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In This Issue:

Radulodon copelandii, Asian Beauty

Thomas Roehl
Newsletter Editor

For several years, MAW has been encountering an unusual fungus that produces white teeth on dead logs. You've probably seen this mushroom; I estimate it's about as common as true Turkey Tail in the DC area.

I first encountered this mushroom on my second foray with MAW, a late November foray in 2015 that was MAW's last foray of the year. We were at Scott's Run and came across five or more logs coated with large patches of this white toothy fungus. Some patches were pristine, others were dried up, and some had mold growing on them. This gave us lots of samples that varied from young to old – an ideal range for successful identification. Despite this, nobody knew or even recognized the fungus. I tried to identify it after I got home with no success. It was also at this foray that Jon Ellifritz invited me to join the MAW Board and I accepted the vacant position of Newsletter Editor.

We encountered the mushroom regularly over the next few years but still didn't have a name for it. I began calling it "Witch's Wool" just to be able to call it *something*. In 2017, one of MAW's members heard from a mycologist that it might be a jelly fungus. In 2018, at the suggestion of another mycologist, MAW began using the name *Basidioradulum radula*, commonly known as the "Toothed Crust" (and not a jelly fungus). In January of this year, I sat down to research the fungus and discovered that the description of *B. radula* was close, but didn't quite match our mystery fungus: our mushroom was just too fleshy, too ephemeral, and the spines were too dense.


Thomas Roehl
What is this crust-like toothed mushroom? It took MAW three years to figure out its name: *Radulodon copelandii*.

I was about to give up after reaching another dead end when I came across the page for *Radulodon copelandii* from Gary Emberger's *Fungi Growing on Wood* website. That page linked to an article in Continued on Page 2

The Mushroom Chronicles: Pharmacopoeia

William Needham
MAW President

Fungi do not make their own food. They rely on plants for sustenance, a characteristic they share with animals such as humans. Paul Stamets, in the book *Mycomedicinals*, offers that this is because "we shared a common ancestor more than 460 million years ago." When one considers that this was shortly after the Cambrian explosion when many life forms appeared overnight (from the geological perspective) and many early phyla were represented by a single organism, this is not as outlandish as it sounds. If it hasn't already, DNA evidence will undoubtedly demonstrate that this relationship can be genetically proven. The point of asserting this verisimilitude is that if fungi are similar to animals and have had to compete in a world governed by survival of the fittest, then those that have survived have done so by evolving the means to ward off predators. This would include things like microbes and viruses that also prey on animals. According to this logic, fungi should be a rich source of proven chemical combinations that ward off pathogens.

Homo sapiens have had to cope with insidious diseases throughout our shared history of some five million years. Drug therapy from naturally occurring substances was most assuredly a matter of serendipity. Through the ages, the lore of folk medicine was passed down through tribes and clans as the purview of the shamans of Asia and the medicine men of the Americas. It is well documented that Native Americans used plants for treatments of everything from menstrual cramps (spicebush) to sore throat (bloodroot). Their use of fungi is less well known, though there is evidence they employed fungi for the treatment of joint pain and congested organs. The only well documented use of fungi by Native Americans was as a

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Mushrooms

Continued from Page 1 FUNGI magazine from 2011 titled "Mysterious Asian Beauty Conquers Eastern Massachusetts" by J. Ginns and Lawrence Millman. The title caught my eye because it reflected MAW's experience: an unknown mushroom suddenly became one of the most common mushrooms in the area.

Reading further, I found that the description of the fungus matched exactly – after three years and two months I had finally figured out the name of this bizarre fungus: *Radulodon copelandii*!

After being your Editor for nearly four years, I am leaving to pursue a Master's degree in biology (focusing on mycology) at the University of Wisconsin-La Crosse. I wanted to leave you with this story of *R. copelandii* because it bookends my time at MAW surprisingly well and also to encourage you when you can't identify a mushroom. Mushroom identification is challenging under the best circumstances and can be impossible if you don't have access to the right resources. But keep your eyes open and keep exploring – you never know when you'll stumble across the right answer!

So, without any further ado, let me introduce you to North America's newest mushroom: *Radulodon copelandii*.

Description

Radulodon copelandii is a distinctive fungus that produces a mat of whitish teeth along the surface of recently dead broadleaf trees, usually oaks. The mushroom recently arrived on the continent from Asia, which gives the mushroom its common name: "Asian Beauty." The Japanese names for the mushroom are "Sagari haritaki" and "hanging needle mushroom." *R. copelandii* is currently spreading in eastern North America and is quickly becoming one of the most common mushrooms within its range. This is concerning, so the species warrants further study and monitoring – hopefully by people like you!

Radulodon copelandii is basically a combination of a crust fungus and a toothed fungus: it is a flat surface that lies against its substrate and sprouts teeth that hang down. The surface begins as a small circular to oval-shaped patch and spreads outward, often fusing with other patches. At its largest it can cover entire logs, although individual patches are usually no longer than 30cm across.

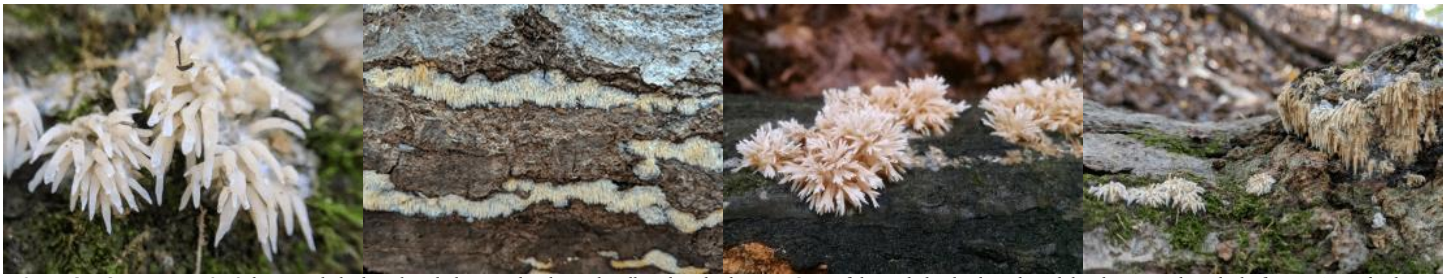
The teeth of *R. copelandii* are usually flattened, slightly lobed, and up to 1.2cm long. Teeth often branch a few to several times, although branching is absent or difficult to distinguish in many specimens. They hang down off the surface icicle-like, unless they grow on top of a log, in which case they grow more like a fountain. I find the teeth on top of a log are usually thicker than the ones on the side, probably because they require more support to stand up. When fresh, the teeth grow thick enough that you usually can't see the flat spreading surface behind them. The teeth are white when young, but they soon become off-white to dull yellowish. However, the tips remain white as long as they continue growing. Once the mushroom stops growing and begins to decay, the tips turn brownish; the orange-brown color spreads up the tooth as that part of the fungus dies back. The teeth get thinner as they dry up, revealing the flat surface beneath them.

Behind the teeth, the flat surface is the same color as the teeth. When this surface is actively spreading, it has a white ring along the edge and has a slightly fibrous appearance. This area is generally free of teeth, which start developing just at the edge of the white zone. After the mushroom stops spreading along the surface, the edge turns yellowish like the rest of the fungus and teeth begin growing all the way up to the edge.

R. copelandii doesn't have many other defining features. It produces no distinctive odor and does not change color when injured. This lack of features actually helps eliminate some similar species.

Ecology

In my area, *R. copelandii* is a decomposer of recently dead oak trees and occasionally other hardwoods. This mushroom has also been collected from maples and beeches in the United



Left to right: Photo 1: *R. copelandii* has irregularly shaped teeth that are whitish to pale yellowish with white tips. Some of the teeth develop branches while others are unbranched. **Photo 2:** *R. copelandii* fruits from dead wood of broadleaf trees, often oak trees. It usually appears on standing dead trees or logs that still have bark on them. The mushroom usually appears in the furrows of the bark. **Photo 3:** R. copelandii usually produces teeth that hang down, but it may grow in a more fountain-like arrangement when on top of a log. **Photo 4:** This picture demonstrates how the same mushroom can slightly change its growth habit based on where it grows on a log. *Pictures by Thomas Roehl*

States and I have seen a picture of it growing on a sycamore. It causes a white rot on standing dead trees, logs that still have bark on them, and sometimes older deadwood. One of the distinctive features of *R. copelandii* in North America is its preference for fruiting in bark furrows. Asian specimens also grow on dead hardwoods, although in Asia the mushroom can appear on small sticks as well as logs of a variety of broadleaf trees. So far, the mushroom is known to grow in the United States, Canada, Japan, China, Korea, Philippines, Sri Lanka, Malaysia, and eastern Russia.

Although *R. copelandii* seems to prefer cooler temperatures, it fruits at any time of the year. It is most abundant during the fall and winter in North America and during the summer and fall in Japan. However, it is still a common sight at any other time of the year as well.

R. copelandii is one of the most common fungi in my area – I *always* find it on forays – and it might be as common as *Stereum ostrea*. This is surprising, since it was first spotted in the United States only ten years ago. The first North American report was from November of 2009 in Bradley Palmer State Park in Ipswich, Massachusetts. Other specimens were found in early 2010 in a few areas 10-20 miles from Boston, Massachusetts.

In November 2015, I found *R. copelandii* fruiting profusely in Scott's Run Nature Preserve just outside of Washington, DC. If the fungus did arrive first in Massachusetts (given how poorly fungi are documented, this is difficult to say for certain), this means it managed to become a dominant species in an area over 400 miles away in only six years. That's a range increase of about 67 miles every year.

Based on the maps from **iNaturalist** and **Mushroom Observer**, the fungus is now present in 11 US states and one Canadian province, from its northern limit just outside Ottawa south to the mountains of North Carolina and from its western limit of far eastern Ohio east to Boston, Massachusetts. Mushroom Observer also has a record from Missouri, although I'm not sure that was identified correctly.

Assuming *R. copelandii* continued to spread a rate of about 67 miles per year, it should have reached Detroit (Michigan) Columbus (Ohio), Blacksburg (Virginia), and Raleigh (North Carolina). *R. copelandii* is actually a little bit ahead of these predictions in North Carolina. Using the furthest observations, the fungus could have already reached Knoxville (Tennessee), Louisville (Kentucky), and Indianapolis (Indiana) and could be approaching Chicago (Illinois). There are no records of the fungus from those cities, but that could just be because nobody is looking for it or knows what to call it. If it took MAW three years to put a name on this fungus, other clubs will probably face the same challenges, making it difficult to accurately track the fungus' spread.

Speaking of spread, I have to wonder what factors are contributing to the mushroom's amazing rate of range expansion. I tend to find more *R. copelandii* mushrooms in more urban areas, which could indicate a human role in the fungus' expansion (of course, I spend most of my time in urban areas, so that may just be a result of selection bias). I've also seen a number of different insects crawling on *R. copelandii* – perhaps one of those is helping to spread the fungus. *R. copelandii* has also been noted for producing spores in astounding numbers. Once, a MAW member watched *R. copelandii* give off clouds of spores as if it were smoking. Its ability to produce so many spores is likely a major factor in helping the fungus spread.

Given its prevalence and Asian origin, *R. copelandii* is likely an invasive species. For something to be considered invasive it must meet two criteria: 1) it is not native to a region and 2) it causes harm. *R. copelandii* is definitely not native to North America. However, nobody has ascertained whether the species is causing harm somehow. Since it is now one of the most common mushrooms within its North American range, it seems likely that *R. copelandii* is outcompeting native species. This could drive some native species to extinction and disrupt the relationships between wood decomposing fungi and insects, birds, other animals, and other fungi. Since nobody has tied *R. copelandii* to a specific harm, the fungus is not considered an invasive species (at least, not yet).

I've tried to be thorough, but I hope you can see how much we don't know about this fungus. How did it get to the United States? When did it arrive? Where is it now? What factors contribute to its spread? How is it interacting with the North American ecosystem? None of those questions will be easy to answer, but at least *R. copelandii* would

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Photos left to right: Photo 1: This mushroom is still young; the flat spreading surface is still visible beneath the developing teeth. **Photo 2:** *R. copelandii* starts off white but turns yellowish as it gets older. Here, the teeth are also starting to dry out and are getting thinner as a result. **Photo 3:** *R. copelandii* tends to turn reddish brown and then black as the teeth die back. In this picture, you can see all the color transformations that the mushroom goes through. **Photo 4:** *R. copelandii* often covers a large area. It is normal to find the mushroom completely coating half a log or more. *Pictures by Thomas Roehl*

Continued from Page 3 be an easy organism to study: you can find it any time of year, it is exceptionally common within its range, and it is easy to identify.

You can help study this fungus simply by taking pictures! If you find *R. copelandii*, take a photo and upload it to **iNaturalist** or **Mushroom Observer**. The more records there are, the easier it will be to track the spread of *R. copelandii*.

Similar Species

Crusts that have teeth are not very common, but there are a few species that could make identification confusing.

The most similar species is probably *Sarcodontia setosa*, which I have never seen. This mushroom grows on branches and logs of fruit trees and sometimes other broadleaves. Like *R. copelandii*, *S. setosa* grows flat against its substrate and produces dangling teeth. *S. setosa* can be distinguished by its yellow to bright yellow flesh that bruises reddish when injured and its fruity to very unpleasant odor. Additionally, *S. setosa* seems to be only one color: except where bruised, the teeth are the same color throughout their length. To differentiate *S. setosa* from *R. copelandii*, do the "Scratch & Sniff Test": scratch the mushroom to see if it bruises and smell the mushroom to see if it has a distinctive odor.

Basidioradulum radula is another similar species: it produces a flat surface with teeth that are white at the tips and yellowish white closer to the base. Unlike *R. copelandii*, however, its teeth are patchy so you can often see the flat surface underneath. It also seems to have a much tougher texture so its flat surface tends to crack when it dries out.

Irpex lacteus has a similar color to *R. copelandii* but is easy to differentiate. *I. lacteus* produces a surface of irregular white teeth on broadleaf sticks. It is actually a polypore and if you find a fresh mushroom the "teeth" will be tiny pores at the very edges of the mushroom. When mature, the teeth have the consistency of stiff paper, making them much tougher than those of *R. copelandii*. *I. lacteus* usually features a downturned top edge, creating a tiny pileus (*R. copelandii* never does this). The species *Pseudochaete olivacea* is very similar to *I. lacteus* except that *P. olivacea* is brownish throughout development and usually does not produce a tiny pileus.

Steccherinum ochraceum is probably the most regular toothed crust fungus. It has small cylindrical teeth that are evenly spaced along its flat surface. Like *I. lacteus*, its upper edge is usually downturned to make a small pileus. The upper surface and spreading edge of *S. ochraceum* are whitish, which contrasts sharply with the orangish teeth and tooth-producing surface.

Hericium species (such as *H. erinaceus*) are definitely not crusts, but they produce whitish teeth that hang down from dead broadleaf wood and may appear similar when young. *Hericium* species grow out from a single point and have a central branched structure that can support the mushroom's weight. This allows *Hericium* to grow several centimeters up and out from its substrate. *Hericium* species either produce much longer teeth than *R. copelandii* or form an intricately branched mushroom that is more coral-like than crust-like. Finally, *Hericium* does not produce a flat spreading surface and therefore cannot be called a crust.

Spongipellis pachyodon is another white toothed mushroom that grows on living or dead broadleaf trees, but it always creates a distinct pileus, making it very easy to differentiate from *R. copelandii*.

Trichaptum biforme sometimes produces crust-like growth on broadleaf wood (especially on the bases of recently dead but still standing oaks), although you usually find it producing distinct caps. When it grows in a more crust-like fashion, it produces very short teeth (or pores, since it is actually a polypore) and usually has a purple hue. Even when crust-like, there will be some tiny caps that stick out from the flat surface. These features are enough to confidently separate it from *R. copelandii*.

Taxonomy

R. copelandii (which was formerly *Radulomyces copelandii* and *Mycoacia copelandii* before that) belongs to the family Meruliaceae, which contains other crust fungi. Many of these species, such as *Phlebia tremellosa*, have a wrinkly spore surface and a pileus, making them a little more differentiated than most crust fungi. These fungi are all situated in the order Polyporales, so some of their closest relatives are polypores.

Radulodon is derived from the words "radula" – a tiny tooth that mollusks use to scrape food off of surfaces – and "-odon" – which refers to teeth.

And, because I know you were wondering, *R. copelandii* is inedible.

Fungi in the News

Annie Greene
MAW Newsletter Contributor

Editor's Note: This article contains summaries of the biggest fungus-related news from January through June 2019. Visit the link following each topic below for a closer look.

Denver and Oakland Vote to Decriminalize Psychedelic Mushrooms

In May 2019, the city of Denver, Colorado became the first city in the US to decriminalize the use of psychedelic mushrooms for adults aged 21 and over. Citizens of the city voted to approve this measure in which magic mushrooms remain technically illegal, but law enforcement officers are now considering psilocybin mushroom possession cases as low-priority, and city resources may not be used to impose criminal penalties for possession. Oakland, California soon followed suit and passed a similar decriminalization law in early June. These changes in legislation come on the heels of scientific research led by institutions including Johns Hopkins University, which has shown that psychedelic mushrooms have potential medical value for treating conditions like substance use disorder and post-traumatic stress disorder, and may help people with terminal illnesses cope with their diagnosis. Read more at: **https://www.denverpost.com/2019/05/08/denver-psychedelic-magic-mushroom/**

Ancient Fungal Fossils from Canada Offer Clues to Early Life on Earth

Scientists had previously postulated that fungal life on land dates back to 1 billion years ago, and newly discovered fossils strengthen that theory. A team of Canadian researchers recently found fossilized single-celled fungi on a piece of shale that had been naturally preserved in an Arctic estuary. The sample's structure and composition confirm that it is indeed a fungus, and analysis dates the fossil to 1 billion years ago, but it's still unclear what this fungus consumed for food and how it interacted with other ancient lifeforms. This new-to-us fungal species was named *Ourasphaira giraldae.* These findings confirm previous DNA-based predictions and will help scientists understand the origins of land-based life on Earth. Read more at: **https://www.nytimes.com/2019/05/22/science/fungi-fossils-plants.html**

Common Dirt-Dwelling Fungus in Australia Traps Gold Particles

Researchers in western Australia recently found that a local strain of the dirt-dwelling fungus *Fusarium oxysporum* gathers molecules of gold from its environment and sequesters the gold in microscopic clusters on its mycelium. This golden adornment is not only for show: *F. oxysporum* seems to grow larger and faster when associated with the precious metal. Scientists hypothesize that the gold molecules might help the fungus break down certain types of carbon for energy. In the future, miners may take samples of this wild fungus to detect underground gold deposits instead of conducting exploratory drilling, which is expensive and destructive. It also may be possible to utilize this fungus to recover gold from discarded electronic devices and sewage. Read more at: **https://www.livescience.com/65562-gold-studded-fungus-australia.html**

GMO Fungal Spores Expressing a Protein from Spiders May Help Fight Malaria

Mosquito species that carry malaria are increasingly developing resistance to insecticides, prompting researchers to get creative in their efforts to control mosquito populations. Spores of the fungus *Metarhizium pingshaense* are naturally lethal to mosquitoes, but the effects are too slow to effectively prevent malaria's spread. In a recent collaboration between researchers at the University of Maryland and researchers in West Africa, scientists genetically modified *M. pingshaense* strains so their spores express a toxin found in spider venom. When these modified spores encounter mosquito hemolymph (the insect equivalent of blood), the spider toxin activates and kills the mosquito quickly. In preliminary tests in controlled environments, contact with the toxin-expressing spores was deadlier to insecticide-resistant mosquitoes than contact with unmodified spores. These results come with the disclaimer that this strategy to fight malaria is in its infancy, and it's unclear how feasible this approach will be due to the cost of producing the spores and concerns about releasing genetically modified organisms into the environment. Read more at: **https://www.sciencemag.org/news/2019/05/fungus-venom-gene-could-be-new-mosquito-killer**

Two New Plastic-Eating Fungal Strains Discovered in India

Researchers in India have found two new strains of fungi that can break down plastic waste. Scientists at Phule Pune University collected soil samples from coastal areas that serve as plastic dumping sites. They then brought these samples back to the lab, isolated 109 individual fungal strains, and examined each strain's ability to degrade polyethylene, the main component in plastic bags. The most efficient plastic-degrading strains belonged to the species *Aspergillus terreus* and *Aspergillus sydowii*. Researchers aren't yet sure which enzymes these plastic-eating fungi use for this process, but experiments showed that the fungi can break polyethylene down into harmless byproducts. Since polyethylene can take around 1,000 years to degrade on its own, fungal degradation strategies represent an eco-friendly way to deal with plastic waste. Read more at: **https://weather.com/en-IN/india/pollution/news/2019-04-29-can-tiny-fungi-be-a-solution-to-our-giant-plastic-problem**

Events

Meeting Files

Thomas Roehl
Newsletter Editor

February 5: Lichens with Manuela Dal Forno

The first meeting of 2019 took place on February 5 and featured lichenologist Manuela Dal Forno. Manuela's presentation covered the basics of lichens, from ecology to morphology and identification to taxonomy and importance. Lichens are too complex to fit into this short summary, so if you're interested in them, you'll have to do some research on your own.

Lichens are composite organisms made up of a fungus and algae. The fungi form the structure of the lichen and the algae produce the food. Some lichens are flat, others are leafy, and some look like miniature shrubs. Because of their size, lichen identification requires examining tiny features; loupes are essential tools for lichenologists. Features important for identification include: spots on the surface, powdery areas, eyelash-like structures around the edge, and the color and texture of the underside.

Lichens are ecologically important because they provide food, homes, and camouflage for many animals. Humans use lichens for dye, perfume, food, to assess pollution, and to make litmus paper.

March 3: Foraging in Spain and Mushroom Cultivation

MAW's March 3 meeting had two presentation: one on mushroom hunting in Spain from members Albert Casciero and Connie Durnan and another on mushroom cultivation from Mycoflora Committee Chair Jared Urchek.

The presentation from Albert and Connie reviewed their recent trip to Spain, which centered on the Extremadura region and focused on local mushrooms. The pair described each town they visited, what they ate, and the mushrooms they found. Next year, Albert is planning a trip to Croatia.

Jared's presentation was an overview of the different ecological types of mushrooms and the difficulties in growing each of them. Saprophytes, for example, decompose organic matter and are usually easy to cultivate (oyster, shiitake, and button mushrooms are good examples). Parasites attack living hosts and are therefore often difficult to cultivate. Mycorrhizal fungi partner with living tree roots and therefore cannot be cultivated.

April 2: Walt Sturgeon's Overview of Appalachian Macrofungi

The April 2 meeting featured Walt Sturgeon, who went through some of the more interesting mushrooms featured in his recently published field guide. Most of the species he covered also grow in the Washington, DC area, but Walt also highlighted some interesting regional differences. Walt's presentation was highly reliant on his excellent pictures and detailed personal knowledge, so this short summary cannot do it justice. Walt discussed *Lactarius*, *Russula*, *Amanita*, boletes, toothed fungi, morels, *Verpa*, *Gyromitra*, chanterelles, polypores, and mushrooms that are less common but no less interesting.

May 7: A Year of Wild Edibles with Matt Cohen

For the May 7 meeting, Foray Chair Matt Cohen took the club outside its comfort zone a little bit with a presentation about edible plants. Believe it or not, there are more things to eat in the forest than just mushrooms. Matt's presentation covered some of the most common edible plants during each season.

Matt began in winter, a time of year where you don't find many fungi or plants. However, you can extract sap from maple or birch trees to make syrup and you can harvest spicebush twigs to

Upcoming Events

The events listed below may change due to weather, speaker availability, etc., so read MAW emails and check our website at **http://mawdc.org** for up-to-date information on events. Exact foray dates and locations will be set closer to the event in order to take weather conditions into account.

Scheduled Programs

Sept	27-29	**Sequanota Foray**, guest mycologist: Timothy Baroni
Oct	1	**Monthly Meeting** featuring Richard Jacob on the medical potential of hallucinogenic mushrooms.
Oct	6	**Mushroom Fair** at **Brookside Gardens**. Volunteers are needed to help set up, talk to visitors, etc. Volunteers can **register** online.
Oct	12	**Fall Tasting**: experience the best food MAW has to offer as members show off their cooking skills. Registration is $15 and free for cooks. This event sells out, so **register** early!
Nov	5	**Monthly Meeting** featuring Dennis Whigham, a botanist at the Smithsonian who will talk about orchids.
Dec	3	**Monthly Meeting**

*Unless otherwise noted, monthly meetings will be held on the first Tuesday of the month at 7:00 PM in the **Kensington Park Library, 4201 Knowles Avenue, Kensington, MD**. Attendees are encouraged to bring mushrooms for sharing and identification. Members of the public are welcome to drop in.*

Special thanks to MAW member Ray LaSala for proofreading this newsletter!

make tea. When things begin to warm up a bit, early plants like field garlic, bittercress, chickweed, violets, ramps, and garlic mustard (an invasive – eat it all!) start to appear. You can be sure of finding some of these during morel season, even if morels are elusive.

The end of morel season is marked by the flowering of black locust trees, but fear not – those flowers are edible (Matt calls them "Kettle Corn of the Woods")! Pokeweed, bamboo, and greenbrier also start growing around this time, but you have to get those plants early. Wood sorrel, lambsquarters, and purslane are other edibles that appear in spring.

In summer, look for serviceberry (widely planted as an ornamental shrub), white mulberry, common milkweed, black raspberry, wineberry, and sumac (avoid poison sumac, which grows in swampy areas). Later on in summer, pawpaw, Chinese chestnuts, wild grape, and persimmon appear.

June 4: Introduction to Ergot and Argentinian Mushrooms

MAW Programs Chair Tom McCoy kicked off the June 4 meeting with an overview of *Claviceps purpurea*. *C. purpurea* causes the blackened growths on grasses called ergot. Rye is highly susceptible to infection, but it also appears occasionally on wheat and barley. *C. purpurea* produces toxins that restrict blood flow and cause hallucinations (in fact, one of these became the basis for LSD).

C. purpurea was particularly destructive for humanity during the Middle Ages. When people ate infected rye (primarily poor people who couldn't afford wheat), they experienced a burning sensation in their limbs due to constricted blood flow. This was called "Holy Fire" and was presumed to be divine punishment. Because the cause was not understood treatment was ineffective and many people died from the gangrene.

C. purpurea is also linked to witch trials, Viking victories (they didn't eat rye), and the Elysian Mysteries.

For the second half of the program, Ilan Siegel described his work collecting samples of ectomycorrhizal roots with mycologists in Argentina. In addition to describing his work digging up root samples, cleaning them, and sequencing DNA, Ilan shared pictures highlighting the culture, architecture, environment, and mushrooms of northwest Argentina.

July 2: Heather Hallen-Adams on the Human Microbiome

A growing number of scientists are investigating the human microbiome – the bacteria, fungi, and other organisms that live in and on humans. Most of this research has focused on the gut and has discovered that bacteria play a huge role in human health and disease. Not as much is known about the fungi that inhabit humans, so Heather Hallen-Adams tried to close that knowledge gap during the July 2 meeting.

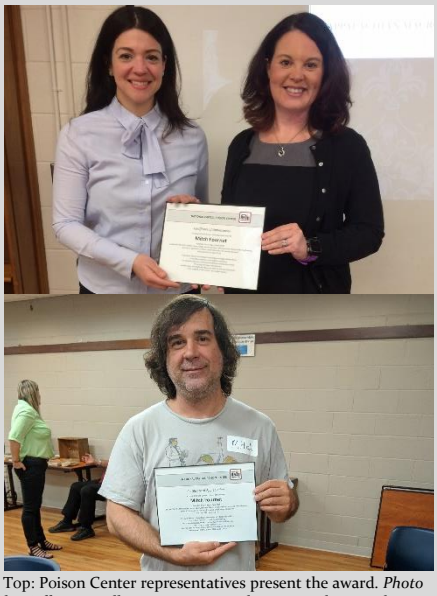
Heather explained that bacteria make up 99% of the human microbiome, so fungi are not as important. However, they are present and can cause disease. Dandruff, for example is caused by *Malocezia* spp. The fungal community on the skin is dominated by *Malocezia*, but some other fungi are present (the webbing between toes hosts the most diverse fungal community). Inside the body, fungi are largely absent except for in the gut. Heather's research discovered that relatively few fungal species live in the gut: on average the human gut hosts only 3.4 species of fungi. Interestingly, vegetarians were found to have on average 12 species of fungi in their gut.

Heather also touched on how cheese-dwelling fungi interact with the human gut. The most interesting phenomenon was that *Debariomyces* never shares the gut with *Candida* (the organism responsible for yeast infections). Heather found that some *Debariomyces* strains kill *Candida* and that activity persists at human body temperature. Does this mean that doctors should prescribe cheese to treat yeast infections? It's Continued on Page 8

Mitch Fournet Receives Poison Center Award

Thomas Roehl

At the April 2 meeting, MAW Second Vice President Mitch Fournet was presented with a Certificate of Appreciation by Nicole and Pela from the National Capital Poison Center. Mitch was unable to make the meeting in person, but Nicole and Pela presented the award to him over the phone (Mitch later received the award at the July 2 meeting). Mitch has been volunteering his services as a mushroom identifier for the Poison Center since July 2011. In that time, he has assisted with identifying mushrooms in 150 poisoning cases involving children, teens, adults, seniors, and pets. The Poison Center offers advice in all kinds of poisonings free of charge with just a phone call. This service can be provided only with the aid of volunteers like Mitch who offer their expertise on specific topics. Thanks to Mitch's time and mushroom identification skills, the National Capital Poison Center was able to provide quick answers and sound advice for people poisoned by mushrooms.



Top: Poison Center representatives present the award. *Photo by William Needham*. Bottom: Mitch receives the award. *Photo by Thomas Roehl*

Events

Continued from Page 7 too early to say – more research needs to be conducted.

August 6: Mushrooms and Farming with Max Dubansky

Max Dubansky runs Backbone Farms in far western Maryland. The farm produces a variety of products, from vegetables to pigs to shiitake mushrooms. Max gave an overview of how he uses mushrooms on his farm and then described ways that fungi, farms, and environmentalists can work together. Fittingly, the motto of Backbone Farms is, "Working with nature to grow better food."

On the farm, Max uses mushrooms in several ways. Most basically, he grows mushrooms like shiitake, oyster, and winecap. Oysters take on a second life once they're done fruiting: Max uses them as fertilizer, worm food, and pig feed. Winecaps are useful even before they fruit: they quickly turn woodchips into compost and even help filter bacteria from runoff. Max also takes care of the mycorrhizas on his farm by carefully managing soil production. All the production on his farm comes down to soil. Max explained, "I don't consider myself a vegetable farmer or animal farmer, I consider myself a soil farmer because without soil none of that is possible." Max has also found an additional unexpected benefit to all this: "Getting better at growing mushrooms has enabled me to be a better wild mushroom forager."

Beyond the farm, fungi have many uses in managing the environment. There are fungi that kill harmful insects. Fungi can be used to help repair mountaintop removal sites by creating soil. Of course, they also have medicinal and artistic uses. Max wrapped up his presentation by saying, "My favorite thing about mushrooms: they're a cure for boredom!" For more information on Max's farm, visit **https://backbonefarm.com/**.

September 3: ID Workshop

The September meeting was focused on helping MAW members improve their identification skills. To that end, members brought in a wide array of mushrooms and learned ID tips from some of MAW's experts.

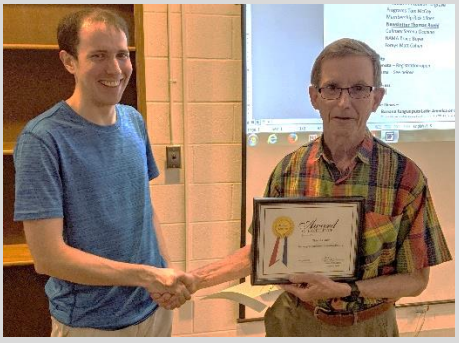
Additionally, the meeting included short presentations from Jared Urchek and Megan Romberg. Jared gave an overview of MAW's Mycoflora Project. This project is part of the North American Mycoflora Project, which aims to get local mushroom clubs to help sequence all the mushroom DNA in North America. If you're interested in helping with MAW's mycoflora efforts, contact Jared, the mycoflora chair, at **mycoflora@mawdc.org**.

Megan gave a brief presentation on how to use a microscope. MAW recently acquired a used microscope from the USDA, so Megan's presentation will hopefully help the club take advantage of this resource at future meetings and events.

Thomas Roehl Receives MAW Award

Thomas Roehl

MAW's Newsletter Editor, Thomas Roehl, was honored at the August 6 meeting with an Award of Excellence from MAW. The award was presented in recognition of nearly three years of service to MAW, compiling the newsletter, leading forays, and assisting in various other ways. Thomas has left to study mycology at the University of Wisconsin-La Crosse and this will be his last newsletter.



Thomas receives an award from MAW at the August meeting.
Photo: Jared Urchek

Mushroom Visions

Daniel Fahey

When the rain is falling
And the chill wind blows,
That's when you'll find me
In the old mush-rows.

With a staff in my hand
And a long-legged stride,
My emotions are lifted
With a fungophile's pride.

Beneath oaks and bay laurels
I wander about,
On the path less traveled
Where my mind can clear out.

My sight becomes filled
With mushroom visions
While those who can see me
Look on with suspicions.

In the silent moment
I spot the first,
Swollen with water
By its voracious thirst.

Its yellow peak rises
From the wet, leafy floor.
I pause to admire it
And sense there are more.

Some fruit in the open,
Others hide under ferns,
By the creekside they lie,
Wherever I turn.

Now found and admired
I move to the next
And gather these flowers
Of glorious flesh.

They're pleasant to look at
But better to eat,
With butter and garlic
And onions so sweet.

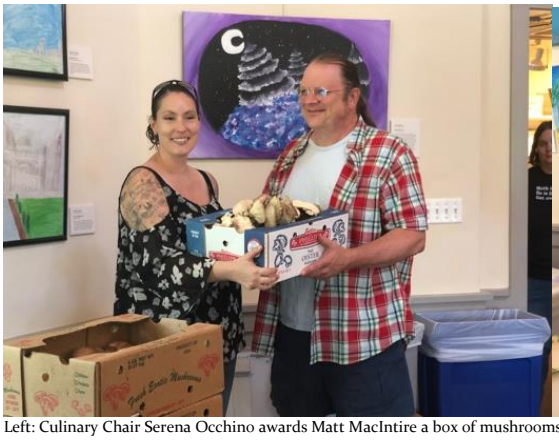
I thank the 'shroom goddess
For this bountiful patch,
And pray for more rain
A new harvest to hatch.

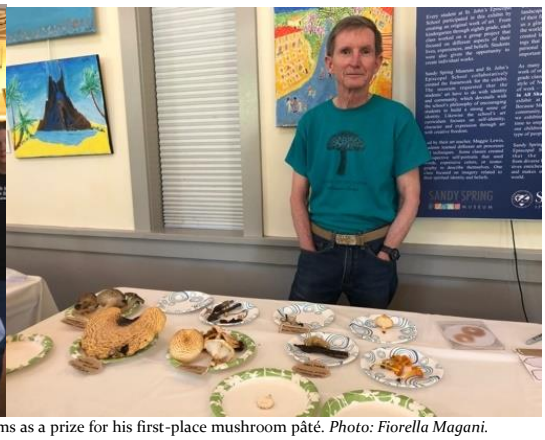
So close to the masses
These treasures are found
That I think to myself
Of advice that is sound:

If anyone asks,
You'll be wise not to tell
Lest you happen to lose
Your patch de chanterelle.

May Culinary Event

Annie Greene
MAW Newsletter Contributor





Left: Culinary Chair Serena Occhino awards Matt MacIntire a box of mushrooms as a prize for his first-place mushroom pâté. *Photo: Fiorella Magani.*
Right: MAW President William Needham eager to discuss the findings from the club's morning foray. *Photo: Annie Greene.*

This Spring's MAW Culinary Tasting event that was held on Sunday, May 19th featured an array of hearty mushroom-filled lunch fare. Ten cooks prepared a variety of dishes for the 50 hungry tasters. Some cooks used foraged mushrooms and ingredients from home, while others utilized the wide variety of mushrooms generously donated by Phillips Mushroom Farms based in Kennett Square, PA. The fungi in attendance included shiitake, maitake (hen of the woods), portabella, white beech, royal trumpet, cremini, enoki, pom-pom (lion's mane), oyster, and chicken of the woods mushrooms.

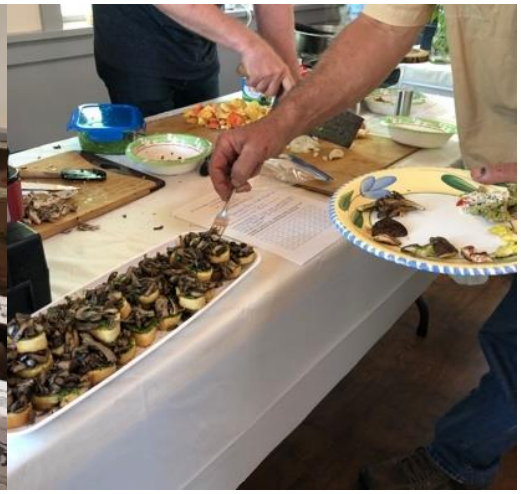
The cooks began preparing their mushroom-based meals around 10 o'clock AM, and the tasters started rolling in around noon. It wasn't difficult to find our event space in the Sandy Spring Museum - all you had to do was follow your nose to the unmistakably earthy, savory scent of cooking mushrooms! While the talented cooks put the finishing touches on their dishes, tasters mingled with each other and MAW President William Needham showcased the wild mushrooms that club members had collected at a foray earlier that morning.

Finally, tasting time arrived! Some of the appetizer-style dishes included dry-roasted maitake and shiitake mushrooms with an array of delicious homemade dressings by Karin Edgett and Steve Blume. Another hit was the crostini topped with wild garlic mustard pesto and sautéed mushrooms by Caroline Joyce. Other great dishes included a creamy mushroom soup, mushroom and asparagus bread pudding, mushroom and veggie curry over white rice, creamy creminis, spaghetti with mushroom-sausage sauce, and a mushroom and grain stir fry. All the dishes were well-crafted and satisfying.

After tasting all the plates (sometimes twice, just to be sure!), attendees voted for their top choice. My personal favorite, which received the 3rd place prize, was the "chicken" satay by Vice President John Harper. John sautéed chunks of chicken of the woods mushrooms that he found, placed the cooked mushrooms on skewers, and prepared a delicious peanut satay sauce as an accompaniment. The 2nd place award went to Marisol Perez's creamy mushroom risotto. Her delicious risotto was hearty, satisfying, and of course, chock full of mushrooms! First place went to the mushroom pâté by Matt MacIntire. This pâté, which was bursting with mushroom flavor, was simply served on crackers or toast with the option to add a topper of freshly sautéed mushrooms. The pâté recipe called for shiitakes, oysters, and reconstituted dried porcinis. The cooks of these top three dishes were awarded large boxes of mushrooms from Phillips Farms to celebrate their culinary accomplishments.

Many thanks to our Culinary Chair, Serena Occhino, for being the head organizer of this fabulous event that went off without a hitch. Of course, thanks are also due to everyone else who had a hand in organizing the event, the volunteers that helped set up and break down the room, and all MAW club members - your annual dues help support events like these!

The next culinary event is scheduled for this coming Fall. Keep an eye on club emails for forthcoming details.



Left: The variety of mushrooms provided by Phillips Mushroom Farms. Right: A taster grabs a crostini topped with mushrooms and wild garlic mustard pesto, while John Harper prepares his "chicken" satay in the background. *Photos: Annie Greene*

Pharmacopoeia (Continued)

Continued from Page 1 styptic for the topical treatment of wounds. The manner in which it was applied attends to the caricature of the hardened warrior, as the fungi (typically a polypore-like tinder fungus) was applied to the place affected and then set alight to burn the skin over the area of the wound. This practice was also common in China, perhaps an indication of the origins of the Native American peoples.

Fungi were also used by the early Europeans. In 1991, a Neolithic man was discovered in the Italian Alps when he emerged from ice in which he had been frozen since his death about 5,300 years ago. Named Ötzi for the Italian region in which he lived, he carried a thong with several pieces of Birch Polypore, *Fomitopsis betulinus*, threaded on it. Speculation is that he carried it as an antibiotic medicine, for it is now known that *F. betulinus* contains an antibiotic that acts on bacteria, resins that attack whipworms (an intestinal parasite), and agaric acid which is a carminative (causing gas to be expelled from the intestines). In that an autopsy revealed that Ötzi had worms, it is likely that this was his palliative. He also carried *Fomes fomentarius*, the tinder fungus; an essential for any alpine trekker in the winter. The tinder fungus, also called Amadou, was used both as a means to start a fire from a spark and as a way to transport an ember from one campfire to another. Remnants of fungal material fabricated in this manner have been found at Upper Paleolithic hominid sites dating back to 11,600 BCE. The tinder fungus was also an acknowledged curative, as the Greek Hippocrates identified it as a topical treatment for wounds over 4,000 years ago.

It is not clear why fungi never made the transition from evidently well-known and practiced ancient herbalism to modern folk remedies to the extent that plants have. Historically, the identification of medicinals became a matter of the written record, necessary in order to identify the source, the manner of preparation, and the appropriate dosage for the given ailment. These listings of drugs are called pharmacopoeias; The Greek physician Dioscorides compiled one of the first pharmacopoeias called *Materia Medica* in 65 CE. In this book, one fungus, the "Agarikon Fungus" which most likely refers to the *Fomitopsis officinalis*, was listed as a panacea for ailments ranging from kidney disease to epilepsy. The Agarikon was a staple of pharmacology until at least the 18th Century, when it fell into obscurity. This is at least in part due to fact that Carolus Linnaeus, the father of taxonomy, gave the generic name *Agaricus* to a group of gilled mushrooms, of which the pedestrian supermarket button mushroom (*Agaricus bisporus*) is a member. The United States Pharmacopoeia appeared in 1820 and the International Pharmacopoeia was established by the World Health Organization in 1951.

It should come as no surprise that mushrooms, or more properly fungi, have proven to be useful sources of potential medicinal attributes. In 1928, Sir Alexander Fleming discovered that the spread of the ubiquitous pus-producing bacterium *Staphylococcus aureus* (it is gold or *aurum* in color) was arrested by a green mold. This mold was a species of *Penicillium*, so he named the fungus's active bacteria-killing compound penicillin. This marked the beginning of the antibiotic era. It wasn't until the advent of World War II that a way of producing large quantities of the new "miracle drug" was developed. The rest of the story is that *Penicillium* is the genus of about 250 species of blue or green mold fungi. Interestingly, the name *Penicillium*, and hence penicillin, has the same etymology as pencil, as the ends of the mold's conidiophores are tufted, like an artist's brush from which the modern pencil is derived. So, the first miracle drug was a fungus.

Of the approximately 15,000 species of mushrooms, it is estimated that about five percent are utilized for medicinal purposes somewhere in the world. There are currently more than 250 species that are known to have therapeutic properties based on accepted clinical research. The primary medicinal agents in fungi are polysaccharides, which generally act against cancers and enhance the body's immune response. The healing and curative properties of fungi have been recognized and used for medicinal purposes in China and Japan for millennia. The earliest known pharmacopoeia in China (100 CE), *Shen Noug Pen Ts'ao Jing*, lists a number of mushrooms with medicinal applications. They have gained even greater import in the modern era as the fungi can in many cases be cultivated. The traditionalist medicine of the East has captured the imagination of the medical conservancy of the West. Acupuncture is one example. Fungi penetrate the pharmacopoeia of the general practitioner and in all likelihood will continue to do so. Three examples will suffice to demonstrate the potential for modern medical treatments: the *Trametes versicolor* or Turkey Tail, the *Ganoderma lucidum* or Varnish Conk, and the *Lentinula edodes* or Shiitake.

Turkey Tail, known as *Yun Zhi* or "cloud mushroom" in China, is probably the most thoroughly studied of the medicinal fungi, as it is among the most widely used in East Asian medicines. In traditional Chinese herbalism, the fruit bodies are harvested and ground to a powder to make a tea that was used to reduce phlegm, treat pulmonary maladies, and promote a healthy liver. The Ming dynasty version of the pharmacopoeia provides that if the *Yun Zhi* is taken over a long period of time, "it will make one vigorous and live long." In the modern era, *T. versicolor* derived protein-bound polysaccharide (PSK) has been shown clinically to be effective against human cancers, particularly when used in combination with other agents. A 1982 study of cervical cancer patients given PSK with

radiation found that the three-year survival rate was 85 percent compared to 59 percent for those given radiation without PSK.

Ganoderma lucidum is known in China as *Ling Zhi* which means mushroom of immortality. The Latin name *lucidum* refers to the coruscating, varnish-like shine of the fruiting body when it first emerges from the side of a tree. It has been used in Chinese and Japanese folk medicine for at least four millennia in the treatment of age-related maladies such as heart disease, hypertension, and chronic bronchitis so as to increase longevity. It was considered so powerful that it was used as a talisman to protect individuals and homes from evil spirits. In the last 30 years, it has been used in numerous human clinical studies to treat insomnia, duodenal ulcers, progressive muscular dystrophy, diabetes and Alzheimer's disease. It's efficacy in treating bronchitis was demonstrated in the 1970's when 75 percent of 2,000 patients showed marked improvement after two weeks of therapy.

Shiitake mushrooms are named for their association with the Asian shii tree; the Latin species name *edodes* refers to their edibility. They grow wild in Japan and China but are not indigenous to North America. Their widespread availability is instead due to facile cultivation; they are second only to the *Agaricus bisporus* in commercial production. The two most important medicinal derivatives of the shiitake are LEM (*Lentinula edodes* mycelium extract) and lentinan. Both chemicals have strong anti-tumor properties; they work by enhancing the body's immune system rather than attacking the cancer directly. There have been innumerable clinical trials of the shiitake. For example, a controlled trial of 275 patients with advanced gastric cancer showed that those given lentinan with chemotherapy had statistically improved longevity and improved immune response. In a separate study, a group of Japanese women who ate 90 grams of shiitake mushrooms daily for one week had a 12 percent drop in serum cholesterol.

Fungus as pharmaceutical is a bit antithetical to the prevailing wisdom that wild mushrooms are deadly toadstools. Few stop to consider the source of penicillin, even as it established the idea of "miracle drug" that we have come to expect whenever we are sick. But tastes change as time proceeds. Instead of taking two aspirin and going to bed, perhaps in the future you may sit down to a meal of shiitakes with a turkey tail on the side.

Nam Jim Tua

Thai peanut sauce for satay

Editor's Note: This was one of Jon Ellifritz's favorite recipes. He usually served the sauce over cooked Chicken of the Woods for a great Chicken of the Woods Satay.

Ingredients

1	Tbsp	panang curry paste (e.g., Thai Maesri brand)
~1	Tbsp	peanut oil
1	can	southeast Asian coconut milk (e.g., Chao Koh brand)
1	pkg	Lobo brand Satay Mix packet B (mostly dried, ground peanuts)
1⁺-2⁺	Tbsp	crunchy peanut butter (or creamy + some crushed or ground peanuts)
1+	Tbsp	tamarind paste (e.g., Tamicon brand, found in Indian groceries)
½-1		[lime or] lemon, juice only
1-2	tsp	sugar [e.g. palm, coconut, or light brown]
a bit of		salt and/or MSG
1/2	can	southeast Asian coconut milk (e.g., Chao Koh brand)

Directions

1. Fry the curry paste in a skillet in the oil for ~2 minutes. Add the coconut milk. Mix well and continue cooking over low to medium heat until the oil in the coconut milk starts to separate out, 5 - 10 minutes.
2. Add the remaining ingredients. Stir until thoroughly mixed.
3. Adjust the flavors according to taste. Gradually add more curry paste if more heat/spice is desired. Add more peanut butter if a stronger peanut flavor is desired. Both tamarind paste and lemon juice increase sourness, although the latter is a bit easier to use in making fine adjustments. A bit more salt or MSG can bring out more flavors of all kinds, and a bit of sugar can help mellow heat or sourness.
4. Shortly before serving, add the remaining coconut milk and mix it in thoroughly [This mellows strong flavors a bit more and lightens the color of the sauce].

From Jon Ellifritz's friend Anop (Nicky) Juntanaroj

Tales of the Fun Guy

by Loretta E. Chi