

Acicularia elongata: A Dasyclad alga from the Corallian (Upper Jurassic) of North Yorkshire, U.K.

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ABSTRACT: Disarticulated plates of the dasycladacean alga *Acicularia elongata elongata* (Carozzi) 1955 have been described from the Coralline Oolite Formation (Corallian; Lower to Middle Oxfordian, Upper Jurassic) of North Yorkshire, U.K. The occurrence of these algae extends the Upper Jurassic distribution of the genus *Acicularia* in Europe from Yugoslavia, Italy, Switzerland and France to England. The presence of the forms also solves the apparent anomaly of the absence of dasycladacean algae from the Corallian of England. The algae grew in coralliferous facies in a period of carbonate deposition (the Corallian) which occurred during 'the great Oxfordian spread' of Arkell. This alga is important as a paleoenvironmental indicator of tropical shallow-water conditions.

INTRODUCTION

Elliott (1977) remarked on the absence of dasycladacean algae in the Corallian rocks of England. During petrographic studies on samples from the Hambleton Oolite Member and the Coral Rag Member of the Coralline Oolite Formation (Lithostratigraphy after Wright 1972; text-fig. 1) disarticulated plates of an alga identified as *Acicularia elongata elongata* (Carozzi) 1955 were recorded. These are the first dasycladacean algae recorded from the English Corallian which is of Oxfordian age (text-fig. 1).

The samples were taken from several localities and the plates were observed in stained acetate peels. Diagenetic alterations have affected the grains such that cemented moulds are the only trace of the originally aragonitic structures.

The presence of these algae extends the known paleogeographic range of this genus in the Upper Jurassic and is also important as a paleoenvironmental indicator.

SYSTEMATIC DESCRIPTION

(Systematics to tribe level after Valet 1969)

Phylum CHLOROPHYTA

Order DASYCLADALES

Family ACETABULARIACEAE

Tribe ACETABULARIEAE

Genus ACICULARIA d'Archiac 1843

Species ELONGATA Carozzi 1955

Superspecies ELONGATA (Carozzi) Bouroullec and Deloffre 1970

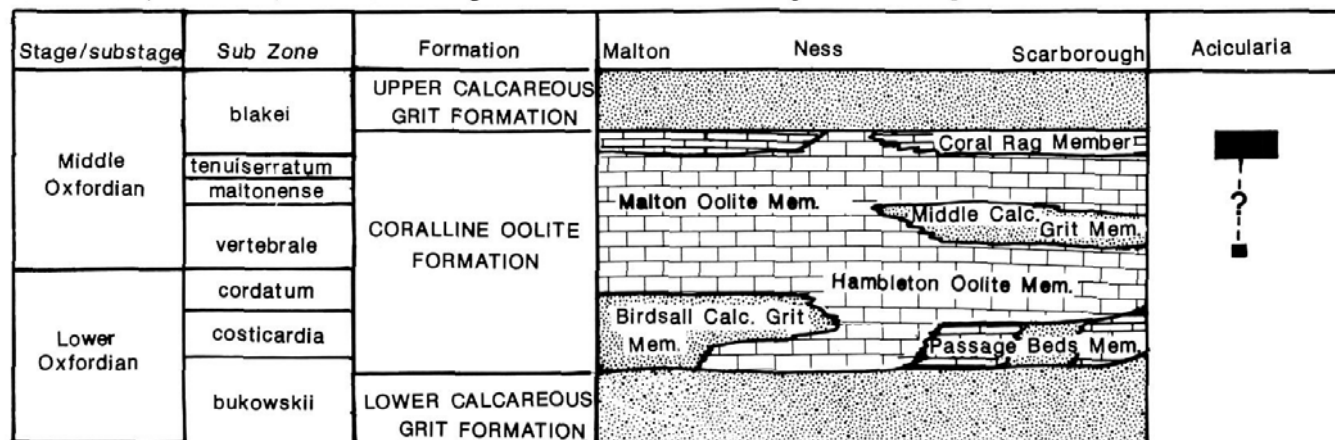
Description - Plates

The disarticulated plates examined are circular in outline 0.12 to 0.46mm (120 to 460µm) in diameter and are punctuated by sporangial cavities (now infilled by lime mud or cement). Sporangial cavities range in size from 20 to 40µm in diameter, number 4 to 16 and open to the plate margins (Pl. 1 and text-fig. 2).

Description - Plants

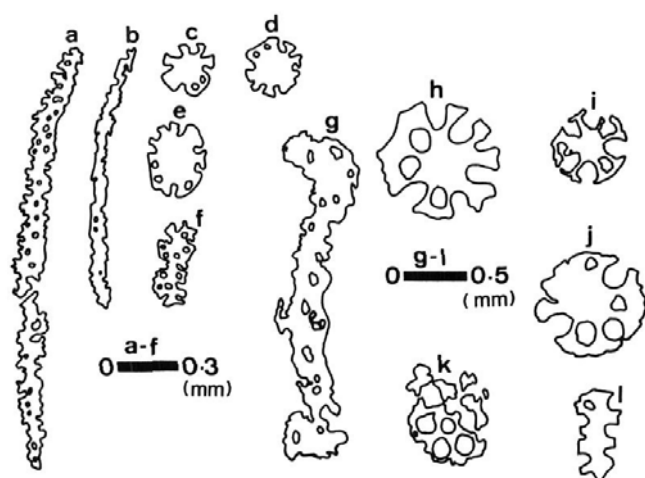
No intact algal thalli were encountered but descriptions of the extant species indicate parasol-like (Johnson 1964) or delicate

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TEXT-FIGURE 1

Lithostratigraphy of the Yorkshire Corallian, U.K. (after Wright, 1972 and 1980)



TEXT-FIGURE 2

Comparison of *A. elongata* Carozzi and *A. elongata elongata* (this paper); a-f *Acicularia elongata elongata* (after Johnson 1964); g-l *Acicularia elongata elongata* (Yorkshire samples)

plants, a few centimetres high with a slender central stem bearing an inverted umbrella-shaped disc at the apex (Wray 1977).

Taxonomic Description - *Acicularia* and *Terquemella*

Algae of the genera *Acicularia* d'Archaic 1843 and *Terquemella* Munier-Chalmas 1877 are usually found as isolated plates (Deloffre and Genot 1982). Identification and differentiation of these rather similar genera is, therefore, achieved on the basis of thin sections. Deloffre and Genot (1979) described these genera in a 'key'. *Acicularia* is described as:

"Spicules fortement calcifiés, élargis, à une extrémité, isolés ou associés latéralement; dans ce dernier cas, ils forment des portions de disque. Section circulaire, ovale ou aplatie. Emplacements des cystes représentés par de petites cavités arrondies disposées sur tout le pourtour du spicule ou sur leurs faces inférieure et supérieure (dans le cas de spicules aplatis)."

Translation: "Spicule" well (or strongly) calcified, getting wider at one termination (extremity), laterally isolated or in assemblage; in the last case, they form part of disc, circular, ovoid or flat sections. "Cysts" are represented by small rounded cavities surrounding the "spicule" or onto their lower and upper faces (in the case of flat spicules).

Terquemella was described as: "pas de cavité; cystes irrégulièrement répartis; corpuscules isolés, sphériques, ovoïdes, lenticulaires ou discoïdes, présentant sur tout ou partie de leur surface des pores qui conduisent chacun à une petite cavité (emplacement d'un cyste) à la périphérie de l'ampoule."

Translation: absence of cavity; cysts randomly distributed; disoidal, lenticular, ovoid, spherical and isolated minute structures, with surfaces partly or totally punctuated by pores that are related each one to a small cavity (cyst setting) on the "bulb" periphery.

An important distinguishing feature of *Terquemella* is the random distribution of the sporangial cavities. In the samples examined (Plate 1) the cavities are arranged at the periphery of the plates, a feature characteristic of *Acicularia*. In addition

TABLE 1

Morphometric data on selected Jurassic species of *Acicularia* (in part after Bouroullec and Deloffre 1970).

TAXA	NUMBER OF SPORANGIAL CAVITIES	DIAMETER OF SPORANGIAL CAVITIES (mm)	EXTERNAL DIAMETER (in mm)
<i>A. jurassica</i> JOHNSON, 1961	8 - 12	0.013-0.018	0.073-0.125
<i>A. elongata elongata</i> CAROZZI, 1947	6 - 16	0.03-0.06	0.14-0.35
<i>A. elongata elongata</i> (Nikler & Sokac, 1967 data)	10 - 16	0.05-0.06	0.24-0.38
<i>A. elongata elongata</i> (this paper)	4 - 16	0.02-0.40	0.12-0.46
<i>A. elongata aquitanica</i> BOROULLEC & DELOFFRE, 1970	9 - 17	0.03-0.05	0.20-0.352
<i>A. elongata</i> (Basson & Edgell, 1971 data)	7	0.022	0.12

strongly elliptical plates with one 'wider termination' (Plate 1.6) and acicular plates (Plate 1.8) have been observed.

The plates observed are, therefore, considered to belong to the genus *Acicularia* d'Archaic 1843.

Taxonomic Discussion - *Acicularia*

Johnson (1964) recorded two Jurassic species of *Acicularia*; *Acicularia elongata* Carozzi 1955 was recorded from Switzerland and France, whereas *A. jurassica* Johnson 1961 was described from Alabama. The specimens of *A. elongata* illustrated by this author are very similar to those encountered in the Coralline Oolite Formation of Yorkshire (text-fig. 2).

Bouroullec and Deloffre (1970) revised the genus *Acicularia*, and in particular the Jurassic forms. They identified two subspecies of *A. elongata*; *A. elongata elongata* (Carozzi) 1955 and *A. elongata aquitanica* Bouroullec and Deloffre 1970. *A. elongata aquitanica* was cited as occurring in the Upper Sinemurian (Lower Lias), whereas *A. elongata elongata* was described as occurring in Upper Oxfordian to Valanginian rocks. The Oxfordian record is significant in the context of this paper. Text-figure 3 shows the stratigraphic and geographic distribution of *Acicularia elongata* taxa from a literature survey. Examination of these data suggests that the *Acicularia* plates described in this paper belong to *A. elongata elongata* on both morphologic and stratigraphic grounds. In addition, this subspecies also occurs in the Aquitaine area which is geographically close.

Table 1 summarizes the characteristics of *Acicularia* from six literature sources. It is apparent that the samples from Yorkshire show greatest affinity to *A. elongata elongata* on the basis of morphometric data.

On the basis of both morphometric and stratigraphic data the Yorkshire algae have therefore been identified as *Acicularia elongata elongata* (Carozzi) 1955.

SYSTEM		JURASSIC										CRETACEOUS							Location	Reference
SERIES		LOWER (Lias)			MIDDLE (Dogger)				UPPER (Malm)			LOWER								
STAGE		Hettangian	Sinemurian	Pliensbachian	Toarcian	Adenian	Bojocian	Bathonian	Callovian	Oxfordian	Kimmeridgian	Portlandian	Berriasian	Valanginian	Hauterivian	Barremian	Aptian	Albian		
ACICULARIA TAXA																				
A. elongata elongata (this paper)										■								U.K. (Yorkshire)	This Paper Hitchings, 1982	
A.elongata aquitanica			■															Aquitaine Yugoslavia	Bouroullec & Deloffre, 1970	
A.elongata ?aquitanica					■													Italy (Aurunci)	Chiocchini et al, 1979	
Acicularia			■	■			■	■	■	■	■							France/Spain (Pyrenees)	Peybernes, 1979	
A. gr. elongata									■	■								Italy (Ermit. Simbruini)	Chiocchini et al, 1979	
A.elongata										■	■	■						Lebanon	Basson & Edgell, 1971	
A.elongata elongata										■		■	■					Aquitaine	Bouroullec & Deloffre, 1970	
A.elongata elongata											■	■	■	■	■			Yugoslavia	Nikler & Sokač, 1967	
A.elongata ssp.																	■	Italy (Aurunci)	Chiocchini et al, 1979	

TEXT-FIGURE 3

Stratigraphic and geographic distribution of European and Near Eastern Jurassic *Acicularia* taxa

PALEOGEOGRAPHY OF EUROPEAN JURASSIC ACICULARIA

Wray (Wray 1977) has described the Jurassic as a time when the solenoporacean and dasycladacean algae reached the height of their development. Dasycladaceans were also described as being abundant and widespread in shelf deposits of this age. The apparent absence of dasycladaceans in the English Corallian noted by Elliott (1977) is therefore surprising, especially considering their widespread occurrence in the Upper Jurassic rocks of Europe.

Hallam (1971) discussed provinciality in Jurassic faunas on the basis of invertebrates, chiefly molluscs. Two 'realms' were recognized; the Boreal and Tethyan (terms adopted by Arkell 1956 based on ammonite faunas). The Boreal Realm essentially occupied the north of the present northern hemisphere, and the northern side of the Tethyan Realm included southern Europe and the Mediterranean (text-fig. 4). Hallam (1969, 1971) proposed three marine facies associations which occurred between the Boreal and Tethyan realms:

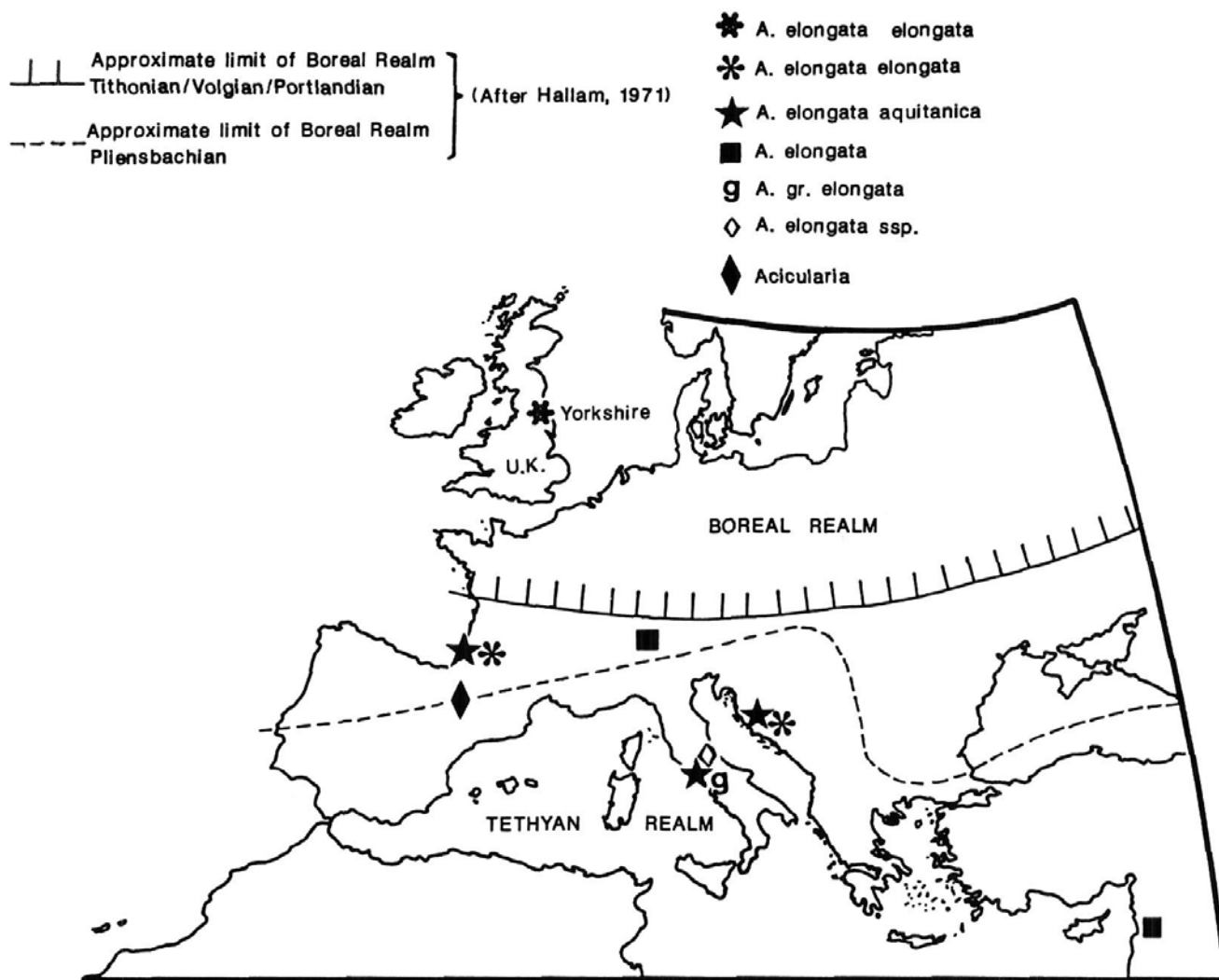
1. Terrigenous clastic facies association (includes much of the Yorkshire Jurassic),
2. Intermediate facies association (includes most of the Jurassic of southern England),
3. Calcareous facies association; further subdivided into a) shallow water, and b) deeper water.

The shallow water calcareous facies association comprised "massive reefoid limestones with rich and diversified fossils including dasycladacean algae and hermatypic corals."

Text-figure 4 illustrates the distribution of Jurassic *Acicularia* taxa in Europe and the Near East (data from Nikler and Sokač 1967; Bouroullec and Deloffre 1970; Basson and Edgell 1971; Carozzi et al. 1972; Chiocchini et al. 1979; and Peybernes 1979). It is clear that *Acicularia* was confined to the Tethyan Realm. The occurrence of these dasycladacean algae in the North of England was due to the northward migration of the Tethyan Realm in the Oxfordian (the great Tethyan Spread of Arkell 1956). No precise Boreal-Tethyan boundary can be defined but the occurrence of dasycladaceans in the Yorkshire Corallian seems to represent the northernmost spread of these algae in the Jurassic.

PALEOECOLOGICAL DISCUSSION

Dasycladacean algae occur in shallow water at depths of less than 10m (Cloud 1952; Johnson 1961) and they prefer muddy or silty substrates (Johnson 1957). Flügel (1977) noted that Senes (1967) and Klement (1966) describe "rich autochthonous dasycladacean floras" from coastal tropical marine environments of very shallow depths, often less than 5m. Valet (1979) described them as tropical or warm subtropical and further defined a number of biotopes from several different environments. Wray (1979) referred dasycladacean algae to the lagoonal-reef and Rácz (1979) gave a back-reef distribution for such floras.



TEXT-FIGURE 4
Palaeogeographic distribution of Jurassic *Acicularia* taxa in Europe and the Near East

In the present case dasycladaceans have been recorded from isolated coral-bearing facies within the oolitic Hambleton Oolite Member of the Coralline Oolite Formation (Wilton Heights, Plantation Quarry). More extensive records occur in the Coral Rag Member (Hitchings 1982; text-fig. 1). Hitchings (1982) defined nine facies within the Coral Rag Member and *Acicularia* occurs in the first seven of these:

1. *Thamnasteria*-facies,
2. *Solenopora*-gastropod facies,
3. *Bourguetia* facies,
4. *Terebratula*-gastropod facies,
5. Nerinacean facies,
6. Phaceloid coral facies,
7. Coral debris biomicrite facies,
8. Rounded biopelsparite facies,
9. Transition or 'shell' bed facies.

Text-figure 5 illustrates the areal distribution of the main facies and the distribution of *Acicularia* localities. They are most common in the *Bourguetia* facies rocks which are characterised in the field by numerous gastropods of the species *Bourguetia saemanni*. The facies is interpreted as having developed in the proximity of thamnasterian bioherms in areas of moderate to

high hydrodynamic energy, high productivity and soft mud to very fine-grained sands.

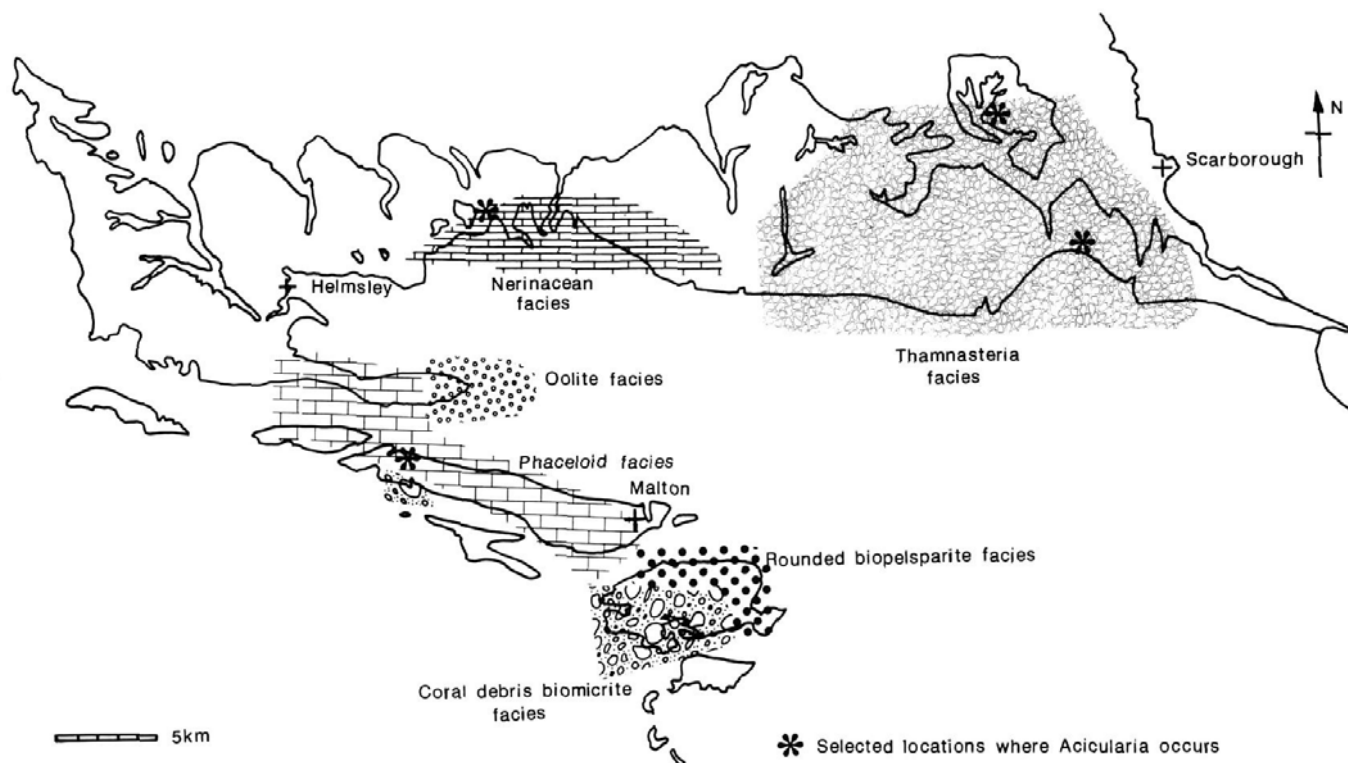
Peybernes (1979) ascribed *Acicularia* to the middle and inner infralittoral (shallow subtidal) and schematically (op. cit. fig. 2) indicated an association seawards and lagoonswards of barriers. The association of *Acicularia* with biohermal (patch reef) facies in the Yorkshire Jurassic is in accord with this interpretation.

REMARKS

The identification of *Acicularia elongata elongata* (Carozzi 1955) in the Yorkshire Corallian of England is important in that it fills an apparent gap in the known palaeogeographic distribution of this genus. Its occurrence is in accord with the expansion of the Tethyan Realm during the Oxfordian (Late Jurassic). The presence of *Acicularia* is important in paleoecological interpretations of the rocks of the Corallian (Coralline Oolite Formation).

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TEXT-FIGURE 5

Distribution of facies and *Acicularia* in the Coral Rag Member, Corallian, Yorkshire

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PLATE 1

All figures bear a standard linear scale of 0.1mm in the top left hand corner of each photograph.
All sections are taken from stained acetate peels. Magnification $\times 65$.

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|---|--|
| 1 Cross-section of plate, from Wilton Heights Plantation Quarry (SE 861 844), Coral Oyster horizon. | 6 Tangential sections of plates, from Bell Heads Quarry, Silpho, Coral Rag Member, <i>Bourguetia</i> facies. |
| 2 Cross-section of plate, from Bell Heads Quarry, Silpho (SE 957 918), Coral Rag Member <i>Bourguetia</i> facies. | 7 Tangential section of plate, From Bell Heads Quarry, Silpho, Coral Rag Member, <i>Bourguetia</i> facies. |
| 3 Cross-section of plate, from Bell Heads Quarry, Silpho, Coral rag Member, <i>Bourguetia</i> facies. | 8 Longitudinal section of plate, from Bell Heads Quarry, Silpho, Coral Rag member, <i>Bourguetia</i> facies. |
| 5 Tangential section of plate, From Bell Heads Quarry, Silpho, Coral Rag Member, <i>Bourguetia</i> facies. | |

