Book Reviews

Ecological Catastrophes: Man's Role Debated

Pleistocene Extinctions. The Search for a Cause. Proceedings of the 7th congress of the International Association for Quaternary Research, vol. 6. P. S. MARTIN and H. E. WRIGHT, JR., Eds. Yale University Press, New Haven, Conn., 1967. x + 453 pp., illus. $12.50.

This book brings together a series of most interesting papers on a problem that has been often debated but never resolved. The cause of the faunal extinctions that occurred during the Pleistocene is not only a matter of intrinsic interest to zoologists and paleontologists but also is of considerable importance to the anthropologist-archeologist. It is perhaps fair to say that a consideration of man's role in this process is a matter of vital significance in assessing his capacity to change the ecological balance of his habitat and in evaluating the cultural adjustments consequent upon the extinctions.

The battle lines in the debate, as they have emerged from the somewhat scattered publications during the past quarter century, have been fairly clearly drawn. There are those like Loren Eiseley who maintain that man's influence on Pleistocene extinctions was minimal, and others, like Richard Foster Flint and this reviewer who consider the "human effect" to have been considerable.

The present volume does not resolve the issue any more than have past efforts. The two camps are still as divided as they ever were. This collection of papers does, however, bring an enormous quantity of new and well-reasoned data to bear on the problem. Thus it leads to greater refinement of argument and to a less simplistic assessment of man's role in the catastrophes that befell so many creatures at the very time when man gained ascendancy over his fellow animals.

Still, fundamentally the argument boils down to two major questions. Could culture, that unique human attribute, have been responsible, either wholly or as the straw that broke the camel's back, for the extinctions? Are the patterns of Pleistocene, especially late Pleistocene, extinctions atypical of extinctions as we know them from paleontological records of earlier periods?

Following a very useful "Bestiary for Pleistocene biologists" compiled by Paul S. Martin and John E. Guilday and a brief introduction by Edward S. Deevey, Jr., the first major section concerns itself with the problem of Pleistocene extinctions in general.

In his contribution "Prehistoric overkill" Martin, who aligns himself with the faction that views man as a major agent in the extinction process, points out that although this process took place prior to, during, and after the climatic shifts involved in the course of the last glaciation, the patterns of extinction appear to have been independent of climatic causes. Furthermore, in every well-documented case human beings were clearly present in those areas in which extinctions occurred. One might add that in those regions where man was a latecomer on the environmental scene the extinctions began proportionately later than in those parts of the world where his presence was of longer standing. Martin does, however, point out that one should beware of overgeneralizations: there are a number of unexplained survivals and extinctions which do not fit the pattern. Still, it is "when the full complement of extinct Pleistocene animals are considered, when all major land masses are included in the analysis, and especially when the chronology of extinction is critically set against the chronology of human migrations and cultural development . . . that man emerges as the only reasonable answer . . ." to the question.

Sharply opposed to this viewpoint is Guilday in his examination of "Differential extinction during Late-Pleistocene and Recent times." Guilday believes that the magnitude of the extinction phenomenon has been exaggerated. For America he notes that our best evidence derives from a narrow time zone during the terminal Pleistocene associated with the human presence, whereas our knowledge of the earlier Pleistocene is, in general, far less detailed. In other words, our data are inadequate for a full assessment of the problem. Guilday believes that if we "had comparable faunal samples from successively earlier glaciations the picture would appear much less dramatic." In fact, he points out some specific cases that seem to support his contention. He extends the argument to certain areas of the Old World, citing, *inter alia*, Kurtén's interesting observation that a number of species that became extinct in late Pleistocene times had a long history of size deterioration, a trend that is indicative of increasing ecological stress. The implication of these arguments is that the process of extinction predates the postulated effective interference of man. This does, however, tend to ignore the possibility that man, once he was effectively present, could have administered the *coup de grâce* to many such deteriorating species. Furthermore, in the light of ethnographic and, to some extent, prehistoric evidence regarding irrational and wasteful hunting practices, I am not at all convinced that we should depreciate, as Guilday does, the "primitive hardware and low numbers of early nomadic cultures" in their effect on the extinctions. Not only should the hardware and low population density be assessed more positively, but to these factors should be added the superior intelligence of *Homo*, which, combined with his purely cultural proclivities and technical know-how, can demonstrably play havoc with his prey.

The other contributors to this section of the book align themselves to a greater or lesser degree with one of the two fundamental positions presented by Martin and Guilday. Thus, William E. Edwards in considering "The Late-Pleistocene extinction and diminution in size of many mammalian species" concludes that the only reasonable explanation for the demise of the Pleistocene mammals under consideration remains man and his culture. He adds the interesting and surely relevant observation that "proportionately many more land mammals became extinct than plants and marine invertebrates, which apparently have much narrower

climatic tolerance. . . ." This can hardly be brought in line with the viewpoint of those who would hold that climatic factors were primarily responsible for the extinctions.

Bob H. Slaughter, discussing "Animal ranges as a clue to Late-Pleistocene extinction," sees the inflexible mating habits established under certain environmental conditions which were subsequently subjected to rapid change at the end of the Pleistocene as the major factor in the extinction process. Although this argument is derived mainly from American data, it is also meant to apply, more ar less implicitly, to other parts of the world. In the light of the many severe climatic and consequently ecological fluctuations that occurred throughout Pleistocene, I find this argument unconvincing. Why do we not seem to have evidence for similar patterns of extinction for, say, the time periods involved in the Riss-Würm glacial-interglacial-glacial sequence?

"The agency of man in animal extinctions" is the subject of James J. Hester's study. Hester argues, largely on the basis of the American evidence, that man could not have been a major factor in the extinctions. Instead he suggests that climatic changes during the retreat of the Wisconsin ice substantially affected the vegetation on which much of the fauna under discussion subsisted. Thus, the extinctions were caused by a change in the food supply of animals that were unable to adjust to the new ecological conditions. As in the case of Slaughter's paper, one might argue against this position by asking why a similar pattern of extinction has not been noted for prevous periods of rapid environmental changes during the Pleistocene.

Finally, Arthur J. Jelinek in his evaluation of "Man's role in the extinction of Pleistocene faunas" reiterates the point that none of the extrahuman factors cited by the other authors can by itself satisfactorily account for the vanishing of so many animals. After reviewing the evidence he notes that ". . . *Homo sapiens* remains as a new element in the environment, with a formidable potential for disruption, whether directly as an extremely efficient and rapidly expanding predator group, against whom no evolved defense systems were available, or indirectly as the source of profound changes in ecology already under the process of adjustment as a result of considerable climatic stress."

The second section of this book consists of 11 regional studies. These papers, to the extent to which they address themselves directly to the problem of extinction, reflect the same divided opinion as the more general and fundamental ones discussed in the preceding paragraphs. Four of the papers deal only very marginally with questions of faunal mortality.

Estella B. Leopold is concerned with "Late-Cenozoic patterns of plant extinction." To the extent to which Leopold shows that plants *did* become extinct during the crucial period, and to the extent to which such extinctions are a function of climatic changes, her observations are of interest. It now remains to be seen how such plant mortality may correlate with the demise of the fauna. C. Vance Haynes has contributed a detailed paper on "Carbon-14 dates and early man in the New World." This study is of a purely chronological nature. It provides a reasonably firm temporal framework for that period in American prehistory during which the faunal extinctions took their course. Cynthia Irwin-Williams discusses "Associations of early man with horse, camel, and mastodon at Hueyatlaco, Valsequillo (Puebla, Mexico)." The only significance this interesting paper has with respect to extinctions is that it adds further evidence for the already known fact that man in the New World did indeed hunt many of the animals that subsequently became extinct. D. A. Hooijer's brief discussion of "Pleistocene vetebrates of the Netherlands Antilles," although of interest because of the scarcity of paleontological data from this part of the world, adds nothing to the solution of the problem at hand. Much of the fossil material appears to be of late Pleistocene age, but "No means have yet been found for dating the various bone-bearing deposits in the Netherlands Antilles. . . ."

Of more direct relevance to the problem are Peter J. Mehringer's, Ernest L. Lundelius, Jr.'s, and Gerald E. Schultz's contributions. The first of these authors deals with "The environment of extinction of the Late-Pleistocene megafauna in the arid southwestern United States." He notes that as far as his area of investigation is concerned, the deglaciation in terminal Wisconsin times should have led to an increase in herbivores rather than a decrease. Furthermore, the fact that the diverse species of extinct megafauna occupied highly varied environments during the last ice age argues against changing climatic conditions' having been the single causative factor in the faunal demise. Many of the species involved appear to have been quite tolerant of wide climatic and environmental ranges. Lundelius examines the "Late-Pleistocene and Holocene faunal history of central Texas," stressing the coincidence of climatic change at the end of the Pleistocene with certain specific changes in the faunal composition of his area. These changes involved both a northward withdrawal of some animals and the extinction of the megafaunal forms. Schultz describes "Four superimposed Late-Pleistocene vertebrate faunas from southwest Kansas," ranging from middle Illinoian to late Wisconsin times. He concludes that the assemblages reflect great numerical and species diversity through time and that the differences in faunal composition "result from northward and southward migrations or population shifts and thus reflect changes in climate and local habitats in the region under study. All these factors make it difficult to establish any sort of extinction chronology for the Late Pleistocene on the basis of this study alone."

Two excellent papers by Kazimierz Kowalski and N. K. Vereshchagin deal specifically with the faunal extinction problem in relation to human activities. Kowalski, in his study entitled "The Pleistocene extinction of mammals in Europe," emphasizes the differential nature of faunal mortality, noting that while some forms extensively preyed upon by man became extinct, others effectively survived. Furthermore, he points out that some animals, such as Cave lion and Cave hyena, which probably were only infrequently taken by man, also became extinct. He obviously implies that human agency should here be discarded as a significant factor. One might rejoin that the disappearance of these animals may nonetheless have been connected with man's activities, since the beasts competed with *Homo* for the same game that *did* become extinct. In the main, Kowalski believes that the faunal extinctions at the end of the Pleistocene were caused by changes in the specific habitat to which the beasts in question had been previously adapted.

Vereshchagin considers the problem of "Primitive hunters and Pleistocene extinction in the Soviet Union." Marshalling a great quantity of data, he concludes that the terminal Pleistocene extinctions and range reductions were caused by climatic changes, although he grants that man may have added to

the calamity by his hunting activities. Both Kowalski and Vereshchagin are persuaded that man did not become effectively destructive to wild animals until the development of agriculture and animal husbandry, which went hand in hand with great increases in the human population.

Finally, two papers in the volume under review deal with subrecent faunal extinctions in Madagascar. R. Battistini and P. Vérin note that "Ecologic changes in protohistoric Madagascar" are complex in that they encompass both drastic changes in the vegetation of the island and the disappearance of numerous animal species. The authors conclude that man was certainly present when these processes began, and that he was largely responsible for them. Climate per se does not appear to have had much to do with these changes. On the other hand, they note that it "is apparent that the disappearance of the forest was a determining factor in the annihilation of certain species, among them the large lemurs." At the root of it all, however, the instrumentality of man seems certain. Alan Walker, in considering the "Patterns of extinction among the subfossil Madagascan lemuroids," generally supports the ideas developed by Battistini and Vérin. He stresses, however, that on the basis of knowledge of the morphology and inferred behavior of the large, extinct Madagascan lemuroids, these slow-moving, diurnal, terrestrial animals must have become extinct as a result of predation. Although environmental factors may have played some part in this process, Walker concludes that in "the absence of any large hunting carnivore, the pattern must be attributed to Man."

The book just reviewed offers an excellent summary of the problem as it stands today. The fact that the views still clash simply implies that we still do not have enough facts for a final assessment. Yet, if this reviewer may be permitted some additional comments, he would like to say this: it might be fruitful if, over and above such vital considerations as the paleontological evidence and the paleoecological setting, more attention be given in future inquiries into Pleistocene extinctions to the unique status of man as a reasoning and highly effective technological animal. Precisely his special, human status sets man apart from the rest of creation. He can and does master his environment, and against his "minding" and technological skills most other creatures are defenseless because, as Jelinek in this volume has pointed out, they are not adapted to cope with this higher order of being. Finally, it may also prove useful to investigate in some greater detail the question of differential gestation and maturation rates of some of the animals that became extinct. Inasmuch as many of these creatures appear, by analogy with modern representatives, to have been slow breeders, often with no more than single offspring, specific hunting practices that focused, for instance, on younger and immature animals might well have had disastrous effects on these species. Finally, the often demonstrably irrational hunting practices of aboriginal populations, especially in the case of herding animals that are also slow breeders, may have taken a toll far beyond what might be expected from the undoubtedly limited numbers of human hunters during the terminal Pleistocene.

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Vieta and Modern Algebra

Greek Mathematical Thought and the Origin of Algebra. JACOB KLEIN. Translated from the German edition (Berlin, 1934–36) by Eva Brann, with an appendix containing Vieta's *Introduction to the Analytical Art* translated by J. Winfree Smith. M.I.T. Press, Cambridge, Mass., 1968. xv + 360 pp. $12.50.

Geometry is a Greek word, and the subject is primarily of Greek origin; *algebra* is an Arabic word, but is the subject of Arabic origin? Al-Khowarizmi in the 9th century composed the *Al-jabr,* through which medieval Europe became familiar with the systematic solution of linear and quadratic equations, an operation which was given a symbolic form in the Renaissance. A key role in the modernizing of algebra was played in the late 16th century by Franciscus Vieta, and it is a reinterpretation of this role which Klein has presented. Klein argues that the *Ars analytice* of Vieta grew out of a generalization of the concept of number and that it stemmed from the syncopated *Arithmetica* of Diophantus rather than from the rhetorical *Al-jabr* of Al-Khowarizmi. A close philological scrutiny of ancient uses of such words as *arithmos* and *eidos* and *monas* leads the author to conclude that in its "theoretical logistic" of fractions one finds in the Diophantine arithmetic a more sophisticated concept of number than that adopted in the ordinary computation (logistic) which Plato had spurned. In this respect he feels that Diophantus is not far removed from views found in the three "arithmetical" books (VII–IX) of Euclid's *Elements.* The Diophantine numerical approach, supported by Platonic geometric analysis as described by Pappus, was, Klein believes, more appropriate as inspiration for the "symbolic concept of number" in Vieta's "general analytic art" than was the Arabo-Latin technique the very name of which Vieta disliked.

It is now more than 30 years since Klein first argued this case, persuasively and with close reasoning supported by full scholarly apparatus, in a journal of limited circulation. The original German text was published as "Die griechische Logistik und die Entstehung der Algebra" in the regrettably short-lived *Quellen und Studien zur Geschichte der Mathematik, Astronomie und Physik,* Abteilung B: *Studien,* vol. 3, fasc. 1 (1934), pp. 18–105; fasc. 2 (1936), pp. 122–235. The present careful translation by the author's colleague at St. John's College, Annapolis, will make this erudite study, including almost a hundred pages of helpful notes, more widely available to scholars, and it should encourage further attention to a critical problem in the history of mathematics. Few doubt that symbolic algebra was a product of the Renaissance in Europe; but that age was buffeted by varied crosscurrents, of which the revival of classical thought, so eloquently argued here, was but one. The element of novelty or rebirth has perhaps been overstressed by Klein at the expense of the continuity of medieval influence represented by the 16th-century rules of "cosa" stemming from the Arabs. The application, in Vieta's "logistica speciosa," of arithmetic operations to quantities not necessarily numerical was not entirely novel; recently it has been pointed out [*Mathematical Reviews* **35**, 512 (1968)] that the 9th-century Muslim mathematician Thabit ibn Qurra had used the terms *multiplication* and *division* to denote operations performed upon quantities regarded as nonnumerical. Such adumbrations could have played a part in the "symbol-generating abstraction" of Vieta which here is seen as "mainly initiated by the reintroduction and assimilation of the *Arithmetic* of Dio-