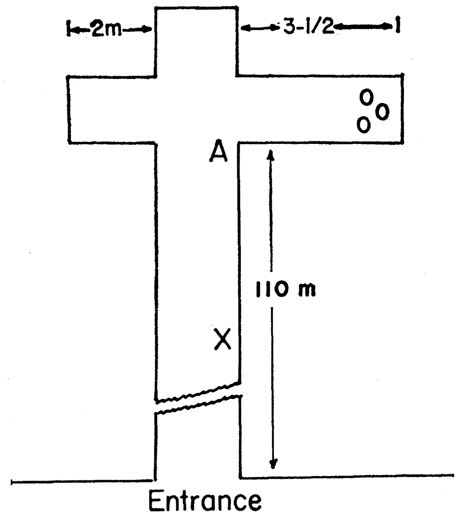

Fig. 7. Diagram of a tunnel in Nagasaki. *A*, subject interviewed; *X*, casualty; *O*, uninjured persons.

ter of the bomb impact (Fig. 7). The shelter did not have a baffle wall protecting the entrance although material had been acquired for that purpose. Subject A was standing with her back toward the entrance when the explosion occurred. She was knocked over by the blast and was burned on the back of the legs and on the upper part of the right arm. The scars remaining from the burns had the appearance of dark brown blotches such as might result from burns inflicted by hot sparks. Subject A had been wearing cotton slacks of a dark green color, which she had rolled up above her knees, and a sleeveless shirt. No burns were inflicted on any part of her body that was covered by clothing. She stated that she suffered no ill effects other than the burns. Persons working in the 12-ft (3⅔-m) T-section of the tunnel suffered no injuries. A woman working at spot *X* (Fig. 7) was facing the entrance and was burned on the face, arms, and upper part of the chest, but she recovered and suffered no aftereffects. All of the persons outside of the shelter died as a result of severe burns.

Subjects B, C, and D, with about 20 other persons, were working on another shelter, located in a steep earth bank 50 to 60 ft (15 to 18 m) high, about 600 yd (550 m) directly west of the center of the bomb impact. They were working in shifts of eight persons inside the shelter, with the rest outside at the time of the explosion. The layout of the shelter and the location of the persons in it at the time of the explosion are indicated in Fig. 8. Subject B, who was in charge of the group, was thrown backward against the wall of the tunnel and stunned for a brief time, but suffered no burns or other injuries. As soon as he was able, he went to investigate the condition of the people outside and found all of them badly burned. Some of them had been able to walk or crawl into one of the shelter entrances. Realizing that he could do nothing for them, he went back into the shelter to do what he could for those inside. (All the persons outside the shelter either died instantly or within a 2-day period.) Subjects C and D were both knocked over by the blast and stunned for a short time. The only possible manifestation of radiation effect suffered by subject C was gingivitis (bleeding of the gums). Subject D was reported as having suffered no ill effects. The persons whose locations are indicated by *X* (Fig. 8) were burned on the back, and some swelling was noted, but both of them have recovered with no apparent ill effects. The persons whose location is indicated by *O* suffered no injuries. All of the subjects saw a flash and indicated that the blast was very hot. When they attempted to go out of the shelter, the whole area was enveloped in a black or gray smoke through which they could see flames shooting high into the air.

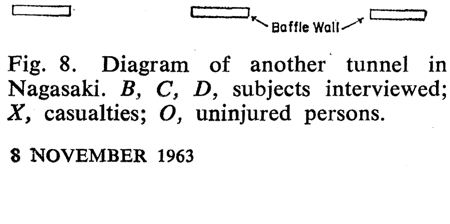

Fig. 8. Diagram of another tunnel in Nagasaki. *B, C, D*, subjects interviewed; *X*, casualties; *O*, uninjured persons.

It was the opinion of the subjects interviewed and of civilian defense officials questioned that if the people had taken the proper position in these two tunnel shelters—not in the entrance—most of them would have suffered little or no injury.

This report has been presented to emphasize the need for immediate reaction to adequate warning systems and proper safety measures in case of nuclear attack. The injuries, the effects of fallout or residual radiation—in fact, all the tragic aftereffects—have been well described in numerous studies and releases published since 1945. Perhaps the mounting volume of such information has developed in the public a sense of inadequacy and a fatalistic attitude regarding the need for civil defense. Still, thousands of people did survive in Japan, and many more would have lived if proper warnings had been given and acted upon.

I believe in the necessity of achieving the most reliable and accurate warning system that can be devised, and in generating the complete confidence, cooperation, and response of the populace to this system. Irrespective of the protective measures devised, the shelters prepared and identified, and the instructions issued, the immediate and unquestioning compliance of the individual with safety procedures will be the greatest factor in survival. The achievement of this end must be one of the most important concerns of our age.

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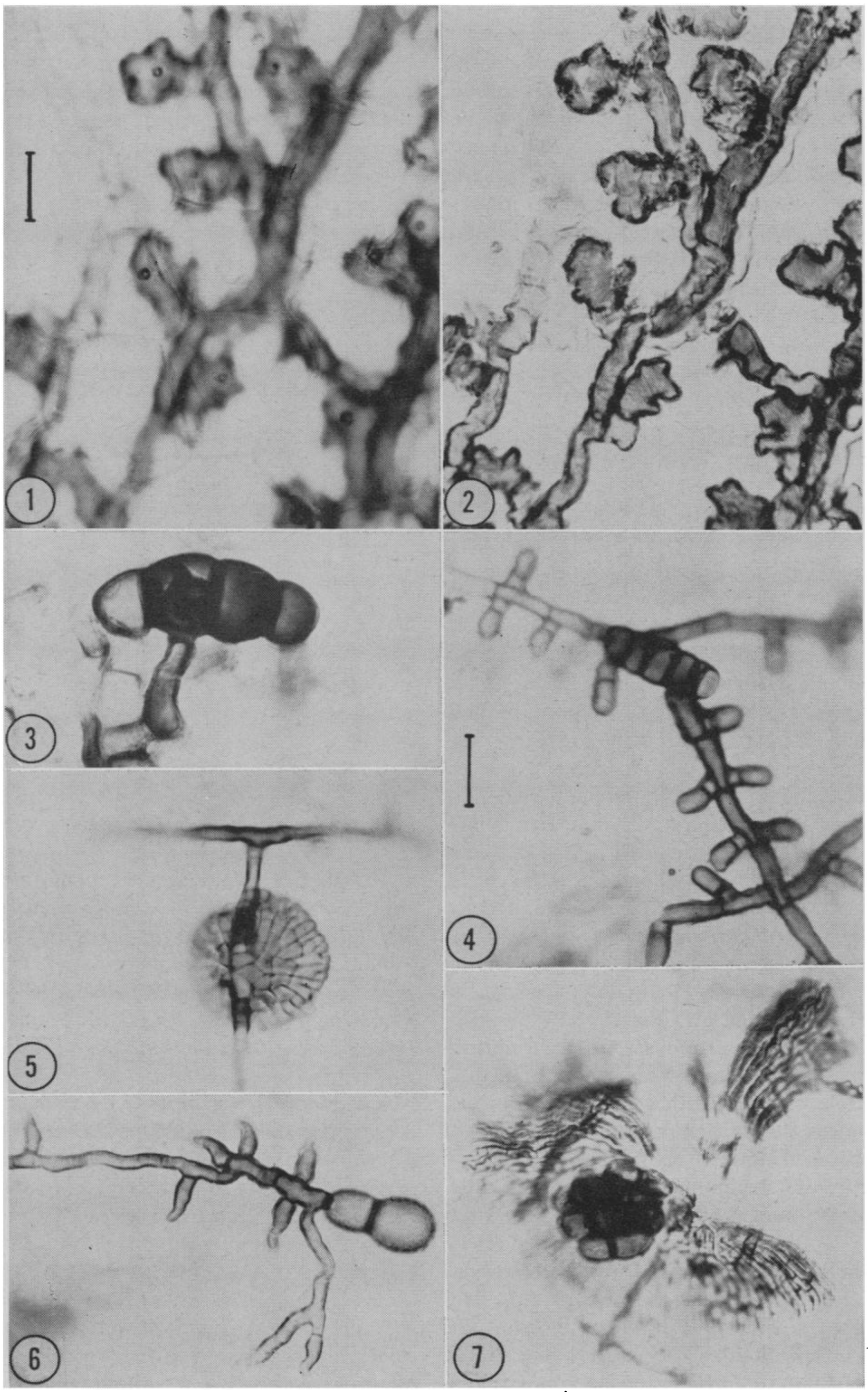
15 August 1963

Eocene Epiphyllous Fungi

Abstract. *Fossil fungi belonging to the Meliolaceae and Microthyriaceae were found in Eocene deposits in Tennessee. Germinated spores for each form of fungus were identified. One of the two forms of the genus* Meliola, *(Meliolaceae) appears to have parasitized the leaf upon which it grew. The vegetative, sexual, and asexual reproductive structures are preserved in a member of the genus* Asterina *(Microthyriaceae). The discovery of these fungi indicates that Western Tennessee was warm and humid during the Eocene.*

Fossil leaves from lower Eocene clay deposits in Tennessee contain epiphyllous fungi, including members of the families Meliolaceae and Microthyriaceae. This is the first record of these families from fossil deposits in the Western Hemisphere. Both have previously been found in Eocene deposits in Germany (*1*) and Scotland (*2*) and in Oligocene-Miocene deposits in Australia (*3*). The Meliolaceae and Microthyriaceae are now widespread throughout the world. The discovery of these fungi in Tennessee indicates that the rarity of the Meliolaceae and Microthyriaceae in the fossil record of the New World is probably due to lack of preservation rather than to absence from the fossil flora. The fungi were found on well-preserved leaves that were removed intact from the surface of broken pieces of clay, cleared in a 5 percent solution of potassium hydroxide, and mounted on slides for examination (see Figs. 1–7).



Figs. 1–7. Fossil fungi. Fig. 1. Mycelia and hyphopodia of *Meliola*, produced by the germinating spore shown in Fig. 3, in low focus showing pores in the epidermis of the leaf. Scale, 17 μ (× 600). Fig. 2. The mycelia and hyphopodia of *Meliola* shown in Fig. 1, in high focus (× 600). Fig. 3. Germinating spore of *Meliola* (× 600). Fig. 4. Germinating spore of *Meliola* showing hyphae and hyphopodia. Scale, 25 μ (× 400). Fig. 5. Immature fruiting body (probably pycnidium) of *Asterina* (× 600). Fig. 6. Germinating ascospore of *Asterina* showing hyphae and hyphopodia (× 600). Fig. 7. Mature ascocarp of *Asterina* containing a cluster of ascospores (× 400).

Two forms of the genus *Meliola* were found. The only other fossil member of this genus was reported by Köck (*1*) in 1939. He found the fossils in German Brown Coals, which are also of Eocene age. Thus the Meliolaceae, as represented by the genus *Meliola*, had a widespread distribution during the Eocene and must have had an early association and development with the angiosperm floras of the world.

The basis for distinguishing two forms of the genus *Meliola* is the difference in the size, shape, and septation of their ascospores and the arrangement and shape of their hyphopodia. One form has a 4-septate (five-celled) spore (Fig. 4) which characteristically develops a two-celled hyphopodium directly from one of its terminal cells; the other form (Fig. 3) has a 3-septate (four-celled) spore which does not produce a hyphopodium directly. Capitate hyphopodia are produced by the mycelia of both forms; one produces alternately arranged hyphopodia (Fig. 2) while the other form produces oppositely arranged hyphopodia (Fig. 4). In the form produced by the spore shown in Fig. 3 pores on the lower surface of the hyphopodia correspond to pores in the epidermis of the leaf (Figs. 1 and 2). These pores are surrounded by a thickened wall formed by the parasitic organism around each area of invasion in the host leaf. Thus haustoria which are common in the modern *Meliola* (*4*) were also present in this fossil form.

In the family Microthyriaceae fungi belonging to the genus *Asterina* were found (several other genera belonging to this family were also found, some of which are shown on the cover of this issue). This is the first fossil record of this genus. Cookson (*3*) described some fossil fungi similar to the modern *Asterina* for which she established the new genus *Asterothyrites*. The new genus was proposed for forms in which the ascospores are unknown. In the fossils I am discussing, I found a few two-celled germinating ascospores attached to hyphae which they produced (Fig. 6) and which in turn produced hyphopodia. No pores are present in them, nor is there any indication of infection on the host leaf. A series of growth stages in the fossil material shows the development of the fruiting bodies.

Growth of fruiting bodies was initiated by mycelial cells, which divided to form a group of cells between the leaf surface and the mycelia. These cells grew radially and the marginal cells bifurcated, thus increasing the number of radiating rows of cells as the fruiting bodies grew in diameter (Fig. 5). No well-defined ostioles were present, but at maturity fissures developed radially in the fruiting bodies and groups of cells often broke away from the center (Fig. 7), allowing the spores to escape.

Two distinct groups of fruiting bodies can be distinguished in this form of *Asterina* on the basis of size. In one group the diameter of the fruiting bodies ranges from 36 to 42 microns; in the other group (Fig. 7) (in which ascospores have been found) it ranges from 100 to 210 microns. No pycnidiospores were found in association with the smaller fruiting bodies, although several of the smaller bodies had split open and hence were mature. In modern forms of *Asterina* pycnidia identical with mature ascocarps, except for their diminutive size, are present (*5*). Hence the smaller fruiting bodies of the fossil may be pycnidia. Thus both asexual fruiting bodies (pycnidia) and sexual fruiting bodies (ascocarps) are present in this fossil form of *Asterina.*

As this study continues several presently little known or unknown fungi will be added to the fossil record. As various morphological forms of the life cycles of these fossil epiphyllous fungi are found they and their often isolated parts can better be related to the modern groups to which they belong. Because of the preliminary nature of this report, species names have not been assigned to these fossils (*6*).

Meliola and *Asterina* are presently distributed around the world but are most abundant in warm, humid areas. Thus this discovery of these two genera supports the theory proposed by E. W. Berry (*7*) that the vegetation of the Mississippi embayment in Tennessee during the Eocene reflects the influences of a humid, subtropical climate.

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5 August 1963

Equatorial Undercurrent and Related Currents off Brazil in March and April 1963

Abstract. *In 1963, the source of the Equatorial Undercurrent appeared to be near 38°W. This undercurrent was an equatorial extension of a narrow saline current setting east-southeast at the surface near 2°N 42°W. Near 38°W, a retroverse branch of the Guiana Current also joined the Equatorial Undercurrent. Surface flow was easterly along all of the east-southeast current and the undercurrent observed. The subsurface-velocity maximum of the undercurrent was higher at 35°W than at 38°W.*

Observations taken off northeastern Brazil during March and April 1963 (*1*) indicate the westernmost position of the Equatorial Undercurrent on the Equator in its typical form and clearly delineate the currents which lead to that location. These observations, consisting primarily of closely spaced measurements of temperature and salinity and measurements of current on the Equator by means of parachute drogues (*2*), were apparently the first specifically designed for the investigation of the Equatorial Undercurrent and related currents off Brazil. Many valuable confirmations were provided from the less accurate indications of current by departures from dead reckoning and by the behavior of the hydrographic wire.

Among the distinguishing characteristics of the Equatorial Undercurrent in the Atlantic listed by Metcalf *et al.* (*3*) and by Montgomery (*4*) are a subsurface eastward velocity maximum and a high maximum salinity (near the velocity maximum) in the upper thermocline very close to the Equator. These characteristics were observed in 1963 as far west as 37°W (see Figs. 1 and 2) and existed probably up to 38° or 39°W. But at 40°W, the drogues showed a surface current of 2.7 km/hr (1.5 knot) west-northwest, the Guiana Current, and virtually no current at 100-m depth. However, eastward flow may have been present below 100 m. At 42°W, the slopes of isosteres in the vertical section (Fig. 3) do not show that the Equatorial Undercurrent was present on the Equator, and the maneuvering necessary to maintain a small wire angle at the station on the Equator indicated a surface current to the northwest, the Guiana Current.

The Equatorial Undercurrent appeared as an extension of a surface current setting mainly east-southeast, which entered the region of observation between 1° and 3°N, as Fig. 1 shows. Since it has no appropriate name, this current will be referred to as the ESE current. At the westernmost line, it is clearly indicated to depths exceeding 300 m from the slope of isosteres given in Fig. 3. The current was characterized by a high salinity maximum (Fig. 2) between 60 and 90 m where the water temperature was 22.5° to 25.5°C. To the south, it was separated from the Guiana Current by a small region of low maximum salinity. To the north, the northern branch of the South Equatorial Current was distinguished by low maximum salinity.

Neumann's (*5*) chart of geostrophic surface currents shows the ESE current. The chart is based on data taken at all seasons over a period of many years until 1946. Such a chart may be subject to question, but it is in good agreement with the *Laserre* observations (*1*).

The maximum salinities (Fig. 2) indicate that a retroverse branch of the Guiana Current joined the Equatorial Undercurrent near 38°W. The high salinity region, near 40°W broadened, apparently at the turn of the current. The salinity maximum at 37°W was higher than that in the ESE current. Thus the tongue of high salinity between 40° and 35°W evidently came from the south. The tongue was not centered on the Equator, but close to 1°S, apparently because the water of the Guiana Current remained on the south side of the stream. Preliminary topography of the isosteric surface of 200 centiliters per metric ton suggests a turn in the geostrophic current in agreement with that inferred from the maximum salinity distribution.

It is noteworthy that the turns in both the ESE current and the branch of the Guiana Current were found quite near the Equator.

Easterly surface flow was observed in