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Zonotrichites (Calcareous Algae) from the Arabian Triassic

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With 2 plates (I and II)

RÉSUMÉ

Déjà connue du Trias de la Silésie, l'algue *Zonotrichites lissaviensis* BORNEMANN décrite ici, provient d'une formation du même âge de la Péninsule d'Oman. Ce fossile a été comparé par son auteur à certaine Myxophyceae actuelle. D'autres détails caractéristiques de la structure de ces algues actuelles, en particulier le pseudo-embranchement des filaments, ont été observés sur ce fossile de la Péninsule Arabe.

ABSTRACT

Already known from the Triassic of Silesia, the alga *Zonotrichites lissaviensis* BORNEMANN described here comes from a formation of the same age in the Oman Peninsula. This fossil was compared originally by its author with certain living Myxophyceae. Further details of structure characteristic of these living algae, especially the pseudo-branching of the filaments, are now described from the Arabian fossils.

INTRODUCTION

Triassic algae are not common in the Middle East. The rich dasyclad microfloras of Central and Southeastern Europe do not occur in the extensive Triassic outcrops in the northern mountain belt which runs through Iraqi Kurdistan (ELLIOTT, 1960), due apparently both to facies and to subsequent dolomitisation, and very few algae have been recorded from the outcrops to the south in Oman. The example now described from the latter area belongs to the Myxophyceae (Cyanophyceae), or blue-green algae, a primitive group whose fossil representatives are usually unsatisfactory both as stratigraphical markers and as paleobotanical evidence, since the simple, indifferently-calcified threads function mostly as sediment-tanglers from a geological point of view. However, the excellent preservation of some examples in the material examined permits full description and correlation with similar Triassic occurrences elsewhere.

The material was collected by Mr. D. M. MORTON on the south side of the Bih-Ghail wady-plain, Jebel Hagab, Oman Peninsula, Arabia (see map in HUDSON, MCGUGAN & MORTON, 1954). The algal sample occurred about 110 m below the top of the 600 m thick Ghail Limestone, a rock-unit resting on Permian limestones below and succeeded above by limestones of queried Noric age (see HUDSON 1960, for full account); the Ghail thus represents the Lower and Middle Trias, and per-

haps the lower part of the Upper Trias also. The alga has been recorded in fossil lists by ELLIOTT (1960) and HUDSON (1960). The writer is indebted to the Management of Iraq Petroleum Company Ltd., for permission to publish this account.

Description and discussion

The alga occurs in a hard grey limestone. In thin section, this is seen to consist of calcareous rubble with components of various sizes set in clear transparent calcite. A minority of ooliths and oolite-coated fragments occurs, with occasional shell fragments, foraminifera and rare echinoid spines. The algae are abundant, occurring as growths or crusts up to several mm in diameter, often broken, and showing radial thread structure; these pieces may comprise an appreciable amount of the rock (Pl. II, fig. 3). Algal growth from a foreign body is suggested by some examples. The rock may be described as a calcarenite rich in larger broken algal growths.

Preservation of detail in the algal growths is variable: in some the original dark thread structure has been destroyed or replaced by secondary calcite, in others an etched appearance to the thread detail is probably due to some form of pressure solution, analogous to that supposed for stylolite growth (Pl. I, fig. 2). Most of the growths show some form of alteration. When well preserved they show radiating systems of dark algal threads, of about 0.025 mm thread diameter, wavy in course and apparently branching, so giving an obscurely zoned or banded effect. Some threads appear to show evidence of division into consecutive cells or sections, and occasionally separate adjacent rounded cells are visible, though these must not be confused with transverse cuts in the plane of section of those other threads which are filled with white calcite.

Of described material from the Triassic elsewhere for close comparison, *Zonotrichites* (BORNEMANN 1887) from the lower part of the Upper Trias of Silesia, and *Cayeuxia* from the Middle Trias of Czechoslovakia (LE MAÎTRE 1946) are relevant, both showing growths with spaced radially-branching structure. In *Cayeuxia*, better known from higher in the Mesozoic, the threads or tubules continue closely parallel after branching, giving a more regular and close-packed appearance in section than in the Arabian fossil; moreover, *Cayeuxia* normally occurs as a species pair, with associated separate growths referable to one or other of two types differing in tubule diameter (FROLLO 1936, PFENDER 1939, ELLIOTT 1957), and this has not been seen in the present case.

Zonotrichites (BORNEMANN 1887) occurred as nodular and crust-forming growths, sometimes on pieces of molluscan shell; the thread structure appears closely similar to that of the Arabian alga. BORNEMANN compared his material in some detail with that of growths of members of the living myxophyte family Rivulariaceae, which deposit lime within the mucilage sheaths of the threads, and so form calcareous nodules. He emphasised the close similarity, and showed comparable preparations of Recent rivularians and of his Triassic nodules.

In the living Rivulariaceae (FRITSCH 1952) the apparent branching of the threads is due to a new thread originating at the side of the old, and then continuing along the original line of growth, the older thread diverging at an angle and

appearing as the branch. The threads show serial division into cells, and small separate rounded cells known as heterocysts may be common, often at the initiation of a new thread. Both of these phenomena are believed to be discernible in the best-preserved Arabian fossils, as well as the pseudo-branching (Pl. I, fig. 1; Pl. II, fig. 1, 2). However, ordinary branching, where the original thread divides into two branches, apparently occurs also.

In order to resolve this problem sections were prepared of a Recent rivularian nodule, the algae dead but the nodule not yet fossilised. This nodule was known to be formed from algae having the pseudo-branching mode of growth. It was found that where a new thread originates below an older thread (from the point of view of the observer), the appearance in section (Pl. II, fig. 5) is that of ordinary branching. Moreover, the enveloping mucilage sheaths, in which calcification takes place around the filaments, may themselves be continuous around old and new filaments (cf. the Recent *Schizothrix*). It is easy to see how changes in fossilisation would obliterate most evidence of pseudo-branching in these small structures.

It is therefore considered that the Arabian fossil is referable to *Zonotrichites*, and that BORNEMANN's views on the botanical origin of his material are confirmed and supplemented. The differences in the material from the two localities are probably due to preservation, the Arabian growths being more fragmented than the Silesian, so they are referred to the same species *Zonotrichites lissaviensis* BORNEMANN. Comparison between the two is much closer than with other Triassic myxophytes, e.g. the *Girvanella* of SCHALEKOVA (1959) or the *Sphaerocodium*-like nodules of HANAČEK (1956). The type occurrence of *Zonotrichites* is in a deposit yielding fishes, reptiles and mussels, and interpreted as fresh water; the Ghail sample is marine from the echinoid evidence. Blue-green algae, however, show enormous tolerance of both temperature and salinity, and the very shallow marine environment suggested by the matrix would not preclude their occurrence. Certain features of the Ghail suggest deposition in an evaporite environment (HUDSON 1960), and part of the range of abnormal salinities associated with this would also have been suitable for the growth of these plants. Moreover, modern calcareous nodules of the type discussed are usually formed by associations of two or three myxophyte genera and species, and this botanical detail does not survive in the calcareous structures formed, which are closely similar irrespective of the precise algae involved.

Although this type of alga usually has a very long stratigraphic range, it is interesting that the Silesian and Arabian occurrences, far apart, are at much the same stratigraphical level in the Trias; moreover, the writer has recently recognised *Zonotrichites* sp. in the Upper Triassic of Borneo.

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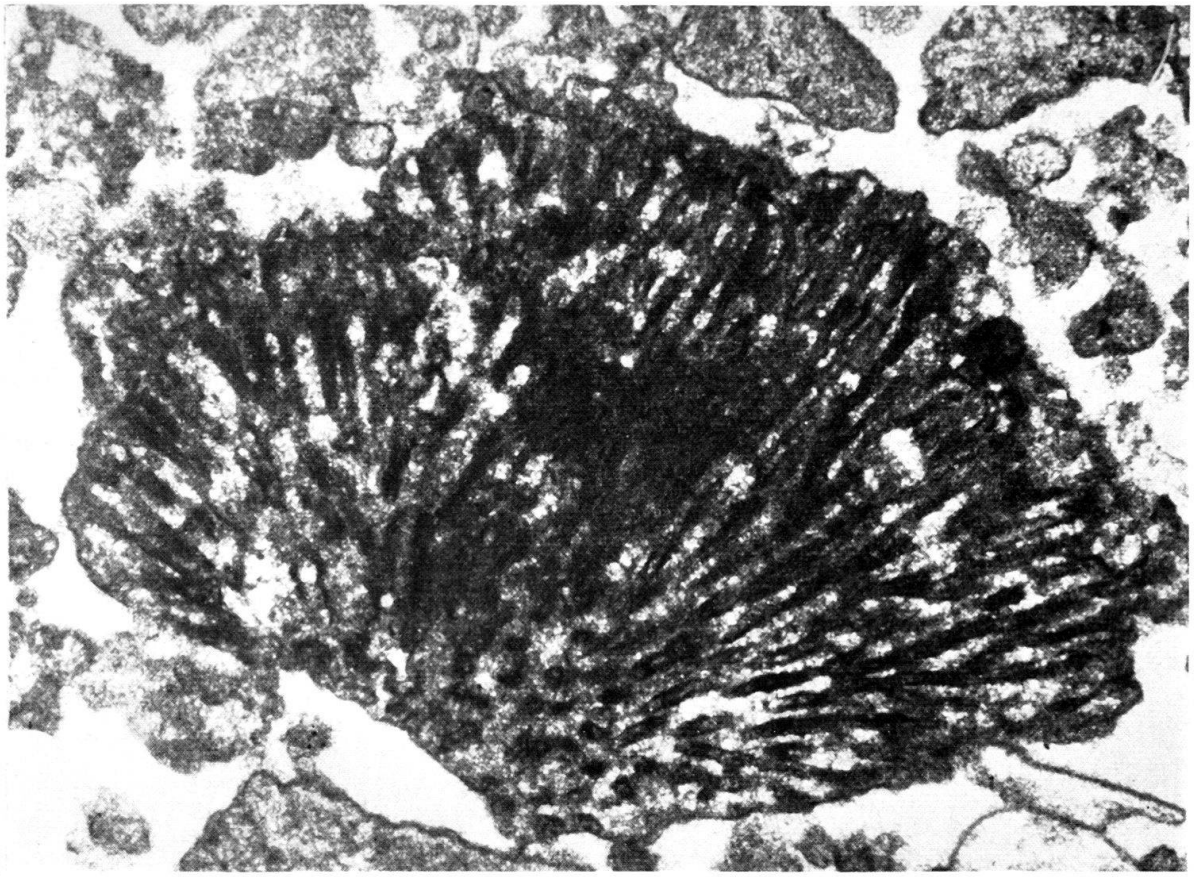
Plate I

Fig. 1. *Zonotrichites lissaviensis* BORNEMANN, thin section (× 50) of a well-preserved growth showing details of pseudo-branching and thread structure. Ghail Limestone, Middle-Upper Trias level, Jebel Hagab, Trucial Oman, Arabia. Brit. Mus. (Nat. Hist.) Dept. Palaeont. reg. no. V.51506.

Fig. 2. *Z. lissaviensis*, thin section (× 50), growth showing pressure-solution alteration of boundaries between threads and calcite. Same locality and horizon as fig. 1; reg. no. V.51508.



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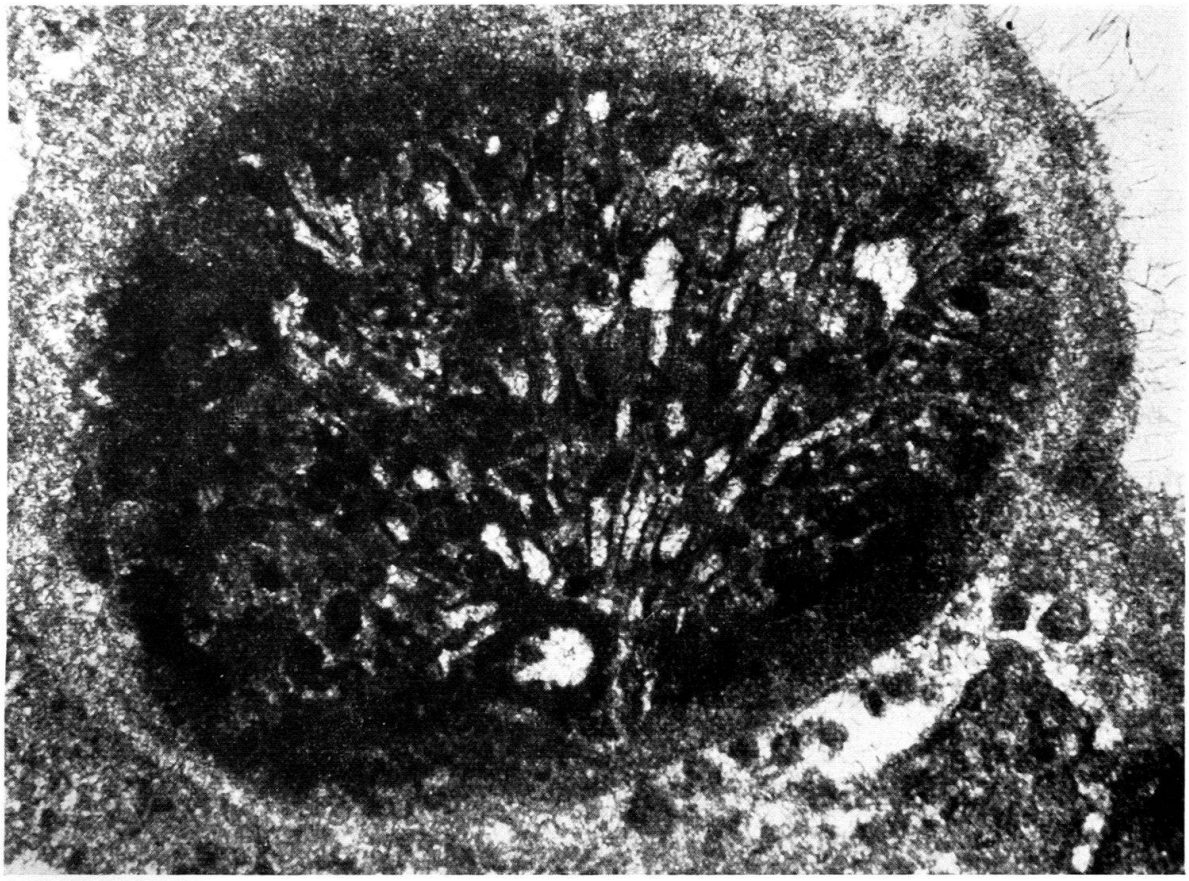

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Plate II

Figs. 1 and 2. *Zonotrichites lissaviensis* BORNEMANN, thin sections (× 50), small growths with wellpreserved thread structure. Ghail Limestone, Middle-Upper Trias level, Jebel Hagab, Trucial Oman, Arabia. Reg. no. V.51507.

Fig. 3. Limestone composed mostly of *Zonotrichites*, thin section (× 12). Same locality and horizon as figs. 1 and 2. Reg. no. V.51510.

Fig. 4. *Z. lissaviensis*, transverse thin section (× 50) of small radial growth. Same locality and horizon. Reg. no. V.51509.

Fig. 5. Detail of pseudo-branching (centre, × 200) of the dried algal threads in a Recent calcareous nodule formed by *Schizothrix*, *Rivularia*, etc. Belvedere Lake, Mullingar, West Meath, Eire. Reg. no. V.51511.

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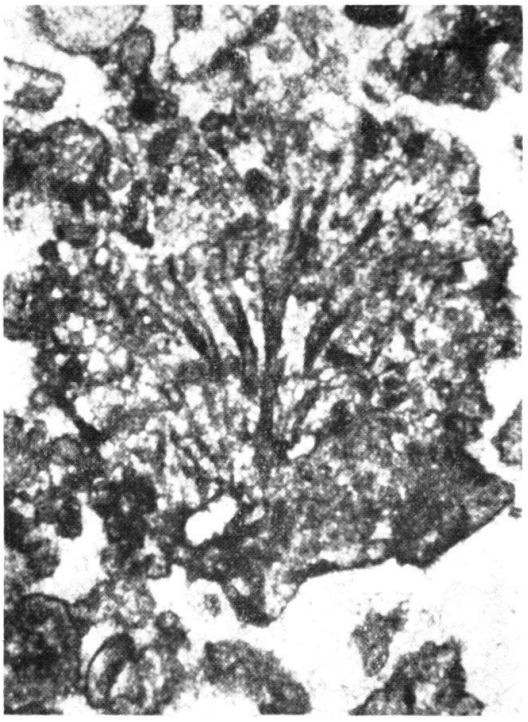

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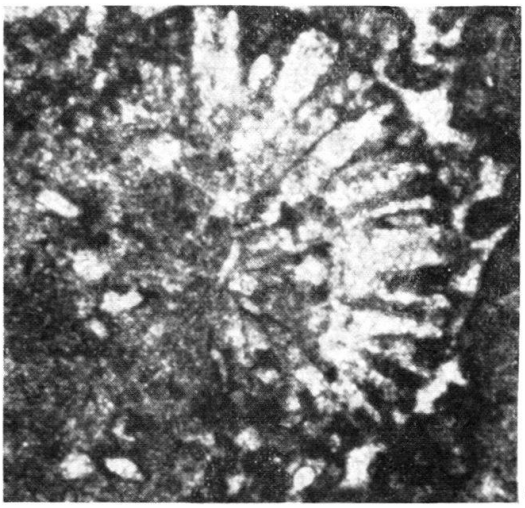

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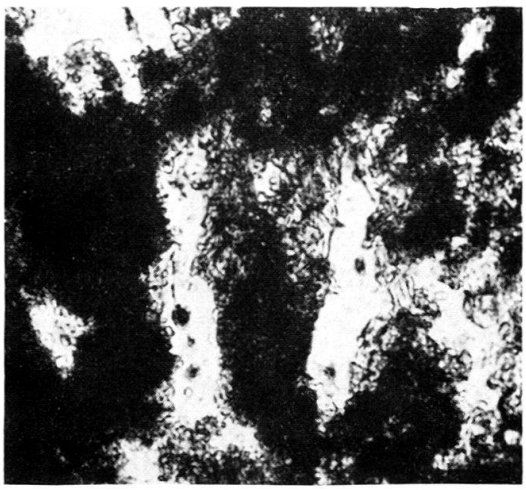

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