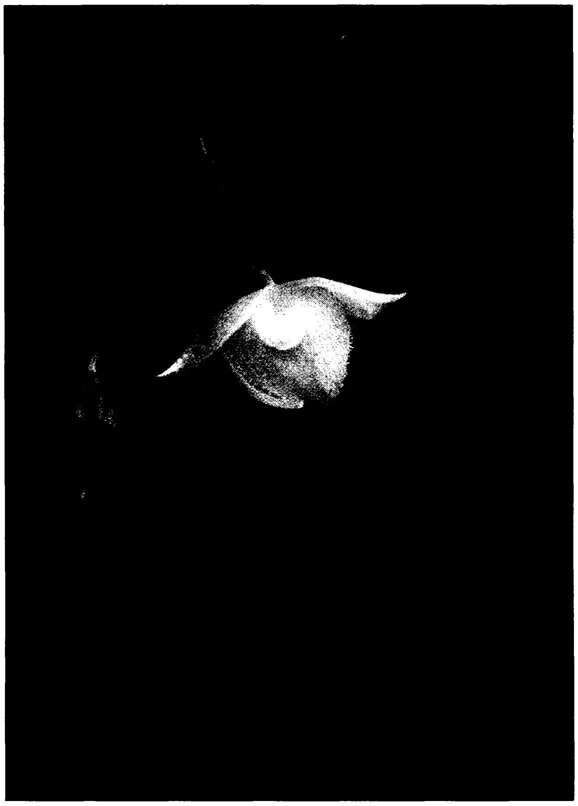
California Flora

The Jepson Manual. Higher Plants of California. JAMES C. HICKMAN, Ed. University of California Press, Berkeley, 1993. xviii, 1400 pp., illus. $65 or £50.

Willis Linn Jepson can be considered one of the founding fathers of the study of the flora of California. Born in central California in 1867, he developed an early appreciation of the plant life of his surroundings. As waves of settlers began to arrive in California from the East, he came to believe that the flora of the state deserved not only serious study but also protection from destruction. In 1915 he founded the California Botanical Society, which sponsored field trips to various parts of the state. He also helped form both the Sierra Club and the Save-the-Redwoods League, conservation organizations that are still active today.

Among Jepson's many contributions to California botany is his 1925 *Manual of the Flowering Plants of California*, the first single-volume guide to all of the flowering plants that were known to grow wild in the state (information on ferns and gymnosperms is also included). When Jepson died in 1946, an endowment, the Jepson Research Fund, was left to the University of California at Berkeley to fund further work on his unfinished multivolume *Flora of California* as well as assure continued publication and periodic updating of his *Manual.* It was Lawrence R. Heckard (1923–1991) who convinced James C. Hickman (1941–1993) that updating the 1925 volume was feasible; he went on to spearhead the project with him. The product of a comprehensive 10-year effort by hundreds of people, the new *Jepson Manual* reflects what is currently known about 5862 species of higher plants found in California. In contrast to the 1925 *Manual*, which was written almost entirely by Jepson himself with acknowledged contributions from just eight other botanists, the present volume contains contributions from 189 botanists from across North America and beyond.

The Jepson Manual is both traditional and revolutionary. It has all the features—plant descriptions, dichotomous identification keys, detailed illustrations—that one would expect to find in a work of its type. Yet its underlying rationale (the same as that of Jepson's original *Manual*) sets it apart from many other contemporary floristic manuals: "The Jepson Manual Project was based on a virtually revolutionary premise: a single work of this magnitude can be simultaneously accessible to dedicated beginners and indispensable to professional botanists." A 26-member horticultural council contributed information about the use of native California species in gardens and devised a system for indicating care requirements and climate zones in which individual species are likely to flourish. Although the inclusion of this horticultural information within the individual plant descriptions is clearly a radical departure from floristic manual tradition, it succeeds in making the volume useful to a wider audience.



Calochortus pulchellus. [From *The Jepson Manual*; photograph by Jo-Ann Ordano]

Botanists accustomed to using floristic manuals often skip over the prefatory material, going straight to the keys and plant descriptions, but I urge all users of *The Jepson Manual* to first read the exceptionally clear introduction, in which the underlying philosophy is set out and the many conventions that were used in crafting the plant descriptions are explained. Not only does it provide instruction on how to use the book, it emphasizes limitations to keep in mind. The illustrated glossary, resembling those typically found in introductory systematics textbooks, was designed to accommodate the diverse backgrounds of users. There is also an informative chapter explaining the geological history of the state in relation to the extant flora and another on the geographical subdivisions of California. Each of the plant descriptions that, together with keys, form the bulk of the book includes a brief range statement that uses abbreviations for one or more of the 50 geographical subdivisions to indicate where the plant is found—a system that may confuse readers expecting county maps. Line drawings illustrate the diagnostic features of over 4000 taxa.

As interest in conserving native biodiversity increases, it seems appropriate that botanists and plant enthusiasts should be able to refer to a common information source, one that is clear and accessible to amateur and professional alike. The occurrence of an extremely diverse flora (including approximately one-quarter of the species of higher plants known to exist in North America) within the most populous of the United States makes California the ideal place to test such a marriage.

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Planetary Systems

Protostars and Planets III. EUGENE H. LEVY and JONATHAN I. LUNINE, Eds. University of Arizona Press, Tucson, 1993. xiv, 1596 pp., illus. $90. Space Science Series.

Nothing in the fundamental laws of physics and chemistry logically entails the formation of a star and planetary system. Yet humankind is decidedly a planetary phenomenon; thus the study of the origins of our species must begin with the formation of the sun and the coeval accretion of the planets, including the Earth, from the residual debris of that process. *Protostars and Planets III*, following *Protostars and Planets I* (1978) and *Protostars and Planets II* (1985), is a most ambitious and successful summary of the present state of our understanding of these events.

Planetary systems are the long-lived remnants of the birth of both stars and planets. Several decades of investigation have now produced a consensus within the scientific community that the formation of the solar system is but one example of a process that occurs frequently in nature and, moreover, one that is probably a natural consequence of the formation of stars. Stars form from what is essentially a

Vignettes: Blank Verse

Before there was writing, any culture carried by language had to be transmitted orally. People memorized poems that incorporated the knowledge that was to be passed on to future generations. . . . Now, we are accustomed to think, things have changed: there are texts and chronicles, and the art of memorization has gone almost entirely out of use. We don't need it for the storage or transmission of knowledge, and the old chore of learning poems by heart in school has been almost entirely dispensed with. Feats of memory, outside some technical contexts (in the theater or in medicine, for example) have become curiosities, useful to intellectuals who are unexpectedly imprisoned and need something to keep them sane, but otherwise merely freakish or decorative.

It is worth noting, though, that in fact there are still at least two poems that everyone who has the most rudimentary education learns and remembers. Learning them indeed is a condition for participation in the literacy that makes the old feats of memory unnecessary. One of them is the alphabet, and the other is the series of names for the integers. They don't look like poems, but on reflection they obviously are poems: words that belong together, to be remembered and recited in a given but not intuitively obvious order.

—*Peter Caws*, in *Yorick's World: Science and the Knowing Subject* (University of California Press)

"Counting": Ounce, dice, trice, quartz, quince, sago, serpent, oxygen, nitrogen, denim.

—*Alastair Reid*, in *Ounce, Dice, Trice* (Little, Brown, 1956), as quoted by Alan L. Mackay in *A Dictionary of Scientific Quotations* (Institute of Physics)

hard vacuum—NASA would be proud to achieve the densities and pressures that are commonplace in the interstellar medium—yet assemblies of approximately 10^{57} atoms regularly contrive to progress from this rarified interstellar state to the highly structured, chemically differentiated, fusion energy–processing entity that is a star and planetary system. It is unlikely that the detailed evolution of such a complex process will soon, if ever, be modeled completely from first principles. However, *Protostars and Planets III* shows that close interaction between astronomical observations, laboratory measurements, and theoretical investigations is resulting in steady and substantial progress in a discipline that perforce must link aspects of astronomy, astrophysics, plasma physics, and planetary science.

This is an enormous book. Spanning nearly 1600 pages, it contains 39 chapters by 91 authors, almost a quarter of whom also contributed to at least one of the book's precursors, as well as illustrations (including color plates), a glossary, a complete bibliography, and an index. Like the two earlier volumes, *Protostars and Planets III* is the product of a scientific conference and a special issue of the journal *Icarus*. Yet this is most definitely not a typical symposium volume. The chapters—in some cases enhanced versions of the journal articles—have been rigorously refereed and logically ordered. As a group, the contributors represent an excellent sampling of the expertise in the subject; collectively they are able to provide greater objectivity and more detail than could have been achieved by a smaller number of voices. Despite its comprehensiveness, the book manages to avoid repeating material contained in its predecessors.

It has been clear for some time that understanding the origins of the solar system will require testing our models against nature. This entails extending the realm of planetary science to the observational and theoretical study of other stars and their environs. The progress made in this regard in the seven years since the publication of *Protostars and Planets II* has been substantial. New instruments, especially in the infrared and submillimeter wavelength regimes, have now established a database that characterizes the evolution of material from an interstellar cloud to a main sequence star, including the time history of circumstellar disks—the presumed birthplace of planetary companions to other stars.

The most surprising result, totally unanticipated by prior theoretical developments, is the bipolar outflow phase of the collapse of a circumstellar disk. As Shu and his co-workers note, "Given the angular momentum difficulty likely to be faced by any object which forms by contraction through many orders of magnitude from an initially extended, rotating state, the birth of stars through the accretion of matter from the surroundings may simply not be possible without the *simultaneous* accompaniment of powerful outflows." Studies of the formation, morphology, composition, dynamics, and energetics of these objects and the protoplanetary disks into which they evolve make up half the book.

Much of the remainder addresses the subsequent evolution of the circumstellar disks into planetary systems. Schematically at least, the time sequence of events has long been clear: as the disk cools, its gases condense, chemically differentiate, and form planetesimals that accrete into planets. Calculation of the details, however, has had significant implications for our understanding of the early evolution of the Earth. The last few planetary accretion impacts were catastrophes that outstripped the Nuclear Winter scenario by many orders of magnitude. Melosh and co-workers understate matters when they remark, "The recognition of the importance of large individual impacts as well as of the cumulative effects of smaller impacts has led to a revolution in our approach to the modeling of the processes of planetary formation and differentiation, including the origin of the Moon and evolution of atmospheres."

Protostars and Planets III covers the emerging discipline of planetary systems science with extraordinary completeness (as of about 1990). It will be useful to workers in the field as a reference volume as well as to graduate students as a textbook. In addition, it contains many intellectual nuggets that will interest the general scientific community. For example, plate 7 is a photograph taken by the Hubble Space Telescope of a protoplanetary disk in the Orion Nebula. Chemists may wish to study the inventories and production mechanisms of the molecular species found in interstellar clouds, in comets, in Pluto, or in the atmospheres and moons of Uranus and Neptune. Geologists seeking insight into the ultimate origins of the material they study will find discussions of nucleosynthesis, of meteoritic constraints on conditions in the solar nebula, and of the effects of impacts of meteoritic material on the early environment and subsequent evolution of the terrestrial planets. This book is a testament to the broad scientific appeal and utility of investigations of the origins of the solar system.

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