Birch tree with the rarely photographed resupinate pore surface of the sexual reproductive stage of *Inonotus obliquus*. Photo courtesy of Tuomo Niemela.

CHAGA'S SIGNIFICANT OTHER

by Lawrence Millman

The fruiting body of *Inonotus obliquus* is so rarely encountered that the late Sam Ristich once referred to it as a Holy Grail among polypores (Ristich, pers. comm.). Few mycologists have ever seen it; and if they have seen it, they probably dismissed it as an unidentifiable mass of not necessarily fungal tissue. By comparison, the sterile conk (a.k.a., chaga), a rather different sort of Holy Grail, is quite common. That there's any connection between the two wasn't proposed until as recently as 1938 (Campbell and Davidson, 1938). This is hardly surprising: who would suspect that a cracked clinker-like protrusion and a resupinate poroid basidiocarp usually at a distance from each other would belong to the same species?

In North America, the host of *I. obliquus* is typically mature black, paper, or yellow birch—all long-lived trees. Gray birch, which is relatively short-lived, is almost never a host. Infection of the tree occurs through the trunk, not the roots, and mostly through branch stubs and open *Nectria* cankers. Like many other primary decayers, *I. obliquus* tends to die shortly after the demise and fall-down of its host tree; once the tree has fallen, its mycelium is usually replaced by secondary saprobes (Niemelä et al., 1995). This helps to explain why the fruiting body is found on standing trees, but not very often on birch logs.

The sterile conk (not to be confused, as it often is, with a sclerotium) usually appears while the tree is still alive, but the fruiting body doesn't appear until after the tree has died ... sometimes as long as several years after it has died. So infrequently does the fruiting body grow on a living tree that on one of the few occasions when it did, the incident was documented in a paper (Cha et al., 2011). Fruiting bodies are seldom more than a foot long, so when a twelve foot fruiting body appeared on a yellow birch snag in October Mountain State Forest in Massachusetts, that incident was documented as well (Campbell and Davidson, 1938).

Most resupinate polypores grow in contact with the soil or on the undersides of logs; the fruiting body of *I. obliquus* grows at a height on its host, invariably above the sterile conk, and within the decayed wood adjacent to the host's cambium—i.e., directly under the bark. The only other polypore species that forms a fruiting body under bark on a vertical or sloped substrate is *Inonotus andersonii*, one of the primary causes of mortality among oaks in the Southwest (Gilbertson and Ryvarden, 1986). But you seldom need a rope and pitons or a stepladder to locate a specimen of I. andersonnii.

Curious as it might already seem, the tale of *I. obliquus* now gets (to quote Alice, of Wonderland fame) curiouser and curiouser: its yellow-brown, reddish-brown, or grayish-brown basidiocarp erupts from the dead tree's bark in a manner that recalls the explosion of the miniature alien from the astronaut's belly in the sci-fi film Alien. So powerful is the pressure immediately preceding this eruption that the pattern of the inner bark sometimes appears on the visible basidiocarp (Bondartsev, 1971). No matter, because the fertile surface is now exposed.

"Of course," you might say, "a fungus needs exposure to the air in order to disperse its spores." But not so fast. Shortly after the fruiting body has forced open the bark, it loses almost all of its obvious morphology. That's because it's been colonized and then consumed by insects. In Finland, the larvae of the monophagous beetle *Triplex russica* seem to be among the primary consumers (Schigel, 2011), but this species is not known in North America. The North American consumers are doubtless either fungivores or parasitoids of the fungivores—probably beetles and dipteran species, along with various larvae.

So while the sterile conk of *I. obliquus* is a perennial, the fruiting body isn't even an annual. Indeed, it usually doesn't last much longer than a few days ... a very short time for any fungus other than a fleshy one like a *Conocybe* or a *Psathyrella*. For collection purposes, this is also a short time, since it's difficult to tell that the fruiting body is actually a fruiting body with so little of it left. One of the diagnostic features of that fruiting body is that its contextual hyphae stain dark brown or black in KOH (Boulet, 2003; Gilbertson and Ryvarden, 1986); in an insect-ravaged specimen, those hyphae don't stain because they no longer exist.

Fungal tissue contains choline, B vitamins, lipids, and sterols, all of which are important for the growth and reproduction of insects (Gilbertson, 1984). Yet certain fungi, rather than being passive sources of nutrition, seem to solicit insect diners. Think of the Phallales (stinkhorns), for instance. And while many polypores, like other fungi, put up a defense against mycophagous insects, some of them would appear to be extending dinner invitations to them. Several *Gloeophyllum* species possess an odor that makes them a termite attractant (Schigel, pers. com.); *Bjerkandera adusta* is a magnet for thrips; and *Cryptoporus volvatus* eagerly hosts beetles on the inner part of its veil. But with none of these species do insects or their larvae wreak the same sort of havoc that they do on the fruiting body of *I. obliquus*.

"Many polypores are eaten by

insects, but in my experience none so quickly as *I. obliquus*," Leif Ryvarden has observed (Ryvarden, pers. com.). Such alacrity suggests a chemical compound that says "eat me" to hungry insects and "be my guest" to egg-laying ones. The insects already dining on the fungus might also possess a pheromone that relays a "good eating" message to insects of the same species. In return, all the fruiting body would seem to ask of its diners is that they serve as taxis for its basidiospores.

There are obvious arguments in favor of an anemophilous (wind-pollinated) rather than an insect vectoring of the spores: a relatively high proportion of fungi that depend on insects for spore dispersal have spores with a sugary slime coating (Ingold, 1953) or ones with spines or knobs, but the spores of *I. obliquus* are neither coated or ornamented; the violent manner in which the basidiocarp forces open the bark expresses a need for air and thus an anemophilous form of dispersal (Niemelä, pers. com); and insects restricted to basidiocarp tissue normally do not invade wood (Gilbertson, 1984), which would make a chemical attractant an unnecessary investment. Yet the unusually quick destruction of the fruiting body seems to indicate that insects are, if not a primary, at least an auxillary vector of spore dispersal. For a fungus that disintegrates so quickly might need several spore dispersal strategies if it wants to avoid extinction.

The rarity of the *I. obliquus* fruiting body has precluded study of its insect populations. Since we don't know exactly which insects they are, we also don't know if those insects might be equipped with mycangia (a special spore pouch), which would make them vehicles of spore transmission. Likewise, this rarity has hampered study of the fruiting body itself. But rarity is perhaps not the appropriate word to describe a species that typically hides under bark and grows high up on its substrate. A better word might be elusive. And given such elusiveness, this paper is necessarily speculative, a compendium of "usuallys," "maybes," "probablys," and "suggests." Despite this fact or maybe because of it, the paper is also intended to be an introduction to a remarkable fungal entity.

DESCRIPTION

Basidiocarps short-lived, resupinate, widely effused on vertical substrates, with tubes elongated to 2-3 cm; dimensions up to 30 cm x 6 cm, but occasionally much larger; at first yellowish-brown or fuscous, but quickly becoming cracked and dark reddish or blackish-brown; at first somewhat coriaceous-fleshy, then drying brittle; context light yellowish-brown, faintly zonate, continuing without change into the trama; no cystidia; pores round to angular, 6-9 per mm, but sometimes as few as 2-4 per mm; hyphal system monomitic, with parallel, thick-walled brown hyphae 3-5 microns across; generative hyphae with simple septa; contextual hyphae dark brown to black in KOH; basidia clavate, 15-20 x 6-9 (12) microns, with 2 or 4 sterigmata; basidiospores hyaline, later pale yellow to pale yellowish-brown, negative in Melzer's, sometimes 1-guttulate, ellipsoid to subglobose, 6-10 x 5-7.5 microns.

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