ORDOVICIAN RECEPTACULITID ALGAE FROM BURMA

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ABSTRACT. *Fisherites burmensis* sp. nov., is described from the Lower–Middle Ordovician Wunbye Formation in the western part of the southern Shan State, Burma. This extends the geographic range of receptaculitids known from North America, Europe, and Australia to south-eastern Asia, where they have hitherto been poorly known.

SINCE the first publication 179 years ago (Hüpsch 1805) receptaculitids have had a vagrant history. Like a pendulum they have swung from sponges to algae with brief pauses in a considerable variety of animal Phyla. However, most workers preferred to banish them to a remote place of retirement among sponges, and Rauff (1892) alone argued that they were algae. The oscillations of this systematic pendulum have stopped only in the mid 20th century. Byrnes (1968), Rietschel (1969), and Nitecki (1972), among others, produced new and convincing evidence that receptaculitids are plants. However, Byrnes's (1968) arguments that they were dasyclads and Nitecki's (1976 and subsequent) propositions that, although not dasyclads, they were nevertheless an independent order of green algae within siphonous complex of Chlorophyceae, cannot any longer be maintained (Rietschel 1977). A detailed demonstration of the algal nature of receptaculitids will be presented elsewhere; suffice it to say here that the arrangement of branches in whorls or circlets and the calcification of the thallus are common features not only of chlorophytes, but also of certain other groups of algae. Furthermore, since we do not know the exact nature of receptaculitid reproduction, we cannot assign them with any degree of certainty to any specific group of thallophytes.

Receptaculitids range from Lower Ordovician to Permian but they are most abundant in the Ordovician, particularly in North America, where they are very common and are frequently used as index fossils. They decline rapidly in the Middle Devonian, and are known only from single localities in the Carboniferous (Roemer 1897) and Permian (Parona 1933). Receptaculitids are known from all continents except Antarctica.

In many North American localities receptaculitids are a major component of organic buildups (Toomey and Nitecki 1979). They are not well studied in South America and are known only from the Ordovician of Argentina (Nitecki and Forney 1978) and the Devonian of Bolivia (Branisa 1965).

Although rather rare in Europe, receptaculitids have been studied there for a considerable period of time; many taxa have been described, and their morphology is well understood. The entire stratigraphic range of receptaculitids is represented in Europe, but the best known European ranges are the Silurian and Devonian (Rietschel 1969).

African receptaculitids have been figured from the supposed Ordovician of Morocco (Termier and Termier 1950) and from the Devonian of Algeria (Le Maitre 1952). In Australia, receptaculitids are less common than in North America but considerably more abundant than in Europe. Their stratigraphic range is more restricted than, but otherwise similar to, the North American distribution (Byrnes 1968).

The least well-known receptaculitids are from Asia. Except for single taxa known from: (1) Soviet Asia, particularly the Ordovician of Siberia, where receptaculitids have been described in detail (Miagkova 1965); (2) the Ordovician of Manchuria (Endo 1932); (3) the Devonian of Iran (Flügel 1961); and (4) the Devonian of Afghanistan (Nitecki and De Lapparent 1976), Asian receptaculitids have either been misidentified or are poorly known. Kobayashi (1960) illustrated, but did not

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otherwise describe, Ordovician *Receptaculites* from Vietnam. He also described a sponge, *Archaeoscyphia*, from Malaya (Kobayashi 1959); this last taxon is an undoubted *Calathium*. Thein (1973) listed *Receptaculites* from the Ordovician of the southern Shan State in Burma.

The new receptaculitids from the Middle Ordovician of Burma described here are the first receptaculitids from south-east Asia available for detailed description; they thus extend the geographic range of these fossils and fill a gap in their global distribution.

SYSTEMATIC PALAEONTOLOGY

Class RECEPTACULITAPHYCEAE Weiss 1954
Order RECEPTACULITALES James 1885
Family RECEPTACULITACEAE Eichwald 1860
Genus FISHERITES Finney and Nitecki 1979

Fisherites burmensis sp. nov.

Pl. 47, figs. 1, 2

Diagnosis. Thallus subglobular to globular; nuclear area of small and very numerous meroms; intercalation asymmetrical, occasionally symmetrical; meroms of two distinct sizes.

Holotype. Nuclear hemisphere FMNH PP 20079.

Other material. Eight more or less incomplete specimens FMNH PP 20076 to FMNH PP 20083.

Derivation of name. From Burma.

Terminology. The terminology used in descriptions of receptaculitids was confused in the past mainly due to the conflicting interpretations of the nature of receptaculitids. When receptaculitids were considered sponges, sponge terminology was used (e.g. Hinde 1884); when they were believed to be dasyclads (e.g. Byrnes 1968), dasyclad terminology was applied. Now that we can be certain that they are algae (although independent of Dasycladales), a terminology has evolved which in many ways is unique to this group of fossils. The terminology in this paper follows Fisher and Nitecki (1982) as modified from Rietschel (1969).

Shape and size of thalli. The specimens are preserved only as flat, incomplete discs, a very common state of preservation of receptaculitids. They were certainly neither conical nor cylindrical and were probably subglobular to globular in the adult stage; the small specimens (FMNH PP 20081 and PP 20083) appear to have been globular. The diameter of the preserved thallus is between 6 cm (3 specimens) and 10 cm (1 specimen). Due to the fragmentary nature of the specimens, maximum diameter is unknown. We assume that the adult thallus was at least 12 cm in diameter.

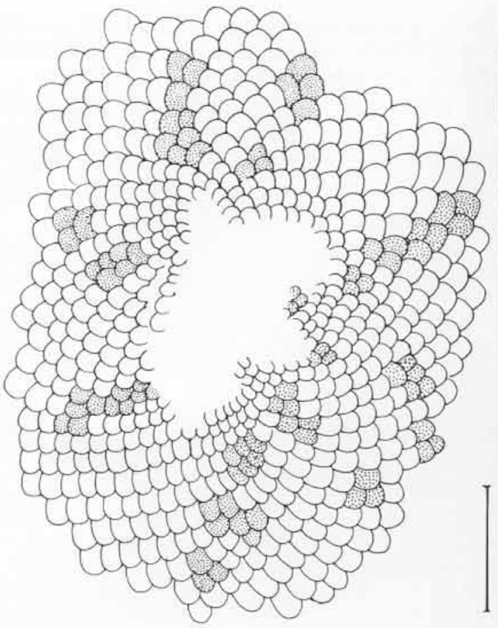
Nucleus. Nuclear area is preserved only on the outer side of the intervallum (FMNH PP 20079). Although the nucleus itself is obscure, a large number of small meroms is discernible (Pl. 47, fig. 1*b*). The plates in this area were not more than 0·3 to 0·4 mm in largest dimensions.

Lacunar hemisphere. Not preserved in any specimens available.

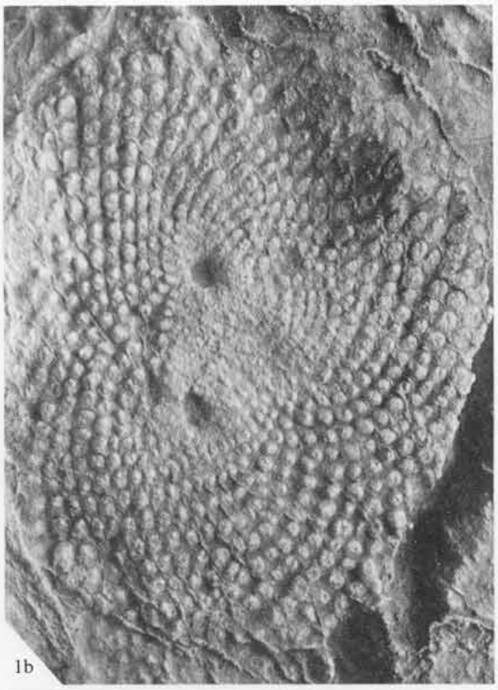
Nuclear hemisphere. Intercalation is predominantly either dextral or sinistral and thus asymmetrical (in the terminology of Fisher and Nitecki 1982) or M_1^3 (in the terminology of Rietschel 1970). Occasionally, the intercalation is in both directions, and thus symmetrical or M_2^3. Orthostichies are pronounced, and

EXPLANATION OF PLATE 47

Figs. 1, 2. Nuclear hemispheres of *Fisherites burmensis* sp. nov.; Middle Ordovician, Wunbye Formation; southern Shan State, Burma. 1, holotype; FMNH PP 20079; bar = 3·29 cm. 2, FMNH PP 20082; bar = 1·78 cm.



1a



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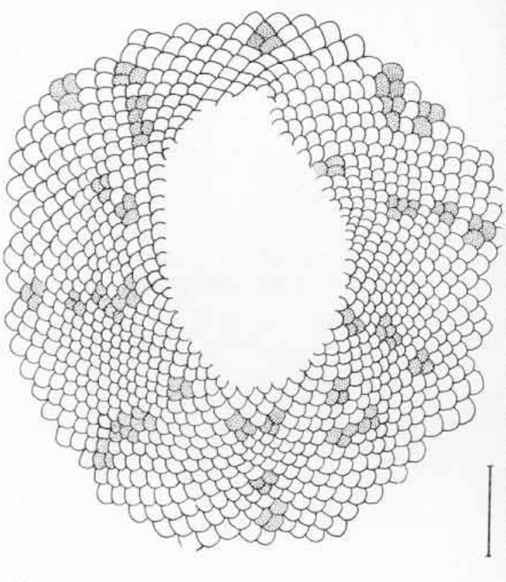

2a

2b

RIETSCHEL and NITECKI, *Fisherites*

intercalations are clustered along them. Intercalations are thus not distributed at random, and areas of thallus free from intercalary meroms are pronounced. In the holotype (Pl. 47, fig. 1*a*) there are 29 visible asymmetrical intercalations, 14 sinistral and 15 dextral, and thus left and right intercalations are approximately of equal number. In FMNH PP 20082 (Pl. 47, fig. 2*a*) there are 35 intercalary meroms of which 15 are asymmetrical sinistral, 18 asymmetrical dextral, and 2 symmetrical.

Meroms. The size of the merom plates increases away from the nucleus and can be estimated from the positions of merom shafts. Thus, plates range from very minute in the nuclear area to 2·5 mm in largest dimension at the preserved edge of the thallus. Complete meroms are observed in only three specimens, and their distances from the nucleus are unknown: (1) on the weathered outer surface of FMNH PP 20078 the height of the merom is 8·5–10·0 mm; thickness 2·0 mm; plate size 2·5 mm; foot, largest dimension 2·1 to 2·2 mm; (2) on the polished surface of FMNH PP 20081 the length of the merom is 10 mm and the thickness 1·8 mm (maximum); (3) on FMNH PP 20080 the height of the merom is at least 3·5 mm and the thickness is greater than 2·3 mm. The sizes of meroms do not increase greatly on individual specimens because intercalations are relatively abundant, allowing the sizes of plates to remain relatively constant. There are about 1,100 meroms visible on FMNH PP 20082 (Pl. 47, fig. 2), and about 600 on the holotype (Pl. 47, fig. 1). The meroms have well-developed heads and feet; plates are poorly preserved; and the stellate structures are stout and short.

Discussion. In the past, the criteria used in the definitions of receptaculitid taxa were: (1) the shapes and relative ratios of length to width of meroms; (2) the outlines of plates; and (3) the general shapes of thalli. However, these features of morphology are not sufficient, and other characters now used in receptaculitid systematics include: (4) the intercalation pattern; (5) the morphology of stellate structures; and (6) the relative size of meroms with respect to the size of plates. The pattern of intercalation, which reflects morphogenesis, is now considered of prime importance.

Because our taxon agrees in all but one of these aspects (the length of meroms) with the genus *Fisherites*, and it agrees in only very limited aspects with other taxa, we are assigning it to *Fisherites* Finney and Nitecki 1979.

Stratigraphy and lithology. *F. burmensis* (sp. nov.) occurs in the Wunbye Formation (Lower–Middle Ordovician) of the Pindaya Group (Ordovician) of the western part of the Shan Plateau region of Burma (text-fig. 1). According to Thein (1973) the Wunbye Formation, the principal formation of the Pindaya Group, is distributed extensively in the Bawsaing and Pindaya ranges, Yengan, Myogyi, and Pyaukseikpin areas at Kyaukse East, and between Mandalay and Maymyo in the north. It consists of a succession of thick-bedded limestones, siltstones, and dolomites. The limestones are finely crystalline, grey to bluish grey, sometimes oolitic, and with pink, buff, or yellow silty materials in the forms of burrows, specks, pellets, or irregular and regular laminations; burrow structure is so typical of these limestones that locally the limestone is called the Burrow Limestones. The siltstone sub-units are thin, medium to thick-bedded, yellow to light grey, and soft to indurated. The dolomite sub-units are usually thick-bedded, often massive, but generally with fine laminations, and with highly jointed surfaces in criss-cross pattern; colour is usually bluish grey or grey with submetallic lustre, but dull on weathered surfaces. They are finely crystalline although often oolitic, and do not usually extend laterally for long distances.

F. burmensis occurs in the Burrow Limestone sub-units of the Wunbye Formation. It is not abundant and is distributed locally. The five major localities in the western part of the Shan Plateau region of Burma (text-fig. 1) are listed below.

Specimen No.	Locality No.	Location
FMNH PP 20076, 20079, 20080, 20081	X_1 and X_2	2·4 km due east (X_1) and 2·8 km due south-east (X_2) of Pyaukseikpin village, east of Kyaukse town.
FMNH PP 20077, 20078, 20083	X_3	4·8 km south-west of Pindaya town; 2·4 km north of Wabya village.
FMNH PP 20082	X_4	Just north of Yebyukan village, 5·2 km north-east of Bawsaing.
No specimens collected	X_5	0·8 km north-east of Kyauk-Chaw village.

F. burmensis occurs in association with *Helicotoma*, *Lophospira*, *Cyrtolites*, *Paurorthis*, *Actinoceras*, and *Ormoceras*.

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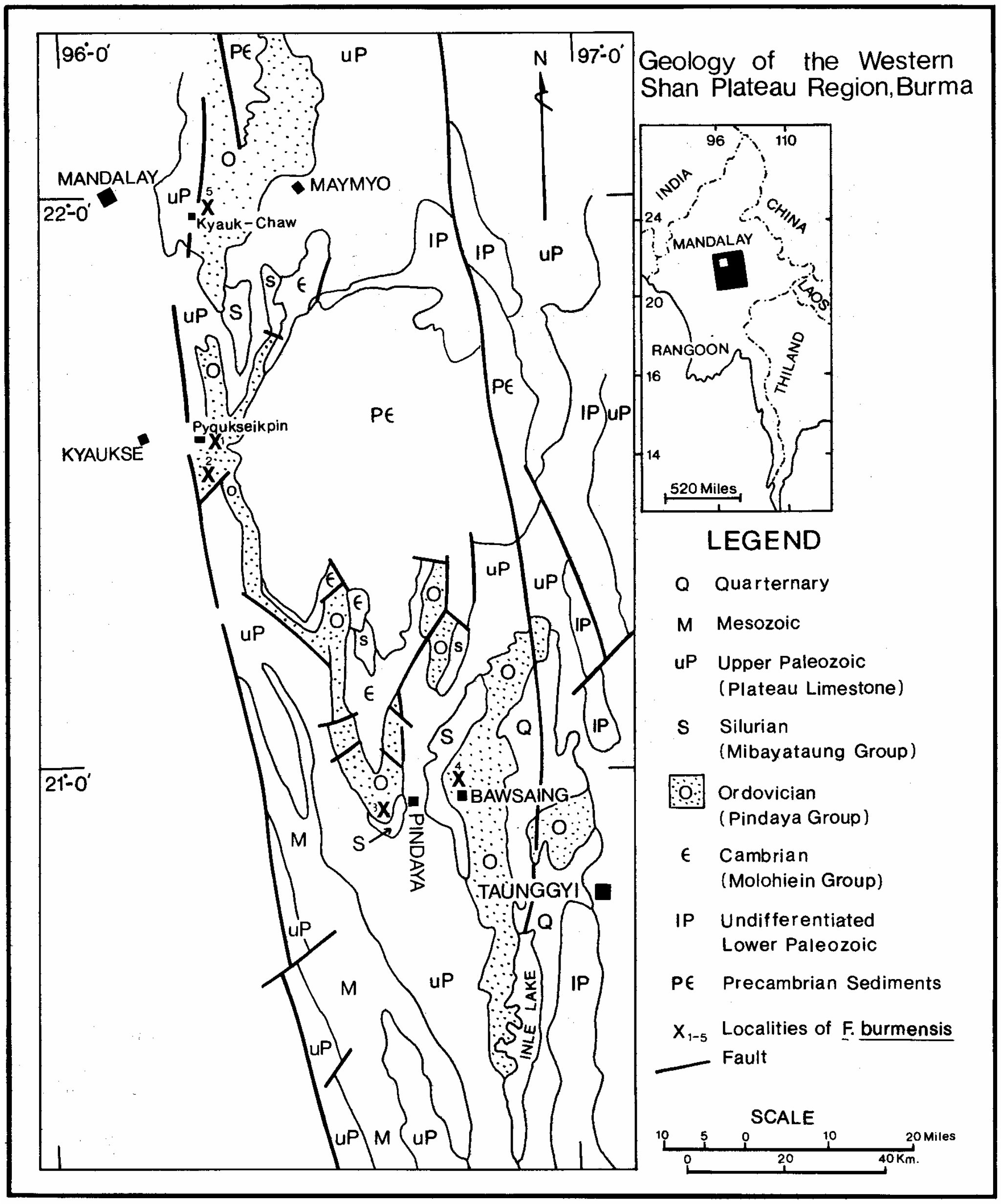

TEXT-FIG. 1. Geological map of the area south-east of Mandalay, Burma showing the geology of the western Shan Plateau region and the localities where *Fisherites burmensis* have been found.

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