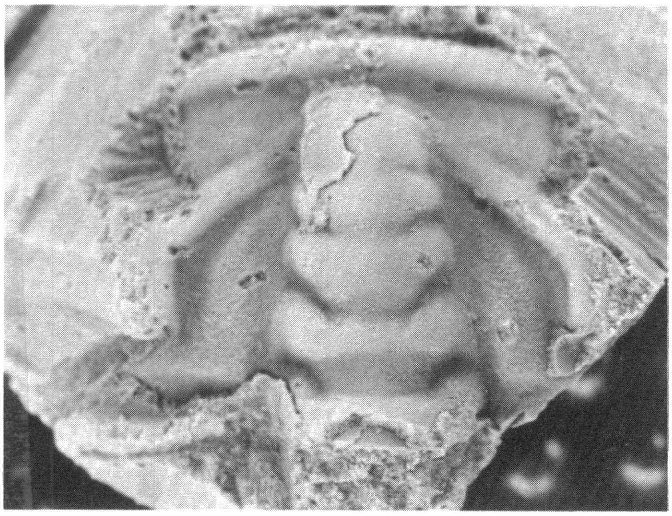

Figure 3. Photomicrograph of archaeocyathid-alga boundstone from Shackleton Limestone (sample number S-84-3D). Note archaeocyathid in upper left, *Epiphyton* alga on right, and intervening sediment and spar occluded cavity. (Scale 500 micron.)

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A new Triassic cycad from the Beardmore Glacier area of Antarctica

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The living Cycadales represent a relic group of gymnospermous plants that today include 10 genera that are restricted geographically to the tropics and subtropics. Fossil members of this order were widespread during the Mesozoic based on abundant foliage remains, and the group is believed to have originated from the late Paleozoic seed fern group Medullosales. Despite a wealth of information about the leaves of fossil cycads, details regarding the anatomy of the stems is limited to descriptions of a few small fragments. One of the most characteristic features of cycad stems is the so-called girdling configuration of the leaf traces, in which the traces to the laterals extend horizontally for some distance within the cortex before passing into the base of the petiole.

Several silicified stems which demonstrate typical cycad anatomy have been identified from plant material collected by members of the Institute of Polar Studies during the late 1960's from the Fremouw Peak locality in the Beardmore Glacier area of East Antarctica and are described in detail elsewhere (Smoot, Taylor, and Delevoryas in press). The Fremouw Formation fossils are regarded as being early-middle Triassic (Collinson, Stanley, and Vavra 1980). Because of the permineralized nature of the specimens, it has been possible to obtain a considerable amount of histologic information about these interesting plants and to consider aspects of their evolution.

The specimens range up to 3.7 centimeters in diameter and appear to represent more basal regions of the plant. The stem consists of an extensive, parenchymatous ground tissue that contains two zones of mucilage canals. The outer surface of the cortex is bounded by a periderm (figure 1). The vascular system consists of a ring of endarch vascular bundles separated by large rays (figure 2). Secondary tissue development is present in the Fremouw specimens and consists of a small amount of secondary xylem tracheids that exhibit circular bordered pits, cambium, and phloem zone containing sieve cells with elliptical

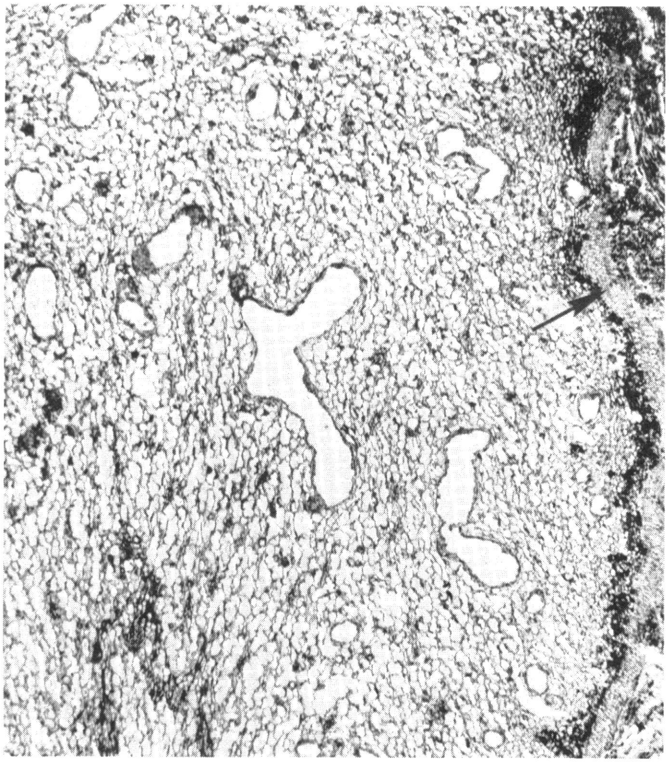

Figure 1. Transverse section of cycad stem showing parenchymatous cortex with mucilage canals (clear areas). Arrow indicates position of outer limiting periderm. [587-5 (SR-4a) × 21.]

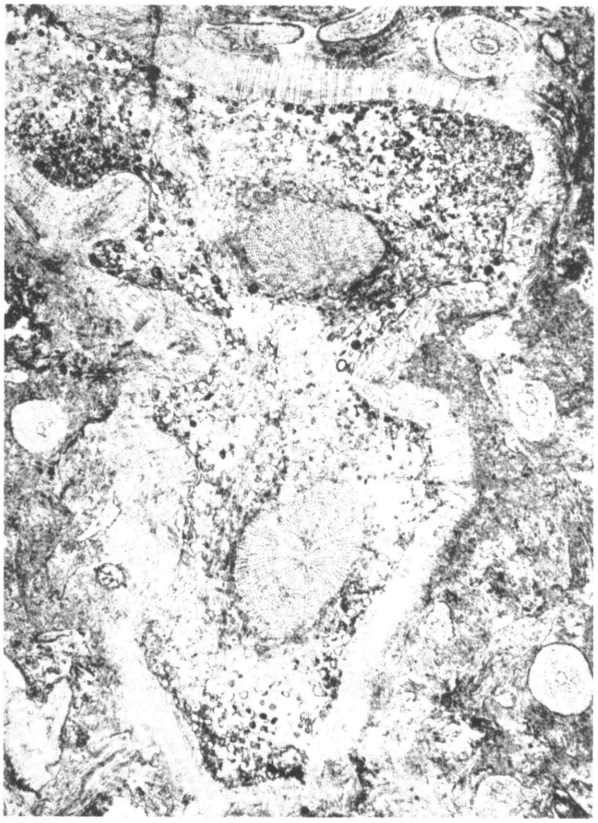

Figure 3. Dichotomizing root bounded by zone of periderm. [568 B (T-2-a) × 10.]

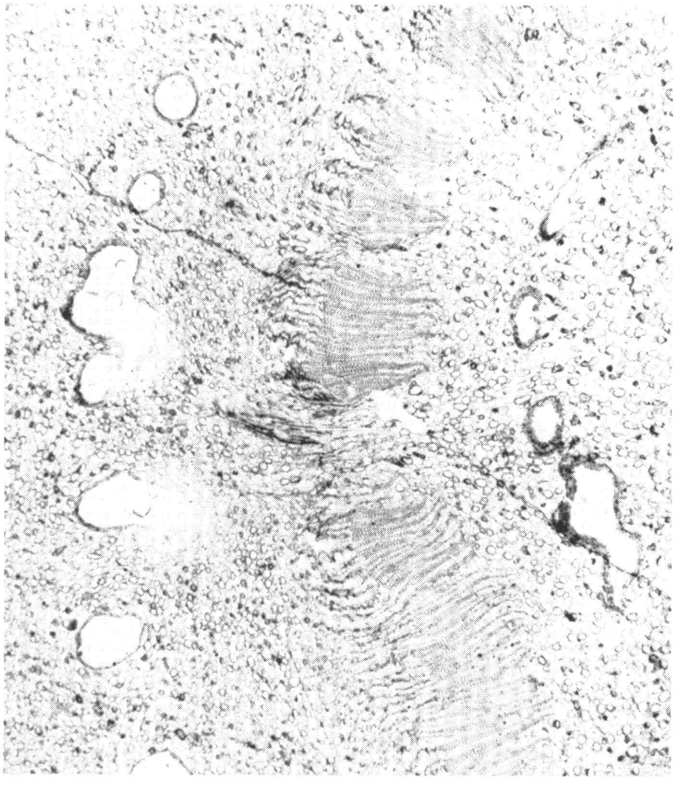

Figure 2. Partial transverse section of stem showing inner and outer mucilage canals and ring of vascular bundles (center) separated by vascular rays. [568 B-1B (T-20-b) × 18.]

sieve areas. Traces to the laterals connect with both the primary and secondary vascular tissues and may extend directly to the periphery of the stem or demonstrate the girdling trace configuration that is characteristic of members of the Cycadales. None of the Fremouw specimens contain leaf bases; rather the stems are regarded as being more basal regions of the plant because of the presence of diarch-polyarch roots (figure 3).

Despite the antiquity of the Cycadales, there is relatively little information available about the stem anatomy of these plants. To date only two cycadalean stems have been described from sediments of Triassic age. *Michelilloa* (Archangelsky and Brett 1963) is a silicified specimen from Argentina consisting of a narrow vascular cylinder interrupted by vascular rays. The surface of the stem contains filamentous hairs and persistent leaf bases. Girdling leaf traces and mucilage canals in the pith are two of the features used to associate the Triassic genus *Lyssoxylon* with the Cycadales (Gould 1971). All of the structurally preserved cycad stems including the Tertiary genera *Borora* (Archangelsky, Petriella, and Romero 1969) and *Menucoa* (Petriella 1969) are remarkably similar anatomically to modern cycads. The specimens from Antarctica currently represent the oldest anatomically preserved cycad stems. The similarity of anatomical features shared by the Triassic and extant forms suggests a relative evolutionary stasis within the Cycadales, at least as can be determined from the analysis of vegetative features. The validity of this assumption will be tested if the reproductive organs of the antarctic cycads are subsequently discovered.

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Fossil fungi in antarctic wood

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Silicified specimens of gymnospermous wood collected from two localities near the Beardmore Glacier illustrate a type of fungal decay that is seldom found in the fossil record. The fossil specimens occur at two localities that have provided numerous silicified plant organs in which histologic details are exceptionally well preserved. One site is located at Fremouw Peak within the Upper Beacon Supergroup and is regarded as Triassic in age (Barrett 1970). The second locality is considered to be middle or late Permian and is located at Mount Augusta (Schopf 1970).

Specimens of *Araucarioxylon*-type wood (figure 1) and axes of *Vertebraria* (figure 2) possess numerous perforate areas that are the result of extensive fungal activity. In transverse section, the decayed areas (pockets) appear circular-irregular in outline (figures 1 and 2); in longitudinal section these areas of disrupted tissue are somewhat spindle-shaped. Individual pockets may be uniformly scattered throughout the stem or may be restricted to a narrow zone.

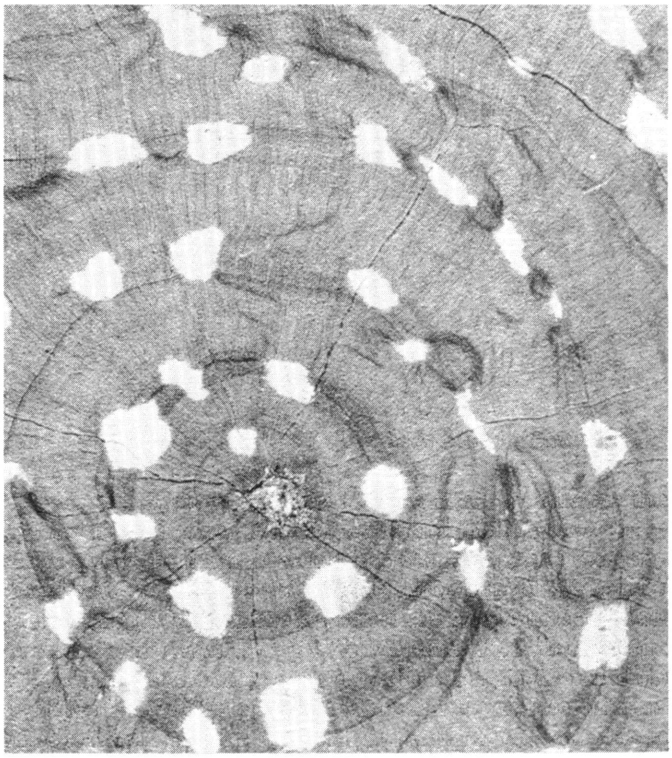

Figure 1. Transverse section of *Araucarioxylon*-type wood with numerous pockets of decay. (× 8.)

Fungi are represented by vegetative hyphae (figure 3A) that may be present in the pockets, as well as in tracheids and ray parenchyma cells. Hyphae are branched, septate, and possess both simple and medallion clamp connections. They pass through both radial and tangential walls of infected cells, as well as through pits. In addition to cavities which typically show no evidence of cell remnants, other areas of the wood show varying degrees of cell-wall modification that are associated with fungal activity. In these areas it has been possible to follow the sequential destruction of cell-wall components. In some cells, swollen and separating wall layers are evident while in others, individual cells are represented only by the thickened middle lamellar regions in the corners between adjacent cells. The cells in other regions often possess highly elaborated secondary walls which resemble wall appositions in extant plants and often nearly occlude the cell lumen (figure 3B).

When compared with the activities of modern fungi, the pattern of these woods in Antarctica is similar to extant white-pocket rots that are caused by members of the Basidiomycotina (e.g., Blanchette 1980-a, 1980-b; Otjen and Blanchette 1982). Research currently in progress focuses on an analysis of the decay process in a number of fossil plants from Antarctica. This type of study may provide indirect evidence for the presence of certain types of fungi in the fossil record and, at the same time, offer clues that help explain evolutionary changes in fungal biology.