the central area of the anvil increased markedly (Fig. 4C). The maximum birefringence increased from the initial 6×10^{-5} to 6×10^{-3}. The lower diamond showed no visual indication of flow or other deformation. Its strain birefringence was unchanged.

In addition to the 1.72-Mbar experiment, Table 1 lists details of experiments in which the maximum pressures were 1.36, 1.43, and 1.55 Mbar. These experiments were terminated because of sudden failure of one of the diamonds in each instance. Although diamond failure appears to be a random process, the fact that one of the diamonds used in the 1.72-Mbar experiment did not flow or fail suggests that it may be possible to generate pressures higher than this.

The pressure of 1.7 Mbar is the highest sustained static pressure ever achieved experimentally. This maximum pressure is almost 3.5 times higher than the highest pressures reported by other laboratories in which continuous internal calibration was employed (*7*). The depth in the earth that corresponds to a pressure of 1.7 Mbar is approximately 3000 km (*8*) and is within the earth's core. The techniques described here can be applied to geophysical problems under conditions simulating those of the core-mantle boundary, as well as to a wide range of physical or chemical experiments on the nature of matter.

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Chytrid-Like Fossils of Pennsylvanian Age

Abstract. *Chytrid-like fungal sporangia are described occurring in saccate pollen grains of Pennsylvanian age. Both endo- and epibiotic sporangia are present, and may exhibit discharge papillae and a coarse rhizomycelium. Sporangial features, choice of substrate, and the presence of a light refractile body in presumed zoospores suggest relationships with the Chytridiales.*

There are a number of aquatic fungi that possess a reduced thallus and motile spores or gametes. In these forms the fungal thallus ranges from one to several cells which may be endobiotic or epibiotic relative to the substrate. Saccate pollen grains like those of the Pinaceae are a common food source for many of these types.

We describe here several morphological forms of aquatic fungi that occur in Pennsylvanian age cordaitean pollen grains of the genus *Sullisaccites* (*1*). We recovered the infested pollen grains from the calcium carbonate matrix of the coal ball permineralization using dilute (2 percent) hydrochloric acid (*2*). The fossil remains consist of sporangia that occur either on the surface (epibiotic) or within (endobiotic) the central body of the saccate pollen grains. In the endobiotic form the sporangia are globose and occupy the majority of the central body lumen of the pollen grain (Fig. 1, A and C). These sporangia vary from 20 to 25 μm in diameter, and, because of the presence of numerous folds in the pollen grain sporoderm, we have been unable to discern a rhizoidal system in this form. The apparent absence of specific discharge papillae may indicate that these sporangia are immature. The majority of sporangia of this type contain numerous irregularly shaped dark bodies (up to 2.5 μm in diameter) that undoubtedly represent unicellular zoospores. The preservation of such delicate structures as zoospores in rocks of Pennsylvanian age should not be regarded as unusual since numerous examples of subcellular preservation are well documented (*3*). Presumed zoospores frequently have a light refractile area centrally (Fig. 1A). The light refractile bodies within these planospores may represent the remains of oil droplets, a central vacuole, or the granules known for most aquatic motile fungi. Refractile granules are especially characteristic of zoospores in the Chytridiales (*4*).

Several forms of epibiotic sporangia also occur on pollen grains from the same sample. In one example the globose sporangium possesses several discharge papillae apically (Fig. 1E, small arrows) but contains little evidence of zoospores. The rhizoid is swollen at the base of the sporangium and resembles an irregularly shaped apophysis (Fig. 1E, large arrow). Rhizoids are approximately 3 μm in diameter, and a portion of the rhizoidal system appears to terminate at the bases of two neighboring sporangia.

A second epibiotic sporangium type is characterized by laterally located discharge papillae (Fig. 1D, arrows). In this specimen the sporangium appears to have grown out through the wall of the pollen grain air sac. In both this specimen and the epibiotic sporangium (Fig. 1B), it was not possible to locate the endobiotic rhizoidal system. It is surprising that discharge papillae are absent on the sporangium in Fig. 1B, since it contains a prominent mass of zoospores. Although exit papillae in some extant forms may not appear until shortly before spore release, it seems likely that this sporangium is an operculate type and lacks exit papillae. This form may constitute a developmental stage of the two previous types or may represent still another distinct species.

It is impossible to determine exactly the systematic relationships of these zoosporic fossil fungi. The simple morphology of the thallus is chytrid-like, but this feature is present in some members of at least five orders of extant fungi. The number and position of the zoospore flagella is the single criterion that is most important in establishing relationships among extant Phycomycetes (*5*), and we have not determined this feature for these fossils. It is also useful in extant aquatic fungi to observe the sporangium development, including formation of zoospore discharge structures, and the zoospore emergence and swimming habit. The presence or extent of a rhizoidal system is quite difficult to establish for extant fungi grown on pollen grains and has also been difficult to observe in the fossils.

Morphologically, sporangia of the endobiotic form appear holocarpic and monocentric, and they lack prominent discharge papillae. These features are characteristic of some members of the Chytridiales (Olpidiaceae), Hyphochytriales (Anisolpidiaceae), Lagenidiales (Olpidiopsidaceae, Lagenidiaceae), and Saprolegniales (Ectrogellaceae) (*6*). The epibiotic fossil forms appear to be eucarpic and either mono- or polycentric, and in this regard appear most similar to some families within the Blastocladiales

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(Blastocladiaceae), Chytridiales (Cladochytriaceae, Rhizidiaceae), Hyphochytriales (Rhizidiomycetaceae), and some problematical biflagellates (Thraustochytriaceae).

We believe that these fossil remains are most likely to have affinities with the Chytridiales, because of the thallus morphology evident and because pollen is a common substrate in that order, more so than in other chytrid-like biflagellates. We believe these fossil sporangia display too much variability to be considered natural forms or developmental stages of a single taxonomic entity. It has been demonstrated, however, that chytrid sporangium morphology and size may change, depending on the substrate and environment (*7*).

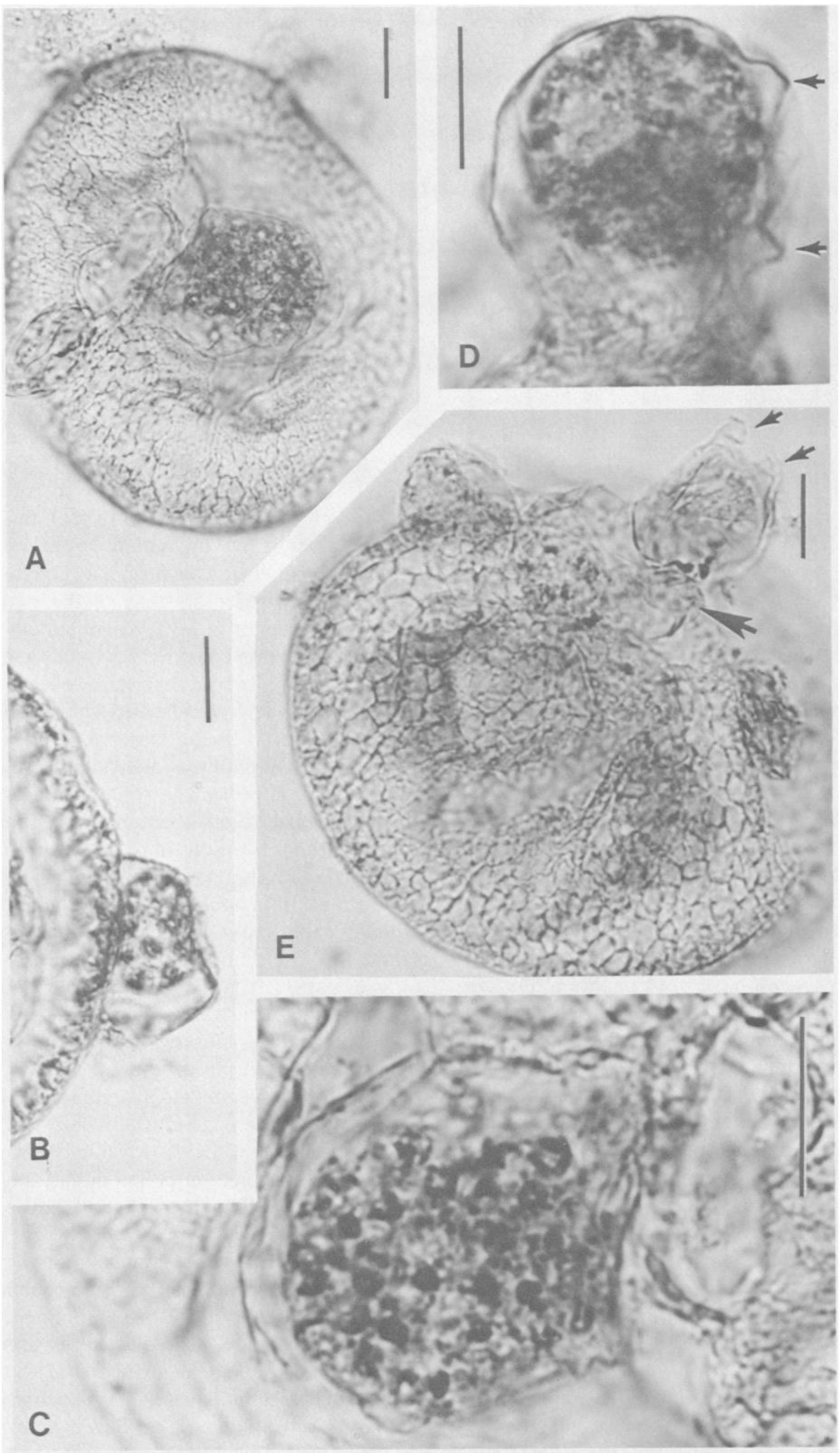

Fig. 1. Fossil zoosporic fungi infesting pollen grains of Pennsylvanian age. (A) Endobiotic sporangium showing refractile bodies in zoospores. (B) Epibiotic sporangium. (C) Detail of zoospores of sporangium within the central body of pollen grain. (D) Epibiotic sporangium extruding from the air sac wall, showing the lateral position of discharge papillae (arrows). (E) Epibiotic sporangia connected by rhizomycelium. Small arrows indicate the position of discharge papillae. The large arrow indicates sporangial apophysis. Scale represents 10 μm.

Many presumed fossil phycomycetes reported to date consist of septate or nonseptate hyphae bearing terminal swellings that resemble chlamydospores (*8*). Some of these remains resemble the mycelia of the Peronosporales, but the mycorhizal habit of many of these fossils suggests instead that they are imperfect stages of ascomycetes. Far less is known about fossil chytrids and chytrid-like organisms. Possible reports of fossil chytrids consist of borings in a calcareous, chitinous, or phosphatic matrix without organic remains (*9*), a variety of structureless spots on leaves (*10*), spherical thick-walled structures thought to represent resting sporangia present in the matrix (*11*), or tissues of other organisms (*12*). None of these remains appears similar to the fossil fungi we have described, and it is significant that previously reported remains are not associated with pollen grains.

Within recent years paleobiologists have become increasingly aware of the existence of many forms of fungi as important components of the fossil record. Despite a long and diverse geological history, detailed studies of fungal organisms are almost unknown. This scarcity of information for many groups reflects the generally small and fragile nature of the organisms and the short-lived duration of many features of the life cycle. For example, the discovery and report of *Palaeancistrus* (*13*) demonstrates the existence of the basidiomycetes in Pennsylvanian time, based on the diagnostic features of the mycelium. Of potentially great significance is the report of an ascomycetous fruiting body (*14*) produced by a *Palaeancistrus* mycelium. Although one might dispute the biological identity of these two organ genera, the potential phylogenetic importance of this discovery constitutes the first significant paleobotanical contribution to understanding the phylogeny of major groups of fungi.

Although there are other reports of chytrid-like organisms in the fossil record, we believe that the material described here is the most convincing evidence assembled to date that establishes the presence of modern chytrid-like forms as early as Pennsylvanian time. The existence of well-preserved Phycomycetes in rocks of Carboniferous age provides the potential impetus upon which the origin and subsequent evolution of this widespread group of organisms may be better understood.

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Mummy of the "Elder Lady" in the Tomb of Amenhotep II: Egyptian Museum Catalog Number 61070

Abstract. *An unidentified female mummy found in a cache of great kings and queens in 1898 in the Valley of the Kings was examined from the viewpoint of Egyptology, x-ray cephalometry, biostatistics, and biochemistry. The result was the identification of Queen Tiye, of the Eighteenth Dynasty, wife of Amenhotep III and mother of Akhenaton.*

In 1912, Elliot Smith (*1*) described from the viewpoint of an anatomist the mummified remains of the kings and queens of the New Kingdom of Egypt (1575 B.C. to 1070 B.C.). Their mummies had been deposited in two hiding places at Thebes; the first cache, discovered in 1881, was in the reused tomb of the early Eighteenth Dynasty Queen Inhapy at Deir el-Bahari, and the second find, made in 1898, was in the tomb of King Amenhotep II of the middle Eighteenth Dynasty. From these two caches were recovered the mummies of most of the kings of the New Kingdom and a number of the queens. The mummies had been hidden in these two tombs about 3000 years ago after robbers had plundered the original tombs of the kings and queens in the Twentieth Dynasty. During the Twenty-first Dynasty, these mummies were collected and restored or rewrapped, since for the most part they had been badly damaged by tomb robbers looking for treasures placed on the mummies beneath the wrappings.

In a number of cases no identification whatsoever was found on the wrappings or coffins of these mummies. This should not be completely surprising since the grave robbing had occurred over a long period of time, and the royal mummies, after having been badly damaged at the hands of the grave robbers, had been moved from place to place for safety. The priests of the Twenty-first Dynasty were rewrapping mummies some of which were even then as old as 500 years (*2*).

Some of the royal mummies' identities are therefore in question; perhaps none is more intriguing than that of No. 61070, titled by Smith "The Elder Lady in the tomb of Amenhotep II" (*1*, p. 38). He describes her as "a middle aged woman with long (0 m. 30 cent), brown wavy, lustrous hair . . . the left hand was tightly clenched, but with the thumb fully extended: it is placed in front of the manubrium sterni, the forearm being sharply flexed upon the brachium" (Fig. 1).

One of us (E.F.W.) has suggested that the unique position of the arms of this lady indicated that she was of great importance and was perhaps Queen Hatshepsut or Queen Tiye. The former queen had indeed ruled Egypt as a pharaoh and had assumed the titles and raiment of a king as depicted in temple scenes and in statuary after the death of her husband Thutmosis II and during her coregency with her stepson Thutmosis III, who had been born to Thutmosis II by a minor queen. Queen Tiye was the beloved wife of Amenhotep III and mother of the heretic pharaoh Amenhotep IV who changed his name to Akhenaton. Her importance during her husband's reign and the reign of her son Akhenaton was reflected in statuary, inscriptions, and reliefs in temples and tomb chapels. She was even involved in diplomatic correspondence with heads of foreign states. Representations of a queen illustrate a similar arm position to that of the mummy 61070 (Fig. 2).

Since 1967, the University of Michigan, together with the Egyptian Department of Antiquities, has been conducting an investigation of the royal mummy collection in the Egyptian Museum in Cairo. In order to expand the studies of Smith, whose observations had necessarily been limited to visual examinations, the Michigan team used a radiographic approach, which was in fact suggested by Smith in 1912. Not only were conventional full body x-rays obtained from the ventral position, but also cephalometric or specially oriented, lateral head plates were obtained. The cephalograms are similar to those obtained in the orthodontist's office, and they permit the comparison of measurements between one cephalogram and another. A special cephalometer, developed by one of us (A.T.S.), uses an optical orienting device which directs the central x-ray beam through porion (the ears), where conventionally it is accomplished mechanically with ear rods. The delicate condition of the mummies and the fact that most of their ear openings are plugged with resin necessitated the development of the optical approach.

By the early 1970's, the University of Michigan had surveyed radiographically the entire Egyptian Museum collection of Royal Mummies. The mummy of the "Elder Lady," however, was not in the collection, to the dismay of the research team. One of us (I.E.N.) traced the mummy back to the Valley of the Kings and a side chamber in the tomb of Amenhotep II. In 1975, permission was received from the Egyptian Department of Antiquities to open this side chamber, and the mummy was fully examined by x-rays. These x-rays revealed that the mummy was indeed that of a woman in