



FRE MONTIA

A JOURNAL OF THE CALIFORNIA NATIVE PLANT SOCIETY



IN THIS ISSUE:

ISLANDS WITHIN ISLANDS: VIEWING VERNAL POOLS DIFFERENTLY

by Michael G. Barbour and Carol W. Witham 3

FROM SPORE TO SPORELING: THE BIRTH OF A FERN *by Guenther K. Machol* 10

RUDOLF & LOIS FINK: A REMEMBRANCE *by Falene Hamilton* 16

JUNE McCASKILL (1930-2001) *by John M. Tucker* 19

KATHERINE LAYNE CURRAN BRANDEGEE, AN UNCOMPROMISING REBEL

by Elizabeth Rush 24



FREMONTIA

VOL. 32, NO. 2, APRIL 2004

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California Native Plant Society

Distributed in August 2004

Linda Ann Vorobik, Editor
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CALIFORNIA NATIVE PLANT SOCIETY

Dedicated to the Preservation of the California Native Flora

The California Native Plant Society (CNPS) is a statewide nonprofit organization dedicated to increasing the understanding and appreciation of California's native plants, and to preserving them and their natural habitats for future generations.

CNPS carries out its mission through science, conservation advocacy, education, and horticulture at the local, state, and federal levels. It monitors rare and endangered plants and habitats; acts to save endangered areas through publicity, persuasion, and on occasion, legal action; provides expert testimony to government bodies; supports the establishment of native plant preserves; sponsors workdays to remove invasive plants; and offers a range of educational activities including speaker programs, field trips, native plant sales, horticultural workshops, and demonstration gardens.

Since its founding in 1965, the traditional strength of CNPS has been its dedicated volunteers. CNPS activities are organized at the local chapter level where members' varied interests influence what is done. Volunteers from the 33 CNPS chapters annually contribute in excess of 87,000 hours (equivalent to 42 full-time employees).

CNPS membership is open to all. Members receive the quarterly journal, *Fremontia*, the quarterly statewide *Bulletin*, and newsletters from their local CNPS chapter.

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Prepress by ScanArt / Printed by Business Point Impressions

CONTENTS

GUEST EDITORIAL	2
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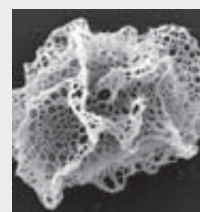


ISLANDS WITHIN ISLANDS: VIEWING VERNAL POOLS DIFFERENTLY *by Michael G. Barbour and Carol W. Witham* 3

Intrepid researchers from the University of California at Davis take a new look at vernal pool plant communities. This recent study shows that vernal pools actually contain a number of different plant associations, often in unique combinations. The results of this project will provide critical information on regional distribution of plant associations, rarity, and endangerment of some associations, and useful guidance on restoration and mitigation goals.

FROM SPORE TO SPORELING: THE BIRTH OF A FERN *by Guenther K. Machol*..... 10

The hidden life of a fern holds many surprises. For instance, the curious plantlet that emerges when a fern spore germinates has no resemblance whatever to the familiar fern—it has no stem, no leaves, no veins, and no roots! In this article, the author describes fern reproduction by spores against a backdrop of lore, terminology, and images.

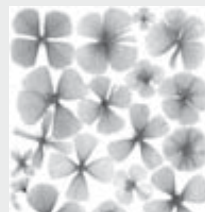


RUDOLF & LOIS FINK: A REMEMBRANCE *by Falene Hamilton* .. 16

The Finks were long time members of the California Native Plant Society (CNPS), and their joy of the mountains and California wild places are shared here by their daughter, Falene Hamilton. It was this joy that later inspired their family to generously support CNPS Publications, ultimately helping with the publication of the Flora of Mt. Diablo.

JUNE McCASKILL (1930-2001) *by John M. Tucker* 19

June McCaskill, well-loved herbarium curator at UC Davis for 40 years, is remembered in this tribute by her supervisor, Dr. John Tucker. June was also known and well appreciated for her teaching and plant identifications. She passed away in May 2001.



KATHERINE LAYNE CURRAN BRANDEGEE, AN UNCOMPROMISING REBEL *by Elizabeth Rush*..... 24

The author writes of Katherine Layne Curran Brandegee, one of California's first women botanists. Brandegee, a physician, abandoned medicine for botany and made her mark on that science with her extensive collecting, her reform of botanical publication in the West, and her gift of thousands of meticulously prepared specimens to the University of California Herbarium. She possessed a brilliant mind governed by a deeply eccentric personality.

VERNAL POOL AND GRASSLAND RESOURCES	28
GROWING NATIVES: RESOURCES FOR GROWING FERNS	29
NOTES AND COMMENTS	30
LETTERS TO THE EDITOR	30
BOOKS RECEIVED	31

THE COVER:

Vernal pool at Mather Field in Sacramento County. Photograph by D. Rosen (see www.wildsidephotography.com).

GUEST EDITORIAL

The lead article in this issue provides some upbeat information on our expanding knowledge about vernal pools and their plant associations. The late-breaking news on the scientific front is even better. In conjunction with their vernal pool vegetation study, researchers at UC Davis are unraveling the mystery of hydrologic interconnectivity between vernal pools and much larger watersheds. Several of the graduate students in Dr. Michael Barbour's research lab are tackling other questions about vernal pool ecology, including mitigation practices and their success.

The bad news is that we are still losing vernal pools every day to development and agricultural conversions, and the rate of loss is escalating. The City of Roseville in Placer County just voted to annex over 5,000 acres of vernal pool grassland. The newly-formed City of Rancho Cordova, just west of Sacramento, has a sphere of influence that contains some of the most biologically rich vernal pools in Sacramento County, and plans to develop 1,500 acres are already in the works. Then of course there is the proposed University of California campus and associated new community in Merced County that will destroy over 1,000 acres of vernal pool grassland and foster urban sprawl. These are just a few of the bigger projects. Smaller projects are even more abundant. All of this adds up to a substantial cumulative loss and increased fragmentation of the remaining habitat.

The current administration in Washington has also been weakening the very laws that could help protect vernal pools. The US Army Corps of Engineers has determined that many vernal pools—particularly those in Southern California—are isolated wetlands and therefore not subject to regulation under the Clean Water Act. The US Fish and Wildlife Service (USFWS) recently issued a critical habitat designation for 11 listed plants and 4 listed crustaceans occurring in vernal pools. The final ruling eliminated over one million acres and five counties from the designation, based purely on economic considerations. In a similar ruling, USFWS refused to grant listing to the Midvalley Fairy Shrimp because it claimed that the current listed status of other fairy shrimp would protect this species. Yet at the same time it admitted that this species is only known to co-occur with listed species in a very small number of locations.

Add to all this the threat of West Nile Virus, and we could witness the virtual extirpation of vernal pools within our lifetime. While biologically intact vernal pools produce very few mosquitoes due to a balance in the aquatic food chain, disturbed and created pools are often mosquito breeding grounds. In a panic over the predicted spread of this pathogen, the general public may well demand the poisoning or draining of vernal pools. Both will lead to the destruction of this unique California ecosystem and the plants and animals that make up its complex web of life.

So what can you do? Visit the vernal pools near your home. Take along your friends and neighbors. Share your knowledge of this rich resource with school children. Write your city council and county board of supervisors, telling them that you want to preserve vernal pools and the open space they provide. Invite them to visit the vernal pools with you. The more people who see and know about vernal pools, the more likely we will be able to save them.

Carol W. Witham, President
California Native Plant Society

USEFUL WEBSITES AND CONTACT INFORMATION

Wetland resources:

See p. 28

California Native Plant Society (CNPS):

www.cnps.org, with links to conservation issues, chapters, publications, policy, etc.

To sign up for "NPCC News," e-mail news on native plant science and conservation, send a request to npcc@cnps.org.

For updates on conservation issues:

Audubon Society

www.audubon.org

Center for Biological Diversity

www.sw-center.org

Natural Resources Defense
Council

www.nrdc.org

Sierra Club

www.sierraclub.org

Wilderness Society

www.wilderness.org

For voting information:

League of Women Voters

www.lwv.org, includes online voter guide with state-specific nonpartisan election and candidate information.

US Senate

www.senate.gov

US House of Representatives

www.house.gov

California State Senate

www.sen.ca.gov

California State Assembly

www.assembly.ca.gov

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The White House

1600 Pennsylvania Ave. NW
Washington, DC 20500

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US Senate

Washington, DC 20510

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Washington, DC 20515



Vernal pool on the Department of Fish and Game Thomes Creek Ecological Reserve in Tehama County. Photograph by C. Witham.

ISLANDS WITHIN ISLANDS: VIEWING VERNAL POOLS DIFFERENTLY

by Michael G. Barbour and Carol W. Witham

As if we were citizens of “Texas-west,” Californians love to brag about bigness in the state. Big, as in: area, population growth, tall mountains and deep trenches, the size of public parks, the cost of houses, the sprawl of cities, our network of dams and canals that move water, faults and earthquakes, the annual yield of agricultural produce, and the economy itself. Those of us who read *Fremontia* often join in, but with a focus (of course) on plants: the number of taxa in California, the fraction of the flora that is endemic, the height of tall trees, the age of clonal circles of desert shrubs and timberline pines, the expanses of natural vegetation, the number and richness of biodiversity hotspots, and the number of floristic provinces

that collide here. Somehow, vernal pools don’t fit this image of bigness. Vernal pools are downright small, and the plants which occupy them are even tinier, such that they are sometimes called members of the “Eentsiaceae” Family by ecologist Bob Holland, or disparagingly labelled “belly plants” by others. These miniature herbs typically live for only half a year, then shrivel to nothing, leaving practically invisible seeds and bits of dry litter to mark the landscape, to remind us the rest of the year that they were once there and that they will return again. Yes, of course they produce brilliant color shows—splendor that makes you ache to roll in it, forgetting adult propriety—but these are very short-running shows, over in a few weeks. There’s nothing very big or long-lived about vernal pool plants.

VERNAL POOLS AS THE STATE VEGETATION TYPE

While readily overshadowed by other plant communities, vernal pools could easily be adopted by the California Native Plant Society (CNPS) or the State of California as the poster child of endangered habitats, biota, and communities. Although most often associated with California’s Central Valley, vernal pools also occur in the Coast Ranges, Modoc Plateau, and several other places along the east side of the Cascade-Sierra Nevada axis, Transverse Ranges, Sierra Nevada foothills, and such coastal lowlands as the Mendocino region, the Sacramento Delta, the environs of San Luis Obispo and Santa Barbara, and

HOW MANY FLOWERS IN THAT POOL?



Specialist bee collecting pollen from horned downingia (*Downingia bicornuta*). Photograph by D. L. Briggs, courtesy of R. Thorp.

Vernal pools are often noted for their multi-colored rings and ribbons of flowers. Each species occupies a different hydrologic position and microhabitat within the pool. And each produces a dense and abundant display of flowers.

Besides delighting the eye of visitors, there is an important ecological reason for the flowers of a given species to bloom in mass synchrony. Many of the showiest vernal pool flowers (yellow carpet, meadowfoam, goldfields, and downingia) are pollinated by specialist bees in the family Andrenidae. These solitary, ground-nesting bees use the pollen of these species to feed their young. And, during the course of collecting pollen to provision their

neests, they perform the vital function of cross-pollinating vernal pool flowers. (For an informative photo tour of the relationship between vernal pool plants and their unique native pollinators visit www.vernalpools.org/Thorp.)

One day in the spring of 2002 our UC Davis team of vernal pool researchers came across a large pool that was a vibrant and nearly solid blue with flat-faced downingia (*Downingia pulchella*). This pool, at about an acre in size, was clearly visible from the road. For long moments we just gazed at the flowers and inhaled their bouquet. No one wanted to be the first to crush blossoms under foot. But, as we had a job to do, we eventually ventured into the pool to collect our data. Thankfully, the flowers were so fresh and resilient that the pool was no worse for wear a couple of hours later.

Likely most *Fremontia* readers have played the guessing game of "How many jelly beans are in the jar?" Those of us who work with rare plants are always trying to guess the number of plants in a population, often reverting to estimating orders of magnitude when the numbers are too mind-boggling. At the end of that day and over a cold beverage, our field team leader decided to undertake the challenge of determining how many individual downingia flowers were in that pool. Mind you that we had already measured the pool, estimated cover in numerous plots, and could approximate the average size of the downingia blossom. The result? Twenty-five million flowers, give or take a few.

— Carol W. Witham



Pool dominated by flat-faced downingia (*Downingia pulchella*) at Grasslands State Park in Merced County. Photograph by D. Wechsler.

portions of San Diego County. Vernal pools are so widespread and close-at-hand and such obvious parts of landscapes near large cities, that they just might be the most often-seen example today of California vegetation that existed before the arrival of European settlers. Because of the particular set of soil and hydrologic conditions in vernal pools that make them difficult to invade by exotic species, vernal pools are one of the very few low-elevation habitats still dominated by native plants and animals. Furthermore, their taxa are largely restricted to pool basins within California, and a number are legally listed as threatened or endangered. Of approximately 100 plant species commonly found in vernal pools, about 90% are native and 55% are endemic to the state. Photographs of distant subalpine meadows and desert canyons may appear on more calendars and coffee tables, but they are not seen in person by as many Californians as are vernal pools.

We are convinced that a case could be made strong enough to persuade legislators to select vernal pools as the official state vegetation type. (We have an official state flower, tree, animal, mineral, and just about anything else, so why not a state vegetation type?) At the same



Fremont's goldfields (*Lasthenia fremontii*) is a common component of vernal pools throughout most of the vernal pool regions identified by Keeler-Wolf et al. (1998). Photograph by C. Witham.

time, the commonness of vernal pools and their presence on flat and inexpensive land make them easy targets of land conversion, whether it is conversion from unplowed rural land to agriculture, or from agriculture to suburbs. We do not know exactly how much vernal pool landscape has been lost to development in the last 200 years, but estimates based on soil maps, the presence of relictual pools (those persisting over time despite changing conditions), and inference suggest a loss of 60–95%. At one time, there may have been approximately 4 million acres of vernal pool landscape throughout California. Vernal pool acreage continues to be lost every year, despite the attention being paid to this habitat by conservationists. Yes, mitigation via the creation of new pools within existing pool landscapes is being practiced, but the longest monitoring records (a bit more than ten years now) show that created pools contain more cover by exotics and fewer species of vernal pool endemics than nearby natural pools. A debate currently bubbles and boils among ecologists as to the degree of “success” such mitigations currently exhibit, how to improve the techniques of pool construction, and what floristic criteria to use for better judging the degree of success achieved.

WILL WE KNOW WHAT WE HAVE BEFORE WE LOSE IT?

We want to tell you some good news about recent vernal pool research being conducted by a team of botanists, ecologists, and hydrologists at the University of California, Davis (UCD). This team—supported by funds from the Packard Foundation, the California Department of Fish and Game, and the California Department of Transportation—has been survey-



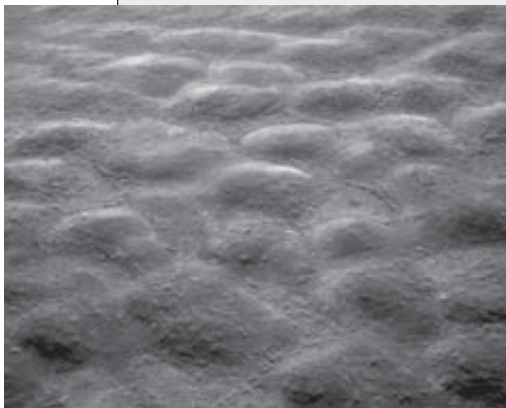
Figure 1. Vernal Pool Regions of California. Adapted from Keeler-Wolf et al. (1998).

ing vernal pool vegetation throughout California since the spring of 2000. Their objective is to sample pools in each of the 17 vernal pool regions described by Todd Keeler-Wolf (Figure 1), to enter the data in a classification-friendly database format called Turboveg, and then to treat the data with statistical techniques that combine similar vegetation samples into units called associations (plant communities).

An association is a unique collection of species that tend to co-occur wherever a particular set of environmental conditions recur. Some of the species in an association are virtually restricted to it and are rarely found in other associations; these are called differential species because their presence is diagnostic for a particular association. Others are more widespread. The widespread species are also part of the association, but they don't distinguish it from other associations. Like species, associations can be widespread, more local, or even rare, and some rare associations can be in a threatened or endangered status. We do not yet know how many vernal pool associations exist in California. There are 17 vernal pool regions, which differ in geography,



Vernal pool popcornflower (*Plagiobothrys stipitatus* var. *micranthus*) was one of six species of popcornflower found in three adjacent pools in eastern Merced County. Photograph by C. Witham.



Aerial view of eastern Merced County vernal pool landscape. Photograph by D. Wechsler.

VERNAL POOLS ARE LIKE SNOWFLAKES

In a science education program offered by Sacramento Splash (www.sacsplash.org), fifth graders get hands-on experience with the insects, animals, and flowers that occupy the vernal pool grassland ecosystem. The 13-unit curriculum on water quality uses vernal pools as a kid-sized example of a watershed and wetland system. Each of the 60 classrooms currently enrolled in the program also gets to go on a field trip to visit the Mather Field Vernal Pools in Sacramento County. During the course of the spring field trips, the students are often told, “Vernal pools are like snowflakes—botanically speaking, no two are exactly alike.”

Well, I’ve known that since I began studying vernal pools many years ago, but that lesson really hit home one blustery spring day in eastern Merced County. It was cold and windy, and raindrops swirled around occasionally. We’d been working in the field for over a week under similar climate challenges, but that particular day I was oblivious to the discomfort because I was having one of the best botany days of my life.

The reason for my rapture was three adjacent pools—close enough to toss pinflags between—with unbelievable inter- and intra-pool diversity. Each pool averaged 34 species. Between the three there were 45 taxa of which only 19 were common to all three pools. And to top it off, within these pools there were three species of downingia, four clovers (*Trifolium*), and six species of popcornflower (*Plagiobothrys*). To a vernal pool fanatic, this was surely botanical heaven.

— Carol W. Witham

geology, and climate, but we don’t know how many associations are in each region. Until the UCD team began its work, the only vernal pool classification that emphasized species (rather than habitat) defined five northern California and three southern California groups. This rough summary of vernal pool diversity appeared in *A Manual of California Vegetation* (Sawyer and Keeler-Wolf 1995). The *Manual’s* co-authors wrote that these groups were not equivalent to associations because too little information was available.

A DIFFERENT WAY TO SAMPLE VERNAL POOLS

Before the UCD team began field work, its members made a critical decision: they would sample only homogeneous patches of vegetation, and this meant that most vernal pools would be sampled internally in several places because pool vegetation is notoriously non-homogeneous. Even the earliest publications about vernal pools wrote about concentric rings of vegetation in a typical pool, the deeper part of a pool generally containing a group of species typically different from those in a shallower part and different from those at the very edge of the pool. These zones were obviously different, even if one did not know the species, because they represented changes in plant growth forms (e.g., grasses versus forbs), degree of plant cover over the ground, and (most obviously) in leaf and flower color. This particular sampling design was dramatically different from the approach taken by previous botanists, who either made a species list from the entire pool or who placed samples randomly throughout a pool or along transects from edge to center. Their methods mixed together species from different zones, blurring and

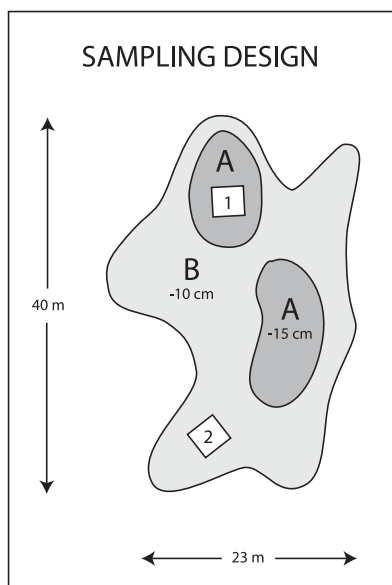


Figure 2. Vegetation zonation within one Jepson Prairie pool. The location of the different polygons and of the plots are shown to scale. Polygon A occupied the deep part of the pool (-15 cm) and polygon B occupied the shallow part (-10 cm). Adapted from Barbour et al. (2003).

melding apples and oranges. Unlike human societies, melting pots do not make good associations. An example of how the team sampled one pool in Jepson Prairie, near Dixon in Solano County, is shown in Figure 2. This pool had two visually different types of vegetation: type A, with an elevation 15 cm below the pool rim, and type B, with an elevation 10 cm below the pool rim. These two types were not distributed as concentric circles, because the pool basin was uneven. One plot was placed in type A and another in type B; each plot was 10 square meters in area. All species present in a plot were listed and their percent cover estimated.

After this was completed, a scale drawing of the entire pool was made, showing the location of the different types and where the plots had been placed, and a search was made for any other species not included within the plots. This drawing and data were called a “whole-pool” sample, and these samples were useful later in the analysis phase, to show which associations most often occurred together in the same pool.

RESULTS SO FAR

Over the course of three spring seasons, the team was able to visit 70 locales (each locale being a complex of many pools), sampling approximately 400 pools with 2,000 plots (Figure 3). The locales fell into 14 of the 17 vernal pool regions, the number of samples in each region being proportional to the size and complexity of the region. The locales were selected so as to include as many environmental differences as possible (geology, soil, elevation, land use history) within time and budget constraints.

So far, only one-third of the data have been analyzed, resulting in the characterization of 16 associations, all within the northern two-thirds of the Great Central Valley. Hardpan, claypan, and volcanic vernal pools were included. They showed that a given vernal pool typically consists of two or more associations, and that these associations recur in different pools often with different associations. That is, a vernal pool does not consist of one homogeneous association, but rather of a complex of apparently independent associations. This fundamental character of vernal pool vegetation would not have been revealed had vernal pools been sampled according to the whole-pool model followed by other researchers. Associations were not distributed at random, but were correlated with particular habitat characteristics. The presence of rare, threatened, and endangered species were closely linked with particular associations. Typically, each association was restricted to a single vernal pool region, meaning that conservation objectives should be locally focused.

WHAT REMAINS TO BE DONE

By the end of 2005, the remaining data will have been analyzed.



Vernal pool team members Rod McDonald and Bob Holland collect data on relative depth and associated vegetation at Del Mar Mesa in San Diego County. Photograph by S. McMillan.

This will enable researchers to develop a catalog of associations that includes each association’s floristic composition, habitat requirements, degree of commonness or rarity, endangerment status, distribution limits, and links with rare species. Each association will be named after its diagnostic species. We can expect that the number of associations will approach 50, and that only a few will have wide ranges extending over several vernal pool regions. The last part of the analysis phase will involve the construction of keys to the associations, and a listing of the most likely combinations of associations in the pools of each region. The associations can then be

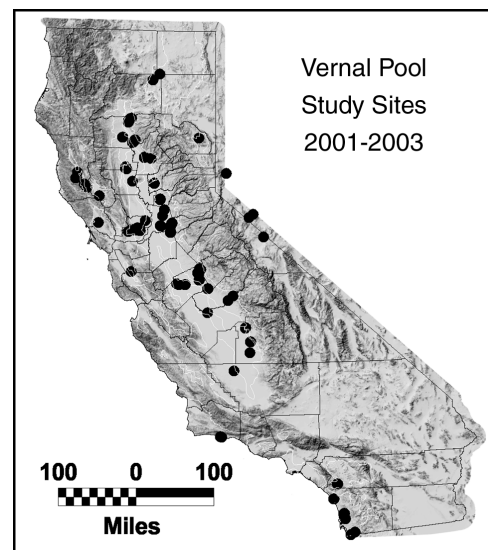


Figure 3. Location of the 70 sites visited during the 2001-2003 field survey. Map courtesy of R.F. Holland.

THE SURROUNDING SEA: A REVISED LOOK AT ANNUAL GRASSLANDS

While there are certain notable exceptions, most Central Valley vernal pools occur in a mosaic with annual grassland. Destruction of the pools and their endangered plants and animals is somewhat regulated through the Clean Water Act and the state and federal Endangered Species Acts. The same is not true for the grasslands that surround the vernal pools.

It is time for the California Native Plant Society, the botanical community in general, and the regulatory agencies to refuse to accept the term “non-native annual grasslands” in resource assessment documents. It is also time for plant protection advocates to demand that consultants conduct their botanical resources inventories during the correct time of year so as to detect the full suite of species present in annual grasslands.

If you go out in July, of course, the only thing to be seen is the remains of non-native an-



Annual grassland showing profusion of native wildflowers at the Tule Ranch in Yolo County. Photograph by C. Witham.

nual grasses. As with vernal pool species, most native forbs that occupy the annual grasslands are delicate. They wither and die in late spring, leaving only tiny twigs and tinier seeds. This presents a plant identification challenge for even the most experienced forensic botanist, and certainly an impossible situation for the novice.

Yet too often, those of us who review environmental documents see out-of-season surveys used to erroneously portray annual grassland as a weed patch and therefore unworthy of protection or mitigation.

The fact is that these grasslands are often the last refuge for many native plant species which were once more common in the Central Valley. As we continue to lose these annual grasslands to more intensive agriculture and urban development, we often lose

an amazing array of native plants that have nowhere else to live. Yes, some of them may be common, but are unlikely to remain so if we continue to destroy our annual grasslands.

While the majority of the biomass in an annual grassland is often attributable to non-natives, the diversity of native annual forbs and perennial bulbs nestled in and amongst the grasses can be very high. Additionally, the annual grasslands of California are not homogeneous. Different soils, water regimes, and microhabitats produce a mosaic of plant associations, some of which are quite rare.

During the course of our vernal pool vegetation studies, we sampled grassland vegetation at each of our sites. While that data has yet to be fully analyzed, ini-



Miniature lupine (*Lupinus bicolor*) can be quite common and abundant in annual grasslands. Photograph by C. Witham.

used to judge the uniqueness of pools subject to “take” (destruction of the affected habitat) by proposed developments. Are the associations common or rare, widespread or very local? Are they already protected in parks or by easements elsewhere or completely unprotected? Finally, are the associations endangered or not? This new scientific data will also be useful in helping to formulate decisions regarding the appropriateness of proposed mitigation measures, set targets for created or restored pools, and evaluate more accurately the degree of success or failure of restoration activities. It’s an exciting time for vernal pool conservation work!

ACKNOWLEDGEMENTS

The participants in the UCD team include: Professors Michael

Barbour, Randy Dahlgren, and Graham Fogg; overseas ecologists Drs. Sarel Cilliers (South Africa), Jose Antonio Molina (Spain), and Ayzik Solomeshch (Russia); California expert consultants Jennifer Buck, Janell Hillman, Robert Holland, Rod Macdonald, and Carol Witham; and graduate students Virginia Meyer, Christina Owens, and Sandi Starr.

The team was joined and helped in the field by many regional experts, including Zak and Linda Bell, Jim Chance, Kirsten Christoferson, Greg DeYoung, Tina Fabula, Rob Hansen, Kerry Heise, John Kelsey, Jaymee Marty, Scott McMillan, Mary Anne McCreary, Pam Muick, Jim Nelson, Chuck Peck, Rich Reiner, Lisa Sims, Bart Topping, Joe Silviera, John Vollmar, Greg Warrich, Marden Wilbur, Chuck Williams, and Dennis Woolington.

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- See also *Fremontia* V29 Nos 3 & 4 for information on rare plant monitoring and legislation.

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tial review suggests that annual grasslands throughout California are quite diverse. Most contain a complement of native species that exceeds the non-native component in number and diversity. Grassland composition varies regionally by geomorphic setting and by management practices. Several rare and endangered associations are likely to be identified.

So the next time you see a biological assessment that proposes no protection or mitigation for “non-native annual grassland,” question that premise. If we do not slow the destruction of our annual grasslands, we will lose what remains of this rich botanical heritage—once common in the Central Valley—poetically described by John Muir in 1869:

When I first saw this central garden... it seemed all one sheet of plant gold, bazy and vanishing in the distance... I at length waded out into the midst of it. All the ground was covered... with radiant corollas, about ankle deep next to the foothills, knee-deep or more five or six miles out... Sauntering in any direction, hundreds of these happy sun-plants brushed against my feet at every step, and closed over them as if I were wading in liquid gold.



Tomcat clover (*Trifolium willdenovii*) is one of 12 native clovers that occupy the annual grasslands at Jepson Prairie in Solano County. Photograph by C. Witham.



In the annual grasslands, the seedpods of spokepod (*Thysanocarpus radicans*) turn a delicate pink as the annual grasses begin to dry. Photograph by C. Witham.

FROM SPORE TO SPORELING: THE BIRTH OF A FERN

by Guenther K. Machol

"We have receipt of fernseed, we walk invisible."

— Shakespeare (1596)

Perhaps the most remarkable thing about fern reproduction is the curious plantlet that emerges when a spore germinates—it has no resemblance whatever to a fern! This strange plantlet is just one of many interesting aspects of the secret life of a fern—the reproductive process that begins with a tiny spore and ends with a sporeling. This secret life is well-understood today, but for a long time it was a deep mystery. Even as late as the 19th century, ferns and other non-flowering plants were called “cryptogams” because their reproduction was hidden. The mystery centered on the nature of the “dust”—then called *fernseed*—that fell from the

underside of fern leaves. Was it truly seed, as some botanists believed, or was it something akin to pollen? It was not until the middle of the 19th century that the mystery was finally solved. The steps that led to its solution are recounted in Moran (2004).

Today the answers are clear. A fernseed is a spore, not a seed, for it contains no embryo. It germinates to form a tiny, usually short-lived plantlet that is entirely different in both appearance and function from the spore-bearing fern. This plantlet is, in fact, the precursor to the fern. It develops male and/or female organs, carrying sperm and eggs, respectively. Only after fertilization does the very young fern—the sporeling—finally appear. Surprisingly, this life cycle, which alternates between spore-

bearing and reproduction, is common to all land plants.

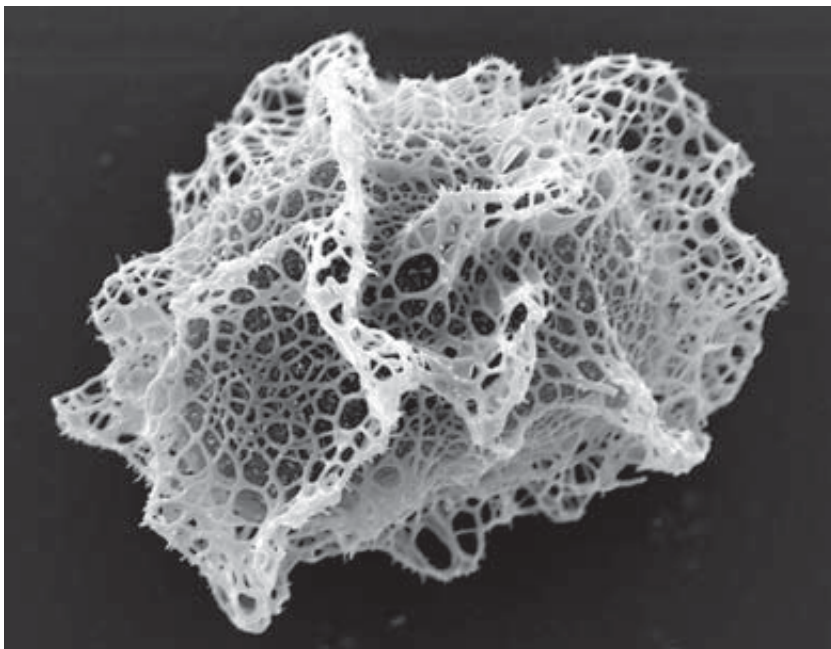
TWO KINDS OF FERNS

Most ferns produce just one kind of spore, and are called *homosporous*, but a few species have evolved that produce two kinds (called *heterosporous*). Of California's 85 fern species (including horsetails), 80 are homosporous, including those of bracken (*Pteridium*), chain fern (*Woodwardia*), cliff-brake (*Pellaea*), maiden-hair (*Adiantum*), polypody (*Polypodium*), sword fern (*Polystichum*), and wood fern (*Dryopteris*). Only species of mosquito fern (*Azolla*), water-clover (*Marsilea*), and pillwort (*Pilularia*) are heterosporous.

HOMOSPOROUS FERNS

A fern spore consists of a body, usually a single cell, surrounded by a generally hard wall that gives the spore durability. The spore of a homosporous fern is tiny, having a diameter of 20–60 micrometers; by comparison, the thickness of a dollar bill is about 114 micrometers. The spore may be pyramidal or bean-shaped, and its wall surface is often elaborately ornamented with bumps, ridges, and protuberances.

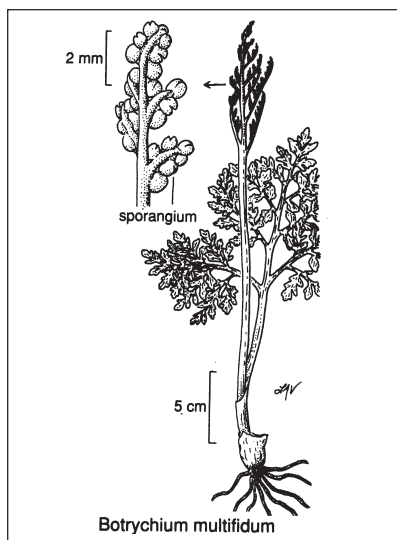
Spores are produced in a specialized organ called a *sporangium* (plural, *sporangia*). In most homosporous species, the sporangium is a stalked, globular capsule that resembles a tiny lamppost with an oversized globe, perhaps 0.3 milli-



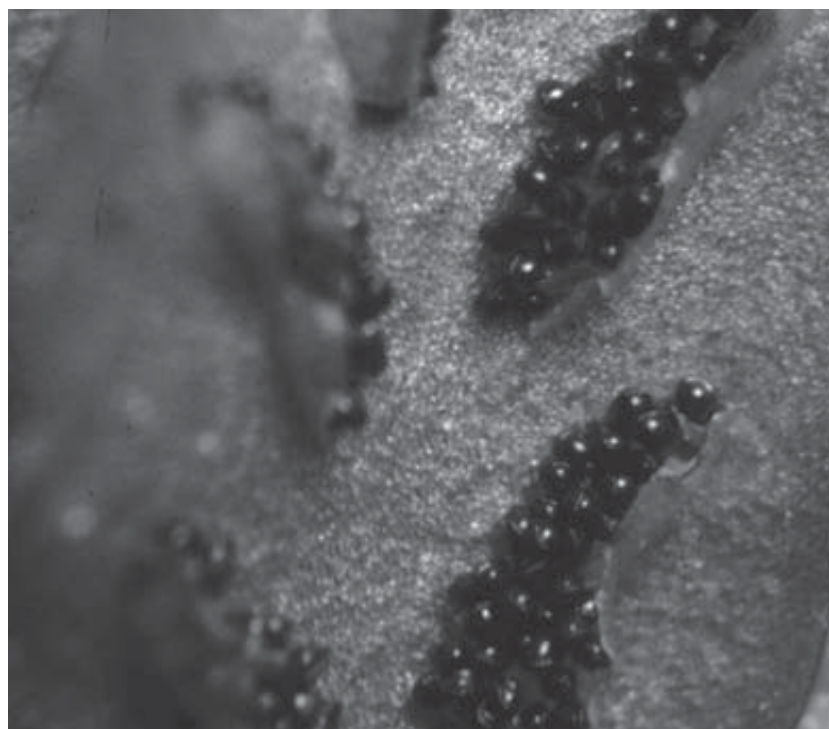
Spore of *Lomariopsis bederacea*, a fern of Gabon, Africa. The perforated wings are thought to aid in spore dispersal. Photograph by J. Garrison Henks, used with permission from R. Moran.

meters in diameter, and which contains a small number of spores, typically 32 or 64. When mature, the capsule ruptures and the spores are literally flung away from the plant. In a few homosporous species, however, the sporangium is a larger, stubby capsule about one millimeter in diameter which contains hundreds to thousands of spores. When this kind of sporangium breaks open at maturity, the spores merely sift out. Technically, a plant that produces spores is called a *sporophyte* (“phyte” meaning “plant”). The sporophyte of a fern is the familiar-shaped, spore-bearing structure.

Sporangia are usually found in clusters called *sori* (singular, *sorus*). The clusters are often associated with veins that provide nourishment to the developing sporangia. Depending on the species, sori may be seen on the undersides of the leaves¹ (polypody, *Polypodium*), at the leaf margins (maiden-hair, *Adiantum*), on specially modified leaves (deer fern, *Blechnum*), or on special stalks (grape-fern, *Botrychium*, as shown in the illustration below). According to W. Carl Taylor, ferns are “a



Leather grape-fern (*Botrychium multifidum*). The sporangia are borne on a special stalk called a sporophore. Illustration by L. Vorobik, from *The Jepson Manual*, used with permission from the Regents of the University of California.



Close up of sori and indusia of maidenhair spleenwort (*Asplenium trichomanes*). Some of the indusia have been removed to reveal sporangia. Photograph by M. Edgren.

sight for sori.”

In some homosporous ferns, the sori are covered by flap-like membranes called *indusia* (singular, *indusium*; Latin for “tunic”). The indusia can have various shapes, often similar to those of the sori, such as

round, elongate, or horseshoe. In some species where sori are situated at the leaf margin, the margins are curled inward to cover the sori; these are called “false” indusia. The widespread bracken fern (*Pteridium*) has both true and false indusia.

MAGICAL FERNSEED

In Shakespeare’s time, fernseed was believed to have magical properties, and it could also be used to locate treasure or conserve wealth. Because it was so small as to be nearly invisible, the belief arose that a person holding it would also be invisible. But the fernseed could only be collected on the bottommost of a tall stack of pewter plates at midnight of Midsummer’s Eve—provided the goblins and fairies, who were free to roam the woods only on that night, didn’t snatch it first! (Moran 2004).

Fernseed could also be used to locate hidden treasures in the earth. As Frazer (1922) relates, “Now it is a property of this mythical fernseed that whoever has it, or will ascend a mountain holding it in his hand on Midsummer Eve, will discover a vein of gold or will see the treasures of the earth shining with a bluish flame.” In Russia it was believed that, if you threw the fernseed up into the air, it would, according to Frazer, “...fall like a star on the very spot where a treasure lies hidden.” It was even thought, “... if you place fernseed among money, the money will never decrease, however much you spend.”

¹ The term “leaves,” referring here to the fronds of a fern, conforms to such usage in *The Jepson Manual* (Hickman 1993) and elsewhere.

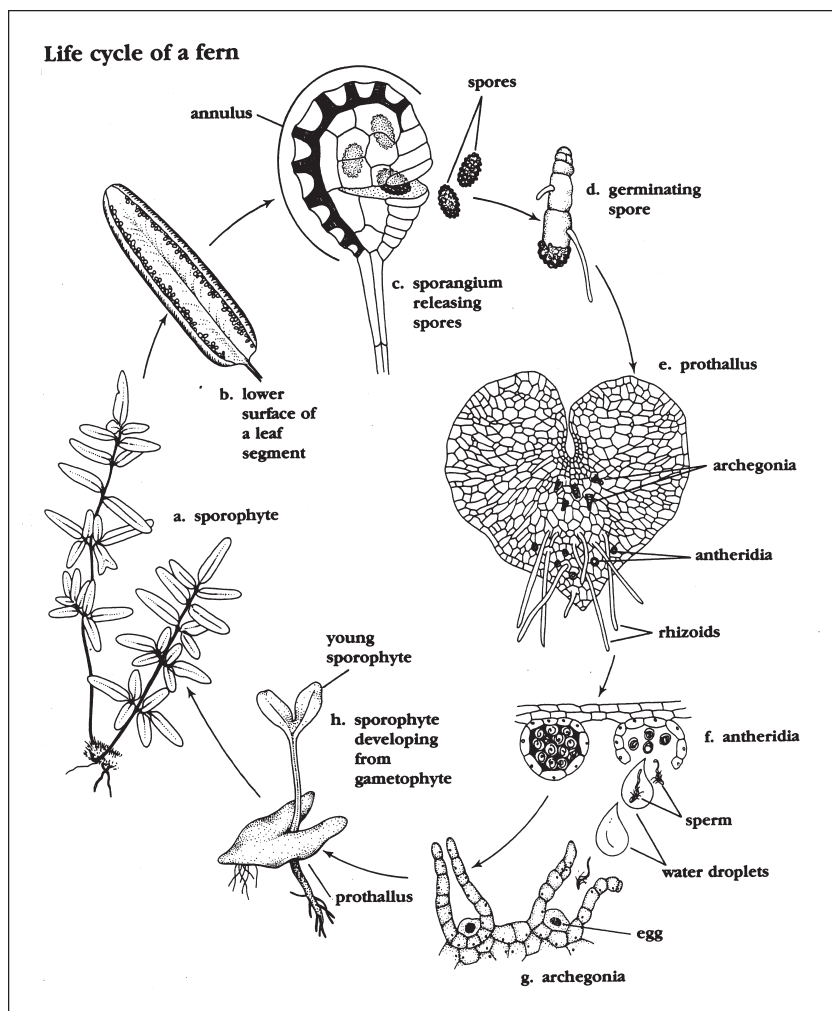


Figure 1. Life cycle of a homosporous fern. The sporophyte is the fern (a) with leaves, underground stem (rhizome), and roots. The gametophyte is the prothallus (e). Illustration by P. Nelson, used with permission from W.C. Taylor (1984).

A REMARKABLE PLANTLET

Under the right conditions, the spore of a homosporous fern germinates and develops over a period of months into a small plantlet. Remarkably, the plantlet has no stem, no leaves, no veins, and no roots! It is usually a tiny green, photosynthetic, heart-shaped membrane less than one centimeter across, anchored to the ground by thin filaments called *rhizoids*. Sometimes, as in grape-ferns (*Botrychium*) and adder's-tongue ferns (*Ophioglossum*), the plantlet is tubular and subterranean, receiving its nourishment through a symbiotic relation with

mycorrhizal fungi. Because this plantlet is the precursor to the sporophyte, it is called the *prothallus* (plural, *prothalli*). Prothalli are seldom noticed in the wild because they are inconspicuous and usually short-lived.

What possible function does the prothallus serve? Close examination reveals that it bears reproductive organs: male organs, called *antheridia* (singular, *antheridium*), in which sperm develop; and/or flask-like female organs, called *archegonia* (singular, *archegonium*), in each of which a single egg is produced (Figure 1). During the course of its development, a prothallus passes through an all-male

or all-female stage before becoming bisexual. A female prothallus has the ability to release hormones that stimulate nearby prothalli to develop only antheridia, thus promoting cross-fertilization.

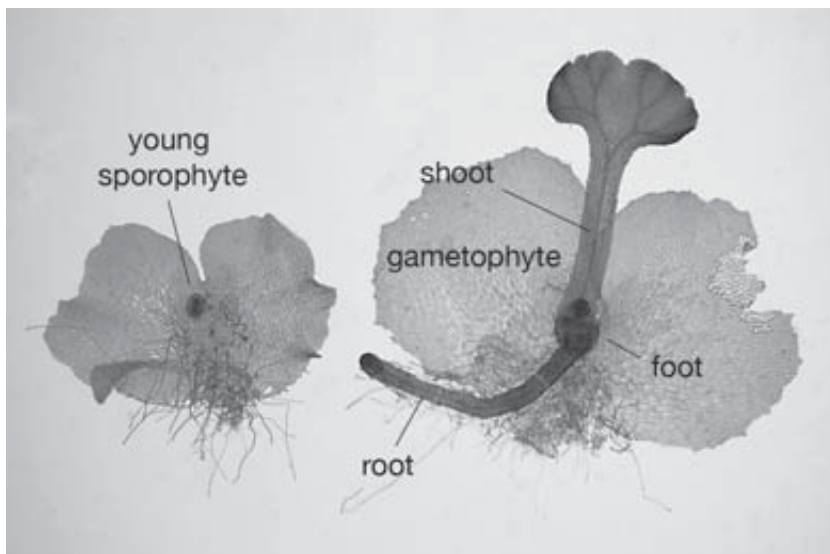
In the presence of water, mature sperm are released by the antheridia. Stimulated by an attractant emitted by the archegonia, and propelled by flagella—hair-like appendages—the sperm swim to the archegonia and effect fertilization. Each fertilized egg remains attached to the prothallus and develops into an embryo.

The embryo absorbs nutrients from the surrounding prothallus tissue and forms a root, a first leaf, and rhizome (see photograph on page 13). As the rhizome grows, it produces additional roots and leaves. Once the roots provide sufficient nutrients (in a few weeks or months), the prothallus is no longer needed, and it withers away. The first leaves to form are quite simple and small. Subsequent leaves, provided with more nutrients from the growing roots, become larger and more dissected. This new young plant or sporophyte will eventually mature to become the familiar sporophyte.

Technically, eggs and sperm are called *gametes* (from the Greek word *gamein*, meaning “to marry”), and any plant that bears them is called a *gametophyte*. Some authors use *prothallus* and *gametophyte* interchangeably in reference to homosporous ferns.

HETEROSPOROUS FERNS

“And now for something completely different!” That Monty Python catchphrase aptly describes heterosporous ferns, for they reproduce in a way strikingly different from that of homosporous ferns. Only three families of ferns are heterosporous: floating ferns



The young sporophyte, emerging from the prothallus, receives nourishment through a foot. Image used with permission of photographer, C. Clark.

JARGON: IT'S ALL GREEK TO ME

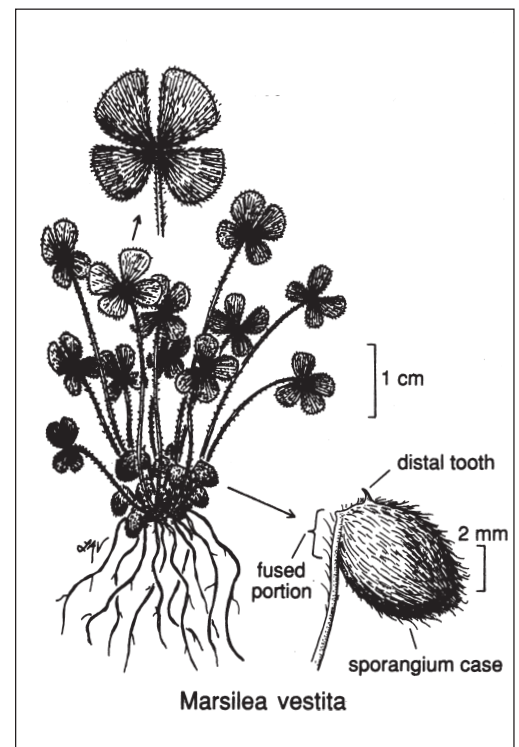
If the terminology related to ferns puzzles you, and you're thinking, "It's all Greek to me," you're actually on the right track. Much of the terminology used in botany dates to the 19th century, and it makes use of many elements derived from Greek. Word origins are instructive; some even provide unexpected touches of humor. For example, the word "sorus" (a cluster of sporangia) derives from Greek for "heap;" "indusium" (the covering of the sorus) comes from Latin for "tunic;" and "gamete" (an egg or a sperm) comes from the Greek word "gamein," meaning "to marry."

The origins of the terms used in this article are listed below. Greek words are in *italics*; the one Latin word (*indusium*) is signified by L.

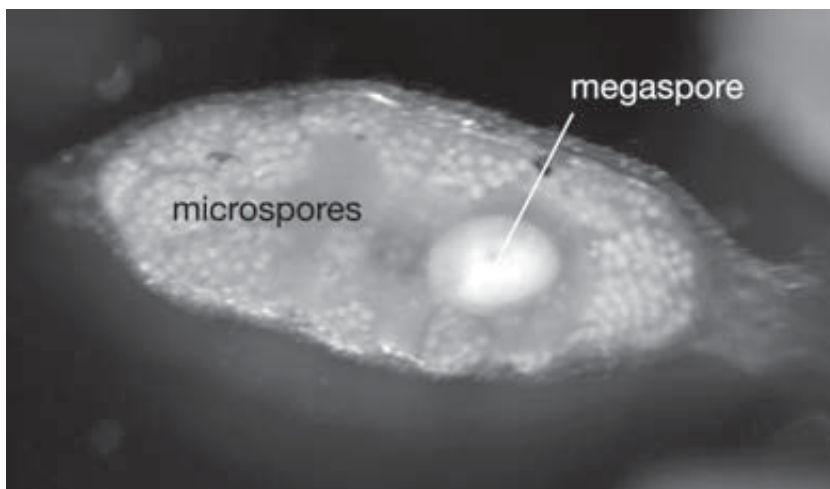
antheridium	<i>anthos</i> , flower + <i>-idium</i> , small one
archegonium	<i>archein</i> , to begin + <i>gonos</i> , procreation
cryptogam	<i>kryptos</i> , hidden + <i>gamein</i> , to marry
gamete	<i>gamein</i> , to marry
gametophyte	<i>gamein</i> , to marry + <i>phyton</i> , plant
heterosporous	<i>heteros</i> , different + <i>-sporous</i> , having spores
homosporous	<i>homos</i> , alike + <i>-sporous</i> , having spores
indusium	L. <i>indusium</i> , tunic
mycorrhizal	myco-, fungus + <i>rhiza</i> , root
prothallus	<i>pro-</i> , precursory + <i>thallos</i> , green shoot
rhizoid	<i>rhiza</i> , root + <i>-oid</i> , resembling
rhizome	<i>rhiza</i> , root + <i>-ome</i> , mass
sorophore	soro-, sorus + <i>phoros</i> , carrying
sorus	<i>soros</i> , heap
sporangium	spor-, spore + <i>angeion</i> , vessel
spore	<i>speirein</i> , to sow
sporocarp	sporo-, spore + <i>-karpus</i> , fruit
sporophyte	sporo-, spore + <i>phyton</i> , plant

(Salviniaceae) and mosquito ferns (Azollaceae), both of which are free-floating; and water-clover ferns (Marsileaceae) that grow in mud or shallow water. Collectively, members of these three families are called water ferns.

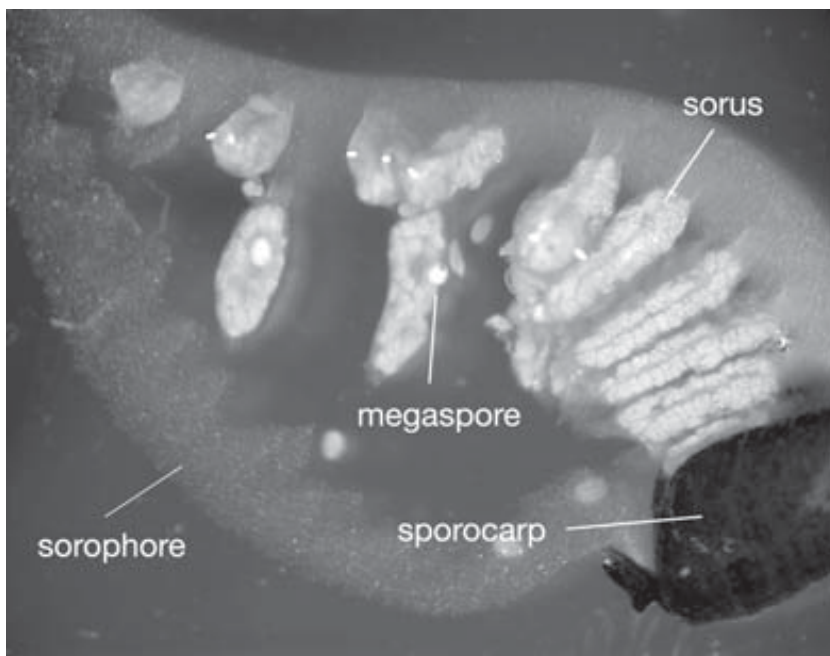
All members of these three families have two kinds of spores: small male spores (*microspores*) 20-30 micrometers in diameter that are produced in *microsporangia* and give rise to male gametophytes; and much larger female spores (*megaspores*) up to 700 micrometers across that are produced in *megasporangia* and give rise to female gametophytes. The sporangia in heterosporous ferns are contained within a structure called a *sporocarp*, found either at the base of the fern or among the leaves. The sporocarp protects the sporangia from drought conditions. Dry sporocarps of *Marsilea* can remain viable for a century.



Water-clover fern (*Marsilea vestita*). The sporangia in heterosporous ferns are borne in sporocarps. Illustration by L. Vorobik, from *The Jepson Manual*, used with permission from the Regents of the University of California.



Sorus of *Marsilea*. The sorus is a cluster of both male and female sporangia. The megaspore and microspores are visible through the transparent walls of their respective sporangia. Image used with permission of photographer, C. Clark.



Sori of *Marsilea* emerging from the sporocarp. A gelatinous, tail-like structure called a sorophore (seen here unfolding) holds the sori. Image used with permission of photographer, C. Clark.

Water-clover (*Marsilea*) is an interesting representative of the water ferns (see illustration on page 13). This small aquatic or amphibious fern has leaves that resemble those of four-leaf clover. It occurs in many California counties, where it is found in vernal pools and at the edges of ponds and lakes. *Marsilea* has a long-creeping rhizome that produces long-petioled leaves at

nodes along its length. One or more hard, bean-shaped sporocarps are borne on stalks at or near the bases of the petioles.

Each sorus within the sporocarp is a cluster of both microsporangia and megasporangia. Each microsporangium contains numerous small microspores, while each megasporangium holds only one large megaspore. The sori are at-

tached to a transparent, tail-like gelatinous structure called a *sorophore* (see photographs to left). This specialized structure prevents the megaspores and microspores from being swept apart by water currents, thereby ensuring their sperm and eggs will remain in close proximity.

WITHIN SPORE WALLS

Over time, the sorophore absorbs moisture and expands, rupturing the sporocarp wall. The sorophore is extruded into the water, its attached sori resembling “grains of white rice arranged in a row” (Hoshizaki and Moran 2001). The spores are released into the water from the sporangia, and they complete their germination entirely within their spore walls. Each megaspore develops rapidly into a female gametophyte, each microspore into a male gametophyte. The antheridia and archegonia project through their respective spore walls, and fertilization occurs within hours. Sporelings may appear within a few days. Wagner and Smith (1993) explain the likely origin of this process: “The heterosporous cycle may have been originally an adaptation to strongly seasonal or xeric habitats where moisture was available only for short periods during sporadic or vernal rains. Reproduction by this process is rapid because it is not necessary to grow a whole photosynthetic thallus, as in the homosporous cycle.”

ALTERNATION OF PHASES

In all ferns, the life cycle alternates between two forms or phases: the spore-producing, or *sporophyte* phase, and the sperm- and egg-producing, or *gametophyte* phase. This cycle is known as “alterna-

IMAGE GALLERY

A delightful animation of fern reproduction and many interesting images of the ferns and structures described in this article can be found in color on the Web. Below are a few examples.

- Animation of fern reproduction. Go to url below, select “ferns,” “introduction,” “Skip to animation,” then click on pictures. It’s fun!
www.nzplants.ac.nz
- “*Botrychium multifidum*” by K&R Rasbach.
www.nhm.ac.uk/hosted_sites/bps/rasbach/RAS002M.JPG
- “A classically heart-shaped fern prothallus,” by G.J. Proper.
www.nhm.ac.uk/hosted_sites/bps/wof/WF011BL.GIF
- “A sporeling fern, still attached to the now redundant prothallus,” by G.J. Proper.
www.nhm.ac.uk/hosted_sites/bps/wof/WF011BR.GIF
- Sori of “California Polypody [*Polypodium* sp.]” by Charles Webber.
http://elib.cs.berkeley.edu/imgs/512x768/8120_3181/4904/0054.jpeg
- Sori of assorted ferns.
www.csupomona.edu/~jcclark/classes/bot125/resource/graphics/pte_sori.html
- Spore of *Ceratopteris*, a homosporous fern.
www.science.siu.edu/landplants/Pterophyta/images/Ceratopteris.spore.JPG
- “Marsilea male, female gametophytes.... a large female gametophyte, still inside the megaspore wall. The bulge at one end contains an archegonium.” by Curtis Clark.
www.csupomona.edu/~jcclark/classes/bot125/resource/graphics/pte_mar_gph.html

tion of phases” or more traditionally “alternation of generations.” Alternation of phases is exhibited by all land plants, not just ferns. For example, in flowering plants the sporophyte is the familiar plant with roots, stem, leaves, and flowers. And because flowering plants are heterosporous, there are two kinds of gametophytes. The male gametophyte is the pollen grain,

formed from a microspore produced in the anther. The female gametophyte is the embryo sac (which contains an egg), formed from a megaspore produced in an ovule. This universal life cycle was first demonstrated in 1851 by the German botanist William Hoffmeister, and is today taken for granted. And so, the secret life of a fern is no longer a secret.

ACKNOWLEDGEMENTS

The author is grateful to Curtis Clark, Margery Edgren, Robbin Moran, W. Carl Taylor, and Linda Vorobik for providing photos and drawings, to Alan Smith for technical advice, to Ruth Kirkpatrick for reviewing the draft, and to all those who helped with technical information, comments, and support.

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RUDOLF & LOIS FINK: A REMEMBRANCE

by *Falene Hamilton*



View into Yosemite Valley. Photograph by L. Vorobik.

Every family has its favorite stories and one of mine was the description of my parent's first trip to Yosemite Valley. It can be a hot, dusty trip approaching the Valley from Merced, and the closer they got the more dismayed they became. The terrain was certainly rugged, but the green of pines was absent and the possibility of a valley ahead that matched the descriptions in their heads seemed remote. Turning to each other, they voiced their disappointment and surmised that they had read too much into the literature about the Valley. Well, as every visitor knows, the entrance into the Valley is both abrupt and spectacular and it surpassed my parent's expectations completely. Captivated, they set out immediately to hike and explore, not only the Valley, but Glacier Point and Little Yosemite as well. Curious about the geology and the flora and fauna of the Valley, they struck up a conversation, one afternoon, with an agreeable and friendly photographer setting up his camera in one of the valley meadows near the Merced River. He must have liked this young eager couple because he told them about the Sierra Club and offered to sponsor their membership in the club (in those days, one needed a member's

recommendation to become a member). The photographer's name was Ansel Adams and he not only sponsored them, but took photographs of them as well.

My parents joined the Sierra Club shortly after this trip and began going on the weekend fieldtrips organized by the Natural Science Section (or NSS as it was usually referred to) of the club. These outings were planned to combine day hikes with specific opportunities to see seasonal wildflower displays, geological features, marine life, etc. Monthly meetings, with a lecture format, were held in the Sierra Club office in San Francisco, usually preceded by dinner at Shroeder's Cafe with, what I remember as a child,

it's slightly risqué murals. Frequently these lectures were given by NSS members, many of whom were scientists or knowledgeable amateurs, willing to share their expertise. Outside speakers were invited as well. As a child, I often had trouble staying awake during these lectures and was always grateful when the lights were dimmed for slides and I could indulge in a short nap, hopefully undetected.

Most of the hikes took place in Marin County or up in the Sonoma and Napa valleys, although Mt. Diablo and Moss Beach were destinations as well. Fellow members, whose names should be familiar to California Native Plant Society members, were John Thomas



Lois B. Fink, circa early 1940s. Photograph by A. Adams, from the personal collection of F. and G. Hamilton.

Howell, Mary (Leo) Bowerman, and Elizabeth McClintock. Because of their presence, the emphasis tended to be toward plant identification and habitat exploration. I can still hear Tom Howell's patient voice with gentle humor correcting and encouraging someone lost in the process of keying out a plant. My parents were always grateful for this tutoring which helped nurture their lifelong love for the special flora of California. I can also remember, as a young person, being excited to learn the exactitude of life zones and the predictability of the plant life within each zone.

In the early years, I was usually the only young person along on these fieldtrips, and I sometimes became impatient to start hiking again while others were still "belly botanizing." Fellow members, who seemed to me like a benevolent group of aunts and uncles, would amuse me with stories and jokes until we again got started hiking. I

also remember with fondness the trips home on the Greyhound bus when the group would start singing campfire songs in the back of the bus. Did the other passengers mind? I don't think so since of course they were welcome to join in.

In the late 1940s my mother took over the job of running a junior museum group at the California Academy of Science in San Francisco. Later, with the help of co-leader Joanne Taylor, she developed a program that taught natural science through lectures, workshops, and fieldtrips for 12- through 18-year olds. One of her students was Peter Raven who has since become director of the St. Louis Botanical Garden. An exceptional student, Peter in those days explored several fields before settling on the field of botany. The Academy's junior museum provided an excellent setting for these young people to explore various scientific fields at



The Fink family (Rudy, Lois, Falene, and a student friend from California Academy of Sciences) camping near Tuolumne Meadows, 1952. Photographer unknown.

their own level.

During the late 1940s and early 1950s my parents continued to explore the Sierra during their summer vacations. With a group of six to eight friends they packed in for two weeks at a time, doing about an 80 mile round trip. Packers left supplies at an agreed upon drop-off about halfway through the trip; the rest they carried on their backs. I was eight years old when I went on my first trip with them and felt quite responsible as I carried the jello in my backpack as my contribution! My father kept me going over the high passes with promises of another lemon drop after "x" number of switchbacks had been completed. The mountains seemed like one vast, wonderful playground to me and I've loved them ever since. All of us learned to appreciate the beauty of the mountain wildflower gardens, and the almost Japanese quality of these high alpine displays influenced the approach my parents took as they planned and developed their own garden. They sought out the few native plant nurseries that existed then and used natives extensively throughout their garden before this approach became popular in later years. Only once did we go on a Sierra Club high trip and that trip hiked the Benson Lake and Kerrick Meadows area. These



Rudolf E. Fink, circa early 1940s. Photograph by A. Adams, from the personal collection of F. and G. Hamilton.

trips were very large then, with pack animals and commissary for about a hundred or so people—just too large for my parents' taste, although they made some good friends on that trip. A highlight for me on that trip was learning to fish for delicious mountain trout. Dr. Cutter of Cutter Labs in Berkeley kindly outfitted three of us eager ten-year-olds with flies, line, and tips to get us started. We caught quite a few, which indicates that the fish were either very hungry or very unwary, since our skill was pretty rudimentary. I learned a lot about streams and their quiet beauty.

During the late 1950s and 1960s my father's job with Kaiser Engineers took our family to India and Brazil for extended periods, and when they returned to the Bay Area, building their home in Orinda that my father designed took much of their time (both my parents had started out as architectural majors at UC Berkeley). Well settled in by the 1970s, they joined the California Native Plant Society (CNPS), attending some of the programs, fieldtrips, and plant sales as time allowed, since my father's work still involved extensive travel abroad. They also became active in the Northern California Herb Society and through that group's activities met August and Susan Fruge.

I believe the NSS ceased as an active hiking group sometime in the 1970s, although many of the members remained close friends. My mother's health became an issue in the 1980s and my parents were unable to do many of the activities they had formerly enjoyed. They never lost their desire to save native plant habitats and, although they could no longer hike the high country trails, their love for the Sierra and coastal mountains remained as strong as ever.

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THE REVISED FLORA OF MT. DIABLO

In 2002, CNPS published *Flowering Plants and Ferns of Mt. Diablo* (see book review in *Fremontia* 30 (3 & 4):70-71). The flora was originally written by Mary Bowerman, and was extensively revised by Barbara Ertter and Mary Bowerman, resulting in "a fascinating, invaluable account of environmental change on the mountain and of progress in scientific understanding" of the flora, according to Bruce G. Baldwin, Curator of the Jepson Herbarium, UC Berkeley. This book could not have been published without the generous support of the Lois B. and Rudolph E. Fink Publication Fund, Mary Bowerman, and other CNPS members.

CNPS Press is dedicated to publishing books about our native flora, especially those which might not otherwise be published by trade presses, such as local floras like that of Mt. Diablo. And yet it is just these types of publications that are needed for CNPS members to understand the delicate diversity of our back yards, and share this knowledge with others so that we may protect our floristic natural heritage. If you would like to contribute to CNPS Press, contact Michael Tomlinson at the CNPS office (see page 1 for contact information).



Mary Bowerman at a 2003 book signing event, sponsored by the nonprofit organization, Save Mt. Diablo. Photograph by L. Vorobik.



Barbara Ertter approaching Mt. Diablo, Contra Costa County. Photograph by L. Vorobik.

JUNE McCASKILL (1930-2001)

by J. M. Tucker

In the spring of 2001, many of us were saddened by the death of June McCaskill, following a sudden heart attack on the 9th of May. June had suffered from Alzheimer's disease for about a year, and had moved to southern California to be close to her sister and brother. I will always remember her for her warm and cheerful disposition and her generous, friendly nature. She was always ready to help others; she is sorely missed by a host of friends.

Her career at the University of California, Davis spanned nearly 40 years. First joining the botany department in 1953, she retired in 1991 as curator emerita of the

University of California at Davis Herbaria.

June was born in Altadena, California, June 2, 1930, and grew up in Pasadena, where her parents had established a small nursery. Her father, a plantsman with a passion for camellias, was adept at hybridizing them and developed a number of new cultivars. Two of the most attractive he named for his wife and for June: *Camellia japonica* 'Billie McCaskill' and *C. japonica* 'June McCaskill,' respectively.

As a youngster, June worked in the nursery along with her brother, Jack, helping with a variety of tasks. Eventually, she remembered, they were earning the princely sum of

35 cents an hour from their dad.

The nursery was a family enterprise in every sense of the word. Her father—hard working, quiet, and rather reserved—was the knowledgeable technician, and more a plant lover than a businessman. Her mother, a truly charming lady, was the gracious salesperson meeting the public. Over the years the business thrived, and in time "McCaskill Gardens" became the largest camellia nursery in southern California.

The school system in Pasadena was apparently quite progressive at that time, and a bit unusual. At the Grant Elementary School which June attended, she remembered



June McCaskill, circa 1990, at the University of California at Davis Herbarium. Photographer unknown.



June McCaskill, circa 1990, at the University of California at Davis Herbarium, surrounded by an array of her herbarium specimens. Photographer unknown.

learning about opera in the first grade, catching butterflies and making collections, and, in the sixth grade, operating their own little radio station. The school system was referred to as the “six-four-four plan:” a six-grade elementary school, a four-grade junior high, followed by Pasadena City College, a four-year school.

June went to City College just one year, taking among other courses, a botany course with a friend. Greatly impressed with this experience, where she learned about the internal structure and physiology of plants for the first time, she decided to go elsewhere rather than continue at City College. She and her friend opted for Mills College in Oakland, entering in the fall of 1949. Here she pursued her chosen field, taking courses from and working closely with the widely known plant taxonomist, Professor Howard

McMinn. June graduated in 1951 with a degree in botany.

The summer following graduation, June worked at Cal-Tech’s newly constructed Earhart Plant Research Laboratory (or “phytotron”)—a splendid facility for experimental plant physiology. Although her work was routine for the most part, she got to work with some of the best plant physiologists of the time. Her boss was the renowned Fritz Went. Others for whom she worked included such notables as James Bonner and Anton Lang, all of whom were engaged in early experiments on plant growth regulators.

That fall she returned to Mills where, over the next two years, she assisted McMinn in the small teaching herbarium and the greenhouses, and served as a teaching assistant to Lucile Mason. June also took additional courses, although not with a

graduate degree in mind.

I first met June early in 1953 at the California Botanical Society’s annual dinner in Berkeley. She had come with McMinn, who knew I was looking for a herbarium assistant. Both he and Lucile Mason had recommended June highly, and I was very favorably impressed after this one meeting. So in due course, after a visit to Davis and an interview with Vernon Cheadle, our department chairman, June was hired in the summer of 1953.

In preparation for her new position at the UC Davis Herbarium, she spent several days at the herbarium at UC, Berkeley, where she got to observe how a major herbarium operates. She also learned the fine points of mounting specimens, working alongside experts. This brief stint, coupled with her two years experience with McMinn, had prepared her very

well for her new position.

Initially June's most important responsibility at Davis was to handle the frequent requests that the herbarium received from individuals for plant identifications, a service which the herbarium provided free-of-charge. These came mainly from farmers and farm advisors, veterinarians, and horticulturists, but also from the general public. Usually a specimen was involved—either fresh or pressed and dried.

On occasion, however, the "specimens" could present special challenges. Some examples: the envelope containing a specimen so thoroughly pulverized as to be recognizable only as plant material; or the water weed sample in a plastic bag, half-decomposed and reeking; or a portion of a bale of hay suspected of containing poisonous plants. However, with her cheerful acceptance of these and other duties, and with her careful and meticulous work habits, June proved to be an ideal assistant and co-worker.

Early on during her time at Davis, expanding the herbarium's library became an important priority for June. The small shelf of reference books I had relied on consisted of a dozen or so western floras and botanical/horticultural manuals, and not much else.

Prior to June's arrival, my requests for books for the herbarium had been exercises in futility. Wilfred Robbins, chair of the botany department prior to Cheadle, had always been quick to point out that the main library was only a short walk from the botany building. After Robbins retired, however, things began to change for the better. June and I initiated an acquisition program that soon resulted in an expanded library collection, including a number of manuals for other regions of the US, an array of local floras, and taxonomic monographs and revisions of specific groups. Thus, over

the years, her efforts to acquire and make use of the most authoritative and current references proved an important factor in the accuracy of her identifications. And it was this high level of accuracy, as well as her prompt, dependable, and helpful responses that earned her an ever-widening "clientele" among California agriculturists.

Incidentally, June's earliest years at Davis coincided with the final years of Margaret (Maggie) Bellue, pre-eminent weed specialist in the California Department of Agriculture, and coauthor with Wilfred Robbins and Walter Ball of the widely used *Weeds of California*. June promptly assumed Bellue's mantle. Maggie, although she had enjoyed a noteworthy career, was happy to retire—and was looking forward to spending more time at another favorite place: the golf course.

With Cheadle as chairman of the botany department, the fortunes of the herbarium—and, indeed, of the whole department—began to improve dramatically. At the beginning of his first year, in July 1952, he made provision for a half-time herbarium assistant for just nine months. Then June was hired in July of 1953, and wonder of wonders, a new steel case—the first in our herbarium—was purchased on April 8, 1954. The requisition authorizing the purchase bore the notation: "Our herbarium cases are bursting at the seams. Materials kept in boxes cannot be made insect-proof, and cause excessive loss in time, money, and energy." (During the previous year, with no case space available, newly mounted specimens had been stored in boxes under a workbench.)

Five more new cases were purchased in 1955; two more in 1957; and four more in 1958. Thus, when we moved into Robbins Hall in 1960, we had a total of 12 to add to the 61 provided in the building plan, for a grand total of 73. Needless to say, there were quite a few empty

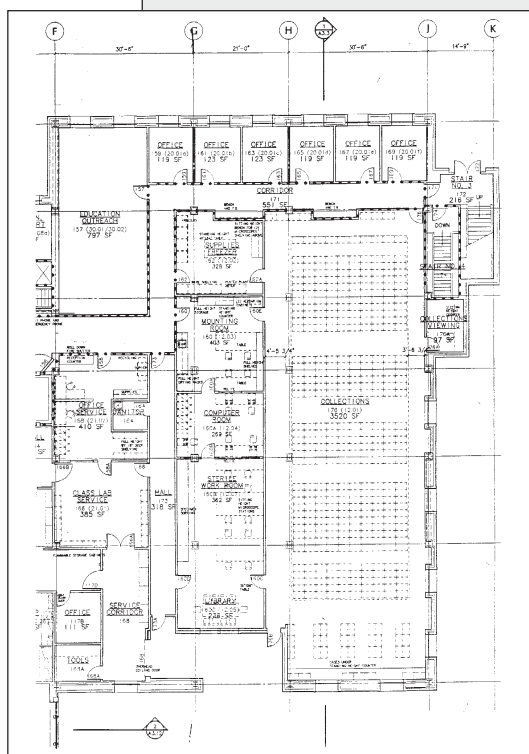
cases for a number of years. We were planning for the future, but the fact that our plan survived all review committees with minimal cutbacks surprised Cheadle as well as June and me. June had been fully involved in developing our plan over several years.

As June's reputation grew, she became increasingly a highly valued source of information for agriculturists of many stripes, as well as academic faculty at UC Davis and elsewhere, veterinarians, regional poison centers, and police officers in various communities. Although she was never called to testify in court, she provided plant identifications that were highly useful in two murder trials, as well as in a number of drug cases.

Her service to Fresno County Farm Adviser Bill Fischer led to coauthorship of the *Growers' Weed Identification Handbook*, a loose-leaf book published by UC Agricultural Publications. She also established several new weed records for California, one of which was apparently new to the Western Hemisphere, *Monochoria vaginalis*, a member of the pickerel weed family (Pontederiaceae). This rice field weed, common in tropical Asia, turned up as an "unknown" at the experimental rice station at Biggs, in Butte County. The two of us, after a lengthy investigation, were able to pin it down as a species previously unrecorded in the New World; we jointly published a note in *Madroño* in 1955.

Throughout her years in the herbarium, part-time student assistants were her main source of additional help, either for pay or as interns for university credit. June was always very patient and helpful in training and supervising them, and in time developed an informal but comprehensive course in herbarium procedures. She once estimated that over a period of 35 years, she had close to 200 student assistants helping her.

The University of California at Davis (UCD) Herbarium is on the move. This coming fall, the herbarium's 250,000 specimens and associated botanical library will be moved to a new facility that will be called The Center for Plant Diversity. It will be located on the first floor of a beautiful new teaching laboratory building in the heart of the biological sciences corridor along Hutchinson Drive at UCD. The Center for Plant Diversity will continue the herbarium's outreach programs, taxonomic training, and plant identification services, upon which many people in northern California rely. The advantage of the new facility is that the collec-



Floor Plan of New Herbarium Space in the Science Laboratory Building. The Center's main plant identification room will be named The June McCaskill Plant Identification Laboratory.

tions area will be kept at 60°F—uncomfortably cold for both humans and the beetles that have routinely infested the herbarium's specimens over the past century. By eliminating insect damage, the important collections of eminent UCD botanists such as Ledyard Stebbins, Jack Major, Michael Barbour, Grady Webster, John Tucker, Katherine Esau, Beecher Crampton, Harold Olmo, and June McCaskill (and the dozens of students they helped) will be preserved for future users. Work areas with microscopes will be kept at a more welcoming temperature, and staff will look forward to serving your needs in the new facility.

The collections that comprise the UC Davis Herbarium have come together from many different sources, the most important of which are: The Viticulture Herbarium (founded 1885) and the Agronomy Herbarium (founded 1913—named the Beecher Crampton Herbarium in 1984) which were both founded on the UC Berkeley Campus and later moved to Davis; and the Botany Herbarium (founded 1922—named the John M. Tucker Herbarium in 1986) and the Horticulture Herbarium (founded in the 1960s) which were both started at UC Davis.

The greatest strength of the UCD Herbarium is its representation of the flora of California. Due to the research interests of Beecher Crampton, the herbarium has excellent collections of *Navarettia* and California grasses. John Tucker's legacy has been a well-curated collection of New World oaks. Thanks to Grady Webster, we have the best-curated collection of the spurge family (Euphorbiaceae) in California and interesting collections of tropical plants, especially from Ec-

uador. Les Gottlieb has donated his *Clarkia* collections, Roman Gankin his *Arctostaphylos*, Bruce Baldwin his tar weeds, Mike Sanderson his *Astragalus*, Jack Major and his students their alpine plants, and Carol Witham and Rob Preston their vernal pool collections. Many UCD students have donated important collections, including Fred Hrusa, who donated thousands of his general collections during his tenure here. In addition, because of the long decades of doing plant identifications for UC Cooperative Extension, the herbarium has a good representation of California's non-native flora.

June McCaskill's special talent was identifying plants for UC Cooperative Extension and for anyone else who needed it. Because of this, the campus would like to name the Center for Plant Diversity's main plant identification room The June McCaskill Plant Identification Laboratory. The fundraising goal is \$150,000, of which nearly \$125,000 has been raised. If you are interested in donating a gift in June's memory, please either email Ellen Dean at eadean@ucdavis.edu, call the herbarium at (530) 752-1091, or go to the herbarium website, www.herbarium.ucdavis.edu, and download the June McCaskill pledge form.

June would never have expected to be honored in this way, but someone who for so many years was the heart of the herbarium and the UCD botany department deserves to be remembered. This room, with photographs of June and all the fittings for plant identification, will help keep her memory alive.

—Ellen A. Dean, Director
UC Davis Herbarium

June had also been interested in the university arboretum since her earliest years at Davis. In 1971 when the university suffered a severe cut-back in its budget, the arboretum was especially hard hit. Aside from funding for maintenance by the Grounds Division, its budget was completely eliminated. Many in Davis—townspeople as well as the campus community—were deeply concerned and quickly rallied to express support and decide on appropriate action. Shortly thereafter, the Friends of the Davis Arboretum was born. Today it is the largest support group on campus, with nearly 1,000 members. From its inception June was actively involved, serving as its first membership chairman.

Twenty years later, the Herbarium also faced a difficult period financially, although by no means as severe. Grady Webster had become its emeritus director with no replacement in sight, June was fast approaching retirement herself, and the budget had been reduced. The herbarium's future looked increasingly grim.

Again a support group was formed, this one called the Davis Herbaria Society. At its inception in 1991, its first members included Grady Webster, June, and Larry Mitich, a weed scientist hired in the 1970s and a very strong supporter of the herbarium. Others soon joined the founding trio, and within a year or so the new organization was functioning vigorously with Larry as the first president. June agreed to continue in the herbarium on a volunteer, part-time basis, and for the next four years kept things operating as smoothly as possible. The new director and curator, Ellen Dean, was eventually appointed and began work on July 1, 1995.

In addition to her many years of work at the herbarium, during the 1970s June also became involved in environmental education events sponsored by the arboretum. Fol-

lowing the arboretum's 1971–72 crisis, its policies and programs underwent a marked change, due to new personnel (notably Warren Roberts, Superintendent) and the influence of the Friends. As the objectives of the group began to jell, a series of new programs was initiated: environmental education, plant propagation for an annual plant sale, and events for the general public such as visits to parks and gardens of the region.

June's special interest in these events led her to participate as organizer and tour leader. Beginning in a small way, the trips soon became more ambitious. Eventually, working with travel agencies, she organized and conducted a number of longer and more elaborate tours. The following list includes the major ones: Santa Barbara, CA, 1982; Southern California, 1983; Hawaii, 1984; Canada, 1985; Mid-Atlantic states, 1986; Hawaii, 1988; Costa Rica, 1990; Catalina Island, 1991; Texas, 1992; Scandinavia and Russia, 1994; Atlantic Seaboard, Charleston to Montreal, 1995; and New Zealand, 1996.

In the summer of 1985, June participated in a very different kind of tour, a University of California research expedition to Greece led by Professor Louis Grivetti, a cultural nutritionist at UC Davis. His broad objective was to study the food habits in rural Greece. With a team of 10 other participants, June collected and pressed plants for 135 miles along the Peloponnesus Peninsula. Approximately 2,500 specimens were brought back to the herbarium, where June worked on them as time permitted. For June it was a frequently exhausting but tremendously exhilarating experience. Today the task of identifying all of them is still far from complete.

As a scientific staff member in the University, June's position was in the museum scientist classification, and eventually she rose to the highest rank, principal museum sci-

entist. This achievement was due not merely to her length of service at the University or her seniority in the UC system, but by virtue of her truly superior performance and outstanding accomplishments. At the time, she was the only faculty member in the plant sciences department at UC Davis to have attained that level.

Always quiet and unassuming, and never one to seek the spotlight, the recognition that June eventually received was clearly earned—by years of dedicated service, performance of sterling quality, and a willingness to help in many ways, on innumerable occasions. The following awards and honors were richly deserved:

- Outstanding Performance Award, Botany Department, UCD, 1974, 1987.
- Selected (as one of 18 participants nationwide) to attend a workshop on Developing, Managing, and Maintaining Collections at the Smithsonian Institution, Washington, DC, 1977.
- Award of Excellence, California Weed Society, 1985.
- Oral History in the Women in Botany Project: "June McCaskill, Herbarium Scientist, University of California, Davis," 1989. Regional Oral History Office, Bancroft Library, UC Berkeley.
- Award of Distinction, College of Agricultural and Environmental Sciences, 1991.

The last, a highly prestigious award, represents the ultimate recognition of an outstanding career of service to scientific agriculture—that field of endeavor that formed the historical roots of our campus, and which still remains today a major field of inquiry for the foreseeable future.

John Tucker, Plant Biology, One Shields Ave., University of California, Davis, CA 95616



Katherine Layne Curran Brandegee. Photographer unknown, its use courtesy of the University Herbarium Archives, University of California, Berkeley.

KATHERINE LAYNE CURRAN BRANDEGEE, AN UNCOMPROMISING REBEL

by Elizabeth Rush

When Dr. Katherine Layne Curran (later Brandegee) became curator of the herbarium at the California Academy of Sciences in 1883, the collection, she said, was in shocking condition. The Academy president, Harvey Harkness, put it bluntly. “Our herbarium was nearly destroyed by insects and almost entirely useless for lack of classification. Many of our valuable books...had been stolen from us. Our publications having ceased in 1878, our exchanges...had greatly diminished and were dwindling daily.”¹

¹ Selected references are provided at the end of the article; contact the author for a complete list of references and sources for quotes.

The new curator quickly turned things around. She understood the rigors of the scientific method and was determined to make western botany a respectable science. As a medical student she had studied botany with Dr. Hans Behr, who backed her for the position of curator when Dr. Albert Kellogg retired. At the time she took over at the Academy, it was (however inadequately) the center of botanical research in the West, since the University of California herbarium was not established until later in the decade.

In addition to setting the herbarium to rights and collecting specimens, Curran (Kate) began the

task of bringing some order to the institution’s publications. The old journal, *The Proceedings*, had been put out sporadically with a recent twelve-year gap in publication. The prevalent custom in the West was to “publish” new species at oral meetings with print publication occurring years later, and the delays confused the assigning of priority to the discoverers. It was a time when, to quote the late Dr. Lincoln Constance, emeritus professor of Botany at the University of California, “Publication was simply random and anything that came in off the landscape was published. There was very little critical sense involved. It was before people were doing

monographs much. They were simply hauling in novelties and the concentration was on that.”

Curran was appalled by this state of affairs, and within a few months, the incipient *Bulletin of the California Academy of Sciences* was published. She took on the task of determining the correct status of species previously described in *The Proceedings* and wrote up her findings in the first volume of the new *Bulletin*. As acting editor she established the policy of scrupulous review of manuscripts and of going to press on time. Although she produced the *Bulletin* almost single-handedly, she was listed only as “acting editor.” After all, a woman’s name as editor would have resulted in a loss of prestige—and subscriptions. In spite of this, as “acting editor” she succeeded in bringing about—without confrontation—a creditable West Coast vehicle for the naming of new species, a process that previously had been routed through the eastern hegemony of Asa Gray at Harvard. Botanist William A. Setchell said of Curran, “She had little patience with careless untidiness and her eye caught and held distinctions of importance. She believed in public reproof of errors and attitudes of mind contrary to her own idea of scientific accuracy and methods.”

Lincoln Constance agreed. “Much of her attention was devoted to chopping Greene [botanist Edward Lee Greene, a species “splitter”] into small pieces, which probably was fun. She was very good, no doubt about it. She was a very observant student and critic. The sort of thing she did is exhibited in the herbarium. For example, she anticipated in a sense some of the later work that was done with what we now call *Clarkia*, which was then called *Godetia*. She would mount, say, 20 flowers on the same sheet showing different patterns. Those were eventually shown to be in part genetically determined and led to a lot of modern research. She antici-



University Herbarium (UC) collection of California poppy flowers from the Brandegee herbarium, showing the artistry of Kate’s collections. Label information: “*Eschscholzia californica* Cham.; Lake Mead, San Francisco; Katherine Brandegee; May 1908.” Use of image courtesy of the University Herbarium Archives, UC Berkeley.

pated some of that. It was that kind of thing that I think of her as being particularly good for.”

She was in tune with Asa Gray’s evolutionary ideas at a time when many of her contemporaries were not. Dr. A. Hunter Dupree, Gray’s biographer, wrote of her, “She made systematic studies, with careful attention to variation and stages of development, of many families of California flowering plants. Her contributions to the herbarium carry, by means of the labels and the specimens themselves, a record of her research from which later generations can profit.”

Kate’s contributions to the

University Herbarium at Berkeley were enormous both in size and in quality. She and her second husband, Townshend Stith “Townie” Brandegee, gave some 100,000 plant specimens to the herbarium, doubling the size of the collection and giving it the most complete representation of Pacific Coast flora in the West. She collected indefatigably in almost every county in California, in parts of Nevada, and on one occasion in Baja, California.

She wrote to Townie from one of her collecting trips, “I am going this morning to be camped alone, at an altitude of 10,000 feet on Mt. Silliman. I will finish this letter when



University Herbarium (UC) collection of California poppy from the Brandegee herbarium, including disks below flowers and developing fruits, showing Kate's attention to variability within populations. Label information: "*Eschscholzia californica* Cham.; San Francisco; Katherine Brandegee; April—July 1909." Use of image courtesy of the University Herbarium Archives, UC Berkeley.

I get there and can judge how long I will remain, but I think not more than a week. As soon as my plants are dry, on my return I will leave here and walk towards the valley, and then go to San Francisco." In a previous letter she had written, "There are numerous bears in these mountains, many mountain lions, and an occasional gray wolf, but I am assured they will be much more alarmed at me than I at them. There are also coyotes that have a very different cry from any I have heard

before."

Her marriage to Townshend Brandegee in 1889 was the beginning of a remarkable collaboration that lasted until her death 31 years later. She wrote to her sister, "I have fallen insantly in love." That feeling persisted over the years. Brandegee, a Yale educated engineer, was also an avid plant scientist and collector. For their honeymoon the couple walked from San Diego to San Francisco, botanizing all the way. Townie had an independent

income, enough to allow Kate to resign the curatorship in 1894 and devote herself (along with her husband) to the collection and study of plants. Before she retired she recruited Alice Eastwood as her replacement.

The Brandegees moved to San Diego (Townshend was particularly interested in the flora of Baja, California and Mexico) where they established an herbarium, a library, and a large native plant garden.

Dr. Albert W.C.T. Herre wrote of them, "They kept many plants under observation for years, plants gathered from a wide variety of environments. Often they were new species or seemed to be, but they would not publish them until they found out how those plants behaved in another environment. They made every effort to trace all variants and get their real relationship."

Botanist Marcus Jones described Kate as an uncompromising rebel and her relationship to Townie as droll—robust, red-blooded, aggressive Kate passionately in love with small, quiet, retiring Townie. But Jones said, "...the stimulus of being united to a man with the commanding intellect of Brandegee was just the necessary tonic his wife needed..." Perhaps that stimulus was not quite sufficient, because in 1906 the Brandegees moved to Berkeley to be close to a center of botanical activity. There they worked in the herbarium at the University of California until they died—she in 1920 and Townie five years later.

At the time of her death she was said to be better equipped than any other botanist to prepare a flora of California. Marcus Jones wrote that her memory was so prodigious that she carried most of her vast reservoir of information in her head and, "when the hand of death struck all was lost....Her worst sin was excessive caution, which led her to put off publication too long. We could



Kate Brandegee and her guinea hen. According to the back of the photograph, "Lincoln [Constance] says Setchell [UC Professor] said that when the guinea hen died, Kate couldn't bear to stay in San Diego without it, so the Brandegees and their herbarium came north eventually to UC." Photographer unknown, its use courtesy of the University Herbarium Archives, UC Berkeley.

do without 90% of published stuff and not miss it, but not hers." Townie said jokingly that if his wife ever wrote a flora of California, it would probably contain only one lumped species. Though her one-species flora was not forthcoming, her many specimen sheets are still in use: their pristine beauty belies the hundred years since their collection.

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VERNAL POOL AND GRASSLAND RESOURCES

Compiled by Carol W. Witham

BOOKS

Unfortunately, there are no books about vernal pools geared toward beginners. Most of the available literature is in technical journals and symposium proceedings, many of which are out-of-print. For those interested in vernal pools, I recommend the following:

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Witham, C.W., E.T. Bauder, D. Belk, W.R. Ferren Jr., and R. Ornduff, eds. 1998. *Ecology, conservation, and management of vernal pool ecosystems: Proceedings from 1996 conference*. California Native Plant Society. Sacramento, CA. Also available at www.cnps.org/vernalpools/contents.htm.

WEBSITES

There are a wealth of websites about vernal pools and the unique species that occupy them.

General Information

www.vernalpools.org. California Vernal Pools, a collection of information and resources. A one-stop-shopping site for information on vernal pools including places to visit, educational links, conservation, law, and publications.

http://ceres.ca.gov/wetlands/whats_new/vernal_sjq.html. Vernal Pools: Their History and Status in California's Central Valley. California Wetlands Information System, The California Environmental Resources Evaluation System, State of California.

www.epa.gov/owow/wetlands/types/vernal.html. Vernal Pools. US Environmental Protection Agency.

www.nmnbsi.edu/botany/projects/cpd/na/na16g.htm. Vernal Pools of California, USA, and Baja California, Mexico. North American Regional Centre of Endemism.

www.worldwildlife.org/wildworld/profiles/terrestrial/na/na0801_full.html. California Central Valley Grasslands. World Wildlife Federation.

www.faultline.org/place/2001/07/vernalpools1.html. California's Vernal Pools. Joe Eaton, Faultline Magazine.

Regional Information

www.stanford.edu/~rawlings/pool.htm. A Different Type of Wetland in the South Bay. Valerie L. Layne, Santa Clara Valley Chapter, California Native Plant Society.

www.becnet.org/vernalpool.html. Butte County Vernal Pools: An Endangered Habitat. Butte Environmental Council, Chico.

<http://tchester.org/srp/vp/index.html>. Vernal Pools of the Santa Rosa Plateau. Tom Chester.

www-rohan.sdsu.edu/~etbauder/Photos/index.html. San Diego's Vernal Pools. Ellen T. Bauder, San Diego State University.

<http://nrs.ucdavis.edu/jepson.html>. Jepson Prairie Reserve, Solano County. University of California Davis, Natural Reserve System.

www.cnlm.org/pixley.html. Pixley Vernal Pools, Tulare County. Center for Natural Lands Management.

www.tnccalifornia.org/our_proj/lassen/vina/vina.asp. Vina Plains Preserve, Tehama County. The Nature Conservancy of California.

Education: Kids

www.sacsplash.org/mather.htm. Mather Kids Web. A fifth grade curriculum by Sacramento Splash, Sacramento.

www.wildbynature.org/vernal.html. Vernal Pools. Wild by Nature, Environmental Education for Youth.

Education: Teachers

www.sacsplash.org/. Life in Our Watershed: Investigating Vernal Pools. A fifth-grade curriculum by Sacramento Splash, Sacramento.

<http://projects.edtech.sandi.net/miramesa/vernalpools/teacher.html>. Vernal Pools Curriculum of the San Diego Unified School District. Geared to high school biology or ecology courses.

Animals and Plants

www.vernalpools.org/species.htm. Animals and Plants of Vernal Pools. A collection of internet links on both common and rare species.

www.vernalpools.org/jepson/jepson.htm. Jepson Prairie Wildflowers. An interactive plant identification tutorial for the Jepson Prairie docent program, Solano County.

www.sacsplash.org/mather.htm. Mather Kids Web. A fifth grade curriculum by Sacramento Splash, Sacramento.



Downingia cuspidata. Illustration used with permission from *The Jepson Manual*.

GROWING NATIVES: RESOURCES FOR GROWING FERNS

Compiled by Linda Ann Vorobik

Selected information and resources from the Internet about growing ferns and fern allies is presented below. Growing ferns from spores can be an interesting hobby or school project. Don't forget to check the California Native Plant Society (CNPS) website page, http://www.cnps.org/links/grow_links.htm, for links to websites with information and resources for growing native plants. If you are interested in growing a specific fern, search for it by name on the Web or look for it at your local CNPS plant sale.

<http://amerfernsoc.org/growfrnc.html>. The American Fern Society. This site has a wealth of information about ferns and their relatives, including instructions for growing ferns from spores. If you

have had success with growing ferns, the American Fern Society would like to hear from you. If you are interested in either growing ferns from spores or collecting fresh spores for the American Fern Society, see their webpage, <http://amerfernsoc.org/sporexyy.html>.

<http://www.sdfern.com/>. The San Diego Fern Society. Included here is a page on growing ferns as well as descriptions, plant and spore resources, fern societies worldwide, book resources, event listing, and fern-related links. There is much useful information at this site, although most of the information here is not confined to native plants.

<http://hardyfernlibrary.com/ferns/>. Hardy Fern Library. This site is not for gardeners per se, but contains images and descriptions of a great num-

COLLECTING SPORES

Adapted from the American Fern Society Website

To grow ferns you first need to collect spores. In most cases, spores are dropped from sporangia located on the underside of the frond [leaf], appearing as brown colored spots or lines. In temperate regions, the best time to collect [with the appropriate permission] is late summer. Place the frond or piece of frond between two pieces of paper, and protect from damage. Next, lay the frond in a warm, dry, and draft-free area for about 1-2 weeks. Then, carefully open the two pieces of paper and remove the dried up remains of the frond. You will see (if the frond was fertile) a collection of debris and spores. To separate the debris from the spores, hold the paper at an angle and tap the paper; the debris is lighter and less sticky than the spores and will fall first. The spores are the "dust" that remains slightly stuck to the paper. Finally, fold the paper in half and tap more vigorously to collect the spores into the fold for easier planting.



Licorice fern (*Polypodium glycyrrhiza*), is native to the coastal regions from Alaska south to California, and will grow in moist, shady spots in the garden with leaf mold and summer watering. Illustration by L. Vorobik.

ber of ferns that are useful for determining the most suitable ferns for different locations. It also includes glossaries and a wealth of illustrations.

<http://www.ces.uga.edu/pubcd/B737-w.htm>. Growing Ferns, Prepared by P.A. Thomas and M.P. Garber, Cooperative Extension Service, College of Agriculture and Environmental Sciences, The University of Georgia. This website includes extensive information about ferns, their life cycle, and both indoor and outdoor horticulture. While it was written for East Coast residents, it has useful information for those of us who live in the west.

NOTES AND COMMENTS

RARE PLANTS

CNPS Inventory Updates

Since the publication of the California Native Plant Society (CNPS) *Inventory of Rare and Endangered Plants of California*, 6th edition, in September 2001, a number of major changes to the taxon entries (i.e. name changes, ranking changes, additions, and deletions) have been identified. To obtain a consensus opinion about these changes, CNPS uses a formal review process (see www.cnps.org/rareplants/inventory/changes/process.htm) in which we consult with the knowledgeable experts in each region of the state. Changes under review and finalized changes are posted each quarter at www.cnps.org/rareplants/inventory/changes/index.htm and disseminated via the Online Inventory. Check periodically to see what changes are happening.

"Postponed" Taxa

During the development of the CNPS *Inventory of Rare and Endangered Plants of California*, 6th edition, over 300 taxa which were considered as possible new additions were "postponed" due to significant taxonomic uncertainty and/or lack of information regarding distribution, abundance, rarity, and/or endangerment (see the list at www.cnps.org/rareplants/inventory/postponed).

If you have data which indicate that any of these taxa deserve inclusion in the CNPS Inventory as a valid, rare taxon, please share it with Misa Ward, Rare Plant Botanist, at mward@cnps.org. We need your help!

WIDE SUPPORT FOR ENVIRONMENT

Several polls taken this spring and early summer show continuing broad support for environmental protection in general, and endangered species protection in particular. This is not new. Polling data has consistently shown strong, consistent support for conservation of resources and biological diversity. However, there remains a broad misconception that the people of the US do not care about the environment and do not trust science or scientists in land use and management decision-making. Neither of these ideas is supported by data. The media and elected officials, who have been known to spread misconceptions about public opinion on the environment, need to be reminded frequently of the public's strong support for the environment.

The data below, from a poll commissioned by the Unified Endangered Species Campaign, should be helpful in reminding and convincing elected officials and the media of these facts when opportunities arise to communicate with them via letters, emails, or faxes. For more data, see similar poll results at <http://www.stopextinction.org/ESA/ESA.cfm?ID=1476&c=21>.

- Nearly all voters (90%) recognize as important that the Endangered Species Act provides a safety net for wildlife, plants, and fish that are on the brink of extinction.
- Understanding the importance of habitat protection, fully 95% of voters agree that one of the most effective ways to protect species

is to protect the places they live.

- Most voters are aware of the Endangered Species Act (ESA), and fully 86% of voters nationwide support it. Even as 69% of voters agree that government is too intrusive in their daily lives, concerns about species protections trump this anti-government view.
- Fully 90% of voters are responsive to the view that they owe it to their children and grandchildren both to be good stewards of the environment, and to avoid causing species to go extinct. They believe people must leave behind a legacy of protecting species and the special places they call home so that future generations can also see animals in the wild.
- Voters view species protection as so important that they are nearly unanimous in their agreement that when the science is uncertain, it is better to err on the side of caution; once a species goes extinct, it is gone forever. They are also very moved by the view that people have a duty to prevent the extinction of species because once they are gone, we cannot bring them back.

In conclusion, while voters believe that the federal government and government regulation are too intrusive in daily life, rather than supporting a rollback in the Endangered Species Act, they favor expending additional resources on species and critical habitat protections. They also believe that allowing species to go extinct is simply not acceptable. Any perception that there is a ground swell of support for weakening the Endangered Species Act is clearly a misperception.

LETTERS TO THE EDITOR

Weeds and *Fremontia* Scope

My congratulations on a great article and editorial on weeds in the

April 2003 *Fremontia* (Volume 31(2):8-12). It was an interesting paraphrase of a Biblical passage and a previous

Fremontia article, an important part of the clarion call for more California Native Plant Society (CNPS) involve-

ment in the ever-increasing problem of invasive plants, micro-organisms, and animals, and it fit in well with the article on "Tree Encroachment on Klamath Mountain Meadows" by M. Murray (Volume 31(2): 13-18). Unfortunately global warming and invasive species seem to be acting synergistically. Hopefully, this article and the discussion at Cal-IPC meetings will augment efforts to increase local level CNPS involvement in these problems.

I feel strongly that this particular issue reinforces the value of *Fremontia* as a publication of general interest to CNPS members as serious students of plant science but not necessarily professionals. Suggestions have been made by people whose opinions I deeply respect, that receipt of *Fremontia* be a cost-saving option, or that "professional" and/or other levels of CNPS membership be offered. I respectfully disagree with these suggestions.

One of the many aspects of CNPS I appreciate most is the camaraderie among members of widely differing levels of formal natural science education. The late George Clark, with a PhD in biochemistry; George Stevens, like me, with an MD, and Bill Jenkins, Dave Magney, and Rick Burgess, without initial botany degrees, have all made important contributions to our society.

Dirk Walters once described CNPS as "a general nature organization with a particular interest in native plants." We are ONE society, united by our love of plants, especially California natives, and not divided by our levels of training! In my opinion, *Fremontia* serves as an important bridge between the truly technical

publications, such as *Madrono* and *American Journal of Botany* among others, and general nature publications, such as *National Geographic* and *Smithsonian*.

Charlie Blair
San Luis Obispo Chapter

To Educate or Activate?

In the old days, *Audubon Magazine* was famous for being perhaps the most beautiful nature magazine in the US and as such served the National Audubon Society (NAS) in two important ways. First, by showcasing America's spectacular birds it awakened in many a latent interest in bird life. As Audubon members, we became committed conservationists, ready to support NAS at whatever level felt comfortable year after year.

Second, by educating us about America's fascinating bird life, we became hooked on learning even more and gradually many of us became amateur ornithologists. We were the organization's collective eyes and ears that brought conservation concerns backed by local knowledge to the forefront. The core activists used our field intelligence to support NAS activities where it would be most effective. Award-winning *Audubon Magazine* contributed both depth and direction to the national organization.

During the heady days of the 1970s and the increase in environmental activism, the magazine suddenly changed course. I recall reading the first of many issues devoted to the latest activist causes, which bragged that it contained not a single bird picture. Audubon became, I suppose, "required" reading; however, it certainly was no pleasure to read. In subsequent years some bird lovers left

NAS, many with bitter feelings. To this day, we have people wanting to join a local chapter on the condition that they do not have to subscribe to Audubon. In short, NAS floundered, having lost depth and direction, being an advocate of every environmental cause, but a poor one at best.

Then about ten years ago, Audubon's new president successfully struggled to bring NAS back to its original focus on bird and wildlife conservation. The new president accomplished this, in part, by firing many hard core staff activists who had by this time lost any sense of a coordinated long-term mission. Also in place now is a new editor of *Audubon Magazine* who is once again featuring birds and nature.

I share this organizational history with *Fremontia* readers because I hope that the July/October Special Issue of *Fremontia* is not the beginning of a similar trend such as the one that nearly destroyed the National Audubon Society. The latest October 2003 issue also looks on the face of it to be like my beloved *Fremontia* of old, but is lean on plant appreciation and knowledge while long on activist causes.

While I want to be kept informed about these important and timely activities and how I can help, the *CNPS Bulletin* and the state CNPS website can serve this function. For the long-term health of CNPS and of the California flora that depends on us, please assure me that these issues are exceptions, and that through your editorship CNPS will continue to dedicate *Fremontia* exclusively to the appreciation and education of our spectacular flora.

Paul Keller
Channel Islands Chapter

BOOKS RECEIVED

Wild Lilies, Irises, and Grasses: Gardening with California Monocots, by N. Harlow & K. Jakob, editors. 2003. UC Press, Berkeley, CA. 287 pp., with 74 line drawings by

CNPS member, Kristin Jacob (illustrator of CNPS Sierra plants poster), and 58 color photographs. This contains valuable information on exactly which species are best adapted to gar-

den conditions, how to grow them, and where to obtain them from nurseries and mail-order suppliers. A Phyllis M. Faber Book. Price \$24.95, paper.



Red columbine (*Aquilegia formosa* var. *formosa*) from *Columbines*, by R. Nold. Illustration by C. Nelson-Nold, used with permission from Timber Press.

Columbines: *Aquilegia*, *Paraguilegia*, and *Semiaquilegia*, by R. Nold. 2003. Timber Press, Portland, OR. 193 pp., 45 color photographs, and 4 line drawings. This book covers 65 species of *Aquilegia* in detail, with complete descriptions and sprinklings of historical background and ethnobotany. Striking color photographs and Cindy Nelson-Nold's exquisite watercolors brighten the text. Price \$24.95, cloth.

California Desert Wildflowers: An Introduction to Families, Genera, and Species, by S. Morhardt & E. Morhardt. 2003. UC Press, Berkeley, CA. 287 pp., 300 color photographs by the authors, and 45 line drawings. This easy-to-use guide to the most visible families of California desert flowers includes family and genus keys, photographs, and a wealth of diagrams. Created as a primer on identification to family and genus, the book takes readers to a new level of understanding and appreciating wildflower relationships and their habitats and adaptations. A Phyllis M. Faber

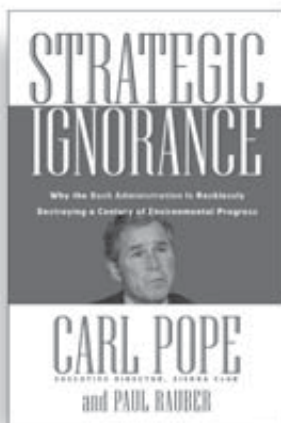
Book. Price \$29.95, paper.

California Natural History Guides. UC Press, Berkeley, has been revising their popular series of books on various aspects of the natural history of California, with new photographs, and revision of text. Congratulations to past *Fremontia* Editor, Phyllis M. Faber, who spearheaded this project. The size for all is a handy 4.5 x 7.25 inches. The series includes:

Introduction to California Desert Wildflowers, by P.A. Munz; edited by D.L. Renshaw and P.M. Faber. Revised, 2004. UC Press, Berkeley. 248 pages, 226 color photographs, 1 map, 111 line drawings. Price \$39.95, cloth; \$16.95, paper.

Introduction to California Spring Wildflowers, by P.A. Munz; edited by D.L. Renshaw and P.M. Faber. Revised, 2004. UC Press, Berkeley. 302 pages, 249 color photographs, 80 line drawings, 2 maps. Price \$39.95, cloth; \$16.95, paper.

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Members and others are invited to submit material for publication in *Fremontia*. Instructions for contributors can be found on the CNPS website, www.cnps.org, or can be requested from *Fremontia* Editor, Linda Ann Vorobik, vorobik@rockisland.com, or c/o University and Jepson Herbaria, 1001 Valley Life Sciences Bldg. #2465, University of California, Berkeley, CA 94720-2465.

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FROM THE EDITOR

From wildflower lover to sage professor of botany, members of the California Native Plant Society (CNPS) join together to revel in, understand, and help protect our native flora. This issue of *Fremontia* reflects the breadth of our society and its varied goals, in that articles range from information on vernal pools (new research) and ferns (literature research) to memories of friends who have left us.

Carol Witham offers the guest editorial and lead article, with coauthor Michael Barbour, to update our understanding of vernal pools and the annual grasslands within which these pools occur. Barbour and Witham explain how pools are sampled for diversity of vegetation, and share their preliminary findings: these pools are

indeed like snowflakes, with no two alike. In fact, in their study they found up to 50 different plant associations. In the next article, Guenther Machol presents stories, images, and diagrams that help to unravel the intricacies of fern reproduction, from spore to plant and back to spore again.

For those in search of less technical reading, the last three articles honor several individuals who made major although very different contributions in support of California botany. First is an article remembering Rudolf and Lois Fink by their daughter, Falene Hamilton. Not only did the Finks inspire a love for native plants in their family and others, but they generously supported the CNPS publication program, ultimately resulting in the publication of the re-

vised Mt. Diablo flora. Next, the late June McCaskill, who was curator of the herbarium at UC Davis, is remembered by her fellow faculty member, John Tucker. In the final article, freelance writer Elizabeth Rush paints a personalized portrait of one of California's pioneer botanists, Katherine Brandegee. In it she draws on Brandegee's own letters, as well as impressions from the botanist's professional colleagues and friends.

For those whose learning appetite remains unsatisfied, see the back section for Internet and literature resources on vernal pools or growing ferns; for those with views to share, see the letters selection, and if inspired to do so, send me *your* comments.

Linda Ann Vorobik,
Fremontia Editor

CONTRIBUTORS

Michael G. Barbour, PhD, has been a plant ecology faculty member of UC Davis for 35 years and currently is a member of the Environmental Horticulture Department.

Ellen A. Dean, PhD, is current director and curator of the UC Davis Herbarium. She teaches California floristics and ethnobotany, and trains students in herbarium curation and plant collecting.

Falene Hamilton is a board member of the Pennsylvania Native Plant Society and a co-leader of a weekly faculty hiking/x-country skiing club that plans special wildflower hikes in the spring. She is a Mills College graduate, and did graduate work in art history at Stanford University and UC Berkeley.

Guenther K. Machol, PhD, is a retired electrical engineer and a member of the Santa Clara Valley Chapter of the California Native Plant Society.

Elizabeth Rush is a freelance writer who lives in Los Altos Hills, California. She has written for *California Wild*, *Outdoor California*, *Bay Nature*, *Fremontia*, and *Pacific Horticulture*.

John M. Tucker, PhD, is professor emeritus of botany and former director of the J.M. Tucker Herbarium at the University of California, Davis. He has published numerous articles on the genus *Quercus* (oaks), including the taxonomic treatment in *The Jepson Manual*.

Carol W. Witham is a consulting biologist specializing in the endangered plants and animals of vernal pools. She is also currently president of the California Native Plant Society and founder of *VernalPools.org*, a grassroots organization dedicated to saving California's vernal pool landscapes.



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