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## Giants in the Mist

Researching the coast redwood and its unique distribution in the coastal fog belt of California

Anyone taking a trip to the central or northern California coast is in for one of nature's real treats—standing among the world's tallest tree species—coast redwood, *Sequoia sempervirens*. The experience of the redwood forest is memorable for everyone not only because of being able to see the massive size of this tree, but to also enjoy the cool, moist environs of the redwood forest embedded within what is generally considered a hot and dry Mediterranean climatic zone. It is this very experience as well as the fact that only 3-4% of the original coast redwood forest remains today that has motivated our ecological research on redwood trees and the forests they compose.

Many researchers have noted that redwoods occupy a narrow strip along the California coast, rarely straying far from the fog belt. One overall goal of our research is to understand the role of fog and of climatic variation (El Niño-La Niña cycles) in the water, carbon and nutrient relations of these massive trees and the forests they inhabit. Work we have already published shows that fog can comprise 30-40+% of the total annual water used by redwoods. Fog drip from redwood canopies contributes between 40-100% of the water used by the understory plants in summer such as the redwood sorrel, *Oxalis oregana* and the sword fern, *Polystichum munitum*.

You may have been drenched by “rain” under redwoods on a foggy morning. This “fog drip” occurs because water accumulates on redwood needles as they are impacted by fog droplets. It turns out that redwoods are excellent fog-interception surfaces. We found that removing the trees from an area can cause a 50 percent or greater decline in water inputs from fog. This loss of water input during the critical summer months can lead to much lower stream flow and ground



Photo courtesy of Humboldt State University, Puritan Collection

Organizations such as the Save-the-Redwoods-League (1917) were founded to save old growth redwood forests from unchecked logging.

water levels in the region. Since water essentially “drives” many other key cycles in this ecosystem, the loss of the redwood trees and the water they help to capture from fog has an impact on the entire ecosystem's function.

In addition to creating fog drip, fog also contributes directly to the redwood water supply. Redwood canopies can directly absorb fog, which raises many questions about how this water source influences the growth and carbon relations of this tree species. For example, is this one reason they grow so tall? Another question is whether direct absorption of water by leaves indirectly influences their nutrient relations. Why? Because there are significant amounts of nutrients dissolved in the fog, such as nitrogen, and so an important question we hope to answer is, can redwood foliage absorb

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## Stable Isotope Analysis of Water and Redwood Research.

Isotopes are atoms of the same element with different masses. Their masses differ because they have different numbers of neutrons in their nuclei. Atoms are classified as the same element when their atomic nuclei have the same number of protons. Naturally occurring isotopes come in two flavors: stable and unstable (radioactive). You have probably heard a lot about unstable isotopes. That is because atoms of unstable isotopes decay by losing protons, and loose protons wreak havoc with biological molecules such as DNA, making radioactive emissions biologically hazardous. Stable isotopes, on the other hand, do not decay and are therefore not radioactive. The non-radioactive isotopes of each element are less notorious, but far more abundant and important to life on earth. Indeed, we are all com-

posed of various combinations of stable isotopes of different elements such as hydrogen, carbon, nitrogen, oxygen, and phosphorus.

In the center for Stable Isotope Biogeochemistry, housed in the Valley Life Sciences Building on the UC Berkeley campus, we can measure the ratio of the natural abundance of the heavy and light stable isotopes in water (as either hydrogen [ $2\text{H}/\text{H}$ ] or oxygen [ $18\text{O}/16\text{O}$ ]). These measurements made on any given sample (e.g., rain water, fog drip, ground water) provide us with a powerful tool for identifying the origin of that water source. For the coastal redwood forest system, it has proven useful for our work to know that fog and rainfall have very different H or O isotope ratios. These can be thought of almost like a “fingerprint”. Because plants do not change

(fractionate) the isotope ratios of water during the uptake process, if one characterizes the isotopic “fingerprint” in waters that might be used by plants and then also measures the isotope ratio in the water extracted from the plant’s sap, one can determine the water sources used by the vegetation. For our purposes, this has permitted us to not only determine that plants in fact use fog drip as a water source, but to quantify how much. Our studies indicate that redwood trees get between 8–43% of their water from fog drip. Understory plants get, on average, about 66% of their water in summer from fog drip but in the drier, El Niño years, this can increase to 100%. These data indicate that fog is not only an important water input, but a critical water source for the plants of the coastal redwood forest.

*(continued from page 1)*

nutrients too?

To answer these and other questions pertinent to water relations theory, postdoctoral researcher Dr. Steve Burgess and I are using sapflow, stable isotope analyses (see side bar) and other physiological measurements to document the role of fog in the redwood’s functional ecology. This work is running in parallel to work being done by Drs. Steve Sillet of Humboldt State University and George Koch of Northern Arizona University on what leads to dieback in large redwood canopies. Along a second front, we are extending our work on fog water inputs to the ecosystem scale and asking how these inputs and the nutrients contained in them are influencing the ways in which water, carbon and nitrogen cycle within the redwood forest. Here we are looking at inputs, fluxes and fates of water, carbon and nitrogen along a natural coast-to-inland fog gradient. This research is being done in collaboration with Professor Mary Firestone in the Ecosystem Science Division at UC Berkeley and Drs. Kathie Weathers at the Institute of Ecosystem Studies, N.Y. and Stefania Mambelli at the Center for Stable Isotope Biogeochemistry, UC Berkeley. We also hope to be able to

manipulate inputs in field and glass house experiments. I believe our work has clear conservation and forest management implications.

We are also analyzing variation in tree-ring dimensions and stable oxygen-isotope composition to reconstruct the growth and physiological histories of individual redwood trees. These data also yield information about past climatic changes, especially the El Niño-La Niña cycles within coastal California. This work is being done with Professor John Roden at Southern Oregon University and Jim Johnstone, a graduate student at UC Berkeley.

Linked to the tree ring research above is a keen interest within my research group in understanding why all of the taxa of the redwood family (Taxodiaceae) have undergone such dramatic reductions in their current biogeographical ranges when once they covered vast areas of North America, Asia, and both northern and central Europe. As already mentioned, today coast redwood is restricted to a narrow band from the California-Oregon border to the southern Santa Lucia Mountains. However, fossil data show that it was once abundant and dominant through out much of the western United States and Asia. Interestingly, this kind of range

## DIRECTOR'S COLUMN

*I go to nature to be soothed and healed, and to have my senses put in order.*

—John Burroughs

On September 11th, 2001, American's perception of the world underwent a seismic shift. The world now seems much smaller, as we join much of the rest of humanity who possess the tired wisdom of long having known terrorism in their own countries. These recent national and global events have led many Americans to greater introspection and fostered a desire for connection—with home, family, friends, and neighbors.

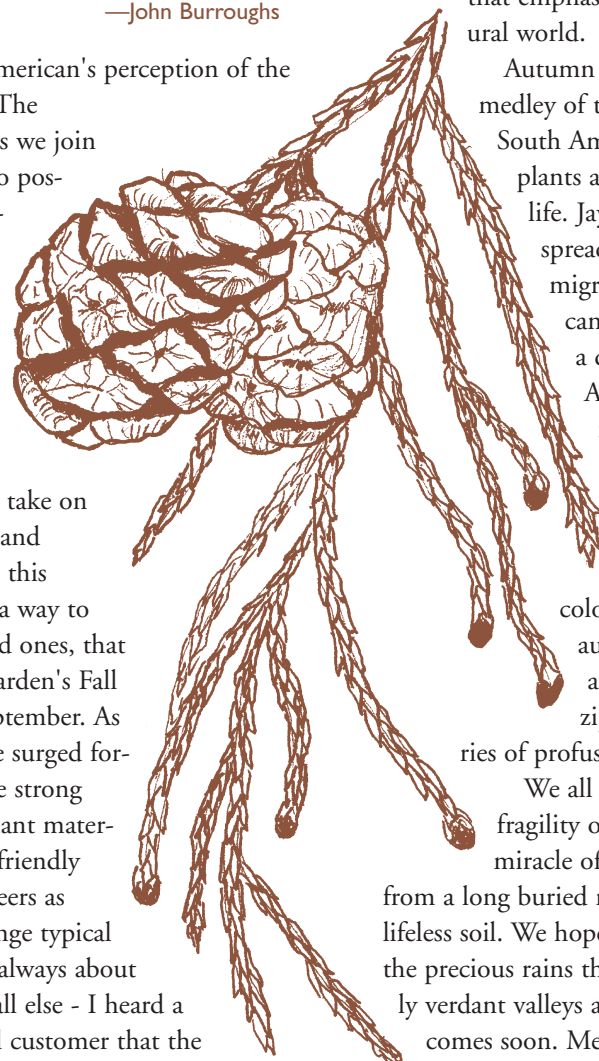
At times like this, our gardens take on greater meaning as places for rest and peaceful reflection. Perhaps it was this renewed interest in gardening, as a way to connect with our homes and loved ones, that led to record attendance at the Garden's Fall Plant Sale the last weekend in September. As the gates opened, over 100 people surged forward into the sale. Yet, despite the strong interest and enthusiasm for the plant material, customers were exceptionally friendly and courteous to staff and volunteers as well as to each other. In an exchange typical of UCBG plant sales - which are always about the plants and the people before all else - I heard a volunteer reassuring one potential customer that the plant that had been trampled in her garden may still be living beneath the soil, and recommended that she wait

before purchasing a replacement. The friendly talk of gardens and plants prevailed and provided an atmosphere of calm that emphasized to me the rightful order of the natural world.

Autumn at the UC Botanical Garden offers a medley of textures and moods. In the California, South America, and Mediterranean sections, many plants are dormant, but there is still abundant life. Jays are consuming California bay fruits; spreading the skins about. Mixed flocks of fall migrating birds are moving through tree canopies and woodpeckers probe the bole of a dead oak that fell in a winter storm. In Asia and Eastern North America the early fall provides serene greens, but as bright warm days and cool crisp nights stimulate senescence, these give way to vivid leaf displays that rival the native range. However, by far the most colorful and lively section of the Garden in autumn is the Mexican/Central American area. It is full of fearless hummingbirds zipping around defending valuable territories of profusely blooming salvias and penstemons.

We all share the same terrible knowledge of the fragility of life. It is reassuring to focus on the miracle of a seedling, or a tender sprout arising from a long buried root, to see life spring from the seemingly lifeless soil. We hope soon to see renewal in the coming of the precious rains that will again coax life from our seasonally verdant valleys and hills. Let us hope that peace, too, comes soon. Meanwhile, let us all seek solace and reflection in gardens.

—Ellen Simms



*Sequoiadendron giganteum* drawing by UCBG horticulturist Judith Finn.

reduction is also seen today in both the dawn redwood (*Metasequoia glyptostroboides*), and the sierra big tree or giant sequoia (*Sequoiadendron giganteum*). We would like to know why these species once had such broad ecological ranges but are much more restricted in where they live today. To answer this question we are involved in a comparative investigation of the living Taxodiaceae. The aim here is to better understand the link between their unique physiology and their current and past ecological distributions. We are therefore

addressing how physiology may have or have not changed as this very ancient group has 'seen' major climatic shifts during its long history on Earth. We hope this information will lend some insight into interpreting how changes through time may be linked to changes in climate, physiology and distribution.

—Todd E. Dawson, Associate Professor,  
Department of Integrative Biology, UC Berkeley; Director,  
Center for Stable Isotope Biogeochemistry, UC Berkeley

## The History of Redwoods in the UCBG Collection

### Famous Evolutionary Link

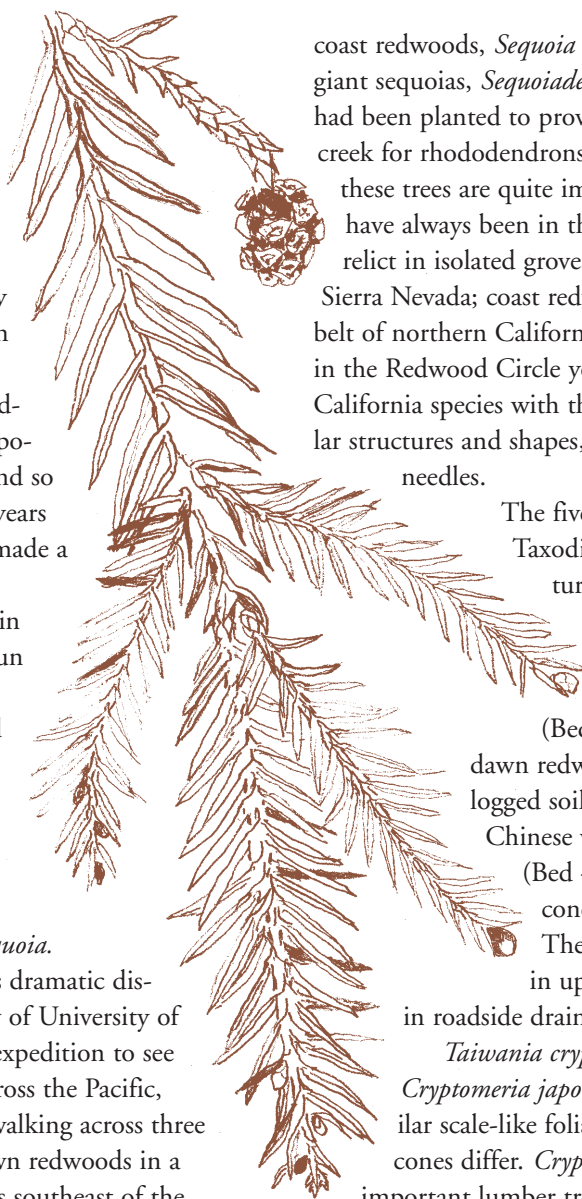
The dawn redwood, *Metasequoia glyptostroboides* (Bed #245A), is a "living fossil" link to the evolutionary past. For many years the fossil redwoods from around the Northern Hemisphere were thought to be sequoias, closely related to the coast redwood. But in 1941 Dr. Shigeru Miki noted that fossils from Japan, previously considered to be sequoia samples, had opposite rather than alternate needles, and so he named this *Metasequoia*. Three years later, a Chinese forester, T. Wang, made a historic botanical discovery.

At this time the Szechwan area in China was quite isolated and overrun with bandits. To improve wartime communication with the provincial capital, a road was built into the area. Wang followed this road to a formerly isolated village and came upon an enormous tree. On close comparison, the tree turned out to match exactly the fossils of *Metasequoia*.

Botanists were thrilled with this dramatic discovery and soon Dr. Ralph Chaney of University of California, Berkeley, organized an expedition to see these amazing trees. After flying across the Pacific, traveling down river by boat, and walking across three mountain ranges, he found the dawn redwoods in a sandstone soil valley about 40 miles southeast of the Yangtze River. He collected seeds and seedlings: only the third set to be returned to the United States for propagation. Fifty-four years after this pilgrimage into the backcountry of China, we now have five healthy trees, elegant in leaf and form, a fitting centerpiece to the Redwood Circle.

### Local and Exotic Redwoods

But the dawn redwoods were not the first trees to form the Redwood Circle. A few years earlier our local



coast redwoods, *Sequoia sempervirens* (Bed #248), and giant sequoias, *Sequoiadendron giganteum* (Bed #245D), had been planted to provide moist conditions by the creek for rhododendrons. Though only 56 years old, these trees are quite impressive, and look as if they have always been in the canyon. Giant sequoias are relict in isolated groves on the western slope of the Sierra Nevada; coast redwoods are limited to the fog belt of northern California and southern Oregon. Here in the Redwood Circle you can compare these two California species with the dawn redwood and see similar structures and shapes, especially in the cones and needles.

The five other members of the Taxodiaceae in the Garden have features that also show taxonomic relationship. From the southeastern U.S. comes the bald cypress, *Taxodium distichum* (Bed #302), deciduous like the dawn redwood, that prefers almost waterlogged soil. We also have a specimen of Chinese water pine, *Glyptostrobus pensilis* (Bed #245D), a close relative with cones of different shape and size. These, like the bald cypress, grow in up to a foot of water and do well in roadside drainage channels.

*Taiwania cryptomerioides* (Bed #245C) and *Cryptomeria japonica* (Bed #246) have quite similar scale-like foliage when mature but their cones differ. *Cryptomeria* or Japanese cedar is an important lumber tree in Japan and is widely planted there. Here in California stands of *Cryptomeria* have been selected for forest restoration projects because of their similarity to coast redwoods and their long taproot. Probably the most unusual-looking member of the group is the Japanese umbrella tree, *Sciadopitys verticillata* (Bed #246), with its whorled leaves that resemble the ribs of an umbrella.

—Stephanie Kaza (with edits by Janet Williams)  
Excerpted from, *The Redwood Family Tree*,  
UCBG Newsletter Summer 1988

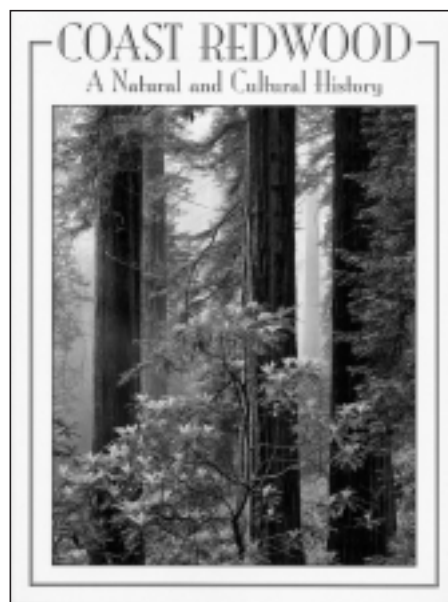
## BOOK REVIEW

*Coast Redwood: A Natural and Cultural History*, ed. by John Evarts and Marjorie Popper; written by Michael Barbour, Sandy Lydon, Mark Borchert, Marjorie Popper, Valerie Whitworth and John Evarts; Cachuma Press, Los Olivos, CA, ©2001; b/w & color photos; drawings; map; appendices; bibliography; index; 240 pp.; cloth, \$36.95, paper \$25.95.

There is no better time than the beginning of the second millennium to publish a book about the natural and cultural history of a tree with an individual life span of over 2,000 years and an extensive family history going back to its earliest ancestors in the Cretaceous period 135 to 65 million years ago. *Coast Redwood: A Natural and Cultural History* is a comprehensive and beautifully illustrated survey of the botany, ecology and conservation of these famous trees and their place in California today.

The coast redwood is one of over 600 species of conifers worldwide. It belongs to the Taxodiaceae family whose members are characterized by large, long-lived, fast growing trees with reddish trunks and thick, fibrous bark. Taxodiaceae contains 10 genera and 17 species, all of which, with the exception of Tasmanian cedar, are scattered over the northern hemisphere. Each genus appears on only one continent and contains one to three species.

The coast redwood written records began only 232 years ago. Father Juan



Crespi, travelling from San Diego to Monterey Bay in 1769, wrote about the 'palo colorado'—red wood—discovered near the Santa Cruz mountains. It was 55 years later when, from specimens in Archibald Menzies' collection, (see Book Review Summer 2001) redwood received *Taxodium sempervirens* as its botanical name. Finally, in 1847, it was classified as *Sequoia sempervirens*.

California statehood and rapid commercial development were fueled by the Gold Rush and the wealth ("Sequoia Gold") of a seemingly unlimited supply of lumber from the redwood forests. Until the end of the 19th century, timber harvesting was done by hand with the aid of oxen and horses. The advent of steam engines and the railroad completely revolutionized the industry. In the 20th century chain saws, caterpillar

tractors and then, more recently, helicopters, made it possible to log trees faster than the following second growth forest could regenerate to viable size.

The history of the conservation movement in the United States closely parallels the development of the modern redwood timber industry. Before 1900 far-sighted individuals, observing the chaos following timber harvesting, were working to preserve pristine old growth stands in the Santa Cruz mountains. The Sempervirens Club, founded in 1901, and the Save-the-Redwoods-League, founded in 1917, were formed to save outstanding redwood groves from logging. It is believed that there were 1.6 to 1.9 million acres of virgin redwood forest in 1800.

Today only 75,000 acres, less than 5%, remain. This survey concludes with a view to the future. We have preserved all that we can of the remaining old growth forests. Our job now is to find a way to improve, conserve, and use wisely the forests in private and public care.

The six authors of *Coast Redwood: A Natural and Cultural History* have divided their material into chapters they each know most about. This division leads inevitably to some repetition in background exposition, however, not enough can be said about the breadth and depth of the authors' research. It makes this book a reliable resource as well as a pleasure to read.

— Elly Bade

### Additional Reading on Redwoods

■ *Conifers of California*, by Ronald M. Lanner; illus. by Eugene O. Murman; Cachuma Press, Los Olivos, CA, ©1999; color photos; maps; appendices; bibliography; 274pp.; paper, \$24.95.

■ *Discovered Alive, The Story of the Chinese Redwood*, by William Gittlen; Pierside Publications, Berkeley, CA, ©1998; b/w photos; drawings; map; bibliography; 167pp.; paper, \$14.95.

## Diseases of Redwoods

A search reveals that there are a number of diseases found on redwoods. However, most of those are diseases found in the native habitats of the trees. There are not many diseases found in cultivated redwoods and this may be due in part to the fact that because of the eventual size of the trees, they are not commonly used as landscape plants.

The most common problem in redwoods under cultivation results from infections by the fungus *Botryosphaeria dothidea*. This results in the death of scattered branches through the tree. These sometimes are called "flags". The problem is very common on giant sequoia though it has been recorded on coast redwoods. In giant sequoia, the problem has to do with the effect of higher temperatures on the trees resulting in attack by the fungus. In the Bay Area, it is common and does not do much damage, but giant sequoia cannot be grown in the arboretum at Davis because of this problem. It is of interest to note that trees vary considerably in their response to temperature and the resulting damage done by the fungus. As you approach the two large giant sequoias just across the bridge on the main path toward the Conference Center in the Garden, the tree on the left has quite a few "flags", while the tree on the right has very few. Though pruning the "flags" will improve things aesthetically, it will not control the problem and other branches eventually will become infected.

A less serious problem occurs only on coast redwoods when individual trees develop galls on the branches and twigs. These can vary in size from very small to swellings 6 to 8 inches or larger in size. The problem can be seen in a tree found in a group of redwoods along the creek just west of Haviland Hall on the campus. It also has been found on trees in Mount Tamalpais and Aptos. These galls do not seem to be damaging to the trees, and in experiments by a UC plant pathologist, it was not possible to find any disease-producing organisms in the galls nor was it possible to transmit any

gall-producing entity to other plants. The fact that the tree on the campus with the most galls is in a cluster of other redwoods but none of the others show galls, suggests that the problem is not infectious. Galls should not be confused with burls, which are very large swellings, usually on the lower portions of main trunks.

Both redwoods are susceptible to *Armillaria mellea*, commonly called the oak root fungus. This name is slightly misleading for it suggests that the fungus is a problem on oaks. It is true that it is commonly found in the roots of oak tree, but it rarely damages them unless they are mistreated by poor cultural practices. A main problem is that the fungus prefers dead wood to living wood, so once oak trees or any others that have the fungus in the roots are cut down, the fungus moves through the whole dead root system. The fungus does not grow through the soil and infection can take place only by the root of a susceptible plant contacting a root in which the fungus is active. Once this happens, the fungus will girdle the tree and kill it. Control is not easy and though removal of infected root systems will help, this is difficult for large established trees with extensive root systems.

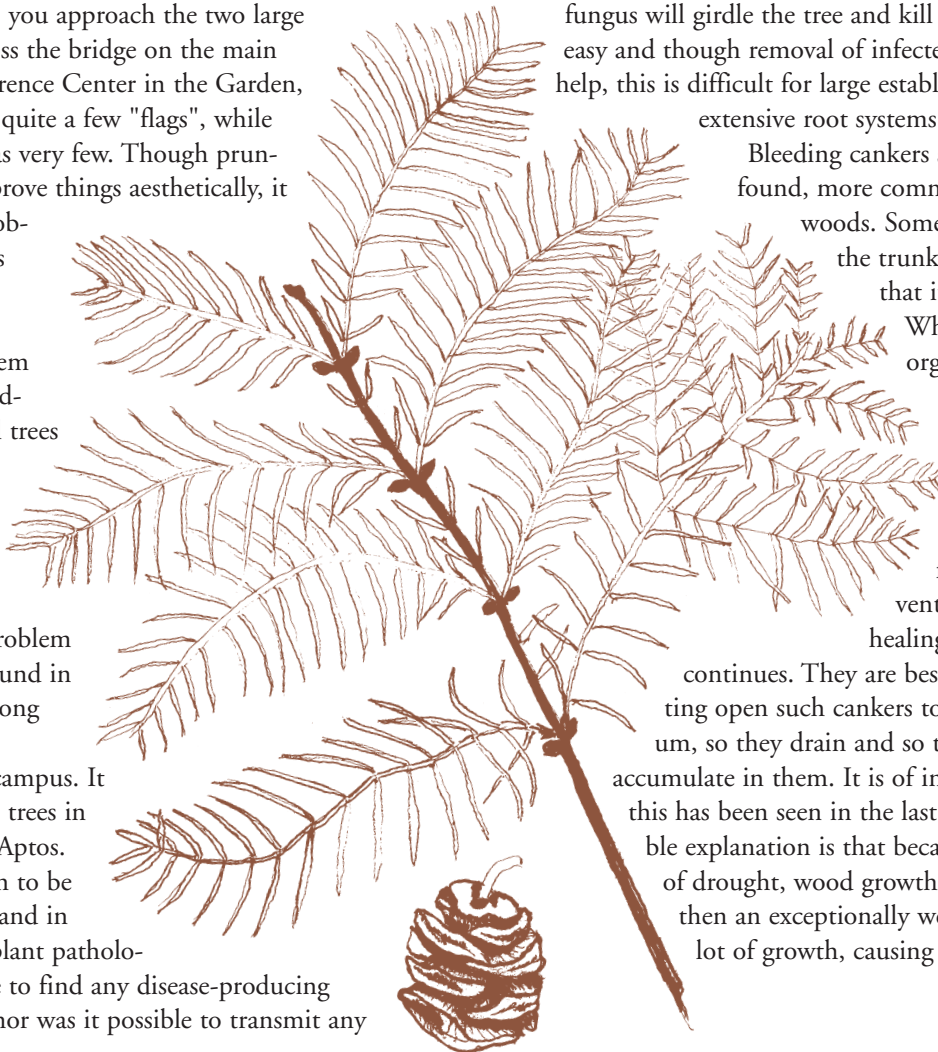
Bleeding cankers sometimes are found, more commonly on coast redwoods. Sometimes a wound in the trunk or a branch is such that it does not dry.

When this occurs, organisms such as bacteria, fungi and yeasts, grow in the sap that collects.

In the process, materials are formed which prevent the cambium from healing so the process

continues. They are best controlled by cutting open such cankers to the good cambium, so they drain and so that water cannot accumulate in them. It is of interest that much of this has been seen in the last few years. A possible explanation is that because of seven years of drought, wood growth was very slow and then an exceptionally wet year resulted in a lot of growth, causing the bark to split.

—Robert D. Raabe



## In Memoriam

*Lincoln Constance*



Photo by Noah Berger

The Garden and larger botanical community were deeply saddened to learn of the death of **Dr. Lincoln Constance**, a highly respected botanist and administrative leader at the University of California, Berkeley. Aged 92, he died in June at Alta Bates Medical Center in Berkeley.

Dr. Constance was a long-term fixture of our Garden community. He kept many plants in the Garden's research greenhouses, which made him a familiar sight in the Garden, strolling through the collections, satchel of research instruments at his side, on his way to work on his plants. He always had a kind word for the staff and a ready willingness to help with identifications in the parsley family (Apiaceae). Several accessions in the Garden were gifts from his research collection, especially in the genus *Eryngium*. A number of rare Californian plant species were named in his honor, including *Arabis constancei* (Constance's rock cress), *Eryngium constancei* (Loch Lomond button-celery), *Lupinus constancei* (the Lassics lupine) and the genus *Constancea* (*Constancea nivenii*, Nevin's woolly sunflower, can be found in the Garden's California Area–Channel Islands beds). He served as acting director of the Garden when Dr. Robert Ornduff was on his many trips abroad. He published *Botany at Berkeley, the First Hundred Years* in 1978, and in 1990 he wrote a three-part history of the Garden for this *Newsletter*.

Born in Eugene, Oregon, on Feb. 16, 1909, Dr. Constance graduated from the University of Oregon in 1930 and entered UC Berkeley as a graduate student in botany. He studied under Willis Linn Jepson, the author of the first systematic survey of California plants.

After obtaining his PhD in botany in 1934, Dr. Constance served as herbarium director at Washington State College (now Washington State University), before returning to UC Berkeley in 1937. He served as Director of the University Herbarium from 1963 to 1975. An inaugural

trustee of the Jepson Herbarium from 1960 until his death, Dr. Constance helped oversee the new edition of Jepson's 1925 *Manual of the Flowering Plants of California*, when it was republished in 1993 as *The Jepson Manual, Higher Plants of California*. Dr. Constance was also the Dean of the College of Letters & Science from 1955 to 1962, and served as Vice Chancellor for Academic Affairs from 1962 to 1965—coinciding with the turbulent free speech years.

After retiring in 1976, Lincoln Constance was an active professor emeritus of Botany; particularly as an expert on plants of the Apiaceae, an economically important group that includes carrots, parsley, fennel and poison hemlock. Throughout his career he contributed to numerous plant manuals, including compendia of the plants of Nevada, Arizona, Texas, Panama, Venezuela and Peru.

A memorial service was held in late October. Lincoln Constance's family requests that donations in his memory be sent to the UC Botanical Garden or the University Herbarium.

*This obituary was taken from a University of California, Berkeley, press release, dated June 11, 2001, written by Robert Sanders, and edited by Holly Forbes.*

*Leonard Skinner*



Photo by Richard Anderson

We are feeling the loss of volunteer **Leonard Skinner**, who passed away in September. Leonard completed Docent Training in 1987, after he retired from his accounting career, and was available for anything and everything in the tour repertoire from that point forward. We often referred to him as "Mr. Docent 100%" because, in addition to taking on endless touring commitments, he volunteered for a myriad of committee duties, including identifying and labeling obscure slides, giving talks for local seniors and garden groups, and serving as Docent Chair. He seemed to know every plant in

*(continued on page 11)*

## UCBG Welcomes New Staff Members



Photo by Janet Williams

**RICHARD HENDERSON**, *Associate Director*

**KIM KASO** joined the UCBG staff as Volunteer and Program Coordinator in September.

Kim is one of the world's most versatile people! She has worked in many different careers—including the US Navy - and lived in many different locations—all over the US and three years residing in the UK. After a college degree majoring in Speech, Drama and English she held several jobs before joining the Navy, where she worked in communications, cryptology, training, recruiting and teaching English Literature. After leaving the Navy she began a career focused on various aspects of volunteerism. All along the way Kim has pursued a love of plants and gardening learned "at her mother's knee" and while roaming the wild woods with her friends as a child. Kim has used her love of gardening as an effective strategy in coping with moving throughout the years, she notes "It is interesting to see the different terrain, and what plants thrive and what plants people try and impose to remake their memories of home. My establishing a garden or maintaining and adding to the one that was already there was always a very important part of our making a home in each new place." She is still adjusting to the different feeling of the seasons here and is enjoying experimenting with her new garden to see what thrives. Kim is excited to join the Garden team and looks forward to working with all of the wonderful people here, staff and volunteers alike; especially helping to create new opportunities for people to share in the Garden. Welcome Kim!

**RICHARD HENDERSON** joined the UCBG team as Associate Director in October.

The Garden is very pleased indeed to welcome Richard Henderson, newly appointed Associate Director. Richard has a longstanding knowledge of the Garden having attended many events here while serving as the Information Technology Director for the Haas School of Business in the early and mid-'90s. Most recently, he has been Associate Provost at the University of the South in Tennessee where he was active in the Herbarium, Landscape Analysis Laboratory and in museum planning programs. Richard's early exposure to the botanical world took place in the "biological paradise" of the Great Smoky Mountains National Park in North Carolina and Tennessee. This grounding taught him to take delight in native plants in their habitat. His attendance at California Native Plant Society meetings in the past will serve him well in his current personal horticultural pursuit: to mix California natives into his home garden. Such plantings to be organized, of course, in his trademark style: according to a prioritized, efficiently organized scheme! Richard plans to put his interest in both plants and system organization to work for the Garden; in addition to his many other duties here, he will be leading the master planning process and institutional capacity building efforts. Welcome Richard!



Photo by Janet Williams

**KIM KASO**, *Volunteer and Program Coordinator*

## EDUCATION AT THE GARDEN

The single largest public outreach by the Garden each year is our rich and growing tour program to northern California school children and to adults from around the world. Seventy-five dedicated, trained docent volunteers share their enthusiasm and rich storehouse of information to almost 10,000 individuals each year. The Garden's docents lead more than 20 different tours, ranging from "First Look at Plants" for kindergarteners, to "Plants through Time" for high school students, to tours for the general visitor.

This year, through the extra effort of docent Bonnie Mackenzie, we undertook a review of who we are serving with our tours for school children. Where do they come from? Is the demand growing? What tours are most in demand?

During the past six school years, docents conducted tours for 23,707 school children, or about 4,000 students each year. Students came from 249 different schools in 58 cities, with the largest number coming from Oakland (74 different schools) and Berkeley (34 schools). The average school came to the Garden three times during the six year period of review.

The most popular tours were Five Senses (4,163 students), Native American Uses of Plants (3,282 students), Flower Walk (3,155 students), and California Habitats (2,596 students). One new tour begun in Spring 1998, Foods of the



Americas, drew 1,999 students during the past three years.

In addition to Garden tours, docents travel to local elementary schools to present "Grocery Store Botany", a one-hour interactive demonstration. In this presentation, docents use vegetables and fruits from the grocery store to teach basic botany and the role of plants in everyday life. Over 4,000 students in 14 Bay Area cities saw this presentation during the six years studied.

In addition to tours for school children, docent tours for adults are increasing. A primary difference between tours for school aged children and adults is that children's tours usually are selected from a list while adult tours are tailored on the spot to fit the interests of the group requesting the tour or drop in for Thursday and weekend free tours. However, during the past three years specialized tours have been developed for adult groups, including "Plants of the Bible".

The demand for tours is increasing. In an effort to more evenly space out when teachers bring their children to the Garden we advertised tours that are especially effective in our collection in the fall. The result is that we are totally booked

for school tours for this November and December. This response again demonstrates the value local educators place on docent led tours at the Garden.

—Jennifer Meux White

**BRIDGET LAMP** joined the Garden's horticultural team in June.

While receiving a Master's degree in Science in Horticulture and Agronomy at UC Davis, Bridget interned at Filoli and Lotusland Gardens, gaining diverse and valuable practical experience to complement her degree. Bridget's interest in plants developed as a result of her mother's love of plants and gardening. Family trips to Descanso Gardens during lilac blossom time and being allowed to choose plants at the local nursery for the family's home garden remain for Bridget as key plant experiences in her youth. Bridget has been particularly interested in drought tolerant plants and especially enjoys California natives. However, she is fast finding an appreciation for the diverse flora of the Mediterranean area which is one aspect of her gardening responsibility here at UCBG. In addition, she is responsible for the Eastern North America area and is enjoying making the acquaintance of new plants in that section too as she prunes and weeds, and repairs irrigation leaks and roads in her sections. Bridget



BRIDGET LAMP, Horticulturist

Photo by Janet Williams

professes enthusiasm for the "Museum Scientist" aspect of her new job—the processes and record keeping associated with collection development here—providing a whole new multi-tasking aspect to her performance as a well-rounded horticulturist. Welcome Bridget!

## Research in The Garden

The Garden was credited for providing some of the many research materials which resulted in the following papers:

**Sangtae Kim, Chong-Wook Park, Young-Dong Kim, and Youngbae Suh** of Seoul National University and Hallym University in Korea: *Phylogenetic relationships in family Magnoliaceae inferred from ndhF sequences*, published in the *American Journal of Botany* (Am. J. Bot. 88:717-728. 2001). The cover of this issue is comprised of a colorful assortment of Magnoliaceae flowers, including *Magnolia sharpii*, photo credit to Holly Forbes.

**Wendy B. Zomlefer, Norris H. Williams, W. Mark Whitten and Walter S. Judd:** *Generic circumscription and relationships in the tribe Melanthieae (Liliales, Melanthiaceae), with emphasis on Zigadenus: evidence from ITS and trnL-F sequence data*, published in the *American Journal of Botany* (Am. J. Bot. 88:1657-1669. 2001). The Garden provided material in the genera *Zigadenus* (death-camas) and *Xerophyllum* (beargrass).

**Susana Magallon, Patrick S. Herendeen, and Peter R. Crane:** *Androecidium endressii gen. et. sp. nov., From the Late Cretaceous of Georgia (United States): Further Floral Diversity in Hamamelidoideae (Hamamelidaceae)*, Int. J. Plant Sci. 162(4):963-983. 2001. The Garden is acknowledged for providing plant material used for comparative purposes.

Research materials were provided to the following:

Prof. **David D. Ackerly**, Stanford University, again visited to collect many species in the Rosaceae. He is looking at the evolution of the “evergreen sclerophyll” strategy in California chaparral. The strategy is to examine each of the major taxa

in comparison with their close relatives from non-chaparral habitats, employing a phylogenetic approach where possible.

Dr. **Robert P. Adams**, Baylor University received samples of *Calocedrus decurrens* (incense cedar) for

comparison with a new conifer from Vietnam. He and his colleagues are attempting to see where it fits within the Cupressaceae (cypress family).

Dr. **John E. Casida**, UC Berkeley, Department of Environmental Science, Policy, and Management, and dissertation student **Eric Haux**, received samples of *Datura* and *Physalis*. They are conducting research on the mechanism by which a plant growth regulator changes the growth characteristics of plants.

Dr. **Joe Di Tomaso**, UC Davis, is working on a text investigating weeds in California. He visited the Garden this summer to photograph several species for the book. His visit served a reminder that what may remain in check in one part of the world can be a weed in another.

Dr. **Michael Freeling**, UC Berkeley, via laboratory assistant **Zoya Akulova-Barlow**, received several samples of grass species for a morphological study of ligules.

Dr. **Eric Knox**, Rutgers University, visited to collect several samples of the Lobeliaceae family. He was able to provide some species identifications for the Garden.

Dr. **Susana Magallon-Puebla**, UC Davis, post-doc with Profs. **Michael Sanderson** and **James Doyle**, received samples of several species for their study of seed plant phylogeny, the age of angiosperms, and the evolution of pentamery among basal eudicots.

Ms. **Jodi McGraw**, dissertation student with Prof. **Wayne Sousa**, in Integrative Biology, began a new soil seed bank study in the Garden’s research greenhouse.

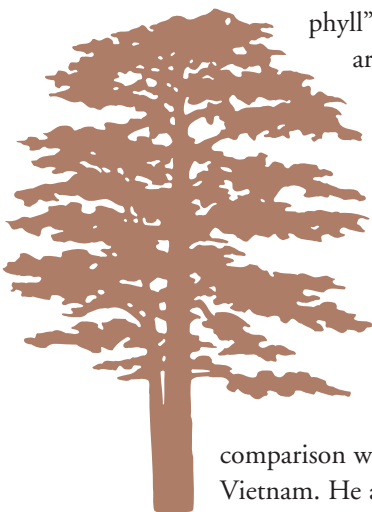
Dr. **Jeffrey Mitton**, University of Colorado, Boulder, received a sample of *Fitzroya cupressoides* (alercé). He had extracted DNA from *Fitzroya cupressoides* wood that is 45,000 years old and wished to compare two cpDNA sequences with contemporary individuals.

Dr. **J. Michael Moldovan**, Stanford University, and colleagues, received a variety of species for their study of a chemical signature of flowering plants found in ancient fossil-bearing rocks. The chemicals, called oleanenes, work against insects, fungi and various microbes.

Dr. **Jorge Santiago-Blay**, Roanoke College, VA, visited the Garden this summer to collect resins. He and a colleague are studying the chemical fingerprint of resins (recent and ancient). They are especially interested in samples of ancient ambers as well as of recent plant resins

Dr. **Alan Smith**, UC Berkeley and dissertation student **Raymond Cranfill**, sampled several species of ferns for their study of evolutionary relationships.

Dr. **Joe Williams**, University of Colorado at Boulder, returned to the Garden for more samples of *Schisandra*, *Kadsura* and *Illicium* for his study of primitive angiosperms.



## GARDEN NOTES

BOTANICAL GARDENS ANNUAL MEETING...Manager of Collections & Horticulture **Chris Carmichael**, Curator **Holly Forbes**, and Associate Director for Education **Jennifer White** attended the annual meeting of the American Association of Botanical Gardens and Arboreta, held July 3-7 in Denver. Holly gave a presentation on the value of documentation in botanical gardens.



SEED EXCHANGE...Curator **Holly Forbes** and horticulturists **Roger Raiche** & **Nathan Smith** spent five days in the Shasta-Trinity and Klamath National Forests collecting seeds of various species for the Garden's biennial seed exchange program. They were able to collect nearly 100 species. Roger & Nathan tested their tree-climbing skills to retrieve precious pine and fir cones for this program. The seed exchange list is made exclusively available to other botanical gardens and research institutions all over the world.

PLANT CONSERVATION MEETING...**Holly Forbes** represented the Garden at the annual meeting of the Center for Plant Conservation, this year hosted by the New England Wildflower Society in Framingham, MA. The CPC is a network of 33 gardens across the continental United States and Hawaii. The weather cooperated to provide the peak of the fall foliage display by the end of the meeting. Holly returned with the latest thinking on several conservation techniques. This year Holly and Curatorial Assistant **Barbara Keller** began a demographic study of *Delphinium bakeri* (Baker's Larkspur) in Marin County in collaboration with **Dr. Jason Koontz**, Center for Biodiversity of the Illinois Natural History Survey (and expert on the genus) and the California Department of Fish & Game with funding from the Genetic Resources Conservation Program at UC Davis. Information learned during this study will help determine future conservation efforts for this state listed rare and federally listed endangered species.

### Leonard Skinner

(continued from page 7)

the Garden and backed up his knowledge with stories or demonstrations of weird flower structures or pollination strategies, which made him enormously popular with children.

Leonard was a Master Gardener too, and for years was a regular presence at Dr. Raabe's Sick Plant Clinic, working as part of the team, but especially working with UC entomologist Dr. Nick Mills; he delighted in learning about Garden pests. He was also the mastermind who constructed the shaded Hold Area at virtually every Garden plant sale for a decade. Leonard has left a huge gap in our docent forces that will be tough to fill.

—Nancy Swearingen

### GARDEN STAFF

Dr. Ellen Simms, *Garden Director*  
Richard Henderson, *Associate Garden Director*

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Margaret Richardson, *Tour & Rentals Coordinator*  
Michael Rimar, *Administrative Assistant*  
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Holly Forbes, *Curator*  
Barbara Keller, *Curatorial Assistant*  
Anthony Garza,  
*Supervisor of Horticulture and Grounds*  
John Domzalski, *Propagator*  
Judith Finn, *Horticulturist*  
Peter Klement, *Horticulturist*  
Bridget Lamp, *Horticulturist*  
Lawrence Lee, *Horticulturist*  
Jerry Parsons, *Horticulturist*  
Dr. Robert Raabe, *Garden Pathologist*  
Roger Raiche, *Horticulturist*  
Eric Schulz, *Horticulturist*  
Elaine Sedlack, *Horticulturist*  
Nathan Smith, *Horticulturist*  
Gerald Ford, *Building and Grounds Maintenance*

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# CALENDAR OF EVENTS

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## ROSE PRUNING

Expert Garden Horticulturist, Peter Klement, will once again offer his popular workshop on rose pruning.

*Saturday, January 19, 9:30 am–noon*

*Saturday January 26, 9:30 am–noon*

Fee \$20 Members, \$28 Non-members. Reservation required

## SCHOOL GARDEN CONFERENCE: Sharing Successes and Best Practices

*Saturday March 2. Call (510) 495-2805 for further details*

Fee \$10. Reservation required.

## UNSELT BOTANICAL LECTURE

Worldwide traveler and expert ethnobotanist, Dr. Tom Carlson will present the second annual Unselts lecture on the topic: “Plants and People in Polynesia: Ethnobiology in the Pacific Region”

*Sunday, March 10 at 2 pm*

Free. Reservation required—please register early.

## BEGINNING BIRDWATCHING

Learn the basics of finding and identifying birds with our long-time instructor, Dennis Wolff

*Tuesdays, April 9, 16, 23, 30 9:30 am–noon*

Fee \$50 Members, \$65 Non-members

## FIBRE & DYE EXHIBIT

Feel the fibres and delight in the plant dyes used to make the world’s fabrics.

*Saturday April 13–Sunday April 28*

Free with Garden admission.

## SPRING PLANT SALE

A wonderful array of plants—many available only here at the Garden plant sales!

**Members Only Sale**

*Friday April 26, 5 - 7:30 pm*

**Public Plant Sale**

*Saturday April 27, 10 am–2 pm*

## UNSELT BIRDING BREAKFAST

Join bird-watchers extraordinaire Chris Carmichael and Dennis Wolff for an early morning stroll in the Garden, followed by coffee and delicious breakfast eats!

*Saturday, May 11, 8 am*

Free. Reservation required, numbers very limited—please register early.

## MOTHER’S DAY TEA

Celebrate Mom’s special day with tea and delicacies, music and a stroll in the Garden in its glory!

*Sunday, May 12, seatings on the hour at 1 pm, 2 pm, 3 pm.*

Fee \$10 Members, \$15 Non-members, children under 12 \$5.

Reservation required.

## SICK PLANT CLINIC

UC plant pathologist Dr. Robert Raabe, UC entomologist Dr. Nick Mills, and their team of experts, will diagnose what ails your plants.

*First Saturday of each month, 9:00 am–noon.*

Free. No reservations required.

## STAY TUNED FOR MORE INFORMATION ABOUT:

- Walks around the Garden led by our expert horticulturists!
- The 3rd Annual Garden Party!

To register for any program or event call 510-643-2755.

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GARDEN HOURS: Open 9 am to 5 pm. Closed first Tuesday of each month. Closed December 25th.

SUMMER HOURS: Memorial Day to Labor Day: 9 am to 7 pm. THURSDAYS ARE FREE. Garden Shop is open from 10:30 am to 4:30 pm.

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