BOOK REVIEW

Numerical Methods in Quaternary Pollen Analysis. H.J.B. Birks & A.D. Gordon. Orlando, FL: Academic Press, 1985. Pp. viii, 317. $70.00.

In 1986, I reviewed Birks and Gordon's book for *Geoarchaeology* (Davis 1986). I concluded then that it was "an excellent summary of the pre-1983 literature on quantitative pollen analysis," but I faulted its lack of microcomputer implementations of the numerical techniques treated in the text. Since then I have used the book in my own research and as a reference for an introductory pollen class, and now I have an even higher opinion of the text than in 1986. Partly, this is due to the availability of the appropriate software—but more about that later.

Numerical Methods is clearly-written and relatively error-free, but it is not particularly easy to read. The "journal article" style of the text is broken up by long lists of references. Although these are used appropriately and their value is obvious, the references are very distracting for beginning readers. Furthermore, the authors assume familiarity with mathematical and statistical techniques. Without advanced preparation and guidance, the book would be difficult for students in an introductory palynology class. I use it as a reference, not as a primary text.

The book begins with a succinct introduction to Quaternary pollen analysis and the preparation of the pollen diagram. Chapter Two treats the basic statistics. The remaining four chapters deal with the areas of palynology that have been the focus of numerical inquiry: diagram zonation, sequence matching, analysis of surface samples, and quantitative interpretation of fossil sequences. Each topic is thoroughly discussed, and examples are provided using data sets from Scotland and North America. The authors compare the relative merits of various approaches to each problem without unfair bias toward the many techniques they have developed.

The field of numerical analysis is an active one, and many valuable papers have been written since *Numerical Methods* was published. The book is not out-of-date in its general coverage, but many recent papers, e.g., Overpeck *et al.* (1985) and Hill (1979), should be included in the second edition.

Sadly, numerical methods in general and Birks and Gordon's book in particular have not evoked much interest from archaeological palynologists. Despite the great number of samples that have been analyzed, I know of very few papers containing numerical analyses of pollen samples from archaeological sites (Ackerly's dissertation [1986] is an example), yet surely the interpretations of these reports would have benefitted from such analyses. Both the palynologists and the contractors are to blame. The vast majority of papers on archaeological palynology are unpublished site reports, and often the goals of archaeological pollen analysis do not lend themselves to numerical analysis. In the Southwest, many samples are studied only to establish the presence of distinctive cultigens. However, numerical analyses could be very beneficial in problems such as the interpretation of the age and season of occupation of archaeological sites, and of the functions of site structures and features.

Birks and Gordon's text can serve as a guide to the appropriate numerical techniques for the investigation of these problems, but the techniques themselves must be readily available before they receive wide application. Happily, the situation is much better than it was when I first reviewed the book. All of the programs mentioned in the text now have been adapted for the microcomputer by John Birks, who has distributed these on a limited, personal-use basis. Some of the programs have been translated to BASIC by Lou Maher (University of Wisconsin-Madison), who also has made the programs available to interested persons.

As an example of the potential applications, I will use some of Maher's programs to analyze two data sets collected from two stratified cultural middens near El Portal in Yosemite National Park (Davis 1984). These neighboring sites are in similar environmental settings and cover roughly the same time period. An example of a use of numerical techniques would be to pool the two sets to produce a combined pollen diagram, using the program SLOTSEQ. In Figure 1, the samples from MRP 250 are marked with asterisks in the deteriorated pollen column; the other samples are from MRP 382. The solution is based on 16 pollen types (4 not shown in Fig. 1), and a different sequence results if deteriorated pollen is not included. Note that the program correctly positions sample 16 (95 cm depth from MRP 250, 2360±140 yr B.P., BETA 8747), above sample 17 (80 cm depth from MRP 382, 2430±90 yr B.P., BETA 8752).

Another question one might ask of these data is, "When did the major changes take place in the environment?" This is the problem addressed by zonation, and two general approaches exist. One tactic is to plot dissimilarities between adjacent samples (p. 52). Larger values indicate greater change. This is illustrated at the extreme right of Figure 1. The greatest change is between samples 20 and 21, with a secondary peak between samples 17 and 18. A second tactic is to group samples into homogeneous clusters. The results of the program CONSLINK are shown in the left margin of Figure 1. The major groups are samples 1-17 and 18-24, with minor divisions of samples 1-5 and 6-17, and 18-20 and 21-24. These could be labeled, e.g., the "historic" (1-5), "main occupation and early historic" (6-17), "early occupation" (18-20), and "pre-occupation" (20-34) zones. The greatest change coincides with the beginning of site occupation, with a relatively smooth transition from Indian to Park Service occupation.

Other clustering techniques such as SPLITINF and SPLITLSQ emphasize different aspects of the data and produce different cluster diagrams, and within CONSLINK one can choose from three different measures of dissimilarity and two kinds of amalgamation. Each technique may suggest interpretations that may not have occurred to the investigator. As these tools become more accessible, Birks and Gordon's text will become increasingly valuable to the archaeological palynologist, as a guide, as a reference, and as an inspiration.

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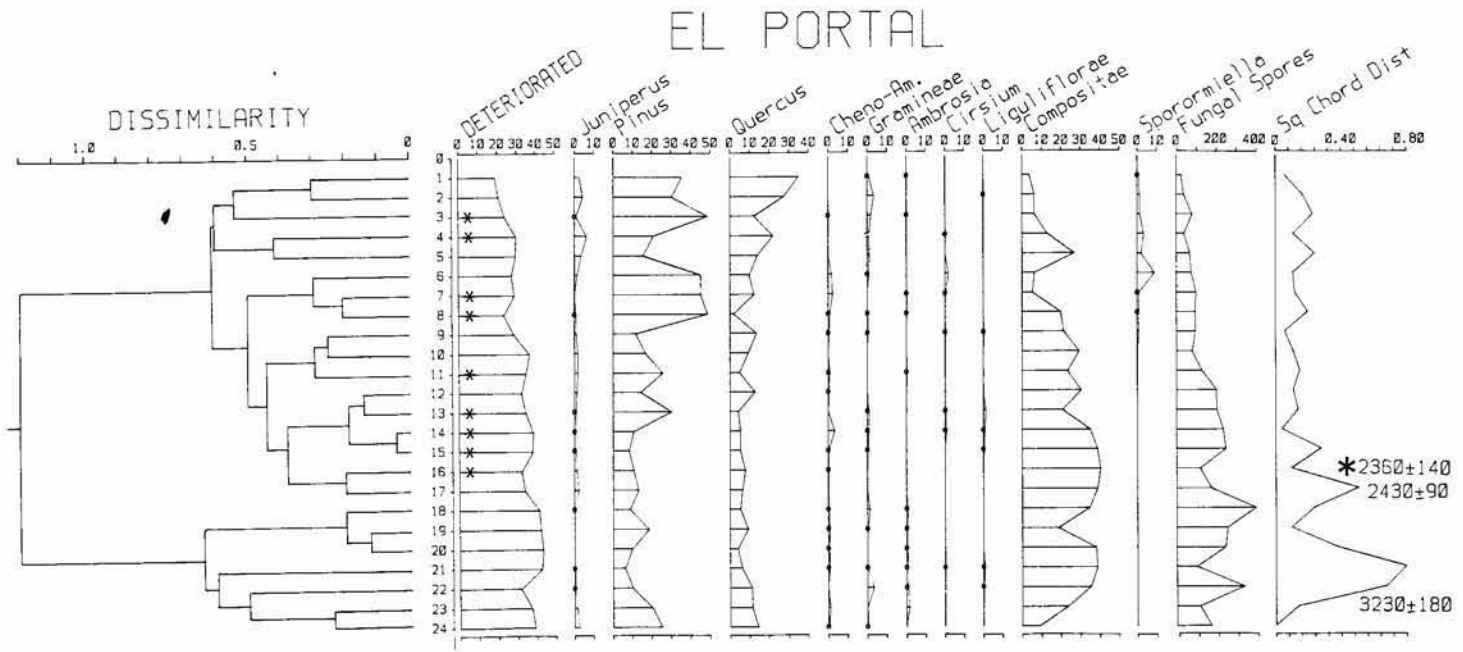

FIG. 1.—Percentage pollen diagram from sites MRP 382 and MRP 250 near El Portal, Yosemite National Park, California. Asterisks in deteriorated column mark samples from MRP 250, other samples are from MRP 382. Radiocarbon dates for MRP 250 (with asterisk) and MRP 382 are shown at right margin. Dissimilarity (calculated as squared chord distance) between adjacent samples is plotted as right-most curve. The dissimilarity diagram on the left margin is based on squared chord distance between samples and groups of samples, and the least-similarity agglomeration, using a program written by L.J. Maher.

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