SPORE PRINTS

BULLETIN OF THE PUGET SOUND MYCOLOGICAL SOCIETY
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WHY SOME MUSHROOMS GLOW IN THE DARK

Drew Marsh

Morning Ledger, March 20, 2015

A new study by researchers at Dartmouth's Geisel School of Medicine in Brazil has revealed that mushrooms emit light to attract insects, including beetles, flies, wasps, and ants. The research report was published in the Cell Press *Journal of Current Biology*.

A team of researchers has found that fungi emit light to attract insects because they help to spread fungal spores around.

"It appears that fungi make light so they are noticed by insects who can help the fungus colonize new habitats," said Cassius Stevani, PhD of Brazil's Instituto de Química-Universidade de São Paulo. The circadian control of bioluminescence makes the process more efficient.

Neonothopanus gardneri is one of the biggest and brightest of bioluminescent mushrooms. It is also called "flor de coco" by locals in Brazil, where the mushroom can be found attached to leaves at the base of young palm trees in coconut forests. Researchers found that the mushrooms' glow happens under the control of a temperature-compensated circadian clock. This level of control probably helps the mushrooms save energy by turning on the light only when it's easy to see.

Researchers made sticky, fake mushrooms out of acrylic resin and lit some from the inside with green LED lights. Those pretend fungi were placed in the forest where the real bioluminescent mushrooms are found. Researchers observed that "the ones that were lit led many more staphilinid rove beetles, as well as flies, wasps, ants, and true bugs to get stuck than sticky dark mushrooms."

According to Jay Dunlap, a geneticist and molecular biologist at Dartmouth College's Geisel School of Medicine, they want to identify the genes responsible for the mushrooms' bioluminescence and explore their interaction with the circadian clock that controls them.

Researchers are also using infrared cameras to watch the interaction between *N. gardneri* mushrooms and arthropods more closely. They believe that the findings are important in understanding how mushrooms are dispersed in the environment. That's key because mushrooms such as *N. gardneri* play an important role in the forest ecosystem.

"Without them, cellulose would be stuck in its form, which would impact the whole carbon cycle on Earth," Stevani said. "I dare to say that life on Earth depends on organisms like these."

Wikipedia

Neonothopanus gardneri.

TESTS USING DRIED *AMANITA MUSCARIA*

http://driedmushroomsok.bravesites.com/, Jan. 21, 2015

The 18th century Siberians seem to have used dried *Amanita muscaria* to increase their feeling of strength before battle. Dr. Angus McDonald did a 1978 study in California with human volunteers using placebo capsules of whole wheat toast and capsules with dried powdered *Amanita muscaria* using specimens provided by the Mycological Society of San Francisco. Among the symptoms were nausea, increased salivation, time changes, and improved color vision. There were also auditory, visual, and bodily distortions including a sensation of increased strength. Motor coordination (standing on one foot, putting nuts on bolts) was decreased, but dart throwing was not. If any conclusion can be drawn about Siberian berserkers, they probably slept before battle and wobbled around, but threw lances just swell.

The six human volunteers and McDonald himself had enough in the way of unpleasant symptoms to outweigh any pleasant feelings. Only two wanted to repeat the experiment at one-third of the dose used in the study.

CAN MUSHROOMS SAVE THE HONEYBEE?

Sylvia Kantor

Mycolog, Humboldt Bay Myco. Soc., March 2015

Source: http://crosscut.com/2015/02/can-mushrooms-save-honeybee/

Paul Stamets has had a life-long love affair with mushrooms, one that goes well beyond their culinary and psychedelic qualities. Wearing his signature hat—made from mushrooms—a turtle pendant and, always, a blue scarf, the nearly 60 year-old mycologist runs Fungi Perfecti, a family-owned farm and business in Shelton, Washington. Stamets jokes that it only took him three decades to have his epiphany about the relationship between his beloved fungi and the threatened honeybee. He first began to connect the dots after noticing honeybees feeding on the mycelium (root-like filaments) of mushrooms growing among the wood chips in his garden.

Later, through research supported by the National Institutes of Health and the Department of Defense, Stamets showed that certain species in a class of mushrooms called polypores contained substances that were effective against human pathogens such as pox viruses, flu viruses, and herpes. He later learned that these same mushroom compounds, present in certain polypores associated

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CALENDAR

Apr. 14	Membership Meeting, 7:30 pm, CUH
Apr. 20	Board Meeting, 7:30 pm, CUH Monday ID classes begin, 4–7 pm, CUH atrium
Apr. 21	*Spore Prints* deadline
Apr. 26	Field Trip (see PSMS website for details)
May 9	Field Trip (see PSMS website for details)

MEMBERSHIP MEETING

Tuesday, April 14, 2015, 7:30 pm, Center for Urban Horticulture, 3501 NE 41st Street, Seattle


Dr. Steve Trudell

Our speaker for April will be PSMS Scientific Adviser Dr. Steve Trudell. The arrival of spring is eagerly awaited by mushroom hunters. Time to get out the basket and head to the woods in search of morels and other fungal quarry. To help refresh your search images, Steve will present a pictorial review of a number of the Pacific Northwest's common spring-fruiting mushrooms.

Dr. Trudell is a forest ecologist and itinerant educator who has been hunting, photographing, and learning about mushrooms for over 35 years. He is author of (and photographer for) *Mushrooms of the Pacific Northwest* (with Joe Ammirati), *Tricholomas of North America: A Mushroom Field Guide* (with Alan Bessette, Arleen Bessette, and Bill Roody), and *Mushrooms of the National Forests in Alaska* (with Kate Mohatt). Steve has taught mycology, botany, and biology courses at the University of Washington, The Evergreen State College, and Bastyr University, as well as classes and workshops at many mushroom festivals, NAMA forays, and local mushroom club events. His particular interest is in understanding why there is such a tremendous diversity of mushroom-fungi and the roles that they play in forest carbon and nutrient cycling.

Would persons with last names beginning with the letters A–K please bring a plate of refreshments to share after the meeting.

NEW FIELD TRIP POLICY—LIABILITY WAIVERS

Marian Maxwell

This year all PSMS members or any invited guests will be required to sign liability waivers before participating in a field trip or foray. We will be sending a broadcast note to the membership where you can read the privacy policy and sign it online. If you pay for your membership by mail you may also download a copy of the waiver to sign and mail it in.

BOARD NEWS

Denise Banaszewski

New Board: We will welcome our new Board as of April 20. Marian Maxwell will continue on the Board as Immediate Past President. Kim Traverse will be President, Luise Asif will step off as Trustee to be Secretary, and the following new Trustees will join the Board: James Ardena, Carlos Cruz, Brady Raymond, Erin Raymond, and Milton Tam. I will step off as Secretary, and the following Trustees will step off the Board: Teddy Basladynski, Jon Hall, Andrea Rose. and Reba Tam. Our alternate Trustees are Paul Hill and Gwen Heib. **Banquet:** The Banquet went well, and the truffle presentation by James Nowak was great (and delicious). **Mushroom Maynia**: We have had one planning meeting, and about 20 people volunteered to help. Kim Traverse plans on having two more planning meetings at CUH. If you would like to help, please contact Kim. **Liability Waiver:** We have finalized our liability release, which all members and field trip attendees will need to sign. **Heavy Metals Research Project:** Erica Cline, a PSMS member, is doing a research project on heavy metals in mushrooms. If you'd like to help, Erica will be at our 2015 spring and fall field trips and will provide information. There is no obligation to do this, just an opportunity if you are interested in helping with her study. **Privacy Policy:** We will soon be finishing and posting our **p**rivacy policy on our website, which will explain the member information we collect, who has access to it, and what we do with it. We intend for the privacy policy to go into effect on July 1. **New Fund:** We will set aside $1,000 per year into a new scholarship fund for Washington public and tribal schools (K–12), up to $200 for each classroom. This will be in addition to the current Ben Woo fund. This grant can be used for kits, books, Petri dishes, slides, etc.

In closing, this is my last Board News. It has been an honor serving as Secretary of this great organization for the past 6 years!

NEW PSMS K–12 GRANTS FUND Marian Maxwell

As I will be stepping down from the presidency but still remaining on the board, I have volunteered to chair a Scholarships Committee for PSMS to review grants that come in to the Ben Woo Grant fund. In addition, I am pleased to announce the PSMS Board has formed a new grant fund as well, the PSMS K–12 Grants. The PSMS board will have final determination of any grants that are awarded.

Our goal in establishing this fund is to help fund the study of mycology in K–12 Washington public and tribal schools. We realize that it is often difficult for these schools to fund additional science materials, and would like to offer interested classrooms the chance to supplement their study of fungi with cultivation kits, books, or other educational materials for learning about fungi. We will offer pre-approved classes up to $200 per class and will reimburse them for the cost of materials. Our fund is set at $1000.00, with an option by the board to replenish the fund yearly if interest in the fund is warranted.

This fund will tie in with the NAMA (North American Mycological Association) teaching kit, which Danny Miller (Education chair), Dr. Steve Trudell (our scientific advisor), and I will be reviewing in preparation for PSMS being the coordinator for NAMA for this kit. We will have this kit streamlined and available to classrooms in the Pacific Northwest by this summer in preparation for the upcoming school year.

For more information about this or the BenWoo Grant Fund or the NAMA teaching kit for the upcoming year, please contact Marian Maxwell at grants@psms.org or you may leave a message on the general PSMS voice mail at 206-522-6031. The application for this grant as well as the criteria for the grant will be listed under "Resources," just click on PSMS K–12 Grants. Let's get the kids in our community excited about mycology!

MONDAY ID CLINICS TO OPEN APRIL 20

Brian S. Luther

The spring 2015 Hildegard Hendrickson ID Clinic at the Center for Urban Horticulture will begin on Monday, April 20. It will run continuously on Mondays until sometime in June, except for the Memorial Day Holiday on Monday, May 25, when it will be closed. ID Clinic hours will be 4:00 to 7:00 pm. This is a free public service, compliments of the Puget Sound Mycological Society. PSMS members and the public are invited to bring in fungus specimens for identification during these hours. Mushroom experts will be on hand to answer your questions. This will be held at the Miller Library atrium at CUH, located at 3501 NE 41st St., just south of University Village on the east campus of the University of Washington.

When collecting samples for ID, please be sure to bring the entire fruiting body, which may involve digging it up to get the whole specimen. Be sure to segregate different species (but you can put several samples of the same species together) in individual paper or wax paper bags. Also, never use plastic bags because they don't breathe and the specimens can start decaying. Pay attention to habitat and associated trees (bring in a small sample of trees or write a simple data slip for collections) because this information helps us to identify your specimens.

LECTURES IN THE BARN AT THE MEMORIAL DAY WEEKEND FIELD TRIP Brian S. Luther

As with last year, I'm requesting volunteers interested in giving PowerPoint or color slide lectures upstairs in the barn during this field trip. I started this in 2013, and I'm pleased that it has attracted a large and enthusiastic audience ever since. Any subjects dealing with fungi, myco-gastronomy, mushroom tours, nature, etc., are welcome. I do ask that your presentations include colorful photos.

I'm designating half-hour or hour-long blocks on both Saturday and Sunday nights, from 7:00 to 9:00 pm. Please let me know well ahead and send me a brief overview of your subject/topic, so I can get you on the schedule. I'll be giving the first lecture at 7:00 pm on Saturday night, right after the big potluck—a brief history of Leavenworth, Washington, as seen through antique picture postcards.

METALS IN MUSHROOMS STUDY Erica Cline

Have you ever wondered whether some types of mushrooms are safer than others with respect to the metals they contain or whether some foraging areas are safer than others? Would you like to get involved in a local research study to help answer these questions? Supported by a grant from the Stuntz Foundation, my lab at the University of Washington Tacoma will be testing metals in mushrooms collected by volunteers during Puget Sound Mycological Society forays this spring and fall. If you would like to participate, all you need to do is show up for the foray. Members of my lab will provide a brief training for anyone who wishes to participate in collecting during the foray, and hand out sample bags for mushrooms and an adjacent duff (forest floor) sample. We are testing commonly consumed mushrooms such as chanterelles, boletes, morels, etc. At the end of the foray, you can drop your sample(s) in the labeled cooler and we'll do the rest.

This study will help to understand the impacts of consuming wild mushrooms on human health in regard to toxic metal exposure. The results will help to determine locations in the Puget Sound region where metal accumulation in mushrooms is high and which mushroom species contain levels of metals that might pose a risk to human health based on chronic exposure. The information will be freely shared with PSMS members and disseminated in a scientific research article after the conclusion of the study. Thanks for your participation!

CAMPGROUND CLOSED FOR 2015

Brian S. Luther

I recently received notice from the US Forest Service that **a Campground has been closed for the entire 2015 season**, because of concerns about flash flooding due to the Chiwaukum Creek Fire.

The fire was very close by but did not actually burn any of the campground. As a precautionary measure, it's being closed all year because vegetation loss from the fire could cause mud slide/wash out conditions. Sadly, I already had a fall 2015 reservation for a PSMS field trip at the group camp, and this had to be cancelled. Let's hope that the Forest Service downgrades the hazard potential for this Campground for 2016.

FUNGUS-ILLUSTRATED STAMPS FROM GREAT BRITAIN (excluding British Crown dependencies, territories, possessions, etc.)

Brian S. Luther

This article includes fungus-illustrated postage stamps and postal items issued by Great Britain. Two of these include Royal Mail stamp booklet covers illustrated with fungi, although the stamps within the booklets do not have fungi on them. Another booklet illustrates fungi inside the booklet, but again none of the stamps have fungi on them.

Not included are postage items issued by British Crown dependencies (e.g., Isle of Man and Bailiwicks of Jersey & Guernsey) as well as British possessions and territories, e.g., Gibraltar, Ascension Isl., Tristan da Cunha, St. Helena, Falkland Islands, British Indian Ocean Territory (Diego Garcia), British Virgin Islands, etc. Many have issued lovely sets of mushroom stamps, but they are far too numerous to be covered in this particular article.

Also excluded are fungus-illustrated GB "locals," another category of postal-like Cinderellas (seals) issued by a number of small Scottish islands, such as Eynhallow, Staffa, Easdale, Bernera, etc., none of which are genuine postage according to the Scott Postage Stamp Catalogues but which are colorful and fun to collect. All of the postal items listed in the table and discussed here are official issues by the British Royal Mail.

This is the most up to date and complete listing of mycophilatelic postal items from Great Britain. In addition to the obvious fungi, my goal has always been to include all obscure fungin the design of the illustration (MIDs), which are usually overlooked in most mycophilatelic catalogs as well as by collectors because they're not readily seen. Although I've been studying these items for many years, it's possible I may have missed an obscure entry.

Unfortunately, separate international stamp catalogs from around the world have assigned different numbers to postage, so there is no uniformity. Philatelists in Great Britain and most Commonwealth Nations use the Stanley Gibbons Catalogue of postage stamps, but all catalog numbers in this article are from the Scott Postage Stamp Catalogues.

M = mushrooms or fungi as the main illustration; MID = mushrooms or fungi in the design of the illustration, or in the background or border, but not the primary stamp illustration; AF = Alexander Fleming mentioned; presentation pack = a special packet or folder with the stamp set mounted within, along with additional background information about each stamp and attractive illustrations of the same theme. These are usually available at a cost slightly more than the set of stamps themselves and are collector's items.

Discussion

Four of the stamps listed in different sets in the table below show *Penicillium* spp. on them. Scott 519 shows a Petri plate culture of the fungus used to extract the antibiotic from and is the very first postage stamp ever issued commemorating penicillin, in the year 1967. It is also the first British stamp with a fungus as the main illustration. Coincidentally, the first postage stamps issued from both Great Britain and the United States (Luther, 2014) that have fungi as the main illustration show penicillin mold (*Penicillium*

Great Britain Scott 519. This is the first stamp to commemorate penicillin, in 1967.

Great Britain mycostamps in chronological order

Issue Date MO/DAY/YR	Value	Scott Cat. #	Type	Comments
9/19/1967	1 s	519 (set 518–21)	M	First stamp ever with *Penicillium* sp. mold shown
10/1968	N/A	BK115	MID	Polypore on booklet cover, with Pied Woodpecker
10/5/1977	9 p	816 (set 816–20)	MID	Two gilled mushrooms on Hedgehog stamp
1/19/1988	34 p	1204 (set 1201–4)	M	*Morchella* spp.
4/12/1988	N/A	BK532	M	Mushrooms on booklet cover only – recipe cards
3/7/1989	32 p	1250 (set 1248-51)	MID	Stilton blue cheese, with *Penicillium* mold veins
2/5/1991	1 s	1358 (set 1350–59)	MID	*Trametes versicolor* with Peacock Butterflies
8/10/1993	N/A	BK 158	M	Beatrix Potter booklet with fungi shown inside
9/14/1993	---	1510–13 (set 1510–14)	MID	Autumn leaves with fungal pathogens on 4/5 stamps:
"	18 p	1510	"	*Aesculus hippocastanum* – leaf disease
"	24 p	1511	"	*Rubus fruticosus* – leaf disease
"	28 p	1512	"	*Corylus avellana* – leaf disease
"	33 p	1513	"	*Sorbus aucuparia* – leaf disease
1/20/1998	63 p	1790 (set 1785–90)	M	*Boletus satanas*. Endangered species stamps
3/2/1999	43 p	1849 (set 1847–50)	M, AF	*Penicillium* sp. mold. Millennium 1999 set, "The Patients' Tale"
9/16/2010	58 p	2835 (set 2834–39)	M, AF	*Penicillium* sp. mold, Medical Breakthroughs

sp.). It's hard to believe that we had to wait until the year 1967 for the first postage stamp devoted to this miraculous fungus to appear, especially in light of the remarkable discoveries leading up to the development of penicillin and knowing how it saved lives for the Allies on an astronomical scale during WWII and continues to save lives to this day around the World.

The cover of booklet BK115 shows a Pied Woodpecker, but has a polypore conk beside it growing on the tree, which is stylized and not identifiable to species.

Brian S. Luther

Booklet cover, BK115.

The two mushrooms on Scott 816 are identified as "*Clitocybe nebularis*?" in McKenzie (1997). To me they appear to be a species of either *Clitocybe* or *Tricholoma*.

Brian S. Luther

Scott 816.

Scott 1204 shows five morels and commemorates the 200th anniversary of the British Linnaean Society. The stamp is labelled "Morel *Morchella esculenta*," but notice that three different species of morels are actually shown.

Brian S. Luther

Scott 1204.

Scott BK532 booklet cover shows a scene of food in a kitchen, with five stylized edible mushrooms on it. This booklet is titled "Recipe Cards" in the catalogs, and the stamps inside have no fungal illustrations—the mushrooms are only on the booklet cover.

Brian S. Luther

Cover of booklet BK532.

On Scott 1250 (Food and Farming Year) you can clearly see the blue veins of the *Penicillium roqueforti* mold in the cheese that's cut open. Although it's not labeled, this appears to be a (delicious) British Stilton, a popular English variation on Blue Cheese.

Brian S. Luther

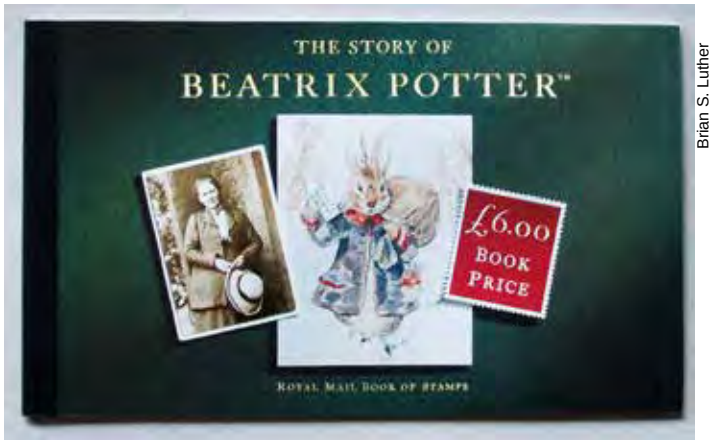
Scott 1250, Penicillium roqueforti on Stilton cheese.

Scott 1358 shows a stump with two Peacock Butterflies and a stylized fungus with zonate pilei growing all around it. According to the 2011 Scott Catalogue the insects are "Peacock Moths," which is incorrect. I count nine basidiocarps on the stump. The fungus is identified in McKenzie (1997) as "Stereum ? sp.", but it could easily also be *Trametes versicolor* (Turkey Tails). We'll never know for sure, because we can't see the hymenial layer to determine if it's stereoid (with a smooth hymenophore) or poroid.

Brian S. Luther

Scott 1358, with Trametes versicolor

Booklet BK 158 is titled The Story of Beatrix Potter. This is a Royal Mail book of different postage stamps (none with fungi, but some with her illustrations), but it tells the life story of Beatrix and is chock full of old photos of her, her family, friends, and homes along with non-stop illustrations she did from her numerous books. Inside are two paintings of *Hygrocybe punicea* (not shown here).



Brian S. Luther

Beatrix Potter stamp booklet, BK158. Mushrooms illustrated inside.

For those of you interested, Beatrix Potter was an amateur mycologist, besides being a popular writer and artist, and has many beautiful paintings of native fungi. A number of her originals are held by the Armitt Library in Ambleside, Cumbria, England, and are on public display. A couple of different books showing her illustrations of fungi have been published and can easily be found by searching online. Of course there's a wealth of information available on Beatrix Potter, but for two additional articles on her in the PSMS *Spore Prints*, go to No. 332 (May), 1997 & No. 482 (May), 2012, online at www.psms.org

cont. on page 6

Great Britain Stamps, *cont. from page 5*

Scott 1510–14 is a five stamp set entitled The Four Seasons. They show five different plant leaves and four of these have fungal plant pathogens visible on them. McKenzie (1997, p. 21) confidently provides the scientific names for these fungus parasites, in case you're interested.

Brian S. Luther

Scott 1510–1513.

Scott 1790, the Devil' s Bolete (*Boletus satanas*), is one of six British endangered species shown in this set of stamps. The others include a rodent, an orchid, a bird, a snail, and an insect. The Presentation Pack issued by the Royal Mail tells a lot more about all of these endangered organisms and the work that's being done to help them recover. For the bolete there's a beautiful color photo of two buttons in the wild and a chart showing only six known locations left in Britain where it has been found recently. It's mycorrhizal with Beech trees (*Fagus sylvatica)* which are only found in southern England and loss of habitat appears to be the main problem.

Brian S. Luther

Scott 1790.

Brian S. Luther

Scott 1849 is one of a four stamp set issued to commemorate the millennium, titled "The Patients' Tale," showing a *Penicillium* sp. mold growing. The stamp says "Millennium 1999/38, Fleming's penicillin," in part.

Scott 1849.

Scott 2835 shows a Petri plate with *Penicillium* sp. mold growth and is one of six stamps in the Medical Breakthroughs series. This stamp is titled "Antibiotic properties of penicillin discovered by Sir Alexander Fleming, 1928." The set (2834–39) was also issued in a handsome Presentation Pack which has a photo of Fleming's original Petri plate of the mold, other illustrations, and a paragraph entitled "Antibiotic Properties of Penicillin" which gives a brief historical time line and overview of those who helped develop this life-saving antibiotic.

Brian S. Luther

Scott 2835.

References

Luther, Brian S. 2014. United States Postage Stamps with Fungi—In Color. Online and in color on the PSMS homepage at www.psms.org (under Education).

McKenzie, Eric H. C. 1997. *Collect Fungi on Stamps*. 2nd ed. Stanley Gibbons Ltd. London and Ringwood. 86 pp.

Can Mushrooms Save the Honeybee?, *cont. from page 1*

with trees and rotting logs, help bees break down pesticides, herbicides, fungicides, and other toxins and bolster the bees' immune systems.

This is welcome news, because the modern day honeybee faces a litany of health threats. As many as 61 different variables may be at play in colony collapse disorder, the mysterious phenomenon responsible for a mass disappearance of bees in the last decade. Although researchers have yet to identify a specific cause, pathogens play a key role in colony collapse disorder. Scientists, beekeepers, and farmers are working feverishly to protect the tiny insect that packs such a huge economic punch. At stake is our food supply and a $15 billion U.S. agricultural industry that depends on bees for pollination.

Mycologist Meets Entomologist

Early last year, Stamets asked Washington State University entomologist Steve Sheppard to help confirm his hunches about bees and fungi. The two have since joined forces to explore the connections that, as far as they know, no one has ever made before. This unlikely pairing of entomology and mycology could lead to less toxic and more effective ways to control the diseases and pests that are implicated in winter hive losses and colony collapse disorder. Steve Sheppard credits his great grandfather, a beekeeper in Savannah, Georgia, for his own interest in bees. As a child Sheppard was surrounded by the books and beekeeping inventions his great-grandfather had left behind. It was no wonder then that seeing one of his college professors handle bees captivated him.

"I watched him spread bees around with his hand like they were a bunch of leaves or something," Sheppard recalls. "It was fascinating seeing someone interact with these social insects that could sting you to death, but didn't." Sheppard would go on to become an entomologist known for his work on the evolution and genetics of honeybees. He now chairs the department of entomology at WSU. He also heads up the APIS Molecular Systematics Laboratory, or the bee lab, where he works with commercial beekeepers to develop practical solutions for the challenges they face.

It's normal, says Sheppard, for commercial beekeepers to lose five to 10 percent of their hives in winter. But not long after the *Varroa destructor* mite arrived on the scene in 1987, those losses rose to an average of 15 percent. Since 2006, the rate of loss has doubled. "With a 30 percent loss, commercial beekeepers can still make it, but it's very tough" says Sheppard. "Imagine losing one third of your cattle in one year." *Varroa* mites spread viruses that can be deadly to bees. Sheppard explained that what keeps many commercial bee-keepers up at night is the fact that the pesticides currently used to control mites are becoming ineffective. Mites have such a short life span that they quickly evolve and develop resistance to synthetic pesticides. Sheppard and Stamets may have found a way around the problem.

Beehives Made of Mushrooms

The research partners are studying how different mushroom extracts—particularly those with antiviral qualities—affect honeybees. Initial screening has identified extracts that reduce the virus load without hurting the bees. "Steve's biggest thing is, 'let's not harm the bees'," Stamets says. "I appreciate that, because he protects them like they're his little children." Sheppard and Stamets tested extracts from about a dozen different mushrooms

by mixing the extracts with sugar water and feeding dif ferent concentrations to different groups of bees. When they compared the results to the control group of bees, which had received only sugar water, they discovered that several extracts had a significant and unexpected impact.

"I was surprised that some actually kept the bees alive longer than bees in the control group," Sheppard says. "The viral counts were also significantly lower among bees given the fungal extracts." The extracts were provided by Fungi Perfecti. They came from mushrooms that grow on birch, willow, and Douglas-fir trees, trees that bees visit to collect the resin they use to seal up gaps in their hives. It's no coincidence, says Stamets, that bees favor trees whose resident fungi come with antiviral properties. It's way too soon to explain why bees that received mushroom extracts lived longer, says Sheppard. The initial study did not identify which viruses were affected by the extracts. "This is a really new area," he says. "Once you find out what's working, you want to get at why it's working."

Stamets and Sheppard are now repeating their extract trials, this time looking at the impacts on bees injected with specific viruses.

They are also assessing the fungus called *Metarhizium anisopliae,* which is known to parasitize and kill insects. Based on evidence that the fungus can kill *Varroa* mites without harming bees, Sheppard and Stamets are designing experiments to expose the mites to *Metarhizium* spores. One experiment involves a prototype beehive made from mushrooms. The hive's panels are compressed sawdust that has been mixed with mycelium of the *Metarhizium* fungus. As the bees do their work, they'll spread the spores of the parasitizing fungus around the hive—to the detriment of the mites. Sheppard and Stamets will also try placing pieces of cardboard impregnated with mycelium into standard bee boxes. Sheppard explains that bees don't like clutter and will tear the cardboard apart to get rid of it, in the process dusting bees and mites with fungal spores.

The research duo plan to put their lab results to the test in the field. Working with one of the largest commercial beekeepers in the state, they intend to set up large-scale experiments with their mushroom extracts. The hope is to establish a sound body of evidence for what could become a commercially viable and sustainable alternative to pesticides. And in so doing, save the honeybees. "Nature leads us to solutions if we connect the dots, are open minded, and think creatively," Stamets says. "We need to be innovative to create solutions that help tilt the balance to help bees, and ultimately us. Working with Steve Sheppard is a perfect example of scientists working across disciplines to become part of the solution."

Paul Stamets and a beehive made of mushrooms

Shiitake mushrooms were grown almost exclusively in Japan until 1982. Prior to the 1970s, shiitakes were kept out of the USA because they were mistaken for a fungus that caused railroad ties to decay.

from *The Post and Courier*, January 21, 2015

POSSIBLE SUPER ANTIBIOTIC FOUND IN DUNG-LOVING MUSHROOM

Jim Drury

http://www.thestar.com.my, March 21, 2015

Coprinopsis cinerea, *the inky cap.*

Reuter -Chemists around the world have been racing against time to concoct a solution to the growing problem of bacteria becoming resistant to antibiotics. It's a major threat to the health of the global community, which for a long time has assumed that antibiotics would always be available to cure bacterial illness.

The problem is so serious that a World Health Organization report released in 2014 classifies it as a "serious threat that […] has the potential to affect anyone, of any age, in any country." Already, many of the currently available antibiotics are losing their ability to work against infections like tuberculosis and influenza.

A research team led by Markus Aebi, Professor of Mycology at the Swiss Federal Institute of Technology in Zurich (ETH Zurich), Switzerland, believe they may have found a solution: copsin, a compound naturally found in the common inky cap mushroom, *Coprinopsis cinerea*.

Lead researcher Andreas Essig and his colleagues from ETH Zurich and the University of Bonn cultivated the fungus in a laboratory, along with several different types of bacteria, and found that the fungus' presence killed certain bacteria.

Further research demonstrated that copsin produced by the mushroom was responsible for this antibiotic effect. "Copsin kills bacteria by binding to an essential cell wall building block," says Essig. "The cell wall is the Achilles' heel of bacteria. And when you disrupt the cell wall synthesis, bacteria usually die rapidly."

Copsin's unique way of killing bacteria gives it the edge over normal antibiotics that scientists have been looking for. "...copsin should be active against bacteria resistant to conventional antibiotics," says Essig.

One good reason why copsin has eluded scientists for so long is that the inky cap mushroom from which it comes has a certain fondness for growing on horse manure. According to Essig, it's the rich substrate of horse manure that gives copsin its bite.

"Horse dung is a very rich substrate that harbors a diversity of micro-organisms, including fungi and bacteria," says Essig. "Now these micro-organisms are in a constant competition for nutrients and space and it's therefore very likely to find potent antibiotics in such an environment, which are used by the different organisms to inhibit the growth of the competitors."

Instead of dung, they use grow their crop of copsin in liquid culture via a methylotrophic yeast called *Pichia pastoris*.

"Copsin is an exceptionally stable protein, so you can, for example, boil it at 100°C; you can put it in strong acid for hours," he says.

"This feature allows us, for example, also to go into applications in food industry, food preservation, and production, where strong acids in high temperatures are very common."

Despite its potential as a wonder drug, Aebi says it remains uncertain whether copsin could be used as an antibiotic. But even if that application is out, research into the properties of copsin remains important.

PRESIDENT'S MESSAGE — Kim Traverse

Let's see...10 months of the year we have Membership Meetings, eleven months of the year there are Board Meetings...let's say three hours for each plus an hour travel time both ways: that's over one hundred hours per year times the five years Marian Maxwell has been President. And she continued her long time role as Chair of the Tray Arranging and Display Committee for the three days of each Fall Wild Mushroom Show during those five years. Only she knows how many special meetings, hours spent responding to emails, President's Messages written for *Spore Prints*, public presentations, *and* last year's NAMA Foray! And the sad loss of so many long-time members during those years that Marian steered PSMS with sure hand. I'm not sure how she could possibly have done all that but she did. I know her husband, Scott, was an able First Man but Marian has been the Public Face of the club so long that I doubt there is a member who doesn't recognize her. We owe Marian an enormous debt of gratitude and a resounding Thank You! I have an impossible act to follow but I will do my best. Wish me luck!

I know too how hard all Board Members work during a term of office, and let's all thank the members going off the Board—Teddy Basladynski, Jon Hall, Andrea Rose, and Reba Tam—for the hours spent at meetings and doing all the extra things they have done (and I hope continue to do) for special events and daily operations. These are some the people who make PSMS the incredible organization it has always been.

Maybe, at a later date, when I have more time to think and energy to list, I'll make a stab at thanking ALL the people who help in so many ways to make PSMS a thriving organization. We might need a double issue of *Spore Prints*!

MUSHROOM ASTROLOGY — Bob Lehman, LAMS

Aries (Mar. 21 – Apr. 19): You are energetic in your mushroom hunting and love to explore new territory. You visit several sites in the course of a day's foraying even if the first site had more than enough mushrooms for you. You are confident and enthusiastic, and you act on inspiration. When everyone else knows it's too dry for mushrooms, you go find them. You like to make quick identifications and you risk poisoning yourself.

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