Book Reviews

Deciphering Vegetation History

Quaternary Plant Ecology. Proceedings of a symposium, Cambridge, England, Mar. 1972. H. J. B. BIRKS and R. G. WEST, Eds. Halsted (Wiley), New York, 1974. x, 326 pp., illus. $44.50.

Pollen analysis of lake and wetland sediments was developed more than 60 years ago as a method of presenting stratigraphic data so as to permit both ecological and historical interpretations and, with regional studies, to add the dimension of plant geography. Since then, the late Quaternary vegetational history of most lake-bearing temperate regions has been worked out, although still little is known of tropical regions or of earlier Quaternary history except in western Europe. The last 15 years have seen great advances in pollen-analytical theory and methods, and pollen-analytical methods have in turn been applied to the study of other fossil remains in lake sediments. This volume recounts some of the advances and defines further problems.

The symposium on which the volume is based was held under the egis of the British Ecological Society, and the audience of diversified ecologists stimulated most of the authors to make their remarks easily understood. The flavor of the audience and the perspicacity of the speakers are revealed in the transcribed discussions that follow each set of papers.

Among the contributions to methodology that have solidified and refined pollen-analytical theory are the use of pollen surface samples to identify modern analogs for past vegetation types, and the expression of stratigraphic variations in terms of absolute influx of pollen grains per unit of lake surface rather than simply as percentage differences among pollen types. These two approaches are combined in a paper by Margaret Davis and co-workers, which uses forest-survey data as a quantitative measure of forest composition (basal area of tree species) and compares it with pollen influx to 29 lakes in Michigan.

The surface-sample technique is also used by C. R. Janssen, who made short transects across known vegetation types in a large bog in northern Minnesota, to illustrate variable dispersal distances of different pollen types, providing a useful distinction between local and regional pollen deposition.

Other papers concerned with modern pollen dispersal and representation describe studies in Denmark, Sweden, the tropics, and arctic and alpine regions, as well as dispersal by streams.

Another group of papers comes under the heading Vegetational History and Community Development. Of these the one of greatest theoretical interest is that of W. A. Watts, who stresses the time scale involved in the invasion of a stable forest by a new tree dominant. Examples are drawn from published studies of sites in which annually laminated sediments provide a highly refined time scale and thus the opportunity to examine population dynamics on a large scale. Lake of the Clouds in northern Minnesota, where white pine immigrated into a stable conifer forest over a period of about 1000 years, until it attained a stable population, is such a site. Watts stresses the ecological importance of following the invasion patterns as well as the stable patterns in the interpretation of pollen profiles, pointing out that the standard procedure of subdividing the pollen sequence into zones tends to overemphasize the stable patterns.

The volume concludes with paleolimnological studies of the pollutional history of two lakes—Lough Neagh in Northern Ireland by Battarbee, O'Sullivan, and Oldfield, and Shagawa Lake in northern Minnesota by Bradbury and Waddington. Both papers emphasize the value of stratigraphic diatom analyses of short cores as a record of water quality. Critical in such historical reconstruction, and sometimes requiring great ingenuity, is the independent determination of the sedimentation rate, so that changes in the diatom assemblages can be correlated with historical events. In the case of Lough Neagh, a date of A.D. 1820 for maximum change in paleomagnetic declination is used, as well as a date of A.D. 1943 for a sharp maximum in cereal-grain pollen, correlated with a wartime program to divert lands from pasture to plough. At Shagawa Lake the key date (1890) is for the opening of iron-ore mines on the lake shore, recorded in the lake sediments by a sharp influx of distinctive mineral fragments.

The book is well edited and well produced. Its large format allows the incorporation of large pollen diagrams without the necessity of many foldouts. The stratigraphic diagrams in the volume, however, are highly variable in style and clarity. Some (such as those of Janssen) are elegant and ingenious in presenting stratigraphic and interpretative detail and others (such as those of Winifred Pennington and R. E. Sims) are so difficult to decipher that the reader can easily be frustrated or lose interest in the paper.

The volume well illustrates the vigor of Quaternary plant ecology as a field of diversified studies, combining the principles of historical geology with modern ecological theory. In fact, much theory that involves models of vegetational stability or successions can be adequately tested for the long time range only by critical attention to the biostratigraphic record. Refined techniques of sediment coring, fossil analysis, and data presentation, as described in this volume, show how lake muds and bog peats can be used to decipher recent earth history and add a valuable perspective of time to an understanding of the natural environment.

H. E. WRIGHT, JR.
Limnological Research Center, University of Minnesota, Minneapolis

The Next California Earthquake

The Jupiter Effect. JOHN R. GRIBBIN and STEPHEN H. PLAGEMANN. Walker, New York, 1974. xviii, 136 pp., illus. $7.95.

This book has received considerable popular attention because of its sensational implications. This attention possibly has been influenced by the authors' being physical scientists of respectable academic background.

The book mainly concerns empirical analyses of five correlations between astronomical and geophysical phenomena: (i) sunspots with tides raised in the sun by planets; (ii) solar activity

with the earth's weather; (iii) the weather with the earth's rotation; (iv) rotation with earthquakes; and (v) tides in the earth with earthquakes. The authors tie together correlations in the first four categories to conclude that

> A remarkable chain of evidence . . . points to 1982 as the year in which the Los Angeles region of the San Andreas fault will be subjected to the most massive earthquake known in the populated regions of the Earth in this century . . . there is no question about the implication: in 1982 . . . Los Angeles will be destroyed.

The main basis for the date of this prediction is that in 1982 a close alignment of the planets will occur such as to maximize their tidal pull on the sun. This pull depends mainly on Jupiter, Venus, Mercury, and the earth, in that order; the other planets contribute less than 3 percent. Such an alignment occurs about once every 179 years. A peak in the 11-year cycle of sunspot activity is also predicted for 1982. The fifth correlation, between tides and earthquakes, is introduced presumably to demonstrate that external global-scale forces can be sufficient stimuli for quakes.

While there is no doubt about the planetary alignment, there is considerable reason to doubt the earthquake prediction because of several defects in the intervening analysis.

1) There is no attempt to compare the earthquake record in the past with the variation in planetary tidal pull on the sun or with sunspot activity. In fact, there was no marked earthquake activity around the last alignment, about 1803, and the correlations of earthquake activity since 1900 (*1*) with sunspot activity and with planetary tides in the sun are irregular.

2) There is no discussion of why a slightly higher-than-usual peak in planetary tidal pull should lead to an exceptional peak in solar activity. The tides often come within a few percent of the 1982 peak; the peaks in the sunspot number oscillate by a factor of 3.

3) There is no explanation of why the massive earthquake of 1982 will occur in the Los Angeles region rather than somewhere else. The enigmatic remark is made that "in geological terms southern California is ten times more active seismically than the rest of the Earth." In fact, only about 0.5 percent of the world's seismic energy release between 1900 and 1970 was in California, despite the San Francisco earthquake of 1906 (*2*).

4) In the discussion of the triggering of earthquake activity, there is no recognition that the time scale of the triggering stimulus may be of significance. Similarly, there is no discussion of what sort of phase lag there should be for solar activity after its stimulation by planetary tides.

5) There is virtually no examination of whether there is any relation between variations in the earth's rotation rate and earthquakes. Mansinha and Smylie's suggestion that earthquakes excite polar wobble is discussed, but Haubrich's critique is not even referenced, nor are the most recent spherical elastic models which find earthquakes insufficient (*3*). Considerable attention is given to Tamrazyan's assertion that earthquakes occur much more often when the moon's perigee is near alignment with the sun, but Knopoff's demonstration that this conclusion is spurious (*4*) is ignored. (The perigee moves as a result of torque by the sun, hence it lingers where this torque is a minimum.)

6) There is occasional sloppiness that does not breed confidence in the authors' physical insights or objective attention to detail. For example, the definitions of nutation (motion of the pole with respect to the fixed stars) and wobble (motion of the pole with respect to the crust) are confused. That the 14-month period of the wobble is well known to be a free oscillation is obscured. Tidal triggering of moonquakes is cited as evidence for tidal triggering of earthquakes without mention of the great differences in circumstances, including factors of 50 in excitation frequency, 300 in excitation amplitude, and 10^{13} in energy release rate. Sunspots are described as only 100 times as bright as the moon (actually they are about 200,000 times as bright). A reprinted graph is described as showing variations of tide height on the sun, when actually it shows the absolute value of the change in the tide height at the sub-Jupiter point due to the earth and Venus at conjunction (or opposition) since their last opposition (or conjunction) (*5*). It is even suggested that Pluto may contribute to triggering of sunspots.

The authors make some jokes about astrology. Their inference that major instabilities inside the sun and the earth are triggered by predictable astronomical events is based on the same simplistic wish that nature play fair and not behave in a stochastic way (*6*). In both the sun and the earth plausible small imbalances of internal forces could be much stronger triggers than exogenic effects.

Empirical correlations have been the starting points for some very important science, and in the subject areas discussed in this book some significant and promising work is currently being done (*7*). The meaningfulness of such correlations is normally proportionate to the extent to which they are related to plausible cause-and-effect models. Otherwise, the data combinations are so numerous that one can always be found to yield a seeming statistical significance. It is true that important practical efforts have been undertaken on the basis of empirical evidence without complete understanding of underlying causative mechanisms. But in *The Jupiter Effect* the selectivity in examining the evidence is excessive, the popularized format of the book precludes serious scientific modeling, and the correlations demonstrated are too weak to warrant practical action.

It is quite likely that there will be a seriously damaging earthquake in California within the next 50 years. The authors are correct in saying that better preparation for such an event is needed. However, to predict a specific year in which the quake will occur does a disservice, like crying wolf; from present evidence the quake is no more likely to occur in 1982 than in 1975 or 2001. All we can confidently predict now is that in 1975 Gribbin and Plagemann will sell a lot of copies of their book as a consequence of the new spectacular *Earthquake* which Universal Pictures is readying for the Christmas trade.

WILLIAM M. KAULA
Department of Planetary and Space Science,
University of California, Los Angeles

References and Notes

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