Post-Pleistocene Foragers

Guilá Naquitz. Archaic Foraging and Early Agriculture in Oaxaca, Mexico. KENT V. FLANNERY, Ed. Academic Press, Orlando, FL, 1986. xx, 538 pp., illus. $98.50. Studies in Archaeology.

Guilá Naquitz is a small rock-shelter in the Tlacolula arm of the Valley of Oaxaca, not far from the famous Zapotec ruins of Mitla. Although the area of occupation measures only about 8 by 11 meters, it has been made the subject of a monograph of over 500 pages of small print, with contributions by 21 specialists. Lest it be thought that this is a case of swatting a fly with a cluster bomb, let me say at the outset that not since Graham Clark's classic Star Carr report on an equally small Mesolithic site in Britain has so much information been extracted from such modest data.

The basic research problem as set forth by Flannery was "to develop a model that would not only deal with some of the underlying and more universal aspects of early domestication but also tie that process into the specific cultural pattern for the Valley of Oaxaca." The really big question is why the process leading to incipient agriculture should have occurred more or less simultaneously, between 10,000 and 5,000 B.C., at widely scattered spots around the globe.

As he has done before, Flannery adopts an ecosystem approach to the analysis of the preceramic components of Guilá Naquitz, one derived from cybernetics and not linked to linear-causal or "prime mover" models. The core of the model for end-Pleistocene Oaxaca is a small human population of foragers (rather than collectors, who would have been more sedentary) moving through the annual plant harvest year after year for centuries.

According to "acceptable" ^{14}C dates, the cave was occupied from 8900 to about 2000 B.C. The living floors of Guilá Naquitz represent a series of microband camps made by families of four to five persons who arrived in the Mitla area toward the end of the mesquite season (late August or early September) and who stayed in the rock-shelter until the end of the acorn harvest, presumably in late December. The preceramic Mitleños also harvested piñon nuts, prickly pear fruits and pads, and wild beans. Planted crops included squashes and the bottle gourd, which Flannery, following a suggestion of Donald Lathrap's, believes is the New World's oldest domesticate, albeit used exclusively as a container.

No *Zea* remains, either maize or teosinte, are securely associated with preceramic levels in the cave, but if primitive maize was being grown by 5000 B.C. in the Tehuacán Valley, about 150 kilometers to the northwest, it seems likely that the Mitleños were growing this plant at the same time. Flannery remains a proponent of the origin of maize from teosinte. He recognizes, however, that the archeological evidence for this hypothesis is weak; in fact, it largely rests upon the identification by James Schoenwetter of pollen grains in early preceramic levels of the nearby Cueva Blanca as teosinte (*Z. mexicana*). Final judgment will have to be deferred until the publication of the Cueva Blanca results in a separate volume. Until then, I see little reason to dismiss the pop-podcorn hypothesis of Paul C. Mangelsdorf as untenable.

The individual contributions to the analysis of environmental data (especially pollen), artifacts, and food remains are all of the highest caliber, but no justice can be done to them here. I can only raise a query about the late Eric Callen's analysis of the coprolite sample from Guilá Naquitz. Because these contained animal hair, insect parts, beetle larvae, and "other such items," he diagnosed them as animal rather than human. Insects and their larvae still form part of the Mesoamerican diet, and, though animal hairs do not, there is still the possibility that a few of these objects might be human feces.

A unique feature of this report is that the same excavation data—occupation floors and the distribution on them of artifacts and food remains—have been subjected to three independent analyses, using computers. C. S. Spencer and Flannery concentrated on spatial variation and found that the sexual division of labor was its most important source. R. Whallon undertook a dimensional analysis of variance by excavation squares; the visual results do not conflict with Spencer and Flannery's. R. G. Reynolds performed a multidimensional scaling of four living floors, by means of which he was able to isolate not only men's and women's processing areas but also pathways into and within the cave.

The final chapter, "A visit to the master," is like the finale to a great fireworks show, a pyrotechnic display of Flannery's intellectual virtuosity. Presented in the fictional form of a supposed pilgrimage to an archeologically savvy guru, it can be read both as a wonderful parody of Castaneda's Don Juan series and as Flannery's summation and interpretation of the Guilá Naquitz results. Although Flannery, following Ernst Mayr, eschews the search for laws like those of physics in the biological and human realms and cautions against single-cause theories, he does believe that end-Pleistocene climatic changes and population growth around the world led to a density-dependent shift in human behavior, especially since emigration and high mobility could no longer be solutions to problems. The result of these changing strategies was that people, including those of southern Mexico, began to interfere with the evolution of plant species, eventually achieving domestication.

This is must reading for all those interested in early moves toward an agricultural life.

MICHAEL D. COE
Peabody Museum of Natural History, Yale University, New Haven, CT 06520

Paleobiology

Phanerozoic Diversity Patterns. Profiles in Macroevolution. JAMES W. VALENTINE, Ed. Princeton University Press, Princeton, NJ, and Pacific Division, American Association for the Advancement of Science, San Francisco, 1985 (distributor, Princeton University Press). x, 442 pp., illus. $50; paper, $15. Princeton Series in Geology and Paleontology. From a symposium, Santa Barbara, CA, June 1982.

Paleobiology, the study of evolutionary and biological aspects of the fossil record, continues to blossom and thrive. This book is an excellent survey of paleontological data and theory relating to large-scale patterns in the history of life (macroevolution). In the 1970's, paleobiologists sought to test whether speciation occurs by gradualism or by punctuated equilibria, but they discovered that most segments of the fossil record just are not well enough dated to tell the difference conclusively. The 1980's seem to be the decade of mass extinctions and global diversity. Even if speciation cannot be readily studied in the fossil record, at least the big patterns (megaevolution, as it was once called) can be made out.

This volume of 14 papers by a cross-section of the best North American workers in the field is based on a meeting held in 1982. Regrettably, then, it predates the "cyclicity of mass extinctions" debate, and a number of the ideas presented in it have by now been published elsewhere. Nevertheless, the book contains a great deal of meat for paleontologists and evolutionary biologists.

Four papers survey the empirical evidence of the diversity of life through Phanerozoic time, the past 570 million years of abundant life. Marine animals are dealt with by Sepkoski and Hulver, terrestrial vertebrates by Padian and Clemens, vascular land plants by Niklas, Tiffney, and Knoll, and marine invertebrates by Signor. These authors all comment on the main problem of these kinds of studies, which is the incompleteness of the fossil record. The land vertebrate record is particularly weak, and this is illustrated by the apparent fact that the dinosaurs died out completely not once but dozens of times during their history. Padian and Clemens note that a strict reading of the fossil record shows a total extinction of dinosaur genera every five million years or so, at the end of each geological stage.

Signor surveys the possibilities for applying correction factors to take account of the patchiness of the fossil record. It has been argued that our knowledge of fossil distributions depends on at least three factors: the volume of sedimentary rocks laid down during each time period, the area of these rocks that is now exposed, and the degree of research attention that has been devoted to them (so-called "paleontological interest units" may be calculated). Signor finds that broad correction factors for these biases may be applied to the fossil record of marine invertebrates and that when they have all been allowed for there appears to have been a rising trend in species diversity through time, with a particularly great increase during the Cenozoic, the last 66 million years.

Several papers look at ecological aspects of the diversity of life and seek to explain how major groups replace each other through time and why the overall diversity of life has increased. In the case of marine invertebrates during the Paleozoic (570 to 245 million years ago), Sepkoski and Miller find that each successive fauna appears first in an onshore location and later extends to offshore environments. This study relies on the assumption that there exist major "communities" (in the paleontological sense) that maintain their integrity for tens or hundreds of millions of years as species and genera come and go. Richard Bambach finds that major increases in diversity of marine animals are related to the "discovery" and utilization of empty ecospace (opportunistic adaptive radiation), and certain major adaptive zones may remain empty for a long time after a group becomes extinct and before an ecologically equivalent group evolves. The idea of empty ecospace is very important, and it may suggest that the history of life is not dominated by high levels of competitive interaction in which resources are all hotly contested and adaptive radiations are driven by wholesale improvements in competitive ability. The hard-to-define idea of "progress" in evolution again comes into question.

Progress and competition in macroevolution form part of the equilibrium viewpoint, that the diversity of life tends to increase to a certain level, a kind of global carrying capacity, and a dynamic equilibrium will be established. A new equilibrium level can be attained only if the biosphere is perturbed in a major way. In a theoretical paper, Kitchell and Carr develop a non-equilibrium mathematical model to describe the patterns of diversity and replacement of Phanerozoic marine animals. This stochastic approach offers a workable alternative to the equilibrium (deterministic) approach to global diversity of Sepkoski and others. Just as many ecologists now argue that equilibrium modeling of ecosystems may have limited validity because ecosystems rarely, or never, reach equilibrium, so Kitchell and Carr argue that the diversity of the biosphere is in a state of "continual disequilibrium" because of perturbations (extinction events) and major evolutionary innovations.

In contrast to the global approach of the papers just described, a few tackle particular aspects. For example, David Jablonski attempts a test of the popular theory that many mass extinctions were caused by global marine regressions. He examines modern marine faunas and finds that, even if all species on the continental shelf were wiped out, there would be a reduction in numbers of families of only 13%, much less than the magnitude of the end-Permian (245 million years ago) mass extinction event (52% reduction). Ward and Signor look at the relatively well known fossil record of ammonites and attempt to find regular patterns of diversification. However, the different families expand and contract through time with a great variety of patterns, and there is no single easy explanation.

James Valentine, the editor of this book, published seminal papers on Phanerozoic diversity patterns in the late 1960's and 1970's. Great strides in our understanding have been made since then, but there are still major problems: how good is the fossil record? what is the "shape" of the history of life? are the patterns caused by equilibrium or non-equilibrium processes? The questions could not be larger, but they are all the more exciting for that.

M. J. BENTON
Department of Geology, Queen's University of Belfast, Belfast BT7 1NN, Northern Ireland

Marine Mammals

Fur Seals. Maternal Strategies on Land and at Sea. ROGER L. GENTRY and GERALD L. KOOYMAN, Eds. Princeton University Press, Princeton, NJ, 1986. xviii, 292 pp., illus. $40; paper, $14.50.

This multi-authored volume describes an approach for extending traditional land-based studies of seals by using an ingenious instrument known as a time-depth recorder to obtain information from free-ranging animals at sea. This approach is employed to provide a more complete description of maternal behavior in five species of fur seals and one sea lion experiencing varying degrees of environmental uncertainty. For each species, observations of females and their pups on land are supplemented with diving records from the females' excursions offshore to obtain food. For one species, the approach was extended by using isotopic tracer methods to estimate some components of energy budgets of females and pups during the nursing period. The results are collated and compared in the final chapter to investigate how maternal strategies in otariid seals vary with environmental predictability.

Small sample sizes plague research on marine mammals and are a particular problem when the techniques required to obtain data are costly. In this case, expense limited the number of time-depth recorders employed, and the tendency of such instruments to break down reduced sample sizes even further, in some cases to three or fewer animals. Though the authors carefully detail such limitations in the data they present, it remains for the reader to remember them, particularly in the final chapter, where small databases tend to get lost sight of in interspecific comparisons.

This work is not without some more avoidable problems. There are annoying inconsistencies, both within and between chapters, and probabilities associated with statistical tests are presented in an often flawed manner. The term "attendance behavior," defined in the preface, is subsequently used in so many different contexts that its intended meaning becomes obscured. In several chapters, estimates of feeding success of female otariids during foraging trips at sea are based on questionable assumptions about food requirements or intake. Equally questionable is the use of yearly mean sea surface temperature as an index of environmental uncertainty. The editors compare the "most extreme environments (subpolar and tropical) inhabited by otariids" in fig. 1.1 and conclude (p. 5) that "the sites differed most in the rapidity of [annual temperature] change around the overall mean." Yet, this pattern disappears when the two graphs in fig. 1.1 are plotted