Summer 2018

Fungi Kingdom News

The newsletter of the Pioneer Valley Mycological Association

In this issue ...

The group ponders Pluteus cervinus on one of our recent walks.

Fungi Kingdom Festival!

September 22 will be here before we know it! We're deep into the planning process for our big event: the Fungi Kingdom Festival at Arcadia Wildlife Sanctuary in Easthampton. You may already have heard from me regarding volunteering for this event, but if not, please reach out! We have many exciting opportunities for our members to take part in this afternoon festival, including assisting with walks, greeting visitors, and helping at the displays.

We can't make this event a success without volunteers! Please email me at **JessicaBensonEvans@gmail.com** if you are willing to volunteer your time. Also, please consider sharing this event on social media or with family and friends; the event will be posted online in early September.

Our Fungi Kingdom Festival will be **September 22, from 1-5 p.m.**, at Arcadia Wildlife Sanctuary in Easthampton, MA.

BOARD OF DIRECTORS
Jessica Benson Evans, *president*
Michael Ostrowski, *treasurer and membership secretary*
Joan Adler, *secretary*
Dianna Smith, *chief mycologist*

Philip Hadley, *Scholarship*
Sue Lancelle, *Newsletter & Citizen Science*
Devorah Levy, *Education*
Stephanie Reitman, *Hospitality*
Paul Thomas, *Citizen Science*

OUR MISSION STATEMENT
The Pioneer Valley Mycological Association is dedicated to enhancing the public's knowledge and appreciation of the fungal kingdom by providing ongoing educational programming in the form of guided mushroom walks, lectures, newsletters, information on multi-day regional and national forays, and citizen science projects. Because fungi are integral components of complex ecosystems, we are committed to advocating for responsible and sustainable study and collection methods. We focus on, but are not limited to, the three counties of the Pioneer Valley in western Massachusetts (Franklin, Hampshire and Hampden).

PVMA is a member of the Northeast Mycological Federation (www.nemf.org) and the North American Mycological Association (www.namyco.org).

www.fungikingdom.net

We Welcome Your Submissions!
This is your newsletter; we'd love to have you contribute to it!
Prose, verse, photos, drawings, recipes, scientific observations – send them all to:

jessicabensonevans@gmail.com
sue.lancelle@gmail.com

From the President...

It's early July as I write this message, and so far, it seems like we've had a slow start to the season compared to last year's early abundance! Fungi have been few and far between given the general lack of rain, but we've still had some great group walks and found a variety of interesting fungi. I am especially grateful for our patient members; even on walks where we've had nothing to enjoy but large quantities of *Megacollybia rodmanii* or a few beautiful *Ganoderma tsugae*, we've still had a great time.
We have a wide variety of activities and events planned for our members in the coming months which I am certain will be enjoyable whether there are twenty or two hundred species to be found. I'm looking forward to a walk in Cummington with our friends from CVMS, a hike in my home town of Shutesbury at a great loop trail, and Bill Yule's upcoming talk at Arcadia on August 25 (see page 13), among others! I hope to see many of you at these great events.

I'm also excited about our very first ever Fungi Kingdom Festival, in partnership with Arcadia Wildlife Sanctuary, which will take place on September 22. We have many volunteer positions available for the event and hope that our members will take part in this incredible afternoon!

I'll be headed to the NEMF Foray in Geneseo, NY during the last week of July along with Dianna and a few other members; the four-day event will include forays, presentations, and mycophagy. I'll be sure to take lots of pictures and share my adventure with all of you when I return!

Hope to see you soon,

– Jessica

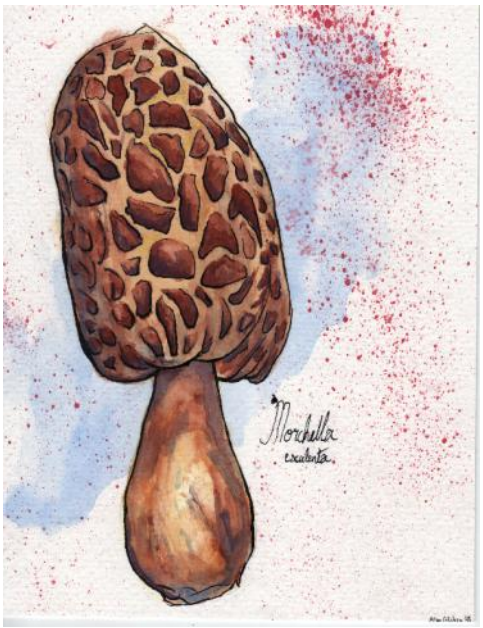

Illustration by Alan Callaham

This spring turned out to be a pretty good season for morels here in the Pioneer Valley! This area isn't known for vast numbers of morels, but many of you had some good luck this year. And those of you who went a little further afield were rewarded even more. Now we've moved into the season for chanterelles, black trumpets, choice milkcaps, oysters and chickens. And more edibles will be showing up soon. Happy hunting!

2018 Fungi Kingdom University

Participants in the workshops wrote brief summaries of the six incredibly informative workshops we held this spring, on a wide variety of topics.

Dianna Smith: Myco-Speak

The first workshop began with a bit of a meet and greet at Dianna's beautiful home. Dianna then herded us into her large dining room that she has set up as a classroom, with plenty of good viewing for everyone. Dianna started her presentation with terms used by mycologists to describe macro-fungi, types of fungal nutrition and ecological roles of fungi. She went on to detail such things as what fungi are made of, how they reproduce, and details of their morphology. Then she discussed the questions you have to ask yourself in order to adequately describe a fungus, so you can try to identify it to genus and species. These include details of what the fungus looks like, smells like, and tastes like, as well as where it lives and feeds and how it attaches to its substrate.

Dianna's detailed handout and slides (most of them her own intricate photos), as well as her hand motions and sound effects really helped make what could be an overwhelming amount of information interesting and easier to understand. I believe all of us who attended will be more prepared to utilize mushroom field guides and to identify fungi on our walks. Lunch break included a delicious variety of foods to share and interesting conversation. As always, Dianna's passion was contagious and I am excited to continue learning about and looking for fungi.

– Robin Doran

Noah Siegel: *Cortinarius*

If you're looking for a mushroom genus to spend the rest of your life studying, look no further than *Cortinarius*, the largest genus in the Agaricales. The genus itself isn't too difficult to recognize: look for a rusty brown spore print and the remnants of the cobwebby partial veil, the cortina, intact on very young mushrooms or the remnants visible on the stems of older mushrooms. The only other genera in our area with rusty brown spores, according to Noah, are *Galerina* (of deadly galerina fame) and *Gymnopilus*. Beyond the genus level, things get considerably more complicated: 3,000 to 4,000 species worldwide, many of which will require DNA sequencing to distinguish look-alike specimens, as yet to be named.

Should you wish to collect *Cortinarius* specimens for identification, here are a few things to know: 1) Handle the mushrooms by their caps and do not touch the stem because you need to be able to see the remnants of the veil/cortina on the stem and you don't want to accidentally rub them off. 2) If possible, get samples of the mushrooms in all stages of development. 3) Make detailed notes on the habitat and associated trees – all are ectomycorrhizal, grow on the ground, and are associated with either conifers or with hardwoods in the Fagaceae (Oak Family) or the Myrtaceae (Myrtle Family). 4) You will need to get a younger mushroom to describe the colors accurately; all of the corts

Noah Siegel

Cortinarius pholideus, showing all of the characteristics that identify this mushroom as a Cortinarius.

end up looking brown as they get older; these same mushrooms could be purple, violet, or some other beautiful color when they first appear. 5) Note the smell – or lack of a smell - as many species have distinctive odors. 6) Note the color of the young gills and of the flesh; older specimens will all have brown gills which are not useful in following a key. 7) You will need mature spores to look at under a microscope; get them either from the stem or from a spore print; note the spore shape, size, and ornamentation. 8) Some species react to a drop of KOH by changing color on the cap or stem so carrying a small bottle of potassium hydroxide liquid is useful. 9) Note any color changes from handling or bruising. 10) Note whether the cap and/or stem is slimy, dry to the touch, or silky.

Alas, I am only scratching the surface of Noah's lecture. He went on to describe the groupings, or subgenera of the genus *Cortinarius* – I counted seven of them, all based on morphological characteristics rather than genetic relationships. There are many instances of convergent evolution, where species which are not closely related end up looking alike, having evolved along different paths to arrive at a common destination. And DNA sequencing has also put some mushrooms into the genus *Cortinarius* which look like they belong somewhere else. Noah also showed photographs and described dozens of

Cortinarius species found in the Northeast and gave tips for identifying them. All of the experts studying *Cortinarius* in the United States are on the West Coast. Noah's recent book, *Mushrooms of the Redwood Coast,* reflects that phenomenon. The most active researchers in the East are in Quebec, not in the U.S. Noah recommends the website **Mycoquebec.org** which describes 247 *Cortinarius* species.

To finish up, Noah gave us same great tips for photographing mushrooms, especially how to document the details needed for identification.

– Devorah Levy

The 3 Foragers: Beyond Garlic and Butter

The 3 Foragers are Karen Monger, Robert Gergulichs and their daughter Gillian. They prepare delicious dishes not only from wild mushrooms, but also wild plants that they have foraged. They treated us to an informative and tasty session.

The day started with an overview of the history of human use of mushrooms. Two resources that Karen recommended that are available for free online are "Wild edible fungi: A global overview of their use and importance to people" by Eric Boa (**http://www.fao.org/docrep/018/y5489e/y5489e.pdf**) and "Mushrooms, Russia and history" by Valentina Pavlovna Wasson and R. Gordon Wasson **(http://www.newalexandria.org/archive/**).

Karen then told us about the best basic way to cook mushrooms: start with minimal fat (use a neutral oil like canola rather than olive oil or butter). The goal is carmelization and nice browning of the mushrooms. Evaporate the liquids, add oil as needed just to prevent sticking. Finish with a little butter at the end for flavor if desired. Then season with salt and an acid like vinegar or lemon juice.

However, there is so much more that can be done with mushrooms! We learned about different ways to preserve them: cook first, then freeze; dry, and then turn to powder if desired; brine in salt; lacto-ferment; or use to flavor alcohol. Karen gave us examples of which mushrooms were best for each method.

Some noteworthy examples of how to use mushrooms, going "beyond garlic and butter": Dry and powder black trumpets and use the powder in choux pastry, then fill with cream cheese flavored with herbs; the powder can also be used to make a black pasta. Lion's mane mushrooms can be used as a substitute for crab in crab cakes. *Tylopilus alboater* (the black velvet bolete) is not bitter and can be used to make black fillings for savory pastries or pastas. The beefsteak fungus, *Fistulina hepatica*, can be eaten raw, so can be used for sushi. Hen-of-the-woods is good in many types of dishes as a substitute for meat: in soup (cook the mushroom first), in tapenade, sausage, for making jerky (which we tasted...yum!), and when ground and mixed with chickpea flour, for making burgers. Both species of chicken-of-the-woods are, as the name suggests, great substitutes for chicken in recipes. It can be marinated, grilled, sautéed, stuffed in bread, used to make sausage, used as a wonton filling, and used to make "chicken" salad.

J. Benson Evans

Chicken coconut soup, one of the tasty dishes The 3 Foragers prepared for us.

After Karen's presentation, we moved on to the kitchen where The 3 Foragers treated us to a variety of delicious dishes they had prepared. We discovered just how versatile mushrooms can be!

Follow The 3 Foragers on Facebook and check out **the3foragers.blogspot.com** for recipes and inspiration.

– Sue Lancelle

Bill Yule: Bugs, Slugs, and Other Mushroom Thugs

During our Fungi University session with Bill Yule, we all had the pleasure of entering the magical world of fungi and insects that he has had the pleasure of traversing on a regular basis. The interesting connection between fungi and insects is that some insects' mouthparts have evolved to eat the mushrooms' spores. So, in this unique world, there are "grazers," like fly maggot larvae, and "predators," like the rove beetles, which are "the lions of the mushroom surface." Their ecological interactions help to illustrate the importance of fungi to other living things. The fungal spores feed the "grazers", which in turn feed the "predators," all on the surface of the fungi. As Bill Yule, and the late Gary

Lincoff, like to say, “Fungi connects me to the rest of the world.”

We met several types of insects on our journey with Bill. These insects included the dung beetles, often found on *Amanita jacksonii*; the picnic or sap beetles, which are found in the gills of jack o'lantern mushrooms or in old polypores; the pleasing fungus beetles, which are orange-headed with a black body, and are a tell-tale sign you have oyster mushrooms; and the rove beetles, the predators of fly maggots and smaller beetles.

Bill Yule

One of the pleasing fungus beetles, Megalodacne heros. These are often found in large numbers on Ganoderma tsugae in May and June.

Storytelling is a great way to learn about these organisms, and Bill shared with us several tales. My favorites included:

Treehoppers – Insects have also used fungi as models for protecting themselves via evolutionary development. The treehoppers, which are true insects (three pairs of legs, antennae with distinct segments, and three body segments -- head, thorax, abdomen), have a “little horn” that grows out of their thorax, and often looks like a thorn. Some of these treehoppers have evolved to have more ornate decorations instead, and a tropical species has appendages that mimic the *Cordyceps* fungi, which can infect certain insects as parasites, changing their behavior, and eventually killing them.

The Rove Beetles – Beetles that eat the “bugs” that eat mushrooms. They are predators of other insects and there are 4,000 species in North America. An interesting behavior that rove beetles possess is that they lift their abdomens in the air like scorpions when they feel threatened. One of the most common genera is *Oxiporus*, which create “Cheerio” tracks in the pores of boletes that serve as “beetle bunkers” for the rove beetles to hide in. The *Oxiporus* rove beetles then pop up, duck down, and pop up again from these holes. They are fungivores, too, and eat the fungus tissues as they create the tracks, and regurgitate the soft tissue to feed their young, which they care and tend to as they develop. They are the biggest of the rove beetles and there are only 11 species of them.

Ash Tree Bolete Aphids – The ash tree bolete aphids have a special relationship with the ash tree and the ash tree bolete (*Boletinellus meruloides*), which is not actually mycorrhizal. The ash tree bolete hyphae form a swollen “sclerotium” underground, which harbors the aphids that are feeding on the ash tree roots. In return for this shelter, the aphids provide sugars to the fungus.

“Boogie-Woogie Aphids” -- Groups of *Grylloprociphilus imbricator*, or the beech tree woolly aphid, are stimulated to follow your motions when you wave your hand in the air over them. They drink sugars from the tree, and cause honeydew to collect where they feed. A fungus, *Scorias spongiosipes*, is attracted to the honeydew and uses it as a substrate to grow. It is amber and gelatinous at first, then as it dries out, it turns black. Fallen aphid bodies become mummified in the sticky surface of the fungus.

Horned Fungus Beetles – Reishi, *Ganoderma tsugae*, are home to the horned fungus beetles (*Bolitotherus cornatus*). They spend their lives on the shelf. Male and female beetles come together in opposite directions, and rub back and forth on a bump on their bodies to create music that stimulates the female. They also have an interesting courtship behavior. The males will lock horns and battle by trying to push the other off the end of the shelf. There is one female beetle per fruiting body, and the males travel to each shelf trying to win a mate.

Zombie *Cordyceps* and the Revenge of the Fungi – One *Cordyceps* species invades an ant’s body and alters its behavior after infesting the ant. The fungus causes the ant to climb high into a tree, and forces it to clamp onto a branch, where the ant becomes weak, and eventually dies. After the ant dies, the *Cordyceps* fruits from the ant carcass, then releases its ascospores. It is known as summit disease, and it is found all over the insect world. Different *Cordyceps* species are found to invade grasshoppers, katydids, spiders, beetles, flies, and more.

– Jess Whitaker

Bill Bakaitis: Ecological Functions of Fungi

Fungi are ubiquitous in our environment and play many important ecological roles. Bill Bakaitis summarized some of these for us. Ecological categories of fungi include parasitic, pathogenic, saprotrophic, mycorrhizal, or endophytic.

Parasitic fungi feed on living organisms such as plants, insects and animals causing their demise. They give nothing in return. Pathogenic fungi may cause the slow death of their preferred substrates but are not as virulent as parasitic fungi.

Saprotrophic fungi feed on dead organic matter, such as dead branches and wood, insects and other animals. They can also decompose inorganic matter. They are earth's recyclers. Most macro-fungi, the mushrooms we search for, are saprotrophs. There are two main types of saprotrophic fungi. White rot saprotrophs recycle both the cellulose and the lignin of hardwoods. Brown rot fungi feed on the cellulose but

D. Smith

Bill Bakaitis discussing the ecological roles of fungi

are not capable of breaking down the lignin. Most brown rot fungi feed on dead conifers. The lignin over a long period of time forms cubical structures that eventually add to the soil layer. As they break down their preferred substrates, saprotrophic fungi convert them into smaller molecules consisting ultimately of an assortment of chemicals and nutrients that can be taken up by mycorrhizal fungi and passed on to plants and other soil organisms, insuring the mutual survival of all.

Ectomycorrhizal fungi form close connections of their mycelia with the root tips of trees and other woody plants. In return for the fungus providing water and nutrients, the woody plants pass on sugars created in their leaves through photosynthesis. Ectomycorrhizal fungi include ones that form the large fruiting bodies that we are familiar with, such as the boletes, *Amanita*, *Cortinarius, Russula, Lactarius, Inocybe* and many others. Endomycorrhizal fungi do not produce large fruiting bodies above ground. There are relatively few species of endomycorrhizae compared with those that produce large fruiting bodies, but they are much more pervasive.

Endophytic fungi are found in leaves and grasses. They serve to provide protection to plants from pathogens such as insects, animals, bacteria, and other fungi. They also can enhance plant growth. When the plant goes into "hibernation" or senescent mode as winter approaches, the fungi may act to decompose the substrate.

Another interesting part of the discussion involved invasive species. Plants in the mustard family, such as the invasive garlic mustard, along with the alien worm population in our soils, have a detrimental effect on both ectomycorrhizal and endomycorrhizal fungi. Garlic mustard releases chemicals into the soil to increase its chances of surviving at the expense of native plants and fungi. The worms are especially voracious eaters of fungal mycelium and other organisms.

I think we all left this talk with a much better understanding of the important and widespread roles that fungi play in the ecosystem!

– Dianna Smith

Elinoar Shavit: Medicinal Mushrooms in the Mideast

This year's Fungi Kingdom U. workshops concluded with a fascinating presentation by Elinoar Shavit focusing primarily on the various species of desert truffles and their historical and present uses. From Elinoar, we heard the incredible connections between biblical references to "manna' and the fruiting habits of *Tirmania nivea*, a desert truffle that fruits after the rains and "pops" up out of the ground, practically glowing against the sandy desert. Inhabitants of the Mediterranean and North African desert regions have been eating this truffle for thousands of years.

From Elinoar's presentation, we learned that much is being done now to support the planned cultivation of *Tirmani nivea* in areas where it is relied upon for both food and income many months of the year. This particular truffle fruits in conjunction with the root systems of the flowering desert plant *Helianthemum*, and efforts are underway to plant large numbers of these flowering bushes that have been inoculated with *Tirmania nivea*. One such effort at sustainable agriculture can be seen in the example of Wadi Attir, Israel.

More incredibly, we learned of the medicinal uses of the truffle *Terfezia boudieri*, from which a compound is

derived that is used to treat the blinding eye ailment Trachoma. This same remedy was used hundreds of years ago, before scientific research was done to confirm its efficacy.

Elinoar's excellent presentation demonstrated a new way to look at fungi: from an ethnomycological perspective. People have been using fungi for both food and medicine for far longer than perhaps we imagined. I can think of no better way to conclude this year's sessions; as mycophiles, we join a long and storied history of those interested in mushrooms!

– Jessica Benson Evans

J. Benson Evans

Dianna Smith with Elinoar Shavit

2018 PVMA Scholarship Winner

Dean patiently posing for Ella on one of our member walks

We are excited to announce that the winner of our 2018 PVMA Scholarship is member Dean Colpack! Dean has been a member since 2015, and last year led a wonderful walk at the William Cullen Bryan Homestead in Cummington. Dean may often be found jotting down notes about fungi in his little notebook or assisting Ella with closer inspections of various fungi.

Dean will be using the PVMA scholarship to travel to either the New Moon Mycology Summit or the Deep Creek Mushroom Camp; both events will be held in August in New York State. We are looking forward to hearing about Dean's adventures this summer in our next newsletter!

Be careful out there!

The incidence of tick-borne illnesses is on the rise, and it's not just Lyme disease we have to worry about any more. Anaplasmosis, babesiosis, alpha-gal allergy (to meat) and even Rocky Mountain spotted fever have all made their appearance in our region. Anyone who spends much time outdoors (and that includes all of us mycophiles) should be very vigilant to avoid tick bites. This includes tucking your pant legs into your socks, tucking your shirt into your pants, wearing a hat, wearing light-colored clothing so that you can see ticks, and using insect repellent liberally. You won't win any fashion awards in this get-up, but it should help prevent ticks from getting to your skin. You can also buy permethrin-impregnated clothing or treat clothing yourself with permethrin spray. It lasts through several washings. In addition, take a shower as soon as you come in, and check for ticks very carefully. They can even hide between your toes, and the nymphs can be so small as to be almost microscopic. So get out there and keep enjoying the outdoors, just take these tick avoiding precautions to help you stay safe!

Using the Microscope to Help get that I.D.

II. Hyphal Structures

By Sue Lancelle

Onward with our microscopy adventure! In the last newsletter issue, we provided an introduction to the microscopy of fungal spores. In this column, we will discuss microscopy of the basic gill structures in members of the gilled fungi (Agaricales). Once you learn about these structures, you can extend your study to the surface of the cap and the stipe, and the arrangement of the hyphae in these parts of the mushroom. You can also apply these same techniques to study members of the Boletales, keeping in mind that you are typically dealing with pores rather than gills. In future columns, we will try to cover some of the structures found in other basidiomycetes and ascomycetes.

The structures we are interested in are hyphae – the filaments that make up the fruiting body of the fungus – or developmental modifications of hyphae leading to specialized cells. Gills are typically lined with cells that are either basidia, the spore producing cells; basidioles, which are immature basidia that are not producing spores; or cystidia, cells of unknown function that are typically larger and shaped differently than basidia and do not produce spores. The important diagnostic features of these cells are how many spores the basidia produce, and the presence, shapes, sizes and locations of the cystidia. The presence or absence of specialized hyphal structures called clamp connections is another characteristic that is used to help identify fungi.

In order to understand where these structures are, you must think about the three-dimensional arrangement of the mushroom cap and gills, and then visualize how we can look at the structures in two dimensions on a slide. This will usually involve making a very thin section through part of the cap and gills in order to get a cross-section through the gills. In that way, you can look at the face of the gills and the gill edge.

There are different ways to accomplish this. One way is that described by Largent et al. *(How to Identify Mushrooms to Genus III*), and illustrated in Figure 1. The first step is to cut a small wedge in the mushroom cap, starting at the center if possible, large enough to include several gills (Figure 1A, B). Using a very sharp single-edged razor blade, cut the cap rim (on your wedge) off to expose the gills (Figure 1C). Pinch the wedge between your thumb and index finger to form a horseshoe shape (the tighter you can hold this tissue, the easier the sectioning will be) (Figure 1D,E). Then, slicing carefully toward your thumb, remove one or more very thin sections. Using a dissecting needle or something similar, transfer the sections to a drop of slightly soapy water, 5% KOH, or a stain solution (more on stains later) (Figure 1E).

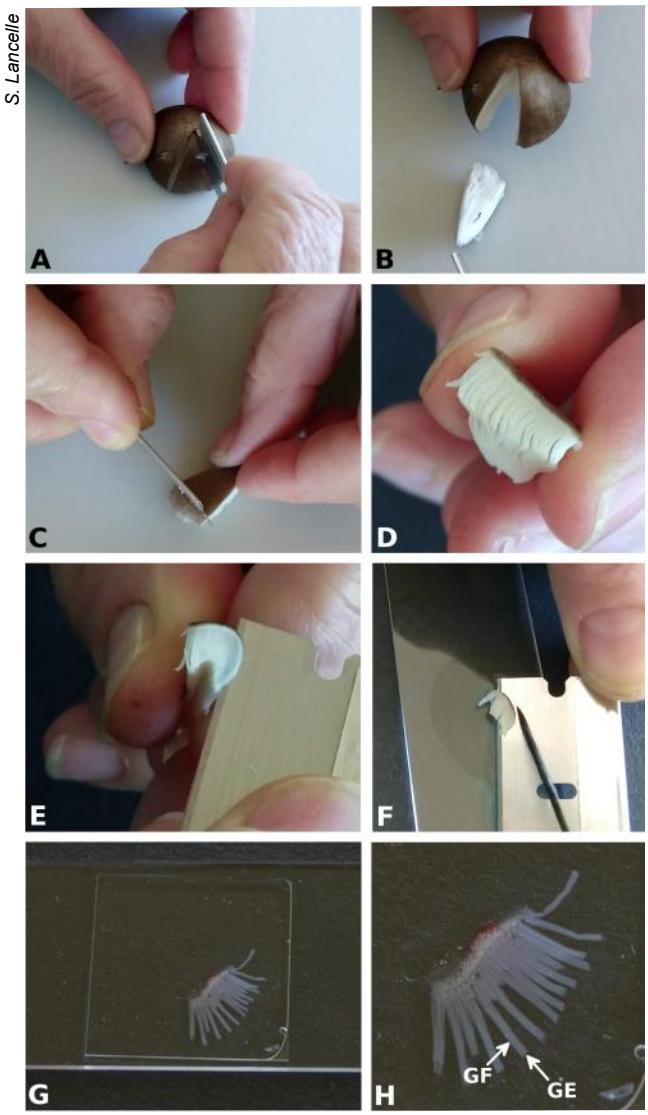

Figure 1. Obtaining a section. A and B. Cut a wedge from the mushroom cap. C. Slice off the cap edge, revealing the gills (D). E. Squeeze the piece of cap into a horseshoe shape and slice a very thin section, gently bumping up against your thumb to finish the cut. F. Transfer the section to a couple drops of solution (water, KOH or dye). G. Cover the section with a cover glass and add solution to eliminate air bubbles. Gently tap down on the cover glass to squash a bit if desired. H. Orientation of the gills, showing the location of the gill face (GF) and gill edge (GE). Note that this section is thicker than ideal, but is used for illustrative purposes. Even thick sections such as these reveal important information!

If the thought of sectioning against your thumb gives you nightmares of trips to the ER for stitches, it really isn't that dangerous if you work slowly. If you would still rather not try this method, you can always make a longitudinal slice in a piece of carrot and slide the wedge of cap tissue into it. Then squeeze the carrot together and cut some thin sections, right through the carrot as well. You can gently tease away any pieces of carrot as you place the sections on the slide.

Cover the tissue with a cover glass and add more liquid if necessary so that you have no air spaces under the cover glass (Fig 1G). If the section is somewhat thick, you may need to gently tap on the cover glass with the blunt end of the dissecting needle or something similar to squash the tissue a bit.

For purposes of illustration, the section in Figure 1 is much thicker than is ideal, but even with a thick section, you can glean a lot of good information. The key is to keep track of the orientation of the tissue, so you know where the gill edges and faces are (Figure 1H). It is also important to realize that very small or very large caps, as well as very mature tissue, is much more difficult to section. Do not get discouraged, because even less than perfect sections can be very useful.

Another type of very useful preparation is to cut a small piece of the whole gill that includes the edge (cut a shape like a trapezoid that will let you keep track of the gill edge), place it in liquid on the slide, and gently squash it a bit under a cover glass. This will let you double-check for the presence of cystidia on the gill edges, since it is sometimes difficult to get the gill edge on a gill cross-section. If there is a variety of cystidial shapes on the gill edge, using a whole mount will also make it easier to see that.

Just a note on terminology: Just like describing fungal spores, there are so many terms used in describing the various hyphal structures that it can be overwhelming. It really helps to have some kind of glossary with illustrations at hand to help you sort it out. The aforementioned book *How to Identify Mushrooms to Genus III: Microscopic Features* by David Largent, David Johnson and Roy Watling is an excellent source; other excellent books that are not currently in print but are available on the used market include *How to Know the Gilled Mushrooms* by Alexander Smith, Helen Smith and Nancy Weber and *A Glossary of Mycology* by Walter Snell and Esther Dick.

Generating Contrast

If you view a fresh section of fresh tissue in a standard light microscope, it can be difficult to see much of anything. This is because cells are made mostly of water, and water doesn't inherently generate contrast. Expensive research microscopes may have specialized optics that can generate contrast in the image you see (phase contrast or Nomarski DIC, for instance), but most people will need to generate contrast another way. One way of doing this is to shut down the diaphragm in the condenser until you can see the tissue. Figures 2 and 3 show the difference between leaving the condenser diaphragm open as it normally would be for light microscopy, and shutting it down a bit to get some contrast. Be aware that doing this reduces the resolution (or detail) that can ultimately be generated, but you do need to see the tissue, so we need to accept that trade-off.

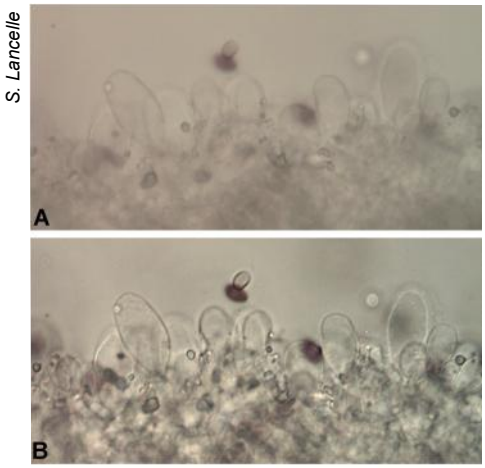

Figure 2. Generating contrast. A. Image obtained from a normally aligned light microscope. B. Same are as in A, with the condenser diaphragm closed down a bit to generate contrast.

Another way to see the tissue is to use a colored stain. Mycologists use many different stains, some for very specific uses, but good general purpose stains include Congo Red and Cotton Blue. Place tissue sections directly in the stain, let it sit for a few minutes, then draw off the stain with a tissue or small bit of paper towel and replace with water or KOH. Sometimes even after using a stain, it helps to close the condenser diaphragm down a bit (Figure 3).

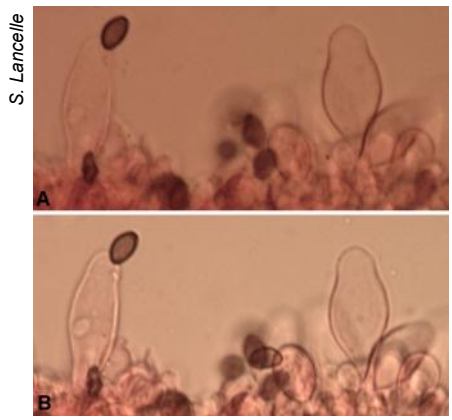

Figure 3. Use of dye to generate contrast. Tissue has been stained with Congo Red (A). In (B), the condenser diaphragm has been closed down a bit to add even more contrast.

Basidia and Basidioles

Basidia are the spore-producing cells and are found all over the gills. In almost all cases, the basidia are club-shaped, so the shape itself is not usually a defining characteristic. Spores are attached to little prongs, termed sterigmata (sterigma in the singular) at the apex of the basidia (Figure 4A). Basidioles look like basidia, but do not have sterigmata. Most often there are four sterigmata per basidium, although you may have to look at the basidium on an angle or focus up and down a bit to see all of them (Figure 4B, C). Some species have two-spored basidia (Figure 4D, E), sometimes there is a mixture of two- and four-spored basidia, and sometimes the number of spores per basidium changes as the cap matures! Thus you must be careful in describing this feature and do a lot of careful observation to be certain. Be aware that you typically see spores in various stages of development (Figure 4B-E); this is why, when you are looking at spores, it is best to measure ones that have fallen on a spore print if possible, to make sure you are measuring them in a mature state.

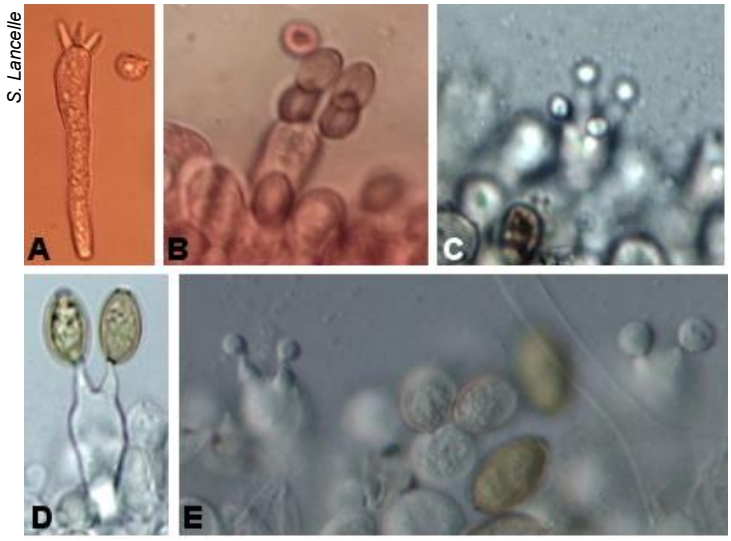

Figure 4. Basidia. A. Typical club-shaped basidium with four sterigmata. B. Four nearly mature spores on a basidium. Sometimes it takes careful focusing up and down to see all four. C. Four very young spores, observed with the basidium at an angle. D, E. Two-sterigmate basidia from *Conocybe macrospora*.

Sometimes basidia and basidioles contain granules that take up certain dyes, and this can be a diagnostic characteristic. Figure 5 shows the "cyanophilic granules" that stain with Cotton Blue in the basidia of *Lyophyllum decastes*.

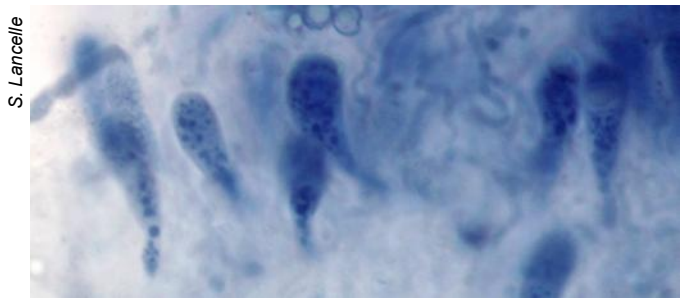

Figure 5. Cyanophilic granules. Basidia from *Lyophyllum decastes* stained with Cotton Blue, showing the dark granules inside.

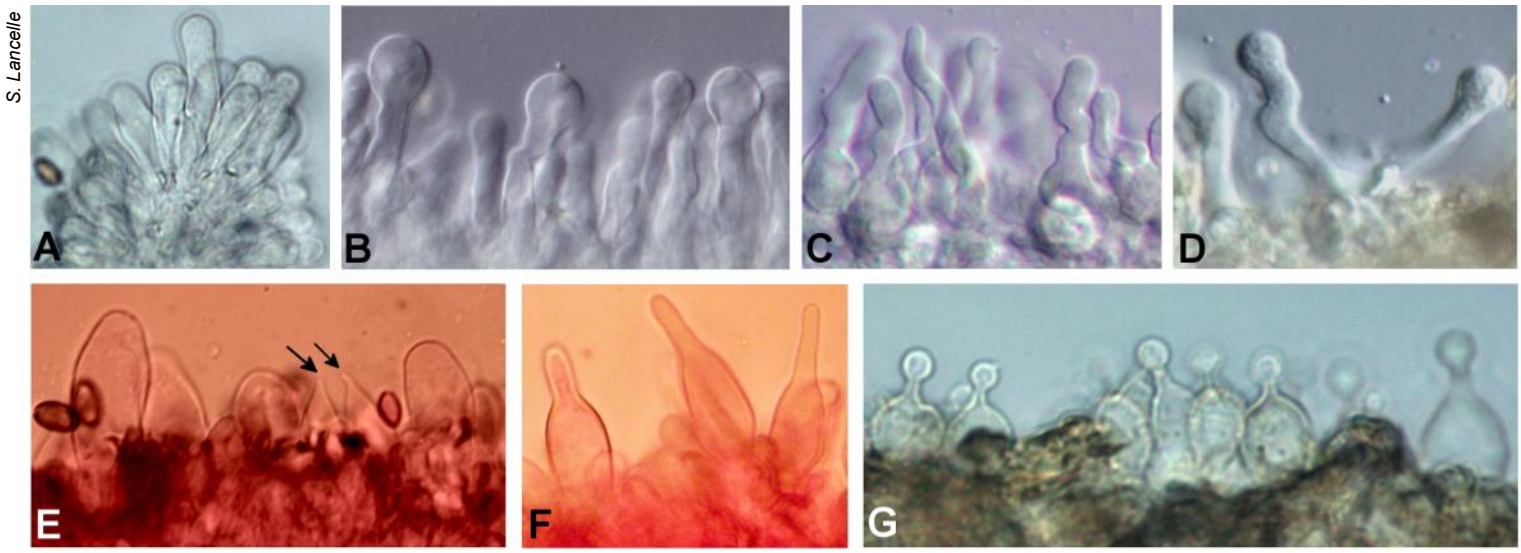

Figure 6. Variety of cheilocystidia shapes. Cheilocystidia are found on the gill edges. A. Cylindrical, *Psathyrella candolleana*. B. Capitate (with a bulbous apex), from an unknown species. C. Strangulate, from a coprinoid species. D. Cylindrical to strangulate with a capitate apex, *Flammulaster erinaceellus*. E. Two shapes, widely cylindrical and mucronate-rostrate (with a pointed or beaked apex, arrows), *Stropharia rugosannulata*. F. Ventricose (widest in the middle), *Agrocybe arvalis*. G. Lecythiform, typical of some *Conocybe*.

Cystidia

The key to distinguishing cystidia from basidia or basidioles is that cystidia are typically larger and/or longer, or else a very different shape. Cystidia found on the gill edges are generally called cheilocystidia, with other variations of that term describing variations on a basic thin-walled cystidium (leptocystidium). Figs. 6 and 8A show a variety of cheilocystidia shapes, imaged in various ways.

Cystidia found on the faces of the gills are generally called pleurocystidia. They may be the same shape as the cheilocystidia, or they may be an entirely different

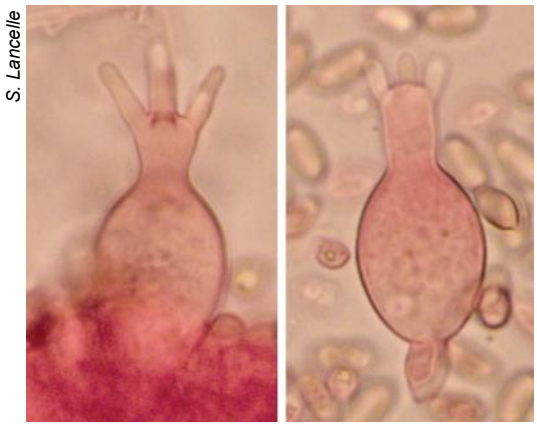

Figure 7. Pleurocystidia of *Agrocybe arvalis*. Ventricose with a digitate (with finger-like projections) apex.

shape – compare Figure 6F with Figure 7, both from *Agrocybe arvalis.* The distinctive "horned" pleurocystidia of *Pluteus cervinus* (Figure 8A) are very different from the variety of shapes displayed by the cheilocystidia of the same species (Figure 8B).

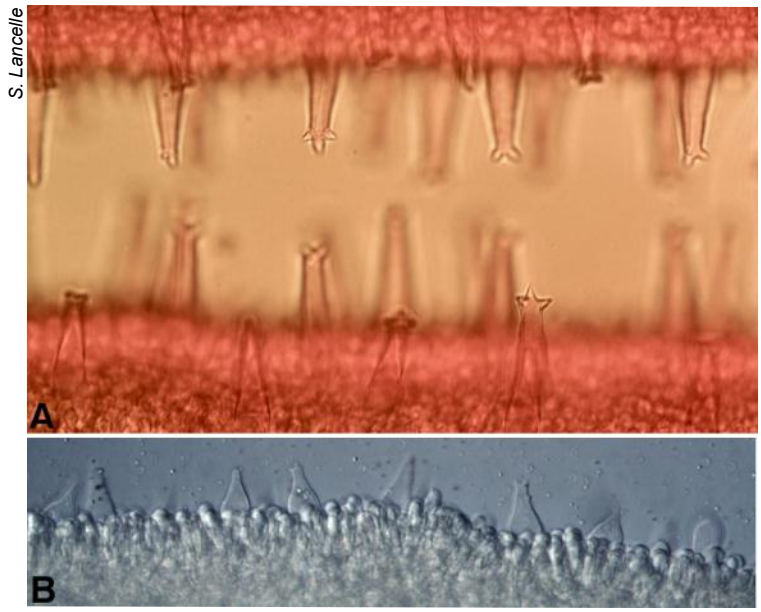

Figure 8. Cystidia of *Pluteus cervinus.* A. The characteristic pleurocystidia are thick-walled and contain a number of "horns" at the apex. B. Variety of shapes of cheilocystidia, seen here with a whole mount of a piece of a gill.

Cystidia can develop crystalline inclusions inside the cells (Figure 9); these are referred to as chrysocystidia, and are typical of the genera *Stropharia* and

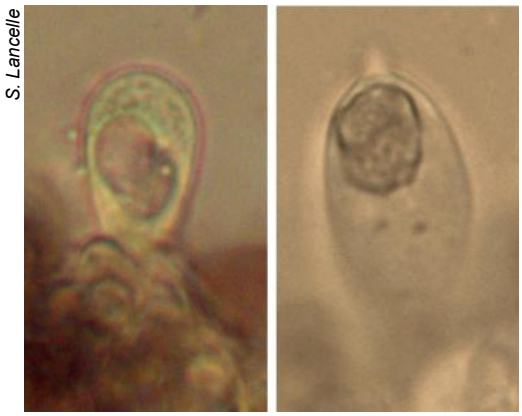

Figure 9. Pleurocystidia from *Protostropharia alcis.* These contain large crystalline inclusions. The descriptive term then becomes "pleurochrysocystidia."

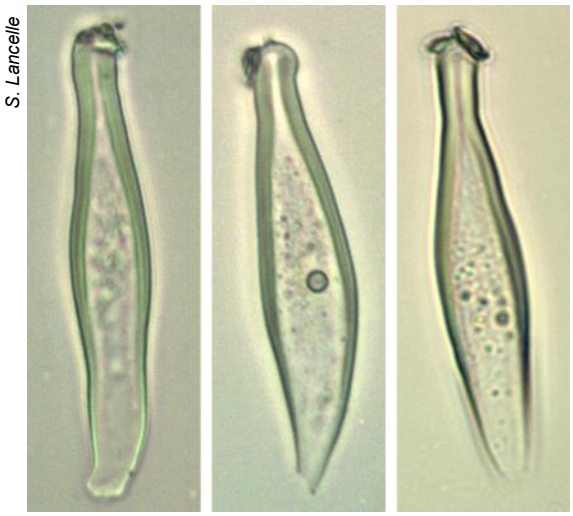

Figure 10. Pleurocystidia from *Inocybe* sp. These are typical of some species in the genus, with encrustations at the apex and thick walls (lamprocystidia).

Protostropharia. The characteristic pleurocystidia of some *Inocybe* develop encrustations on the outside of the cell at the apex (Figure 10). Thick-walled cystidia such as these are termed lamprocystidia.

Be aware that characteristic cystidia can also be found on the surface of the cap (pileocystidia) and the stipe (caulocystidia), and sometimes it helps to look carefully for those as well.

It can be very difficult to measure cystidia, because of the need to see the entire cell. After careful observation of your slide preparation, you can try gently tapping or pressing on the cover glass to gently squash the tissue. This sometimes releases the cells so that you can get a clearer view.

Clamp Connections

Another diagnostic microscopic characteristic that you

often see mentioned in formal descriptions of fungi is the presence or absence of clamp connections. These are swellings that may occur at the point of the hyphalseptae, or crosswalls, and can be found at the bases of basidia, basidioles, cystidia, or along any of the other hyphae. They function in distribution of cell nuclei during hyphal elongation. Figure 11A shows what clamp connections look like when you are able to tease out the hyphae from the rest of the tissue. More commonly, you are looking for them in a mass of tissue, as shown in Figure 11B. You have to look carefully but after a while you can pick them out if the tissue isn't too thick.

S. Lancelle

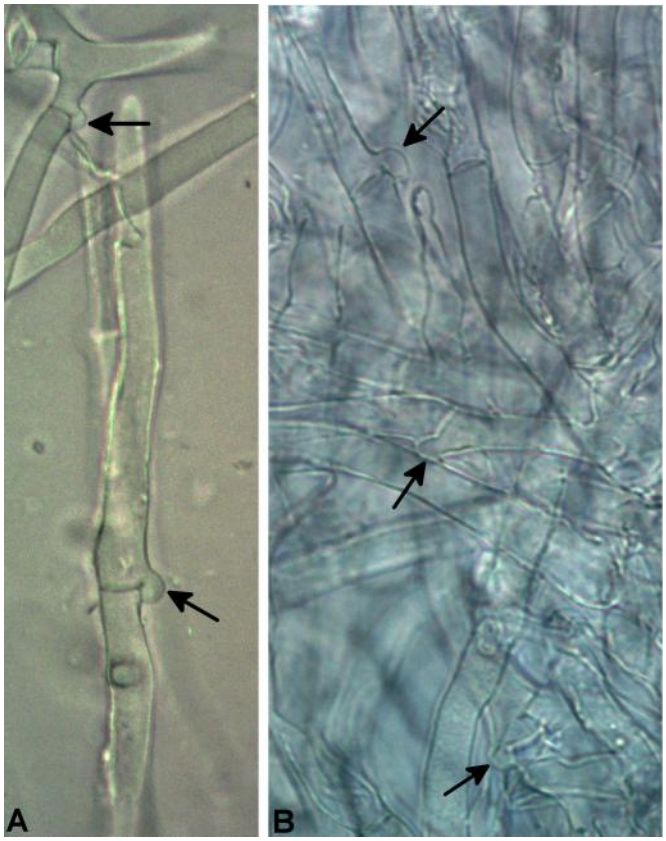

Figure 11. Clamp connections in *Infundibulicybe squamulosa*. A. The clamp connections are swollen areas that are seen at the locations of septae, or crosswalls, in some species. They are easy to see when the hyphae can be teased away from the rest of the tissue, but are often seen in a mass of tissue (B), where you have to look more carefully for them.

This has been just a brief overview of some of the important microscopic features of mushroom gills. Delving into the micromorphology of fungi is a challenging but worthwhile endeavor if you want to take your ID skills to the next level. Warning: it can become a very consuming pastime!

My heartfelt thanks to Dr. Roy Halling for his generous and patient advice and guidance during my quest to learn how to study the micromorphology of fungi.

Mark your calendar!

The Secret Lives of Woodland Mushrooms with Bill Yule, Naturalist

Saturday, August 25, 1:00 – 4:00 pm
Arcadia Wildlife Sanctuary, Easthampton, MA

There will be a nominal fee for this event, as it will be available to members of the public as well as PVMA. Audubon members pay $15, while non-members (and non-registered PVMA members) pay $20 to attend the talk and events. **PVMA members who pre-register with Jessica will pay just $5 (via check or PayPal prior to the event.)**

Please note: You **must** pre-register with me in order to pay the PVMA rate for this event ($5). PVMA volunteers for this event or the Fungi Kingdom Festival on 9/22 will receive free admission to this presentation. Email Jessica at **JessicaBensonEvans@gmail.com** to pre-register.

Monadnock Mushroomers Unlimited Mushroom Show

Saturday, September 15, 10:00 a.m. – 4:00 p.m.
Jaffrey Civic Center 40 Main St, Jaffrey, NH.

A fun-gi filled day with forays and talks on fungi identification and other topics. From Rt 101 in Marlborough, NH, turn right on Rt 124 E. Go 12.3 miles to Civic Center on the left. Park on road, in small Civic Center parking lot or in town lot (right at 2nd light past Civic Center).

And, of course, our own

Fungi Kingdom Festival

Saturday September 22, 1-5 p.m. at Arcadia Wildlife Sanctuary in Easthampton, MA.

Musings on a late May foray: My personal and somewhat off-beat account

By Jessica Benson Evans

It hadn't been done before, but I resolved this spring to host a club walk in May, in hopes that I'd be able to introduce members to some of the lesser-known spring (and year-round) species often overlooked by the time the large fleshy fungi are in abundance. My friend Larry Millman* proposed to join me in this quest, and after some dizzying back-and-forth emails between various parties on dates and transportation options, a plan was made. Larry would travel to our area via a friend, and I'd host him overnight and get him back to the train station the day after the scheduled walk. Simple, right?

Oh, but the best-laid plans often go astray in some form or another. In our case, we all ended up exactly where we were meant to be, while accoutrements of travel managed instead to go astray. Thus, I give you my account of our mycological wanderings as well as the fascinating true story of Larry's lost baggage.

We met at the trailhead to Jabish Brook Conservation Area, Larry having arrived some time before and forayed down the trail ahead of the walk's start time. "Hellooo!" I called, as I spotted him walking back up towards the parking area. Larry greeted me enthusiastically and filled me in; he'd lost a sandal from his backpack somewhere between Cambridge and our current position. A quick search was no help, and members began to arrive for the scheduled event. We'd revisit this again, later.

A cheerful foray was held; members and guests with Larry's guidance were able to enjoy a wide variety of fungi, including a species new to the PVMA collection list: *Vibrissea truncorum.* Other interesting finds included *Cudoniella clavus, Kuehneromyces marginellus,* and *Peziza varia.* Despite the unseasonably hot day, we were marvelously entertained by Larry's knowledge; members in particular enjoyed the lighting of a *Fomes fomentarius* in order to ward off mosquitoes! We ended the foray pleased with our finds and delighted with the company.

Fortified further by a visit to a local record shop and a lovely dinner in my tiny apartment with guests, Larry and I (along with Ella) resolved to foray again the next morning despite the rainy forecast.

The next morning, after the essential cups of coffee were had (but not by Ella), I led Larry out to my backyard. There, a short trail leads to an old logging site which contains acres of woody debris – the saprotrophs delight! We could have been several hours out there, but we had other items on the agenda.

We headed over to make a search of the Jabish Brook site one more time for Larry's missing sandal (and a small pouch which also absented itself from Larry's bag at some point!) then brunched sufficiently at a local vegan place and headed out for the trails. We visited portions of the Robert Frost Trail in Amherst as it rained intermittently. We delighted in finding various fungi as well as several harvestmen (Larry) and a few lovely groupings of *Cypripedium acaule* (Ella).

Despite our clear understanding that we'd need an hour to get Larry back to the train station in Fitchburg for his return home and had left plenty of time to get there, somehow, the GPS disagreed. This, as you might imagine, caused a small amount of panic among my car's occupants. We then, against all better judgment, entered into an argument with an electronic device incapable of understanding even our simple commands (I'm so ashamed!). I wrote the next paragraph in the days directly following our weekend foray in an email to Larry:

"The intrepid travelers, weary from two days' pursuit of minuscule mycological wonders amidst the often-incessant chatter of a seven-year-old chief identifier, found themselves arguing most passionately with an electronic nincompoop. 'Take me to Wachusett,' I exclaimed. 'Le Creuset?' it asked. 'You're an idiot!' the mycophiles rejoined. 'Did you mean, Hong Kong Kitchen?' the GPS replied. Clearly, if we were going to get Larry back to the train station, we'd need to rely on our own wits."

Eastward progress was thankfully made, and our threesome arrived at our port of call with minutes to spare. As the vehicle came to a stop, one member of the party spotted something rising up from the ground in the distance. The sun shone through drizzly clouds, highlighting the glow of something special arising from the concrete. "Manna!" Larry exclaimed. Could it be? But, no. This was no *Tirmania nivea***. It was ... Larry's missing sandal! Reunited at last, Larry and the sandal boarded the train; each chattering excitedly about all they'd seen.

Some poetic license was taken, of course, in my description of the events of that fantastic weekend in May. Our fungal finds, our argument with the GPS, and our overall enjoyment, however, are depicted accurately. After all that excitement, there's only one thing left to do: schedule another foray!

**Lawrence Millman is an author and mycologist with the Boston Mycological Society. He will be leading a walk for us on Sunday, Oct. 14.*

***Many thanks to Elinoar Shavit; without her enlightening presentation on desert truffles, this comparison might never have been made.*

Members enjoying the walk at Jabish Brook

Discover NAMA!

NAMA, the North American Mycological Association, is a valuable resource for information on toxins, book reviews, newsletters, cultivation, medicinal fungi, cooking, photography, art and much more. NAMA also organizes an annual multi-day foray and smaller regional forays, where you can learn from top experts in diverse areas of mycology. NAMA recently produced a very nice informational video to introduce itself (and some mycological characters you might have heard of) to people who are unfamiliar with it. Find it at **https://www.youtube.com/watch?v=glqwOl9TkiQ&** or on the information-packed NAMA web site at **www.namyco.org**. Membership in NAMA costs only $25 for affiliated club members and includes a subscription to their newsletter, *The Mycophile*. The Pioneer Valley Mycological Association is an affiliated member of NAMA.

The NAMA video was filmed at last year's annual foray, The Northwoods Foray in northern Wisconsin.