Crockford, p. 61.

Holotype: Lost, in the Garden Palace Fire of September, 1882 (de Koninck, in David, 1898, p. xiii).

Neotype (chosen Crockford, 1941a, p. 414): SUGD 1408, from the Artinskian *Fenestella* Shale of the Branxton Formation, Maitland Group, at Farley, New South Wales; 537540 Paterson 1:63,360 military map, near the junction of Por. 65, Par. Maitland and Por. 66, Par. Gosforth, Co. Northumberland, just east of Farley Railway Station, New South Wales (Crockford, 1941a, p. 414, pl. XIX, fig. 1).

Diagnosis: Infundibuliform *Polypora,* having three rows of zooecia across the branch and three or four zooecia per fenestrule; nodes strongly developed in relation to the middle row of zooecial apertures.

Remarks: Previously the locality had been given as 'Railway Cutting near junction of Por. 26, Par. Gosforth and Por. 65, Par. Maitland'. The two portions mentioned are separated by a distance of approximately five miles. The corrected type locality is quoted above.

Description of Bowen Basin Material

Micrometric Formula

R/B	B/10	D/10	Z/5	N/5	Bw	Zd
3-5	8-12	6-8	14-16	?	0.44-1.18	0.14-0.18

Branches are straight and characteristically covered by three rows of zooecial apertures. Proximal to bifurcation the branch width may increase to 1.18mm, and distal to bifurcation it resumes the usual proportions. If three rows of zooecial apertures are present the width ranges from 0.44mm to 0.6mm; if four, from 0.79mm to 0.92mm and if five, from 1.02mm to 1.18mm. Branches are generally wider than the fenestrules.

Fenestrules have a width of 0.36-0.75mm, and their length ranges from 0.8mm to 1.3mm. They are oval except where they are indented by peristomes.

Dissepiments range in width from 0.2mm to 0.5mm. Apertures do not encroach on dissepiments.

Zooecial apertures are arranged in three rows, but proximal to bifurcation this may increase to five. Centres of successive apertures are separated by 0.34-0.56mm. There are three, or less commonly four, zooecia per fenestrule.

Poorly preserved nodes are associated with the centre row of zooecial apertures in a few places.

The reverse surface shows branches and dissepiments to be evenly rounded, and covered by irregularly distributed tubercles.

Remarks: Species similar to *Polypora woodsi* include *P. varsoviensis* Ulrich, 1890, which has shorter fenestrules and narrower dissepiments than the Australian species.

Of the Russian species, *Polypora repens* Trizna, 1939, *P. punctata* Shulga-Nesterenko, 1952, and *P. michalevensis* Shulga-Nesterenko, 1955, are similar to *P. woodsi,* but they differ in the dimensions of branches, dissepiments, and sometimes fenestrules.

Polypora martis (Fischer, 1837) possesses more apertures per 5mm with a different spacing from those in *P. woodsi.* Nodes are absent in *P. martis.*

Range and Distribution: *Polypora woodsi* has been listed from both Western and eastern Australia. In the west it has been recorded from the ?Sakmarian Callytharra Formation and the Artinskian Noonkanbah Formation (Crockford, 1951).

In Tasmania it has been found in the Artinskian Berriedale Limestone; in New South Wales, the species has been recorded from the Artinskian *Fenestella* Shale of the Branxton Formation and the Artinskian Conjola Formation; in Queensland the Artinskian Lakes Creek Beds and the Bowen River Coalfield have yielded specimens of the species (Crockford, 1951). Specimens from the Bowen Basin and their localities are: CPC 7109, SP 720; CPC 7123, SP 748; UQGD F40560, L 997; UQGD F40304 and 40305, L 1554.

Genus PROTORETEPORA de Koninck, 1877

1877 *Protoretepora* de Koninck, p. 178.
1941a *Protoretepora* de Koninck; Crockford, p. 405.

Type species (by original designation): *Fenestella ampla* Lonsdale, in Strzelecki, 1845, p. 268, pl. 9, fig. 3b; *not* figs 3, 3a, 3c, from the southern part of Tasmania.

Diagnosis: Branches non-carinate, non-nodose, with more than two rows of zooecial apertures on the branches; dissepiments celluliferous to the exclusion of dissepimental tissue.

Range and Distribution: Bassler (1953, p. G125), lists the range of the genus as Carboniferous-Permian, possibly because he considered the specimen in his figure 86, 2 to have come from Carboniferous rocks. The figure is reproduced from Strzelecki (1845, pl. 9, fig. 3b) and comes from the Permian. A search of the literature has not revealed a reference to *Protoretepora* in the Carboniferous. The genus has been recorded from eastern and western Australia and doubtfully from Germany, England, Russia and USA.

PROTORETEPORA AMPLA (Lonsdale, 1844)

(Pl. 13, fig. 4)

1844 *Fenestella ampla* Lonsdale, p. 163.
1845 *Fenestella ampla* Lonsdale, p. 268, pl. 9, fig. 3b only.
1877 *Protoretepora ampla* (Lonsdale); de Koninck, p. 180, pl. 8, fig. 5.
1941a *Protoretepora ampla* (Lonsdale); Crockford, p. 406, pl. 19, fig. 4, text-fig. 2A.

Holotype: Lost; from the southern part of Tasmania.

Neotype: No material suitable for the erection of a neotype is present in collections made by the writer from the possible type locality, as discussed by Smith (in press).

Diagnosis: Wide branches connected by celluliferous dissepiments of similar width; oval fenestrules; zooecia in four to eight rows on the branches, two to three rows on the dissepiments; four to six zooecia per fenestrule.

Description of Bowen Basin Material

Micrometric Formula

R/B	B/10	D/10	Z/5	N/5	Bw	Zd
4-6	6-9	4-6	12-15	0	0.8-1.3	0.16-0.24

Branches are straight, diverging slightly from one another. They are non-carinate and non-nodose. Proximal to bifurcation, the branch width is 0.58mm and distal to bifurcation it is 1.6-1.75mm. The usual proportions are attained gradually. Branches are joined by dissepiments about as wide as and normal to the branches.

Fenestrules are oval, with a width of 0.56-1.12mm, and a length of 1.2-1.9mm. They may be indented by peristomes.

Zooecial apertures are found in four to six rows on the branches, and there may be an additional two or three rows on the dissepiments. Proximal to bifurcation of a branch the number of rows is increased to six or eight, whereas distal to bifurcation it is reduced to three. From three to four, or sometimes five, zooecial apertures border a fenestrule and there may be two or three lateral to a dissepiment.

The reverse surface is finely granular and striated, and in unweathered specimens small nodose projections can be observed.

Remarks: Specimens collected by me from the possible type locality at Lower Sandy Bay, Hobart, Tasmania, are more variable than Crockford's (1941a). For this reason specimens from the Bowen Basin are referred to the species.

Range and Distribution: The species has been recorded previously by Crockford (1951) from the Noonkanbah Formation in Western Australia, an unknown horizon in Tasmania, and the Upper Branxton Formation in New South Wales. If the unknown horizon in Tasmania is the Bundella Mudstone, the range of the species is Artinskian to Kungurian-Kazanian. The occurrence of the species in the Bowen Basin does not alter this. Specimens recorded and their localities are: CPC 7026, SP 732; UQGD F40554-7; L 997; UQGD F40475, SP 451.

Genus FENESTELLA Lonsdale, 1839

1839 *Fenestella* Lonsdale, p. 677.
1849 *Fenestella* Lonsdale; King, p. 388.
1880 *Fenestella* Lonsdale; Shrubsole, p. 241.
1890 *Fenestella* Lonsdale; Ulrich, p. 395.
1956 *Fenestella* Lonsdale; Elias, p. 317.
1960 *Fenestella* Lonsdale; Elias & Condra, p. 294.
1961a *Fenestella* Lonsdale; Miller, p. 225.

Type species (by subsequent designation of Riley, 1962, p. 76): *Fenestella subantiqua* d'Orbigny, 1850, p. 180, from the Silurian, Wenlockian, Wenlock Limestone, at Wrens Nest, Dudley, Worcestershire, England.

Diagnosis: Zoarium fan or funnel shaped; zooecia in two rows on the branches, commonly increasing to three proximal to bifurcation; rows of zooecia separated by a nodose carina on obverse surface; reverse surface of varying ornamentation.

Range and Distribution: Ordovician-Permian; cosmopolitan.

FENESTELLA HOROLOGIA Bretnall, 1926

For a complete description of *F. horologia* and discussion of its conspecific nature with *Minilya duplaris* Crockford, the reader is referred to Wass (1966b).

In the present study the species has been recorded from the following localities: CPC 7097, L 2575; CPC 7098, SP 732; CPC 7099-7102, SP 720; UQGD F40542, L 997; UQGD F40292-3, L 1554.

FENESTELLA AFFLUENSA Bretnall, 1926

(Pl. 14, fig. 3)

1926 *Fenestella affluensa* Bretnall, p. 16, pl. 1, fig. 8.
1931 *Fenestella affluensa* Bretnall; Hosking, p. 12.
1936 *Fenestella spinulifera* Moore (partim); Chapman, in Raggatt, p. 128 (*fide* Crockford, 1944b, p. 158).
1944a *Fenestrellina affluensa* (Bretnall); Crockford, p. 188, pl. 1, fig. 6.
1944b *Fenestrellina affluensa* (Bretnall); Crockford, p. 158, pl. 4, fig. 10.

Lectotype (chosen Crockford, 1944a, p. 188): GSWA 2/2405E, from ?Sakmarian Callytharra Formation, east of the Gascoyne-Wyndham River junction, Western Australia (Crockford, 1944a, pl. 1, fig. 6) (type locality of *R. ambrosioides*).

Diagnosis: Species of *Fenestella* with three or four zooecia per fenestrule, lateral slopes of branches steep, thereby accentuating height of carina; nodes large, widely spaced.

Description of Bowen Basin Material

Micrometric Formula

B/10	D/10	Z/5	N/5	Bw	Zd	Zb
12-13	7-9	15-16	6-8	0.32-0.48	0.16-0.22	P

The expanse is rather irregular, with the branches variably oriented. Proximal to bifurcation the branch can increase to 0.65mm in width, but it resumes the usual proportions distal to bifurcation. Branches are of similar width to the fenestrules.

Fenestrules are elongate oval, 0.33-0.64mm wide and 0.81-1.18mm long. They do not appear to be indented by zooecial peristomes.

Zooecia are arranged in two regular rows with three or four apertures per fenestrule. Centres of successive apertures are from 0.3mm to 0.4mm apart. Proximal to bifurcation there are three rows of apertures across a branch. Four rows have not been observed.

Associated with bifurcation is a widening of the dissepiments. Dissepiments range in width from 0.22mm to 0.32mm.

Because of weathering the carina is difficult to observe. Nodes are separated by 0.6-0.76mm. The relation between the carina and apertures at bifurcation cannot be ascertained. The zooecial base is pentagonal.

The reverse surface is striated except for the dissepiments, which are tuberculose. Both branches and dissepiments are evenly rounded.

Remarks: Of the Russian species, *Fenestella praemagna* Shulga-Nesterenko, 1951, and *F. subspeciosa* Shulga-Nesterenko, 1955, possesses similar meshwork formulae. Both can be separated from the Australian species because of their narrower branches and dissepiments. *F. bifida* var. *tricosa* Trizna, 1939, has wider dissepiments than *F. affluensa.*

F. lunariostellata Shulga-Nesterenko, 1941, and *F. solida* Shulga-Nesterenko, 1941, have wider dissepiments and longer fenestrules, and *F. reteporinaeformis* Shulga-Nesterenko, 1936, has wider dissepiments and shorter fenestrules. *F. schischovae* var. *schaktavensis* Shulga-Nesterenko, 1941, has narrower branches and dissepiments and generally fewer zooecia per fenestrule.

The American species, *F. gaptankensis* Elias & Condra, 1957, and *F. varifenestrata* Elias & Condra, 1957, are poorly known but possess similar meshwork formulae.

Fenestella loganensis Wass, 1966a, has narrower branches and dissepiments than *F. affluensa.*

Range and Distribution: The species has been recorded previously only from the ?Sakmarian Callytharra Formation in Western Australia (Crockford, 1951).

The presence of *F. affluensa* from Artinskian strata in the Bowen Basin extends the range and distribution of the species. Only one specimen of the species, UQGD F40567 from L997, has been recorded in this study.

FENESTELLA AMPLIA (Crockford, 1944)

(Pl. 14, fig. 1)

1929 (non) *Fenestella spinulifera* Moore, p. 20, pl. 3, figs 3-5.
1936 *Fenestella spinulifera* Moore (partim); Chapman, in Raggatt, p. 128 (fide Crockford, 1944b, p. 159).
1944b *Minilya amplia* Crockford, p. 159, pl. 4, fig. 7.

Holotype: CPC 309 from the ?Sakmarian Callytharra Formation, west of Callytharra Springs, Western Australia (Crockford, 1944b, p. 159, pl. 4, fig. 7) (type locality of *Penniretepora triporosa*).

Diagnosis: Species of *Fenestella* having elongate fenestrules generally with three zooecial apertures per fenestrule; carina developed between two rows of apertures and surmounted by a double row of nodes.

Remarks: Crockford (1944b) quoted F792 CPC, a pre-publication number, as the holotype. The new number indicates that the specimen is catalogued as a type.

Description of Bowen Basin Material

Micrometric Formula

B/10	D/10	Z/5	N/5	Bw	Zd	Zb
10-12	6-8	12-13	23-28	0.5-0.64	0.1-0.16	P

The zoarium is characterized by straight branches surmounted by a carina with a double row of nodes. Proximal to bifurcation the branch width may increase to 0.82mm; immediately distal to bifurcation, the width resumes the usual proportions. Branches are wider than the fenestrules.

Fenestrules in a stable region have a width of 0.36-0.48mm and a length of 1.12-1.4mm. Immediately distal to bifurcation the length may increase to 1.76mm and the width may decrease to 0.3mm. The fenestrules are elongate. Those adjacent to bifurcation may be distorted.

Dissepiments are perpendicular to the branches and range in width from 0.26mm to 0.38mm. Where they join the branches width increases markedly only where a zooecial aperture is situated partly on the dissepiment, which may increase the width by as much as 50 percent.

Zooecial apertures are arranged in two rows on branches, with zooecia of one row alternating with those of the other. There are three, or less commonly four, zooecial apertures per fenestrule. If apertures are placed adjacent to the fenestrule they are surrounded by a peristome which indents the fenestrule. An aperture placed partly on a dissepiment does not show a well developed peristome. Centres of successive apertures are from 0.4mm to 0.48mm apart.

Proximal to bifurcation there may be three rows, but never four. The third row appears 0.5mm proximal to bifurcation. It is inserted distal to bifurcation of the carina.

The carina is wide and rounded and zigzags along the branch. A double row of nodes is developed on the carina, with centres of successive nodes separated by 0.24-0.33mm, measured along the carina. This separation is not greatly affected by bifurcation. Nodes are not adjacent to the apertures. If both nodes and apertures are projected on a median line at the centre of the branch, the arrangement along the line is aperture, node, aperture, node, aperture, node and so forth. This arrangement holds adjacent to dissepiments but is more difficult to observe.

The zooecial base is pentagonal.

On the reverse surface the branches and dissepiments are evenly rounded and lack ornamentation.

Remarks: *Fenestella subvirgosa* Shulga-Nesterenko, 1952, is the species with closest meshwork formula to *F. amplia*. However, *F. subvirgosa* has more zooecia per fenestrule, with narrower dissepiments and longer fenestrules. Other species with similar meshwork formulae to *F. amplia* are *F. volayensis* Shulga-Nesterenko, 1951, which has vaguely developed nodes, and *F. buguniensis higuchizawaensis* Sakagami, 1962a, in which the nodes and their arrangement are poorly known. These two species may be distinguished from *F. amplia* by features other than the development of nodes.

Range and Distribution: *Fenestella amplia* has been recorded previously only from the ?Sakmarian Callytharra Formation in Western Australia (Crockford, 1951).

This is the first record of the species from eastern Australia and it occurs in Artinskian strata (CPC 7035 from SP 720).

FENESTELLA CANTHARIFORMIS (Crockford, 1941)

(Pl. 15, fig. 1)

1941b *Fenestrellina canthariformis* Crockford, p. 510, text-fig. 2A.
1946 *Fenestrellina canthariformis* Crockford; Crockford, p. 132.

Holotype: SUGD 1423, from the Artinskian *Fenestella* Shale of the Branxton Formation, Maitland Group, north of Belford, New South Wales (Crockford, 1941b, p. 510, text-fig. 2A).

Diagnosis: Regular species of *Fenestella* having two or three zooecial apertures per fenestrule and high closely spaced nodes on the carina.

Remarks: The holotype is an external mould of the obverse surface, and the paratype, SUGD 3412, is the reverse surface. Both specimens show the base of the zoarium and are partly weathered. Because of the nature of the specimens the accuracy of the original measurements was in doubt. Therefore, before the Bowen Basin material was studied, specimens UQGD F7970-2, assigned to the species by Crockford (1946), were studied. From this an idea of the species as conceived by Crockford was obtained.

Description of Bowen Basin Material

Micrometric Formula

B/10	D/10	Z/5	N/5	Bw	Zd	Zb
20-23	16-18	16-20	18-22	0.2-0.32	0.1-0.16	T

The branches are straight and capped by a narrow high nodose carina which occupies less than one-third the branch width. The height of the carina gives the lateral portions of the branch a steep concave profile so the apertures open sideways.

Proximal to bifurcation the branch width may increase to 0.72mm; immediately distal to bifurcation the branch assumes the usual proportions. Branches, in the main, are wider than the fenestrules.

Fenestrules have a width of 0.16-0.24mm and a length of 0.36-0.62mm. Their shape is constant at elongate oval, but at bifurcation they may be constricted at their ends.

Dissepiments are from 0.1mm to 0.16mm wide. At the junction with branches they widen noticeably only if a zooecial aperture is situated partly on the dissepiment. In this condition a dissepiment 0.1mm wide at its midpoint may increase to 0.21mm where it intersects the branch.

Zooecial apertures are arranged on the lateral sloping sides of the branches with two or three apertures per fenestrule. Their rims do not indent the fenestrules. The third aperture may be partly placed on the dissepiment. Centres of zooecial apertures are from 0.24mm to 0.32mm apart.

For a distance of 1.44mm on a widened branch proximal to its bifurcation there are three or four rows of zooecial apertures. In one portion proximal to bifurcation there are four longitudinal rows of apertures, each comprising two apertures; these are also transversely collinear. In this condition the middle two apertures of the transverse row farther away from bifurcation are separated by approximately 0.01mm, but the distance of separation of apertures in the transverse row immediately proximal to bifurcation increases to 0.1mm. The carina associated with bifurcation assumes a haphazard arrangement.

Proximal or distal to bifurcation of a branch the carina rises from 0.1-0.16mm above the level of the zooecial apertures. The nodes, as seen, extend for 0.02-0.05mm above the carina. Their centres are separated by 0.16-0.28mm. Lateral to nodes and on the carinate area there are rows of small raised tubercles.

The zooecial base is triangular. The reverse surface cannot be observed.

Remarks: As far as can be ascertained, this is the first description of the obverse surface of well preserved specimens. Some measurements differ from those quoted by Crockford (1941b), but this is considered to be caused by difference in preservation. The number of zooecial apertures and carinal nodes in 5mm, and the zooecial base shape, are recorded for the first time. Crockford tabled the number of zooecial apertures in 10mm at about 34.

F. donensis Morozova, 1955, *F. nodograciosa* (Chronic, 1953), and *F. parviuscula* Bassler, 1929, have similar meshwork formulae to *F. canthariformis,* but have hour-glass fenestrules. *F. subvischerensis* Shulga-Nesterenko, 1951, has more nodes per 5mm and narrower fenestrules. The Japanese species *F. nomatae* Sakagami, 1961, is poorly known, but its fenestrules appear to be hour-glass shaped and wider than those in *canthariformis.*

F. microaperturata Shulga-Nesterenko, 1941, is very similar, but has much smaller zooecial apertures than the Australian species.

Range and Distribution: *Fenestella canthariformis* has been recorded previously from the Artinskian *Fenestella* Shale of the Branxton Formation in New South Wales and from the Lakes Creek Beds and the 'Dilly Stage' in Queensland (Crockford, 1951).

In the present study, specimens CPC 7119-20 came from SP 720.

FENESTELLA cf. COLUMNARIS (Crockford, 1944)

(Pl. 14, fig. 2)

cf. 1944c *Fenestrellina columnaris* Crockford, p. 170, pl. 2, fig. 3, text-fig. 1F, G.
cf. 1957 *Fenestella columnaris* (Crockford); Crockford, p. 58.

Description of Bowen Basin Material

Micrometric Formula

B/10	D/10	Z/5	N/5	Bw	Zd	Zb
18	12-15	17-19	17-18	0.36-0.48	0.12-0.17	P

The branches are straight, with steep lateral slopes accentuating the height of the nodose carina. Proximal to bifurcation branch width may increase to 0.85mm; immediately distal to bifurcation the branch resumes the usual proportions. Branches are wider than the fenestrules.

Fenestrules are elongate oval, 0.22-0.32mm wide and 0.33mm to 0.56mm long. They are not indented by peristomes.

From three to four zooecial apertures border a fenestrule. Centres of successive apertures are separated by 0.24mm to 0.32mm. Proximal to bifurcation three rows of apertures are found across the branch.

Bifurcation of branches is associated with a widening of the dissepiments. Dissepiments range in width from 0.26mm to 0.4mm. The relationship between apertures and dissepiments is stabilized.

The carinal nodes are separated by 0.27-0.34mm. Where associated with bifurcation they become stouter. Proximal to bifurcation the carina divides distally to the first appearance of three rows of apertures across the branch.

The zooecial base is pentagonal. The reverse surface cannot be observed.

Remarks: The specimens described are similar to those described by Crockford (1944c), but are referred to as *F.* cf. *columnaris* because their dissepiments are wider.

Fenestella ornata Shulga-Nesterenko, 1941, has three parameters of the meshwork formula similar to *F. columnaris,* but nodes on *ornata* are poorly known. The number of nodes per 5mm and their spacing serve to distinguish *columnaris* from *F. sokolskayae* Shulga-Nesterenko, 1951. Fenestrules are larger in *F. subornata* Shulga-Nesterenko, 1952, and *F. subquadratopora* Shulga-Nesterenko, 1952, has narrower branches and dissepiments and more irregular spacing of the nodes.

Range and Distribution: *Fenestella columnaris* is listed by Crockford (1951) as occurring in the ?Sakmarian Callytharra Formation. This is thought to be an error, because the only record of the species before 1951 is in Crockford (1944c), where it is recorded from the Wandagee Formation of Artinskian age. Crockford (1957) records the species from the Artinskian Noonkanbah Formation in Western Australia. In the Bowen Basin *F.* cf. *columnaris* is recorded from Artinskian strata. Specimens and their localities are: CPC 7121, SP 732; UQGD F40565, L 997.

FENESTELLA DISPERSA (Crockford, 1943)

(Pl. 15, figs 4-5)

1943 *Fenestrellina dispersa* Crockford, p. 265, pl. XV, figs 4-5.

Holotype: SUGD 3404, from the Artinskian Conjola Formation. Shoalhaven Group, at Warden Head, Ulladulla, New South Wales (Crockford, 1943, pl. XV, figs 4-5).

Diagnosis: Species of *Fenestella* having straight, narrow branches capped by a slight carina with small, regularly spaced nodes; three zooecial apertures per fenestrule, with peristomes not indenting the fenestrules; zooecial base pentagonal.

Description of Bowen Basin Material

Micrometric Formula

B/10	D/10	Z/5	N/5	Bw	Zd	Zb
17-21	15-16	17-18	17-20	0.21-0.32	0.14-0.16	P

The branches are straight and capped by a slight nodose carina. 1.2mm proximal to bifurcation branch width may increase to 0.75mm. Distal to bifurcation the branch resumes the usual proportions. Branches and fenestrules are of similar width.

Fenestrules are subrectangular; they are 0.21-0.32mm wide, and 0.48-0.7mm long. The narrowest fenestrules, but not necessarily the longest, are found distal to bifurcation.

Dissepiments are normal to the branches and range in width from 0.16mm to 0.24mm. A dissepiment of width 0.18mm at its midpoint can increase to 0.28mm where it joins the branch. Usually apertures are not associated with dissepiments.

There are three or four, and rarely two, zooecial apertures per fenestrule. Apertures are surrounded by very thin peristomes, which do not indent the fenestrules. Centres of successive apertures are separated by 0.24-0.32mm.

Proximal to bifurcation, a third row of apertures is inserted 1.2mm from bifurcation. The relationship of zooecial apertures to the carina proximal to bifurcation cannot be observed.

Distal to bifurcation the carina is slight and nodose; nodes are separated by 0.24-0.31mm.

The zooecial base is pentagonal. On the reverse surface both dissepiments and branches are evenly rounded. The surface is ornamented by fine tubercles.

Remarks: *Fenestella hexagonalis* Rogers, 1900, has a similar meshwork formula to *F. dispersa,* but the shape of the fenestrules is different and the form of the expanse in the American species is unusual. *F. retiformis* var. *tenuis* Trizna, 1939, has fewer zooecia per fenestrule; *F. tshechurensis* Shulga-Nesterenko, 1951, has narrower dissepiments, a smaller zooecial diameter, and a wider spacing of nodes; and *F. kotlukovi* Shulga-Nesterenko, 1951, has narrower dissepiments, a smaller zooecial diameter, and different fenestrule dimensions.

Fenestella vischerensis Nikiforova, 1938, has narrower dissepiments, *F. retiformis* (Schlotheim, 1820) has shorter fenestrules, and *F. angustaeformis* var. *pentagonalis* Shulga-Nesterenko, 1936, has more zooecia per fenestrule.

Range and Distribution: *Fenestella dispersa* is restricted to eastern Australia. In Queensland, it has been found in the 'Dilly Stage' at Springsure; in New South Wales, from the Sakmarian Allandale and Rutherford Formations, from the Artinskian *Fenestella* Shale and from the type locality in the Conjola Formation; in Tasmania, from the Artinskian Berriedale Limestone and the Kungurian-Kazanian Malbina 'E' Formation (Crockford, 1951).

In the present study the following specimens have been recorded: UQGD F40549, 40550, and 40562-4, all from locality L 997.

A specimen catalogued as UQGD F40566 from the same locality is referred to *F.* cf. *dispersa,* as is an uncatalogued specimen from L 896.

FENESTELLA FOSSULA Lonsdale, 1844

(Pl. 14, fig. 4)

1844 *Fenestella fossula* Lonsdale, p. 166.
1845 *Fenestella fossula* Lonsdale; Lonsdale, in Strzelecki, p. 269, pl. 9, figs 1, 1a.
1849 *Fenestella fossula* Lonsdale; Dana, p. 170, pl. X, figs 12, 13.
1872 *Fenestella fossula* Lonsdale; Etheridge, p. 332, pl. XXV, fig. 1.
1892 *Fenestella fossula* Lonsdale; Etheridge, p. 217.
1896 *Fenestella* aff. *fossula* Lonsdale; Deiner, p. 83, pl. 7, fig. 8, pl. 8, fig. 4.
1907 (non) *Fenestella fossula* Lonsdale; Etheridge, p. 27, pl. 8, figs 11-13.
1918 *Fenestella fossula* Lonsdale; Laseron, p. 193, pls 13, 14.
1936 *Fenestella fossula* Lonsdale; Reed, p. 5.
1941a *Fenestrellina fossula* (Lonsdale); Crockford, p. 399, pl. 18, figs 2-3, text fig. 1.
1943 *Fenestrellina fossula* (Lonsdale); Crockford, p. 266.

Holotype: Lost, 'from the southern part of Van Diemen's Land'.

Neotype (chosen Crockford, 1941a, p. 400): SUGD 1406, from the Artinskian Grange Mudstone, Cascades Group, on the Huon Road, Mount Wellington, Hobart, Tasmania, about 1000 feet above sea level (Crockford, 1941a, pl. 18, fig. 3, text-fig. 1).

Diagnosis: Species of *Fenestella* with three or four zooecia per fenestrule and wide dissepiments; carina slight with small, rather closely spaced nodes; zooecial base shape pentagonal.

Remarks: Smith (in press) has shown that it is unlikely that the locality of the neotype is the same as that from which Darwin and Strzelecki collected. The Huon Road, as it is today, was not opened until 1860, and before that all access to the mountain was by foot and bridle tracks which did not follow the road of today. The possibility that all Darwin's specimens came from the same locality is discussed by Smith. The locality is Lower Sandy Bay, Hobart and the formation outcropping there is the Bundella Mudstone. The strata outcropping on the slopes of Mount Wellington are stratigraphically higher than the Bundella Mudstone.

Specimens from the Bundella Mudstone are slightly smaller than the neotype but are within the species variation, and, indeed, agree more closely with Darwin's sample than does the neotype.

Description of Bowen Basin Material

Micrometric Formula

B/10	D/10	Z/5	N/5	Bw	Zd	Zb
15-20	9-13	18-24	15-18	0.2-0.4	0.12-0.18	P

The zoaria have a regular meshwork. Branches are straight and are capped by a nodose carina. Proximal to bifurcation the branch width increases to 0.64mm; distal to bifurcation the branch width may be 0.15mm, but it gradually resumes the usual proportions. Branches have a width similar to the fenestrules.

Fenestrules are from 0.22mm to 0.44mm wide, and fenestrule lengths range from 0.65mm to 1.05mm. The fenestrules are elongate oval. The smallest fenestrules are associated with bifurcation and dissepiments adjacent to bifurcation.

Dissepiments are normal to the branches and 0.14-0.24mm wide. Only if a zooecial aperture is partly situated on a dissepiment is there any perceptible increase in width where the dissepiment intersects the branch. In this case the width of the dissepiment at the point of intersection is more than double the width at midlength.

Centres of successive zooecial apertures are 0.23-0.32mm apart. Three or four zooecial apertures border a fenestrule and although apertures are surrounded by peristomes, the peristomes do not indent the fenestrules. If there are four apertures per fenestrule, one is partly situated on the dissepiment.

Proximal to bifurcation a third row of apertures is inserted, but a fourth row has not been observed. The third row of apertures is inserted distal to bifurcation of the carina, which is 0.44mm proximal to bifurcation.

The carina occupies a little less than one-third of the branch width. It is sharp but not raised much above the adjacent surface of the branch. Nodes are placed in a single row and their centres are separated by 0.2-0.3mm.

The zooecial base is pentagonal. On the reverse surface both branches and dissepiments are evenly rounded, and the branches are longitudinally striated. Minute tubercles are found over the entire reverse surface.

Remarks: The Russian species, *Fenestella tshechurensis* Shulga-Nesterenko, 1951, *F. donaiciformis* Shulga-Nesterenko, 1951, *F. miranda* Shulga-Nesterenko, 1951, *F. rotundicellata* Shulga-Nesterenko, 1952, and *F. altshedatensis* Morozova, 1961, have similar meshwork formulae to *Fenestella fossula,* but they can be distinguished by their narrower branches and dissepiments and their varying fenestrule dimensions.

Fenestella kawadae Sakagami, 1962b, can be similarly distinguished.

Range and Distribution: In eastern Australia, the species had been recorded previously from the Sakmarian Allandale and Rutherford Formations, the Artinskian *Fenestella* Shale of the Branxton Formation, and the Artinskian Conjola Formation in New South Wales; the Artinskian Berriedale Limestone in Tasmania; the 'Dilly Stage' at Springsure, and an unknown locality in the 'Middle Bowen Beds' of the Bowen River Coalfield in Queensland (Crockford, 1951).

This study has altered the range of the species. Specimens catalogued and their localities are: CPC 7116-8, SP 720; UQGD F40542 and 40567, L 997.

Uncatalogued specimens referable to the species have been located at MC 957 and L 1363.

FENESTELLA GRANULIFERA (Crockford, 1941)

(Pl. 15, figs 2-3)

1918 *Protoretepora* sp., Laseron, p. 198, pl. 3, fig. 1.
1918 *Phyllopora* sp., Laseron, p. 198, pl. 3, fig. 1.
1941b *Fenestrellina granulifera* Crockford, p. 509, pl. 21, fig. 4.
1943 *Fenestrellina granulifera* Crockford; Crockford, p. 266.
1946 *Fenestrellina granulifera* Crockford; Crockford, p. 132, text-fig. 4.
1964 *?Fenestella granulifera* (Crockford); Maxwell, p. 38.

Holotype: SUGD 1427 from the Artinskian *Fenestella* Shale of the Branxton Formation, Maitland Group, west of Branxton, New South Wales (Crockford, 1941b, pl. 21, fig. 4).

Diagnosis: Species of *Fenestella* with three or four zooecia per fenestrule; zooecial apertures separated by a slight median carina with short, blunt, well spaced nodes; zooecial base shape pentagonal.

Description of Bowen Basin Material

Micrometric Formula

B/10	D/10	Z/5	N/5	Bw	Zd	Zb
11-14	7-9	11-14	11-13	0.32-0.48	0.14-0.21	P

The zoarium is regular. Branches are capped by a straight, slight median carina. Proximal to bifurcation the branch width increases to 0.7mm, but immediately distal to bifurcation it is 0.32mm wide.

There is a gradual increase distally until the branch resumes the usual proportions. Branches are usually narrower than the fenestrules.

Fenestrules are 0.32-0.7mm wide and 0.92-1.5mm long. They are oval to rectangular, the variation being due to the increase in width of some dissepiments where they meet the branches.

Dissepiments range in width from 0.2mm to 0.32mm. A dissepiment 0.2mm wide at its midpoint may double or more than double its width where it meets the branch. This is caused by the presence of an aperture partly on the dissepiment.

Zooecial apertures are in two rows on the branches. There may be two, more commonly three or four, zooecial apertures per fenestrule, and peristomes indent the fenestrules. Centres of successive apertures are separated by 0.32-0.56mm.

Proximal to bifurcation, there are three rows of zooecial apertures, and immediately proximal to bifurcation there may be four. Bifurcation of the carina proximal to branch bifurcation cannot be related to the insertion of the third or fourth row of apertures.

The nodose carina separates the zooecial apertures. Nodes are short and blunt, with their centres 0.44-0.68mm apart. Where they are adjacent to an aperture the apertures open sideways.

The zooecial base is pentagonal.

On the reverse surface, the branches and dissepiments are evenly rounded. The surface is covered by randomly oriented tubercles which, if developed on the branches, tend to be larger than those on the dissepiments.

Remarks: *Fenestella bifida* var. *tricosa* Trizna, 1939, has a similar meshwork formula to *F. granulifera,* as have *F. shamovi* Shulga-Nesterenko, 1952, and *F. buguniensis higuchizawaensis* Sakagami, 1962a. However, the last two species have more zooecia per fenestrule together with a smaller zooecial diameter. *F. bifida* var. *tricosa* has wider dissepiments and generally shorter fenestrules.

F. stschugorensis var. *frivola* Trizna, 1939, has three similar parameters of the formula, as has *F. volayensis* Shulga-Nesterenko, 1951, but both Russian species have vaguely developed nodes.

F. basleoensis var. *magna* Shulga-Nesterenko, 1941, generally has more zooecia per fenestrule, *F. basleoensis* var. *speciosa* Shulga-Nesterenko, 1941, has smaller fenestrule dimensions, and *F. schischovae* var. *schaktauensis* Shulga-Nesterenko, 1941, has narrower branches and dissepiments than the Australian species.

Range and Distribution: *Fenestella granulifera* has been recorded from the Artinskian *Fenestella* Shale of the Branxton Formation in New South Wales, the Artinskian Berriedale Limestone in Tasmania, and the Lakes Creek Beds in Queensland (Crockford, 1951). The specimen recorded by Maxwell (1964) from the Upper Carboniferous Rands Formation in the Yarrol Basin is referred doubtfully to the species.

This is the first record of the species from the Bowen Basin; it extends the range to Kungurian-Kazanian. Specimens UQGD F48369-72 are from L 2580. Uncatalogued specimens have been collected from Du 179.

FENESTELLA SIMULATRIX (Crockford, 1946)

(Pl. 15, fig. 6; Pl. 16, fig. 4)

1946 *Fenestrellina simulatrix* Crockford. p. 127, text-fig. 6.

Holotype: UQGD F7950A, from the Artinskian Lakes Creek Beds, east of Rockhampton, Queensland (Crockford, 1946, p. 127, text-fig. 6) (type locality of *L.? expansa*).

Diagnosis: Fine *Fenestella* with two or three zooecial apertures per fenestrule; fenestrules tending to be hour-glass in outline; carina slight with small, sharp, not closely spaced nodes.

Description of Bowen Basin Material

Micrometric Formula

B/10	D/10	Z/5	N/5	Bw	Zd	Zb
14-20	11-14	16-19	13-15	0.32-0.46	0.13-0.2	P

The branches are straight and narrow, capped by a slight carina. Proximal to bifurcation the branch width may increase to 0.7mm; distal to bifurcation the branch resumes the usual proportions. Increase in width of the branch proximal to bifurcation is associated with a decrease in lateral slope of the branch, and in this region apertures do not open sideways. Branches are as wide as the fenestrules.

Fenestrules are usually oval or rectangular. Their width is 0.22-0.48mm and their length ranges from 0.54mm to 0.84mm. Peristomes may indent the fenestrules, giving them an hour-glass shape.

Dissepiments are 0.14mm-0.20mm wide, increasing to 0.27mm where they meet the branch. In a few cases the increase is associated with overlap of an aperture on to the dissepiment.

There are two or three zooecial apertures per fenestrule. Centres of successive apertures are separated by 0.24-0.34mm. Apertures are surrounded by thin peristomes.

Three rows of apertures, and sometimes four, are seen proximal to branch bifurcation. Three rows of apertures may be observed 0.5mm proximal to bifurcation and if there are four rows they can be observed immediately proximal to bifurcation.

Insertion of the third row of apertures is distal to the bifurcation of the carina. The carina occupies approximately one-third of the width of the branch. Nodes are short, with successive centres separated by 0.28-0.39mm. The carina bifurcates 0.7mm proximal to branch bifurcation.

The zooecial base is pentagonal. In the upper portions of the branch section it may seem to be triangular, but a small flange aids formation of the pentagonal base in the deeper portions of the branch.

Moulds of the reverse surface show that both branches and dissepiments are evenly rounded; tubercles are absent.

Remarks: The micrometric formula of the holotype is 15-20/ 11-13// 15-18/ 12-14// 0.27-0.39/ 0.14-0.16//P

This is very similar to the Bowen Basin specimens: the branches and zooecial diameter may be slightly larger, probably because of better preservation.

An eastern Australian species, *Fenestella dispersa* (Crockford), resembles *F. simulatrix,* but they can be distinguished by the larger dimensions of *simulatrix.*

Fenestella aspratilis Bassler, 1929, has a stable relationship between the zooecial apertures and dissepiments. *F. subornata* Shulga-Nesterenko, 1952, has wider dissepiments and a smaller zooecial diameter than *F. simulatrix,* and *F. subspecifica* Shulga-Nesterenko, 1952, has a smaller zooecial diameter and generally fewer fenestrules per 10mm.

Range and Distribution: *Fenestella simulatrix* has been recorded only from the Lakes Creek Beds (Crockford, 1951).

In the Bowen Basin, the species has been recorded from Artinskian strata. Three specimens of the species are on a slab labelled UQGD F40544 from L 997, and an uncatalogued specimen is referred to *F.* cf. *simulatrix* from SP 720.

FENESTELLA SPINIFERA (Crockford, 1946)

(Pl. 16, fig. 5)

1946 *Fenestrellina spinifera* Crockford, p. 129, text-fig. 8.
1952 cf. *Fenestella shamovi* Shulga-Nesterenko, p. 53, pl. VIII, figs 3-4.
1957 *Fenestella austini* Elias & Condra, p. 76, pl. 4, figs 9-11.

Holotype: UQGD F7955A from the Artinskian Lakes Creek Beds, east of Rockhampton, Queensland (Crockford, 1946, p. 129, text-fig. 8) (type locality of *P. keppelensis*).

Diagnosis: Coarse *Fenestella* with three to six zooecial apertures per fenestrule; fenestrules of irregular shape; carina high, with small nodes.

Description of Bowen Basin Material

Micrometric Formula

B/10	D/10	Z/5	N/5	Bw	Zd	Zb
12-14	9-10	12-15	11	0.34-0.56	0.12-0.18	T

Branches are straight except at bifurcation. Proximal to bifurcation, the branch width may increase to 0.96mm; distal to bifurcation the branch resumes the usual proportions. The width of the fenestrules is from 0.3mm to 0.5mm and their length ranges from 0.96mm to 1.5mm. Fenestrules are of irregular shape, partly because some dissepiments widen at one end of the fenestrule, and partly because not all dissepiments are normal to the branches.

Dissepiments are from 0.16mm to 0.24mm wide, but they may be twice as wide, or occasionally even more, where they join the branches. Most dissepiments have an aperture partly situated on them.

There are two rows of zooecial apertures per branch; centres of successive apertures are separated by 0.24-0.42mm. There are three to five, usually four, zooecial apertures per fenestrule. Peristomes are evident, especially on the side of the aperture adjacent to the fenestrule. They slightly indent the fenestrules.

Proximal to bifurcation a third row of apertures is inserted and then a fourth. Proximal to insertion of the third row of apertures and about 0.5mm from branch bifurcation, the carina divides.

The carina is high; in an unweathered condition it is as much as 0.18mm above lateral portions of the branch. It occupies approximately one-third of the branch width. Because of the height and width of the carina zooecial apertures open sideways. Centres of the thin high nodes are separated by 0.5-0.65mm.

The zooecial base is triangular. The reverse surface cannot be studied.

Remarks: *Fenestella spinifera* has a meshwork formula similar to that of *F. bifida* var. *tricosa* Trizna, 1939, but the latter species has much wider dissepiments and generally shorter fenestrules.

Fenestella basleoensis var. *vuktilensis* Shulga-Nesterenko, 1941, is also similar, but generally has shorter fenestrules.

Range and Distribution: *Fenestella spinifera* has been recorded from localities other than that of the type. The specimen recorded by Maxwell (1964) from the Upper Carboniferous Rands Formation in the Yarrol Basin is doubtfully referred to *F. spinifera;* the specimen figured by Maxwell (1964, pl. 13, fig. 5) as *F. spinifera* from the Lower Permian Yarrol Formation could not be found in the University of Queensland Collections by the writer.

As *Fenestella austini* Elias & Condra it is recorded from the Wolfcampian of the Glass Mountains of the U.S.A.

The species has not been recorded previously from the Bowen Basin. The range of the species has not been altered by finding specimens of *F. spinifera* at SP 732 (CPC 7107) and SP 748 (CPC 7108). A specimen catalogued as UQGD F47373 from L 2580 is referred to *F.* cf. *spinifera.*

FENESTELLA BOWENENSIS sp. nov.

(Pl. 17, fig. 1-3)

Holotype: CPC 7034 from the Artinskian *Eurydesma* Limestone, Cattle Creek Formation, of Reids Dome, south of Springsure, Queensland; SP 720, Lat. 24°51'S., Long. 148°19'E., Springsure Sheet, 0.3 miles at 320° from AOE No. 2 Well, southwest of Rolleston, Queensland.

Paratype: CPC 7125 from the same locality.

Diagnosis: Species of *Fenestella* with wide straight branches connected by wide dissepiments; fenestrules elongate oval, with two or three zooecial apertures per fenestrule; rims of apertures do not indent fenestrules; carina high with rather closely spaced nodes; zooecial base pentagonal.

Description

Micrometric Formula

	B/10	D/10	Z/5	N/5	Bw	Zd	Zb	Fl	Fw	Dw
	15-17	10-13	17-21	16-21	0.3-0.52	0.12-0.18	P	0.32-0.6	0.14-0.28	0.32-0.52
Arithm. Mean			19	19	0.41			0.42	0.2	0.42
Stand. Deviation			1	1.3	0.06			0.07	0.03	0.05
No. of Measuremts			64	36	66			63	68	64

Branches are wide and straight; they are surmounted by a median carina which may be slightly flexuous in outline, and capped by a single row of nodes. The carina when unweathered is narrow and occupies less than one-third of the branch width. Zooecial apertures open sideways on the oblique lateral portions of the branch. Proximal to bifurcation the branch width may increase to 0.8mm, but distal to bifurcation it resumes the usual proportions. Branches are wider than the fenestrules.

Fenestrules are twice as long as they are wide. Their shape is fairly constantly elongate oval, but they may be constricted at the ends, especially near bifurcation. This constriction is due also to the increase in width of the dissepiments where it meets the branch.

Dissepiments with a midwidth of 0.36mm may increase to 0.48mm where they join the branch. They are so wide where they join the branch that two zooecial apertures may be situated partly on the dissepiment and partly on the branch.

Zooecial apertures are arranged in two rows; the centres of successive apertures are separated by 0.24-0.34mm. There are two or three apertures per fenestrule; where there are three, apertures opposite the proximal and distal ends of the fenestrule are partly situated on the dissepiment.

For 0.76mm proximal to bifurcation of the branch there are three rows of apertures. At bifurcation the zoarium is weathered slightly, but there appear to be four rows of apertures.

The carina is raised 0.08-0.12mm above the upper level of the apertures, and nodes are raised slightly above this. Successive nodes are separated by 0.2-0.42mm. The carina seems to bifurcate 0.7mm proximal to branch bifurcation. For 0.34mm proximal to bifurcation two carinae are certainly developed, and where there are four rows of apertures across the branch, there is an aperture outside each carina.

The surface of the branches lateral to the carinal area is ornamented by granules arranged in rows parallel to the direction of growth.

The zooecial base is pentagonal. The reverse surface cannot be observed.

Remarks: *Fenestella bowenensis* sp. nov. is placed in Group A, a, 1 of Key 1 and Group A, a, 2 of Key 2. (See p. 85).

Fenestella rockportensis (McNair, 1937) has a similar meshwork formula, but the nodes and the zooecial apertures proximal to branch bifurcation are arranged differently.

Other species with similar meshwork formulae are *F. cavifera* var. *nitida* Trizna, 1939, on which nodes are poorly known and which has narrower branches and different fenestrule dimensions; *F. tetratheca* Condra & Elias, 1944, which has more zooecia per fenestrule, narrower dissepiments, and a more irregular mesh; and *F. hikoroichensis* Sakagami, 1962a, which has wider fenestrules, narrower dissepiments, and a smaller zooecial diameter. The wider dissepiments of *F. bowenensis* sp. nov. enable it to be separated from *F. ornata* Shulga-Nesterenko, 1941, which has wider fenestrules than the Australian species.

Range and Distribution: *Fenestella bowenensis* sp. nov. is found in Artinskian strata in the Bowen Basin. Other specimens of the species which has been catalogued are CPC 7124 from SP 732 and UQGD F48368 from L 2575.

FENESTELLA SPRINGSURENSIS sp. nov.

(Pl. 16, figs 1-3)

Holotype: CPC 7036 from the Artinskian *Eurydesma* Limestone, Cattle Creek Formation, of Reids Dome, south of Springsure, Queensland; SP 720, Lat. 24°51'S., Long. 148°19'E., Springsure Sheet, 0.3 miles at 320° from AOE No. 2 Well, southwest of Rolleston, Queensland.

Paratype: CPC 7037 from the same locality.

Diagnosis: Coarse *Fenestella* with wide straight branches; three or four zooecial apertures per fenestrule, with apertures in two rows separated by a stout, but not high, nodose carina; insertion of third row of apertures at a distance well before bifurcation of the branch; zooecial base triangular.

Description

Micrometric Formula

B/10	D/10	Z/5	N/5	Bw	Zd	Zb	Fl	Fw	Dw
11-14	11-12	15-18	19-20	0.44-0.72	0.12-0.18	T	0.48-0.8	0.16-0.32	0.28-0.48
Arith. Mean				0.52			0.69	0.22	0.34
Stand. Deviation				0.08			0.08	0.05	0.05
No. of Measurements				63			66	72	66

Measurements have been made at a stable portion of the zoarium. Such a portion is rare because of bifurcation and the frequent changes from two to three rows of zooecial apertures associated with it.

Branches are straight and capped by a nodose carina, which on well preserved material is found to be highest and to have the steepest lateral slope distal to bifurcation, and lowest and gentlest proximal to bifurcation.

Bifurcation occurs at intervals of 4.4-6.2mm. Branch width immediately proximal to bifurcation increases to 1.02mm; distal to bifurcation it decreases to 0.36mm. The width of branches increases rapidly to about twice, and sometimes up to three times, the fenestrule width proximal to bifurcation.

In general, the smallest fenestrules are found distal to bifurcation, with those adjacent to the point of division of the carina showing a perceptible increase in size. They are not indented by the peristomes. In shape, the fenestrules tend to be elongate; some are oval because of the abrupt thickening of the dissepiments where they meet the branches.

A dissepiment 0.24mm wide may increase to 0.36mm in width where it meets the branch. The widest dissepiments are associated with bifurcation. Because of their width it is not uncommon to find one, or even two, zooecial apertures situated on them.

In a stable portion of the zoarium zooecial apertures are arranged in two rows, one on each side of the carina. The carina divides proximal to bifurcation and is followed by insertion of a third row of apertures between the carinae. In some cases a fourth row of apertures is inserted immediately proximal to bifurcation. Here, the relation between the nodes, carinae, and apertures is haphazard.

There are two rows of zooecial apertures only for half the distance between bifurcations. Three, and less frequently four, zooecial apertures are found along the margin of a fenestrule. Where there are four, two apertures encroach on the dissepiment. Centres of successive apertures are separated by 0.23-0.48mm.

Centres of successive nodes are from 0.28mm to 0.44mm apart. Proximal to bifurcation this distance is fairly constant at 0.4mm and the number of nodes in 5mm is reduced. In the unicarinate condition the nodes are more elongate and stouter than in the bicarinate, and their relation to apertures cannot be determined.

The zooecial base is triangular.

The reverse surface of well preserved zoaria shows both dissepiments and branches to be evenly rounded and finely granulose, but when the outer layer is removed longitudinal striations appear.

Remarks: *F. springsurensis* sp. nov. belongs to Group A, a, 2 of Key 1. It shows some resemblance to *F. rockportensis* (McNair, 1937), especially in the early insertion of the third row of apertures.

In *F. springsurensis* the arrangement of zooecial apertures seen in *F. rockportensis* is found only proximal to bifurcation. Distal to bifurcation two rows of apertures become conspicuous, and as this is a characteristic of *Fenestella*, the species is assigned to that genus. *Polypora woodsi* has three rows of zooecial apertures as a characteristic feature and immediately distal to bifurcation it reverts to two rows of apertures (see p. 53). However, this condition only persists for one or two apertures before reverting to the three-row condition.

Since only a few measurements of number of zooecia and number of carinal nodes in 5mm can be taken, they have not been subjected to statistical analysis.

Species with similar meshwork formulae for three parameters are *F. quadratoporaeformis* var. *fortis* Trizna, 1939, *F. bifida* var. *repudiosa* Trizna, 1939, *F. pulchradorsalis* Bassler, 1929, and *F. valentis* (Crockford, 1944c). All these species either have fewer nodes per 5mm or the nodes are poorly known. They all have narrower dissepiments than *F. springsurensis*.

Range and Distribution: *Fenestella springsurensis* sp. nov. has been found only at the type locality. Another specimen recorded is CPC 7111.

FENESTELLA sp. nov.

(Pl. 18, figs 1-4)

Description

Micrometric Formula

B/10	D/10	Z/5	N/5	Bw	Zd	Zb	Fl	Fw	Z/F
8-10	4-8	12-15	3-4?	0.56-1.26	0.18-0.22	P	0.42-6.09	0.44-1.94	4-13
Arith. Mean		13.6		0.78			2.65	0.85	7.8
Stand. Deviation		1.3		0.16			0.85	0.29	1.7
No. of Measuremts		27		72			110	105	75

Branches are capped by an indistinct carina, on both sides of which is a row of apertures. Distal to bifurcation the carina seems to be higher, but this effect may be caused by thinning of the branches. Branch width may increase to 1.76mm proximal to bifurcation, and distally it may decrease to 0.42mm.

A feature of the species is unilateral branching. Off one side of a branch, four branches may arise in 5.5mm, each being normal to the parent. These four branches do not branch unilaterally, but they do bifurcate. Away from the parent branch they show characteristics of a simple, bifurcating portion of the zoarium.

Associated with unilateral branching are structures formed by the bifurcation of a branch. The structures are celluliferous and join neighbouring branches. For over half of their length of 1.5mm they have three rows of apertures. Bifurcation of these structures produces branches parallel to the unilateral branches and having two rows of apertures. In one case, bifurcation produces two two-row celluliferous branches, and on one branch, the narrower, the size of zooecial apertures is reduced. The structures are wider than the widest dissepiment.

Dissepiments have a width of 0.22mm to 0.86mm. Their width cannot be closely correlated with their position in the zoarium: in general, the widest dissepiments are associated with bifurcation of branches, but some narrow dissepiments may be associated with the same portion. Not all dissepiments are perpendicular to branches, and this, as well as the unusual pattern of branching, affects the size and shape of fenestrules.

Many fenestrules have a width of 0.6mm to 1.94mm and a length of 0.96mm to 6.09mm; but some are as small as 0.42mm x 0.44mm. Most, but not all, are associated with unilateral branching and bifurcation of branches.

There are two rows of zooecial apertures. Centres of successive apertures are separated by 0.36-0.5mm. The number of apertures per fenestrule increases distally in some but not most parts of the zoarium. A fenestrule with eight apertures placed along one of its lateral margins may be close to a fenestrule with five apertures along one margin and this, in turn, may be close to a fenestrule with nine apertures along one margin. Rims of the zooecial apertures do not indent the fenestrules.

Three rows of apertures are found across a branch for a distance of 3.0mm proximal to bifurcation. Four rows of apertures may be found immediately proximal to bifurcation.

Remarks: Unilateral branching, a feature of the Acanthocladiidae, has been observed in two other species of *Fenestella*. These are *F. jabiensis* Waagen & Pichl (1887, pl. LXXXVIII, figs 1a, 1b, 1d) and *F. quadratopora* Shulga-Nesterenko, 1939 (Elias & Condra, 1957, p. 99, pl. 11, fig. 10). Both differ significantly from the new species.

Species with similar meshwork formulae to *F.* sp. nov. are *Fenestella chapmani* (Crockford), 1944b, *F. regalis* Ulrich, 1890, *F. magnicellata* Shulga-Nesterenko, 1952, and *F. narynica* Nikiforova, 1933c, but none show the unilateral branching. All except *F. regalis* differ also in branch or fenestrule dimensions. *F. regalis* has more nodes per 5mm than *F.* sp. nov.

F. foraminosa var. *grandis* Shulga-Nesterenko, 1941, possesses narrower branches and smaller fenestrule dimensions than *F.* sp. nov., and *F. solida* Shulga-Nesterenko, 1941, and *F. virgosa* var. *sparsituberculata* Shulga-Nesterenko, 1941, have smaller fenestrule dimensions and generally narrower dissepiments.

Range and Distribution: Only one specimen of *Fenestella* sp. nov. (UQGD F48380) has been found, at locality L 2580 in Kungurian-Kazanian strata.

Subgenus PARAFENESTELLA Miller, 1961

1844 *Fenestella* Lonsdale (partim); M'Coy, p. 201.
1944 *Fenestella* Lonsdale (partim); Condra & Elias, pp. 150, 152, 154.
1961a *Parafenestella* Miller, p. 238.

Type species (by original designation): *Fenestella formosa* M'Coy, 1844, p. 201, pl. 29, fig. 2, from the 'Carboniferous Upper Limestone', Upper Visean, Killymeal, Dungannon, Eire (Miller, 1961a, p. 238, pl. 27, figs 3-4, text-fig. 3).

Diagnosis: See Miller, 1961a, page 238.

Remarks: Miller (1961a) erected the genus *Parafenestella* for species of *Fenestella* possessing a dissepimental node. The significance of this structure is not known. When erecting the genus Miller stated that nodes may be homologous with acanthopores, but he then stated (1963, p. 168) that this interpretation may have to be revised.

Branch nodes on the median carina are an outward expression of the median plate, and this structure is directly associated with the zooecial base chambers as well as with the colonial plexus. Dissepiments arise from outgrowths of the colonial plexus on adjacent branches. If the median plate in species assigned to *Parafenestella* can be shown to lie parallel to the dissepiment, and if the dissepimental node is an outward expression of the median plate, then *Parafenestella* may be raised to generic status. Tavener-Smith (pers. comm.) has told me that dissepimental nodes are flattened laterally with their long axes parallel to the length of the dissepiment on the type specimen. No serial sections through the dissepiment have been made. Until the significance of the dissepimental node is known, I prefer to reduce *Parafenestella* to subgeneric rank.

Range and Distribution: Lower Carboniferous-Permian; North America, Great Britain, ?Russia, and Australia (Queensland).

FENESTELLA (PARAFENESTELLA) sp.

(Pl. 17, fig. 4; Text-fig. 13)

Description

Micrometric Formula

B/10	D/10	Z/5	N/5	Bw	Zd	Zb
16-18	9-11	19-21	21	0.32-0.5	0.1-0.18	P

The zoarium is characterized by wide branches, three or four zooecial apertures per fenestrule, a thin, nodose carina on the branch, and dissepimental nodes. Proximal to bifurcation the branch width may increase to 0.74mm;

distal to bifurcation the branches resume the usual proportions. Branches are wider than the fenestrules.

Fenestrules are from 0.16mm to 0.32mm wide and from 0.64mm to 0.94mm in length. They are elongate oval. Constriction occurs adjacent to bifurcation.

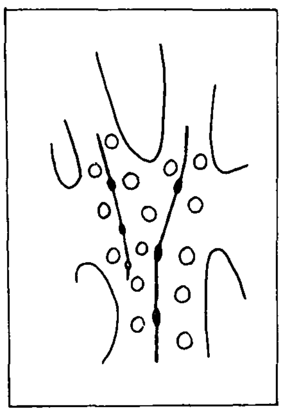
Dissepiments are from 0.22mm to 0.32mm wide. A carina is found on the dissepiment; it is nodose in places, the node being elongated in the length of the dissepiment. Increase in width of the dissepiment where it joins the branch gives the fenestrule an oval outline. There is usually a zooecial aperture placed partly on the dissepiment where it joins the branch.

There are generally four zooecial apertures per fenestrule, but close to bifurcation the number may be reduced to three. If there are four apertures two are placed partly on the branch and partly on the dissepiment. Apertures are surrounded by peristomes which do not indent the fenestrules. Centres of successive apertures are separated by 0.24-0.32mm.

For 0.9mm proximal to bifurcation there are three rows of zooecial apertures. Close to bifurcation there seem to be four rows, but the zoarium is weathered slightly in this region.

Carinae are nodose; the carina on the branch is more obvious than that on the dissepiment. Centres of successive branch nodes are separated by 0.24mm.

Proximal to bifurcation the relationship between the third row of apertures and carinal bifurcation does not bear any resemblance to the described plan of the type species (Miller, 1961a, p. 239, text-fig. 3).



Text-fig. 13.—Camera lucida drawing of *Fenestella (Parafenestella)* sp. illustrating the relation of carinae, nodes, and apertures proximal to bifurcation of a branch. CPC 7038 from SP 720. x20.

The relation between carinae, nodes, and apertures proximal to bifurcation in this species is shown in Text-figure 13.

The zooecial base is pentagonal and the reverse surface cannot be observed.

Remarks: *Fenestella cavifera* var. *nitida* Trizna, 1939, has a similar meshwork formula to the species described but the presence of nodes on the dissepiments is not known, the branches are narrower, and the apertures more widely spaced. The Australian species *Fenestella ruidacarinata* (Crockford, 1944c), has more nodes per 5mm than the described species, and no dissepimental node.

Range and Distribution: The species is the first recorded occurrence of *Fenestella* (*Parafenestella*) from Australia. It has been recorded only from Artinskian strata. Specimens CPC 7038 and CPC 7122 were found at SP 720.

KEYS TO AUSTRALIAN PERMIAN AND CARBONIFEROUS SPECIES OF **FENESTELLA**

Since the turn of the century, palaeontological papers written in Australia have contained descriptions of species of *Fenestella.* So many species have been described as new that it is difficult for a palaeontologist unfamiliar with the genus to place a fragment of *Fenestella* into a species. This is reflected in the many fossil lists, published and unpublished, that cite only 'Bryozoa' or 'Fenestellidae' as present. A key has therefore been devised so that a fragment of *Fenestella* can be placed into a broad group using easily recognizable morphological features.

The first key presented contains all the Australian Permian and Carboniferous species of *Fenestella.* Although it is comprehensive it is not to be regarded as a means to the precise identification of a species, nor can it be used to determine whether or not a species is new. Another limitation is that division into the four major groups of the key is based on the stabilization of the apertures on the dissepiments.

This morphological feature was used by Elias & Condra (1957, p. 71) in their key. The difficulty in assessing the aperture/dissepiment relationship for a species can be gauged from the work of Elias & Condra. If *Fenestella cruciformis* Elias & Condra (1957, p. 145, pl. 20, fig. 5) and *Fenestella horologia* var. *libellus* Elias & Condra (1957, p. 147, pl. 22, fig. 2) are studied, portions of zoaria can be found where apertures are not placed on dissepiments but are displaced into the angle between branch and dissepiment. However

Elias & Condra place both species in Group XII, characterized by having 'the apertures stabilized, all bases of dissepiments occupied by apertures'. In *Fenestella binodata* var. *leonardensis* Elias & Condra (1957, p. 134, pl. 9, fig. 5) a stable and an unstable relationship can be observed in one fragment of a zoarium.

The stable relationship is, to some extent, dependent on the width of the dissepiment, for the aperture is more likely to be located on a dissepiment if the dissepiment is wide. Another problem is whether the fragment studied comes from an immature or a mature portion of the zoarium. In an immature portion, characterized by much bifurcation of branches, stabilization of zooecial apertures on dissepiments would not be a constant feature. All Australian species of *Fenestella* have been erected using fragments of zoaria, some possibly from an immature portion of the zoarium. This makes it increasingly difficult to state accurately the relation between zooecial apertures and dissepiments. Because of this, a second key was constructed in which the aperture/dissepiment relationship was replaced by the shape of the zooecial chamber at its base.

The use of this feature has necessitated revising all the Permian and Carboniferous species of *Fenestella* in Australia. In all cases, the holotype was studied if it was available; otherwise, topotypic material was used.

This key is limited in use especially if external moulds of the meshwork are studied, because the shape of the base chamber cannot be determined from external moulds. The successful use of the key depends on the study of more complete specimens so that all morphological features including shape of the zooecial base can be observed. A basal branch section can be obtained easily by etching the obverse surface of the branch with dilute hydrochloric acid or by cutting serial sections through the branch.

Zooecial Base Shape

One result of studying the shape of the base was to show that sections of the zooecial chamber varied in shape depending on the level at which the section was cut through the zoarium. Base shapes discussed in previous descriptions of species had been observed at different levels of the zooecium and the significance of the shapes was difficult to gauge.

Study of *Fenestella quinquecella* (Crockford, 1941b) demonstrates changes which take place in the shape of sections through a zooecial chamber. Diagrammatic sketches made from the sections are shown in Text-figure 6A-G.

Species of *Fenestella* have been differentiated by Nekhoroshev and other Russians using the shape of zooecial chambers. Nikiforova (1933b) demonstrates that species with the same meshwork formula can possess different zooecial base shapes. Also it is possible for the same zooecial base shape to occur in species possessing different meshwork formulae.

There are some instances where a species of *Fenestella* has been reported as having two different zooecial base shapes in the zoarium, but I have seen no figures exhibiting this feature. It may be due to observations made on sections at different levels of the zooecium.

Importance of Morphological Features used in Keys

Before the morphological features used in the keys are discussed the microstructure of *Fenestella* should be considered in the light of observations made by Shulga-Nesterenko (1941, 1949b) and Elias & Condra (1957).

The first-formed exoskeleton of *Fenestella* is the colonial plexus, which is analogous to the common bud of the Cyclostomata. The plexus surrounds each zooecium and forms the cores of the carinae, nodes, and dissepiments. The base of the plexus is longitudinally ribbed along the branches. Surrounding the plexus is sclerenchymatous material, which is layered, and some layers are laminated. The plexus can be traced from the basal part of zoaria in their earliest stage of development, and therefore features associated with it are considered to be of prime importance in taxonomy.

Bearing this in mind, measurements of *Fenestella* species showed that there was a natural division of fenestrules into long and short, at a length of about 1.30mm. Some species had measurements not satisfied by this division, but the upper limits of their fenestrule lengths were far in excess of 1.30mm. The fenestrule length has a direct relation to the colonial plexus since it is dependent on the outgrowths of the dissepiments from the branches.

The maximum number of zooecia per fenestrule showed some natural division. Some species had values not satisfied by the parameter.

There are two methods of calculating the number of zooecia per fenestrule. One is by counting the number and the other is by dividing the number of fenestrules in 10mm by the number of zooecial apertures in 10mm. The latter is mathematically more correct, but some species give an anomalous figure using this method, e.g. *F. disjecta* (Crockford, 1944c). In the case of anomaly the value judged to be more satisfactory was adopted.

Because the zooecial base chamber is the first appearance of the zooecium in the colonial plexus, it is considered to be of importance, and its shape is used as a feature in the second key.

One problem which had come to light before the key was compiled is that some species may only be variants of others; but because they have been erected from fragmentary zoaria it is difficult to determine whether they are identical until more material becomes available. The possibility of synonymy appears to be greater in the Carboniferous forms. Many species erected differ from previously erected species by minor morphological differences which on re-examination are found to be present on both species.

Additional Information on some Australian Species of Fenestella

Descriptions of some previously erected Australian Carboniferous species of *Fenestella* do not contain sufficient information to enable comparisons to be made with other species. I have restudied type specimens of the species; observations and measurements made are tabled below. Species considered to be identical are discussed.

Fenestella cerva Campbell, 1961, p. 455, pl. 59, figs 1a-c. Branch width ranges from 0.3mm to 0.5mm. There are 13 to 15 zooecial apertures in 5mm.

Fenestella stellaris Campbell, 1961, p. 456, pl. 58, figs 4a-d. There are 15 to 19 zooecial apertures in 5mm. Carinae appear to be absent. Nodes are poorly preserved and this may be the reason for their apparent irregular distribution. Better preserved material may show that nodes are only 0.5mm apart.

Fenestella anodosa Campbell, 1961, p. 457, pl. 57, figs 3a-c. There are 13 to 15 zooecial apertures in 5mm. Preservation is poor but fine nodes are present in places on external moulds.

Fenestella crockfordae Campbell, 1961, p. 457, pl. 59, figs 2a-b, *non* Burckle, 1960. Branch width is 0.42mm to 0.65mm. Preservation of the species as external moulds is very poor, but there appear to be 10 or 11 zooecial apertures in 5mm.

Fenestella stroudensis Campbell, 1961, p. 458, pl. 56, figs 1a-c. The obverse surface is preserved as an external mould. Depressions similar to nodes are situated in the middle of the branch. Branch width is 0.3mm to 0.5mm and there are 15 to 18 zooecial apertures in 5mm.

?*Fenestella altinodosa* Campbell, 1961, p. 458, pl. 57, figs 2a-b. There are 12 to 15 zooecial apertures in 5mm.

Fenestella wilsoni Roberts, 1963, p. 10, pl. 3, figs 10-12. There are 24 carinal nodes in 5mm. The zooecial base is triangular or trapezoidal. In the latter case the two parallel sides are at an angle to the side of the branch.

Fenestella cystica Campbell & Engel, 1963, p. 65, pl. 1, figs 1-3. Carinal nodes are present but poorly preserved.

Fenestella brownei Roberts, 1963, p. 8, pl. 2, figs 3-5. Irregularities are developed on the carina. Whether they are nodose or due to the preservation is not known. The zooecial base of *Fenestella brownei* was given as ovoid (Roberts, 1963, p. 9). However, this observation does not appear to have been made at the base of the zooecial chamber; the zooecial base is pentagonal.

Fenestella propinqua de Koninck, 1877 (Crockford, 1947, p. 35, pl. 6, fig. 4, text-fig. 50). This species shows some resemblance to *F. brownei.* Roberts (1963, p. 10) separates his species from *F. propinqua* because it has a broad carina on the branches, a thinner, more delicate carina on the dissepiments, and the third zooecial aperture (at bifurcation) always situated in the fork of the bifurcation.

Crockford (1947, p. 35) mentions that the carina on *F. propinqua* is faint. It is of similar height to the carina on *F. brownei* but not as broad.

Measurements made on both species are tabulated below.

	F. propinqua	*F. brownei*
B/10	10-13	11-15
Bw	0.21-0.35mm	0.3-0.38mm
F/10	4-5	4-5
Fl	1.5-2.7mm	1.8-3.0mm
Fw	0.38-0.66mm	0.4-0.5mm
Zd	0.08mm	0.1mm
Z/F	5-10	5-9
Z-Z	0.27-0.36mm	?0.4-0.5mm
Z/5	16-18	17-18
Zb	P	P
Dw	0.06-0.4mm	0.2-0.3mm

The similarity between the two species can be seen from the measurements. Distinctions made by Roberts are not considered to be of specific value, especially as the obverse surfaces of both species are preserved as external moulds. *F. propinqua* and *F. brownei* are regarded as being identical.

Fenestella gresfordensis Roberts, 1963, p. 9, pl. 2, figs 6-8. There are 12 to 14 carinal nodes in 5mm. This species is very similar to *F. swaini* Campbell & Engel, 1963 (p. 66, pl. 1, figs 9-12), and measurements of both species are tabulated below.

	F. swaini	*F. gresfordensis*
B/10	16-21	17-18
Bw	0.15-0.3mm	0.15-0.3mm
F/10	8-12	5-7
Fl	0.8-1.6mm	1.0-2.3mm
Fw	0.25-0.5mm	0.2-0.5mm
Z/5	18-20	20-24
Z-Z	0.25-0.4mm	0.26-0.34mm
Z/F	4-7	5-7
Zd	0.08-0.12mm	0.1-0.12mm
Zb	?	T
N/5	12-14	12-14
N-N	0.35-0.5mm	0.4mm
Dw	0.1-0.2mm	0.08-0.15mm

From the measurements it can be seen that there is some overlap in all except the F/10, F1, and Z/5. The discrepancy between the measurements of these elements may be due to observations on different portions of the zoarium.

The two species may be synonymous.

Fenestella macleayensis Campbell, 1962, p. 48, pl. 11, figs 11a-c. This species has 11 to 16 zooecial apertures in 5mm. Nodes are present in some places. Campbell (1962, p. 48) states that the species can be distinguished from *F. crockfordae* because of the presence of nodes and a wide carina on the latter. Material used for description of both species is poorly preserved and I have found it difficult to distinguish them.

Measurements for both species are tabulated below.

	F. macleayensis	*F. crockfordae*
B/10	circa 12	10-12
Bw	0.4-0.5mm	0.4-0.6mm
F/10	3½-4	3½-4½
Fl	2.0-2.8mm	2.0-3.2mm
Fw	0.4-1.0mm	0.5-0.8mm
Z/F	5-7	4-6
Z-Z	0.3-0.55mm	0.35-0.55mm
Zd	0.16-0.2mm	0.16-0.2mm

From the measurements there appears to be a possibility that the two species are identical. The poorly preserved material does not allow a decision to be made, but here the species are regarded as being synonymous.

Fenestella allynensis Roberts, 1965, p. 58, pl. 13, figs 5-7 has 17 to 18 nodes in 5mm and a pentagonal base.

KEY No. 1

Group *A*. Species with short fenestrules

a. Species with apertures stabilized on dissepiments

1. Maximum no. Z/F = 3
   - *F. horologia* Bretnall
   - *F. columnaris* (Crockford)
   - *F. lennardi* (Crockford)
   - *F. micropora* (Crockford)
   - *F. sparsinodata* (Crockford)
   - *F. ?aspratilis* Bassler
   - *F. stellaris* Campbell
   - *F. barringtonensis* (Crockford)
   - *F. princeps* (Crockford)
2. Maximum no. Z/F greater than 3
   - *F. loganensis* Wass
   - *F. amplia* (Crockford)
   - *F. cystica* Campbell & Engel
   - *F. wilsoni* Roberts
   - *F. allynensis* Roberts
   - *F. sparsigemmata* (Crockford)
   - *F. disjecta* (Crockford)
   - *F. affluensa* Bretnall
   - *F. fossula* Lonsdale

b. Species with apertures not stabilized on dissepiments

3. Maximum no. Z/F = 3
   - *F. canthariformis* (Crockford)
   - *F. yarrolensis* (Crockford)
   - *F. cacuminatis* (Crockford)
   - *F. simulatrix* (Crockford)
   - *F. dispersa* (Crockford)
4. Maximum no. Z/F greater than 3
   - *F. ruidacarinata* (Crockford)
   - *F. valentis* (Crockford)
   - *F. quinquecella* (Crockford)
   - *F. osbornei* (Crockford)
   - *F. cribriformis* (Crockford)
   - *F. alia* (Crockford)
   - *F. cellulosa* (Crockford)

Group *B*. Species with long fenestrules

a. Species with apertures stabilized on dissepiments

5. Maximum no. Z/F = 4
   - *F. granulifera* (Crockford)
   - *F. malchi* (Crockford)
   - *F. stroudensis* Campbell
   - ?*F. altinodosa* Campbell

6. Maximum no. Z/F greater than 4
   - *F. swaini* Campbell & Engel
   - *F. spinifera* (Crockford)
   - *F. propinqua* de Koninck
   - *F. cerva* Campbell
   - *F. crockfordae* Campbell, *non* Burckle, 1960

b. Species with apertures not stabilized on dissepiments

7. Maximum no. Z/F = 5
   - *F. rockhamptonensis* (Crockford)
   - *F. anodosa* Campbell

8. Maximum no. Z/F greater than 5
   - *F. sparsa* (Crockford)
   - *F. roucheli* (Crockford)
   - *F. hindei* Crockford
   - *F. nodulifera* (Crockford)
   - *F. chapmani* (Crockford)

KEY No. 2

Group *A*. Species with short fenestrules

a. Species with maximum number of Z/F not greater than 3

1. Zb is triangular/trapezoidal
   - *F. horologia* Bretnall
   - *F. micropora* (Crockford)
   - *F. ?aspratilis* Bassler
   - *F. canthariformis* (Crockford)
   - *F. lennardi* (Crockford)

2. Zb is pentagonal
   - *F. columnaris* (Crockford)
   - *F. cacuminatis* (Crockford)
   - *F. dispersa* (Crockford)

3. Zb is another form
   - *F. sparsinodata* (Crockford)

b. Species with maximum number of Z/F greater than 3

4. Zb is pentagonal
   - *F. ruidacarinata* (Crockford)
   - *F. quinquecella* (Crockford)
   - *F. affluensa* Bretnall
   - *F. osbornei* (Crockford)
   - *F. cribriformis* (Crockford)
   - *F. loganensis* Wass
   - *F. cystica* Campbell & Engel
   - *F. allynensis* Roberts
   - *F. disjecta* (Crockford)
   - *F. sparsigemmata* (Crockford)
   - *F. valentis* (Crockford)
   - *F. alia* (Crockford)
   - *F. cellulosa* (Crockford)
   - *F. fossula* Lonsdale
   - *F. amplia* (Crockford)
   - *F. simulatrix* (Crockford)

Group *B*. Species with long fenestrules

a. Species with maximum number of Z/F not greater than 4

5. Zb is pentagonal
   - *F. granulifera* (Crockford)
   - *F. malchi* (Crockford)

b. Species with maximum number of Z/F greater than 4

6. Zb is triangular
   - *F. rockhamptonensis* (Crockford)
   - *F. sparsa* (Crockford)
   - *F. swaini* Campbell & Engel
   - *F. spinifera* (Crockford)

7. Zb is pentagonal
   - *F. propinqua* de Koninck
   - *F. cerva* Campbell
   - *F. anodosa* Campbell
   - *F. hindei* Crockford
   - *F. chapmani* (Crockford)
   - *F. nodulifera* (Crockford)
   - *F. crockfordae* Campbell, *non* Burckle, 1960

NOTE: The following species, previously considered to be referable to *Fenestella*, are regarded herein as species of *Levifenestella*.

L. acarinata (Crockford)
L. altacarinata (Crockford)
L. cincta (Crockford)
L. expansa (Crockford)

Each of the four species has a pentagonal base.

The species listed above as *F. nodulifera* was previously referred to as *F. expansa* var. *nodulifera*.

CONCLUSIONS

Only a brief summary will be presented here. A full discussion will appear in another paper (Wass, 1968).

For many years the Permian faunas of Australia have been regarded as being divided between a Westralian and an eastern Australian province. Faunal overlap between the two provinces consisted of only one or two genera and very few species. Such a small overlap may have been due to the inadequate information then available. Since 1950, faunas of the Westralian province have been described in several papers (e.g. Coleman, 1957; Dickins, 1956, 1957, 1961, 1963; Thomas, 1958; Dickins & Thomas, 1959) and are now relatively well known. The recent search for, and subsequent finding of, oil in Queensland and its partial association with Permian strata has added impetus to palaeontological studies of the strata.

Hitherto, *Fenestella, Polypora, Protoretepora,* and *Stenopora* were known to be common to the Permian of Western Australia and Queensland (Crockford, 1951, 1957). As a result of this study eight additional genera in common have been recorded. These are *Stenodiscus, Leioclema, Penniretepora, Streblascopora, Saffordotaxis, Ramipora, Fistulipora* and *Liguloclema.* The species *Fenestella amplia, F. affluensa, F.* cf. *columnaris, Protoretepora ampla, Ramipora ambrosioides, Streblascopora marmionensis* and *Penniretepora triporosa* are common to both areas, as well as *Fenestella horologia* and *Polypora woodsi* (Crockford, 1951, 1957). The polyzoan fauna of the Bowen Basin is shown in Table 1.

Comparisons between Queensland and New South Wales (Crockford, 1951) and Tasmania and Western Australia (Crockford, 1951; Banks, 1961) do not reveal the same number of species and genera in common. The former comparison is considered valid because of the large amount of work done in New South Wales, but the latter may not be significant at present because the Tasmanian faunas are poorly known.

Hill (1955) in reviewing a symposium on the correlation and fauna of the Permian in Australia stated that there is evidence from Tasmania which indicates that the Tasman Geosyncline may have been closed to the north and communicated with Tethys around the south of the continent. This is based on work by Banks, who found *Neospirifer* cf. *moosakhalensis, Lyroporella, Streblotrypa,* and *Fenestella chapmani* (Crockford) in the Berriedale Limestone.

The dissimilarity between New South Wales and Queensland polyzoan faunas and the dominance of Western Australian species in the Queensland faunas seems to indicate that Tethys may have communicated with the Tasman Geosyncline in the northern part of the continent. Also of interest is the fact that Carboniferous species of the genera in question show no similarity to the Permian species.

Of the species common to Western Australia and Queensland, all but one are confined to the Tiverton Subgroup and its equivalents (Fauna II). Therefore, if a connexion existed, it may have been open during Fauna II time and become closed or markedly restricted at the beginning of Fauna III time. Isopach maps produced by Malone (1964) for stratigraphic units in the Bowen Basin reveal that Fauna III time is associated with a shallowing of the water, movement of the despositional area westwards, and a change to a partly non-marine environment. Evidence from Malone (1964), Maxwell (1964), and Wass (1965) suggests some epeirogenic movement along the eastern margin of the Bowen Basin at the end of Fauna II time, and this may have been sufficient to cause the sea to have receded from the basin. In the northern and south-western parts of the Basin the Gebbie Subgroup and its equivalents begin with barren non-marine sediments. Throughout the Basin the Tiverton Subgroup is a dominant shale-limestone facies, whereas the Gebbie Subgroup is a sandstone facies. The epeirogenic movement which initiated lithological and stratigraphical changes may have been sufficient to prevent migration of faunas from the west after Fauna II time. Fauna IIIA, found in the lower parts of the Gebbie Subgroup, shows little similarity to Fauna II (Dickins, in Malone et al., 1964) and has no association with any Western Australian faunas.

If one accepts the correlation made by Dickins (1964, Ms.) between eastern and Western Australia based on brachiopods and molluscs, and the possibility that migration of Polyzoa ensued from west to east then a study of stratigraphy and associated faunas will reveal readily that most genera common to Queensland and Western Australia occur first in the west at a stratigraphically older horizon than their first appearance in Queensland. Of the common species, only one, *Protoretepora ampla* (Lonsdale) has its first occurrence in Western Australia at a younger horizon than its first occurrence in Queensland. In my opinion, the Polyzoa are useful for general but not detailed correlation. Correlations made by Dickins (1964, Ms., and in Mollan et al., 1964) hold in a general fashion when the polyzoan distribution is applied. The Cattle Creek Formation and other equivalent units in the Springsure District contain a similar fauna to that found in the Buffel Formation at Cracow and the Tiverton Subgroup in the northern part of the Basin. Similarly the fauna found in the Oxtrack Formation at Cracow is similar to that in the Peawaddy Formation at Springsure and the Blenheim Subgroup in the north of the Basin.

TABLE 1. AGES OF POLYZOA IN THE BOWEN BASIN

SPECIES	FAUNAS I	II	III	IV
Fistulipora sp.		x		
Liguloclema sp.		x		
Ramipora ambrosioides		x		
Stenopora tasmaniensis		x		
Stenopora ovata		x		x
Stenopora crinita		x		x
Leioclema sp.		x		
Stenodiscus sp.		?		?
Stenoporid*			x	
Saffordotaxis multinodata		x		x
Rhombopora sp.		x		
Streblascopora marmionensis		x		
Diploporaria sp.		x		
Penniretepora triporosa		x		x
Penniretepora sp.		x		x
Ptylopora sp.				x
Levifenestella? expansa				x
Polypora keppelensis				x
Polypora magnafenestrata		x		x
Polypora pertinax		x		
Polypora virga		x		
Polypora woodsi		x		
?*Polypora* sp. indet.*	x			
Protoretepora ampla		x		
Fenestella horologia		x		
Fenestella affluensa		x		
Fenestella amplia		x		
Fenestella canthariformis		x		
Fenestella cf. *columnaris*		x		
Fenestella dispersa		x		
Fenestella fossula		x		x
Fenestella granulifera	x?			x
Fenestella simulatrix		x		
Fenestella spinifera		x		
Fenestella bowenensis		x		
Fenestella springsurensis		x		
Fenestella sp. nov.				x
Fenestella (*Parafenestella*) sp.		x		
?*Fenestella* sp. indet.*	x			

* = undescribed

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PLATE 1

Fistulipora sp. .... page 17

1. Oblique section through zoarium SUGD 16401 from L 2575, Buffel Formation, south of Cracow, Queensland. x 40.
2. Oblique section through zoarium, SUGD 16402 from L 2575, Buffel Formation, south of Cracow, Queensland. x 40.

Liguloclema sp. .... page 19

3. Surface of zoarium, CPC 7015 from SP 720, Cattle Creek Formation, Reids Dome, Queensland. x 15.

Ramipora ambrosioides (Bretnall) .... page 22

4. Obverse surface of zoarium, CPC 7018 from SP 720, Cattle Creek Formation, Reids Dome, Queensland. x 15.
5. Obverse surface of zoarium, CPC 7019 from SP 720, Cattle Creek Formation, Reids Dome, Queensland. x 15.

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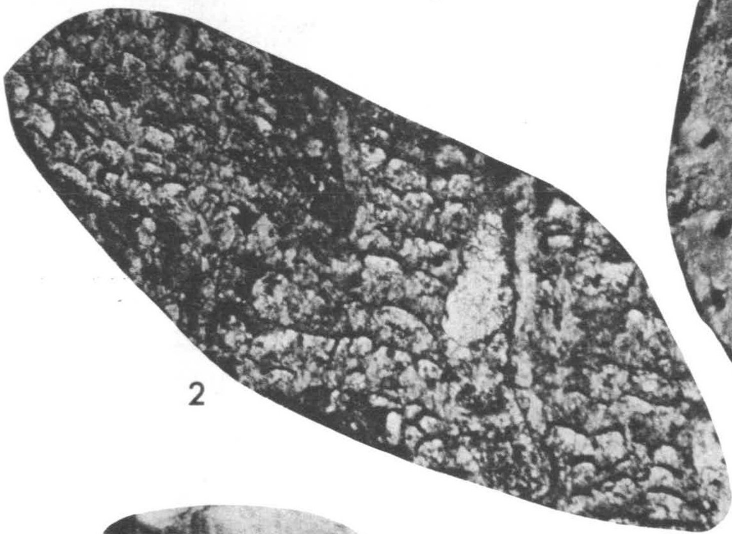

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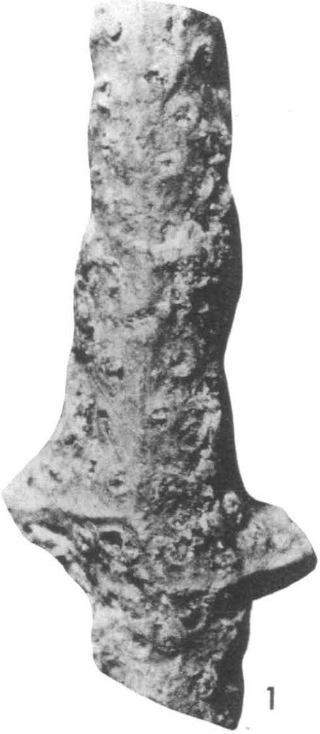
PLATE 2

Ramipora ambrosioides (Bretnall) .... page 22

1. Obverse surface of zoarium showing deviation of carinae. CPC 7017 from SP 720, Cattle Creek Formation, Reids Dome, Queensland. x 15.
2. Obverse surface of zoarium showing orientation of zooecial apertures. CPC 7020 from SP 720, Cattle Creek Formation, Reids Dome, Queensland. x 15.

Stenopora tasmaniensis Lonsdale .... page 23

3. Transverse section of zoarium, UQGD 43417 from L 2487, Oxtrack Formation, west of Cracow, Queensland. x 20.
4. Tangential section of zoarium, UQGD 43417 from L 2487, Oxtrack Formation, west of Cracow, Queensland. x 20.



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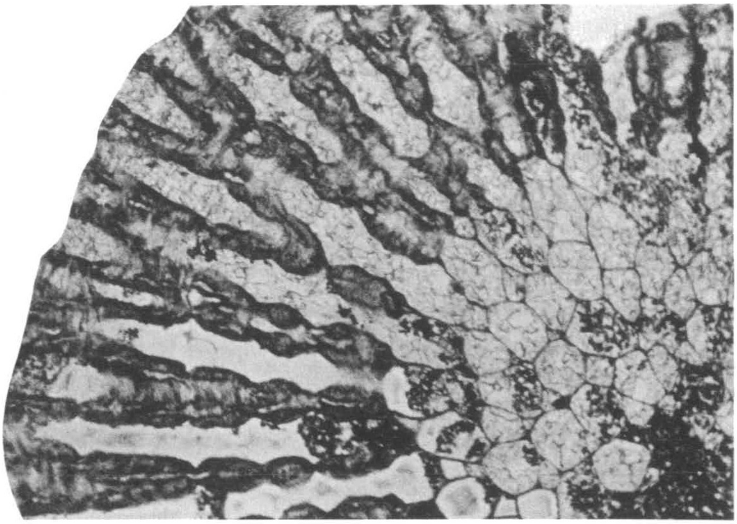

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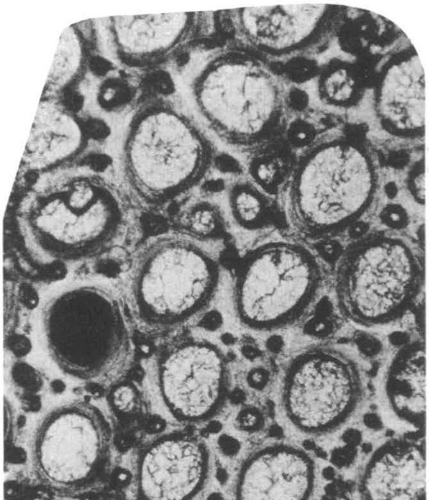

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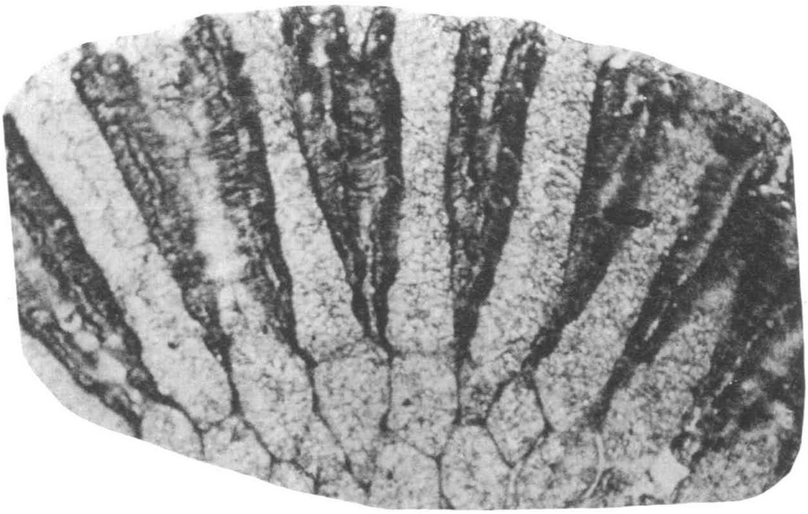
PLATE 3

All figures are x 40.

Stenopora tasmaniensis Lonsdale .... page 23

1. Transverse section of zoarium, UQGD 43416 from L 2580, Oxtrack Formation, west of Cracow, Queensland.
2. Longitudinal section of zoarium, UQGD 43416 from L 2580, Oxtrack Formation, west of Cracow, Queensland.
3. Tangential section of zoarium, UQGD 43418 from L 2487, Oxtrack Formation, west of Cracow, Queensland.



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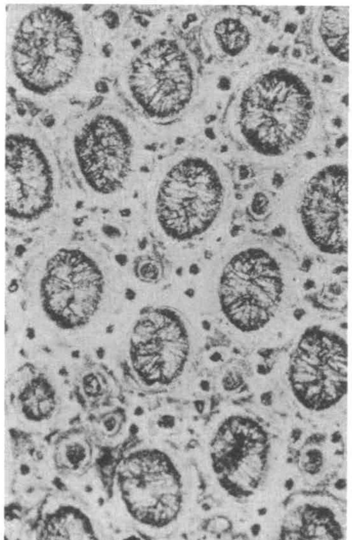

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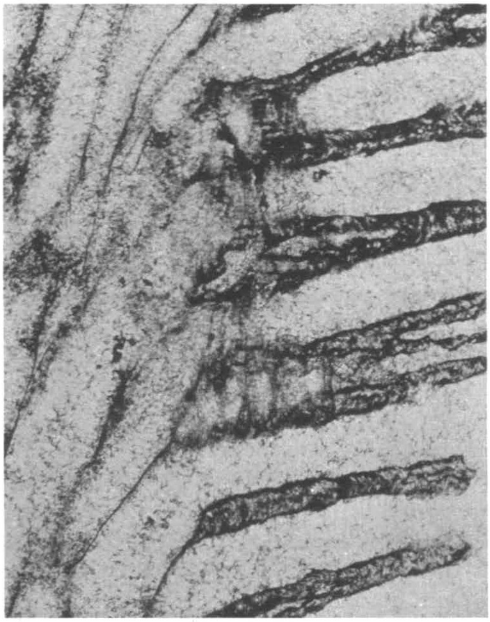
PLATE 4

Stenopora tasmaniensis Lonsdale .... page 23

1. Longitudinal section of zoarium, SUGD 16403 from L 2580, Oxtrack Formation, west of Cracow, Queensland. x 30.
2. Tangential section of zoarium, SUGD 16404 from L 2580, Oxtrack Formation, west of Cracow, Queensland. x 30.

Stenopora ovata Lonsdale .... page 25

3. Tangential section of zoarium through monticule, CPC 7129 from L 2575, Buffel Formation, south of Cracow, Queensland. x 20.
4. Tangential section through normal portion of zoarium, CPC 7129 from L 2575, Buffel Formation, south of Cracow, Queensland. x 20.



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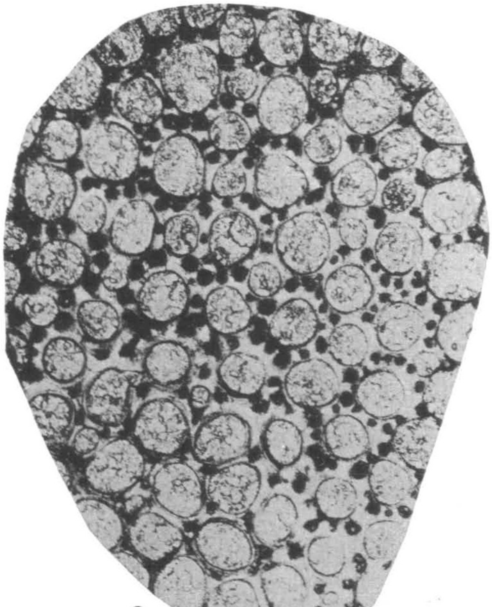

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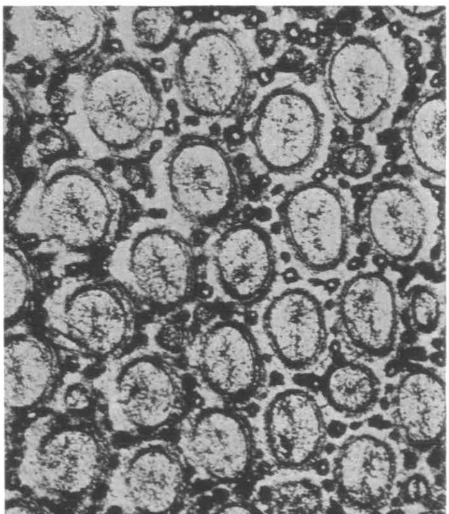

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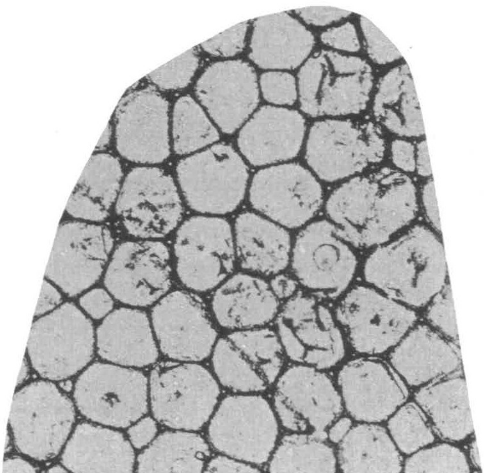

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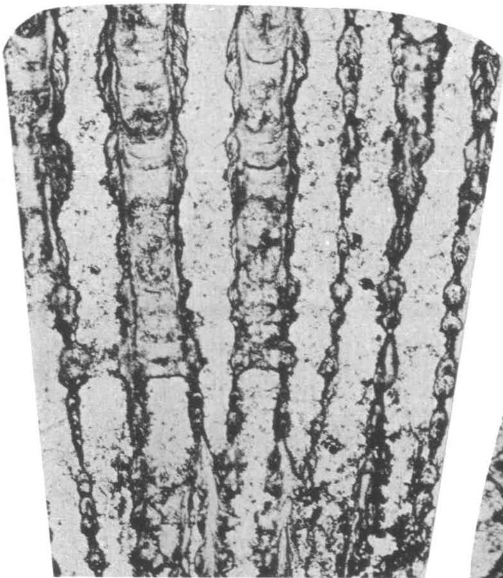
PLATE 5

Stenopora ovata Lonsdale .... page 25

1. Transverse section through mature zone of zoarium, CPC 7129 from L 2575, Buffel Formation, south of Cracow, Queensland. x 20.
4. Longitudinal section through zoarium, CPC 7130 from L 2575, Buffel Formation, south of Cracow, Queensland. x 20.

Stenopora crinita Lonsdale .... page 27

2. Transverse section through mature zone of zoarium, CPC 7127 from CL 12/1, Blenheim Subgroup, northwest of Clermont, Queensland. x 20.
3. Tangential section through zoarium showing arrangement of acanthopores in normal and monticular portions, CPC 7128 from SP 720, Cattle Creek Formation, Reids Dome, Queensland. x 30.



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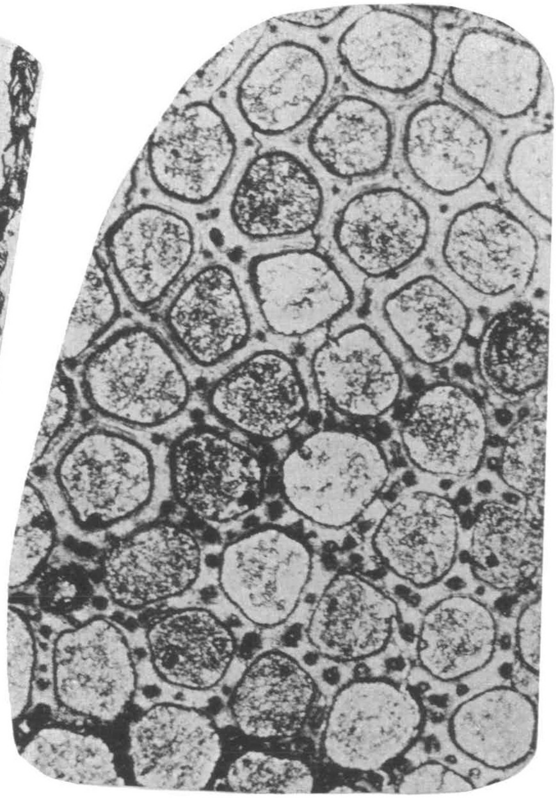

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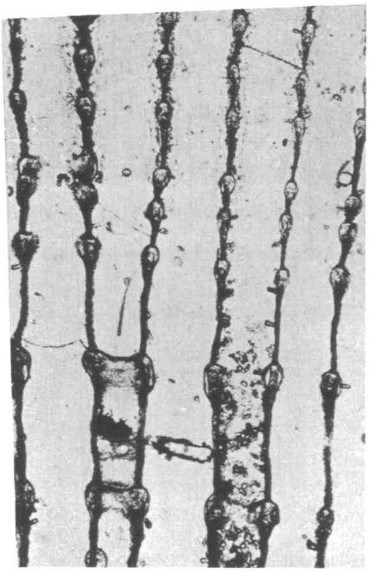

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PLATE 6

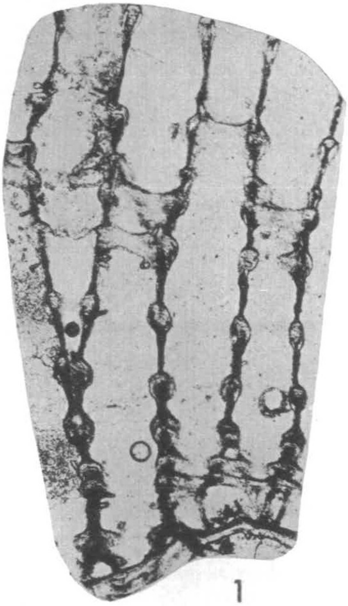
All figures are x 20.

Stenopora crinita Lonsdale .... page 27

1. Transverse section of zoarium showing 'diaphragms' composed of laminae *in* zooecial wall, not across zooecial tube, CPC 7127 from CL 12/1, Blenheim Subgroup, northwest of Clermont, Queensland.

Stenodiscus sp. .... page 29

2. Transverse section of zoarium, GSQ 6003 from CPA 21, 10 chains north of No. 3 camp, Bowen River Coalfield, Queensland.
3. Longitudinal section of GSQ 6010, from Pelican Creek, Bowen River Coalfield, Queensland.
4. Tangential section of zoarium, GSQ 6010 from Pelican Creek, Bowen River Coalfield, Queensland.
5. Transverse section of zoarium, GSQ 6010 from Pelican Creek, Bowen River Coalfield, Queensland.



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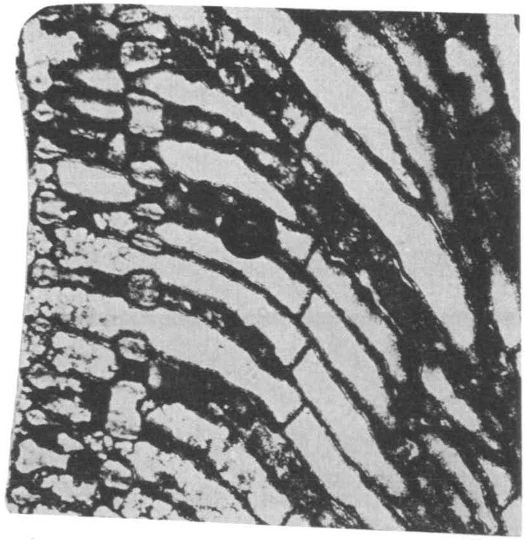

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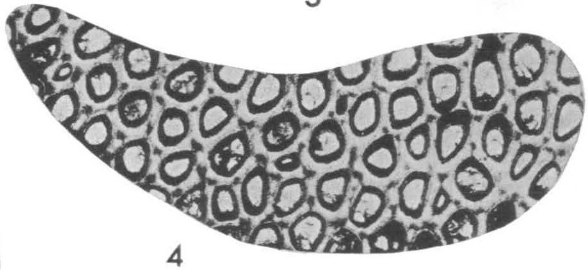

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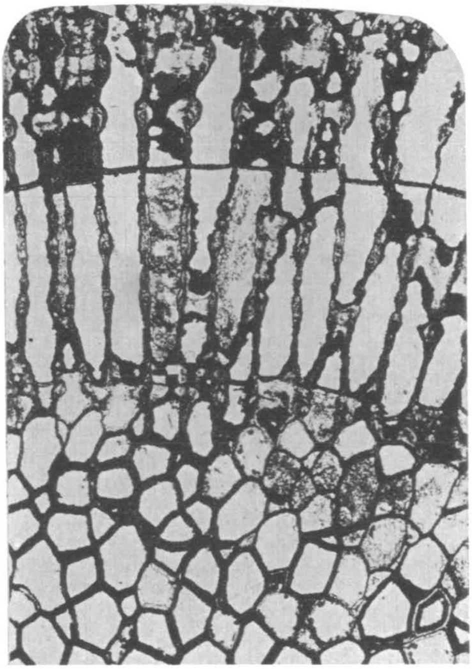

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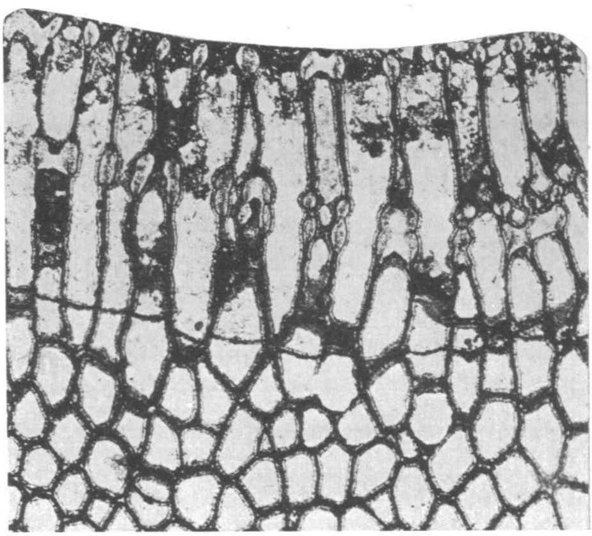

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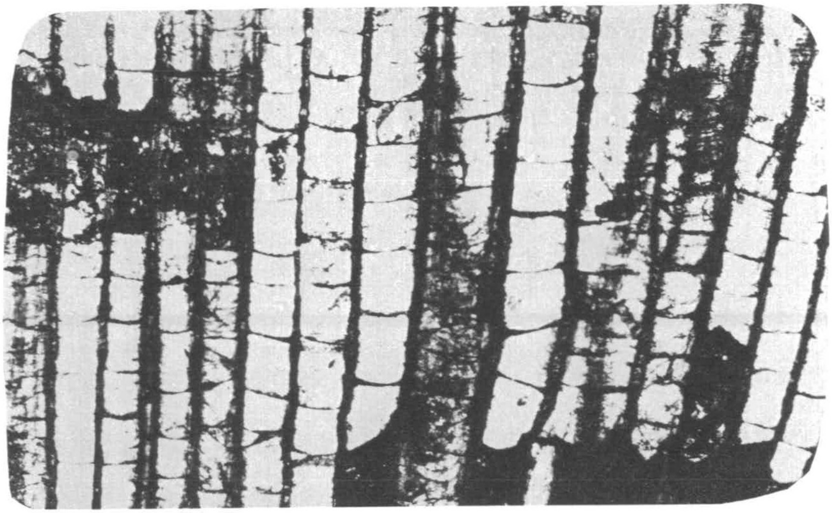
PLATE 7

Leioclema sp. .... page 30

1. Longitudinal section of encrusting zoarium, CPC 7041 from B 1570c, Big *Strophalosia* Zone, Blenheim Subgroup, southwest of Collinsville, Queensland. x 20.
2. Tangential section of zoarium, CPC 7041 from B 1570c, Big *Strophalosia* Zone, Blenheim Subgroup, southwest of Collinsville. x 20.

Saffordotaxis multinodata sp. nov. .... page 32

3. Transverse section of zoarium showing the tubes diverging from a central point, SUGD 16405 from L 2575, Buffel Formation, south of Cracow, Queensland. x 30.
4. Transverse section of zoarium, SUGD 16406 from L 2575, Buffel Formation, south of Cracow, Queensland. x 30.



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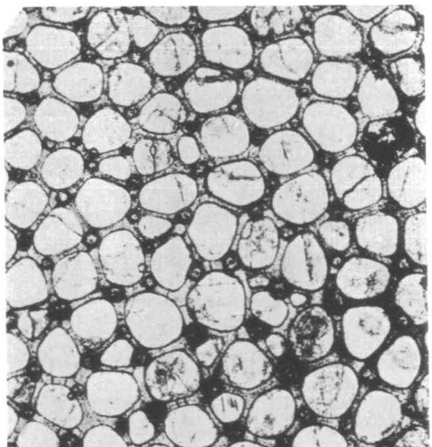

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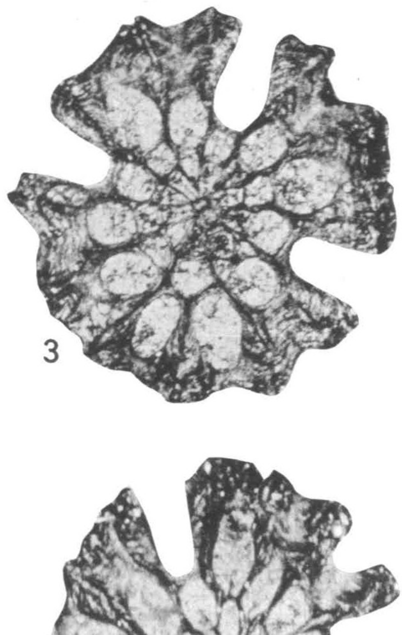

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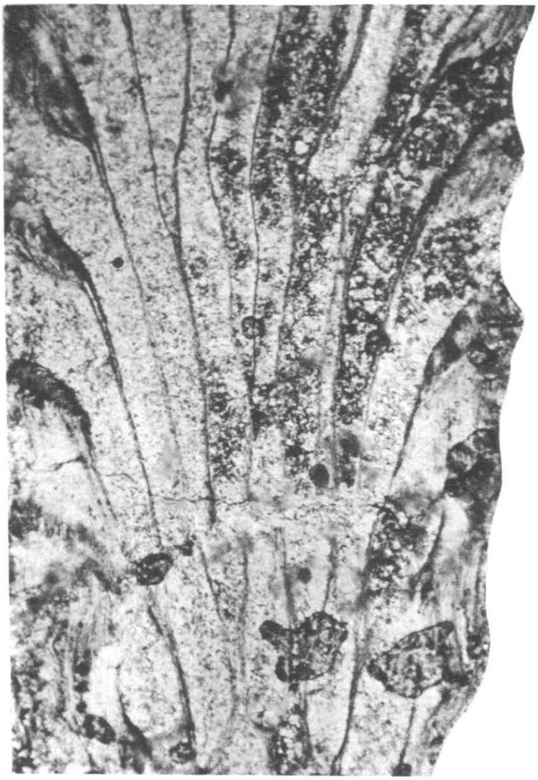
PLATE 8

Saffordotaxis multinodata sp. nov. .... page 32

1. Longitudinal section of zoarium, **holotype,** UQGD 43419 from L 2487, Oxtrack Formation, west of Cracow, Queensland. x 40.
2. Tangential section of zoarium, **holotype,** UQGD 43418 from L 2487, Oxtrack Formation, west of Cracow, Queensland. x 75.
3. Transverse section of zoarium, **holotype,** UQGD 43419 from L 2487, Oxtrack Formation, west of Cracow, Queensland. x 40.

Leioclema sp. .... page 30

4. Longitudinal section of an encrusting zoarium, CPC 7040 from B628, Blenheim Subgroup, southwest of Collinsville, Queensland. x10.



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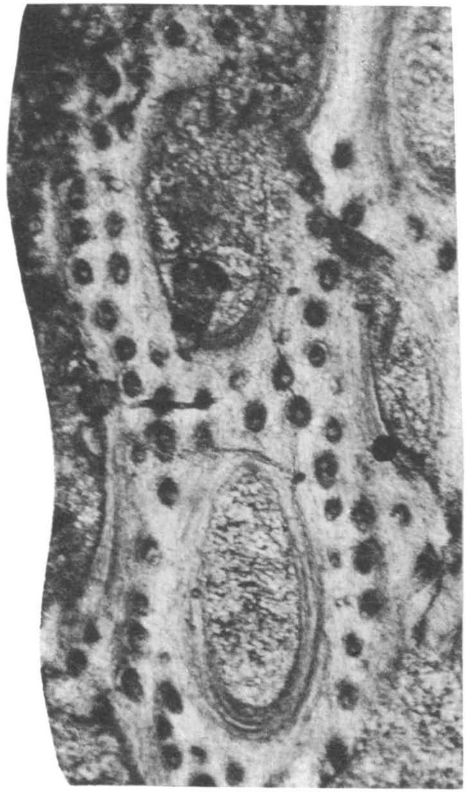

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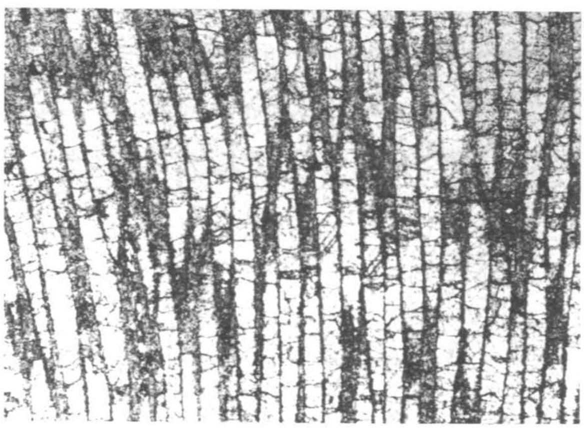

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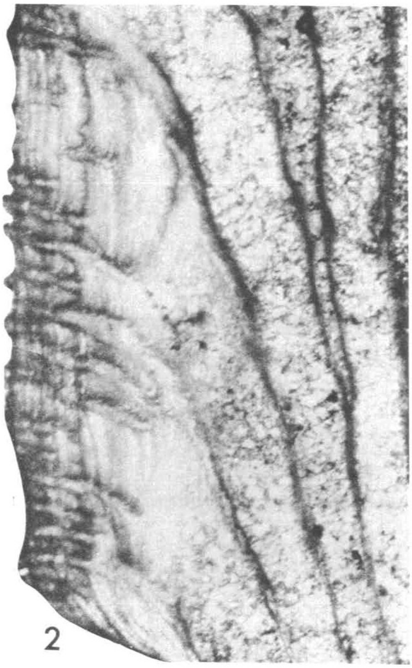
PLATE 9

All specimens come from Buffel Formation, south of Cracow, Queensland.

Saffordotaxis multinodata sp. nov. .... page 32

1. Longitudinal section through zoarium showing mature zone and portion of immature zone, SUGD 16407 from L 2575, x 40.
2. Longitudinal section through zoarium showing abundance of apertures in mature zone, SUGD 16408 from L 2575, x 50.
3. Longitudinal section through zoarium showing narrow mature zone, SUGD 16409 from L 2575, x 30.
4. Oblique tangential section through zoarium, SUGD 16410 from L 2575, x 30.

1



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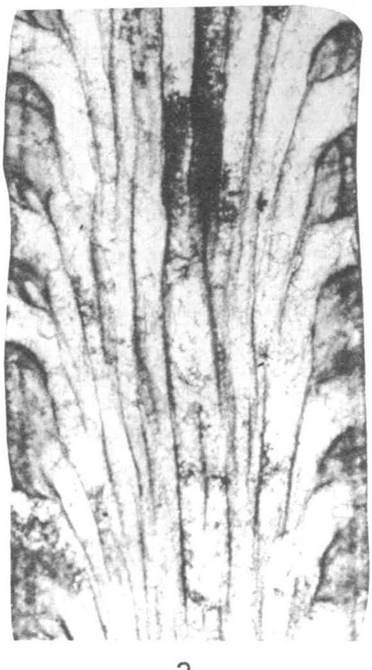

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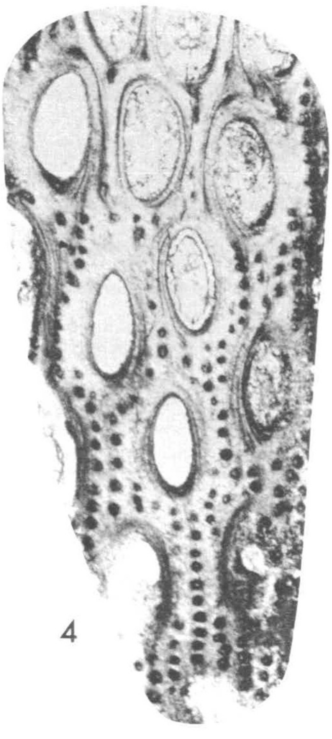

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PLATE 10

All specimens come from Cattle Creek Formation, Reids Dome, Queensland.

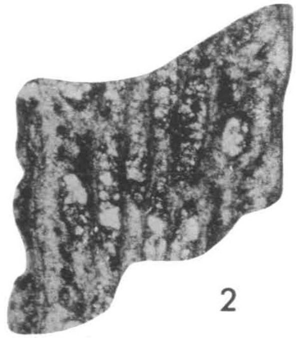
Rhombopora sp. .... page 34

1. External surface of zoarium, CPC 7025 from SP 720, x 15.

Streblascopora marmionensis (Bretnall) .... page 36

2. Longitudinal section of zoarium, CPC 7030 from SP 720, x 30.
3. Longitudinal section of zoarium, CPC 7033 from SP 720, x 30.
4. Transverse section of zoarium, CPC 7032 from SP 720, x 30.
5. External surface of zoarium showing arrangement of apertures and acanthopores, CPC 7028 from SP 720, x 20.
6. External surface of zoarium, CPC 7029 from SP 720, x 20.
7. External surface of zoarium at bifurcation, CPC 7031 from SP 720, x 20.

1



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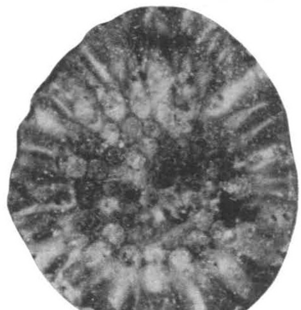

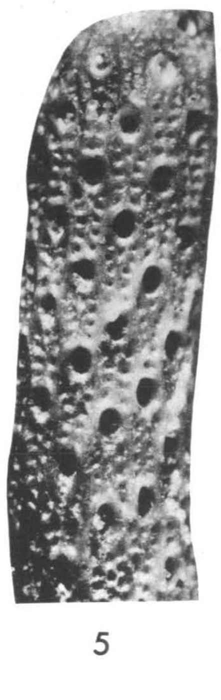

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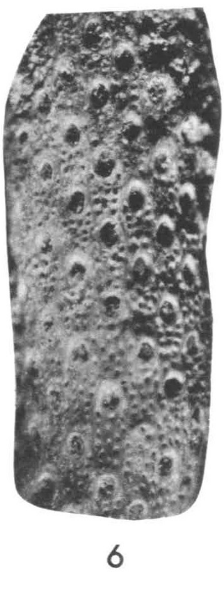

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PLATE 11

All figures x 15.

Diploporaria sp. .... page 38

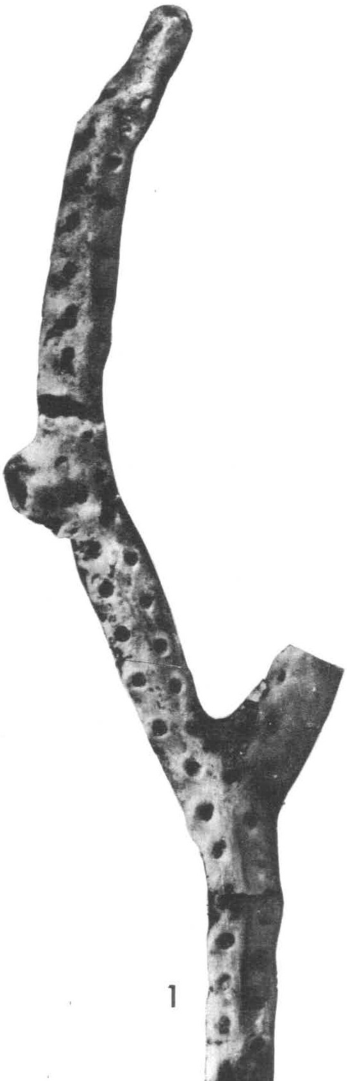
1. Obverse surface of zoarium, UQGD 48387 from L 1554, Cattle Creek Formation, Reids Dome, Queensland.

Penniretepora triporosa Crockford .... page 40

2. Obverse surface of zoarium, UQGD 48383 from L 2580, Oxtrack Formation, west of Cracow, Queensland.

Penniretepora sp. .... page 42

3. Obverse surface of zoarium, CPC 7039 from SL 643, Tiverton Subgroup, northeast of 'Yatton', Queensland.



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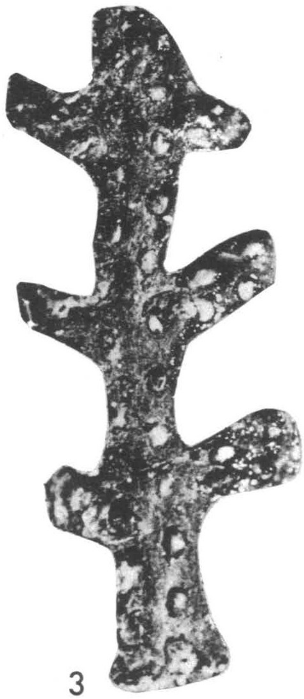

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PLATE 12

Ptylopora sp. .... page 43

1. Obverse surface of zoarium, UQGD 48386 from L 2580, Oxtrack Formation, west of Cracow, Queensland. x 6.

Polypora keppelensis Crockford .... page 47

2. Obverse surface of zoarium, CPC 7112 from MC 293, Blenheim Subgroup, 'Blenheim', Queensland. x 6.

Levifenestella? expansa (Crockford) .... page 45

3. Obverse surface of zoarium, UQGD 48381 from L 2580, Oxtrack Formation, west of Cracow, Queensland. x 6.

Polypora magnafenestrata Crockford .... page 48

4. Obverse surface of zoarium, UQGD 48375 from L 2580, Oxtrack Formation, west of Cracow, Queensland. x 6.


1
3
2
4

PLATE 13

Polypora magnafenestrata Crockford .... page 48

1. Obverse surface of zoarium, UQGD 48377 from SL 643, Tiverton Subgroup, northeast of 'Yatton', Queensland. x 3.

Polypora virga Laseron .... page 51

2. Obverse surface of zoarium, CPC 7110 from SP 748, Cattle Creek Formation, Reids Dome, Queensland. x 6.

Polypora woodsi (Etheridge) .... page 53

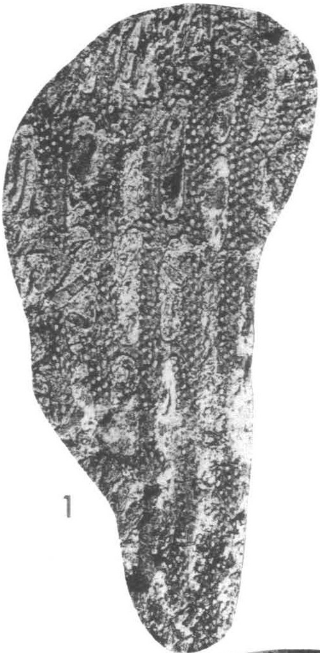
3. Obverse surface of zoarium, CPC 7123 from SP 748, Cattle Creek Formation, Reids Dome, Queensland. x 6.

Protoretepora ampla (Lonsdale) .... page 55

4. Obverse surface of zoarium, CPC 7026 from SP 732, Cattle Creek Formation, Reids Dome, Queensland. x 6.

Polypora pertinax Laseron .... page 50

5. Obverse surface of zoarium, UQGD 40290 from L 1554, Cattle Creek Formation, Reids Dome, Queensland. x 6.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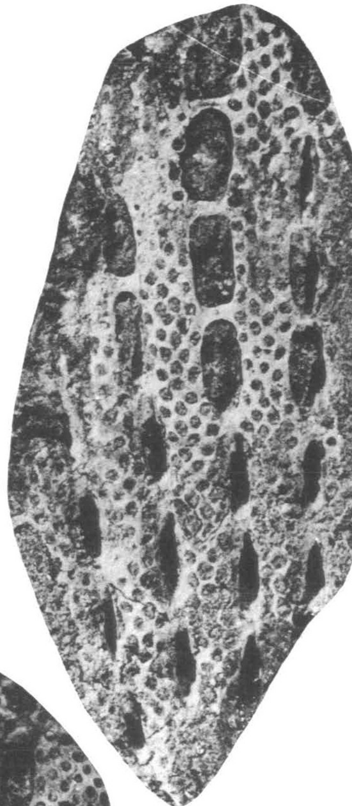
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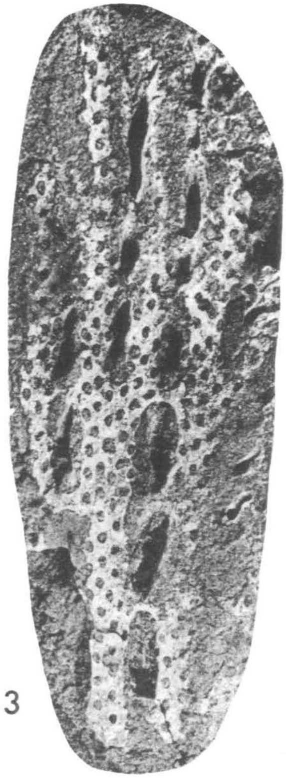
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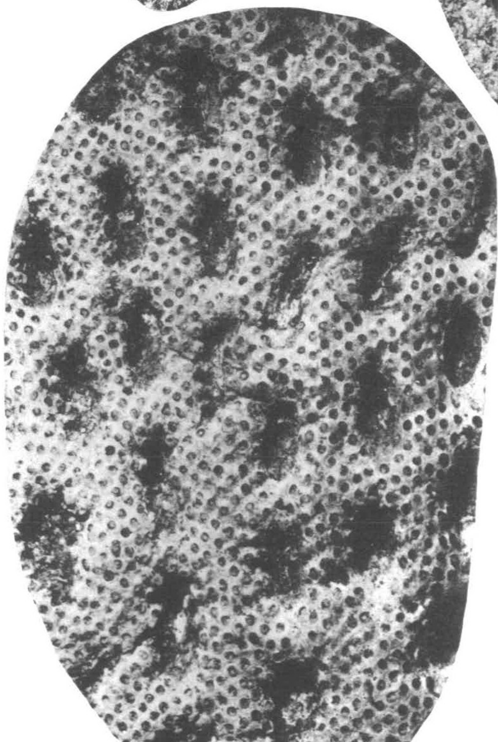
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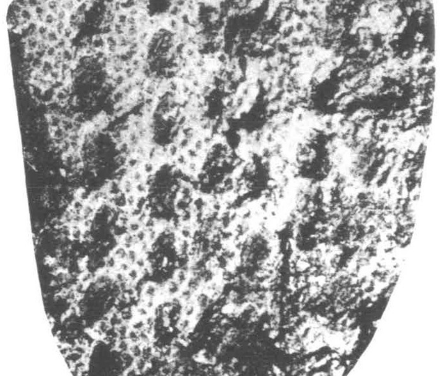
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PLATE 14

All figures x 15.

Fenestella amplia (Crockford) .... page 58

1. Obverse surface of zoarium, CPC 7035 from SP 720, Cattle Creek Formation, Reids Dome, Queensland.

Fenestella cf. *columnaris* (Crockford) .... page 62

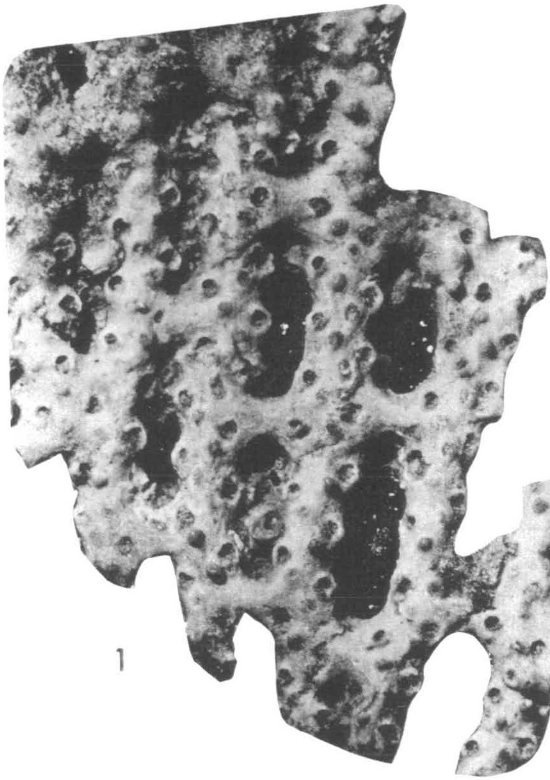
2. Obverse surface of zoarium, CPC 7121 from SP 732, Cattle Creek Formation, Reids Dome, Queensland.

Fenestella affluensa Bretnall .... page 57

3. Obverse surface of zoarium, UQGD 40567 from L 997, Cattle Creek Formation, Reids Dome, Queensland.

Fenestella fossula Lonsdale .... page 65

4. Obverse surface of zoarium, CPC 7117 from SP 720, Cattle Creek Formation, Reids Dome, Queensland.



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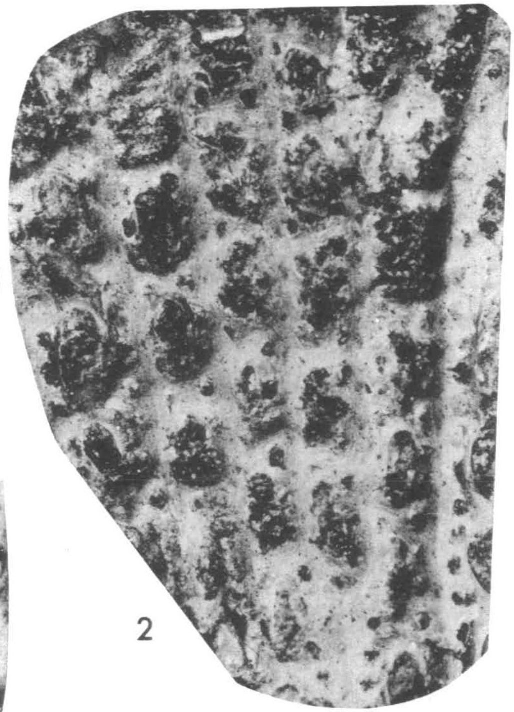

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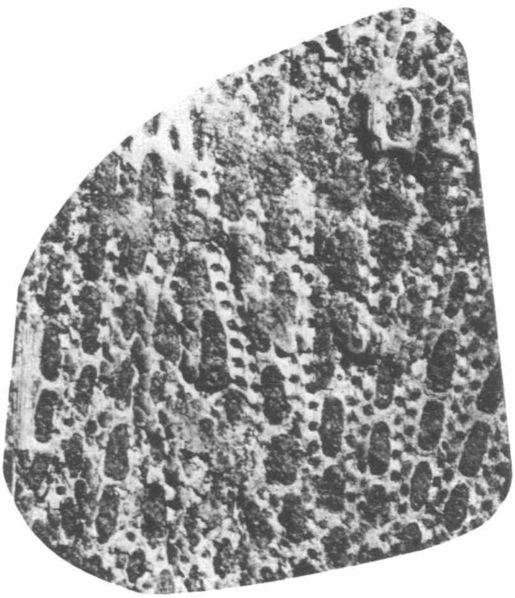

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PLATE 15

Fenestella canthariformis (Crockford) .... page 60

1. Obverse surface of zoarium, CPC 7119 from SP 720, Cattle Creek Formation, Reids Dome, Queensland. x 15.

Fenestella granulifera (Crockford) .... page 67

2. Reverse surface of zoarium, UQGD 48369 from L 2580, Oxtrack Formation, west of Cracow, Queensland. x 6.
3. Obverse surface of zoarium, UQGD 48369 from L 2580, Oxtrack Formation, west of Cracow, Queensland. x 15.

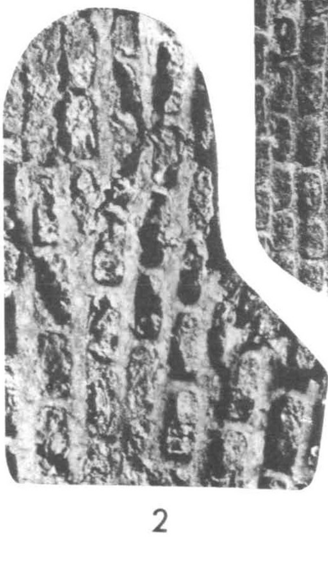
Fenestella dispersa (Crockford) .... page 63

4. Obverse surface of zoarium, UQGD 40563 from L 997, Cattle Creek Formation, Reids Dome, Queensland. x 6.
5. Reverse surface of zoarium, UQGD 40562 from L 997, Cattle Creek Formation, Reids Dome, Queensland. x 6.

Fenestella simulatrix (Crockford) .... page 69

6. Obverse surface of zoarium, UQGD 40544 from L 997, Cattle Creek Formation, Reids Dome, Queensland. x 6.

1



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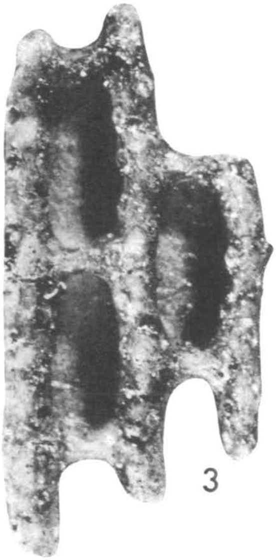

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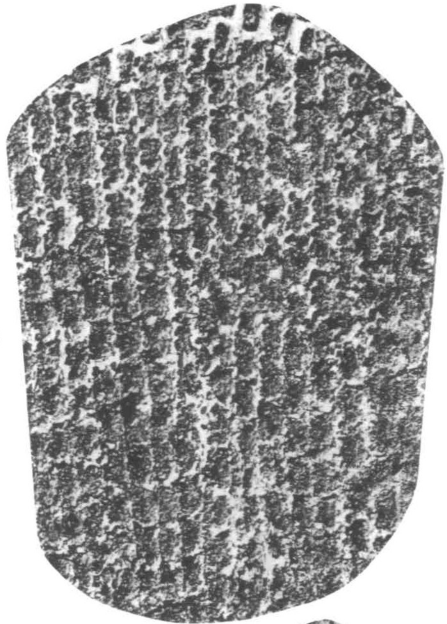

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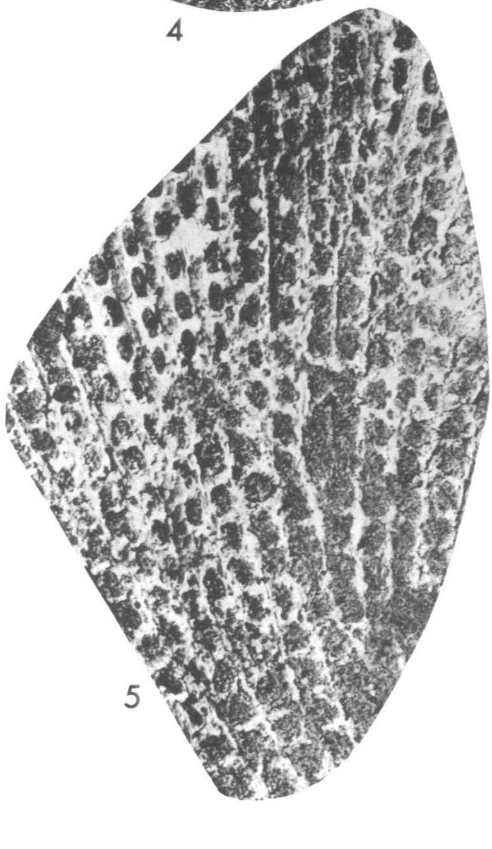

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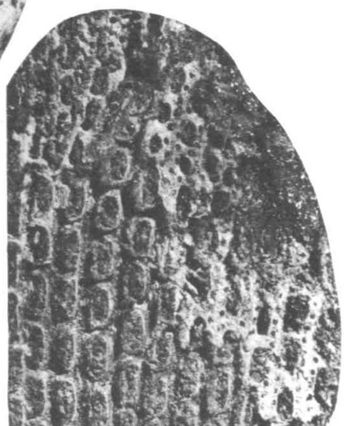

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PLATE 16

Fenestella springsurensis sp. nov. .... page 74

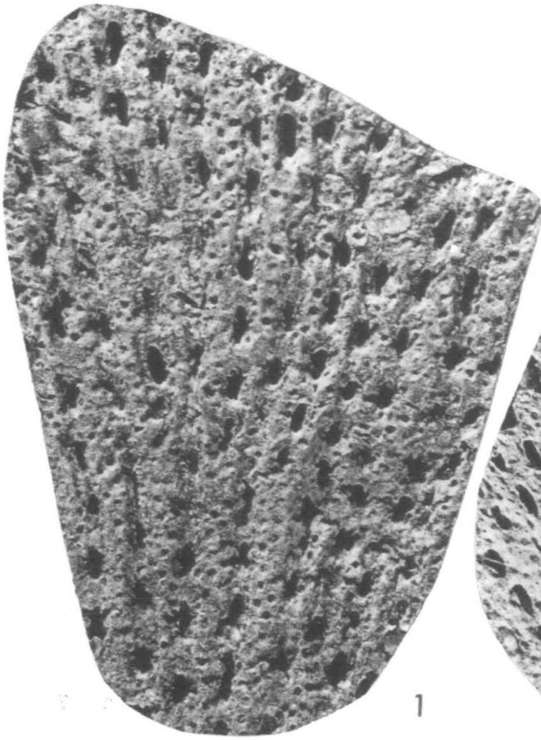
1. Obverse surface of zoarium, **holotype**, CPC 7036 from SP 720, Cattle Creek Formation, Reids Dome, Queensland. x 6.
2. Obverse surface of zoarium, paratype, CPC 7037 from SP 720, Cattle Creek Formation, Reids Dome, Queensland. x 6.
3. Obverse surface of zoarium, CPC 7111 from SP 720, Cattle Creek Formation, Reids Dome, Queensland. x 6.

Fenestella simulatrix (Crockford) .... page 69

4. Internal and reverse surface of zoarium, UQGD 40544 from L 997, Cattle Creek Formation, Reids Dome, Queensland. x 6.

Fenestella spinifera (Crockford) .... page 70

5. Obverse surface of zoarium, CPC 7107 from SP 732, Cattle Creek Formation, Reids Dome, Queensland. x 15.



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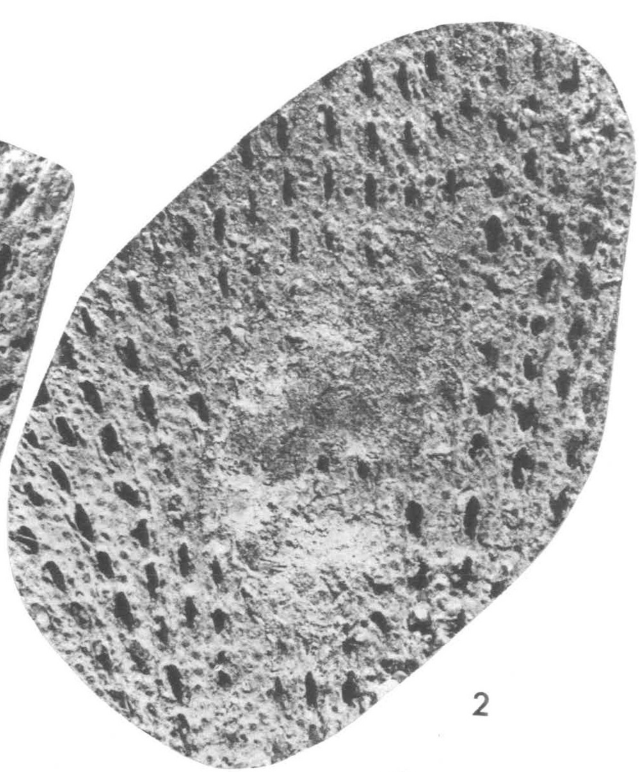

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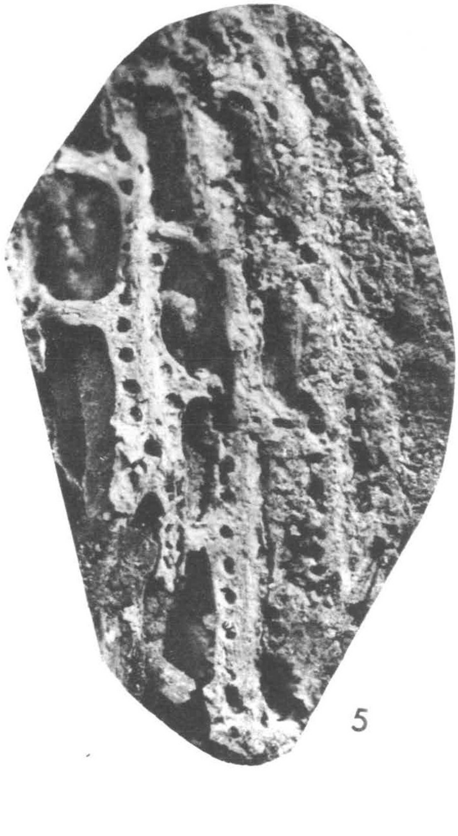

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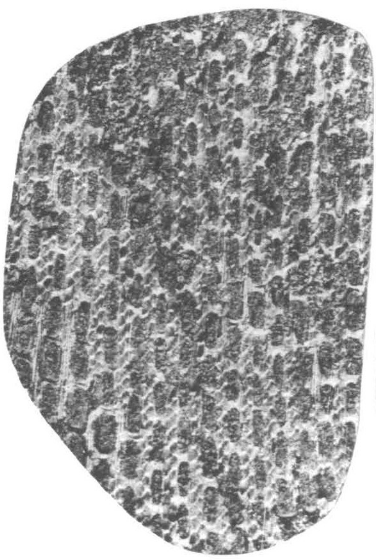

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3

PLATE 17

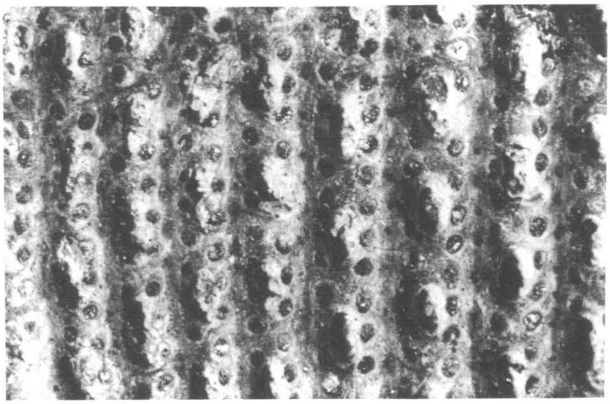
All figures are x 15. Figs 1, 3, 4 come from SP 720, Cattle Creek Formation, Reids Dome, Queensland; Fig. 2 from SP 732.

Fenestella bowenensis sp. nov. .... page 72

1. Obverse surface of zoarium, **holotype,** CPC 7034.
2. Obverse surface of zoarium, CPC 7124.
3. Obverse surface of zoarium, paratype, CPC 7125.

Fenestella (*Parafenestella*) sp. .... page 78

4. Obverse surface of zoarium, CPC 7038.



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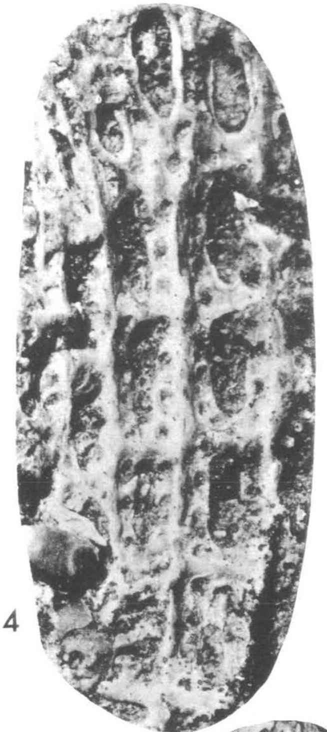

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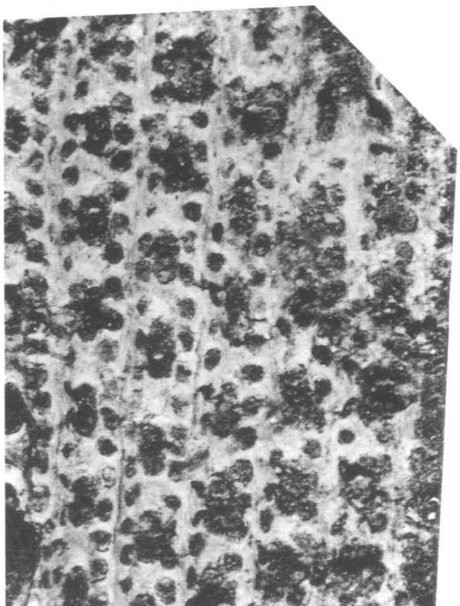

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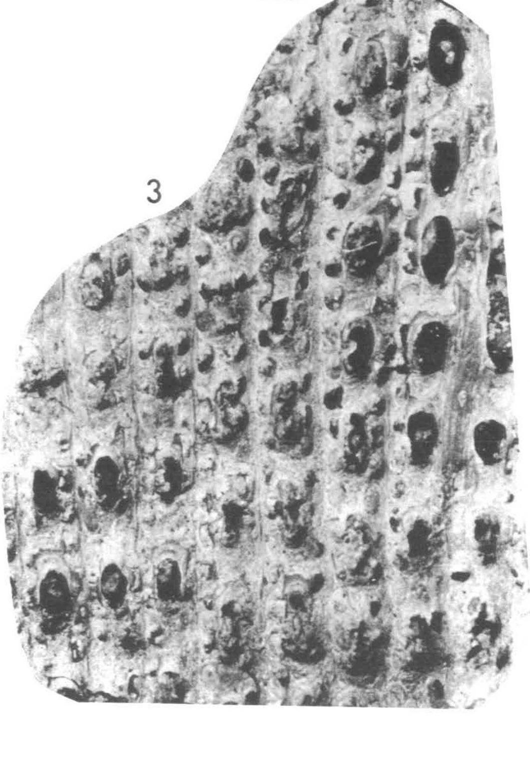

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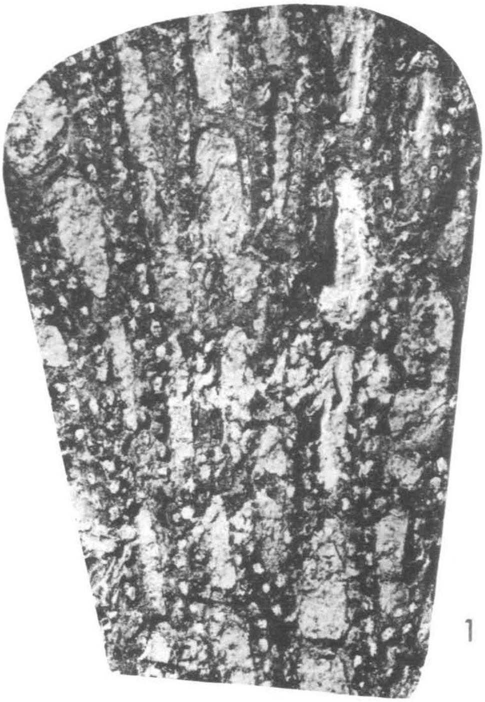
PLATE 18

All figures are of UQGD 48380 from L 2580, Oxtrack Formation, west of Cracow, Queensland and are x 6.

Fenestella sp. nov. .... page 76

1. Obverse surface of immature portion of zoarium.
2. Obverse surface of zoarium showing unilateral branching.
3. Obverse surface of zoarium showing shape of fenestrules associated with unilateral branching.
4. Obverse surface of a mature portion of zoarium.



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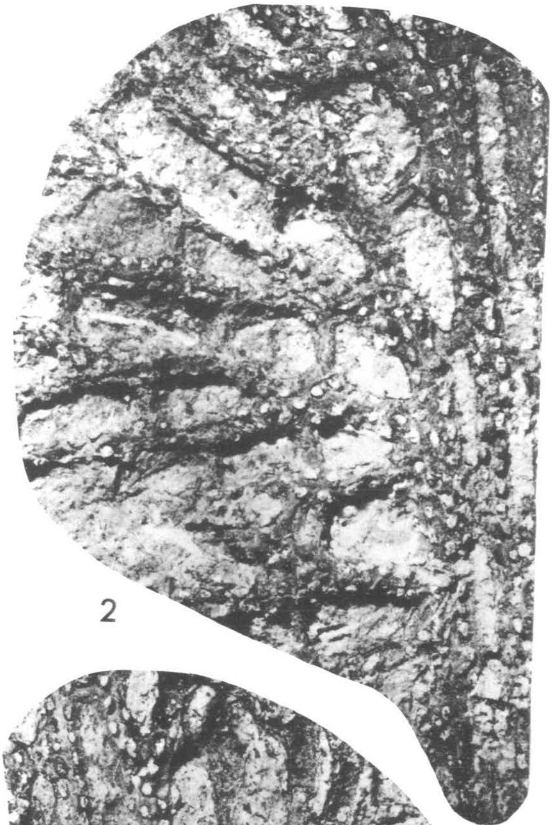

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