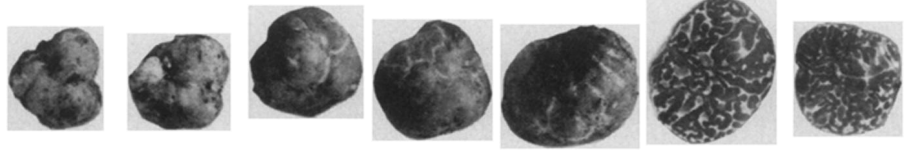


Truffles



The Bottom Link

From gourmet to ground-level perspective, truffles close the circle of forest ecology

BY JANET L. HOPSON

Toadstools—amanitas and galerinas, for example—have gotten themselves a bad name, no question about it. But truffles, those pungent treasures of the subterranean biome, are the most maligned mushrooms of all. Truffles, the careful observer must conclude, are misunderstood.

Most people think truffles are something pigs root up, and that Europeans slice into their omelettes and turkey dressings. They think truffles are hard, knobby little mushrooms that command an absurdly high price in gourmet markets and restaurants (typically \$200 per pound fresh and \$12 per ounce in tins). And they think, if they think about truffles at all, that they will probably never taste their musty pungence.

Well, these things are in fact true, all of them. But they are only a small taste of the complete truffle story. For, if one considers things from a ground level perspective, truffles are the bottom link in the circle of forest ecology. They feed and are fed by the trees. They feed small animals which feed larger animals. The animals replant them. They are a thing of beauty (to a mycologist, at least). And they are a potential agribusiness for two enterprising humans from California.

The person with what is surely the keenest truffle perspective to be found is

James M. Trappe. He is the principal mycologist (one who studies fungi) at the U.S. Forest Service's Forestry Sciences Laboratory in Corvallis, Ore. He has become, in the last ten years, the world's expert on truffles. He has personally named 50 new species and is in the process of writing world monographs of all the genera. Suffice it to say that Trappe, above all, does *not* misunderstand truffles.

"My principle research interest," he says officially, "is the hypogeous mycorrhizal fungi, which, to the uninitiated, is the scientific shorthand for 'the fleshy fungi which fruit underground,' such as truffles." (Trappe is a small, balding man with bushy eyebrows. Even the most officious scientific phrases do not extinguish the blue twinkle from his eyes. He is, voice and all, a rather perfect scientific dryad.)

The mycorrhizal fungi as a group, he says, are fungal species that live in symbiosis with the roots of plants. The plants supply carbohydrate for the fungi, which cannot themselves produce it, being non-photosynthetic and buried in the earth. The fungi, in turn, send out miles of hairlike mycelia, and in so doing, greatly extend the plant roots' surface areas for absorbing moisture and nutrients. Most of the large forest mushrooms, Trappe says,

are the aerial fruiting bodies of mycorrhizae associated with trees. Truffles are the equivalent, only underground.

"Probably something like 99 percent of the world's known species of land plants, particularly trees, are either totally or partially dependent on these root fungi for survival," he says. "If you take something like a sequoia, with its tremendous mass of living material above the ground, you can see what I mean about the dependence." There is a lot of biomass underground, too, he says, but most of that is woody, structural roots, not absorptive tissue. "Most of the absorption of water and virtually all of the nutrients must come through succulent, little root tips. The mycelia of the fungus grow out into the soil, tapping every little nook and cranny, and send their payload, ultimately, up to the tops of the trees to keep things going," he says. The interdependence of mycorrhizal fungi and plants is so strong, in fact, it is likely that they evolved together from early aquatic algae and fungi into the diverse Kingdom *Plantae*.

Basic mycology research has already established the importance of mycorrhizal symbioses to the nutrition of plants—particularly commercial timber species—and has fostered the use of fungal inoculants in nursery soils. Further research will be helpful in understanding the same sym-

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biotic relationships and necessary growth environments. Trappe says, "for grasses, lillies, strawberries and wheat."

But getting back to evolution, and more specifically truffle evolution, these underground mushrooms, Trappe says, represent what is probably the most advanced state of fungal evolution. "They are extremely specialized," he says, "and having gone underground, they are protected from the vagaries of the weather—heat, drought, frost and so forth." In the process, though, they have become dependent on animals for dispersal of their spores. "The little 'varmints' of the woods, the squirrels and mice, deer, pack rats, and so forth, dig them up. The spores go through to the animals' pellets unscathed."

"And all of this," Trappe says, popping up from his chair, "leads to this pile of boxes and viles over here." The viles, packed into several small cardboard boxes piled on a table in his small, cluttered office, contained, it turned out, the contents of the stomachs of small rodents, trapped by one of Trappe's mammologist colleagues. "We are working out the role of truffles in animal and forest ecology," he says, "and this has led to some interesting ramifications." They found, for example, that a small mouse called the California red-backed vole eats nothing but truffles. "As best we can tell, it just tunnels around in the ground, eating its way from one truffle to the next." (A tunneler, one sees, with good taste.) It is one of the few animals so totally dependent on truffles, he says, "and that, you see, explains for us its limited ecological range—the coastal fog belt of the western United States."

In order to attract their necessary contingency of replanting animals, the buried fungi must have a very strong odor and taste. And they do. This is where truffles start to sound familiar again. "All species of these hypogeous fungi produce odors," Trappe says, "some like the spicy-garlicky-cheesy taste of gourmet truffles, and some like sewer gas—and every intermediate. This is part of their advanced evolution." Because they are dependent on being eaten by animals, their smell and taste are critical. In contrast to above-ground mushrooms, truffles mature slowly. A mushroom might come up in the fall, discharge its spores and disappear in a week, he says. The truffle takes two to three months to mature, sending out stronger and stronger odors as more spores mature.

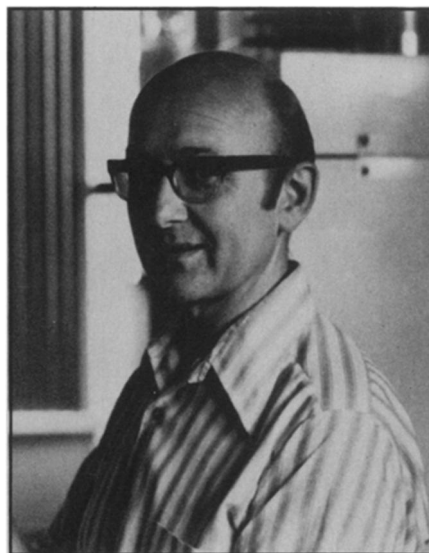
By the time an animal smells the truffle and digs it up, usually around December, there are lots of spores to pass on. But so that the truffle has covered its tracks, so to speak—just in case there is a sudden cold snap during the fall—as it matures slowly there will always be at least some mature spores and a weak attractive signal to attract animals so that spore dispersal can still take place. "It is," Trappe

muses, "a nifty system, isn't it?"

Staring at a picture of the West Coast truffle *Tuber gibbosum* with obvious affection, he says, "What the truffle does is to beautifully tie together so many



A forest in vitro glistens beneath growth lamps. These captive conifers are part of a study on root-fungi interrelationships.



Trappe: A perfect scientific dryad.

things that seem more or less independent on the surface; the whole business of the trees and their absorption of nutrients from the soil, the dependence of the fungus on the tree for its carbohydrates, the source of food for animals, and ultimately its own spore dispersal and with it, potential life for itself and more plants."

Truffles—the bottom link in the circle of forest ecology. The misunderstandings begin to fade. But the idea of truffles primarily as a gourmet food fades slowly. There has been, quite recently, a rebirth of interest in finding edible truffles (those on the spicy end of the spicy-sewer gas continuum) in American soil. North America, after all, has 90 of the world's 200 or so truffles species. Of the 70 or more species in Europe, only six or seven are considered edible. There ought to be

at least a few edible American species out of 90. Right?

"I'm afraid not," Trappe says, "at least not on the basis of the ones I've found so far, most of which have been on the sewer-gas rancid-bacon end of the spectrum." But two semi-retired banking executives from Santa Rosa, Calif., Henry F. Trione and J. Ralph Stone, are more hopeful. So hopeful, in fact, that they have started a company, Tristo, Inc., organized the first California Truffle Conference to be held in Santa Rosa in early November, and are arranging a truffle hunt for later in the year.

The climate and soil in parts of Northern California are quite similar to the truffle-producing climates of Southern Europe, and some areas even have the limestone soil usually associated with edible truffles. Trione, himself of Northern Italian descent, and Stone have imported two Italian truffle dogs. These will be followed up by the arrival of an Italian truffle hunter, Trione says, in time for the December hunt on 100,000 wooded acres near Santa Rosa.

The project has commercial potential—particularly if the dogs and dozens of enlisted Santa Rosa enthusiasts can turn up indigenous edible truffles on the acreage. If not, Trione and Stone hope that edible European species can be encouraged to colonize the roots of American trees. This would, of course, be a longer-term project—perhaps ten years between inoculation of the mycelia and harvesting of the first truffles.

Trappe, in his official Forest Service capacity, has been advising Tristo, Inc., during their preparations for the truffle congress and hunt. He will, in fact, lead the November symposia. Although the expedition is being approached with a good-natured profit motive, it has inspired an alliance between commerce and science that may well profit basic mycology research. The truffle conference, Trione hopes, will "stimulate more research on commercial truffle culture through departments of plant pathology and forestry." He and Stone have even spoken of sponsoring students and research projects, or perhaps a chair in the subject at a California university. Trappe plans to send some of his graduate students on the truffle hunt, and hopes new information on truffle ecology—maybe even new species—will be exhumed.

Whether or not the commercial and scientific interests in truffles are realized, though, the attention they are receiving will almost certify one thing: These pungent, hidden, forest-feeding, convoluted little hypogeous fungi will be misunderstood mushrooms no longer. □

