Symbiosis©

The newsletter of the Prairie States Mushroom Club

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Looking Forward

by Glen Schwartz

Do you ever feel like you are in a rut? Well, I have had that feeling about the mushroom club for a while now. So this year, I decided to shake things up a bit. In early March, all club members were invited to a foray planning meeting in North Liberty. The idea was to gather input from as many members as possible, and to provide a more formal setting for planning club outings.

The foray planning meeting was a huge success. We were able to set up forays for the entire year. We tried to set up a foray once every 3 to 5 weeks - in the past, we had gaps as big as 9 weeks. We also decided on a location for our annual meeting. Once again, that will be at the Wickiup Learning Center near Cedar Rapids. Because we selected an annual meeting site so early, I was able to secure this location on the desired date, October 15th.

In addition to setting up a more regular schedule, I also wanted to spread out geographically. For the past several years, almost all of our forays have been in Linn County, Johnson County, or southeast Iowa. This was entirely unfair to our western members. This year, we have a foray planned for Ledges State Park near

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My First Fungus

by Karen Yakovich

The fruiting bodies of mycelium have always fascinated me, although I knew nothing of them. Like most North American fungophobes, I thought it safest to believe that most wild mushrooms are poisonous.

Some of my favorite things are those kitschy '70s wares with mushroom designs. I own a meager amount myself. But "The One" that forced me to my knees to get the best possible look was the *Lysurus periphragmoides*. The first time I saw it, it was tucked behind an Echinacea. A few weeks after that we laid what I think was cedar mulch, and they began to pop up everywhere. I don't think they came in on the wood chips because one was present before the woodchips were laid. The chips probably provided them with some water retention for fruiting. It was a very sunny spot where they popped up. The little alien looking things fried in the sun and didn't last long at all.

There was even a Siamese twin one. I started to become familiar with their smell, and noticed it as soon as I walked out the door. I would just know there were new ones out that day. They smelled metallic in my opinion. Every new one was fully inspected. Neighbors must have thought I was very strange, on my hands and knees, nose to the ground (they were growing in my front yard). Still a fungophobe those fruit bodies had my respect. I didn't touch a one! Couldn't even muster the courage to poke it with a stick! The first one behind the

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Raindrops Keep Falling On Their Heads (Thanks To Mushroom Spores, That Is)

by Elio Schaechter, January 11, 2016 Small Things Considered blog
http://schaechter.asmblog.org/schaechter/ Reprinted from *The Mycophile 56:2. March/ April 2016, pages 6 – 9.*

I have two purposes in discussing a recent paper[1] from the lab of mycologist Nik Money. One is to present a notion of the way mushroom spores may contribute significantly to rain making. The other one is introduce a noteworthy wrinkle in electron microscopy (previously unknown to me), namely the ability to look at wet objects under the elec- tron beam. These two topics combine in this paper.

Mushroom spores are released into the atmosphere every day by the billions. In weight, this amounts to 50 million tons per year or, if you wish, about 1000 spores per square millimeter of the earth's surface. Together with pollen, bacteria, and other biological particles, they serve as nuclei for cloud formation and, therefore, rain (we leave the intriguing story of atmospheric bacteria for another time). Fungal spores come in different sizes but a diameter of 5 - 8 µm is rather typical. This size is small enough for the spores to be carried aloft even by gentle wafting breezes. Measurements made in Brazil show that fungal spores account for about 35% of the total particles of this size range. The figure is higher and varies less during the year for the heavily forested tropics than elsewhere.

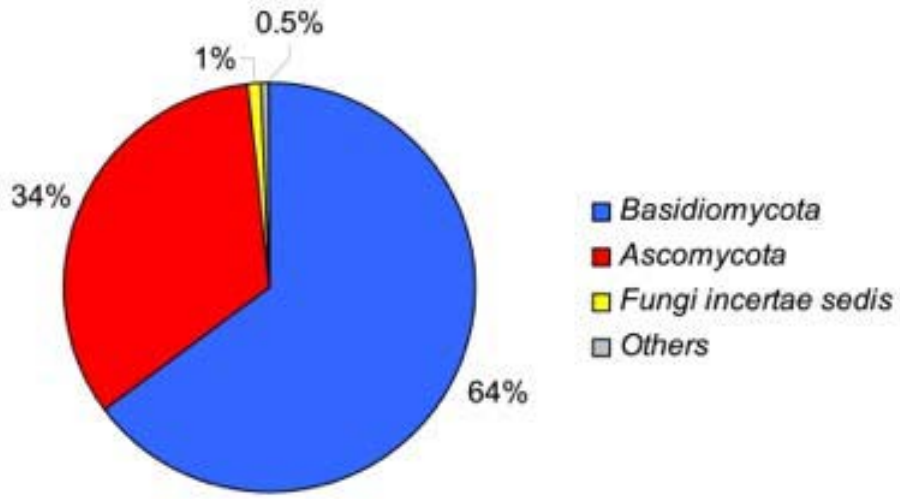

Figure 1. Distribution of fungal phyla represented by DNA in samples of airborne fungi[2]

The atmosphere may be a thin soup all right, but enough material can be gathered for analysis using high capacity filtration techniques and long sampling times (one week is typical). Interestingly, in the samples so collected, mannitol can be used as a suitable biomarker for the presence of fungal spores and, of course, so can DNA. In fact, the DNA analysis shows that about 2/3 of the fungal spores are from fruiting bodies of Basidiomycetes and about 1/3 from Ascomycetes (which include morels and some other mushrooms)[2]. So, mushrooms and other fungi are indeed the largest source of particulate matter acting as nuclei for raindrops in the atmosphere. The species found are quite diverse and include allergenic ones (not a surprise for people suffering from such allergies) and human and plant pathogens (e.g., *Candida*, *Puccinia* or cereal rust).

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Raindrops Keep Falling...

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It doesn't make much difference here, but mushroom spores are made sexually, those of mold largely asexually. And their mechanisms of release into the air are different. Asexual spores conidia they're called are released passively, that is, they simply detach from the hyphae that make them and are limited in their dispersal. Sexual spores of typical mushrooms (but not truffles, puffballs, etc.), on the other hand, are forcibly ejected from their maternal cells and are immediately swept out by air currents.

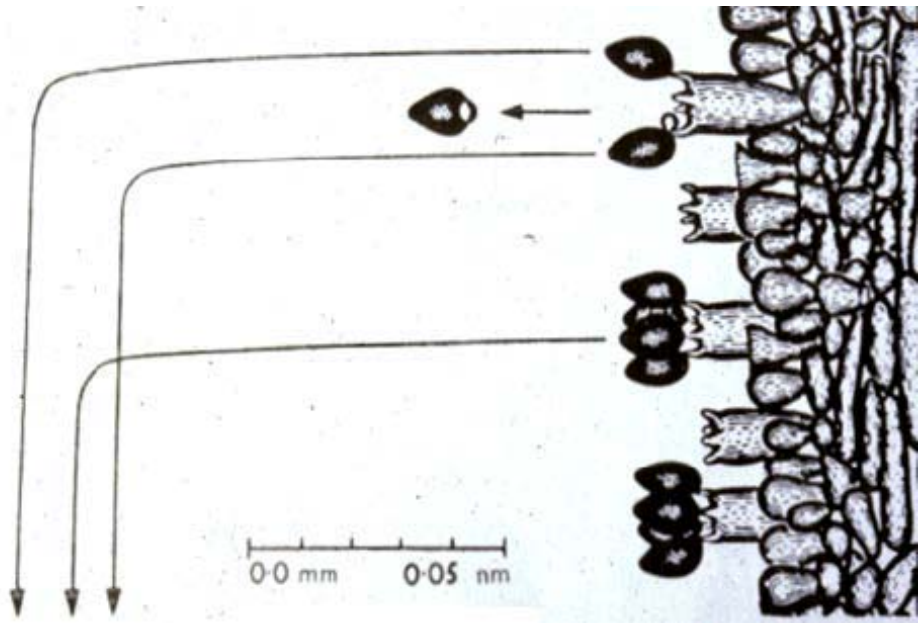

Figure 2. The trajectories of spores being ejected from the gills of a Basidiomycete mushroom. Notice the sharp break in the curve (something a baseball pitcher would dream of !). From AHR Buller, *Researches on the Fungi*, Vol. II, 1922

The mechanism of spore release in both the Basidiomycetes and the Ascomycetes defies the imagination. Basidiospores, as they're called, are ejected from the "gills" or pores found on the underside of mushrooms with an astounding force of over 10,000 x g and an initial velocity of close to 2 meters/second! Of course, the initial velocity is sustained for a very brief time, or else the spore would hit the opposite gill. In fact, the trajectory is interesting: the spores travel horizontally for a short distance, they then "hit a wall", when their momentum cannot overcome the viscosity of air. At this point, they drop vertically, to be caught by air current and carried over a long distance. The mechanism of release depends on the formation of a water droplet at the base of the still attached basidiospore. When this droplet increases in size due to the secretion of hydrophilic substance such as mannitol, it eventually collapses, transferring its center of gravity outwards. This impels the spore to take off at prodigious if sustained extremely briefly - speeds.

Under internal pressure from maturing spores of cup shaped Ascomycetes and humidity, the contents of asci can simulataneously squirt spores into the air anywhere from a few millimeters to about 2 feet. Air turbulence created by the explosive discharge carries the spores further distances. Those of *Sphaerobolus*, aptly called the cannonball or artillery fungus, impel their spherical spores to travel over a 6 m. horizontal and 2 m vertical distance. The force is supplied by turgor built up by an increase in osmotic pressure in the spore-bearing tissue by conversion of glyco- gen into sugars. Overall, spore discharge over distances is more common among the basidios than the ascos.[2] The spore discharge mechanisms of zygomycetes can be even more spectacular than either of the major phyla. Impelled by pressurization, the spores of zygomycete *Pilobolus,* for example, can travel

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Raindrops Keep Falling...

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up to 2.5 meters. Nice, but what does this have to do with rain formation? The proposal from Money's lab is an explanation for the way fungal spores make for nuclei effective in the formation of raindrops. Before considering the possible mechanism, let's do some numbers. Are there sufficient spores in the atmosphere to make a difference?

The answer is yes. To repeat, fungal spores are dispersed every year to the tune of 50 million tons, enough to cover each square mm of the planet with 1000 spores. They are not distributed evenly, with forested regions accounting for the greater share of the production. So, the numbers seem to add up.

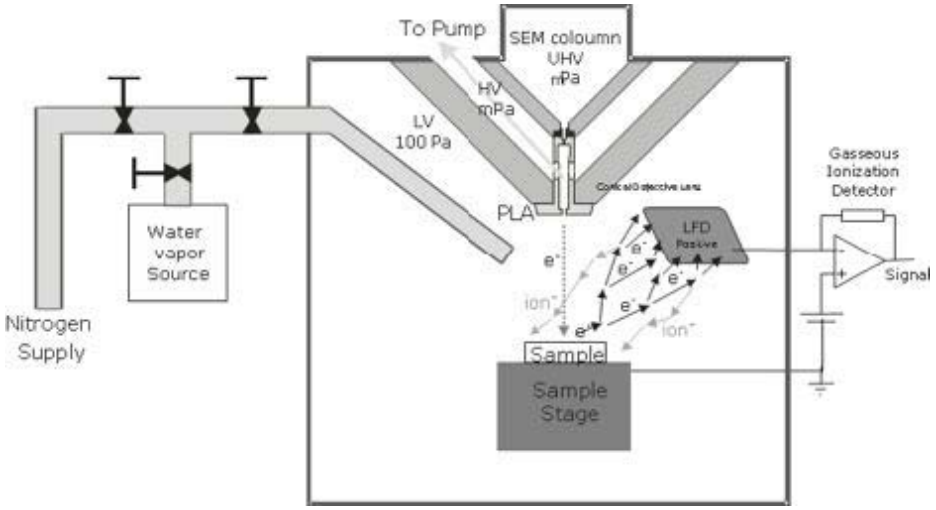

Figure 3. Schematic of the business end of an ESEM.

How to show how fungal spores make rain? The investigators measured the amount of moisture that accumulates on fungal spores at different levels of moisture. For this, they used a not so novel but relatively underused (and to me, previously unknown) variation on the electron microscope, namely one that allows to look at wet objects. Called Environmental Scanning Electron Microscope (ESEM), this machine overcomes the problem of conventional EMs, namely that the objects have to be dehydrated. A webpage by its main developer, GD Danilatos is found here[4]. In the ESEM, the specimens are placed in a small chamber that can be vented with gases, including water vapor. For this purpose, the EM needs considerable modification with regard to pumps and the detection system. It is commercially available, apparently not cheap. Microbes have been studied with the ESEM,[3] but best I can tell, it has only had limited use in microbiology. But this paper does it justice.

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Raindrops Keep Falling...

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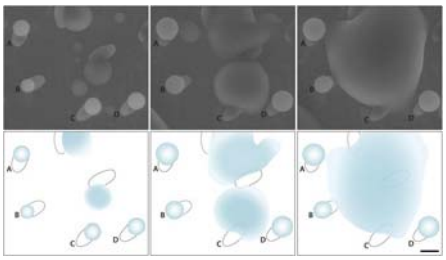

Figure 4. Droplet formation on basidiospore of *Suillus brevipes* in the ESEM at 101% RH.(A-D) Spores are orientated with adaxial surface facing away from surface of the specimen stub, allowing observation of droplets growing from this hygroscopic region of the spore. Note merger of droplets in second and third panels. Scale = 5 ìm. [1]

The authors collected 8 species of mushrooms and placed the spores in the ESEM and altered the relative humidity (RH) in the specimen chamber. Droplets of water formed on the spores at RH values of 101 and 102%. Interesting is that these droplets formed precisely on the sites on the spore where they are seen before being discharged, namely the peduncle where the spore sticks to its mother cell and on its adjacent (adaxial) face. The drops evaporated when RH was lowered below 100%, only to reappear when RH was once again increased.

In time, the water droplet on the face of the spore reached large dimensions (13 µm). The authors also looked at the behavior of spores of basidios such as puffballs that do not forcibly discharge them. Here, the water makes a thin shell around the spores with no specific localization, suggesting that there are different ways whereby spores induce water droplets to form.

Does this benefit the mushrooms? The authors state: “There is no adaptive significance to the putative effect of spores on cloud formation. It is a consequence of the dispersal mechanism that happens to benefit the fungus beyond its effectiveness at distributing spores. If changes in climate reduce rainfall in tropical ecosystems, the resulting inhibition of fungal growth and spore release may exacerbate the frequency of droughts through this unexpected feedback loop”. I guess one could argue whether this feedback loop has adaptive significance. Let me put it this way: No rain, no mushrooms!

1. *Mushrooms as Rainmakers: How Spores Act as Nuclei for Raindrops*. MO Hassett, MV Fischer, NP Money, PLoS One. 2015 Oct 28;10(10):e0140407. doi: 10.1371/journal.pone.0140407. eCollection 2015. http://www.ncbi.nlm.nih.gov/pubmed/26509436.

2. *High diversity of fungi in air particulate matter*, J. Froehlich-Nowoisky, DA Pickersgill, VR Despres, U. Poschi Procedings of the National Academy of Science, 2009 Aug. 4; 106 (31):12814-9: 10.1073/pnas.0811003106. Epub 2009 Jul 17. Abstract on PubMed. http://www.ncbi.nlm.nih.gov/pubmed/19617562.

3. *Advantages of environmental scanning electron microscopy in studies of microorganisms*. Microsc Res Tech. 1993 Aug;25(5-6):398-405. https://www.ncbi.nlm.nih.gov/pubmed/8400431.

4. *ESEM Development and its Future* by G D Danilatos http://www.danilatos.com.

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Note a correction for the last *Symbosis*. The article titled “Soil Carbon and You: The Importance of Sequestering” by Larry Evans was printed from *The Mycophile*. Thanks to NAMA for sharing their articles with us.

Building a PSMC Archive

by Cody Gieselmen

I am working on both a physical and digital archive for the Prairie States Mushroom Club. With the help of several club members, we have assembled a well-rounded though incomplete digital collection of issues of Symbiosis, foray lists, and updates to the club's life list. Though digital archives can be more convenient in many ways, they are infamously fragile, no matter how streamlined and standardized the technology becomes. Thus, it is my goal to balance our digital records with a physical archive.

I have experience with archival work, and I regularly meet with conservation and preservation professionals for my administrative job with the Iowa Conservation and Preservation Consortium. I will do my utmost to preserve our documents, ephemera, and artifacts according to best current practice. If you would like to contribute physical or digital items to the PSMC archive, please get in touch with me at cody.gieselman@gmail.com or Cody Gieselman, 817 Webster St, Iowa City IA 52240.

Anything that is related to our club or club activities is welcome. This includes obvious items like issues of the newsletter but also supporting pieces such as photographs of fungi and members alike, personal notes from forays or meetings, old calendars, correspondence, club business cards, etc. Sometimes seemingly unimportant tidbits can help complete the picture of an organization and the individuals who have been involved over time.

We loan NAMA DVD's

Very informative set of DVD's ready for your viewing. Please phone me, Karen, at 641-217-0009 or email me at uncountedtreasures@gmail.com with your interest and I will mail them to you promptly!

My First Fungus

(cont. from cover)

Echinacea had the advantage of more shade and I was so lucky to see it. It had a feature that I have not seen in any photo. Before it starts to dry and shrivel the cap is very smooth. Where the holes are, before they become holes are pools of black – the blackest of blacks, scary tiny tar pits. The Lysurus periphragmoides gained my immediate fear and respect. I'll never forget it.

Do you have a memorable first fungus? Please let us know, and we'll be happy to share it here.
Email me at uncountedtreasures@gmail.com

Some interesting slime mold growing in the crevasse of a tree. Photo by Karen Yakovich

Actually Tasty Dryads

by Dave Layton

I've been finding dryad saddles *(Polyporus squamosus)* my whole life. Several times I found it young and tender enough that I just had to try it, but, no matter what I did, the watermelon rind or cucumber like flavor always turned me off. Sally liked them even less. In fact she always called them by her own personal pejorative "Squeamish Squamosa" - a name that reminds one more of a disease than an edible fungus.

This spring I found some young tender specimens and I thought I'd try making them edible again. I decided to see what I could find about eating them on the internet. I was amazed to find that a whole lot of folks really like these things and they call them simply "dryads." Moreover there are a number of recipes for dryads. Several called for cooking them in a thick tangy cream sauce of some sort and all called for thin slicing and high heat. The problem was all those recipes called for ingredients that I didn't already have in my fridge, cupboard or garden. However I did have ingredients that seemed like they'd work the same way. As it turns out I got pretty lucky with the ingredients I did have. When Sally came home she said, "What's that smell, roast beef?" Okay she has a poor sense of smell, but she did think they were extremely tasty and would be great with beef and potatoes. Of course I still haven't asked her if she's going to call them dryads now or if they're still Squamosa in her book.

Dryad with Gravy Sauce

2 C. thin sliced fresh young dryads *(Polyporus squamosus)*
1/4 C. chopped chives
3 T. butter
3 T. dry white wine (cheap)
1 t. garlic powder
1 t. dried oregano
1 1/2 t. whole wheat flour
2 t. Heinz Chili Sauce - or similar product
1/2 C. half & half

Melt butter and add garlic and oregano. Raise heat and add wine when butter starts to bubble. Add chives. Add dryads when mixture bubbles. Add flour then chili sauce when moisture comes out of mushrooms into pan. Cook at fairly high heat until most excess moisture from mushrooms disappears. Add half & half and cook until mixture thickens to taste. Salt and pepper to taste.

Great on its own or experiment with combinations such as with roast beef and cucumbers, potatoes, etc.

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Looking Forward

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Ames, and Ashton Park (east of Des Moines). We also have a foray planned for Butler County, (north of Waterloo), and Starr's Cave near Burlington.

Our most ambitious plan is for a two-day foray in Decatur County. Other clubs do this all the time, but this is a first for us. On Saturday, August 27th, we plan to meet at Sibylla Brown's property. She and her husband have created an oak savanna out of scrub forest that they purchased many years ago. Most years, in late summer, it is loaded with boletes. We find so few around here that I am really looking forward to finding and identifying these mushrooms. The next day, Sunday August 28th, we will have a foray at Nine Eagles State Park, near the Missouri state line. Long-time club members say they had a productive foray here many years ago. Being separated from eastern Iowa by more than a hundred miles, I expect a significantly different set of fungi down in Decatur County. I sure hope I can attend both days.

Forays for 2016

June 24th	Amana Nature Trail	Iowa County
June 25th	Ledges State Park	Boone County
July 16th	Shell Rock Bend	Buchanan County
Aug. 13th	Starr Cave	Des Moines Co.
Aug. 27th & 28th	Decatur County (two locations)	
Sept. 10th	Aston Wildwood Park (Heidt leader)	Jasper County
Sept. 24th	Amana Nature Trail	Iowa County
Oct. 15th	Wickiup Hill Outdoor Learning Center (Annual Meeting)	