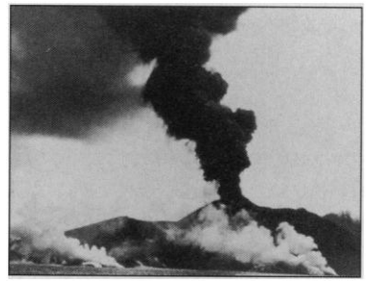
BOOK REVIEWS

Post-Eruption Ecology

Krakatau. The Destruction and Reassembly of an Island Ecosystem. IAN THORNTON. Harvard University Press, Cambridge, MA, 1996. xiv, 346 pp., illus. $39.95 or £25.50.

In the recent book *Song of the Dodo*, David Quammen relates the tale of the young Robert MacArthur and Edward Wilson, who in the '60s were putting the finishing touches on their new, and now famous, equilibrium theory of island biogeography. If the number of species on any particular island is indeed kept at an approximate equilibrium number through the countervailing forces of colonization by new species and extinction of existing residents, it should be possible to find some islands that document these dynamics. In particular, and most crucial to the theory, on a newly created island, colonization rates should far exceed extinctions initially, but the imbalance should gradually diminish, until a species number is reached where the two rates are approximately equal. At this point, MacArthur and Wilson rediscovered the rich and remarkable example of the Indonesian volcanic island Krakatau and quickly set about analyzing the historical records to determine whether the plants and birds fit the expected pattern.

As Ian Thornton documents in this uncommonly well-written book, this was not the first time that Krakatau was at the center of development in the growing field of biogeography and ecology. This scholarly and lucid book summarizes nearly all that is known concerning the history, geology, and natural history of Krakatau, both before and after the cataclysmic eruption of August 1883. For biogeographers interested in colonization and the ecological succession of natural communities, this eruption offered multiple new islands, initially devoid of all life, that were about 44 kilometers from the nearest colonization source.



"Lava entering the sea on Anak Krakatau's north coast in December 1992." Rakata, a remnant of Ancient Krakatau, is at the right, in the background. [From *Krakatau*]

This "experiment" unfortunately was not ideal, since the pre-eruption flora and fauna were poorly known and described. In some cases, all we know of forest trees is from landscape paintings. Thornton explains that we should view Krakatau as actually an experiment within an experiment, because of the secondary emergence of the new island of Anak Krakatau (literally daughter of Krakatau) beginning in 1927 and culminating after several short-lived emergences in Anak Krakatau IV in 1930. This last experimental island, in turn, could be colonized at a much closer distance and from a source community that now was much better known.

Thornton, who has focused his professional attention on Krakatau for the last 20 years, is both entertaining and informative in synthesizing these events and explaining their biological significance in the context of ongoing conceptual debates in ecology and biogeography. For example, he points out that for no taxa is the evidence strong that an equilibrium has been reached, even though species accumulation curves seem to be decelerating. Moreover, where animal extinctions are observed, they can be ascribed in most cases to directional successional changes in the island's vegetation (from grasslands to forest) rather than the stochastic turnover of particularly small populations. Also, and germane to the notion of alternative stable points in ecological communities, the separate islands of Krakatau seem to have diverged from one another in the composition of the common flora. I would have liked appendixes listing the distribution and status of each species on each island today, so that researchers attracted to this fascinating system down the road would have a convenient reference compendium.

Finally, there is an important and unique conservation message here. None of the species on Krakatau is unique to the island; the flora and fauna are simply a subset of those in surrounding Indonesia, yet despite a lack of uniqueness "certain parts of the earth should be conserved with minimal human interference because they are essential for the elucidation of important ecological processes." If this can be accomplished for Krakatau, we may learn as much in the next century as we have in the first since its eruption.

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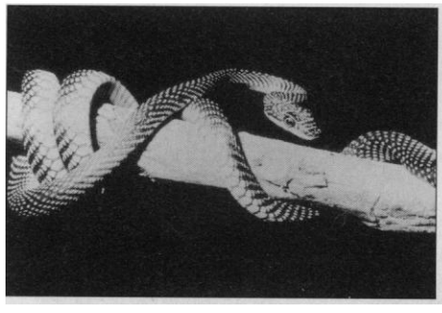

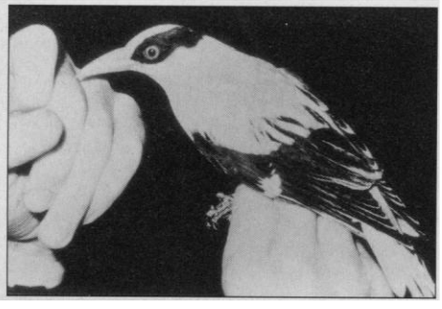

Left, "The paradise tree snake, evidently a fairly late colonist, now occurs on all four islands" in the Krakatau archipelago. Right, "The black-naped oriole, an insectivore-frugivore of high treetops, probably colonized [Krakatau] soon after trees were established." [From *Krakatau*]

Nucleosynthesis and After

Supernovae and Nucleosynthesis. An Investigation of the History of Matter, from the Big Bang to the Present. DAVID ARNETT. Princeton University Press, Princeton, NJ, 1996. xx, 599 pp., illus. $85 or £66.50; paper, $39.50 or £27.50. Princeton Series in Astrophysics.

The nuclear astrophysics community has long awaited this comprehensive treatise on the formation and evolution of the elements in stars, supernovae, and the big bang by an author renowned for his pioneering

studies in explosive nucleosynthesis and multidimensional hydrodynamics.

This present work is characterized by careful, precise numerical studies coupled with deep insight. Arnett consistently points out the uncertainties and difficulties in the field rather than dwelling on what has become established or taken for granted. There is also a consistent attempt to reduce complex results to useful analytic approximations and to carefully summarize the notation and conventions used in the field.

For example, the introductory chapter on atomic abundances includes a useful and well-written summary of various abundance-determination methods and their limitations. This is one of the best overviews I have seen of this complicated range of subjects from stellar atmospheres, meteorites, cosmic rays, and supernovae. The following chapter provides a summary of the relevant nuclear physics and a useful compendium of the rules of thumb that should be of use to both nuclear physicists and astrophysicists.

Some of Arnett's best-known work has been in the area of nuclear reaction flows and energy generation coupled with hydrodynamics. The chapter on reaction networks provides a good summary of the accumulated wisdom of several decades of research into how best to analyze these systems, including pointers for avoiding some of the pitfalls. I would recommend this chapter as necessary reading by anyone contemplating the development of a nuclear-reaction-network code. The chapter on primordial nucleosynthesis provides a fresh perspective that emphasizes the importance of high entropy.

Arnett takes an unusual but enlightening approach in the chapter introducing stellar evolution. He relegates the usual discussions of polytropic stars and the equation of state to the appendixes and instead develops analytic approximations for the interpretation of the various physical processes. These are quite useful for developing intuition. The following chapters on hydrogen burning, helium burning, explosive nucleosynthesis, and the evolution of massive (referred to as neutrino-cooled) stars continue in the same vein, providing analytic interpretations of complex numerical problems that both the novice and the expert could find quite illuminating.

The next three chapters, on astrophysical thermonuclear explosions, gravitational collapse, and supernovae, provide a great deal of insight into the workings of both type I and type II supernovae, particularly those aspects that involve explosive nucleosynthesis. Most of the discussion concerns type II supernovae, but there is a very useful summary of properties of type I supernovae and the associated thermonuclear flame. There is also a nice appendix describing the physics of supernova light curves.

The book ends with a discussion of models of galactic chemical evolution. Thus one is brought from nucleosynthesis yields to the final present abundances in the Galaxy. This chapter gives a good introduction to the essential ingredients of galactic chemical evolution models, particularly the analytic one-zone models. It ends with a nice reminder of the often understated uncertainties in such models.

This book should be in the library of any active researcher or newcomer in the fields of stellar evolution, nucleosynthesis, or galactic evolution. It could also be useful as a graduate text, although it is not really geared toward students. It is one of the best summaries of the relevant physics and analytic approximations for stellar evolution and nucleosynthesis I have found, offering excellent discussions of all the current areas of active research.

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Browsings

Bose-Einstein Condensation. A. Griffin, D. W. Snoke, and S. Stringari, Eds. Cambridge University Press, New York, 1996. xiv, 602 pp., illus. Paper, $39.95 or £29.95. ISBN 0-521-58990-8. Reprint, 1995 ed.

A reissue of a collection of 19 review papers and 17 "brief reports" published shortly before the achievement of Bose Einstein condensation (see *Science* **269**, 182 and 198 [1995]), with a new preface pointing to the now-increased activity in the field.

A Century of Mycology. Brian Sutton, Ed. Published for the British Mycological Society by Cambridge University Press, New York, 1996. xiv, 398 pp., illus. $90 or £60. ISBN 0-521-57056-5. British Mycological Society Centenary Symposium (Sheffield, UK, April 1996).

A dozen British and American students of fungi look backward at the changes that have affected their field and expound features of their study organisms.

Do Lemmings Commit Suicide? Beautiful Hypotheses and Ugly Facts. Dennis Chitty. Oxford University Press, 1996. xxi, 267 pp., illus. $49.95 or £37.95 (ISBN 0-19-509785); paper, $24.95 or £18.95 (ISBN 0-19-509786-6).

A first-person account of researches at Oxford University's Bureau of Animal Population, 1929–1961.

Fragile Objects. Soft Matter, Hard Science, and the Thrill of Discovery. Pierrre-Gilles de Gennes and Jacques Badoz. Copernicus (Springer-Verlag), New York, 1996. xvi, 189 pp., illus. $24. ISBN 0-387-94774-4. Translated from the French edition (Paris, 1994) by Axel Reisinger.

A mix of exposition on the structure of matter (macromolecules, liquid crystals, bubbles and foams), historical tidbits, autobiography, and reflections on research and education as seen from a French point of view; based on talks given to French high school students by the Nobel-Prize-winning senior author.

Kinds of Minds. Toward an Understanding of Consciousness. Daniel C. Dennett. Basic Books, New York, 1996. vii, 184 pp., illus. $20 or C$28. Science Masters Series. ISBN 0-465-07350-6.

Further reflections by the author of *Consciousness Explained* and *Darwin's Dangerous Idea*, including a skeptical consideration of the mental capacities sometimes attributed to non-human animals.

Polygamous Families in Contemporary Society. Irwin Altman and Joseph Ginat. Cambridge University Press, New York, 1996. xvi, 512 pp. $54.95 or £55, ISBN 0-521-56169-8; paper, $27.95 or £19.95, ISBN 0-521-56731-9.

A study by a psychologist and an anthropologist of some two dozen Mormon families living in two communities in the Rocky Mountain area of the United States.

Proceedings of the *Exxon Valdez* Oil Spill Symposium. Stanley D. Rice, Robert B. Spies, Douglas A. Wolfe, and Bruce A. Wright, Eds. American Fisheries Society, Bethesda, Md, 1996. xii, 931 pp., illus. $35. ISBN 0-913235-95-4. American Fisheries Society Symposium 18 (Anchorage, AK, Feb. 1993).

Some 60 papers, reviewed and revised since their original presentation, on the aftermaths of the 1989 Alaska disaster, ranging from tracking and treatment efforts through effects on particular species, especially fish, to "human impacts."

Search for the Tourette Syndrome and Human Behavior Genes. David E. Comings. Hope Press, Duarte, CA, 1996. ix, 309 pp., illus. $34, ISBN 1-878267-36-1; paper, $29.95, ISBN 1-878267-41-8.

An account by a geneticist at the City of Hope National Medical Center of his 18 years of research on the disorder.