SPORE PRINTS

BULLETIN OF THE PUGET SOUND MYCOLOGICAL SOCIETY
Number 443 June 2008

THREE MUSHROOMS FROM MUSHROOM MAYNIA!

Brian Luther

Although Hildegard and I didn't get a lot of people bringing in specimens for identification during Mushroom Maynia!, three fascinating collections were brought in to the Burke Museum which I thought you might like to know a little about.

Malanogaster tuberiformis - This is a false truffle (Basidiomycete) with a rounded or slightly lumpy to irregular tuber shape and a thick brown peridium, some slightly more than 2 cm across in the largest dimension, with a glistening gelatinous black gleba having fine white chamber-like markings on the inside. The gleba was very distinctive in appearance, especially under a dissecting microscope, and the whole fruiting bodies had a strong garlicky odor. *M. tuberiformis* is considered edible and good according to truffle literature. The gleba was so gelatinous that I was not able to make a thin section for microscopic observation. My new sharp razor blade couldn't even get a bite on the heavy gelatinous tissue. I had to remove some of it with ultra-fine micro forceps for a squash mount. Because I suspected (correctly) that it was going to be dark spored, I mounted the tissue in 3% ammonium hydroxide (NH_4OH) only, with no stains added. This species has beautiful rich warm brown, very thick-walled, lemon-drop-shaped basidiospores measuring 12–15 × 7–8 µm, which often have a small section of the thick, untapered sterigmata still attached to the hilar end. Apparently DNA studies have shown it to be closely related to the boletes. I left the specimens in a paper cup in my mycology lab overnight, and when I came back the next day the whole room had a pleasant aromatic garlicky smell. They were brought in from a woman's garden in north Seattle, where they were growing a few inches deep in soil near good sized Douglas Fir trees. She was hoping it was a truffle, but I told her it was most likely a false truffle. False truffles are Basidiomycetes. True truffles, of which we have a couple of species here in Washington State, are Ascomycetes in the order Tuberales. Ninety-nine percent of what people bring or send to me hoping for truffles are actually false truffles. However, a couple of months ago I did get a specimen in the mail from a lady in Bremerton, and after microscopic observations I concluded it was, indeed, *Tuber gibbosum*, one of our true truffles.

Battarrea phalloides - This is a very large stalked puffball with a massive, deep, bowl-shaped volva or cup. It was brought in from a garden in Ballard overlooking Shilshole Bay above Ray's Boathouse. The specimens were dried, but when fresh the stalks are easily 15 or more inches tall. I had previously seen it only from eastern Washington and other cold, sagebrush desert locations, where it was growing in sand. There was a whole shoe box full of beautiful specimens. I showed it to Joe Ammirati, and he was eager to have it for the mycology herbarium. *B. phalloides* starts out looking like a massive *Amanita* coming up, with a very heavy cap; but of course it has no gills to go with the huge volva/cup at the base of the stem. It is a pale off white until maturity, then the whole elevated glebal mass (what looks like a mushroom cap) starts forming millions of spores on a heavy thick stalk. Joe said he had seen it before (rarely) from the Seattle area.

Contumyces rosella (=*Omphalina rosella*) - This was brought in by one of the PSMS volunteers from Cougar Mountain for a mushroom tray arrangement. This species was confirmed by Joe Ammirati and Steve Trudell. It is a very distinctive little omphalinoid fungus with widely spaced, decurrent gills; it has a funnel-shaped cap at maturity with pinkish colors and grows in moss. It can be found in Moser's *Keys to Agarics and Boleti*. (p. 99) under the genus *Omphalina* and on-line under *Contumyces,* the new genus it was transferred to. Apparently it is widespread here in spring, but often overlooked.

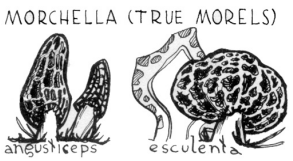
I set up two microscopes next to me for my use during the day, and I had no idea that there would be so much interest by the public in what I was doing. Several people asked if they could come look in the microscopes at what I was observing, so I spent some time with them looking at specimens.

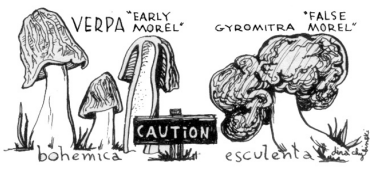
GYROMITRAS AND DISCINAS WANTED

Joe Ammirati

Kerry O'Donnell is interested in receiving recent collections of gyromitras and discinas—he needs digital photos and good location and ecological data. I can process and/or send him materials; if you want to send materials directly to him you may do so as follows:

Kerry O'Donnell
1815 N. University St.
Peoria, IL 61604
E-mail: kerry.odonnell@ars.usda.gov
Phone: (309) 681-6383
FAX: (309) 681-6672
Webpage: http://www.ars.usda.gov/sp2UserFiles/Place/36207000/MGB-ODonnell2.pdf





Spore Prints

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CALENDAR

June 7	Field Trip, Swauk Creek
June 9	Master Gardener's ID Clinic, 4–7 pm, CUH
June 10	Membership Meeting, 7:30 pm, CUH
June 16	Master Gardener's ID Clinic, 4–7 pm, CUH
June 23	Board Meeting, 7:30 pm, CUH
June 23	Master Gardener's ID Clinic, 4–7 pm, CUH
June 28,29	Mushroom Festival, Lacey, Washington

MUSHROOM PHOTOS NEEDED — Martha Perry

The Photography Interest Group is soliciting photos for possible inclusion in a PSMS calendar. We are looking for close-ups of mushrooms, horizontal (landscape) orientation, digital in JPG or TIFF format, sharp enough to be printed at 8½ × 11 in. size. The photo must be taken by a PSMS member and be of a PNW mushroom. Deadline for submissions is July 1. Please e-mail photos to Martha Perry at marthaaperry@verizon.net.

We will also have a photo display and contest at the annual exhibit. For this we will need a print—no restrictions on orientation or whether close-ups or overview. Details will be posted later on the discussion group website.

Two thousand years ago, Martial wrote about aphrodisiacs.

If envious age relax the nuptial knot,
*Thy food be mushroom, and thy feast shallo*t.

MEMBERSHIP MEETING

Tuesday June 10, 2008, at 7:30 pm at the Center for Urban Horticulture, 3501 NE 41st Street, Seattle.

We will be hosting **Dr. Adolf Ceska and Oluna Ceska**, respected Canadian botanists and rare plant specialists, who are based in Victoria, British Columbia. They will be speaking on "Four years of fungi survey on Observatory Hill in Victoria, BC," a special place with three major forest "ecosystems"—Garry oak (Oregon White Oak), old-growth Douglas fir, and Western Red Cedar—containing an incredible diversity of both common and rare fungal species. Adolf is a professional botanist who retired from the British Columbia Conservation Data Center in 2002. Oluna is a recognized authority on fungi and algae. They are members of the South Vancouver Island Mycological Society, are founding members of the Native Plant Society of BC, and contribute to the Eflora website. They operate Ceska Geobotanical Consulting in Victoria and were involved in several regional invasive plant projects including Eurasian milfoil and, more recently, carpet burweed.

Would members with last names beginning with L–Z please bring a plate of refreshments for sharing after the meeting.

SOME FACTS ABOUT MORELS — Aven Andersen

Olympic Peninsula Mycological Society Newsletter, May 2008

Ever wonder why nearby morels appear different? It has to do with morel genetics. Morels are formed by mycelia that are more like colonies than individuals (known as heterokaryotic mycelia). Thus, morels appearing side by side often have different sets of genes. For more on this interesting subject, read *Ecology and Management of Morels Harvested from the Forests of Western North America* by Pilz et al. (US Forest Service, PNW-GTR-710, March 2007, www.fs.fed.us/pnw/publications/grt710/).

More information from this report: Morels seem to have relationships with certain trees (e.g., ponderosa pine, Douglas fir, apple), but not always. Originally, people believed morels were decomposers, but several studies have shown them to be mycorrhizal or "facultative mycorrhizal," whereby they obtain nutrients and water from tree roots and may, in turn, provide the trees some benefits. The abundant fruiting of morels following the deaths of their tree partners (and food source) might represent a "last-ditch effort" to reproduce. Other factors that trigger fruiting are soil temperatures and rainfall. Although they seem to appear overnight, morels go through a growth period that can last a month, with above-ground growth and maturation taking 10 or more days. Mammals and birds rarely eat morels, but certain insects love them. In one experimental plot in Alaska, half of the morels were consumed by insects known as fungus gnats.

Another good reference is *Morels* by Michael Kuo, 2005. University of Michigan Press, vii + 206 pp. List $27.95. It covers the biology of morels; other spring mushrooms; where and when to find morels; cleaning, cooking, and preserving morels; taxonomy; and other aspects of morels and morel hunters.

ENDOPHYTIC FUNGI

http://bugs.bio.usyd.edu.au/Mycology/Plant_Interactions/Endophytes/inGeneral.shtml

Endophytes colonize plant tissue and remain within the tissue except that fruiting structures may emerge through the surface. Indeed, leaves may be fully colonized by a variety of fungi within a few weeks of emergence. The colonies remain asymptomatic and some in perennial parts may have a very long life.

Endophytic fungi are found in all divisions of fungi so have presumably evolved the association independently on many occasions. The most common endophytes are anamorphic members of the Ascomycota, and they are often closely related to fungi known to cause disease, either in healthy tissue or as secondary invaders of damaged tissue. This suggests that the endophytes may have evolved from pathogens or vice versa. The mechanisms of host recognition and development of colonization may also be common.

A wide range of plants have now been examined for endophytes, and endophytes have been found in nearly all of them. An enormous number of different fungi can be isolated from plants growing in their native habitat. Most of the fungi are uncommon and narrowly distributed, taxonomically and geographically. However a few fungi are widely distributed with the host, suggesting a long standing, close, and mutually beneficial interaction. Indeed, some fungi are found in many different terrestrial hosts, especially endophytes of crop plants. While most information has been gathered from terrestrial ecosystems, fungi are found in algae and sea grasses. Just as we know less about marine ecosystems, our understanding of the biology of marine endophytes is extremely limited and will not be discussed further.

Dispersal of the endophytic fungi remains puzzling. Apart from *Neothyphodium* and related species, endophytes are transmitted horizontally. That is, each plant is colonized by fungal propagules that arrive from the environment. The source of transmission has been determined in only a few cases. Propagules of some endophytes have been found in the body of insect pests of the host. Intriguingly, at least two entomopathogens have been documented as endophytic fungi. Thus insects may disperse the fungi from host to host.

Aerial dispersal either in the wind or on vectors is probably the most common mechanism for fungal dispersal. Endophytic fungi colonize various parts of the plant. Many of the fungi sporulate in culture, indicating the potential to release spores in the air. Indeed, sporulation is seen after senescence of plant tissues. However, few cases of dispersal have been documented in the wild and the various mechanisms remain unexplored.

Nutrients are cycled between the host and fungus. The fungus clearly gains a predictable environment in which nutrients are readily available. Thus the benefits are clear for fungi establishing endophytic associations. The loss of plant resources to the fungus, and the potential of some fungi to grow rapidly, indicates that the host regulates development of colonies.

Each plant host has a range of physical, chemical, constitutive, and induced controls over the spread of fungi within tissues. An enormous diversity of phenolic and other deterrent plant compounds is associated with the presence of endophytic fungi, in fact more than are associated with potent pathogens in the same host. In addition, presence of endophytes up-regulates plant responses to pathogens. In the absence of plant controls, proliferation of endophytes through tissues would be expected.

The reaction of the plant to endophytes suggests that the interaction is one of confinement by the plant. Colonization by endophytes ranges from single cells (*Rhabdocline parkeri)* to patchy distribution through leaves and stems (*Chaetomium globosum*). The presence of specific endophytes, the lack of signs of disease, and the long-lived association indicate that further study of the association may yield interesting information of the precise benefits to plants associated with these colonists.

Plants may benefit from the presence of endophytes in many ways. Potential plant benefits have been examined in only a few cases. *Rhabdocline parkeri* produces a compound that reduces needle attack by borers. Metabolites produced by *Phomopsis* spp. in cotton appear to deter larvae of *Helicoverpa* from feeding on leaves. The parallels with *Neotyphodium* are clear. In addition, aphids feeding on leaves of cotton may become colonized by *Lecanicillium lecanii*, when conditions permit. Thus the aphid may be killed or it may transfer the fungus to another leaf.

In addition, endophytes may up regulate host responses to pathogens and pests. *Chaetomium globosum* has been shown to increase host resistance to rust and tan spot pathogens in wheat. Direct interactions appear to be too small to measure in this case. Presence of *Lecanicillium lecanii* appears to reduce the feeding by aphids from leaves of cotton. The interaction is probably due to induction of host responses, which is perplexing because plant regulatory pathways for responses to insects and pathogens are not thought to be complementary.

Endophytes appear to have direct and induced effects on plant responses to biotic agents. The interaction with abiotic agents remains largely unexplored.

The broader, ecological function of endophytic associations is still being debated. Many fungi that are associated with the initial stages of litter decomposition are found in healthy tissue of the same plants. Thus they are involved in the initial stages of resource recycling. Endophytes are also associated with aquatic activities. Many aquatic fungi have an endophytic stage in their life cycle. An enormous diversity of endophytes is found. Endophytes are probably associated with a wide variety of host functions.

Fungal Biology, University of Sydney, http://bugs.bio.usyd.edu.au/Mycology/Plant_Interactions/Endophytes/inGeneral.shtml

NATIVE ORCHID TOUR

Jamie Notman

As President of the Northwest Orchid Society I have been called upon by Ron Post to lead an expedition to look at wild orchids around the Hurricane Ridge area of the Olympic National Park this summer. Ron is planning on renting a van that will seat 15 people with 3 of the seats already spoken for. We would like to keep the group to around 30 people. We were thinking that someone else interested in going may have a van or some other form of group transportation.

The adventure will begin on July 20 at 9 am at the information center right on Race Street outside of Port Angeles just before the entrance into the park. Once the group has arrived we will begin our native orchid tour.

There will be a sign-up sheet at the June meeting.

MUSHROOM WALK REPORT

Brian Luther

I had a very successful public nature walk at Twanoh State Park May 17 with perhaps 25 or so people, including Stacy Ruland, who is one of the main park rangers, her boss, Larry Otto (manager of the park), and Larry's boss, Joel Pillars. I gave some introductory information and a handout and talked about plants and mushrooms as we hiked along the trails. About 20 species of fungi were found, including some surprises. *Phylloporus rhodoxanthus* (with brilliant golden-yellow gills) and *Clitocybe nuda* (the Woods Blewett) were the two off season oddballs that turned up. Other interesting finds included *Kuehneromyces mutabilis*, *Baeospora myriodophylla* which has plain brown caps and gorgeous deep purple gills, and one solitary specimen of the beautiful Ascomycete *Plectania melastoma* which has abundant sparkling rust-colored granules covering the outside and the rim of the cup. No morels were found, but after all this was western Washington. I provided fresh bagels, cream cheeses, hot coffee, and juices for the group, which they had not expected.

The really good news is that several couples wanted to join PSMS afterward. So maybe we'll be getting three new members from the Bremerton/Port Orchard area.

FUNGAL SNARES AND OTHER STICKY ENDS

Else C. Vellinga

Mycena News, Myco. Soc. of San Francisco, February 2008

For over twenty years we have watched a fallen oak be devoured by oyster mushrooms. At first the decay went slowly, but during the last few years it has accelerated. This winter, for the first time, we could not really find the wood, and the oyster mushrooms had disappeared. Wood is a very inhospitable substrate. Its components are hard to break down and, though they are rich in carbon, nitrogen (an essential component for amino acids and proteins) is in very low supply. Wood decayers have come up with ingenious ways to cope with this shortage, including one chemical pathway that has bioluminescence as a by-product (e.g., in the Jack O'Lantern).

Oyster mushrooms and their relatives in the genus *Hohenbuehel*ia (gilled mushrooms chock full of thick-walled incrusted cystidia, with a gelatinous layer in the cap) have come up with a remarkable alternative—they devour nematodes, which are very small worms. The mycelium of these species forms drops (in the case of *Pleurotus*) or adhesive knobs (*Hohenbuehelia*), which contain toxins that paralyze the nematodes. The reaction of a nematode to these toxins is immediate—it stops wriggling and forms a simple target for the hyphae of the fungus. The hyphae hone in on the mouth of the nematode and enter the animal, which is at this point still alive. The hyphae proceed inside and devour the nematode from the inside out. Just like humans eat meat for their protein supply, so does the oyster mushroom "eat" the nematode.

Hohenbuehelia species that do this have been known for a long time, but mostly not in the form of fruiting bodies; rather, they exist as sterile mycelia in the soil under the genus name *Nematoctonus*. Another source of nitrogen for the oyster mushrooms is bacteria, and this might be the case for more species than we realize. There is a report that *Laccaria* species can obtain nitrogen from springtails—another way of getting this essential part of the fungal diet. It is, however, not known how the *Laccaria* are able to kill the springtails.

The nematode-killing abilities of the oyster mushrooms, plus *Hohenbuehelia*, are not found in other gilled mushrooms. Instead, they form a separate group that, in an evolutionary context, is close to the family of the deer fungus, *Pluteus*. However, fungi in the Phylum Ascomycetes have come up with the same idea to supplement their Spartan carbon diet. One order in particular, the *Orbiliales*, is rich in species that have come up with fascinating trapping devices. The genus *Orbilia* is an example; its species form very small, glassy, brightly colored little cups on wood, which are easily overlooked.

The classical and thorough work—with beautiful illustrations— on these nematode-trapping fungi was done by Drechsler in the 1930s. There are at least five different models of these traps, including adhesive knobs, two-dimensional or 3-D networks of adhesive cells, adhesive columns, and a lasso-like structure made up of three cells that inflate (like an air bag) when the nematode pokes in. Rings that do not inflate are also found, but only in combination with the adhesive knobs (which makes sense). Educational movies on the workings of those traps can be found online at www.microbelibrary.org. How these structures have evolved, and which ones are more derived, is not yet quite clear—the two papers dealing with this issue reach opposite conclusions. One paper has the 3-D networks primitive and the adhesive knobs derived, while the other reverses the order.

Recently, hyphae with non-constricting rings were found in a piece of amber dating from the Late Albian period during the Cretaceous (around 100 million years ago). Nematodes were present in the same amber, which indicates that this type of interaction is not a modern invention at all. To put this in perspective, small mushrooms, very closely resembling modern *Marasmius* species, have been found in 90–94 million-year-old amber from New Jersey. Arbuscular mycorrhizal fungi have been found in much older deposits, dating from the Ordovician (460 million years ago).

There is a huge interest in using the nematode-trapping fungi as possible biocontrol agents for those nematodes that cause animal and plant diseases, and also in the fungal species that might be a threat to those nematodes which are, themselves, used to controlling plant-pathogenic insects.

Oyster mushrooms can be found on almost every walk in the woods, and the soils of the grasslands and forests harbor many species of other nematode trappers. Does this make you think of Gulliver? You might not want to stand in one spot for too long!

Tom Volk

Pleurotus ostreatus

Further reading:

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Drechsler, C., 1937. Some Hyphomycetes that prey on freeliving terricolous nematodes. *Mycologia* 29: 447–552.

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Schmidt, A.R., H. Dörfelt & V. Perrichot, 2007. Carnivorous fungi from cretaceous amber. *Science* 318: 1743.

Thorn, R.G. & G.L. Barron, 1984. Carnivorous mushrooms. *Science* 224: 76–78.

Thorn, R.G. & G.L. Barron, 1986. *Nematoctonus* and the tribe *Resupinatae* in Ontario, Canada. *Mycotaxon* 25: 321–453.

Thorn, R.G., J.-M. Moncalvo, C.A. Reddy & R. Vilgalys, 2000. Phylogenetic analyses and the distribution of nematophagy support a monopyletic *Pleurotaceae* within the polyphyletic pleurotoid-lentinoid fungi. *Mycologia* 92: 241–252.

Yang, Y., E. Yang, Z. An & Z. Liu, 2007. Evolution of nemato-detrapping cells of predatory fungi of the *Orbiliaceae* based on evidence from rRNA-encoding DNA and multiprotein sequences. *Proceedings of the National Academy of Sciences,* USA 104: 8379–8384.

TRUFFLE KERFUFFLE GRIPS ITALY

Guardian Unlimited, May 16, 2008

Forever on the warpath against Chinese imitations of its designer clothes and sunglasses, Italy faces an oriental threat to one of its priciest culinary exports, *Tuber melanosporum*, the black truffle.

Researchers in Turin were startled to find DNA traces of *Tuber indicum*, a Chinese truffle, on tree roots in Italy—the first such discovery in Europe—and fear the Asian invader could muscle out its more delicate homegrown cousin.

"[The Chinese truffle] looks the same as the black Italian truffle, but has no taste or smell and grows faster and more aggressively than either the black or white Italian versions," said Paola Bonfante, a plant biologist at Turin University. "If the spores have spread it could usurp them." That could spell disaster not only for gastronomes but also for truffle traders. "Thanks to our studies of the genome sequencing of black truffles, we are also checking to see if hybrids of the Chinese version and the Italian black truffle could one day be found in Italian woods," added Bonfante.

Researchers stumbled on the new arrival when a truffle cultivator near Turin asked for an analysis of some plants he had purchased with roots impregnated with Italian black truffle spores." He was having no luck producing truffles, and our tests found the DNA of the Chinese version," said Bonfante. "'We have no idea who sold him the fungi, but he was conned." Prolonged drought in many of the black truffle's prime growing regions in Europe and predictions about global warming have heightened fears about its future.

SADDLED WITH DIOXIN, TOWN CONSIDERS AN ODD ALLY: THE MUSHROOM

Annie Correal

The New York Times, April 27, 2008

FORT BRAGG, Calif. — On a warm April evening, 90 people crowded into the cafeteria of Redwood Elementary School here to meet with representatives of the State Department of Toxic Substances Control. The substance at issue was dioxin, a pollutant that infests the site of a former lumber mill in this town 130 miles north of San Francisco. And the method of cleanup being proposed was a novel one: mushrooms.

Mushrooms have been used in the cleaning up of oil spills, a process called bioremediation, but they have not been used to treat dioxin. "I am going to make a heretical suggestion," said Debra Scott, who works at a health food collective and has lived in the area for more than two decades, to whoops and cheers. "We could be the pilot study."

Fort Bragg is in Mendocino County, a stretch of coast known for its grand seascapes, organic wineries and trailblazing politics: the county was the first in the nation to legalize medical marijuana and to ban genetically modified crops and animals.

Fort Bragg, population 7,000, never fit in here. Home to the country's second-largest redwood mill for over a century, it was a working man's town where the only wine tasting was at a row of smoky taverns. But change has come since the mill closed in 2002. The town already has a Fair Trade coffee company and a raw food cooking school. The City Council is considering a ban on plastic grocery bags. And with the push for mushrooms, the town seems to have officially exchanged its grit for green.

The mill, owned by Georgia-Pacific, took up 420 acres, a space roughly half the size of Central Park, between downtown Fort Bragg and the Pacific Ocean. Among several toxic hot spots discovered here were five plots of soil with high levels of dioxin that Georgia-Pacific says were ash piles from 2001–2002, when the mill burned wood from Bay Area landfills to create power and sell it to Pacific Gas & Electric.

Jim Wilson, The New York Times

For years, this Georgia-Pacific lumber mill dominated the coast of Fort Bragg, Calif. With the mill closed, the beautiful view remains, but so does toxic waste.

Debate remains about how toxic dioxin is to humans, but the Department of Toxic Substances Control says there is no safe level of exposure.

Kimi Klein, a human health toxicologist with the department, said that although the dioxin on the mill site was not the most toxic dioxin out there, there was "very good evidence" that chronic exposure to dioxin caused cancer and "it is our policy to say if any chemical causes cancer there is no safe level."

Fort Bragg must clean the dioxin-contaminated coastline this year or risk losing a $4.2 million grant from the California Coastal Conservancy for a coastal trail. Its options: haul the soil in a thousand truckloads to a landfill about 200 miles away, or bury it on site in a plastic-lined, 1.3-acre landfill.

Alarmed by the ultimatum, residents called in Paul E. Stamets, author of *Mycelium Running: How Mushrooms Can Help Save the World.*

Typically, contaminated soil is hauled off, buried, or burned. Using the mushroom method, Mr. Stamets said, it is put in plots, strewn with straw, and left alone with mushroom spawn. The spawn release a fine, threadlike web called mycelium that secretes enzymes "like little Pac-Mans that break down molecular bonds," Mr. Stamets said. And presto: toxins fall apart.

In January, Mr. Stamets came down from Fungi Perfecti, his mushroom farm in Olympia, Washington. He walked the three-mile

cont. on page 6

Dioxin remediation, *cont. from page 5*

coastline at the site, winding around rocky coves on wind-swept bluffs where grass has grown over an airstrip but barely conceals the ash piles. It was "one of the most beautiful places in the world, hands down," he said.

Quick to caution against easy remedies—"I am not a panacea for all their problems"—he said he had hope for cleaning up dioxin and other hazardous substances on the site. "The less recalcitrant toxins could be broken down within 10 years."

At least two dioxin-degrading species of mushroom indigenous to the Northern California coast could work, he said: the turkey tail and oyster mushrooms. Turkey tails (*Trametes versicolor*) have ruffled edges and are made into medicinal tea. Oyster mushrooms (*Pleurotus ostreatus*) have domed tops and are frequently found in Asian food.

Above: Pleurotus ostreatus (*Oyster mushrooms*)

Left: Trametes versicolor *(Turkey tail)*

Local mushroom enthusiasts envision the site as a global center for the study of bioremediation that could even export fungi to other polluted communities. "Eventually, it could be covered in mushrooms," said Antonio Wuttke, who lives in neighboring Mendocino and describes his occupation as environmental landscape designer, over a cup of organic Sumatra at the Headlands Coffeehouse.

The proposal is not without critics, however.

"There still needs to be further testing on whether it works on dioxin," said Edgardo R. Gillera, a hazardous substances scientist for the State Department of Toxic Substances Control. "There has only been a handful of tests, in labs and field studies on a much smaller scale. I need to see more studies on a larger scale to consider it a viable option."

On April 14, at a packed City Council meeting, an environmental consultant hired by the city voiced skepticism, citing a study finding that mushrooms reduced dioxins by only 50 percent. Jonathan Shepard, a soccer coach, stood up and asked: "Why 'only'? I think we should rephrase that. I think we should give thanks and praise to a merciful God that provided a mushroom that eats the worst possible toxin that man can create."

Jim Tarbell, an author and something of a sociologist of the Mendocino Coast, said the enthusiasm for bioremediation showed a change in the culture at large. "We are trying to move from the extraction economy to the restoration economy," Mr. Tarbell said. "I think that's a choice that a broad cross-section of the country is going to have to look at."

At the April 14 meeting, Georgia-Pacific promised to finance a pilot project. Roger J. Hilarides, who manages cleanups for the company, offered the city at least one 10-cubic-yard bin of dioxin-laced soil and a 5-year lease on the site's greenhouse and drying sheds for mushroom testing. And the City Council said it would approve the landfill but only if it came with bioremediation experiments.

So, sometime later this year, Mr. Stamets is scheduled to begin testing a dump truck's load of dioxin-laced dirt in Fort Bragg.

"One bin. Ten cubic yards. That's a beginning," said Dave Turner, a Council member. "I have hope—I wouldn't bet my house on it—but I have a hope we can bioremediate this."

TREKKIE "TRICORDER" TRACKS BACTERIA AND FUNGI ON SPACE STATION

RedOrbit, TX
May 11, 2008

Any Trekkies out there? Remember the tricorder? Dr. McCoy and Mr. Spock both carried them, and they came in mighty handy exploring "strange new worlds…where no one has gone before."

On the International Space Station, astronauts are carrying an experimental device that looks strikingly similar: LOCAD-PTS, short for Lab-On-a-Chip Application Development Portable Test System. This hand-held biological lab is the first step along the path to developing something akin to Dr. McCoy's medical tricorder.

"LOCAD is like that tricorder in that it is portable, rapid, and detects a biochemical molecule," says Heather Morris, LOCAD scientist from NASA's Marshall Space Flight Center, and an admitted Star Trek fan. But while tricorders could do almost anything from checking vital signs to finding alien life, LOCAD is a little more specialized: "LOCAD is specifically designed to detect and identify microbes on space station surfaces."

It is a fact of life that wherever humans go, microbes follow. Biologists estimate that every human body has at least a trillion hitchhiking microbes, accounting for as much as 2% of a person's total mass. Most live in harmony with native human cells; others can make you sick.

Here's how it works: An ISS crew member uses a dry swab to take samples of surfaces where microbes might be lurking. Flushing sterile water through the swab converts the sample to liquid form, and the astronaut puts a few drops into the LOCAD. What's in the sample? The system gives its answer less than 15 minutes later. The whole easy procedure is done on location. Nothing has to be sent back to a lab on Earth, which would take time and introduce the possibility of contamination en route.

"It's important to monitor bacteria on the space station so we can find the best way to keep them under control," says Morris, who adds this curiosity: "LOCAD can't yet distinguish between live and dead bacteria." So no one can cry out, it's dead, Jim! "We're working to add this capability in the future."

In addition to detecting Gram-negative bacteria like *E. coli* and *Salmonella*, the latest LOCAD cartridges just sent up to station aboard shuttle mission STS-123 can alert the crew to fungi. Since fungi actually decomposed some electronics on the Russian Space Station MIR, they have become unwelcome "house guests." LOCAD can detect low concentrations of a common fungal compound; this allows LOCAD to find fungi on surfaces before the fungi have a chance to multiply.

By the end of the year, yet another cartridge will be available for the space station. This one will detect the presence of Gram-positive bacteria such as *Staphylococcus* and *Streptococcus*.

"Ultimately we want to provide cartridges for all kinds of microorganisms and chemical compounds," says Morris. "We'd even like to be able to use our system to figure out what 'bug' an astronaut has if he or she becomes ill."

Lisa Monaco, LOCAD project scientist, adds her vision of the future: "What we are developing at MSFC has use not only on the ISS, but also on lunar missions, long-duration stays on other planets, and most certainly here on Earth."

In the years ahead, as space voyages become longer and longer, it will be even more imperative to have ways of checking astronauts' health and monitoring electronics. For the record, no astronaut has ever become seriously ill on any space mission. However, the scientists point out that if an astronaut did ever get sick, it would take too much time to send a sample back to Earth, have it tested, and receive a long-distance answer. With next-generation LOCAD technologies, detection and diagnosis would be quick, easy, and on the spot.


NASA

Dr. McCoy, here we come.

FUNGI ENLISTED TO CLEAN UP DEPLETED URANIUM

Kate Melville

Science A Go Go, May 6, 2008

In a discovery that could have important implications for the cleanup of war ravaged countries, researchers have found evidence that fungi can "lock" depleted uranium into a mineral form that would be less likely to find its way into plants, animals, or the water supply.

Depleted uranium is a by-product of the enrichment process used to create uranium 235, the isotope which is used in nuclear weapons and reactors. It is almost twice as dense as lead, giving it enough kinetic energy to blast through the tough armor of a tank. The Department of Energy considers depleted uranium to be a "waste material" and it is freely available to munitions manufacturers. In munitions, depleted uranium pulverizes into a fine dust upon impact, where it can be inhaled or seep into the soil.

Estimates of depleted uranium in Iraq alone total more than 2,000 tons, with other regions around the world such as the Balkan states also affected. Depleted uranium is linked to birth defects and has an estimated half-life of 4.5 billion years.

There has been little investigation into how an affected environment could be cleaned up after a conflict, but recent work, published in *Current Biology*, by researchers at the University of Dundee in Scotland indicates that nature may be able to lend a hand. "This work provides yet another example of the incredible properties of microorganisms in effecting transformations of metals and minerals in the natural environment," said Dundee's Geoffrey Gadd. "Because fungi are perfectly suited as biogeochemical agents, often dominate the biota in polluted soils, and play a major role in the establishment and survival of plants through their association with roots, fungal-based approaches should not be neglected in remediation attempts for metal-polluted soils."

In the new study, the researchers found that free-living and plant symbiotic (mycorrhizal) fungi can colonize depleted-uranium surfaces and transform the metal into uranyl phosphate minerals. "The fungal-produced minerals are capable of long-term uranium retention, so this may help prevent uptake of uranium by plants, animals, and microbes. It might also prevent the spent uranium from leaching out from the soil," explained Gadd.

The process involves a combination of environmental and biological factors. First, the unstable uranium metal gets coated with a layer of oxides. Moisture in the environment also "corrodes" the depleted uranium, encouraging fungal colonization and growth. While the fungi grow, they produce acidic substances, which corrode the depleted uranium even further. Some of the substances produced include organic acids that convert the uranium into a form that the fungi can take up or that can interact with other compounds. Ultimately, the interaction of soluble forms of uranium with phosphate leads to the formation of the new uranium minerals that get deposited around the fungal biomass.

"We have shown for the first time that fungi can transform metallic uranium into minerals, which are capable of long-term uranium retention," the researchers concluded. "This phenomenon could be relevant to the future development of various remediation and revegetation techniques for uranium-polluted soils."

PRESIDENT'S MESSAGE

Patrice Benson

I am typing this on a Blackberry from the belfry of the Château de St. Julien l'Ars in France near Poitier. Joanne Young is here too, as we needed a vacation after that wonderful first Mushroom Maynia! at the Burke Museum on May 4th.

Sixty PSMS members participated along with mycologists Drs. Joseph Ammirati, Steve Trudell, Michele Seidl, Katherine Glew, and Dean Glawe. Attendance included 300 who paid admission to see the exhibit as well as 70 Burke Museum members, and we signed up about eight new members to PSMS. It was a delightful experience for everybody. Thanks to all who made this possible, especially Dr. Julie Stein and Carl Sander of the Burke for their support in development and planning. By all accounts it was a success and should become a yearly tradition!

We will be losing three dedicated and hard-wroking board members this summer. Molly and Kevin Bernstein and Cynthia Nuzzi will be moving from Seattle. They will be missed.

The mushrooms are finally coming up in the Pacific Northwest after a long cool spring. Two friends and I found 21 morels on May 8th somewhere east of Easton. Reports from the local Knife and Gun shop here in St. Julien l'Ars are that the cepes are up about 7 km from here. Stay tuned! Au revoir.

YAHOO DISCUSSION GROUP

Want to stay in touch over the summer? The PSMS e-mail discussion group maintained by Yahoo Groups is an easy way to keep in contact with other members, circulate information about PSMS events, and post general mushroom information. To join, follow the directions on the PSMS Website (http://www.psms.org) or on page 40 of the club roster.

NEW MUSHROOM MAGAZINE

Carol Deptolla

Milwaukee Journal Sentinel, May 15, 2008

Mushrooms are popping up, and so is a new magazine all about them.

Fungi, based in Richfield, celebrated its launch in conjunction with two five-course mushroom dinners: at Heaven City in Mukwonago on Sunday, and at Sanford in Milwaukee on Tuesday.

Britt Bunyard of Richfield—who holds a doctorate in mycology, the study of mushrooms—is the publisher and editor-in-chief of the new, full-color magazine, called *Fungi*.

Fungi made its debut this month, and will publish five times a year: four seasonal issues and one special themed issue. This year's special issue, due in early fall, will be dedicated to truffles, including those found in such unexpected places as the desert and Oregon, Bunyard said.

The magazine is aimed at amateur and professional mycologists alike, and its offerings will include how-to articles on topics such as cultivating mushrooms, as well as peer-reviewed technical papers.

Articles in the inaugural issue include "Mushroom Love, Morels: Seasonality, Meditation, Celebration," complete with recipes, and a mouthful of a different sort, the scientifically oriented "Myxomycete Plasmodia and Fruiting Bodies: Unusual Occurrences and User-friendly Study Techniques." For more information, see www.fungimag.com.

ROAST VEAL WITH MORELS

Schuyler Ingle and Sharon Kramis

Northwest Bounty, 1988

A good choice for a spring dinner, when the morels are showing up in the woods and the markets. They are heavenly prepared this way. Serve this with fresh asparagus and oven-roasted potatoes.

1 3-pound veal shoulder roast, well-trimmed and tied
2 TBs butter
1½ cups chicken stock
½ pound fresh morels, brushed clean with a mushroom brush
1½ cups heavy cream
Salt and pepper to taste
Dash of nutmeg

Preheat the oven to 350°F. Brown the roast slowly in a Dutch oven in the butter. Add the chicken stock. Remove from the heat. Lay a piece of waxed paper directly on top of the meat and then cover the pot. Bake in the oven for 2½ hours, or until the meat is tender.

Slice the morels and place in a sauté pan. Pour in the cream and simmer for 20 minutes, or until the cream has been absorbed by the mushrooms. Season with salt, pepper, and nutmeg.

Remove roast from pan. Place on serving dish. Add ½ to 1 cup of the pan juices to the mushrooms and heat and serve with the roast. *Serves 6.*

This will be the last newsletter until September.
Have a good summer!

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