Preservation of Fungi in Ancient Wood

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About two years ago a specimen of ancient wood found in Manito Bog, which is a grass- and sedge-covered peat bed located in the northern part of Mason County, Illinois, was submitted to the writer for identification. This wood was so well preserved that with care very acceptable microtome sections could be made of it. In examining such sections filaments of a very fine and delicate fungus were encountered, with indications in the wood that this fungus had been present in the living tree as a parasite. Since then a number of other samples have been secured and sectioned, and the sections have been searched for fungi with the success reported in this paper.

By microscopic characters, the wood might be either larch or spruce. Arthur Koehler, of the U. S. Forest Products Laboratory, who has examined large pieces of it, believes it is the latter because of certain growth-ring ratios considered to be distinctive of spruce. The age of the wood is not capable of exact determination. Manito Bog, which lies eight to nine miles beyond the terminal morain of the Early Wisconsin glacier, was apparently a portion of the drainage channel for waters of the Wisconsin glaciers. It probably came into existence following their retreat. The retreat of the Early Wisconsin glacier has been placed at 40 to 150 thousand years ago, that of the Late Wisconsin at 20 to 60 thousand years ago. The minimum age of the wood specimens may be considered, then, as being very nearly 20,000 years.

The preservation of fungi as fossils through very long periods of geological time has, of course, been demonstrated. Hirmer[1] has given a recapitulation of such reports, showing preservation of very primitive fungi in Silurian, of Pythiaceae in Neocene, and of Pucciniaceae in Carboniferous times. The accompanying figures 1 and 2, which are of original photomicrographs of fossil fungi of Devonian times (from silicified peat beds in Old Red Sandstone at Rhynie, Aberdeen, Scotland) show how perfect preservation in fossil form may be. But preservation of real fungous filaments in their natural state over long periods of time has not been reported before, so far as the writer is aware.

In sections made from the Manito Bog specimens the following four types of fungi have been found.

1. Fungous filaments, shown in figure 6, exhibiting evidence of having been parasitic in the wood at the time the tree was alive. These filaments are very fine and delicate and stain only faintly with stains differential for fungi in woody tissues. They run longitudinally through and laterally across tracheae on both sides of the annual ring boundaries. In passing from cell to cell they frequently make use of the bordered pits, but evidence of their parasitism is presented in part by the fact that they also were able to bore directly through cell walls and in part by the fact that, where this occurred, callosities are still visible on cell walls at many points of pene-

[1] Hirmer, Max. Handbuch der Palaeobotanik. R. Oldenburg, Muenchen und Berlin, 1927. pp. 112-128.

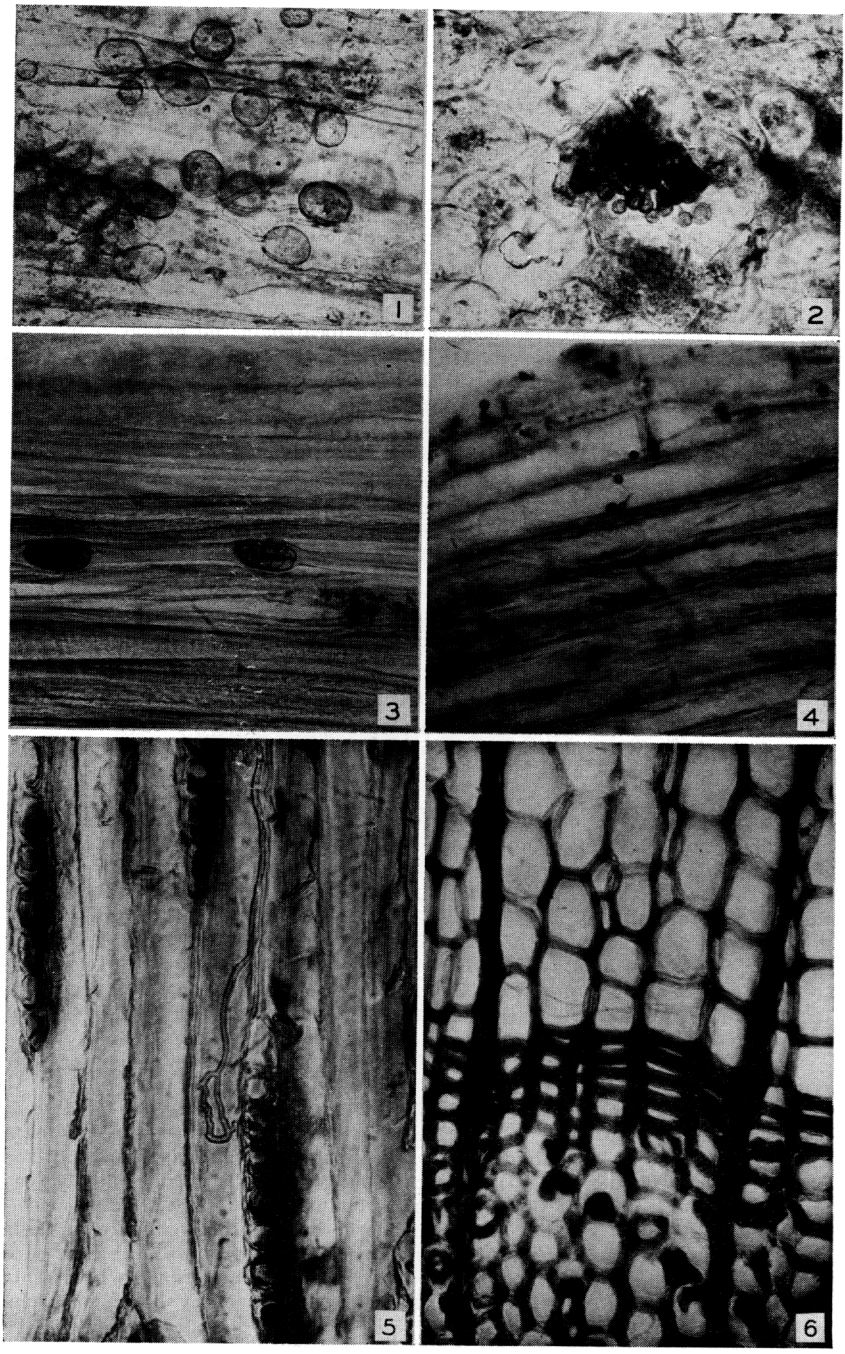

PLATE 1.—Preservation of Fungi in Ancient Wood.

tration. Further evidence of parasitism is seen also in the shrinkage and collapse of secondary and tertiary cell-wall thickenings in heavy-walled fall wood.

2. Fungous filaments, shown in figure 5, that suggest a purely saprophytic relationship with the wood in which they occur. These filaments are coarse and retain differential stains quite strongly. They run lengthwise and crosswise of tracheae and in passing from cell to cell make use only of bordered pits. No instance of direct cell-wall penetration was observed.

3. Fungous hyphae, shown in figure 4, bearing enlarged, dark, chlamydosporic cells. These filaments are of moderate size and are perfectly preserved, even to the cross walls in the hyphae. They still react moderately to differential stains. This form is very similar to fungi now economically important as causes of wood stains in timber.

4. Minute, isolated cell aggregates, shown in figure 3, which are obviously sclerotic resting bodies. These are muriform in structure, brown, and translucent. They do not react to differential stains. Where they were found, no hyphae were observable in any tissues except the rays; and there was no apparent connection between these hyphae and the sclerotia.

The question might be raised whether these fungi are coeval with the wood in which they occur. In the first instance evidence of parasitism is so positive as to permit no doubt that the fungus was associated with the death of the tree. With respect to the other three, circumstances are almost equally convincing. At the present day this preserved wood lies beneath three to four feet of peat. According to available records, the bog has been drained and probably farmed since before 1901. Since drainage and cultivation greatly speed up peat decay, the present three- to four-foot coverage does not represent the total amount of peat deposited following tree growth. The wood specimens had not been uncovered before being taken, and it seems hardly possible that the fungi could have invaded the wood within recent years.

The material discussed in this paper has had two points of special interest to the writer. The first, of course, is the clear evidence of preservation through a very considerable period of time of the very minute and fragile threads of which fungus bodies are made. The second is the indication that diseases of trees, human knowledge of which is but little more than half a century old, were in existence and played important parts both in the death of trees and in the subsequent disintegration of tree tissues as much as 20,000 years ago.

EXPLANATION OF PLATE

Fig. 1.—Pythium-like fossil fungus from Devonian times. **Fig. 2.**—A Puccinia-like fossil sorus on the epidermis of *Rhynia major* from Devonian times. **Fig. 3.**—Isolated sclerotic fungus bodies in crushed woody tissue of ancient spruce. A single fungous hypha can be seen in the cross section of the wood ray. **Fig. 4.**—Fungous hyphae and chlamydosphores similar to present wood-staining fungi in a longitudinal section of ancient spruce wood. **Fig. 5.**—Apparently saprophytic fungous hyphae in a longitudinal section of ancient spruce wood. **Fig. 6.**—Cross section of ancient spruce wood, showing fungus filaments in early spring cells and shrinkage of secondary cell walls in fall wood.

(Photomicrographs by Ray R. Hamm, University of Illinois Photographic Laboratory.)