fortunate, for it is the kind of book that has to be examined and re-examined, and explored at one's leisure, if its full value is to be realized. Those who are able to purchase personal copies will perhaps be gratified by the preface statement that all royalties will be used to establish a fund to support travel by young investigators; the fund will be administered by the International Committee on Biological Acoustics.

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Pollen Analysis

The Last 10,000 Years: A Fossil Pollen Record of the American Southwest. Paul S. Martin. University of Arizona Press, Tucson, 1963. viii + 87 pp. Illus. $4.50.

This thin book with big pages recounts the efforts of a Pleistocene pollen analyst and biogeographer, who has broad interests, to reconstruct through pollen analysis the vegetational and climatic history of the semidesert country of southeastern Arizona since the last glacio-pluvial period 10,000 years ago. This task is fraught with many more difficulties than are encountered in pollen studies of the bog sediments of glaciated regions, where one rarely encounters such problems as poorly preserved pollen, low concentrations of pollen, redeposition, and "long-distance" importation of pollen by variable winds from not-too-distant mountain ranges. Martin's is the first comprehensive research program in which arid-region alluvial sediments have served as the basis for an extended pollen chronology. Its success should pave the way for comparable studies in other arid regions, such as the Mediterranean area, where the archeological record should stimulate efforts of equal magnitude.

The path to a substantial pollen chronology in a new region has many steps, and it is refreshing that Martin supports each one with peripheral studies—of the modern vegetation and modern pollen rain, of variation in the pollen content of multiple surface samples, of variation in size among the pollen of the nine species of Arizona pine, of the statistical validity of a pollen sum of only 200 to 250 grains, and of the effect of different preparation techniques on pollen recovery. All of these supporting studies undercut a skeptic's criticism of the basic premise of pollen analysis—that the pollen stratigraphy of the sediment records a sequence of real vegetational changes.

Martin establishes two important pollen baselines that cannot be controverted—first, the modern pollen rain in its relation to modern vegetation, and second, the contrasting pine-rich assemblage that represents the last pluvial period when conifers, which are now restricted to the crests of the basin ranges, seem to have extended at least as far down as the piedmont. The latter baseline, which has been confirmed by several studies throughout the Southwest, illustrates the magnitude of the environmental changes during the Pleistocene. The former represents the kind of approach that makes modern biogeography and ecology specifically useful to historical pollen analysis on a local and on a regional basis—the kind of approach that is proving productive in several concurrent studies elsewhere in America but which has never been practiced in European work.

Between these two baselines lies the heart of the investigation—an attempt to work out the pollen sequence for the time since the last pluvial period and to relate it especially to the problems of the environment of Early Man and of the extinction of large mammals. Martin concludes that the pollen record does not confirm the long-held notion that an "altithermal" interval of persistent droughts occurred during the time 8000 to 4000 years ago. In fact, on the basis of the relative proportions of three groups of pollen types (Compositae for wet alluvial plains with high water table, Chenopodiaceae-*Amaranthus* for dissected alluvial plains with low water table and alkali soils, and *Pinus* for the mountain vegetation), he proposes that this period was not marked by drought but rather by greater frequency of summer rains, brought to the region by monsoonal circulation from the Gulf of Mexico. This leads to the conclusion that the large mammals were extinguished not as a result of the loss of forage but as a result of the hunting prowess of Early Man, who thereby exhausted his food supply and was forced to develop agriculture.

The presentation is logically organized, with chapters on the geology, climate, vegetation, and modern pollen rain preceding the description of the pollen diagrams from the individual sites, the discussion of the biogeographic or ecologic meaning of the several types of fossil pollen, and a consideration of the climatic sequence inferred from the diagrams. Most of the basic data are clearly presented in various graphs and diagrams whose explanations, however, are in some cases either insufficient or buried in the text.

The text is lucid, although there are gross errors in punctuation and an excessive use of questions at the beginning and end of a paragraph. However, the prize for provocative prose is the preface, by E. S. Deevey, which is replete with mixed and unmixed metaphors. All in all, *The Last 10,000 Years* is good reading for those interested in biogeographic history, Southwestern archeology, paleoclimatology, and the theory and practice of pollen analysis.

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Deserts and Desert Animals

Desert Animals: Physiological Problems of Heat and Water. Knut Schmidt-Nielsen. Oxford University Press, New York, 1964. xvi + 277 pp. Illus. $7.20.

This book is divided into 16 sections, or chapters, that deal with man, the basic problems of desert life, and desert animals—the camel, cattle, the donkey, sheep, carnivores, rabbits and jack rabbits, the ground squirrel, the pack rat, the kangaroo rat, other rodents, estivating mammals, marsupials, desert birds and lizards, snakes and tortoises. Each section follows the same general format in that heat tolerance and regulation, water requirements and water balance are discussed in that order.

The author refutes many older concepts of heat tolerance and water requirements for animals. This is especially true with respect to the camel, which he and his associates have studied in some detail.

Schmidt-Nielsen uses an excellent method of citing authors. No parenthetical, highly abbreviated journal titles stop the reader's eyes as he scans each page. A number follows the cited author's name and this, in turn, is readily found in the "references" section at the end of the book.

It is to be regretted that the author did not have scientific names verified by a taxonomist. The name *Dipus*