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Environmental Archaeology: Three Recent Contributions

Gary W. Crawford

Gregg, Susan Alling. *Foragers and Farmers: Population Interaction and Agricultural Expansion in Prehistoric Europe*. Chicago: The University of Chicago Press, 1988. xx + 275 pp. including index and bibliography. $24.95 cloth, $9.95 paper.

Hastorf, Christine A., and Virginia S. Popper. *Current Paleoethnobotany: Analytical Methods and Cultural Interpretations of Archaeological Plant Remains*. Chicago: University of Chicago Press, 1988. xii + 236 pp. including chapter references and index. $24.95 cloth, $9.95 paper.

Pearsall, Deborah M. *Paleoethnobotany: a Handbook of Procedures*. San Diego: Academic Press, 1989. xii + 470 pp. including chapter references and index. $59.95.

INTRODUCTION

Three books reviewed here make substantial contributions to environmental and subsistence archaeology. *Current Paleoethnobotany* edited by Hastorf and Popper is a self-professed "state-of-the-art volume about analytical methods and cultural interpretations of plant remains" (p. ix). Pearsall's *Paleoethnobotany* is a laboratory/field manual on archaeobotany that attempts to fill a void left by the outdated and Old World oriented works by Renfrew (1973) and Dimbleby (1978) and by a more recent volume edited by van Zeist and Casparie (1984) which for the most part ignores the Americas. Gregg's *Foragers and Farmers* is not explicitly a contribution to paleoethnobotany, although plant food and ecology are central to her model of forager-farmer interactions. Foraging is certainly relevant to each of the works, but the three books mainly offer important insights to the study of prehistoric food production.

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PURPOSE OF BOOKS

Pearsall's and Hastorf and Popper's primary audience is fellow paleoethnobotanists, both students and practitioners. In addition, Pearsall hopes to make paleoethnobotany more accessible to anthropologists and botanists. Few archaeologists receive training in paleoethnobotany, so a text on modern methods in paleoethnobotany has been long overdue. The non-specialists simply had no single source to guide them in their quest for background and 'how-to' information.

Pearsall is light on interpretation, and whereas she emphasizes the 'how-to' side of paleoethnobotany, Hastorf and Popper explore the assumptions underlying paleoethnobotanical interpretations. The books complement each other nicely. In contrast is Gregg's non-use of empirical archaeological data. We never do learn the basis of Gregg's collection strategy, methods, or interpretive techniques. Instead, Gregg produces an untested, and to a large degree untestable, model of prehistoric interaction based on ethnohistoric and non-archaeological environmental data.

Gregg seeks "to generate testable propositions" (p. 18) on the transition to the Neolithic in northern Europe that began about 4500 b.c. The result is a "simple static model that can be refined" (pp. 18–19). At the outset, Gregg rejects expulsion and acculturation models. She chooses to investigate a model that posits interaction between Mesolithic and Neolithic populations. Model building is not attempted in any of the case studies in Pearsall or Hastorf and Popper, so Gregg provides an opportunity for us to see how subsistence data can be integrated toward testing a major problem in prehistory.

ORGANIZATION AND COVERAGE

Paleoethnobotany consists of six chapters, including the introduction. The 470 pages of text are minimally subdivided, but specific topics are easily located with a detailed index. Chapters II through VI deal with recovery techniques, identification and interpretation, archaeological palynology, phytolith analysis, and integrating paleoethnobotanical data. Aspects of Chapters II, III, and VI are examined in *Current Paleoethnobotany*, a compilation of papers from a symposium at the 1985 annual meeting of the Society for American Archaeology. Pearsall is also a contributor to this volume. One paper from a statistician was solicited. The book includes commentary chapters by Richard Ford and William Marquardt. Gregg's revised doctoral dissertation is a more cohesive treatment of a single issue in prehistory and is comprised of a preface and eight chapters. The six substantive ones deal with population interaction, crops, livestock, optimal farming strategies, and wild resource exploitation.

The authors of the case studies in Hastorf and Popper (Virginia Popper, Christine Hastorf, Gail Wagner, Mollie Toll, Naomi Miller, David Asch, Nancy Asch Sidell, Deborah Pearsall, Sissel Johannessen, Tristine Smart, and Ellen Hoffman) do not by any means report a cross section of current applications in paleoethnobotany. Much of what is current in the field appears in neither *Current Paleoethnobotany* nor *Paleoethnobotany*. There are a number of North American laboratories and their

projects not represented—Alabama, Arizona, Boston, New Orleans, North Carolina, Tennessee, and Toronto to name a few.

Particular methodological issues in Pearsall and in Hastorf and Popper pertaining to data analysis and quantification are applied in the American Midwest and Southwest, although South America is emphasized on the whole. Chapters 7 through 10 of *Current Paleoethnobotany* and the final chapter in *Paleoethnobotany* address issues such as culture, resources, and environment. Gregg also deals with these issues.

The training demands on paleoethnobotanists are enormous, in light of the specific botanical knowledge as well as the archaeological, ethnographic, and theoretical expertise required. Implicit in the coverage of Pearsall and in Hastorf and Popper is the view that paleoethnobotanists are distinct from archaeologists. True, paleoethnobotanists have tended to be quite specialized but this is not always the case. Given this tendency to specialize, Hastorf and Popper (p. 13) warn that paleoethnobotanists must work closely with archaeologists. Certainly many American paleoethnobotanists are not field archaeologists supervising multidisciplinary projects. However, there are many field archaeologists with specific training in paleoethnobotany, for example, C. Wesley Cowan, Bruce Smith, Margaret Scarry, and myself. Having the archaeologist and paleoethnobotanist be one and the same person is certainly one solution to archaeologists and paleoethnobotanists working closely together. Gregg, who spent a good deal of time in the field with German archaeological colleagues, exemplifies a particularly healthy approach to integrating environmental/subsistence interests into archaeological programs.

FLOTATION METHODS

Paleoethnobotany and Wagner's chapter in *Current Paleoethnobotany* deal with collection procedures. Pearsall describes the step by step operation of nearly a dozen flotation methods. Wagner evaluates many of the same procedures. Terminology is explained, and the development of flotation methods is reviewed. However, I could not find a good definition of 'flotation' in either book. It seems to me that the only true flotation is froth flotation. The other means involve suspension of particles in a fluid.

In Pearsall's discussion of froth flotation, the general description is fine. However, there are a few inaccuracies about the machine I used (Crawford 1983). The machine illustrated in Figure 2.27 is an 'off-the-shelf' Cambridge machine, vintage 1977. Only the "insert with screen" is an addition to the original apparatus. I made no modifications to the work stand, contrary to what Pearsall writes (p. 68). Although the machine does not have an annular moat, overflow is not quite as characterized on page 70. The water and contents overflow into a trough along a lip the length of one side of the container. In the trough is a drain, about 4 cm. in diameter, through which the overflow pours into geological sieves (see Fig. 2.8 for a photograph of the same machine). Williams may find sludge removal laborious (p. 68), but I do not find this to be the case. We have been removing sludge this way in Japan for 14 years and in Ontario for 11 years. It is a controlled, effective way to

clean out the flotation tank, and I strongly recommend its incorporation into flotation machine designs.

The two paleoethnobotany books classify flotation as either hand or machine assisted, following Watson (1976). The classification, differentiating on the basis of scooping with a hand held strainer versus overflowing into a mesh, ignores a method that has been used since the 1950s (Watson 1976). The simple bucket decanting technique is still a relatively popular technique world wide. This omission is disappointing because it is far easier to organize and operate (and cheaper) than any of the techniques described. This 'hand' technique, first described by Helbaek and taught to me in 1973 by William Hurley (Hurley 1978), involves decanting the so-called 'light fraction' from a bucket, avoiding scooping altogether. I do not recommend scooping under *any* circumstances. Flotation involves suspension of remains that may be dispersed throughout the liquid. Decanting passes the whole volume of liquid through a mesh. Bucket decanting has several advantages over other hand flotation techniques: (1) scooping depends on the skill of the scooper to trap suspended material before it passes through the heavy fraction screen. Decanting eliminates variation in scooping skill. (2) The residue is saved in the bucket for later screening so that collection of small non-suspended remains can be better controlled. (3) Expensive geological sieves can be replaced with cloth or surgical gauze folded into several layers. (4) Anyone can use this technique with minimal outlay of money and with no special construction. (5) I suspect that it is less damaging to plant remains than methods that use strong water currents to maintain materials in suspension. If one wishes to increase the flotation rate, several flotation stations can be set up to operate concurrently. I recommend bucket decanting over the hand-skimming techniques, particularly when soil samples are smaller than about 50 liters.

Field researchers should be cautioned about thoroughly drying soil before flotation. Pearsall states categorically that "soil should always be completely dry prior to flotation" and claims that this is a "widely recognized fact" (p. 50). In fact, many recommend *not* completely drying soil before flotation. I have explicitly pointed this out (1983) and Pearsall cites me in this regard (p. 71). Experiments by Jarman et al. (1972) and Wagner in *Current Paleoethnobotany* have shown that repeated drying and wetting damages delicate carbonized seeds beyond recognition. The particulars of the soil and plant remains of any site are well worth testing before undertaking a specific drying regimen.

The proliferation of flotation methods leads to potential problems in comparability of results. Wagner examines the comparability question in an expansion of an earlier paper (Wagner 1982) and documents the variable results of selected methods but does not argue for standardization of methods. Rather, she hopes for an understanding of biases introduced by particular methods. The review of likely biases and methods for measuring or, at least, recognizing the biases is commendable. Unfortunately, Wagner still cannot offer a way to equilabrate data from various recovery methods. I agree with Wagner that raw data should be published so that we can judge for ourselves the potential biases. Oddly, data in Wagner (Figure 2.1) and Pearsall (Table 2.5) suggest that the IDOT system is the least reliable method. One wonders why Pearsall (p. 27) uses it as the method of choice in her laboratory.

ANALYSIS

After samples have been retrieved from the field, the task of identification and interpretation of macroremains begins. Toll in *Current Paleoethnobotany* and Pearsall (1989 Chapter III) both deal with analysis. Pearsall's chapter is a lengthy discussion divided into five parts: initial processing, comparative collections, basic identification, specialized identification, and presenting and interpreting results. Both chapters have a great deal to offer the uninitiated. For example, Pearsall provides a thorough review of establishing a plant reference collection and of providing botanical introductions to seeds and fruits, wood, roots and tubers, fibers, leaves, and non-woody stems. I have some concerns about the depictions of analysis, however.

A common analytical procedure is ignored almost entirely. Splitting a sample into components of particles larger than or smaller than 2 mm in size is only a partial description of a standard method at several laboratories in eastern North America (e.g., Crawford 1983, Yarnell 1974). Data presentation examples resulting from this method are ignored as well. Considering that a large number of students and researchers use these methods, it is a disservice to students of paleoethnobotany to omit this approach. In Pearsall's defense, she presents her personal approach to analysis; however, in this case, she has a responsibility to do more.

Cultivated plant remains are allowed about half a page of discussion followed by a page and a half bibliography on New World cultigens. The cultigen section is surprisingly poor compared to other sections of the book. For example, Chapter 5, *Phytolith Analysis*, is an examination of a subdiscipline of paleoethnobotany that is one of Pearsall's specialties. Fully 30 percent of the book is dedicated to the subject. The coverage is detailed, thorough, and an extraordinary asset to the book. However, Academic Press has already published an entire book on phytoliths and archaeology (Piperno 1988). The balance is not good.

Macroremains analysis, the area of paleoethnobotany most likely to be faced by cultural resource managers and other archaeologists, is not dealt with at the same level of detail. One reviewer has forgiven Pearsall for this omission (Hansen 1990). However, if phytolith analysis can be detailed then so can seed identification. I would have liked a separate chapter on the subject. Of course, such a chapter would still not do justice to the topic. Pearsall's choice may have been either to do a less than adequate job in a single chapter or to simply introduce the topic as she does. A better introduction to a complex subject could have been accomplished by dealing with the most common North American cultigens such as maize, beans, chenopod, cucurbits, legumes, sunflower, sumpweed, and tobacco.

An example of a perfunctory discussion of macroremains that goes wrong in an otherwise excellent presentation of basic botany is the absence of at least one proper generic seed drawing. On page 144, seed parts such as the embryo, endosperm, seed coat, and cotyledons are discussed with reference to Figure 3.18. None of these terms is properly illustrated. Pearsall leads us through the identification of a chenopod seed, but much is left to the imagination. For example, how does embryo placement vary across taxonomic groups in reality?

Pearsall notes that archaeobotanical research can involve considerable time and expense. Archaeologists who are not paleoethnobotanists often expect whole

collections to be analyzed with little appreciation of the logistics involved. Toll in *Current Paleoethnobotany* suggests one method of acquiring maximum data from a large number of samples while expending minimal time and money. She uses a two level scanning procedure that reduces analysis time by about 80 percent. She fully sorts only a representative sample from a site or region. How the representative sample is chosen is not described, nor is full sorting outlined. Furthermore, I found it difficult to assess Toll's technique. Sample weights or overall sizes are not reported, so we have no way to ascertain the potential labor involved. I wanted to compare it to my procedure but it was not possible. It seems to me to be somewhat problematic to scan a fraction for up to 5 minutes rather than to examine a fixed proportion (e.g. 15 or 30 percent) of each in its entirety. It would also be useful to scan a sample and compare results with a full analysis of the same sample. Based on the data in Toll's chapter, I would not recommend wholesale acceptance of this scanning technique without further assessment of its utility.

WOOD CHARCOAL

The only exception to the succinct papers in *Current Paleoethnobotany* is the one by Smart and Hoffman that is half again as long (39 pages) as the next longest chapter in the volume (26 pages). The authors do not present any of their own data, but summarize and evaluate previous studies. The paper, considering its length, is commendable for its organization and structure. Sections of interest can be read independently of other sections. The authors examine transport of woody plants, preservation, sample collection, analysis, and representativeness of the local environment. Environmental interpretation is explored at length as well. The second on quantification is particularly valuable. Is wood charcoal analysis worth the effort? After placing an extraordinary number of conditions on wood charcoal interpretation, the answer is that, indeed, much can be gained from a carefully planned and executed study.

QUANTITATIVE TECHNIQUES

The three books share explicit discussions of quantitative analysis. This is a pleasant change from over a decade ago when some paleoethnobotanists treated quantification with disdain. Counts, weights, ratios, species diversity, presence (ubiquity) analysis, and estimation of food value are explored. Hastorf and Popper and Gregg explore statistics in depth that are only introduced in Pearsall. The papers in Hastorf and Popper (1988) self-consciously explore the utility and validity of a number of quantitative methods. Marquardt (p. 224) points out that there is no *a priori* quantitative method for exploring plant remains data, so a review of various approaches is welcomed. Sources of patterning of plant remains data, methods for quantifying them, and criteria for choosing a particular quantification approach are examined. Miller focuses specifically on ratios. Popper's discussion of counts, ranking, and diversity are a must-read. Another excellent example of ranking can be found in Yarnell (1974). Miller's discussion of a variety of ratios is also crucial

reading. Kadane (p. 211) cautions that one must consider differential preservation of items used in ratios. However, as long as conditions of preservation for items used in ratios vary little from context to context, ratios may not diminish in value as a comparative statistic.

Pearsall (in *Current Paleoethnobotany*) explores the meaning of abundance and the effect of the seed source and context of deposition of plant remains on the meaning of abundance measures (p. 97). She uses data from Panaulauca Cave, Peru. The probable sources of five classes of plant remains are suggested along with likely ways the remains were introduced to the site and then charred. The identification of sources is based mainly on observations of current use of vegetation and the actual content of camelid dung and sod, for example. Pearsall explicates some interesting questions regarding processes that create the archaeological plant remains record in Peru by combining archaeobotanical techniques as well as ethnoarchaeology.

Johannessen asks, "Are paleoethnobotanical data better than we think?" One wonders what "we think" of paleoethnobotany, given her question. Johannessen shares with the reader her insights based on a large data base spanning 4000 years in the Mississippi valley. She believes that large samples systematically collected and analyzed reduce variation and make trends through time apparent. Johannessen documents several of these trends as agriculture develops: decrease in nut use, increase in starchy seed use, and changes in wood types. Such trends have been reported from the Illinois valley and elsewhere and one wonders how visible such trends would be with smaller samples. Variation is interpreted to be primarily due to age and, therefore, cultural stage. I find little to disagree with in her conclusions; however, I have concerns about certain measures of frequency. Nutshell and wood charcoal are reported as numbers of fragments of each. This assumes that fragmentation is a process directly proportional to quantities of nuts and wood charcoal. However, one nut can be fragmented into two or one hundred pieces, depending on the circumstances of fragmentation. This is much like presence analysis in that one kilogram and one gram of maple charcoal, for example, could have the same value as one fragment. Another assumption is that contextual variation is not an important consideration when the sample sizes are large. Contextual variation is such a significant aspect of many of the papers in this volume that I am concerned to see it ignored here. Others who have conducted regional analyses of subsistence remains are overtly cautious of possible contextual biases (Styles 1981; Monckton 1990). The results of Johannessen's analysis are not unexpected given the trends she is exploring. Possibly the large data sets remove these difficulties, but what about the unexpected?

Paleoethnobotany and *Current Paleoethnobotany* as a matter of course use presence analysis in their interpretations. Presence or ubiquity analysis is given more credit than it is due. The fact that several examples of its application are touted as being successful by several users of the statistic is not sufficient justification for its use. Pearsall's only insight on the matter is that she feels it is important to minimize the impact of absolute quantities because seed charring is accidental and seed caches can skew frequencies (p. 111). In general, high presence correlates with high abundance at Panaulauca, although there are several exceptions. Pearsall (p. 217) informs us that presence and percentage frequency furnish similar results and

does not cite the exceptions in her original study (in *Current Paleoethnobotany*). Kadane, a statistician, includes a compelling discussion on 'ubiquity'. I wish many of the contributors had read it before going to press. He concludes that ". . . the arguments for ubiquity over counts do not seem to bear up under scrutiny".

Another use of quantified data that are relevant to other archaeological issues is outlined by in Asch and Asch Sidell, who present a cogent argument for the contribution of plant remains to stratigraphic interpretation, a problem not addressed by Pearsall's book. Archaeologists are well aware that certain stratified deposits are difficult to interpret on the basis of gross field observations. Plant remains may provide insight on depositional histories that may not be evident in other data sets. The Napoleon Hollow site data are used as an example. Eight points argue the benefits of plant remains in stratigraphic interpretation. Independently, I have applied similar techniques to data from stratified mounds in Kentucky (Crawford 1982; in press).

DIET

Dietary interpretation is a significant problem in paleoethnobotany. Hastorf (p. 122) feels that consumption (presumably of some dietary significance) is actually not often addressed with macrobotanical remains although she claims elsewhere that paleoethnobotany has, indeed, emphasized diet reconstruction (p. 120). The confusion can be cleared up. In *Paleoethnobotany* Pearsall implies that isotopic analysis of human bone is the principal method for determining prehistoric diet, so we can understand why some researchers think that plant remains have little to offer dietary reconstruction. Certainly, quantitative questions about diet are difficult to answer from flotation sample contents alone. It is not impossible in my view, and there are levels of interpretation of diet that one can achieve from flotation sample contents. Flotation samples, as well as desiccated feces and coprolites, are important sources of dietary data. Hastorf draws together a variety of information including plant remains, context, and isotopic data in a thoughtful, provocative manner, providing an insightful examination of the multifaceted problem of diet reconstruction. Isotopic analysis, nevertheless, is an important technique and deserves treatment in some detail in any work synthesizing methods of dietary reconstruction. As for Pearsall's discussion of the technique, glaring omissions will mean that instructors who use this book as a text will need to augment this chapter to a considerable degree. No critical review of the method and the interpretation of results is presented. Conspicuously absent is a discussion of nitrogen isotopes, critical components of interpreting isotopic data. For some time now, researchers have realized that carbon isotopes should not be used in isolation (DeNiro 1987; Schwarz et al. 1985).

Pearsall's final chapter, "Interpreting Paleoethnobotanical Data", is her opportunity to demonstrate how the practitioners have put it all together. Much of *Current Paleoethnobotany* is about how to put it all together as well. Can paleoethnobotany indeed elucidate human-plant relationships in the past? Do the techniques allow us, as Richard Ford puts it, to interpret the "direct interrelationships between humans and plants for whatever purpose as manifested in the

archaeological record" (1979: 286)? The many examples in *Current Paleoethnobotany* begin to show us the extent to which this can be accomplished. The limited examples in *Paleoethnobotany*, however, give some sense that there is potential to accomplish a great deal; however, Pearsall does not go far enough.

The reader is introduced to three integrative case studies in *Paleoethnobotany*, all from sites south of the Rio Grande River. Two of the examples have extraordinary preservation of 'macroremains'. The third examines a project in Panama that combines pollen and phytoliths, but no macroremains. The success of phytolith analysis is measured by the analysis' agreement with a pollen diagram. Phytolith analysis contributed by allowing for different avenues of interpretation. The uninitiated might think that integration might be difficult to achieve, unless their situation is like these. Integrative studies should not be limited to different types of *plant remains*. The key to integration is to pull together *all* classes of archaeological data to elucidate not only human-plant interrelationships but problems in prehistory in general, in a way that Gregg attempts. The plant data are one side of the human-plant interrelationship equation. The other side, the human component, encompasses broad and specific anthropological issues. Once integrative studies are opened to include more than plant remains, many more questions can be raised and, we hope, answered. Pearsall bemoans the lack of understanding archaeologists have of paleoethnobotany. Conversely, paleoethnobotanists must have as extensive a working knowledge of archaeological data and principles pertinent to their geographic and cultural area as any other archaeologist.

FORAGER-FARMER INTERACTION IN EUROPE

Quite antithetical to Pearsall and to Hastorf and Popper, Gregg eschews any substantial archaeological data and their detailed interpretation. The aforementioned works take great pains to document what can be collected from sites and how the resulting remains can be interpreted. Gregg examined archaeobotanical reports from 14 sites (p. 86) but the raw data are not presented. The occurrence of cultigens is glossed over (p. 67) while some detail is provided on weeds (pages 79–94). Weeds are defined as crop competitors only and thus of no benefit to people. This is a modern agronomic interpretation which may or may not apply to the early European Neolithic. Consideration is not given to the potential utility of weeds as medicinal plants, sources of technological raw materials, secondary crops or other food sources, and so forth. Could Mesolithic people not have taken advantage of anthropogenic plant and animal communities associated with *abandoned* farming villages? None of this negates interaction as a process during the transition to food production, but the complexities are likely greater than accounted for by the model.

Gregg ends on a discouraging note, stating that it is ". . . disappointing not to be able to resolve the problems of population interaction . . ." (p. 237). She points out that "current data are inadequate to test the model developed here . . .: and that ". . . there may be little direct evidence of the interaction" (p. 233). In my view, Gregg has failed on one level to produce her "testable propositions" (p. 18). However, she indicates that collection of regional settlement data would allow

examination of a presumed shift from seasonal foraging sites to Neolithic villages. The same data would help determine whether a magnet effect brought Mesolithic sites close to Neolithic sites (p. 234). Studies of paleopathology may assist as well (p. 236). The available archaeological data in Northwest Europe, however, indicate that little, if any, cooperative interactions took place between the late Mesolithic and early farmers (Keeley 1992:91). The two groups appear to have repelled each other.

What went wrong, if anything, and what can we learn about the postulated Mesolithic-Neolithic transition from Gregg? She certainly brings together a disparate body of data, including ethnohistoric information. Surprisingly, archaeological data are not pivotal. Particularly interesting is her model of Neolithic food production. A hypothetical village of six households serves as an arbitrary starting point. Estimates of total nutritional requirements are calculated from a demographic reconstruction. The requirements are limited to calories and protein. Next, crop yields, wheat storage, straw production, and livestock fodder are factored in. Optimal planting strategies and per-capita hectare allotments are then predicted. Optimal resource mixes, including livestock, formed the final predictions. One important conclusion is that farmers "would be able to produce wheat surpluses" that foragers could exchange for their labor and wild food stuffs (p. 167). Meat and milk surpluses would have been created every spring as well (p. 230). Gregg concludes that the Mesolithic hunter-gatherers could have "entered into a mutualistic interaction" with neighboring farmers (p. 230). The problem is to discern what *could have happened* from what did happen. This is where Gregg's model runs into trouble.

Gregg discounts certain types of archaeological data from the Mesolithic. For example, ". . . charred cereals cannot be expected in Mesolithic contexts" (p. 233). Why not? Cultigens may not be common on Archaic sites in eastern North America, but they are certainly present (e.g., Chomko and Crawford 1978; Crawford 1982; Asch and Asch 1985; Smith 1989). Cultigen remains are evident in *Zoku* (Epi-) Jomon sites in northern Japan where there is clear evidence of interaction with the southwestern Japanese Yayoi (Crawford and Takamiya 1990). Collecting such remains requires an extensive sampling effort, but it is possible. In this light, the statement that ". . . organic remains have not survived at many Mesolithic sites" (p. 7) means only that archaeologists are not looking for them. The implication is that there is little to radiocarbon date, and that many Mesolithic radiocarbon dates have been arbitrarily dismissed as too young because they are contaminated, need to be examined. I would like to have seen a summary of radiocarbon dates from the study region. A concerted flotation campaign in conjunction with accelerator dating of seeds might clear up some of the chronological issues. I am more optimistic about the archaeological testability of the interaction model than is Gregg.

CONCLUSIONS

Foragers and Farmers will be received in two ways by the archaeological community. There will be those who praise the work for its attempts to model a process that has

long been a concern of European archaeologists. There are certainly praiseworthy aspects of the model. Others will dislike the book because few substantive archaeological data are used to produce the model. The details of ceramic chronology, settlement pattern, and other excavation results are not dealt with in this study.

Paleoethnobotany: A Handbook of Procedures is a valiant attempt to provide a 'how-to' manual of procedures in a rapidly developing discipline. For the most part, students of paleoethnobotany will receive excellent guidance from Pearsall. Archaeologists who have had neither the time nor the inclination to examine the many facets of field and laboratory aspects of paleoethnobotany will find much of what they need to know to get started in this volume. Botanists, too, will have the opportunity to see how archaeology can depend so much on their discipline. The major drawback of the volume lies in its rather abbreviated guide to techniques for dealing with seeds, fruits, and other 'macroremains'—the heart of the discipline for many of us. Proper analysis and identification of macroremains are essential to a good paleoethnobotanical study. We still await a proper guide to the identification and analysis of such materials in the Americas. Pearsall tends to be spotty in coverage and in many ways is too specialized to satisfy the needs of a growing and enthusiastic cadre of paleoethnobotanists. However, the general archaeological community will find much of value in this book. Pearsall is to be commended for producing a volume that will do much to positively affect future research in paleoethnobotany.

Current Paleoethnobotany should be well received by archaeologists, if Marquardt (Chapter 13) is a typical example. Without doubt the book is a must for all paleoethnobotanists and archaeobotanists. It will be required reading for every archaeology graduate student. Senior undergraduates may find some value in this book, but as general undergraduate reading, it has limited value. I have always had the feeling that, with some significant exceptions, paleoethnobotanists are writing only for each other. With *Current Paleoethnobotany*, prehistorians have the opportunity to appreciate the methodological issues facing paleoethnobotanists and how these issues directly affect them. The papers explicate the constructive contributions plant remains data and their interpretation can make to prehistory. Furthermore, those interested in method and theory, including statistical applications in archaeology will find something in this volume for them.

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