

A Feral Population

Wild Horses of the Great Basin. Social Competition and Population Size. JOEL BERGER. University of Chicago Press, Chicago, 1986. xxii, 326 pp., illus. \$24.95. Wildlife Behavior and Ecology Series.

The spread of feral livestock has been one of the least investigated consequences of the global dissemination of European agriculture in the last 400 years. Surprisingly few scientists have grasped the opportunities offered by these vast and repeated experiments in population and community ecology. Yet scientific information on feral species is now urgently needed for the management that is demanded by an often polarized public. Over no feral species does public opinion take more extreme positions than over the feral horse in North America. This is a timely book, providing an excellent, full, and very readable account of the ecology and behavior of a population of feral horses in part of the Great Basin Desert. The horses were studied in a remote area, free from the effects of cattle or humans but living with native wild herbivores. Over five years the author and his team recorded the resources and habitats seasonally used by the horses, their social organization, and, above all, their individual reproductive success and the social and ecological factors that influenced it. In this area in particular the book goes far beyond being a simple account of feral horse biology and becomes an advanced exploration of the behavioral ecology of the species. Yet it does so in pursuit of what I had considered a rather outdated theme.

The book's subtitle is "Social Competition and Population Size," and on the first page Berger declares: "My central theme is simple: *if individuals that are likely to reproduce do not do so because of the behavior of others, then social limitations are imposed on the size of the population*" (his italics). Nowadays that should produce a chorus of "not necessarily" responses from ecologists, since the statement is true only if the surrendered reproductive output of the affected individuals would have exceeded the extra output gained by their oppressors. In the end, Berger dismisses this "central theme" as unproven since almost all events that could be interpreted as limiting the population are explicable in terms of resources rather than social interactions. However, competition between stallions for control of female bands induced some abortions, increasing interbirth intervals for some mares and lead-

ing to a 4 percent reduction in the number of foals born. This and a few combat-related deaths of adults were the only demonstrable contributions of social behavior to limitation of population size, he believed.

This pursuit of an unprovable "central theme" detracts little from an otherwise straightforward account of reproductive strategies in a wild equid. The book is full of new and intriguing ecological and behavioral insights. For example, familiarity rather than genealogy seems to determine a stallion's behavior toward colts and fillies growing up in his harem; individuals of either sex are apparently not recognized by the stallion after 18 months' separation. Stallion weight is relatively unimportant in fighting in this homomorphic species, but "experience" of aggression is positively correlated with high breeding status. Berger explodes the myths that female horses band for life (at least half will change bands) and that young females are ousted by stallions or other females.

It is pleasing that the publisher has placed the plates, figures, and tables close to the relevant positions in the text rather than clustering them. I personally like having a summary of major points at the end of each chapter but should warn readers that here there are some discrepancies between the text and these summaries. The level of production is very high and the writing very clear. Tests of ideas are carefully introduced and conclusions are usually conservatively drawn.

Berger ends his book with an appraisal of the conservation needs of the Great Basin Desert and its wildlife. He puts forward a well-argued case for a national park kept free of all exotic animals, cattle-raising land from which most horses would be removed, and at least three small preserves (free of cattle) for feral horses. This plan, if implemented, would nicely balance the wishes of those who condemn horses as competitors with cattle or destroyers of native pasture and those who want there still to be wild horses running free. I read this book while taking part in a survey of environmental damage by feral horses in arid central Australia (where there are over 200,000 feral horses). Like Berger, I admired the sight of free-running bands of wild horses; but unlike him I had to watch as surviving horses picked their way past their starved, dead companions to reach water, and I looked out across valleys stripped of grass by the horses, the soil trampled to dust and blowing or washing

away. Preservation of feral horses has little place here, yet this book will have as much value for those who must decide how to manage this overstocked region as for those who wish to keep wild horses in the Great Basin. This is an excellent and thought-provoking book for wildlife biologists and behavioral ecologists alike.

PETER J. JARMAN
*Department of Ecosystem Management,
University of New England,
Armidale 2351, Australia*

Cenozoic Paleooceanography

The Miocene Ocean. Paleooceanography and Biogeography. JAMES P. KENNETT, Ed. Geological Society of America, Boulder, CO, 1985. vi, 337 pp., illus., + microfiches and insert. \$42. GSA Memoir 163.

The Miocene Epoch, 24 to 5 million years ago, marked the beginnings of the modern world, oceanographically, climatically, and biologically. Our biota owes its character to evolutionary events initiated in that epoch. *The Miocene Ocean* provides, in 14 papers full of data and interpretations, a detailed look at the oceanography and biogeography, at least for the pelagic realm, of this important time period for understanding the present.

Thirteen of the papers result from studies of Deep Sea Drilling Project cores collected by the D.V. *Glomar Challenger* throughout the world's oceans, excluding the Arctic. These studies are not loosely collected works but result from a coordinated group effort known as the Cenozoic Paleooceanography Project (CENOP), led by the book's editor, J. P. Kennett. After the initial introductory paper on sea-floor depth changes through the Neogene, the remaining papers all deal with the microfossil record in one respect or another. Age correlation between cores is essential to a study of this nature, and two papers establish the biostratigraphic criteria in detail. Several papers document the oxygen and carbon isotopic record preserved in the Miocene microfossils with the aim of interpreting the thermal history of the oceans. Biogeographic patterns in benthic and planktonic Foraminifera and Radiolaria are documented in six papers.

Of course, not all of the Miocene could be examined in detail, so CENOP chose to focus on three time slices: 22, 16, and 8 million years ago. These provide a changing picture of the Miocene, dominated chiefly by the development of a global latitudinal thermal gradient in the oceans. Along with this gradient came intensification of the

vertical thermal structure of the tropical oceans, more vigorous circulation, partitioning of pelagic biotas biogeographically, and increased ocean productivity. East-west biogeographic differences are also recorded during the Miocene, and these changes are attributed to tectonic restriction of the Indonesian and Middle American seaways. The profound oceanic thermal changes during the Miocene, brought on by the development of permanent polar ice sheets, also had major impact on the terrestrial environment, but this is not intended to be a part of the book.

This book is important to marine geologists and paleontologists of all sorts, including those dealing exclusively with shallow-water, near-shore situations, and to people interested in terrestrial and climatic history as well because of the close linkage between the oceans and climate. Its 23 authors and the editor have provided more knowledge about the oceans than is available for any other time except the Quaternary.

JERE H. LIPPS
*Department of Geology,
University of California,
Davis, CA 95616*

Interplanetary Dust

Properties and Interactions of Interplanetary Dust. R. H. GIESE and P. LAMY, Eds. Reidel, Dordrecht, 1985 (U.S. distributor, Kluwer, Hingham, MA). xxvi, 444 pp., illus. \$64. Astrophysics and Space Science Library, vol. 119. From a colloquium, Marseille, July 1984.

This collection of 80 papers presents a rather up-to-date account of knowledge of and research on interplanetary dust. Following the format of the colloquium from which it derives, the volume contains seven sections: on observations of zodiacal light and the F-corona; space and related ground experiments on interplanetary dust; laboratory studies of interplanetary dust collections; experimental and theoretical studies of grain optics; relationships of interplanetary dust to comets and meteoroids; dust-plasma interactions; and dynamics of interplanetary dust. The term "dust" is restricted to very small particles excluding meteors.

All but two of the sections start with invited reviews that summarize the state of their field and provide useful reference sources. Although not labeled as such, Leinert's paper on the dynamics and spatial distribution of dust has many features of a brief review. Weinberg's review of zodiacal light observations and the contributed papers that follow it present a very up-to-date account of this, the oldest phase of inter-

planetary dust research. Included are brief accounts of balloon-borne infrared measurements and IRAS (Infrared Astronomical Satellite) observations.

In his review of laboratory investigations of optical properties, Zerull briefly describes the theoretical aspect of the problem and then outlines the experimental procedures for studying scattering by individual particles. These include microwave analogue studies, laser and electrostatic levitation, and the use of fine threads for particles sufficiently large compared to thread diameter. The analogue technique, now most vigorously pursued at the Ruhr University at Bochum Laboratory, where Zerull is located, receives the most emphasis. Because particles are scaled up to centimeter dimensions this procedure also permits the composition, structure, and shape of a particle to be readily fabricated. It also requires a large laboratory for carrying out the measurements.

Dust-plasma interactions have received less attention but can have significant effects. These are described by Fahr and Ripken for the heliosphere. Other areas of current interest are planetary rings, particularly for Saturn, and cometary dust tails.

Brownlee's chapter on the collection of interplanetary dust is disappointing in view of his extensive and exciting contribution to the field. About a third of the chapter is an account of Hemenway's early work. The report from the McDonnell Center for Space Sciences by Fahey *et al.* together with Brownlee's review provides a good summary of analytical work on individual particles. As techniques improve and skills in applying them are developed, the study of individual particles will become a major approach to research on interplanetary dust.

Missing from the book is discussion of experimental investigations of the formation and properties of grains condensed from cosmic-type gas mixtures. Study of properties of such grains and their thermal metamorphosis and hydration effects is an important complement to the analysis of interplanetary grains.

An interesting and often valuable feature of symposium proceedings is a report of the discussions that followed presentation of the papers. In this volume only a small fraction of the papers are followed by such reports.

This book on the whole is valuable for finding out where research on interplanetary dust is heading and what its present status is. It is a source of references to work through 1984 but does not stand on its own because of the brevity of the papers.

B. DONN
*Laboratory for Extraterrestrial Physics,
Goddard Space Flight Center,
Greenbelt, MD 20771*

Some Other Books of Interest

Advances in Plant Nutrition. Vol. 1. P. B. TINKER and ANDRÉ LAÜCHLI, Eds. Praeger (Greenwood), Westport, CT, 1986. xviii, 301 pp., illus. \$40.95.

Because of the success with which fertilizers have been used, the editors of this new series note in their introduction, the study of plant nutrition has come to seem stagnant. However, in view of "signs that the subject may once again be entering a period of excitement and rapid development," they have judged it "an appropriate time to launch a series [that will] bring out comprehensive reviews on topics of current interest within the discipline as a whole." Both fundamental science and practical application will be included, and especially, it is hoped, work that joins the two. The inaugural volume contains accounts of six topics: the efficiency of nitrogen fertilizers in cereals as related to climate (Craswell and Godwin); breeding for nutritional characteristics in cereals, especially as related to trace elements (Graham); nutrient uptake rates as related to inorganic tissue components (Glass and Siddiqi); the functions of calcium (Hanson); the role of adenosine triphosphatases in nutrient absorption (Leonard); and the potential use of nuclear magnetic resonance in the study of plant nutrition (Loughman and Ratcliffe). As is intended for future volumes, the present volume includes an "Editorial" describing promising research trends on other topics in the field.

—K.L.

Some Mathematical Questions in Biology: Muscle Physiology. American Mathematical Society, Providence, RI, 1986. x, 234 pp., illus. Paper, \$35. Lectures on Mathematics in the Life Sciences, vol. 16. From a symposium, Detroit, MI, May 1983.

Some Mathematical Questions in Biology: DNA Sequence Analysis. American Mathematical Society, Providence, RI, 1986. x, 124 pp., illus. Paper, \$28. Lectures on Mathematics in the Life Sciences, vol. 17. From a symposium, New York, May 1984.

A symposium entitled "Some Mathematical Questions in Biology" is an annual feature of the AAAS meetings. These volumes represent proceedings of two of the most recent in the series.

The volume on muscle physiology contains papers on the molecular mechanism of muscle contraction by H. E. Huxley, the role of ATP hydrolysis in muscle contraction by E. Eisenberg, a model of the contractile process based on component studies by M. B. Propp, a mathematical method for deter-