Book Reviews

Planetary Science

Asteroids. Papers from a meeting, Tucson, Ariz., Mar. 1979. TOM GEHRELS, Ed. University of Arizona Press, Tucson, 1979. xii, 1182 pp., illus. $19.95.

During the last decade, most of the publicity about exploration of our solar system has gone to the spectacular discoveries made about the surfaces and atmospheres of the terrestrial planets and, more recently, Jupiter and its satellites. During this time, however, a small but growing number of scientists have turned their attention to the asteroids. This effort to understand asteroids has been to a large extent multidisciplinary, particularly with respect to the relations between meteorites and asteroids.

The extraterrestrial origin of meteorites was originally inferred in 1794, and shortly afterward, in 1803, it was proposed that meteorites came from an exploded planet. The asteroid Ceres was first discovered in 1801; this discovery caused great excitement, for Ceres was thought to be the missing planet predicted to lie between Mars and Jupiter following Bode's law. By the end of the 19th century, some 20 asteroids had been found; but it was not until the mid-20th century that asteroidal studies became scientifically "reputable," and not until the 1970's that such studies developed into a discipline in their own right.

The techniques used to investigate the asteroids were in some cases techniques that had been developed for study of the moon and planets before the days of spacecraft exploration. The use of photometric and polarization measurements to understand the surface characteristics of the moon was well developed in the 1960's, and interpretations based on these data were later tested by the return of samples from the Apollo missions. Scientists interested in these techniques were thus able to turn their attention to the asteroids with more confidence than would have been possible otherwise. They were particularly encouraged by the possibility of future spacecraft missions to the asteroids and the need to develop a scientific rationale to support such missions. The composition of the asteroids became important, and the clear possibility that samples of the asteroids already reside in meteorite collections on earth led to closer collaboration between those interested in meteorites and those interested in asteroids.

As a result of all these studies, there has been an explosion in knowledge of the asteroids. The physical properties of individual bodies have been described, the surface compositions have been interpreted and compared with meteorites, orbits have been defined, and the distribution of different compositional types has been established. Thus we now have a much better data base on which to discuss the origin and evolution of asteroids and relate them to the growing knowledge of the history of the solar system.

Planetary workers can no longer neglect such an important field, and this book is ideally suited to inform all of us of the present state of understanding. It is an important reference for those already established in asteroid research and will certainly stimulate considerable interest among newcomers to planetary studies, since it is the obvious starting point for students embarking on research in this field. Though most of the book, which consists of 41 state-of-the-art papers, may delve too deeply into the subject for undergraduate students, the opening three review chapters—on the history of asteroids by Gehrels, on the nature, origins, and evolution of asteroids by C. R. Chapman, and on the accretion, differentiation, fragmentation, and irradiation of asteroids by L. L. Wilkening—provide excellent reading material for undergraduate courses as well as a substantial basis for understanding the later chapters. The book is strongly recommended to all who concern themselves with astronomy and earth science.

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Ecological Recommendations

Conservation Biology. An Evolutionary-Ecological Perspective. MICHAEL E. SOULÉ and BRUCE A. WILCOX, Eds. Sinauer, Sunderland, Mass., 1980. xvi, 396 pp., illus. Paper, $14.95.

Public awareness of the damage being caused by the increasing assault of humans on the environment has been developing with relatively little input from ecologists doing basic research. This is at least partly because participation in applications of science is discouraged by the academic system of rewards, but also partly because researchers are not especially skilled in making recommendations about what they consider to be very complex systems. But if basic research results are applicable to problems of habitat modification and population regulation it is time for experts in these fields to provide some advice.

Editors Soulé and Wilcox present this volume as a step in that direction. The contributors include scientists in the fields of ecology, behavior, genetics, demography, and natural resources. Their papers treat ecological principles of conservation (part 1), the consequences of insularization (part 2), captive propagation (part 3), and exploitation and preservation (part 4). Interesting new information is provided, particularly in the chapters by Eisenberg on tropical mammals and by Benirschke, Lasley, and Ryder on the technology of captive propagation. But the main impression left with the reader is that scientists will continue to be relatively ineffectual in the conservation movement. At least the recommendations offered here are unlikely to be welcomed by wildlife managers as insightful new findings. And only the last two chapters, by M. Coe and P. R. Ehrlich, treat the larger issue of the relation of the world resource base to the growing human population.

L. E. Gilbert presents an elaborate discussion of the food webs and habitat specializations of tropical insects. Because some insects require both early and late stages of vegetational succession to complete their life histories, he recommends that reserves be designed with the largest possible component of disturbance. On the basis of a discussion of disjunct, "patchy" distributions of birds in New Guinea and other tropical islands, J. Diamond concludes that tropical species are less dense and have more habitat specialization and lower dispersal abilities than temperate-zone birds. No data giving tropical-temperate comparisons are provided, however.

Foster discusses the heterogeneity of tropical forest vegetation and recommends with Diamond that tropical reserves be large and widely dispersed. With the chapters by Wilcox and by Terborgh and Winter based on the theory of island biogeography, the reader begins to suspect that ecologists do not define their terms or frame their questions carefully enough or make statistical tests. The authors do not take into account research from other sources indicating that predators are not the primary regulators of prey populations and suggesting that alternative theories explain distributions at least as well as the theory of island biogeography. And their recommendations are cast in vague, relative terms. Perhaps present ecological theory is insufficient as a basis for making decisions, at least about the design of nature reserves.

Populations of animals maintained for several generations at fewer than 50 breeding individuals lose genetic variability and suffer inbreeding depression. According to J. W. Senner, the size of the founder population is less critical than its rate of increase. This means that even the 580-square-kilometer Guatopo National Park in Venezuela is too small to provide for the long-term survival of its estimated 20 jaguars. In fact, Soulé and I. R. Franklin estimate that the minimum population size required to preserve evolutionary potential for the future is closer to 500 individuals. Given the levels of habitat destruction that have already taken place, the long-term maintenance of populations of large vertebrates on reserves is probably not possible. Goodman discusses whether careful modification of the age structure of a population could be employed to control populations without losing genetic variability and presents three applications of this method based upon data for the Pribiloff seal.

How about propagating endangered populations in captivity and then returning them to the wild? W. G. Conway and S. Campbell show that, the limited success that has been achieved with the whooping crane and the peregrine falcon notwithstanding, captive propagation is not economically feasible in most cases. According to Kleiman what is known about the management of captive populations has been learned slowly by trial and error and by sensitivity to species-specific behavioral systems.

The most comprehensive and encouraging chapter is the one by Coe on African wildlife resources. It summarizes the interactions between humans, the vegetation, the climate, and the fauna, emphasizing that if managed properly this system is still capable of renewing itself. The goal of putting conservation in a biological perspective is laudable, but Ehrlich concludes that if biologists doing basic research are going to be effective in the conservation movement more than their willingness to study the impoverished biota and make recommendations about nature reserves is needed. These efforts are only worthwhile if the larger conservation issue is also addressed. How do you get a wealthy nation to stop thinking in terms of an ever-expanding economy? The main message of this volume has to be read between the lines. Biologists are as ill prepared for the imminent resource crisis as the rest of the populace.

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Sexual Selection

Genetic Models of Sexual Selection. PETER O'DONALD. Cambridge University Press, New York, 1980. xii, 250 pp., illus. $32.50.

Darwin's theory of sexual selection, given in detail in *The Descent of Man and Selection in Relation to Sex* (1871), proved even more controversial in the scientific community than had the theory of natural selection. To explain patterns of sexual dimorphism in secondary sex characters and mating behaviors in higher animals, Darwin invoked two main selective agencies, combat or competition between individuals of one sex (usually males) for mates, and preferences exercised by the opposite sex (females) for certain characters in their mate (or mates). A major weakness in Darwin's argument was his inability to suggest why, in many species where males mate promiscuously and invest little or nothing but gametes in the next generation, females should develop sexual preferences for males with extreme characters that are apparently useless or deleterious for survival.

In species with exaggerated male characteristics, such as pheasants (most notably peacocks), birds of paradise, elephant seals, many deer and antelope, and some Hawaiian *Drosophila*, males may congregate at special localities called leks to compete and display for potential mates. In such mating systems differential mating success among males is determined in large part by female mating preferences, which are a major source of variance in male fitness. How are female mating preferences maintained in these systems? R. A. Fisher, in *The Genetical Theory of Natural Selection* (1930, 1958), provided an ingenious solution to Darwin's problem by suggesting that the evolution of mating preferences can be genetically unstable, so that "both the feature preferred and the intensity of the preference will be augmented together with ever-increasing velocity, causing a great and rapid evolution of certain conspicuous characters, until the process can be arrested by the direct or indirect effects of Natural Selection." The publication in 1972 of a Darwin centennial symposium entitled *Sexual Selection and the Descent of Man* (B. Campbell, Ed.) marked a resurgence of interest in sexual selection, which is today a subject of active research.

Peter O'Donald has developed much of the existing quantitative theory of sexual selection. In the volume under review, he summarizes and extends his work of the past several years, which has concentrated on the evolutionary importance of mating preferences. Although a synthesis of the literature on sexual selection is not attempted, whenever possible the models are motivated, illustrated, and fitted with data on mating systems in insects and birds, the emphasis being on experiments by Spiess and Ehrman on the rare-male mating advantage in *Drosophila* and observations by Davis and O'Donald on pairing and reproduction in the Arctic skua. O'Donald stresses that the evolutionary mechanisms of sexual selection are sufficiently complex that a quantitative approach using population genetics models is essential for a clear understanding of the dynamics of the process.

The book begins with a historical review of the theories of Darwin and Fisher and of misconceptions introduced by some prominent evolutionists. For example, A. R. Wallace, cofounder of the theory of natural selection, readily accepted the importance of male combat but refused for religious reasons to believe that species other than humans were capable of esthetic judgment and discrimination; and J. S. Huxley nearly eclipsed sexual selection as a legitimate subject of study for many years by confusing individual and group selection. Until recently it was not realized by many workers that under sexual selection the fitness of a trait with respect to mating success can override its value for survival, decreasing the average total fitness in a population. Further complications may arise from linkage between