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Copy 3

THE LONDON BRIDGE LIMESTONE.

Monaro District,

New South Wales.

by
J.J. VEEVERS.

T H E L O N D O N B R I D G E

L I M E S T O N E.

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C O N T E N T S.

1. SUMMARY

The London Bridge Limestone has been traced along its strike from a point five miles south-south-east of Queanbeyan to a point three miles south-east of Bredbo, a distance of forty miles. At London Bridge this formation attains its greatest development and a large-scale geological map of this area has been prepared. Fossil collections have been made from localities along this formation and the fauna has been examined. A description of the coral Pycnostylus ? sp. nov. is given. The stratigraphical position of this formation has been placed within the Wenlock Epoch, possibly within the Lower Wenlock.

2. INTRODUCTION

The strata discussed strike along a roughly meridional line with its northern end five miles south-south-east of Queanbeyan and its southern limit three miles south-east of Bredbo. The present writer mapped this formation at its type locality, London Bridge, as part of his Sydney University Honours B.Sc. thesis. Collecting of material and the studying of the sections at 'Collingwood' and Bredbo River localities was done in January, 1952 during the Bureau of Mineral Resources survey of the south-eastern part of the Canberra four-mile sheet.

Previous Work. W.R. Browne (1914, 1943) in his first paper on the geology of the Cooma District includes a map of the 'Rosebrook Limestone' which is most likely continuous with the outcrops of the London Bridge Limestone to the North. The second paper deals with the geology of the area just west of the limestones at Bredbo River, Colyer's Creek and 'Collingwood'.

H.B. Brown (1928) mapped several limestones including the important limestone at Colyer's Creek; the fossils from this locality were determined by W.S. Dun.

K. Sharp (1949) in his geological map of the Michelago District included several limestones and contiguous strata from a point four miles south of London Bridge Trig. station to a point three miles south of Michelago.

3. STRATIGRAPHY

The London Bridge Limestone is the name suggested for a sequence of calcareous beds deposited within the Wenlock Epoch, with maximum observed development in the locality of the natural limestone arch, 'London Bridge', eleven miles south of Queanbeyan. This formation can be traced in a discontinuous line, forty miles long, from 'Googong Homestead' five miles south-south-east of Queanbeyan to a point on the Bredbo River, three miles south-east of Bredbo. The lithology of this unit is interbedded normal marine limestone, both massive and bedded types, calcareous subgreywacke sandstone and siltstone, and calcareous slates. The beds are lenticular in shape and when followed along the strike change imperceptibly in lithology, say, from limestone to a calcareous slate.

There is an observable lithological break, without any structural or depositional interruption, between this formation

and the underlying sequence of non-calcareous subgreywacke sandstone and slates with thickness six to eight thousand feet which unconformably overlie the Ordovician rocks to the east. The London Bridge Limestone is overlain by a very thick sequence of acid volcanics to the west. In most localities, quartz-felspar porphyry abuts against the top of this formation. Quartz porphyry at London Bridge has metamorphosed the sedimentary rocks to a width as great as six hundred feet and within this zone has deposited small bodies of haematite. At other localities of the formation, contact metamorphism has been less intense. A later quartz-felspar porphyry at London Bridge has formed an endogenous zone of hybrids with the London Bridge Limestone.

The main localities of this formation from north to south are :

1. One quarter of a mile east of 'Googong Homestead' (62.6N/22.7E) $

2. Between the northern and southern homesteads at London Bridge (61.6 to 61.4N / 22.7E)

3. One and a half miles west of Urialla Trig. Station along the Burra-Michelago road (60.7N / 22.7E) (K. Sharp, 1949)

4. 'Spring Valley' homestead (57.5N / 22.1E) (K. Sharp, 1949)

5. Two miles south of Livingstone Trig. station (58.5N/22.0E) (K. Sharp, 1949)

6. 'Collingwood' homestead (57.5N/22.1E)

7. Colyer's Creek, two miles south of Colinton Trig. station (56.8N/22.1E) (H.B.Brown, 1928)

8. Bredbo River, at crossing of road Bredbo-Cowra Creek (55.6N/22.2E)

$ (Grid co-ordinates from the topographical map, 'A.C.T. and Environs,' National Mapping, Dept. of the Interior, Canberra, 1952).

The maximum thickness of this formation is approximately fifteen hundred feet at London Bridge and about one hundred feet thick one mile to the south. At places this formation can not be recognised due to extreme stratigraphical thinning and/or absorption by the quartz-felspar porphyry. At Bredbo River an approximate thickness of two hundred feet is represented while the unit at 'Collingwood' is of further reduced thickness. The limestones at these two localities dip to the west (as do the strata at London Bridge).

The London Bridge Limestone and contiguous strata over its known extent are so constant in lithology and structure that it is clear that the London Bridge Limestone is a definite stratigraphical rock unit.

4. THE FAUNA OF THE LONDON BRIDGE LIMESTONE.

The following determinations have been made:

Locality: London Bridge (see map).

Hercophyllum shearsbyi
Halysites lithostrotionoides
Halysites cf. chillagoensis
Favosites sp.
cf. Angopora hisingeri
Tryplasma lonsdalei var. scalariformis
Pycnostylus ? sp. nov.
Heliolites daintreei
Syringopora sp. indet.
Fenestella sp. indet.
crinoid stems
Pentamerus sp. indet.
Orthonota sp.
cf. Encrinurus

Locality : 'Collingwood'

Favosites sp.
Pycnostylus ? sp. nov.

Locality : Colyer's Creek

(determinations by W.S. Dun)

Cyathophyllum cf. shearsbyi
Tryplasma lonsdalei
Tryplasma vermiformis
Favosites gothlandica
Favosites goldfussi
Halysites australis
Heliolites minuta
Stromatopora
a stromatoporoid
crinoid stems
Actinoceras
Calymene
Encrinurus

Locality : Two miles south-east of Livingstone Trig.
(determinations by W.S. Dun)

Cyathophyllum shearsbyi
Tryplasma cf. vermiformis
Favosites gothlandica

Locality : Bredbo River

Favosites sp.
Favosites gothlandicus forma gothlandica
Halysites lithostrotionoides
Heliolites daintreei
Multisolenia tortuosa

5. PALAEONTOLOGICAL NOTES

Description of Pycnostylus ? sp. nov.

Phylum - Coelenterata
Class - Anthozoa
Sub-Class - Zoantharia

Ampleximorphs..

Ampleximorphs are solitary or fasciculate Rugosa which have thin walls, short lamellar septa and complete tabulae, and are without dissepiments.

Genus - Pycnostylus Whiteaves 1884

Diagnosis - 'Phaceloid Rugose corals with axial increase, typically quadripartite, with thin walls, short lamellar septa and complete flat tabulae.'

Remarks - '..... the diagnosis brings out a difference between the Australian corals placed herein, and those placed in Tryplasma. In Tryplasma the septa are acanthine but in Pycnostylus they are lamellar.' (Hill 1940)

Species - Pycnostylus ? sp. nov., see plates 1-4

Diagnosis - Corallite diameter twenty to fifty mm. One hundred to one hundred and twenty spined septa, locally in two cycles, generally in one cycle only.

Material - The material available was a hand-specimen of limestone from London Bridge, bearing three corallites from which transverse and longitudinal sections were cut (slides LB 6 to 9 inclusive) and a longitudinal section (HSC 2) from 'Collingwood.'

Description - Little is known concerning the form of the corallum. It is large and the corallites on one surface are spaced from 15mm. to 45mm. apart. Corallites are cylindrical, 20mm. to 50mm. in diameter. The epitheca shows faint longitudinal striations. The wall is thin (1.0mm. to 1.5mm.). There are 100 to 120 thin septa, lamellar and amplexoid, not acanthine; extend back to the periphery of the epitheca. Septa 0.5mm. to 2.0mm. long, 0.25mm. wide. In part of one transverse section, septa are clearly in two cycles, members of one cycle 3.0mm. in length, the others 1.5 to 2.0mm. long. Septal spines are well-developed, extend to a maximum length of 0.5mm. from the inner edge of septum. In longitudinal section there are up to eight septal spines counted in a space of 30mm. The spines are variable in shape, tooth-shaped, blunt, sharp. Tabulae are complete, up to 8mm. apart, slightly undulating. Dissepiments are not developed.

Remarks - This form has too broad a diameter to be conspecific with any Australian species of Pycnostylus. The lack of full material does not allow a complete description to be made so a formal specific name is not given to this form.

An interesting comparison can be made between this form and a coral found in the marble quarry (Bango Limestone), north of Coolalie Railway Station, east of Yass, N.S.W. (Plate 5). The fossil is a surface feature only and sections can not satisfactorily be made. A photograph was taken of a specimen, collected by Dr. I.A. Brown, kept in the Geology Department of the University of Sydney. (For comparison, details of Pycnostylus ? sp. nov. from London Bridge are placed in brackets).

This specimen is an apparently cylindrical corallite, 60mm. (20 to 46mm.) in diameter, with a very thin wall, 0.5 mm. thick (1.0 to 1.5mm). One series of septa number approximately 110 (100 to 120), with length 2.5 to 3.5mm. (0.5 to 2.0mm.), width 0.25mm. (0.25mm.). The septal structure is not known.

Genus - Hercophyllum Jones 1936
Species - Hercophyllum shearsbyi (Sussmilch) 1914. See Plates 9,10.

Locality - London Bridge (Slides LB 3, LB 4)

Remarks. This form is represented by a transverse and a longitudinal section. The transverse section is cut across the calice so that the tabulae do not appear in this section. The transverse outline of the corallite is elliptical due to stress acting upon the circular corallite. The estimated diameter is 35mm. The major septa number 50 and reach halfway to the centre, they are extremely thin, straight. The minor septa are nine-tenths as long as the major septa but are easily differentiated on account of the former's reduced thickness. Septa of both cycles are dilated within the dissepimentarium. The longitudinal section displays splendid development of septa which are slightly tenuous, tabulae which are numerous, incomplete and in one place arched, and mainly horizontal dissepiments. The dissepimentarium has width equal to half the radius.

Genus - Heliolites Dana
Species - Heliolites daintreei Nicholson and Etheridge

Locality - London Bridge (Slides LB 15 to 18).

Remarks. Massive, hemispherical corallum, up to 5cm. in diameter. Tabularia diameter 2mm., 0.3mm. to 2.0mm. space apart, with one to four rows of tubuli between. Tabularia walls slightly thickened, crenulate; tabulae thin, 1mm. apart. Tubuli polyhedric, equal in size; thinner than tabularia walls. Sola thin, ten sola in a space of 5mm. Of the four groupings of Jones and Hill (1940) this form approximates to the first.

Locality - Bredbo River (BC 2, transverse section only). See Plate 22.

Remarks. Tabularia regular elliptical; wall of moderate thickness, slightly crenulate; septa well-developed, grown off crenulations, straight, short, 12 in number, some thickened at base. Tabularia long diameter 2 to 3mm., short diameter 1.5 to 2.0mm. with 1 to 5 tubuli between tabularia. Tubuli mostly regular in 4-to 7-sided figures, walls slightly thinner than those of tabularia.

Genus - Halysites Fischer 1813
Species - Halysites chillagoensis Etheridge 1904. See Plates 11,12.

Locality - London Bridge (Slides 33, 37, 38).

Remarks. This form has been affected by flowage within the limestone. Large irregularly shaped fenestrules; all margins are undulate, while corallite chains in part are very farcimentiform in outline and may contain up to ten autopores. Mesopores and gonopores are absent. Some sections show well-developed septal lamellae with blunt spines, crossed peripherally by complete tabulae.

The absence of mesopores can not be attributed to poor preservation. Since of Etheridge's nine Australian species of Halysites, H. chillagoensis is the only form wanting in mesopores, then the London Bridge form is closely allied to this species but is not considered conspecific on account of its marked development of lamellar spinose septa. The determination is thus Halysites cf. chillagoensis.

Species - Halysites lithostrotionoides Etheridge 1904. See Plates 13,14.

Locality - London Bridge (LB 30 to 36, 38)
Bredbo River (BC 5)

Remarks. Fenestrules irregular, hexagonal, some rectilinear; average diameter 4mm., maximum observed diameter 7mm x 3mm. Walls strong, slightly undulate in transverse section; number of corallites around fenestrule 10 to 20. Autopores long-oval, 1mm. long, free of septa. Indefinite traces of tiny circular mesopores observed between some autopores. Gonopores appear at some fenestrule angles; small, about one-third area of autopores, mostly hexagons. Mesopores and gonopores difficult to distinguish in longitudinal section. The tabulae of gonopores are a little more closely spaced (about 4 to 1mm.) than the tabulae of autopores (about 3 to 1mm.) Tabulae in both types of corallites are complete, horizontal or sagging, equidistant.

Genus - Favosites.
Species - Favosites sp. See Plate 17

Locality - London Bridge (Slide LB 14)

Remarks. Corallite walls and tabulae thin; corallite diameter 1mm. Tabulae straight, 1mm. apart.

Species - Favosites sp. See Plate 19

Locality - Bredbo River (BC 3, transverse section only).

Remarks. Corallites irregular in shape, sub-circular, elliptical, hexagonal and rectangular, 2to 3.5mm. in thickness, some crenulate; septal spines uneven in length, very short with moderately broad base, usually developed from a crenulation in the wall; up to 23 to 30 in the one corallite.

Species - Favosites gothlandicus forma gothlandica. See Plates 20,21.

Locality - Bredbo River (Slides BC 1, transverse, oblique and longitudinal sections).

Remarks. Most corallites of regular hexagonal shape, smaller ones typically pentagonal. Corallites fairly even in size, about 2mm. in diameter (range of diameter 1,0 to 2.5mm) Walls thin, straight. Tabulae complete, thin, many oblique, most horizontal, independently placed in contiguous corallites; about five tabulae in space of 3mm., evenly spaced.

Species - Favosites sp. See Plate 18

Locality - 'Collingwood' (Slides HSC1, transverse and longitudinal sections).

Remarks. Preservation is very poor but outlines of corallites are very clear. Corallites irregular in shape, 5-, 6-, and 7-sided. Maximum diameter is 5mm., commonly 4mm. Walls moderately thin, curved. Tabulae complete, thin, mostly horizontal, about 1mm. apart.

Genus - Angopora Jones 1936

Species - Angopora hisingeri See Plates 15,16

Locality - London Bridge (LB2, transverse section only).

Remarks. It was not possible to prepare a longitudinal section since the only specimen collected was a thin transverse plate. Corallites of two types which intergrade laterally: corallites with thickened walls, showing well-developed short, well-pointed septa, from ten to twenty in number, and, corallites with thin walls devoid of septa. Both sets of corallites are polygonal, dominantly hexagonal; diameter of corallites 1.0 to 1.5mm. The septa are quite short, reaching less than one-fifth the radius of the corallite. No data are available concerning mural pores, tabulae or septa in longitudinal section.

This form is similar to both Favosites nitidus and Angopora hisingeri. The former species has corallite diameter 0.5 to 0.75mm. and while the London Bridge form has corallite diameter 1.0 to 1.5mm. This form is referred to cf. Angopora hisingeri.

Genus - Tryplasma Lonsdale

Species - Tryplasma lonsdalei Etheridge

Variety - Tryplasma lonsdalei var. scalariformis. See Plate 21.A

Locality - London Bridge (LB 1a, 1b.)

Remarks. This form has strict correspondence with Etheridge's description.

Genus - Multisolenia Fritz

Species - Multisolenia tortuosa Fritz. See Plates 6-8

Locality - Bredbo River (BC6, BS7, transverse and longitudinal sections).

Remarks. Septa are difficult to distinguish; those seen are numerous, very poorly developed, very short and narrow. Longitudinal sections show curved corallites with numerous indistinct tabulae, and pores representing the cut ends of solenia.

Phylum - Brachiopoda
Class - Articulata

Genus - Pentamerus J. Sowerby 1813. See Plate 23

Locality - London Bridge (specimens 45, 46)

Remarks. This form is found generally in section embedded in limestone from which it is withdrawn by autoclaving.

The estimated length is 65mm., breadth 45mm. The original shell structure is not preserved. Shell exterior is smooth. The duplex septum extends half the length of the valve.

This form is determined as Pentamerus sp. indet.

Phylum - Mollusca
Class - Lamellibranchia.

Genus - Orthonota Conrad 1841

Species - Orthonota australis Chapman 1908. See Plates 24, 25

Locality - London Bridge (specimen 47)

Remarks. Material is a well-preserved cast and external mould of a left valve preserved in calcareous slate. It is considered that this specimen is not distorted. Length 42mm., height 16mm. All characters agree well with Chapman's species, except for the external ornamentation which is both concentric and radial. Concentric grooves are closely spaced, 14 in a space of 5mm. Radial ridges are more distant and higher, the main ridges 2mm. apart with a lower ridge placed between two higher ridges. This form is certainly congeneric with Orthonota and so is determined as Orthonota sp.

Phylum - Arthropoda.
Sub-Class - Trilobita.
Genus - Encrinurus Emmrich 1845

Locality - London Bridge (specimen 49).

Remarks. This specimen is part of a pygidium slightly distorted. Width is 17mm., length 9mm. It is triangular in shape. There are an estimated 12 segments. Due to poor preservation, this specimen is designated to cf. Encrinurus.

6. STRATIGRAPHICAL POSITION OF THE LONDON BRIDGE LIMESTONE

The close correspondence of faunas at different points along the strike of the London Bridge Limestone denotes clearly that this sequence of rocks, as well as maintaining the same lithological character and relations to contiguous rocks, contains the same fauna. This suggests further that the age of this formation is confined within narrow time limits.

Of notable occurrence are the two species of Halysites, the occurrence in two localities (London Bridge and 'Collingwood') of Pycnostylus?sp. nov. and the peculiar coral, Multisolenia tortuosa, collected at Bredbo River.

It is very difficult to fix the age of this fauna owing to the broad ranges of most of the species. The species which aid most in an assessment of the age are the four types mentioned above. Most of the remaining species are long-ranged owing to their being such broadly defined species By use of these long-ranged species an apparent correlation may be made with the Bowspring Limestone of the Yass section. However, using the four species named above, it is clear that this fauna is lower than the Bowspring Limestone fauna. The restriction of the genus Halysites to the Bango Limestone of the Yass section when other tabulate corals flourished so abundantly in higher strata suggests that Halysites within this region is confined to the lower part of the Wenlock Epoch. Kathleen Sherrard (1951), has identified Halysites from the lower part only of the Wenlock in the Nanima-Bedulluck District.

K. Sharp has recorded higher Silurian limestones in the Michelago District. These western limestones are separated from the London Bridge Limestone by a great thickness of acid volcanics. It is appreciated that a thick volcanic sequence can be deposited within a short time interval so that very little of time value can be inferred from these intervening volcanics.

It is concluded that the age of the London Bridge Limestone falls within the Wenlock Epoch, possibly within the Lower Wenlock and that there is a tentative correlation of this formation with the Bango Limestone.

7. ACKNOWLEDGEMENTS

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G.H. Packham helped in the determination of one of the corals.

Photomicrographs in this record were prepared by D. Havenstein and G. McInnes.

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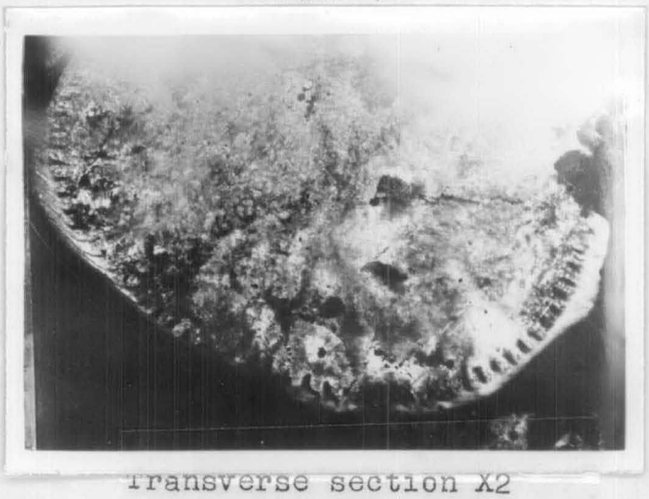
Pycnostylus ? sp. nov.

Locality - London Bridge.

Material - Slide LB 9.

Plate 1.



Transverse section X2

Plate 2.

Transverse section X2

Pycnostylus ? sp. nov.

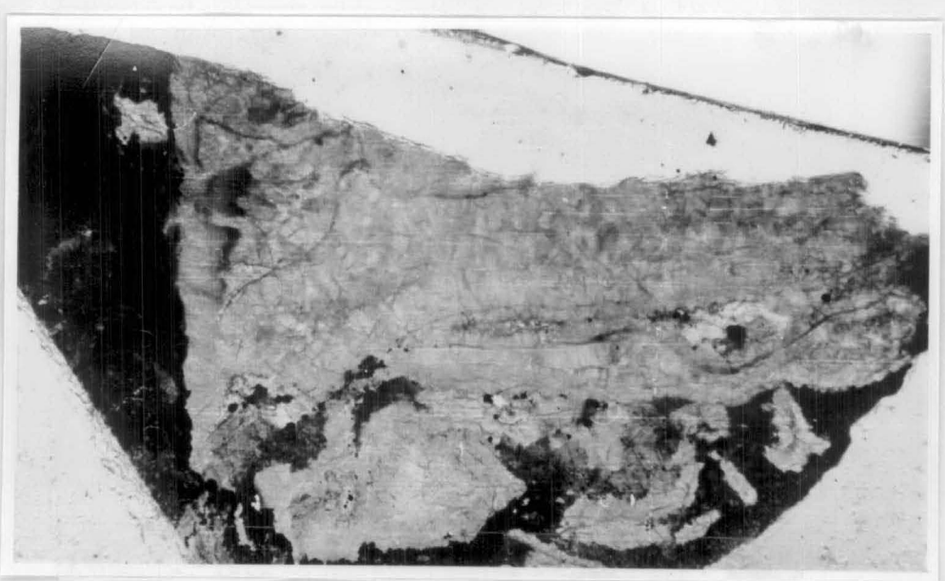
Locality - London Bridge.

Material - Slides LB 7, 8.

Plate 3.

Longitudinal section X 1.5

Plate 4.



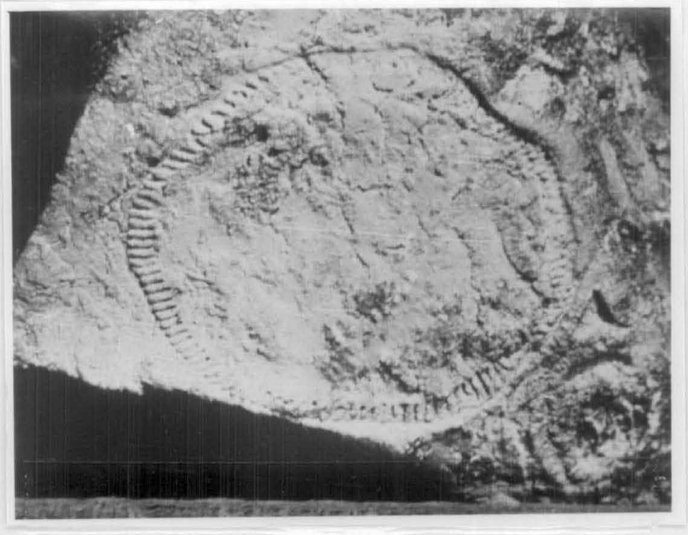
Longitudinal section X4

Pycnostylus ? sp. nov.

Locality - Marble Quarry, north of Coolalie Railway Station.

Material - Hand-specimen in Sydney University Geology Department Collection.

Plate 5.

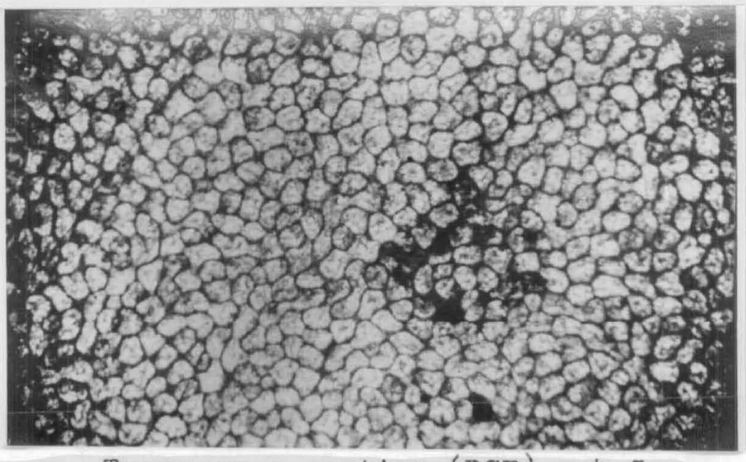


X 1

Multisolenia tortuosa

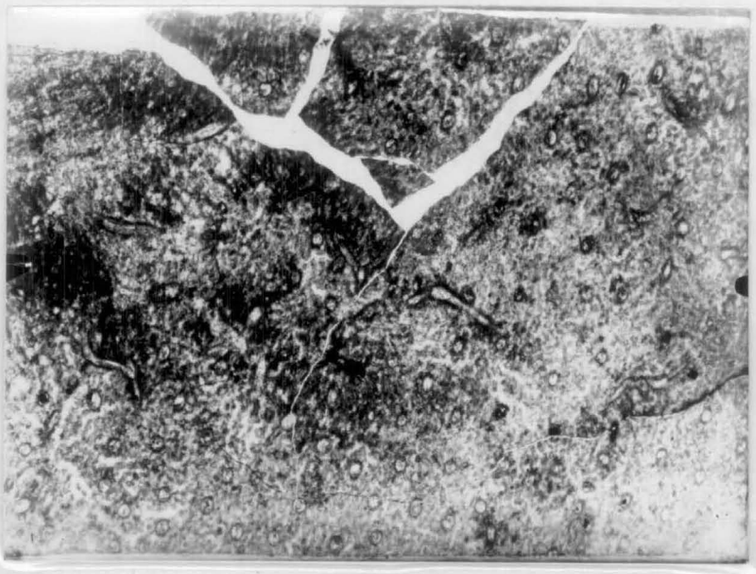
Locality - Bredbo River.
Material - BC6 and BS7.

Plate 6



Transverse section (BS7) x 4.5

Plate 7.



Longitudinal section (BC6) x 3.5

Plate 8.

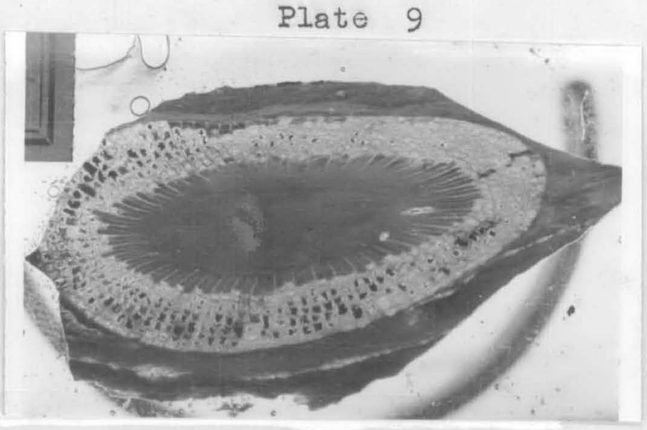
Longitudinal section (BC6) x 3.5

Hercophyllum shearsbyi

Locality - London Bridge

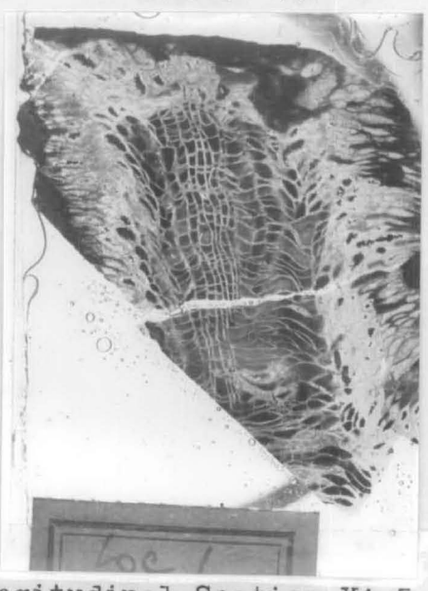
Material - Slides LB 4, 3.

Plate 9



Transverse section X1.5

Plate 10



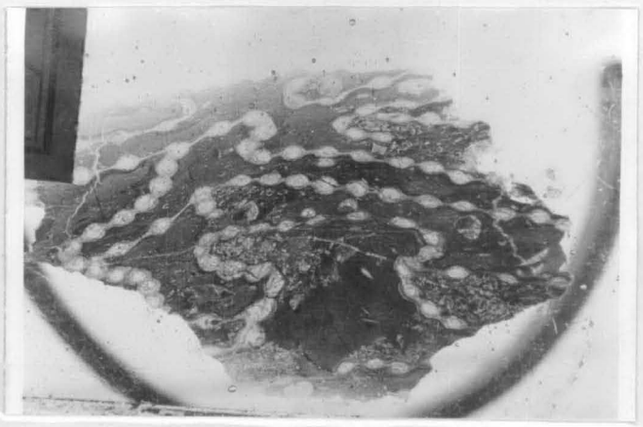
Longitudinal Section X1.5

Halysites cf. chillagoensis

Locality - London Bridge

Material - Slides LB 37, 38.

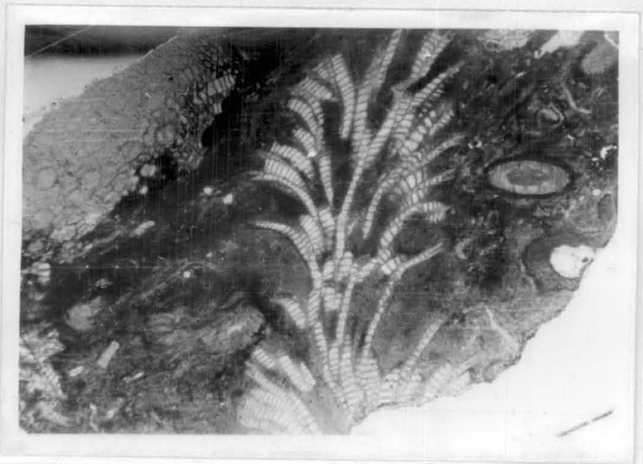
Plate 11



Transverse section X1.5

Propora cf. conferta

Plate 12



bryozoan?

Longitudinal section X1.5

Halysites lithostrotionoides

Locality - Bredbo River

Material - Slide BC 5

Plate 13

Transverse section x 4

Plate 14

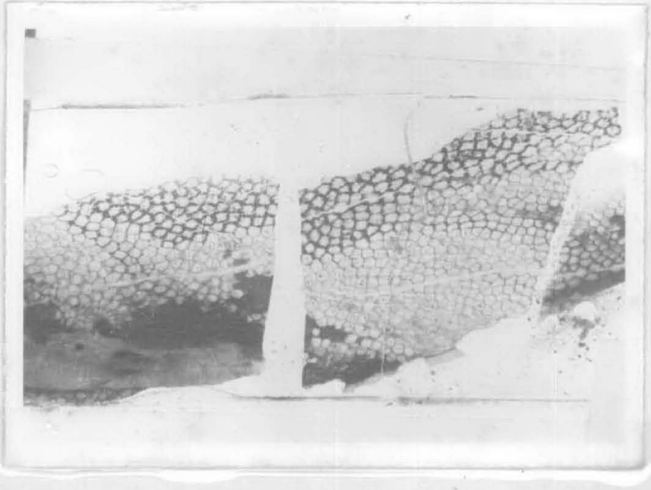
Longitudinal section x 4

cf. Angopora hisingeri

Locality - London Bridge

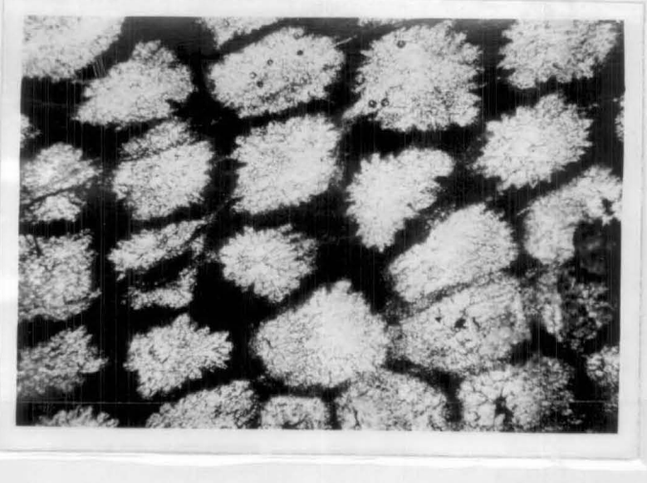
Material - Slide LB 2

Plate 15



Transverse section X1.3

Plate 16



Transverse section X1.3

Favosites sp.

Locality - London Bridge

Material - Slide LB 24.

Plate 17

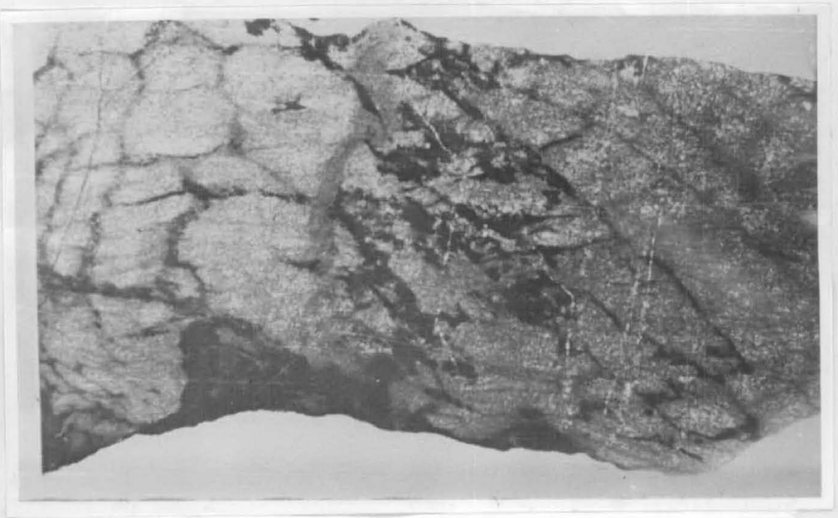
Longitudinal section x 4.5

Favosites sp.

Locality - 'Collingwood.'

Material - HSC 1.

Plate 18



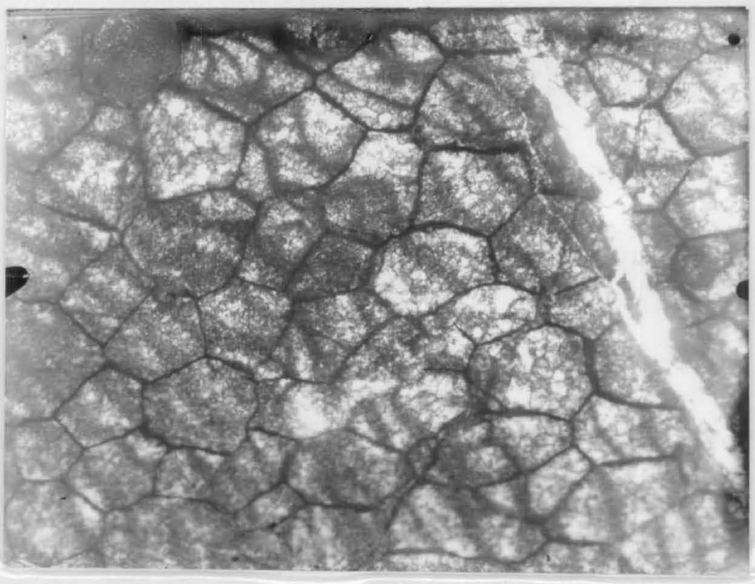
Oblique section x 4.

Favosites sp.

Locality - Bredbo River.

Material - Slide BC 3.

Plate 19



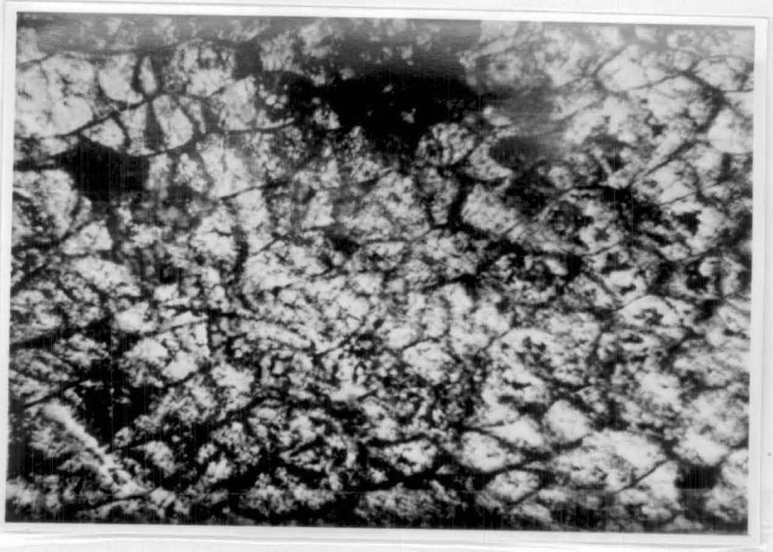
Transverse section x 7.

Favosites gothlandicus forma gothlandica

Locality - Bredbo River.

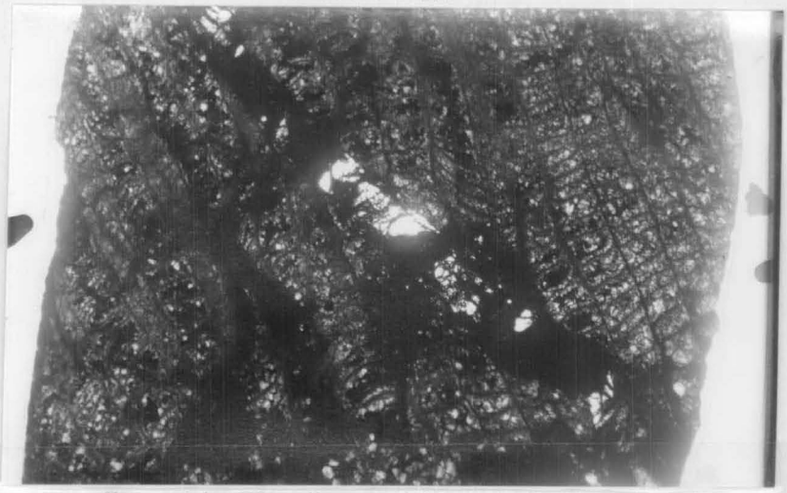
Material - BC1.

Plate 20



Oblique section x 4.5

Plate 21



Longitudinal section x 4.5

Tryplasma lonsdalei var.

scalariformis

Locality - London Bridge

Material - Slide LB 1 (b)

Plate 21 A

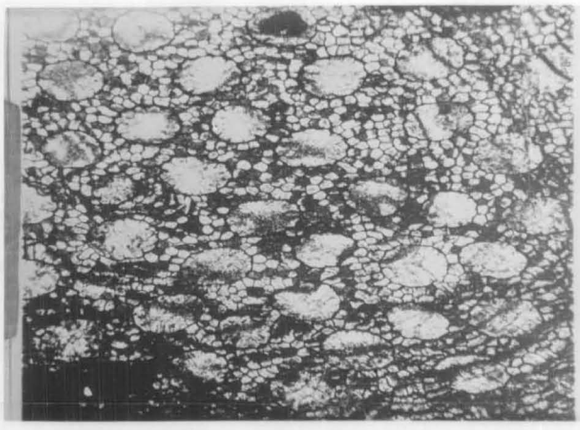
Longitudinal section X1.7

Heliolites daintreei

Locality - Bredbo River

Material - Slide BC 2

Plate 22



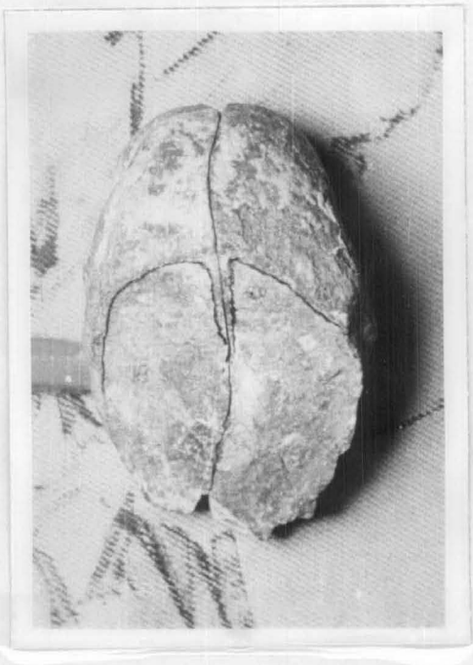
Transverse section x 6

Pentamerus sp. indet.

Locality - London Bridge

Material - Specimen 45

Plate 23



X 1

Orthonota sp.

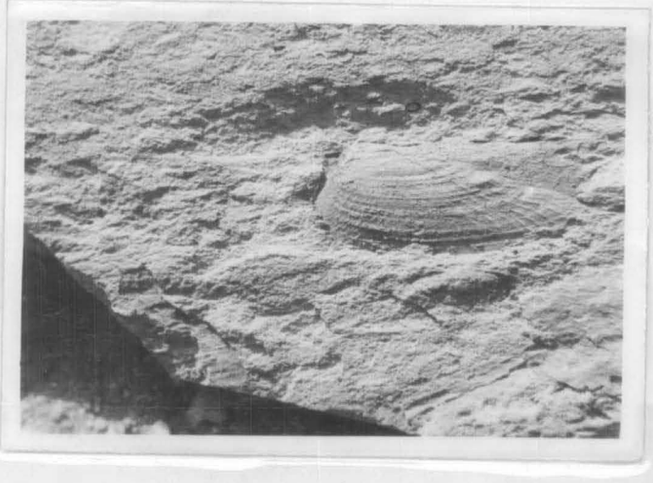
Locality - London Bridge

Material - specimen 47

Plate 24

X $\frac{3}{4}$

Plate 25



X $\frac{3}{4}$

Geological Map

LONDON BRIDGE AREA

Parish of Burra, County of Murray

400 200 0 400 FEET

REFERENCE

LONDON BRIDGE LIMESTONE

Alluvium

Massive Limestone

Bedded Limestone

Calcareous Slate

Calc. Subgreywacke Sandstone

Calc-Silicate Hornfels

Subgreywacke Sandstone

Massive Quartz-Felspar Porphyry

Contaminated Mass. Qtz.-Fspar Porphyry

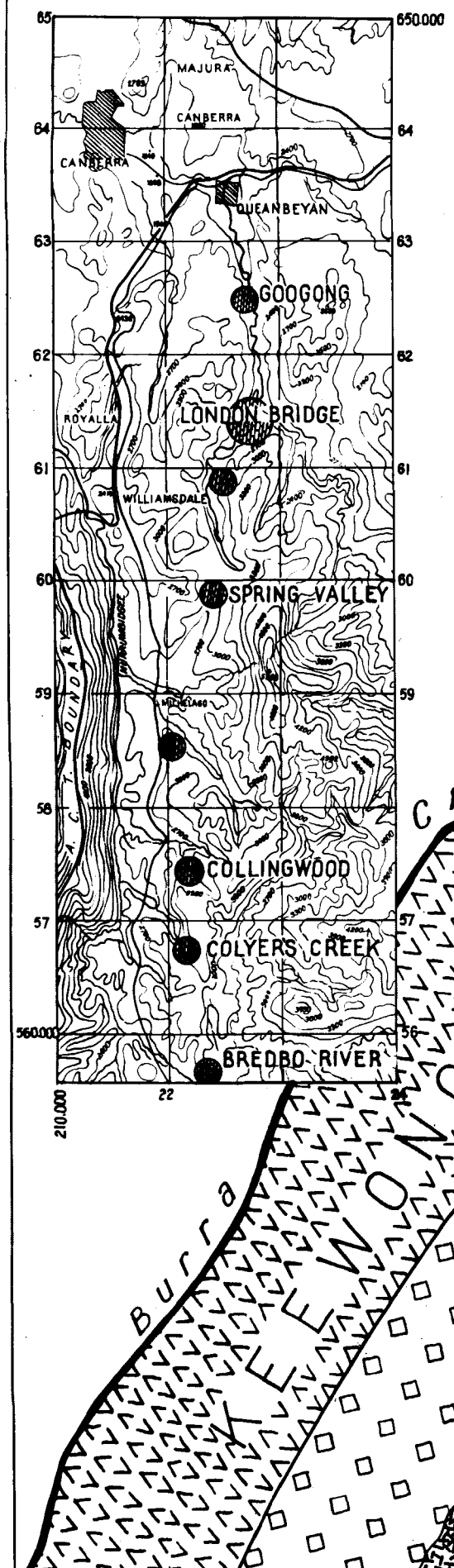
Hematite

Hydrothermal Deposit

Keewong Foliated Quartz Porphyry

LOCALITY MAP BASED ON CANBERRA MILITARY 4 MILE MAP

0 8 MILES



10°28' TRUE MAGNETIC

KEEWONG FOLIATED QUARTZ PORPHYRY

No outcrop

LONDON BRIDGE LIMESTONE

FOSSIL LOCALITY

SILURIAN SANDSTONES AND SLATES

Burra Creek

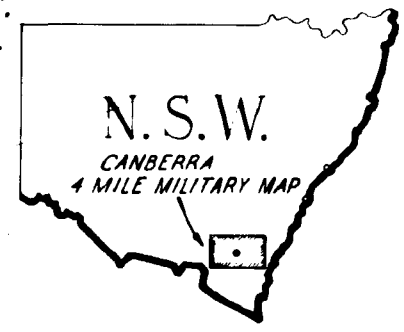
London Creek

No outcrop

No outcrop

VEIN OF HYDROTHERMAL DEPOSITION

LOCALITY MAP



100 0 100 200 300 MILES

Bureau of Mineral Resources, Geology and Geophysics, 14.5.53

Plane Table Survey and Geology by J.J. Veevers.

N69-3 A.Sr