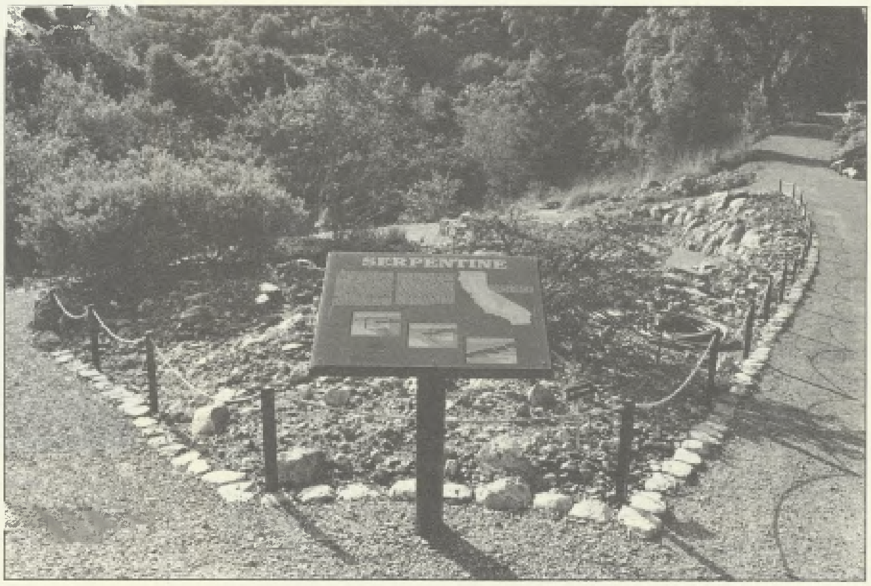
UNIVERSITY of CALIFORNIA
BOTANICAL GARDEN
NEWSLETTER

Volume 18, Number 2 | Published by the FRIENDS of the BOTANICAL GARDEN • Berkeley, California | Spring 1993

Serpentine and Its Plant Life in California

First, a multiple definition: Serpentine vegetation grows on serpentine soils that weather from serpentine (serpentinite) rock that contains serpentine minerals (chrysolite, antigorite, lizardite, etc.). The minerals are composed of iron magnesium silicate. Serpentinite rock is a metamorphic member of the ultramafic family of rocks, derived from the earth's mantle, surfacing where oceanic and continental plates collide.



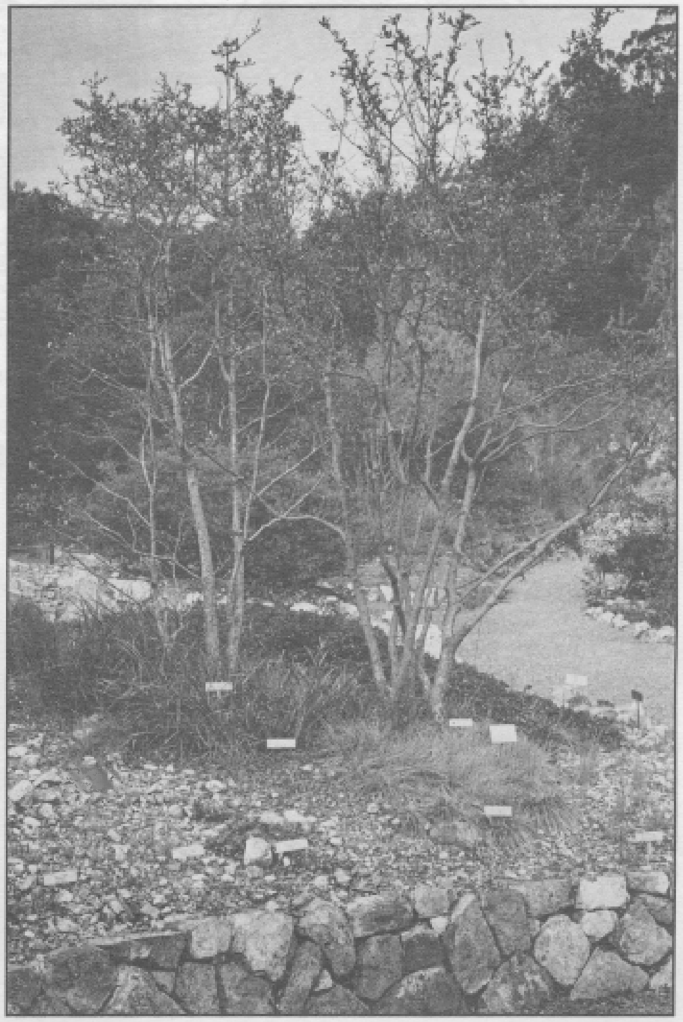
The new Serpentine Section of the Botanical Garden, officially unveiled to the public on April 25, 1993, is one of the world's largest and most inclusive garden displays of serpentine plants on natural soil and rock. (All photos by Richard Anderson)

Although serpentine soils occupy only one percent of California's land area, where they do occur, the "serpentine syndrome" (soil scientist Hans Jenny's term for the complex interaction of plants, soils and rocks), makes a striking impact on living landscapes. Dramatic contrasts of a sere serpentine chaparral or serpentine barren with dense mixed evergreen forest or typical chaparral on adjacent normal soils are clear evidence of the adverse effects of serpentine on vegetation. The word "serpentine" has been used to describe rock, soil, vegetation and flora; yet for the geologist, serpentine is a mineral class, the constituents of serpentinite rock. They are composed mainly of iron magnesium silicate, with "impurities" of chromium, nickel and other toxic metallic elements. Because of this unusual chemical makeup, the soils weathering from serpentinite and other ultramafic rocks (peridotite, dunite) are infertile (high magnesium to calcium ratio) or even toxic to most plants. But nature meets such a challenge with evolutionary opportunism. Plants have become adapted to serpentines everywhere these rocks reach the surface on our planet. The nature of the adaptation to serpentine ranges from strict serpentine endemics, narrowly confined to serpentine (like *Quercus durata, Streptanthus polygaloides* and *Phacelia egena*), to indicator species that occur on serpentines beyond their normal ranges (like *Pinus jeffreyi* and *Calocedrus decurrens* on granites, etc. in the Sierras but largely on serpentine in the North Coast Ranges). Still other native species may range widely on and off serpentine, but often take the form of genetically fixed serpentine-tolerant races when they encounter the demanding serpentine soil. The extreme adaptation for some endemics is not only to tolerate the toxic nickel, but to accumulate it; the Sierran Jewel Flower, *Streptanthus polygaloides,* is one such hyperaccumulator species.

California has the largest exposure of serpentine in North America. The major serpentine rock outcrops are mainly in the North Coast Ranges (especially in Del Norte, Trinity and Siskiyou Counties). Yet other major exposures occur in the inner and outer Coast Ranges all the way to Santa Barbara County. The most spectacular serpentine barrens (treeless expanses nearly devoid of any plant cover) in the South Coast Ranges are in San Benito County (New Idria and San Carlos Peak); major exposures in the Bay Area include Mt. Tamalpais, Tiburon Peninsula and the Peninsula south to San Jose and Morgan Hill. Extensive outcrops occur in the North Bay counties (Napa, Sonoma and Lake) and increase in area northward to the Oregon border. The western Sierra Nevada also has major outcrops, extending from Tulare County north to Plumas County. In the Sierra the serpentines are arrayed in narrow parallel bands roughly in a south-to-north direction. The Red Hills area of Tuolumne County (near Chinese Camp) is an outstanding Sierran display of serpentine; its red soil and distinctive chaparral woodland vegetation (*Ceanothus cuneatus* and *Pinus sabiniana*) are trademarks.

Everywhere serpentine appears in California, its vegetation boldly contrasts with the surrounding non-serpentine plant cover. In the North Coast Ranges, stands of serpentine woodland with widely spaced Jeffrey pine and incense cedar may be surrounded by a lush hardwood-conifer forest. Further south, a distinctive serpentine chaparral dominates the outcrops with endemic *Quercus durata, Ceanothus jepsonii* and *Garrya congdonii* along with non-endemic chaparral shrubs. In the Bay Area (as on Tiburon Peninsula and Jasper Ridge near Palo Alto) a distinctive serpentine grassland is fostered by the inhospitable soil.

Plants restricted to serpentine contribute impressively to the list of California endemics. Over 200 species, subspecies and varieties are restricted wholly or in large part to serpentine. Two species of cypress *(Cupressus sargentii* and *C. macnabiana)* are serpentine endemics and three ferns are commonly found on serpentine *(Polystichum lemmonii, Aspidotis densa* and *Adiantum aleuticum)*. Monocot genera (such as *Allium, Calochortus* and *Fritillaria)* have several serpentine endemics. Certain dicot families cater to endemism on serpentine (Cruciferae, especially *Streptanthus* and *Arabis*); Polygonaceae, Umbelliferae (mostly *Lomatium* and *Perideridia)*; Linaceae (nearly all of Section Hesperolinon), Scrophulariaceae *(Mimulus, Collinsia, Castilleja)*; Hydrophyllaceae *(Phacelia)* and several genera of the Compositae. For the most part, these endemics have close non-serpentine relatives, which suggests that evolution of a serpentine endemic is traceable to species of the nearby flora. A possible scenario for the origin of a serpentine endemic: (1) individuals of a non-serpentine species become genetically pre-adapted to serpentine (tolerating low calcium, high magnesium and overall low soil fertility; (2) next, the pre-adapted individuals multiply to form edaphic races; (3) further divergence in floral and vegetative features, as well as

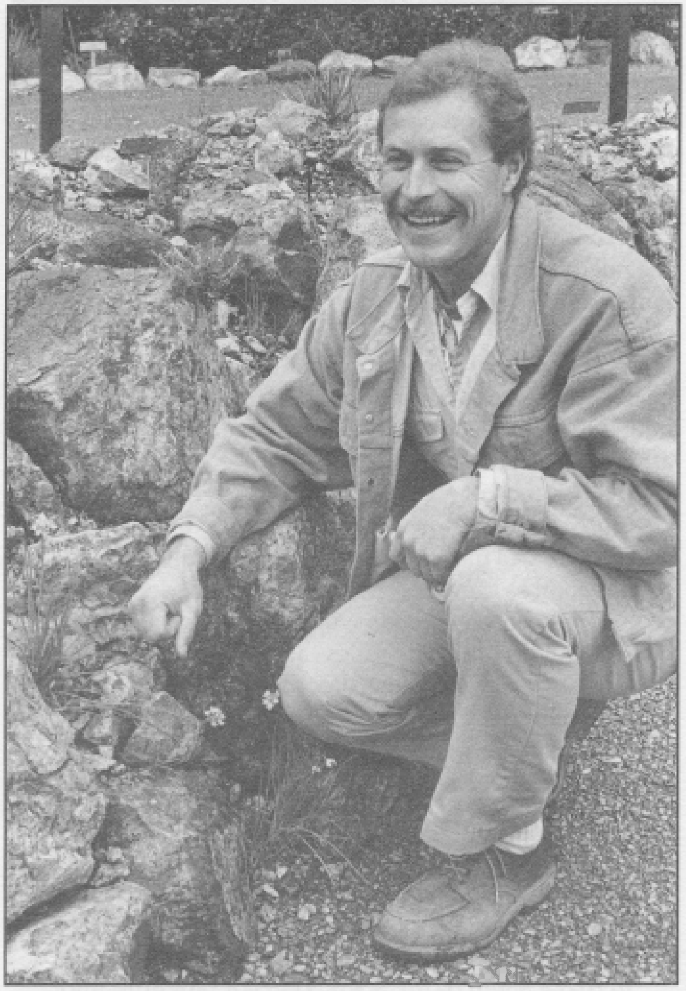


One of the beds of the extensive serpentine section features plants with a strong affinity for serpentine soils.

reproductive isolation, succeeds in making serpentine-endemic species. This scenaria is illustrated in the genus *Streptanthus* where serpentine races are found in *S. glandulosus*, which may have served as ancestors to serpentine-endemics like *S. insignis* or *S. niger*.

Rarity and endangerment of serpentine endemics will be the most likely focus for preserving serpentine habitats. Even though many serpentines, especially the xeric barrens, have been disturbed by humans seeking minerals or geothermal power, no concerted attempt to preserve serpentine landscapes has been mounted. Only when a rare serpentine endemic is threatened does the habitat gain protection. Conservation of serpentine areas will need to go beyond saving rarities; the unique vegetation of serpentine—even on the barrens—merits protection.

Colorful prose on behalf of serpentine landscapes began with botanist William Brewer's 1861 account of



Most of the serpentine plantings for the new section were field-collected by horticulturist Roger Raiche, shown here next to the talus bed.

the New Idria barrens (pp 139-140 in *Up and Down California*). And in our own century, David Raines Wallace in his fine book *The Klamath Knot* gives this vivid description:

"The red-rock forest may seem hellish to us, but it is a refuge to its flora...it is the obdurate physical adversity of things such as peridotite [serpentine] bedrock which often drives life to its most surprising transformations."

—Arthur Kruckeberg

Again, the new Serpentine Section of the Botanical Garden is unveiled to the public on April 25, 1993. Come see the beds and use our new self-guided interpretive brochure! Arthur Kruckeberg is a renowned authority on the serpentine plants of California and the author of the book California Serpentines *(UC Press). We are grateful to Dr. Kruckeberg, Dr. Phyllis Faber, and* Fremontia *for permission to reprint this article.*

FROM THE DEAN

I am using this column — which is usually "FROM THE DIRECTOR"— to inform you of the progress made in the selection process of the new Director, to discuss some personnel changes at the garden in the interim, and to provide you with an update on the Meeting Room renovation project.

At her request, I accepted Dr. Margaret Race's resignation as the Acting Director of the Botanical Garden effective February 1, 1993. Dr. Race did an outstanding job and worked on an impressive number of projects during the past eighteen months.

As we are reaching the end of the Botanical Garden's Director recruitment process, naming a new Acting Director at this time is not desirable. Therefore, I am assuming responsibility for the garden during the interim. In consultation with the Faculty Steering Committee, I will deal with program issues and other responsibilities which the Director would normally handle. Also, I will be the Botanical Garden's liaison with the Friends of the Garden.

Also, I am naming Assistant Dean Sidney Zelaya-Aragón the Acting Managing Director of the Garden. He will deal with financial, personnel, and related matters, and will serve in this capacity until a permanent Director is on board. I expect that all processes at the Garden will function normally and that this hiatus will not be a problem. The Search Committee is in the final phase of the process to select the permanent Director of the Garden. Four outstanding candidates were interviewed between February 10 and March 4, 1993.

Finally, I am pleased to inform you that the Office of University Relations has approved the fund-raising effort for the renovation of the Meeting Room. Also, the staff of the Garden continues to work with the Office of Planning, Design and Construction to transform the greenhouse into an attractive, multi-purpose and utilitarian structure that will serve the needs of the Garden and the Friends. If all goes according to schedule, construction will begin in early August and be completed in time for the Holiday Plant Sale in December.

I appreciate the support the Friends have given the Garden over the years, and I want to do everything within my power to make your efforts worthwhile.

Wilford Gardner
Dean, College of Natural Resources