



Newsletter of the **FRIENDS**
OF THE
FARLOW

Number 65

Spring 2015

Deborah Smiley
Interim Editor

Trees and Treetops: A Study of Phylogeny and Natural History of the Orbiliomycetes in New England

Valentina Rodríguez, Harvard College, class of 2015

As a bright-eyed and bushy-tailed new student to the world of mycology I was shown a short video clip last spring by Dr. Donald Pfister and post-doctoral researcher Dr. Rosanne Healy in which a fungus (*Arthrobotrys* sp.) formed ring-like traps and then ensnared and digested small roundworms (nematodes). I was interested in understanding more. But to do so and to explore these carnivorous fungi it became clear that I would also have to understand the rather tangled history of the class Orbiliomycetes, which includes *Arthrobotrys* and its close relatives.

Orbiliomycetes (phylum Ascomycota, subphylum Pezizomycotina) are cup fungi, producing small reproductive structures that house the

microscopic, sexually generated spores. These fungi are reported in mesic habitats – moist, mostly forest floor environments – and from dry habitats of dead branches in living trees. Although the group had been studied for more than a hundred years by mycologists from around the world it was not until Dr. Pfister's 1997 paper that the asexual and sexual states of *Orbilia* were connected and verified through field collections and cultural studies. This connection was a leap forward in the understanding of the life cycle of the Orbiliomycetes and an upheaval in

the taxonomic relationships and the names used to identify these organisms. The nomenclature has yet to be resolved, but a German indepen-



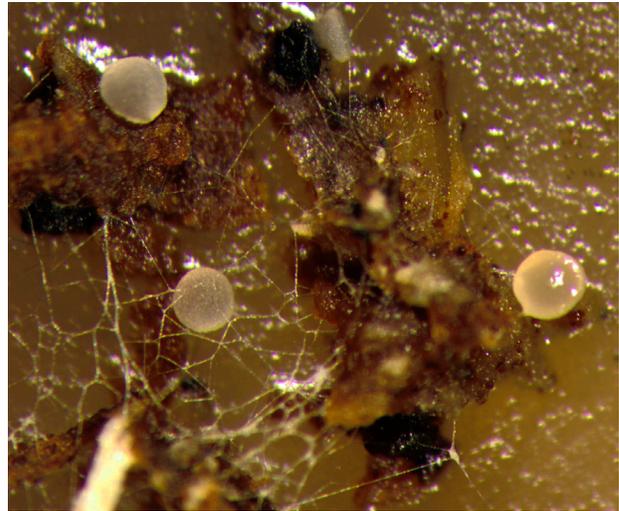
A nematode entangled in hyphal loops.

Friends of the Farlow Annual Meeting
Saturday, November 7th See page 7 for details.

dent mycologist, Hans-Otto Baral, is working up a massive monographic study that will shed light on these nomenclatural and taxonomic questions.

The phylogenetic relationships within the class are at present not well understood. Of the collections that have been sequenced and published, only a handful have come from North America – almost all from the Pfister Lab at Harvard. Furthermore, nearly all of the collections from North America have been from downed wood in moist habitats. The lack of collections from xeric habitats from Northeastern North America led to several questions about the species living here: What *Orbilbia* species live in these dry habitats (e.g. trees)? What is the relationship between the *Orbilbia* species that are known from moist habitats and the species from the treetops, a partially dry habitat? Is it possible that the species living in the canopy habitat are participating in the carnivorous behavior seen in close relatives like *Arthrobotrys*?

To start answering some of these questions, I made collections of dead branches hanging in trees from several local forest preserves in the greater Boston area. I collected almost exclusively from white pine. After being held in moist chambers the branches produced fruiting bodies of *Orbilbia* species. From these wild collections cultures were prepared and sequences were generated. Us-



Here, under magnification, are three apothecia of an *Orbilbia* species that were formed in a community culture plate.

ing this information we were able to compare and contrast the relationships of the xeric tree dwellers to the mesic land dwellers. In addition to the genetic comparison, morphological differences in the asexual spores (conidia) were studied. The resulting phylogeny seemed to show two major groups. First, and maybe unsurprisingly, support was shown for a distinct clade of New England *Orbilbia* species including both collections from this study as well as previous collections from the Pfister Lab. Second, we showed support for a single lineage of predacious *Orbilbia* species.



The Y-shaped conidia of an *Orbilbia* species in pure culture.

Another project was designed to better understand what other organisms cohabit, with *Orbilina* species, the canopy and branches and to assess whether trapping behavior occurred. From the branches on which we found *Orbilina* fruiting bodies, shavings of the tree bark were removed and placed in sterile petri dishes with Corn Meal Agar and allowed to grow undisturbed. These plates quickly showed a wide diversity of fungi, including both sexual and asexual states of *Orbilina*. The identities of these were investigated by sequencing genomic DNA. The plates were also home to a healthy population of nematodes – as you might remember, these are the prey of choice for the “trapper fungi” like the one I had witnessed in the video. This information supported the possibility that the species living in habitats with little water (xeric habitats) had prey available. But, a large number of nematodes persisted in the petri dishes over many months perhaps indicating that trapping was not occurring or that it was at a very low level. The story of the carnivorous *Orbilina* of the treetops seemed to be ending but an alternative possibility still existed; could there be another prey organism?

An exciting afternoon of discovery at the Farlow Herbarium revealed that there were also amoebae living in the community plates and it appeared that hyphal traps (in this case peg-like structures) had caught and invaded the amoebae. This discovery renewed my (at that point, waning) belief that the canopy species were carnivorous. Sadly, we have not been able to replicate this discovery experimentally. Likely our observations occurred under very specialized environmental conditions during which chemical signals allowed the behavior to take place. To date we do not know the specifics of these conditions, moreover we have not been able to replicate in the laboratory the complex natural conditions found in the wild. Another possible explanation is that the observed hyphae belong not to the *Or-*

bilina species but to another fungus also growing in the plates. If true, this would mean that the experiment using cultivated amoebae strains and our isolated *Orbilina* species would have failed even if all of the external conditions were met.

As is always the case in scientific research there is the need for further investigation. This would include expanded collecting efforts to include



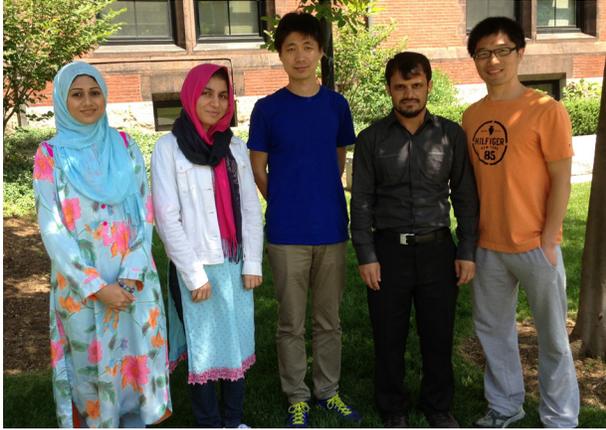
*Amoebae trapped by a fungus in a community plate culture.
Note hyphal pegs.*

wider geographic areas and different heights in the canopy; investigation of the interplay, if any, between mesic and xeric species; continued research efforts to identify the amoebae species that are living in these habitats; and investigation of the parameters that foster trapping behavior. Until then the biology of the treetop carnivores will remain unknown, though it seems we are hot on the trail.

Pfister, D.H. 1997. Castor, Pollux and life histories of Fungi. *Mycologia* 89 (1): 1-23.3

Long-Term Visiting Scholars

Ongoing visitors are Teresa Iturriaga, Chang-lin Zhao and Feng Xu. Three graduate students from Pakistan are here, each spending six months in the lab. Malka Saba, University of Punjab, Lahore, is working on ectomycorrhizal fungi in pine-dominated forests of Western Himalayas. Sana Jabeen is also from the University of Punjab. Sana is



Some of our visitors: (from the left) Sana Jabeen, Malka Saba, Feng Xu, Shah Hussain and Chang-lin Zhao

studying the ectomycorrhizal fungal communities associated with Himalayan cedar in Pakistan. Shah Hussain is a student at Hazara University and the University of Punjab. He is working on phylogenetic studies of Basidiomycota from a region in Pakistan. Teresa Iturriaga continues her work on Venezuelan fungi and other projects.

Visitors & Researchers

Giuliana Furci, founder of the NGO Fundación Fungi spent three weeks in February studying and learning about fungi at the Farlow. She has been an advocate for fungal conservation and has worked to see that environmental legislation in Chile specifically includes fungi. She is author of *Guía de Campo: Hongos de Chile*. This is a well-illustrated and practical guide to the fungi of Chile.

Among our visitors was Wayne Barrar, Associate Professor, Whiti o Rehua School of Art, Massey University in New Zealand. His project,

“Glass Archive,” looks at the diatoms. He examined slides from our extensive diatom collection with the eye to relating the slides to collection activities and landscapes and the culture of the diatomists. While here he was able to evaluate a set of early ambrotypes of diatoms found in the herbarium. These seem to be quite rare and are early examples of the technique and perhaps the earliest “photographs” of diatoms, dating from the 1860s. The discovery will be featured in a future newsletter.

Farewell & Best of Luck

Rosanne Healy, who was a post-doctoral fellow and lecturer here for the past two years, has moved on to the University of Florida where she is working with Matthew Smith, Assistant Professor at the University of Florida, who was also a former Farlow post-doc.



Rosanne Healy at work in the Farlow

Undergraduate Research Activity

Three undergraduate students have been active in the Farlow in the last year.

Valentina Rodriguez has reported here on her work with the Orbiliomycetes. This work was the foundation of her senior thesis.

Tristan Wang continues his work on the genus *Herpomyces* (Laboulbeniales) and their cockroach hosts and he presented findings at the New England Botanical Club Conference held at Smith College in Northampton, Massachusetts on June 6, 2015. His paper, co-authored with Danny Haelewaters and Donald H. Pfister is titled “*Herpomyces chaetophilus*, a New Record of Laboulbeniales for North America.”

Jack Stevenson, is spending 10 weeks in Chile working as an intern with the Fundación Fungi.

Travels & Conferences

The Farlow was well represented at the 2nd International Ascomycete Symposium that was held in Amsterdam at the end of April. Graduate student Danny Haelewaters was co-author with Meredith Blackwell on a paper on the Laboulbeniomyces and on a poster with H.-O. Baral and K. Pärtel titled “A new attempt to classify the families of the Helotiales.” Rosanne Healy presented on her work on asexual and mitosporic state of the Pezizomyces and Don Pfister presented work that Rosanne had done on the nature and development of the spore body in the Orbiliomyces.

Don Pfister and Rosanne Healy were in Chilean and Argentine Patagonia for most of May. The collecting trip was organized by Matthew Smith, former post-doc at the Farlow and now Assistant Professor at the University of Florida, and was aimed at collecting ectomycorrhizal fungi from the *Nothofagus* forests of southern South



Don Pfister in the field in Chile.

America. The project brought collaboration with several local mycologists. In Chile the trip was enhanced through the efforts of Giuliana Furci, of the Fundación Fungi in Santiago, Chile.

Danny Haelewaters also participated in the International Organization for Biological and Integrated Control-West Palaearctic Regional Section Conference in Bornholm, Denmark in May 2015. He spoke on “Can Laboulbeniales parasites (Fungi, Ascomycota) be invasive?” and “Will dual fungal infections increase *Harmonia axyridis* mortality in natural populations?” Along with his

other travels Danny Haelewaters went to the Philadelphia Botanical Club for an invited seminar about Laboulbeniales, invited by David Hewitt (former graduate student at the Farlow). He has been successful in raising money for other travel as well. His grants include those from the Georgia Entomological Society Scholarship; Torrey Botanical Society Graduate Student Research Fellowship; MSA Richard Korf Mentor Student Travel Award; Summer Research Travel Grant, David Rockefeller Center for Latin American Studies; and a Harvard Graduate Student Council Conference grant. These grants have allowed him to participate in international conferences, study Laboulbeniales in Panama, and attend the Mycological Society of America annual meeting.



Matt Smith with collecting gear at a high elevation site in Chile.

In May, Genevieve Tocci, curatorial assistant, attended the Society for the Preservation of Natural History Collections (SPNHC) annual meeting in Gainesville, Florida. The focus this year was on a project titled “Making Natural History Collections Accessible through New and Innovative Approaches and Partnerships.” The Farlow is working on this with our various digitization efforts. She also visited briefly with Matthew Smith and saw the mycological herbarium at the University of Florida.

Michaela Schull is co-teaching the Lichen, Biofilm and Stone class with Judy Jacob (Senior Conservator at the National Park Service) at Eagle Hill Institute, Steuben, Maine from August 16-

22. The class includes lectures on basic lichen morphology and species identification, biofilm morphology and the role of biofilms and lichens in the environment; basic geology; the history of stone quarrying, finishing and construction; and the history of and contemporary practices of preservation “treatments” for stone.

Field trips are planned for forest and shore environments, as well as a quarry and several cemeteries. Lichens, biofilms and stone are being identified in the field and in the laboratory. The impact of surface manipulation of stone (cutting, polishing, chemical applications) and how these impacts may influence (or not) the growth of lichens and biofilms will be examined.

Projects & Activities

Along with the work that is being done by staff and visitors is curatorial work coordinated by Elizabeth Kneiper on the cryptogamic collections of the New England Botanical Club. She and a group of volunteers are checking, re-identifying and processing for inclusion in the Farlow collection the Club’s change to: lichens, algae and bryophytes. These collections add an important historical and geographical component to our holdings.

We have reported previously on our various projects to digitize collections. This work continues on several fronts – lichens and bryophytes, macro-fungi, macro-algae and soon micro-fungi. As of this writing we have the following tally: 169,367 FH specimens and 7,204 NEBC cryptogams databased for a total of 176,571 specimens databased. Still this is only about 12 percent of the collection. As we have previously written there is opportunity to work with these collections online to help us transcribe label data. The sites listed below give you the information you need to start working as a volunteer.

In conjunction with last year’s annual meeting we offered a workshop on how you, as interested



Participants in last year’s workshop on specimen label transcription.

community members, can help with data entry involved in these projects. Please explore the following links to see what you can do to help with these important projects.

- <http://lichenportal.org/portal/>
- <http://bryophyteportal.org/portal/>
- <http://mycoportal.org/portal/index.php>
- <http://macroalgae.org/portal/index.php>

Friends of the Farlow Donates Books to the Fundación Fungi

Each year the Friends of the Farlow receive donations of books for our annual book sale and each year there is a residue of books not purchased. When Giuliana Furci visited the Farlow we offered her the opportunity to select books from our backlog to add to the library of the Fungi Foundation. The list of books can be seen on the Foundation website <http://www.ffungi.org>. This is in the spirit of helping to build mycological infrastructure in Chile. The Friends of the Farlow can be proud of this endeavor.

Updates Around the Building

New windows !! Activity in the algae herbarium reminded us that the original windows in the room were not doing a good job of keeping workers in the room warm in the winter. Luckily we were able to replace the windows.

New AC !! After many years of faithful service the air-handling system in the library gave out. It has been replaced and we are now keeping the books at a suitable temperature and humidity.

Refinished table !! Our historic table in the reading room had seen many events and a good deal of activity. We decided that it was time to renew the surface. Expert refinishing has been done and now the table gleams.

New flooring in the herbarium !! The herbarium wing of the building was erected in 1921. It was provided with a linoleum floor that survived on two floors until this year. This well-worn floor has been replaced with modern tile on the lichen level. The area is much lightened and brightened by the addition. One more floor to go !!

FoF Annual Book Sale

The 2015 selection of books available to the membership was sent out the first week of June with a return deadline of August 15. We hope that you find some tempting titles at reasonable prices so that the sale continues to be a “win-win” for the FoF and members alike.

Additions to the inventory are always welcome so if you have books that you would like to donate please contact Judy Warnement at warnemen@oeb.harvard.edu.

Farlow Library News

In March the Farlow received an archival collection of Arthur Bliss Seymour (1859–1933) papers donated by his great-grandson, Carl Seymour of Sacramento, California. The collection includes

general correspondence including letters from W.G. Farlow, newspaper clippings about Harvard, and a selection of printed materials about Seymour’s classes and publications. For many years Seymour worked for Dr. Farlow on several of Farlow’s projects, the *Bibliographical index of North American Fungi*, *A provisional host-index of the fungi of the United States* and *Host index of the fungi of North America*.

In May of 2015 the Boston Mycological Club presented this unsigned sketchbook of drawings of fungi with field notes attributed to Henrietta Page to the Farlow archives. The sketchbook connects to specimens that are housed in at the New York Botanical Garden. The library plans to digitize the journal and make it available to the public in the near future.

The Farlow at 90

The theme of our annual meeting last year was looking back at the first 90 years of the Farlow. There were several exhibits centered on the Farlow — what we do and how we do it.

But we also looked forward to how collections are used today and how their value will only increase in the future. For those who missed the presentation last November at the Harvard Museum of Natural History we provide here the link to the program and presentation. <http://hmnh.harvard.edu/event/mummies-mildews-manna-and-mosses-four-kingdoms-under-one-roof>

The Friends of the Farlow 2015 Annual Meeting

The annual meeting will be on November 7th. Our speaker will be Gregory Mueller from the Chicago Botanical Garden. Greg has studied agaricoid fungi, particularly the genus *Laccaria*, he has travelled widely and recently has been an advocate for fungal conservation. We look forward to having Greg with us in November.

Join us!

Receive the FOF Newsletter, notification of the annual book sale, discount on Farlow publications and services, invitations to the annual meeting and other events, and a special welcome when visiting the Farlow.

Name: _____

Address: _____

City: _____

State, Zip/Postal Code: _____

Country: _____

Telephone/Fax: _____

E-mail Address: _____

Membership Categories

Associate Member (\$10-15)

Full Member (\$25)

Sponsor (\$50-100)

Benefactor (\$1000)

Pofcher Fund \$ _____

Amount Enclosed \$ _____

Please make checks payable to: Friends of the Farlow
Applications should be sent to: Friends of the Farlow, Harvard University Herbaria
22 Divinity Avenue, Cambridge, MA 02138 USA

22 Divinity Avenue
Cambridge, MA 02138 USA
<http://www2.huh.harvard.edu/collections/fof/fof.html>

FARLOW REFERENCE LIBRARY

OF CRYPTOGAMIC



BOTANY * HARVARD UNIVERSITY

FRIENDS OF THE FARLOW

FIRST CLASS