in the recent literature (G. G. Simpson, in *The Fabric of Geology*, C. C. Albritton, Jr., Ed., Freeman, Cooper, 1963, pp. 24–47, and D. B. Kitts, *ibid.*, pp. 49–68). Simpson's comment that the "immanent characteristics of the material universe have not changed in the course of time" seems a more useful statement of the uniformity principle and, if acceptable, would dispel the need for the catastrophes and nonuniformitarian happenings that Ager reads from the stratigraphic record.

That the record is incomplete and has accumulated or been rearranged spasmodically rather than gradually in many places is stratigraphic commonplace. However, it is wise occasionally to emphasize these facts, as Ager does in his third and fourth essays. Nevertheless there is danger in overemphasis, for it is certainly true that more time is represented than unrepresented in some sections, and much stratigraphic endeavor is directed toward filling in the gaps in one section through correlation with others in which there is a record of the missing intervals. Further, in view of the supernatural taint that "catastrophism" acquired as geologic philosophy was developing, it is unfortunate to revive the word merely as an antonym for "gradualism," no matter how correct this may be in a dictionary sense. However they may seem to newscasters and those unhappy enough to live in the path of one, there is little about hurricanes, windstorms, mudslides, avalanches, turbidity flows, or sudden glacier surges that is catastrophic on the scale of geologic time. Perhaps the stratigraphic record in many places is largely a record of spasmodic events, and not of the placid intervals between them. But to view such a record as catastrophic, or to insist, as Ager does in his fifth essay, that we take a catastrophic view of the uniformity principle itself suggests that there is something unnatural about the spasmodic events themselves, something that cannot be understood from a study of modern processes and phenomena. If stratigraphers assume that the scale and rate on which geologic processes operate have remained constant with time it is necessary to remind them that the record indicates this not to be so. But stratigraphers of the reviewer's acquaintance make no such assumption, so one wonders why Ager pummels this straw man so vigorously.

The summary chapter of Ager's rather personal memoir suggests that anomalous features of the stratigraphic record enumerated in preceding essays can perhaps be understood in the framework of global tectonics, which is also viewed in a quasicatastrophic light. It might as well have been pointed out, of course, that global tectonics ought to be justified in terms of the stratigraphic record.

The Nature of the Stratigraphical Record is provocative reading, particularly as it provides insight into a view of the uniformity principle that is different from that held by many stratigraphers. There are a few minor errors (the "main road of America," joining Chicago and Los Angeles, must surely be U.S. Highway 66 of song and fable, not Highway 70, as asserted on p. 6), and some illustrations are not particularly clear. But these defects do not detract from an otherwise stimulating book that is recommended as fireside reading for a winter night, or as a pleasant diversion on a rainy day when it's impossible to get into the field.

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Paleoclimatology

Climatic Fluctuations of the Ice Age. BURKHARD FRENZEL. Translated from the German edition (Braunschweig, 1967) by A. E. M. Nairn. The Press of Case Western Reserve University, Cleveland, Ohio, 1973. xxiv, 306 pp., illus. $22.50.

This valuable publication brings to the attention of English-speaking scientists the Eurasian evidence of environmental conditions during the warm and cold episodes of the late Cenozoic. The number of glaciations that occurred in Europe and North America during this era was until quite recently thought to be three or four. It is now believed that there were at least ten such events in central Europe. Frenzel has limited his treatment to the Pleistocene, defined as the last 1.0 to 1.5 million years, and has chosen to avoid hypothetical arguments and concentrate instead on setting out the rich paleobotanical data from which climatic inferences are drawn.

The work begins with useful prefaces and a brief climatic survey, followed by an examination of methods of relative and absolute dating; amino acid dating is not mentioned. Qualitative and quantitative methods of determining ancient climates are surveyed involving $^{16}O/^{18}O$, glacial and periglacial sediments, permafrost, fossil soils, dendrochronology, and pollen analysis. The palynological section has some discussion of the traditional difficulties of the relative percentage method which is somewhat incongruous because of the omission of any mention of "absolute" methods of pollen counting, which would answer many of the problems raised. The use of palynological data from entomophilous species (such as ivy, holly, and mistletoe) for precise local paleotemperature values (including winter temperatures) is not mentioned.

A short chapter sets out the evidence obtained by the dating methods for widespread synchrony of climatic fluctuations, including the Allerød–Two Creeks case. Frenzel makes it clear that he does not expect different climates subjected simultaneously to the same impulse to react in necessarily similar ways. Later in the book evidence for synchronous climatic changes in northern and southern Africa, and subsequently for worldwide climatic synchrony, is presented.

Evidence of the principal climatic fluctuations derived from paleobotany (with the relevant fossil permafrost and soils data) is given at length, with a large number of valuable maps of the past distribution of climatically sensitive plants (though some of the maps are wasteful of space). The strong similarity in the vegetational successions between several interglacials (and the Holocene) emerges clearly from this synthetic treatment; it is surprising in this context that the current debate among Holocene phytogeographers about human impact on the late Flandrian development of heaths and sphagnum bogs in northern Europe does not refer more often to this interglacial parallelism.

Frenzel clearly illustrates how in Europe there were successively cooler and drier climates at the height of the cold episodes, and relates this increasingly continental climate to progressive mountain uplift. A detailed examination is made of the paleotemperatures of the last cold episode throughout Europe.

In the final chapter, on the climatic fluctuations of the last cold period, Frenzel extends his survey beyond the confines of Europe and Russia. By contrast with his account of these areas, which because of his language abilities and knowledge of the literature is of great value to readers from other regions, his comments on North American glacial geology rely on outdated

and inadequate references, though the large bibliography (over 800 titles) is one of the major strengths of this work.

The book is a timely contribution in view of the growing general interest in environmental studies and in the geological basis for environmental planning and possible long-term climatic forecasting for the benefit of society. It is a valuable addition to the current debate on "When will the present interglacial end?"

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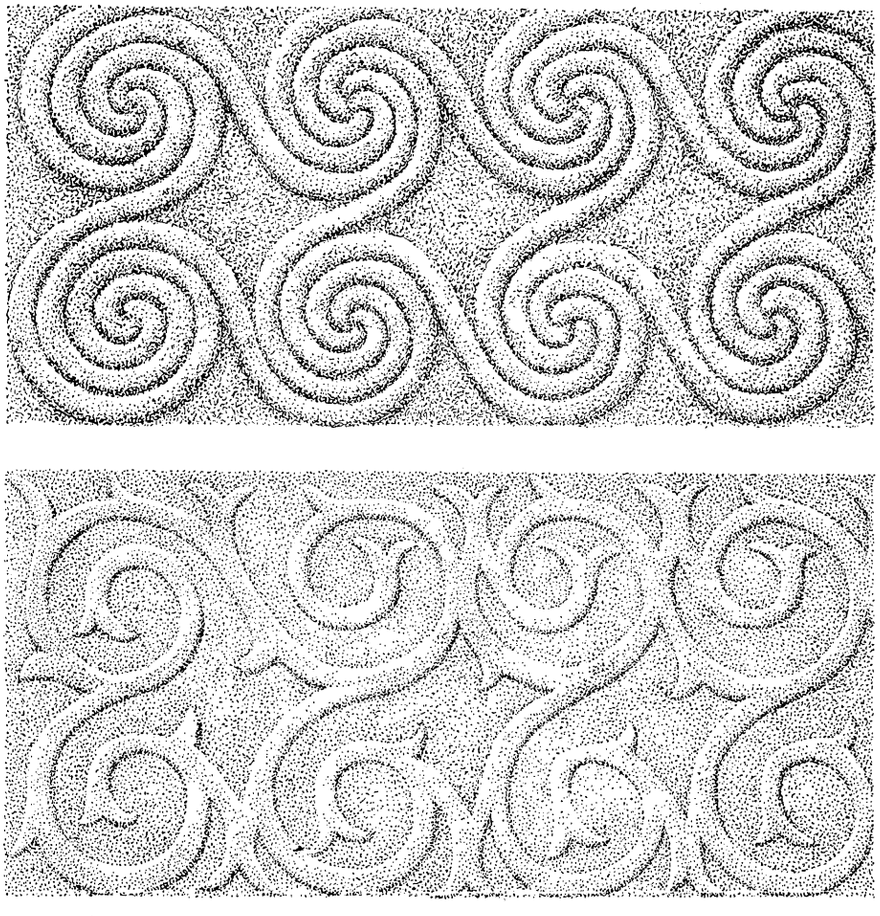
A Rethinking in Archeology

Before Civilization. COLIN RENFREW. Knopf, New York, 1973. 292, viii pp., illus. + plates. $8.95.

In this volume for the general reader Colin Renfrew surveys the controversies brought about by the discovery of the radiocarbon method of dating, interprets its implications, and suggests the future direction of research and fieldwork in European archeology. Almost half the book is concerned with past problems. There is little new for the specialist in his short summary of the traditional methods of dating and the assumptions of the diffusionist school which we know so well from the writings of V. G. Childe.

Most archeologists will find that the chapters on the first radiocarbon revolution and the impact of tree-ring calibration of radiocarbon dates constitute a useful review of the problems that beset the study of the Neolithic and Early Bronze Ages of southwestern Asia, the Mediterranean, and Europe during the 1950's and '60's. Renfrew rightly points out that the upward shift in absolute dates has brought a revolution in our conception of the temporal relationships of European cultures with one another and particularly with the cultures of the Aegean and southwestern Asia. The new high chronology based upon radiocarbon dating forces us to abandon the concept of a linkage between the Neolithic of Iberia and Atlantic Europe and the Aegean Bronze Age, a concept based upon presumptions concerning the diffusion of the Megalithic complex. The traditional tie of the European Neolithic through Vinča with the Early Bronze Age of the Aegean, which long provided the basis for the chronology of the Neolithic cultures of southeastern, central, and northern Europe, must now be given up and an entirely new search be undertaken for the character of the development of the Neolithic in lands beyond the Mediterranean basis. Renfrew's emphasis upon the linkage of the Early Bronze Age cultures of central Europe with the Mycenaean world is significant for archeologists in Anglo-American circles, but less important for many continental European archeologists, who have never accepted this traditional equation which must now be seriously modified in light of radiocarbon dating.

For Renfrew the new radiocarbon dating as now corrected by tree-ring calibrations means the abandonment of traditional diffusionist interpretations of European development. He argues that the cultures of Europe, which were created by peoples now to be viewed in a purely European context, must be explained in terms of the "New Archeology," with its methodological emphasis upon studies of population, economic organization, social organization, and technology and subsistence. Emphasizing that new explanations have yet to be fully formulated, he seeks a broad definition of the parameters of new approaches in dealing with such



"Relief spirals at the Maltese temple of Tarxien (*lower*) compared with spirals on a stele from one of the Shaft Graves at Mycenae, *c.* 1650 B.C. The Maltese temples were traditionally dated by means of this comparison." Some controversy on the matter remains, "Yet applying the tree-ring calibration to the Maltese dates, it now seems likely that the Tarxien phase must have come to an end before 2200 B.C. This would seem to rule out the derivation of any of the decorative motifs in the temples from the middle or late bronze age Aegean. And naturally the new chronology at the same time makes untenable the view, asserted by some, that the temples themselves have a similar origin. . . . The temples are so large, and involved so much labour, that they cannot have been the work of small local groups of only fifty or so people. . . . Some new thinking is needed here, about the society of the temple builders." [From *Before Civilization*]