telescope at the Las Campanas Observatory in Chile. The book's scope includes navigators and observers, amateurs and professionals, teachers and researchers, students and observatory directors, optical and radio astronomy, observation and theory, people and places.

One main theme of the book is the gradual shift, over the last century and a half, of the center of action from English astronomers in Canada to Canadian astronomers with strong ties to the United States. A second theme is the shift from part-time practitioners to fully committed, professional astronomers, and from practical navigation and time-keeping to "pure" research on the nature of stars and the universe.

The book is well written. There are a few minor errors of fact (the United States entered World War I in 1917, not 1914; Andrew McKellar did his graduate work and earned his Ph.D. at Berkeley in physics, not at Lick Observatory or in astronomy), but in the main it is well researched, with copious references to original sources. The author has a good grasp of the whole field of astronomy, though a few of his explanations of observational results are somewhat lacking in focus. However, his description of J. S. Plaskett and J. A. Pearce's observational confirmation of the picture of differential galactic rotation, one of the great triumphs of Canadian astronomy, is particularly clear and vivid.

The Dominion Astrophysical Observatory and its 72-inch reflector with which Plaskett and Pearce did this work were conceived and brought into existence by Plaskett. He and his successor as its director, W. E. Harper, are described by Jarrell as straitlaced, hard-working perfectionists, near caricatures of Victorian, small-town Ontario Protestants. C. A. Chant, who created modern astronomical education in Canada at the Univerity of Toronto and set up its David Dunlap Observatory, was another. Not surprisingly, they forged close links with W. W. Campbell, the longtime director of the Lick Observatory, who shared all these attributes except that he had been born and raised in northern Ohio and educated in Michigan, less than a hundred miles from the Ontario border. Many of their younger associates and students, starting with R. K. Young and with Pearce (who died only this September at the age of 96), served part of their apprenticeships at Mount Hamilton, learning American research methods. All this is well described in *The Cold Light of Dawn*.

Canada has a small population, and its climate is not particularly well suited for astronomy. (Indeed, a third theme of the book, not directly stated by the author, is that its recent most conspicuous successes have come from its new observatories in Chile and Hawaii.) To date it has produced no Galileo, or closer to our own time no Henry Norris Russell or Edwin Hubble, though present work by Canadian astronomers with the Canada–France–Hawaii telescope is at the forefront of world observational research. Hence the book's main interest must be seen in its Canadian context, as only a part of the wider world of science. Overall it is a good book, whose single weakness is that it covers so wide a field that its author cannot explore the most important episodes in real depth. *The Cold Light of Dawn* should be read by Canadian scientists and historians of science, and by everyone with an interest in the history of science in Canada.

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"Visual meteor observers, National Research Council [of Canada], Metcalfe Road, c. 1950." [From *The Cold Light of Dawn*]

String Theory

Superstrings. A Theory of Everything? P. C. W. DAVIES and JULIAN BROWN, Eds. Cambridge University Press, New York, 1988. viii, 234 pp., illus. $39.50; paper, $10.95. Based on a BBC radio broadcast.

In the preface, Davies and Brown state that the intention of their book is to "give both physicists and interested non-physicists an insight into the essential ideas of string theory." They go on to say that they hope "the book offers a useful glimpse of how leading physicists talk and argue about a subject of contemporary importance." These are remarkable aspirations for a relatively short book that avoids using any mathematics or too much technical jargon. What is more remarkable is that the effort succeeds. *Superstrings: A Theory of Everything?* does present the essential ideas of string theory in a manner that is enjoyable for the expert and easily accessible for anyone else. More important, the book contains a series of interviews about string theory with some of the world's leading theoretical physicists. These physicists were asked to discuss the reasons for their optimism, or pessimism, about the role of superstrings as a unified theory of nature. Their answers are profound, sometimes electrifying, and offer a rare and important glimpse of the differing philosophies that guide some of the best scientific minds. There is controversy here, and it is fascinating.

The book divides naturally into two parts. It begins with an introduction that discusses, in a logical order, most of the important topics in theoretical physics that must be contained in a theory of everything. To say the least, this is not easy. A theory of everything must encompass special relativ-

ity, general relativity, the zoology of subatomic particles, electroweak and strong force gauge theories, and the concepts of discrete and continuous symmetry, supersymmetry, and supergravity. Each of these topics is conceptually and mathematically complex, and the aspects of them relevant to string theory are often the most abstract. Davies and Brown consider each of the topics, extract from them the one or two important concepts relevant to superstrings, and present these concepts with wonderful clarity. How does one elucidate, in simple language, the concept of renormalization infinities in quantum field theory, or anomalies? Davies and Brown make the attempt and succeed. They continue on to discuss the shortcomings of previous attempts at unified theories and give a brief discussion of superstring theories. I would recommend this book on the basis of the introduction alone. However, it is the second and larger part of the book that makes it outstanding.

The last two-thirds of *Superstrings: A Theory of Everything?* is given over to the interviews. Four of the nine physicists interviewed, John Schwarz, Michael Green, David Gross, and Edward Witten, are leading proponents of superstring theories. The comments of Schwarz and Green give the reader a clear view of the historical development of string theory in the 1970s and early 1980s, including the subjects' frustrations about the apparent lack of interest in string theory at that time. These interviews also contain interesting explanations of various aspects of superstring theory. The other five physicists, John Ellis, Abdus Salam, Sheldon Glashow, Richard Feynman, and Steven Weinberg, are, in varying degrees, more detached from the development of string theory and represent very diverse points of view. For example, Glashow expresses strong skepticism about string theories and, above all, concern that string theorists are becoming increasingly indifferent to the experimental basis of high energy physics. All these interviews are head-on confrontations with some of the most important current issues in theoretical physics. The questions probe the meaning and philosophy of superstring theory directly and intelligently, and the answers are all strong expressions of the philosophies motivating these leading physicists. The experts, who will probably know all the interviewees, will not be surprised by their answers but will find them expressed clearly, in direct response to interesting questions. For the non-expert, I would say that these interviews are about as close as one can get to the private discussions that occur when, over a lunch or dinner somewhere, high energy theorists debate the past, present, and future of their subject. I highly recommend *Superstrings: A Theory of Everything?* to experts and non-experts alike.

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Some Other Books of Interest

Plant-Animal Interactions. WARREN G. ABRAHAMSON, Ed. McGraw-Hill, New York, 1988. xviii, 480 pp., illus. $47.95.

This book has been written to provide advanced undergraduate and graduate students with "a convenient entry into the theory, empirical data, interpretation, and literature of many kinds of plant-animal interactions." After a foreword by Daniel Janzen the volume opens with an overview of plant-animal interactions by Abrahamson, followed by accounts of pollination biology by R. I. Bertin and of fruits, seeds, and dispersal agents by E. W. Stiles. Interactions between plants and herbivorous insects, herbivorous mammals, and ants are the subjects of chapters by A. E. Weis and M. R. Berenbaum, R. L. Lindroth, and K. H. Keeler. Discussions of carnivorous plants ("one of the great anomalies of the natural world") by T. J. Givnish, effects of plant resources on animal populations by K. N. Rabenold and W. R. Bromer, and plant-animal interactions in agricultural ecosystems by B. R. Stinner and D. H. Stinner round out the coverage. The volume ends with a 48-page listing of literature cited and a combined subject and author index. —**K.L.**

Crystals in Gels and Liesegang Rings. In Vitro Veritas. HEINZ K. HENISCH. Cambridge University Press, New York, 1988. xiv, 197 pp., illus. $54.50.

"It has long been appreciated that advances in solid state science depend critically on the availability of single crystal specimens," writes Henisch, and "as a result, an enormous amount of labor and care has been lavished on the development of growth techniques." In this book, a successor to his *Crystal Growth in Gels* (1970), Henisch sets out to provide "an updated summary of our experience." After tracing the history of the gel method, which, he comments, has been slow to develop despite a "mini-renaissance" of research beginning in the 1960s, Henisch devotes separate chapters to the preparation, structure, and properties of gels, to mechanisms of crystal growth in gels, and to nucleation. The last chapter of the book is devoted specifically to Liesegang rings, systems of discontinuously distributed crystalline precipitates observed in 1896 by R. E. Liesegang while experimenting in his photographic laboratory with gelatin layers on glass plates. (When grown in a test tube instead of on a plane the "rings" are actually disks.) Although these structures attracted the attention of some eminent scientists, among them Wo. Ostwald and Rayleigh, and once were a central concern in the field, the Liesegang ring phenomenon "is even now only partially understood," according to Henisch, and "awaits the attention of another Ostwald." In addition to a general discussion of work on the rings, which he describes as primarily "a labor of love," he presents 10 hypothetical "experiments" that are based on a diffusion algorithm and can be performed on a microcomputer. In keeping with the author's characterization of his earlier book as "playful," this one is written in an informal style, with such caveats as, "The trappings of quantitative research are always enjoyable, but the results should be treated with caution."—**D.F.W., K.L.**

Neodymium Isotope Geochemistry. An Introduction. DONALD J. DEPAOLO. Springer-Verlag, New York, 1988. xii, 187 pp., illus. $49.50. Minerals and Rocks, vol. 20.

The radioisotope samarium-147 decays, with a half-life of 106 billion years, to neodymium-143, and the resulting changes in the abundance of ^{143}Nd relative to other Nd isotopes as determined by mass spectrometry can be used to determine the ages of rocks and hence the timing of events in the chemical evolution of planets. The "principles, models, and assumptions [underlying the use of these isotopes for this purpose] and some of the results of the studies to which they have been applied are the subjects of this book," writes DePaolo in the introduction. The opening section of the volume, Principles and Processes, summarizes the chemical properties of Sm and Nd, compares them with other nuclide pairs used in chronometry, discusses abundances of their isotopes, describes the Sm-Nd method itself, and outlines the methodology of its use in the study of planetary evolution and igneous processes (partial melting, fractional crystallization, and mixing). Parts 2 and 3 are devoted to results. Part 2 provides "a planetary perspective," including a review of data on Nd isotopic variations, correlation with other isotopic variations, and discussion of the relevance of the data to models of crust-mantle evolution. Part 3, devoted to studies of petrogenesis, discusses