SPORE PRINTS

BULLETIN OF THE PUGET SOUND MYCOLOGICAL SOCIETY
Number 547 December 2018

Happy

Postcard contributed by Brian S. Luther.

Holidays !

FUNGI THAT ARE NECESSARY FOR A MERRY CHRISTMAS

Tom Volk

https://botit.botany.wisc.edu/toms_fungi/xmas.html, 2007

Christmas Trees: The primary, although indirect, benefit of fungi to people is mycorrhizae, which are associations between fungi and the roots of plants. Approximately 90% of plant species in nature have a mycorrhizal association with a fungus! Of course the primary Christmas thing that is the direct result of this association is the Christmas tree. Without the fungi the trees would not grow very well at all—at most two or three feet tall in ten years! Most of the Christmas trees from the north (pines, firs, Douglas fir, spruces) are ectomycorrhizal—they form an association with Basidiomycota (and a few Ascomycota), which form fruiting bodies (mushrooms) that are very familiar to most of us. Some other evergreen trees (juniper, cypress) form endomycorrhizae with members of the Zygomycota (order Glomales, related to the "bread molds"), so there are never mushrooms under those kinds of trees. The fungi receive sugars from the plants' photosynthesis and, in return, the fungi provide the plants with increased absorption of water and mineral nutrients. Both the plants and the fungi benefit from this association…and while we're at it, don't forget about that partridge—where would it sit without that endomycorrhizal pear tree?

Paper Products: The necessary and beneficial effects of mycorrhizal fungi for all trees (and almost all plants) has been noted above. Without trees there would be virtually no paper—and no wrapping for those Christmas presents. Another fungus with potential use in the paper-making process is *Phanerochaete chrysosporium*, a very efficient white-rot fungus. It is being investigated as a possible biobleaching and biopulping agent to replace the harsh chemicals that are being used in conventional paper bleaching. This fungus is able to digest the brown lignin in the wood and leave the white cellulose behind for use in making paper. *Phanerochaete*

cont. on page 4

Spore Prints

is published monthly, September through June by the

PUGET SOUND MYCOLOGICAL SOCIETY

Center for Urban Horticulture, Box 354115

University of Washington, Seattle, Washington 98195

(206) 522-6031 http://www.psms.org

OFFICERS: Kim Traverse, President[2015–2019]
president@psms.org (206) 380-3222
Daniel Winkler, Vice President[2016–2020]
me@danielwinkler.com
Donna Naruo, Treasurer[2017–2020]
dn17psms@gmail.com (206) 938-2783
Luise Asif, Secretary[2015–2019]
asiff@hotmail.com (206) 365-6741

TRUSTEES: 2018–2020:
Sweta Agrawal, Paul Hill,
Milton Tam, Anne Tarver

2017–2019:
Shannon Adams, Carlos Cruz,
Derek Hevel, Jamie Notman,
Erin O'Dell

ALTERNATES:

IM. PAST PRES: Marian Maxwell

SCI. ADVISOR: Dr. Steve Trudell

EDITOR: Agnes A. Sieger, 271 Harmony Lane, Port Angeles, WA 98362
sieger@att.net

CALENDAR

Dec. 11	Holiday Extravaganza, 7:30 pm, CUH
Dec. 11	*Spore Prints* deadline (**early**)
Dec. 17	Board meeting, 7:30 pm, CUH board room
Jan. 8	Membership meeting, 7:30 pm, CUH

BOARD NEWS — Luise Asif

Plans are under way for the Holiday Extravaganza on December 11. Sign-up is available on the PSMS Website. The nomination committee is being formed for next year's elections. We will need to replace five trustees, President, and Secretary. Please consider either joining the committee or running for the board. The Bridle Trails Survey is still continuing. There is a wonderful core group who has been coming out on a regular basis, rain, snow, or shine! Thank you all and bravo for your dedication. Interested in joining this group? Contact Daniel Winkler or Luise Asif (fasif@hotmail.com).

MEMBERSHIP MEETING — Marian Maxwell

Tuesday, December 11, 2018, at 7:30 pm at the Center for Urban Horticulture, 3501 NE 4lst Street, Seattle

Since the mushroom fruitings are waning, this is a perfect time to share stories from this year and spend some fun time with your fellow PSMS members!

Please join us on Tuesday, December 11, at the annual PSMS Holiday Extravaganza for great company, door prizes, a fun edible art competition, appetizers, and desserts. Peruse your personal recipes and bring a favorite holiday finger food to share! You can bring wine and beer for service at the bartender's table. Invitations with links to register and more information will be sent out to the membership shortly. The cost is $5 a head, and space is limited (sorry, no refunds). This event is for members only (you may invite and register your significant other even if they are not a member) and is not open to the public. You may submit up to 10 of your favorite mushroom photos from the past year, for the slide show. Photos can be submitted to photography@psms.org and should be received by Saturday, December 8. This event is hosted by your Board of Trustees. Please send any questions regarding registration to Marian at outreach@psms.org.

FIELD TRIP REPORT, Oct. 20 — Brian S. Luther

For a change of pace, we had bright sunny weather at this location, unlike the first two years here when it rained constantly both days. Of the 88 members who signed in, 27 were brand new and experiencing their first PSMS field trip.

Pam and I were among the first to arrive Saturday, but Silas Studley had camped there overnight so he would be prepared. I got a fire going in the fireplace right away. The day started out right, for sure. Hosts Silas and Kitty Loceff set out a delicious assortment of snacks and hot coffee, which was greatly appreciated by everybody. Special thanks, Silas and Kitty! Thanks also to Wren Hudgins for bringing more firewood.

Our six field trip guides were Wren, Les Rawlings, Dave & Wuqi Weber, Andrew White, and Iain McConnell. Thanks to all of you for orienting the new members and making them feel welcome.

Western Washington had received a lot more rain than we'd gotten in eastern Washington, and consequently mushrooms were abundant in the woods. Some of the good edibles found included Yellow Chanterelles (*Cantharellus formosus*), White Chanterelles (*C. subalbidus*), Admirable Boletus (*Aureoboletus mirabilis*), Gypsy Mushrooms (*Cortinarius caperatus*), *Boletus fibrillosus*, Cauliflower Mushrooms (*Sparassis radicata*), Bear's Head (*Hericium abietis*), Angel Wings (*Pleurocybella porrigens*), and *Suillus brevipes* (one of the Slippery Jacks), as well as a few others.


Brian S. Luther

Tables overflowing with fungi.

I did table tours throughout the day and documented 152 different species displayed on four picnic tables that were overflowing with fungi. A few of the more interesting species brought in included *Hygrophorus camarophyllus*, *Lepiota flammeatincta*, *Hygrocybe marchii*, and very large specimens of *Gymnopilus ventricosus*. Some of the extra fragrant species included *Ramaria cystidiophora* var. *citronella*, smelling like sweet citrus, *Cortinarius citrinifolius*, also with a strong fruity odor, and *Clitocybe odora* var. *pacifica* with the unmistakable aroma of anise or licorice. One of the prettiest species was the bright red-orange *Hygrocybe singeri* with a conical bright red-orange cap, a viscid lemon-yellow stem, and staining black overall where handled. I explained, and successfully demonstrated, puffing" by blowing on a large mature collection of Orange Fairy Cups (*Aleuria aurantia*), and the membership was enthusiastically delighted.


Brian S. Luther

Gymnopilus ventricosus 8 inches in diameter found on a dead conifer near the shelter.

The potluck was somewhat small both in terms of dishes and in the number of members participating, but was very welcome indeed after a day of foraging in the woods.

FIELD TRIP REPORT, Nov. 3 — Brian S. Luther

When I got to the gate a little after 7:00 am, it was still locked. Several others arrived before the Head Ranger came 45 minutes later and apologetically opened the gate and turned on the power and lights in the shelter and the nearby restroom. I got a fire going right away in the big fireplace, and the others coming early helped the hosts set up.

Our hosts were Mark Pedini and Rosalyn Claret, and you can be sure that the new members were surprised and delighted at the large selection of morning breakfast snacks, fruit, juice, and coffee they provided. Thank you, Rosalyn and Mark. You made a big difference starting the day off right for everybody.

I usually schedule this field trip at the state park the weekend after our Annual Exhibit, so we know we'll get many new people who just joined. Even though the weather predictions were for rainy conditions, 128 members signed in, making it one of the biggest field trips in a long time. Of those, 30 were brand new to PSMS and eager to learn.


Wren Hudgins

Brian Luther orienting attendees before the field trip.

Our morning field-trip meeting was longer than usual because I had a two-page handout for members and had to explain the documentation required if they wanted to collect specimens within the park. Thanks to the several field trip guides who volunteered to take out new members.

I was fortunate to have Danny Miller helping with ID. With the large number attending, we were both kept super busy all day. Some members found chanterelles and a few Matsutake as well as a number of other edible species, but none in abundance. At the end of the day we had specimens covering six picnic tables.

Just a few of the beautiful fungi found included *Pholiota astragalina* with the color of ripe apricots and *Cortinarius citrinifolius*, a bright yellow mushroom with a strong fruity odor.

The potluck at 3:00 pm was excellent and appreciated by all at the end of a rather wet day. Many stayed to help clean and pack up.

PSMS NOMINATION COMMITTEE

It's time to think about nominating candidates for the upcoming general election in February, and we are looking for a general member to serve on the nomination committee. We will be seeking candidates to fill five trustee positions on the PSMS Board for the years 2019–2021, as well as candidates for President and Secretary. Candidates for officer positions should have experience as a general trustee before running for an executive position. For more information or to volunteer, email Marian at outreach@psms.com.

YOUR NEXT ELECTRICAL SOURCE: BIONIC MUSHROOMS — David Grossman

https://www.popularmechanics.com, Nov. 9, 2018

Anyone who's visited a middle-school science fair is familiar the potato's ability to generate electricity. Now scientists from New Jersey's Stevens Institute of Technology have discovered a new source of electricity that grows in the ground (and goes great with a salad): classic white button mushrooms.

The scientists added 3D-printed clusters of cyanobacteria to the mushroom's cap, which gave the fungus the ability to generate electricity. Researchers also put in graphene nanoribbons to collect the current.

Betting on Bacteria

Cyanobacteria have been in the news lately for negative reasons, as the blue-green algae that's flooding Florida's beaches. But among bioengineers, cyanobacteria have a much better reputation, as they're known for their ability to generate electricity.

That ability has been difficult to harness because cyanobacteria simply can't survive on artificial bio-compatible surfaces. Researchers Manu Mannoor and Sudeep Joshi wondered if mushrooms, which naturally play host to a wide array of bacteria, could find room on their caps for cyanobacteria to live for an extended period. Mannoor, an assistant professor of mechanical engineering at Stevens Institute of Technology, says in a press statement:

"In this case, our system—this bionic mushroom—produces electricity. By integrating cyanobacteria that can produce electricity

cont. on page 7

Fungi Necessary for a Merry Christmas, *cont. from page 1*

chrysosporium is also being investigated as a possible agent of bioremediation—the lignin degrading enzyme it produces may someday be used at toxic waste sites.

Nuts and Chocolate: Without nuts, we would have no need for the Nutcracker Ballet! All nut trees have a mycorrhizal association with a fungus that helps them survive and prosper**.**

The natural bitter cocoa beans are processed into a sweet tasty candy by a "fermentation" (sensu food-scientists) of *Candida krusei* and *Geotrichum*. Sounds yummy! In addition, cacao trees survive because they have mutualistic mycorrhizal associations with *Acaulospora scrobiculata* and other fungi.

Bread and Cookies: Since the world's oldest profession, after all, is baking, the fungus *Saccharomyces cerevisiae* (bakers' yeast) has played an important role in thousands of years of human history. It is the organism that causes dough to rise by producing carbon dioxide. The alcohol that is produced generally evaporates. In addition, Vitamin B_2 (riboflavin) in enriched flour is produced by the ascomycete *Ashbya gossypii*.

Spirits of Christmas: *Saccharomyces cerevisiae,* the brewers' yeast, is necessary for wine, champagne, beer, eggnog, and other holiday spirits. They undergo anaerobic fermentation, producing ethyl alcohol and carbon dioxide, both of which are important in champagne and beer-making. Of course, the alcohol is the major product in wine and the other spirits.

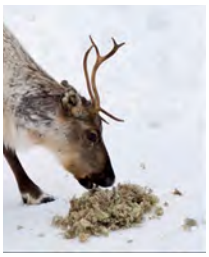
Edible Mushrooms: You can't have Christmas dinner without mushrooms! If you're lucky you might have some chanterelles in the freezer—you haven't lived until you've had chanterelle stuffing in your turkey—or maybe some dried morels or honey mushrooms. You might even be able to find or buy fresh truffles or Matsutake! Even if you have to settle for *Agaricus bisporus, the* white button mushroom, you're still doing pretty good—but it's worth it to try some of the new cultivated varieties found in the grocery store, such as shiitake, oyster mushrooms, portobella, crimini, and enoki.

Cheese: Many good cheeses, such as blue cheese, Camembert, and brie, are ripened through the action of fungi. Blue cheese is ripened *by Penicillium roquefortii*—the blue color is caused by sporulation of the fungus. And the white crust on the outside of brie and Camembert is the mycelium of *Penicillium camembertii.*

Citric Acid: If we believe all the commercials on television, we could not imagine having a holiday (or any day, for that matter) without a soft drink. The citric acid in cola drinks is produced by large-scale vat fermentation of *Aspergillus niger.*

Stone Washed Jeans: Maybe someone bought you some soft stone-washed jeans for Christmas. Now, you didn't really think they make those variable-color, sort-of-faded-out jeans by hiring little old ladies with babushkas to take them out to the rocks on the stream and beating them? No! The jeans are placed in a large vat containing a fungus, *Trichoderma,* which produces enzymes (cellulases) that partially digest the cotton fibers of the jeans, for that stone-washed look and softness.

Reindeer Lichens: Of course Santa's reindeer have to eat something, and for a large portion of the year, reindeer in the tundra feed off of reindeer lichens, *Cladonia rangiferina,* also (incorrectly) known as reindeer moss. They are very abundant in the Arctic and literally cover the tundra. Of course fungi can't take all the credit here—a lichen is a dual organism, the result of a mutualistic (symbiotic) relationship between a fungus and either an alga or a cyanobacterium.



Soy Sauce: If you're celebrating Christmas with an Asian flair, as in "A Christmas Story" (one of my all-time favorite Christmas movies), you will probably have some soy sauce with and in your meal. Authentic soy sauce is fermented in a three-step process with the fungi *Aspergillus oryzae* and *Zygosaccharomyces rouxii,* as well as the bacterium *Pediococcus halophilus*. (Thanks to Dr. S.N. Rajagopal of the Microbiology department at UW- La Crosse for this information.)

Red Wine Yeast: Interestingly, authentic Peking duck is rubbed with the red yeast *Monascus purpureus* to impart its coloration. Coincidentally, *M. purpureus* produces a cholesterol-lowering drug—so you've got a built-in antidote for the fatty cholesterol in the duck! *M. purpureus* is sold commercially as "red yeast rice."" (Thanks to Dr. Debby Hanmer, formerly of my department, who learned this on a trip to China.)

iStock

Saccharomyces cerevisiae and wine fermentation.

Sake: If you're having some sake (or Shinruuchuu, a very sweet Chinese sake) with your dinner, you must thank the fungi *Aspergillus oryzae* (which breaks down the rice starch into sugar) and *Saccharomyces cerevisiae* (=*Saccharomyces sake*, which ferments the sugars), along with the bacterium *Lactobacillus sake* and perhaps other lactobacilli. (Thanks again to Dr. S.N. Rajagopal for this information.)

https://www.decanter.com/

A MICROSCOPE? ME? YOU GOTTA BE KIDDING.

Leslie Reid

Mycolog, Humboldt Bay Myco. Soc., Nov. 2018

If someone had told me a year ago that I'd be spending several days a week staring down the tube of a microscope—and enjoying it—I would have scoffed. But here I am today, taking a break from microscopy to write this. I got my first scope in January and my second in March, when I'd out-grown my first.

What possessed me? Frustration. I wanted to be able to identify those beautiful little lepiotid species, but the attributes that distinguish them are, in effect, invisible to mere mortals. As luck would

have it, my first microscope arrived a week after the last *Lepiota* departed, so the first mushroom I examined was an unknown *Cystoderemella*—either *C. cinnabarina* or *C. granulosa* ("...is very similar..., but lacks the cystidia on its gills"). I focused on the gill edge at 200×, and there, clear as day, were the cystidia. I was hooked. Or Leeuwenhoeked, I suppose.

It only got better after that. Spores are remarkably beautiful, and the ability to test one's own field IDs is amazingly empowering. By March, I was needing better resolution and a better way to capture microscope images, so I upgraded.

So who "needs" a microscope? Probably only those particularly interested in identifying mushrooms for the joy of identifying mushrooms, and those wanting a glimpse of a really intriguing miniature world that most will never see.

And how much microscope do you need? Not a lot to get started—about the price of a nice dinner for two in San Francisco (which is how I rationalized mine). You need a compound microscope that can give you 1000× magnification to get a good look at spores (400× works, but is frustrating). The least expensive scopes make it to 1000× by using a 25× eyepiece with a 40× objective, which isn't ideal—the poor optical quality of the eyepiece is guaranteed to give a blurry image that has enough color aberration to be reminiscent of a Jimi Hendrix album cover, and you can't get a 25× reticule eyepiece for making measurements without a camera. This is the one I started with, and I was still able to measure spores using photos—all you need is another photo of a calibration slide at the same magnification so that you can interpret the measurements.

Much better would be a scope that gets to 1000× using a 10× eyepiece and a 100× objective, but they have the added complication of requiring you to add a drop of special oil to fill the gap between the objective and the slide. It sounds complicated, but it very quickly becomes routine. You'll see some scopes that advertise 2500× magnification, but if they're affordable, they're getting there by using a 25× eyepiece with a 100× objective, and your image resolution won't actually be much better than the 1000×will give you—the blurriness will just be bigger. And more colorful. Save your money for a...

...camera. If you have a cell phone, you already have a pretty good microscope camera. I don't, so I got a camera that is built to slip into the scope's optical tube in place of an eyepiece, and I find it very convenient. These cameras attach to a PC via a USB port and are controlled from the computer.

They come with software, but full functionality for most of the software seems to be restricted to PCs rather than Macs. Most will still work with a Mac, but you won't have access to some of the bells or any of the whistles.

Once you've got the scope and a camera, you don't need a lot of other equipment: slides, cover slips, a calibration slide if you're going to make measurements, a slotted box for storing slides (that's how I dry them after I clean them), forceps, eyedropper, lens paper (for cleaning the oil-immersion lens), immersion oil, and you're good to go.

Leslie Reid

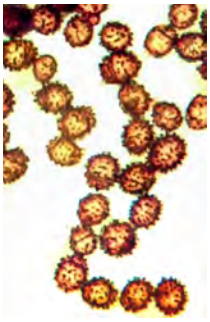
Pachycudonia monticola spores.

Leslie Reid

Trichoglossum hirsutum ascus and spores.

There's a bit of a learning curve involved, but it's a short one that isn't particularly steep. A good website gave me much of the information I needed to get started: http://www.mushroomexpert.com/microscope.html. A second one was even more complete but is now off the air; it lives on in pdf form in the files section of the Pacific Northwest Mushroom Identification Forum on Facebook.

Leslie Reid



Russula atroviolacea spores.

I usually have Dave Largent's *How to Identify Mushrooms to Genus III: Microscopic Features* open next to me while I'm working with the microscope. The terminology can be esoteric, but a good way to deal with that is to start by examining mushrooms you've already identified to see how the published descriptions compare to what you're seeing.

Where do you buy a microscope? There are lots of online sources, but the very best source I've found is local: I got my new microscope from Humboldt County's own Dave Imper, who refurbishes used scopes.

GENETICALLY ENGINEERED FUNGUS IS A MOSQUITO-KILLING MACHINE

FUNGI, Summer 2018

If you're wild about wild mushrooms, you know—and loathe—mosquitoes. But for many in the world, mosquitoes are more than a summertime irritation. Malaria kills nearly half a million people every year, according to the World Health Organization (WHO).

In some of the hardest-hit areas in sub-Saharan Africa, the mosquitoes that carry the malaria parasite have become resistant to traditional chemical insecticides, complicating efforts to fight the disease. A new study by Bilgo et al. (*Nature Scientific Reports 7*[1]: 3433) suggests that a mosquito-killing fungus genetically engineered to produce spider and scorpion toxins could serve as a highly effective biological control mechanism to fight malaria-carrying mosquitoes.

The researchers used the fungus *Metarhizium pingshaensei*, which is a natural killer of mosquitoes. The fungus was originally isolated from a mosquito, and previous evidence suggests that the fungus is specific to disease-carrying mosquito species, including *Anopheles gambiae* and *Aedes aegypti*. When spores of the fungus come into contact with a mosquito's body, the spores germinate and penetrate the insect's exoskeleton, eventually killing the insect host from the inside out.

In nature, the fungus requires fairly high doses of spores and a large amount of time to have lethal effects. To boost the fungus' deadly power, researchers engineered the fungus with several genes that express neurotoxins from spider and scorpion venom. The toxins act by blocking the calcium, potassium, and/or sodium channels required for the transmission of nerve impulses. Both spider and scorpion toxins have already been approved by the U.S. Environmental Protection Agency for insecticidal use.

cont. on page 6

Mosquito-Killing Fungus, *cont. from page 5*

Their most potent fungal strains, engineered to express multiple toxins, are able to kill mosquitoes with a single spore. Further, their fungal strains were capable of preventing transmission of disease by more than 90 percent of mosquitoes after just five days. The fungus is specific to mosquitoes and does not pose a risk to humans. Further, the study results suggest that the fungus is also safe for honey bees and other insects.

How so? When the international team of researchers inserted the toxin genes into the *Metarhizium* fungus, they included an additional failsafe: a highly specific promoter sequence, or genetic "switch," which ensures that the toxin genes can only be activated in the blood of insects. As a result, the fungus will not release the toxin into the environment.

To further ensure the safety of non-target insect species, the researchers also tested the engineered fungal strains on honey bees. The team deliberately infected local bees using both passive methods (exposing the bees to spore-coated fabric) and direct methods (spraying the bees with spores suspended in liquid). After two weeks, no bees had died as a result of the toxin-boosted fungus.

Besides malaria, a number of other mosquito-borne diseases such as dengue, yellow fever, viral encephalitis, and filariasis may also be combated using this new mold.

MUSHROOM SEASON IS FADING OUT ON THE WEST END OF THE OLYMPIC PENINSULA

Zorina Barker

Peninsula Daily News, Nov. 13, 2018

In the fall, there is gold out in the forests of the West End, and anyone can pick it off the ground and sell it by the pound.

Sandy McRuer

A nice haul of chanterelles.

Chanterelle mushrooms start peeking out of the forest floor in late July so that by mid-September the season is in full swing.

Mushroom pickers are easy to spot on the sides of West End roads and highways because they are almost always carrying 5 gallon buckets. Sometimes they just appear out of the timber on the sides of the pavement and disappear the same way they appear, occasionally stashing bicycles in the brush.

There are several wild edible mushrooms that grow in the forest.

Yes, there are ones that can kill people and have names that would be appropriate for death-metal bands. There also are those mushrooms that can take you hallucinating down Alice's rabbit hole. Experienced pickers know the difference between good and bad mushrooms. That is a good thing, too, because some edibles have a look-alike growing very nearby.

The chanterelle pickers begin by considering where the mushrooms grow best. All clear-cuts are out as are deciduous areas because chanterelles like to grow under fir, hemlock, and spruce trees.

Pickers start with a view to getting to the buyer around 3 p.m. because it seems the afternoon is when most buyers open their doors.

So, the pickers have their buckets, a place to go, and they start walking the forest with their eyes looking for the gold-orange scallop shape sticking out of the ground. Once one mushroom is found, chances are there are several close by.

Taking an edge, such as a knife or credit card, the pickers cut the stem at ground level. An experienced chanterelle picker will blow or gently brush off the needles and dirt before placing the mushroom in their bucket. Some even go the extra mile of pulling a T-shirt over the top of the bucket to keep needles and debris from getting inside as they walk through the underbrush.

It's a source of frustration to get to an area and see only orange stems in the ground because that means this area was just picked by someone else.

When the buckets are full, or the forest isn't giving up many mushrooms, pickers head to the mushroom buyers.

There are usually three or four places between Bear Creek and Forks where one can sell the chanterelles. Some buyers will buy other types of mushrooms, such as chicken of the woods, cauliflower, and lobster claw. But the most commonly sold is the chanterelle.

Antigone Barker.

Dennis Barker demonstrating that a cauliflower mushroom can easily be bigger than a man's head.

The buyers sometimes have a board indicating the daily price per pound for each variety. Sometimes the price changes with the quality of mushrooms being sold. This is partially why clean mushrooms are important, because if the buyer has to clean a picker's mushrooms, that picker is not going to get top dollar.

Earlier this season, I heard of a single cauliflower mushroom selling for $200.

Chanterelles can sell for upward of $8 a pound and drop to $2.50. A 5-gallon bucket averages between 15 and 20 pounds.

Prices are dictated by the buyer and seem to drop as the chanterelles are easier to find. A lot of rain makes the mushrooms heavier and thus seems to drop the price as well.

Getting to the buyer as soon as they open is fairly important because they pay in cash and cash can run out.

Sometimes the buyer is not alone and seems to have some "muscle" to protect against thieves who would take the money and run.

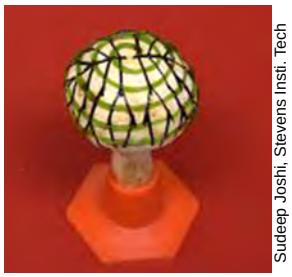
A picker's mushrooms are placed in the buyer's totes and weighed on digital scales. This is a quick process once the picker gets to the head of the line. Cash is paid with no haggling.

The chanterelles are fading out for the year now and some buyers have closed up their shops.

But there are easily enough for a home meal or two, just please ensure it's the right mushroom.

Bionic Mushrooms, *cont. from page 3*

with nanoscale materials capable of collecting the current, we were able to better access the unique properties of both, augment them, and create an entirely new functional bionic system."



Sudeep Joshi, Stevens Insti. Tech

A white button mushroom equipped with 3D- printed graphene nanoribbons (black), which collects electricity generated by densely packed 3D-printed cyanobacteria (green).

The cyanobacteria gelled with the mushrooms comfortably. Cells placed on a mushroom cap lasted several days longer than those left on a piece of silicone. "We showed for the first time that a hybrid system can incorporate an artificial collaboration, or engineered symbiosis, between two different microbiological kingdoms," Joshi says.

Making a Bionic Mushroom

As for collecting the current, the team used a robotic arm doubling as a 3D printer to create what they call an "electronic ink" made of graphene nanoribbons—tiny strips of graphene seen as alternatives to silicon semiconductors. Mannoor says this network of nanoribbons is akin to "needles sticking into a single cell to access electrical signals inside it."

With an electronic ink laid down, Mannoor and Joshi printed a bio-ink containing the cyanobacteria. This bio-ink was printed in a spiral pattern that intersected with the electronic ink of the nanoribbons. From there, all the scientists had to do was flash a light on their new bionic mushroom. The light generated cyanobacterial photosynthesis, and thus a mushroom-born electrical current was generated.

"With this work, we can imagine enormous opportunities for next-generation bio-hybrid applications," Mannoor says. "For example, some bacteria can glow, while others sense toxins or produce fuel."

CATERPILLAR, FUNGUS IN CAHOOTS TO THREATEN FRUIT, NUT CROPS, STUDY FINDS

Diana Yates

https://phys.org/, Nov. 5, 2018

New research reveals that *Aspergillus flavus*, a fungus that produces carcinogenic aflatoxins that can contaminate seeds and nuts, has a multilegged partner in crime: the navel orangeworm caterpillar, which targets some of the same nut and fruit orchards afflicted by the fungus. Scientists report in the *Journal of Chemical Ecology* that the two pests work in concert to overcome plant defenses and resist pesticides.

L. Brian Stauffer

The navel orangeworm. It grows up to be a nondescript-looking moth.

"It turns out that the caterpillar grows better with the fungus; the fungus grows better with the caterpillar," said University of Illinois entomology professor and department head May Berenbaum, who conducted the study with entomology graduate student Daniel S. Bush and U.S. Department of Agriculture research entomologist Joel P. Siegel.

"The fungus is an incredibly opportunistic pathogen. It infects all kind of plants. It also infects animals on occasion, including humans," Berenbaum said. "And it's very, very good at breaking down toxins."

The caterpillar, *Amyelois transitella*, also is an opportunistic feeder. Unlike most insect larvae, it somehow overcomes the defenses of a variety of host plants, including almonds, pistachios, and figs. The caterpillar chews its way in and contaminates the fruits and nuts with its excrement and webbing. It also opens the door to *A. flavus* infection. Unlike many other insects, the navel orangeworm caterpillar can metabolize aflatoxin, making it immune to this toxic fungal byproduct, Berenbaum said.

Prior to the new study, researchers and growers had observed coinfection with the fungus and the caterpillar, but did not know whether the two simply tolerated one another or worked together in a mutualistic partnership.

To find out, the team ran experiments to see how laboratory-reared navel orangeworm caterpillars responded to specific plant defensive compounds and pesticides in the presence or absence of the fungus. They measured caterpillar mortality and time to pupation in a variety of conditions. The tests included a caterpillar strain that was susceptible to pyrethroid pesticides and another that was resistant.

The tests revealed that the caterpillars developed much more rapidly in the presence of the fungus, regardless of the natural or man-made toxins that were also present. Larvae exposed to the plant defensive compound xanthotoxin developed nearly twice as fast when the fungus was also present. Larvae fed a diet containing xanthotoxin or bergapten—another phytochemical in the same class as xanthotoxin—also lived much longer in the presence of the fungus than when exposed to the chemicals alone.

The caterpillars differed in their response to pesticides—with and without their fungal partner. The pesticide-susceptible caterpillars had higher mortality in the presence of the pesticide and fungus than when exposed to the pesticide alone. Pesticide-resistant caterpillars were unaffected by the pesticide, whether or not the fungus was present.

When the researchers incubated the fungus with the pesticide bifenthrin before the caterpillars came on the scene, however, caterpillar mortality went down. This suggests *A. flavus* detoxifies bifenthrin, which helps the caterpillar, the researchers wrote.

"It's very likely that this caterpillar has managed to colonize so many new crops because its partner fungus can break down the chemical defenses of the tree crops that it encounters," Berenbaum said. "It's also giving this caterpillar an extra edge because the fungus is breaking down some of the pesticides that growers are using to combat the caterpillar."

RED WINE MUSHROOMS

Janet McCormick
Herald-Dispatch.com.
via *The Spore Print*, L.A. Myco. Soc.,
Nov., 2018

There is something very deep and soulful about red-wine-soaked mushrooms that are almost steeping in the great flavors of butter, garlic, and any ol' wine you have lying around. Tonight left-over red wine with only a glass to spare became the cloak of choice for these earthy round balls of fungi.

Ingredients

1 lb. button mushrooms
1/3 cup wine
3 cloves garlic
1 stick butter
1 TBs olive oil
Parsley for garnish

Method

In a large skillet melt the butter and add the mushrooms. Cook for one minute. Add the garlic. Cook for one minute. Add the wine and stir. Cover and reduce for 5 minutes. Top with parsley and serve.

OOPS

[ed. note]: New member Joe Gosse pointed out that the term "oriental" used in Hope Cook's recipe last month is considered offensive by many. As you might imagine, I did not mean to offend anybody, and I'll certainly be more careful about this in the future. The recipe, and its title, was taken directly from Hope Miller's cookbook, issued in 1993. Knowing Hope, I'm sure she would not have wanted to offend anyone either.

Thanks, Joe, for taking the time to make the newsletter a little better.

HAVE A GREAT HOLIDAY, EVERYBODY!
SEE YOU NEXT YEAR.

Puget Sound Mycological Society
Center for Urban Horticulture
Box 354115, University of Washington
Seattle, Washington 98195

RETURN SERVICE REQUESTED

Non-Profit Org.
U.S. POSTAGE
PAID
SEATTLE, WA
PERMIT NO. 6545