



THE JEPSON GLOBE

A Newsletter from the *Friends of The Jepson Herbarium*

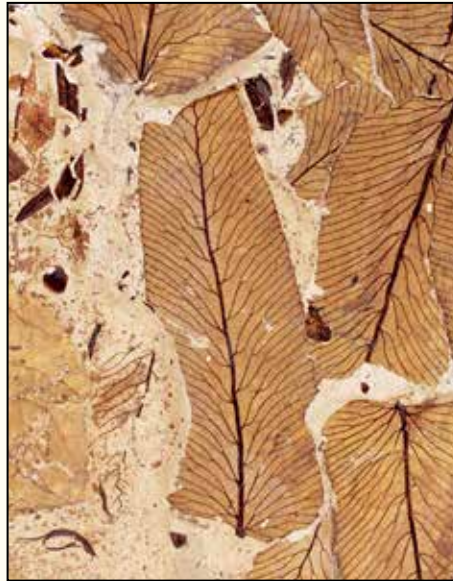
VOLUME 28 NUMBER 2, Fall 2018

Director's Column: Taking Digitization to a New Level at the University and Jepson Herbaria

By Brent D. Mishler

The University and Jepson Herbaria (UC/JEPS) has been fortunate to receive a number of grants in the last decade focused on making data from specimens digitally available, as I discussed in an earlier article (“Herbaria data go mainstream” *The Jepson Globe* 21(2&3): 1–4, 2011). This funding included Mellon Foundation grants for digitizing type specimens and a series of National Science Foundation grants through the Advancing Digitization of Biodiversity Collections (ADBC) program covering vascular plants of California, bryophytes, lichens, macrofungi, macroalgae, and microfungi. Just when it seemed this funding stream was winding up, we were pleasantly overwhelmed this summer to find that we had received three more ADBC grants! [These are in addition to the new NSF mistletoe grant announced in the previous *Jepson Globe* 28(1): 6–7, 2018, which also includes digitization activities!]

The three new ADBC grants include the first in which we are the lead institution for a national consortium. This grant is titled “The Pteridological Collections Consortium: An integrative approach to pteridophyte diversity over the last 420 million years” and the lead PI is Carl Rothfels (UC/JEPS) with two co-PIs, Cindy Looy and Diane Erwin (both from the UC Museum of Paleontology). The goal is to image over



Fossil Osmunda pinnules from the Eocene-Oligocene (34 million year-old) Badger's Nose locality in the Warner Mts., Modoc Plateau, California (UCMP 393085). Photo by Diane Erwin, UCMP.

1.76 million fossil and extant specimens of ferns, lycophytes, and their free-sporing relatives, and unite these data in a novel portal that allows study of diversity through time. Thirty-eight institutions are involved from across the United States and UC/JEPS will coordinate the overall project. This is an unprecedented neo-paleo integrative approach providing a deep-time perspective on the origins and diversification of lycophytes, ferns, horse-tails, and their extinct spore-dispersed relatives—groups responsible for the formation of terrestrial ecosystems as we know them.

The second new ADBC grant is a collaboration among members of the
(Continued on page 4)

TED Comes to the Herbaria



By Carl Rothfels

Carl Rothfels (UC/JEPS), Cindy Looy (UC Museum of Paleontology), and two collaborators (Nathalie Nagalingum of the California Academy of Sciences and Michael Sundue of the University of Vermont) have received funding from the National Science Foundation for an ambitious project examining vascular plant evolution. Their goals are to determine the relationships among the major lineages of all vascular plants that have ever lived (including those that are now extinct) and generate a timescale of their evolution.

This project will build on techniques that scientists use to infer when past evolutionary events occurred. First, by studying similarities in the DNA of different species, researchers can estimate how closely related they are and they can use this information to reconstruct the branching patterns of the “tree of life.” Second, by incorporating information from fossils, they can add a temporal dimension to the tree, inferring when the branching events occurred. These evolutionary timelines are extremely powerful—they allow researchers to study patterns of biodiversity and the impact of major environmental or evolutionary events in Earth’s history.

Traditional methods for inferring
(Continued on page 5)

ALSO IN THIS ISSUE

-  New Faces in the Herbaria
-  2018 Year in Review

New faces in the University and Jepson Herbaria

KEIR WEEFFERLING grew up in Washington State, in Seattle and on Lopez Island in the San Juan Islands. He is joining the Rothfels lab as a post-doctoral fellow funded by a National Science Foundation Postdoctoral Research Fellowship in Biology, focusing on the utilization of biological collections. Before coming to Berkeley, Keir studied with Dr. Sara Hoot at the University of Wisconsin–Milwaukee, working on the systematics, cytogeography, and phylogeography of several Ranunculalean clades—moonseeds and buttercup relatives mostly. Here in Berkeley, he is diving into the wonderful world of seed-free plants.

His doctoral dissertation work focused on disentangling reticulate evolution in the subalpine marsh marigolds (*Caltha* spp., Ranunculaceae) using a number of approaches: phylogeographic (plastid and nuclear DNA sequence data, chronograms

calibrated with fossil data), cytogeographic (chromosome counts, flow cytometry), and taxonomic. This work documented multiple allododecaploid origins of *Caltha leptosepala* with reciprocal hybridization between currently allopatric hexaploid progenitors *C. biflora* and *C. chionophila*.

While working as a post-doc in the Rothfels lab, he is studying the cytogeography, biochemistry, and systematics of *Pentagramma* (Pteridaceae)—the xeric-adapted, western North American farinose goldback and silverback ferns—across their geographic range, and assessing the polyploid “spectrum” (i.e., the range between the extremes of auto- and allopolyploids). He aims to test the hypothesis that there is a particular



*Keir feeling pretty excited to find *Cornus suecica* on the Kenai Peninsula, Alaska. Photo by Kier.*

genetic distance between parents that is optimal for formation of evolutionarily “successful” offspring; i.e., that a goldilocks zone exists, at least within a particular lineage. He will also take every chance he can get to botanize, gawk, and ramble in the surrounding hills and mountains. 🌿

CARRIE TRIBBLE is a Ph.D. candidate in the Rothfels lab studying phylogenetics and the evolution of underground morphology in the order Liliales, which includes lilies. Carrie’s early forays into botany began while researching the ethnobotany of wild medicinal plants in the Peruvian Andes. There, she fell in love with tropical alpine environments and gained a deep appreciation for underground parts of plants; many of the medicinal plants she worked with were collected for their roots and other underground parts.

Carrie also completed a senior honors thesis project in Luana Maroja’s lab at Williams College on the population genetics of a disjunct distribution of a circumboreal plant particularly vulnerable to climate change. Together, these experiences shaped her early interest in elevational gradients, tropical botany, and the processes of evolution that drive diversification and adaptation.

While at UC Berkeley, Carrie has continued to develop her interests in evolutionary processes. During her Ph.D. research, she hopes to describe morphological variation in underground morphology, particularly in tropical geophyte taxa like *Bomarea* (Alstroemeriaceae). She also hopes to further develop comprehensive models of evolution to better understand how morphological variation is connected with diversification and adaptation. Furthermore, her interests in ethnobotany have led her to the fascinating world of domestication in understudied crops, such as the tuberous *Bomarea edulis*.

In addition to her research, Carrie also works to increase the accessibility of scientific research to underrepresented groups. In particular, she has co-founded Project SAFE (Safety and Field Equity) to decrease the incidence of sexual harassment and assault in the field. She has also participated in several science outreach and communica-

tion projects, including an educational video series ([Science IRL](#)) on plant collecting with fellow graduate student Joyce 🌿!



*Carrie poses with a beautiful example of the inflorescence and tubers of *Bomarea acuminata* near the Cuerici Biological Research Station, Costa Rica. Photo by Mauricio Bonifacino.*

DORI CONTRERAS is a plant evolutionary biologist who will be joining the Rothfels lab as a postdoctoral researcher this fall. Dori grew up in Texas with a love for trees and spending time immersed in the woods. After a detour working in auto finance and property management, she returned to school to complete a B.S. in Biology with an emphasis on botany at Texas State University, San Marcos. During those formative scientific years, she had fairly divergent research experiences that shaped her interests and ongoing agenda. Specifically, she joined Dr. Gary Upchurch's Paleobotany and Paleoclimatology Lab and eventually completed an honors thesis describing an extinct species of redwood from the Late Cretaceous. Simultaneously, she delved into tropical plant ecology working on variability in leaf functional traits of tropical trees at La Selva Biological station in Costa Rica for two summers, initially through the NSF REU program. These experiences set in motion a drive to understand plants and their communities through deep time, relying on the interplay between structure and function to interpret fossils through an ecological lens.

Thereafter, she went on to UC Berkeley to complete her Ph.D. in Integrative Biology in Dr. Cindy Looy's Paleobotany and Paleoecology lab. Her dissertation work focused on the evolution of plant communities in warm wet climates following the rise of flowering plants. For this, she reconstructed the diversity and community structure of a 74 million year old forest that was preserved in an extensive ash fall deposit. The flora turned out to be incredibly diverse and one of the earliest leaf floras documented in which flowering plants were the most abundant group across the landscape. She has continued her work with conifers, using new fossil descriptions of Jurassic and Cretaceous species, morphological phylogenetic analyses, and ancestral trait reconstructions to understand the systematics and morphological evolution of conifers through deep time.

Dori's interests consequently range from the organismal to community levels, encompassing both morphology and ecology. She has a slight obsession with incorporating fossils into the evolutionary tree of living plants, which has translated into a postdoctoral position with Carl Rothfels and Cindy Looy. For

the next couple years she will be working with a team of people to generate a total evidence analysis of vascular land plants. When not "science-ing" directly, she enjoys spending time with her family in Davis and getting outdoors as much as possible! 📷



Dori holding a fossil of a conifer shoot that she cracked open during field work in New Mexico, while she was collecting from a Permian plant locality. Photo by Cindy Looy.

JOYCE CHERY is a Ph.D. candidate in Integrative Biology, jointly advised by Dr. Rothfels and Dr. Chelsea D. Specht of Cornell University. Joyce's research focuses on the evolution and development of vascular cambial variants in the stems of a large genus of Sapindaceae lianas, *Paullinia*. These lianas (i.e., wood vines) show an incredible diversity of wood development that deviate significantly from erect plants (i.e., trees and shrubs). Joyce's dissertation combines traditional wood anatomical techniques with a molecular phylogenetic framework to uncover how these plants' strange wood anatomy evolved through time.

Joyce is a native of New York and graduated with her B.S. in Plant Sciences from Cornell University in 2013. Upon graduating, she worked at the Ar-

nold Arboretum of Harvard University as the Curatorial Fellow, focusing on the *Alnus* and liana collections development. In 2014, she joined the Specht Lab as a Berkeley Chancellor's Fellow and NSF Graduate Research Fellow. In addition to her research, Joyce enjoys outreach, public speaking, and engag-

Below: cross section of stem of Paullinia pinnata from Barro Colorado Island, Panama, collected and photographed by Joyce. Right: Joyce at Arnold Arboretum of Harvard University. Photo by Kyle Port.



ing the public in science. For example, most recently, she gave a science talk at a bar in Oakland through the NerdNite!

Joyce currently resides in San Francisco, where she enjoys spending quality time with her fiancé and pug and frolicking through the city. 📷



(New Faces continued on page 4)

(*New Faces, continued from page 1*)

IXCHEL GONZÁLEZ-RAMÍREZ is a Ph.D. candidate in the Mishler Lab. Ixchel grew up in Mexico and, coming from a rural background with a biologist father, she was early exposed to the wonders of plants. Her biology training and several field courses in the tropics made her fall in love with botany. She completed her undergraduate Biology and Master's degrees in the Universidad Nacional Autónoma de México (UNAM). For her Master's, she studied Cretaceous conifers from southern Mexico. This work was the perfect opportunity for her to deeply understand the challenges and joys that systematic work offers. In 2015, Ixchel started to teach botany in her *alma mater* university UNAM. Teaching quickly became one her favorite activities because of the rewards of the job, and at the same time she found it to be a good way to repay society for all the opportunities she received during her education.

Ixchel acknowledges all plants are beautiful and interesting, but she has always had a non-angiospermous plant preference. Therefore, for her Ph.D., she intends to focus her research on liverworts, a wonderful group of plants that has not received enough attention, particularly in Mexico. She also expects to acquire a deeper understanding of liverwort biology and to take advantage of being in a diverse place such as the University and Jepson Herbaria and Department of Integrative Biology to answer exciting ecological and evolutionary questions that will arise while studying liverworts. She hopes to return to Mexico to study bryophyte diversity at different scales, from floristic studies to addressing ecological, biogeographical, and evolutionary topics.



Ixchel admiring a rock with fungi and bryophytes at Los Tecajetes park, Xalapa, México, known for its gigantic tree ferns. Photo by Ana Isabel Pérez.

One of her favorite activities is to hang out with other botanists and identify plants in the field. Outside academia, Ixchel's favorite activities are to pet dogs, watch or play basketball games, and travel to any destination, where she always tries to taste traditional food, learn from the culture, and, of course, to look at the beautiful native flora. 🌿

(*Director's column, continued from page 1*) Consortium of California Herbaria (CCH) and is entitled: "Capturing California's Flowers: Using digital images to investigate phenological change in a biodiversity hotspot." The lead institution is Cal Poly San Luis Obispo (Jenn Yost, lead PI), although UC/JEPS (with me as campus PI) has a large role to play on the informatics side and will also image many of our California specimens. Twenty-two herbaria are participating and the goal is a massive effort on the California flora that will image, database, georeference, and score phenological traits on ~900,000 specimens. CCH will add an additional data portal to facilitate this effort, resulting in a pair of portals with distinctly different aims: (1) CCH1 will contain only vascular plant specimen data for California, drawn from members of CCH and from other data providers around the world. As the continuation of the current single portal, it will remain highly curated and integrated with the *Jepson eFlora* and be the recommended portal

for use in research and conservation activities involving the California flora. (2) CCH2 will contain data from all groups of plants and fungi anywhere in the world, drawn only from members of CCH. Its main use will be for data management activities and facilitating phenology scoring within the general *Symbiota* framework. [We'll present a longer discussion of these developments in CCH in a later *Globe*.]

The third new ADBC grant is to another national consortium, with 17 collaborating herbaria, entitled "Digitizing 'Endless Forms Most Beautiful and Most Wonderful': Facilitating Research on Imperiled Plants with Extreme Morphologies." The quote in the title is a famous line of Charles Darwin from the last sentence of the *Origin of Species*, indicating the goal of this project which is to digitize information from approximately 2,000,000 specimens of angiosperm groups such as cacti and orchids that have both extreme morphologies and many rare and endangered species. The lead in-

stitution is New York Botanical Garden (Matthew Pace, lead PI), with the role of UC/JEPS (Bruce Baldwin, campus PI) being to digitize about 90,000 of its specimens in the 14 targeted flowering plant families throughout their world-wide range.

Working on all these projects at once will be challenging, but rewarding in many ways. It demonstrates the value of UC/JEPS within the university's internal political environment, supports our increasing "big data" research and conservation efforts involving specimens, and maintains our leading role in biodiversity informatics in the world community. 🌿


DON'T FORGET TO RE-NEW YOUR MEMBERSHIP!

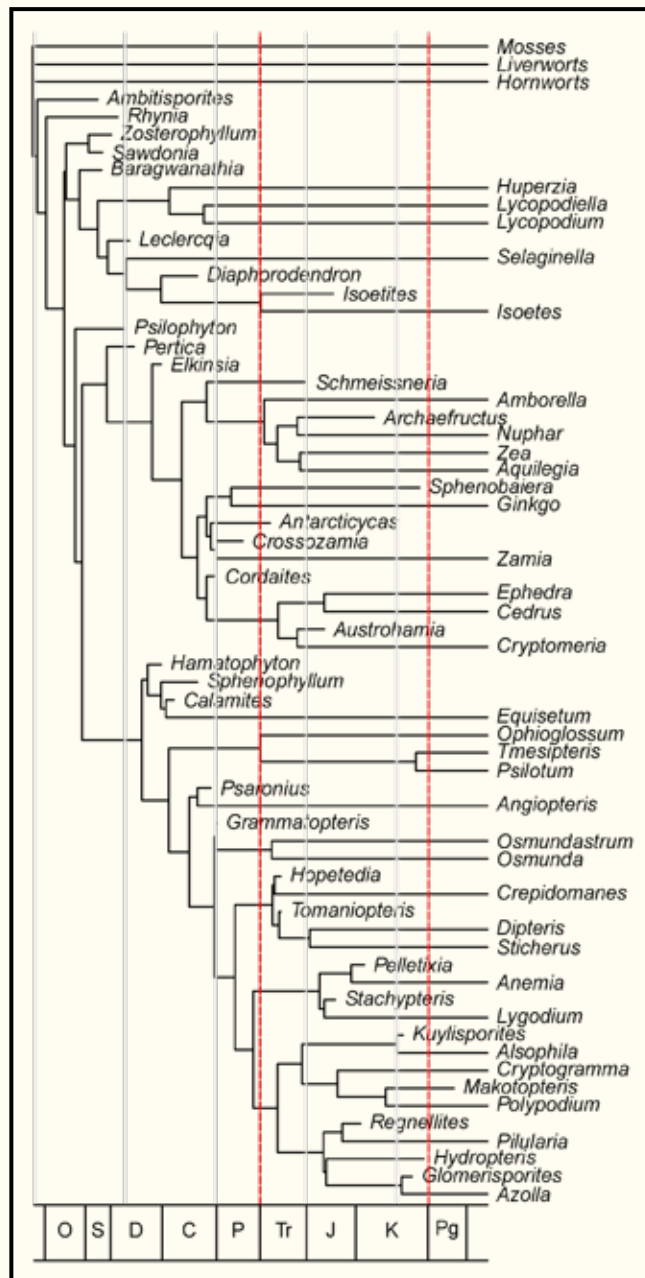
Current *Friends of the Jepson Herbarium* receive a one week window of priority registration when the weekend workshop schedule is announced in the fall.

(TED, continued from page 1)

evolutionary timelines suffer from some technical problems. In particular, they rely on the ability of researchers to assign fossils correctly to particular branching points in the tree, which is difficult or sometimes impossible. Fortunately, newly developed “total-evidence dating” (TED) methods avoid this problem by inferring the position of the fossils directly from their morphological traits. Thus, the position of the fossils, the patterns of morphological evolution, and the timescale of the tree are all inferred simultaneously from the available data, reducing dependence on the judgments of individual researchers.

This project will apply TED methods to a particularly contentious, long-standing problem: the timeline for vascular plant evolution. Vascular plants—the group that includes lycophytes, ferns, conifers, flowering plants, and their relatives—form the foundation of nearly all terrestrial ecosystems and have a rich fossil record; when they came to dominate land is controversial. In addition to providing a robust timeline for vascular plant evolution, this project will promote future research by creating a large public database of mor-

phological data for extinct and living plants. Some of the exciting outcomes of this project will include an updated display about plant evolution in the herbaria atrium and a series of online educational videos. 



A hypothetical total-evidence timeline of selected fossil and extant vascular plants, showing major lineages, possible relationships, and divergence times. Outgroups comprise the three extant bryophyte lineages. Vertical gray lines mark the 100-million-year intervals; dashed red lines mark the end-Cretaceous and end-Permian mass extinctions. Time period abbreviations follow standard IUGS names. Tree topology, fossil ages, and divergence times are synthesized from the literature, particularly Wikström et al. (2001), Taylor et al. (2009), and Rothfels et al. (2015).

JEPSON HERBARIUM RESOURCES & PROJECTS RELATED TO THE CALIFORNIA FLORA

The Jepson Herbarium includes approximately 400,000 plant specimens from California.

Director: Brent D. Mishler
California Phylodiversity Project
Systematics and ecology of *Syntrichia*

Jepson Curator: Bruce G. Baldwin
Jepson eFlora
Systematics and evolution of Calif. tarweeds and relatives (tribe Madieae, Compositae), *Chaenactis* (Chaenactidiaceae, Compositae), and *Collinsia* (Plantaginaceae).

Curator of Ferns and Lycophytes: Carl Rothfels
Divergence and hybridization in Californian ferns and lycophytes (especially *Notholaena*, *Cystopteris*, *Isoetes*).

Curator of W. N. American Botany: Barbara Ertter, *Flora of Mount Diablo* and flora of the East Bay, North American Potentilleae

Asst. Director for Development & Outreach: Staci Markos, *Jepson eFlora*, CCH, and *Globe* editor

Biodiversity Informatics Manager: Jason Alexander

Collections Staff & Plant Identification: Kim Kersh, Ana Penny, and Margriet Wetherwax

Archivist and Librarian: Amy Kasameyer

Public Programs: Allyson Greenlon

Membership, workshop enrollment, and *Globe* design: Edith Summers

Staff Research Associate: Bridget Wessa

Jepson Videos: Staci Markos, Allyson Ayalon, Amy Kasameyer


Trustees:
Vice Chancellor Emeritus Beth Burnside; Professor Emeritus Russell Jones; Professor Emeritus Paul Licht; Professors John Taylor and Brent D. Mishler (ex officio)

Constancea: UC Publications in Botany (online)

**Tucker Curator of Lichenology
University Herbarium**

The University Herbarium is seeking applications for the Tucker Curator of Lichenology, a position funded by an endowment established by Dr. Shirley Tucker, a distinguished scholar whose accomplishments in lichenology, as well as other areas of botany, have been widely recognized.

The successful candidate will conduct research on the systematics of lichens, lichenicoles, and/or allied fungi in California and beyond, will participate in outreach and educational activities involving lichens, and be responsible for the continued growth and curation of the lichen collection at the University Herbarium.

Questions may be sent to Brent D. Mishler, Director, University and Jepson Herbaria (bmishler@berkeley.edu). 



Friends of the Jepson Herbarium 2018 Members' Night

Join us as we celebrate this milestone!

Saturday, September 22, 2018

The Courtyard of the Valley Life Sciences Building
University of California, Berkeley

For more information, see ucjeps.berkeley.edu/workshops/

This is a ticketed event.
Please RSVP

2018 Workshop Year In Review

Photos, facing page, clockwise from top left, by Allyson Greenlon except where noted: the happy group smiles big at their excitement about botanizing at almost 13,000 ft, Summit Lake, Mt. Evans, Colorado Rocky Mountains; three taxa of cacti in flower in Cataviña, Baja California, Mexico: *Myrtillocactus cochal*, *Lophocereus schottii* var. *schottii*, and *Pachycereus pringlei* (the giant cardone!); workshop participants scanning intertidal zone for nudibranchs during the early morning (photo by Alison Young); the adorable flammulated owl camouflaging perfectly with the bark of the oak it sits on, seen while botanizing in Kings Canyon N.P. (photo by Aaron Sims); studying grasses up close during our annual Poaceae workshop; and investigating the flora of a wet meadow in Sequoia National Forest.

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Demonstrate your dedication and commitment to the Jepson Herbarium with a lifetime membership. Gain recognition for your support in *The Jepson Globe* and the *Jepson eFlora*. Share your ideas with the Director and Curator at special, invitation-only events.

HERBARIA FUTURES ENDOWMENT

14891

Support the infrastructure and care of the collections.

- I prefer to receive my copy of *The Jepson Globe* electronically (no paper copy).
- This gift is ___ in honor of, OR ___ in memory of, _____
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Please make your check payable to the **UC Berkeley Foundation**, charge your gift, or give online at: give.berkeley.edu/fund/?f=FU0840000

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Thank you for supporting the Herbaria!

2018 WORKSHOPS YEAR IN REVIEW





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Space is still available in the following workshops!

Sep 29-30 *GIS for Botanists*
Oct 13-14 *Lichens II: Introduction
to Microscopy*

Right: Photo of Hastings Natural History Reservation in Carmel Valley, the venue for the upcoming GIS workshop. Hastings is part of the University of California Natural Reserve System, whose field stations have hosted our workshops all over the state. Photo credit Hastings Reserve.



Don't forget to renew your membership this fall before the new workshop season is announced, and you will receive one week priority registration.

Some of our workshops fill up in the first couple weeks, so this means that you, as a member, will have a chance to get into the workshops you want before they fill!

Your membership expiration date is noted above your name on the mail label.