Newsletter of the FRIENDS OF THE FARLOW

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A fungus among us: rediscovering Thaxter's legacy in the Laboulbeniales of Carabid and Coccinellid beetles

Serena Zhao, Harvard College class of 2012

Roland Thaxter began at Harvard under the tutelage of William G. Farlow as part of the development of the study of Cryptogamic Botany in the United States. One of the most enigmatic groups Thaxter studied was the Laboulbeniales, a group of determinate-growing ascomycetes that rely entirely on their insect hosts for survival. The Laboulbeniales lack mycelia, and the minute thallus consists of perithecia and appendages, often measuring less than 300µm in overall length. The fungi obtain their entire nutrition from the insect host through a foot cell. Although the effect of the Laboulbeniales on their hosts remains a contentious point, they have been demonstrated to cause changes in host physiology and reproduction. Written from 1896-1930, Thaxter's enormous body of work on the Laboulbeniales laid the foundation for the study of this group and remains influential today. Intrigued by these fungi and their insect host I undertook a project from my Senior Thesis research related to the diversity of these most interesting fungi.

Because most groups of arthropods have been found to host fungal associates (Hewyl-Jones 1997), these symbioses are useful for understanding the global diversity of fungi. In order to build a global estimate of diversity, geographic patterns of fungal symbioses must be better understood. When addressing diversity estimates, some general questions arise regarding the ecology and biology of these peculiar fungi. Do ecological models, such as the theory of island biogeography, apply to such obligate symbionts? What is the impact of non-native host species on symbiont patterns of occurrence? And what happens as a host expands its geographic range? Can targeted studies of specific hosts or habitats provide metrics for broader estimates of biodiversity? As obligate parasites, the Laboulbeniales are particularly well-suited for estimating the diversity of arthropod-associated fungi. Because the thalli remain on the host exoskeleton after death, the presence of Laboulbeniales can be observed in museum collections.

Approaches to address these questions include sampling the Laboulbeniales of an assemblage of hosts in one thoroughly-documented location, or sampling the fungi of

The 2012 Friends of the Farlow Booksale!
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one well-studied and wide-ranging host at various locations. In my study I used both approaches, recording infections by Laboulbeniales on a community of carabid beetles on the Boston Harbor Islands and on the widely distributed Asian Harlequin Ladybeetle and its relatives. Pinned beetle specimens from the Boston Harbor Islands collection in the Museum of Comparative Zoology, the National Museum of Natural History, American Museum of Natural History, the Field Museum, the University of Michigan, and the University of New Hampshire were examined under a dissecting microscope. Specimens of Laboulbeniales mounted in eosin dye and glycerol were identified at 100x to 400x magnification using descriptions and drawings from Thaxter's monograph (generally part II, 1896) in which the pertinent species were treated. Beetle specimens included members of the Carabidae and Coccinellidae.

For these obligate symbioses, host diversity was found to predict symbiont diversity, with some complications from differences in host-specificity. Although the pattern of Laboulbeniales species on the Boston Harbor Islands did not follow principles of island biogeography, they followed the distribution of their carabid hosts. In the theory of island biogeography one expects larger land masses and those closer to continents to have a higher diversity than smaller and more distant islands. The Laboulbeniales species with the widest host ranges, *Laboulbenia oopteri* and *L. proliferans* infect fewer host species on islands that are low in beetle diversity, potentially indicating changes in host-specificity based on the diversity of hosts available in a given habitat. Infection rates among carabid species did not differ between native and nonnative beetle species, affirming the predictive potential of the Laboulbeniales system even in systems with introduced species.

Laboulbena oopteri Thaxter on *Platynus decentis* from Grape Island. 40x magnification. BHIL 56. photo by: S. Zhao

Laboulbenia oopteri Thaxter on *Osypselaphus pusillus* from Grape Island. 40x magnification. BHIL 55. photo by: S. Zhao

Although both native and non-native hosts are able to give good predictions of symbiont diversity within one ecological system, infection rates and infection intensities on one host vary between the host's native and non-native ranges. Laboulbeniales infections began to appear in collections of the Asian Harlequin ladybeetle (*Harmonia axyridis*) 10 years after the host population became established in the United States. The fungi that infect this host are from both the host's native range in Asia and its introduced range in North America and include *Hesperomyces coccinelloides*, *Hesperomyces chilomenes*, and *Stemmatomyces panamensis*. This opens up the possibility that both host pursuit and host shift could be mechanisms for symbiont establishment. Once infections appear, the intensity of infection, as measured by the number of thalli present on each affected host individual, decreases over time.

Patterns of particular host-symbiont distribu-

tions do not necessarily reflect patterns of symbioses on related hosts or hosts from the same ecological system. Some relatives of *Harmonia axyridis* show infections by Laboulbeniales, but the prevalence is far lower than in *H. axyridis*. Among the ladybeetles of the Boston Harbor Islands, *H. axyridis* hosts far more Laboulbeniales individuals than other hosts. Estimates of fungal diversity based on symbioses with arthropods must ideally incorporate studies of many host taxa in a range of environments.

Laboulbeniales on *Harmonia axyridis* (Asian Harlequin ladybeetle) from World's End. BHI-010071. photo by: S. Zhao

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News from the Farlow

The Farlow received **212 lichens and 28 bryophtes** from **Christopher W. Leahy**, Gerard A. Bertrand Chair of Natural History and Field Ornithology at the Massachusetts Audubon Society in February 2012. The specimens are currently being curated and inserted in the general collection.

The Farlow herbarium will be participating in the NSF ADBC grant funded project "**The Marcofungi Collection Consortium: Unlocking a Biodiversity Resource for Understanding Biotic Interactions, Nutrient Cycling and Human Affairs.**" The New York Botanical Garden is heading-up the grant and we are looking forward to having the collections be part of it.

Judy Jacob, Senior Conservator, National Park Service in New York City and our own **Michaela Schmull** will teach the "Lichens, Biofilms and Gravestones" field seminar at the Humboldt Field Research Institute in Steuben, Maine from July 8th to July 14th. Participants will study the physical, chemical, ecological and aesthetic relationships between lichens, biofilms and gravestones during the course of the class. There will be lectures, field trips, microscopy sessions and laboratory studies. The website for Eagle Hill is: http://eaglehill.us

Don Pfister has a **new graduate student, Danny Haelewaters** joining us this fall from Belgium. He will work on the Laboulbeniales during his time at Harvard. Because Roland Thaxter's extensive microscopic collection of Laboulbe-

niales is deposited at the Farlow Herbarium, Danny has many possibilities for laboulbenialean research at Harvard, as many of Thaxter's deposited material has not yet been described.

Geraldine (Gerry) Kaye, a founding member of the Friends of the Farlow and a faithful participant in Farlow activities, is moving across the country to settle in Portland, Oregon. Gerry was Farlow Librarian from 1978 for about ten years. During that time she undertook many projects including overseeing the production of the Farlow Library Catalogue in book form (G. K. Hall, 1979); a booklet, Wild and Exotic Mushrooms, that went through two editions (1984, 1986); and articles related mycologists and literature on fungi. We wish Gerry and David a peaceful move and a pleasant landing in the Northwest.

Genevieve Lewis Gentry attended her 5th Integrated Pest Management Working Group (IPM-WG) meeting this past March in New York.

Feng Xu, from the Institute of Plant and Environmental Protection, Beijing Academy of Agriculture and Forestry Science, is working with us as a post-doctoral student studying the molecular genetics of filamentous fungi, specifically the phylogeny and biogeography of *Wynnea*. He arrived in January and will be with us until August.

Matt & Don ready to head to the next collecting site in Melimoyu. Photo courtesy of Sebastian Yancovic.

Don Pfister along with our former post doc, Matt Smith, (now assistant professor at the University of Florida, Gainsville and curator of their fungal herbarium) went on an exciting collecting trip from March 8th to March 22nd. They travelled to **Chile** and collected fungi (and some lichens) near Puerto Montt and Puerto Varas. Then they headed on to collect further in Bariloche, **Argentina**. Their trip involved travel by plane, car, boat and helicopter since some of the areas where they collected were reachable only by the last two modes of transportation. While in Bariloche, they met with Argentinean mycologists, several of whom have visited the Farlow and taken advantage of its valuable resources.

Don Pfister (left), Matthew Smith and Irma Gamundi at her home in Bariloche, Argentina. Gamundi is the grand dame of Patagonian mycology.

Remembering four Friends of the Farlow

from Donald Pfister

When I first arrived at the Farlow I found that **Isabella Tavares** had made Cambridge and the Farlow a regular stop each summer. Tavares died a year ago at the age of 90; she was associated with the University Herbarium at Berkeley California for nearly 60 years. Her research focus on the Laboulbeniales was one of the reasons for her visit to Harvard. Here she could study the specimens described by Roland Thaxter. Indeed, Tavares was responsible for the finding aid to the Thaxter collection. She numbered the slides and made a card index that makes the collection easily accessible. She also was able to take advantage of the Farlow Herbarium's lichen collection where she delved into the historic collections of the genus *Usnea*. She was always a welcome presence on those visits,

gave time to young mycologists, and offered useful tips from curating Labouls to places to eat in Cambridge.

In December 2011 **Norton Miller**, emeritus bryologist and paleobotanist at the New York State Museum, died. Norton was a friend of the Farlow and gave our annual meeting lecture in 1999. He served on the Harvard faculty from about 1975 to 1979. Norton was an extremely broad based botanist having worked bryophytes, both living and from the geological record, and on seed plants. He used the Farlow collections often and was part of the Flora of the Southeastern United States which was spearheaded at Harvard by the late Carroll Wood. His papers will be appreciated for decades for their careful and insightful contributions across these several fields.

Vernon Ahmadjian, who died in March 2012, was connected to the Farlow in several ways. His formal association began in the late 1950s when he came to Harvard to work with lichenologist Ivan Mackenzie Lamb, then director of the Farlow Herbarium. He completed his Ph.D. in 1960. His thesis "The taxonomy and physiology of lichen algae and problems of lichen synthesis" followed his interest in lichens and their algae that was begun in his Masters work at Clark University. His career was a productive one in which he broke important ground regarding the culture of algae and the synthesis of lichens. He published many articles and several books. In later years he visited the Farlow and was a member of the committee that founded the Friends of the Farlow. In 2007 he gave his personal herbarium to the Farlow Herbarium along with supporting literature and documents. These specimens document his work on lichen synthesis and his floristic studies of the lichenized fungi in Worcester County, Massachusetts.

We also report on the passing of **Anna M. Reid**. Anna, known as Nancy, died on May 10th. She was a long time member of the Friends of the Farlow and served for many years as our secretary. She received an M.S. in chemistry from Purdue University but took-up bryology. She seriously collected and identified mosses and had a deep interest in genealogy. Skills from her genealogical studies lead her ultimately to write a series of short biographies of New England bryologists which was published as "Pioneer New England bryologists: a prosopography" in Occasional papers of the Farlow Herbarium of Cryptogamic Botany, April 1987. She took a masters degree at the Harvard Extension School where she wrote a thesis on the lichenologist Edward Tuckerman's early years. The Friends of the Farlow and the New England Botanical Club both benefited from her volunteer work which promoted bryology in New England.

Exhibits from the Library...

Color Wheels by Lisa DeCesare
A Farlow Find Exhibit, May-June, 2012

Photograph courtesy of the Farlow Library of Crptogamic Botany

Anything and everything can inspire an interesting exhibit here in the Farlow. Last month a Friends of the Farlow book sale book was left out on a reshelving truck because the Library Director wanted to check HOLLIS to make sure the Farlow Library had a copy. It was Marcel V. Locquin's Chromotaxia. Chromotaxia was published in 1957 for use by mycologists and pedologists. The six series of compensating color filters each encompasses 319 colors, all with common names.

It definitely caught our imagination and by the end of the day a small exhibit was in place in the Farlow Library. It highlights a handful

of different styles of color charts dating from 1815 through 1957. It was difficult to choose which books to display. Our collection houses some amazing examples and they vary so in size, style, and how they present information about the colors. Because of this we are planning an expanded display in 2013 to share more of our collection of color charts as well as to provide more information on how these have been used historically by both artists and scientists.

Turning Wood Into Art - An exhibit of wood items from the combined collections of the Harvard University Herbaria, Donald & Cathleen Pfister & Gustavo Romero.

A Botany Libraries Exhibit, Spring 2012

Originally we decided to work with the Pfister's on an exhibit featuring their collection of wooden turned bowls. But you know how that goes. A small exhibit doesn't always stay small around here. We began to discuss how this exhibit might benefit the class Science of Living Systems 25 - Trees, Forests and Global Change which Donald Pfister and Andrew Richardson taught in the spring semester.

We decided to use the bowls to highlight the species of woods and discuss the woods properties and uses. There was also a second section on wood rot fungi with examples pulled from the Farlow Herbarium of different types of wood rot fungi and also bowls that were turned using wood that had fungal markings or damage. Lastly, there was a small case that illustrated the amazing diversity of wood collections in the Harvard University Herbaria.

Case in the hall of the Farlow Herbarium with examples of wood rot from the J. H. Faull collection. Photo courtesy of the Botany Libraries of Harvard University.

This exhibit was a success in no small part because of the many people who shared wooden items from their collections. The exhibit featured materials from the herbaria, Donald and Cathy Pfister, Gustavo Romero, Emily Wood, Ned Friedman and Pam Diggle, Marla Gearheart, Jason Karakehian, Lisa DeCesare, and a master woodworker from Massachusetts named Steve Staples.

Oakes Ames the Student and Professor Farlow

Ames as a young man. Photo courtesy of the Archives of the Farlow Herbarium of Cryptogamic Botany

This year's Clara Cummings walk took place at Borderland State Park in North Easton, MA, which is the former estate of Oakes Ames and his wife Blanche. We thought it might be nice to reflect on Oakes Ames and his interactions with Professor Farlow, who in part, Ames thanked for his graduation from Harvard and his future in the field of Botany.

"I came to my Senior Year with full confidence in my ability to obtain the Bachelor of Arts degree. And then a bombshell landed heavily on my hopes. I had prided myself in a cleverly chosen schedule of study. I had, as my anchor to windward, Latin 10, a proverbially easy course with Professor Greenough of Latin Grammar fame. Latin 10 was based on the home life of the Romans. When I went to my first lecture in Harvard Hall, the lecture room was crowded to overflowing. Professor Greenough was visibly disturbed and he made remarks which were not very flattering to some of the students including myself. And although forewarned I was by no means forearmed when the first hour examina-

tion was thrust upon the class. Yet I had been interested enough in the Romans to buy some beautifully bound books at Lauriat's. I worked hard but along lines that were perilous. Then came the dreaded invitation to present myself at the Dean's office. The anteroom was full and I recognized many familiar faces I had come to associate with Latin 10. When I finally reached Dean Briggs, I was greeted with the well known smile and promptly informed that I had failed to pass the examination in Latin 10. Then Dean Briggs informed me that I must leave the course and that Professor Greenough would not reinstate men who failed the hour examination. And then he told me that my degree was in jeopardy because it was too late to enroll elsewhere and I would come to the end of my Senior year a half credit short of requirements. Had I any suggestions? I suggested that he allow me to take a half-course of research with Professor Farlow. Then he told me that I knew better to make such a suggestion, that I already was taking a half course of research with Professor Goodale and that undergraduates were limited to a half credit in research in any one year. I told him frankly that I felt abused. I referred to my beautiful bound books on Pompeii, etc. I assured him that Professor Greenough had played unfairly with the class in his effort to reduce the number of students, etc. etc.

Then the Dean dismissed me saying, 'If Professor Farlow will accept you, an exception will be made in your case.' I hurried to the museum where I found Farlow in his laboratory, sitting on one foot and studying a pupal though his microscope. Farlow was a very short man and to use a microscope he had acquired the habit of placing one foot on his chair and by sitting on it obtain the necessary elevation for microscopic work. Without removing his eyes from his microscope, he heard my sad tale. After a few minutes meditation and hesitation he suggested that I buy collections and study fleshy fungi. So to make a long story short, I owe Professor Farlow my success in graduating with the Class of '98 and to Dean Briggs I owe the knowledge that rules in special cases are meant to be broken."

This is an excerpt from pages 64-64 of Oakes Ames, jottings of a Harvard Botanist, 1874-1950: "Research Professor of Botany and Director of the Botanical Museum and the Arnold Arboretum of Harvard University" edited and with an introduction by Pauline Ames Plimpton; foreward by George Plimpton. 1979.

Exploring the Ames Mansion at Borderland State Park. Photo courtesy of Jason Karakehian

Friends of the Farlow 2012 Book Sale

The 2012 book list arrives with the spring newsletter. We hope that you find the offerings affordably irresistible!

Our inventory was enriched this year by donations from Phillip May and Geraldine Kaye and we continue to add materials from the previous donations of Elio Schaechter, Edna Litten, and others.

The book sale continues to generate revenue that supports FoF activities, so please keep us in mind when you decide to sort out your bookshelves. If you would like to make donations, please contact Judy Warnement at: warnemen@oeb.harvard.edu.

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.

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