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SAS Membership Reminder

Beginning in 1992, the cost for a regular SAS anual membership is $55.00 . This now includes a subscription to the bi-monthly *Journal of Archaeological Science* (*JAS*), as well as a subscription to the quarterly *SAS Bulletin*. SAS members thus save over $200 for the regular subscription rates for *JAS*. The complete cost schedule is as follows:

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In This Issue

News of Archaeometallurgy

The Sixth Nordic Conference on the Application of Scientific Methods in Archaeology has been announced for 19-24 September 1993. It will be held at the Esbjerg Conference Centre in Esbjerg, Denmark, and will follow directly upon the 19th Nordic Archaeology Conference, being held 12-19 September in Munkebjereg, Vejle. Transportation between the two sites is being arranged. The fee in Esbjerg including meals and accommodation will be 4050 Dkr. Registration fee alone is 800 Dkr, which includes the proceedings, the conference dinner and an excursion. Abstracts are due by 1 March 1993 and should be sent to Vagn Mejdahl, The Nordic Laboratory for Luminescence Dating, Riso National Laboratory, DK-4000 Roskilde, Denmark.

The meeting of the Comite pour la Siderurgie Ancienne held last August in Norway was such a success that a reunion in Budalen around 1 July 1994 has been proposed. Write to Professor Arne Espelund at UNIT/NTH Metallurgisk Instituut, Alfred Getz vel 2b, N-7034 Trondheim, Norway with your suggestions.

A book list of works on early mining and metallurgy for sale by the Peak District Mining Museum is available by writing the Museum at Matlock Bath, Derbyshire DE4 3NR England, telephone (0629) 583834. They are official stockists for the Historical Metallurgy Society. They stock the Journals of the Trevithick Society, the Bulletins of the Northern Mines Research Society and the Peak District Mines Historical Society, and also many hard to find pamphlets.

If you have any archaeometallurgical news to contribute, please write or call:

Martha Goodway, MRC 534, Smithsonian Institution, Washington DC 20560, USA; tel 301-238-3733; fax 301-238-3709. □

Archaeometry and the National Science Foundation

John E. Yellen, Archaeometry Program Director

HISTORY AND ORGANIZATION

In 1984 the National Science Foundation (NSF) established an annual archaeometric competition which was administered and funded through its Anthropology Program. Seven years, $6,119,251 and 221 proposals later it seems reasonable both to take stock of progress to date and to share this information with the anthropological community. In part the value of this presentation is historical. However, empirical data presented in this article should provide useful information for potential applicants and should serve as a basis for discussion between the NSF and the anthropological/archaeometric community.

"Over the last seven years significant advances have been made in anthropological archaeometry. The National Science Foundation has assisted in this development, believes the funds awarded were well spent, and plans to continue support to the extent its limited budget allows."

The Anthropology Program supported anthropologically relevant archaeometry research well before the inauguration of an archaeometry competition and such proposals were reviewed in the same context as their strictly archaeological counterparts. Several reasons underlay the decision to establish a named archaeometric competition. First, it served to emphasize the importance NSF attached to such research and the contribution it made to anthropological knowledge. It also signaled the Foundation's increased financial commitment to such work. Finally, it changed in subtle but significant ways how many archaeometric proposals were evaluated. The Anthropology Program uses a two stage process to review all "senior" (as opposed to doctoral dissertation) research applications; each proposal is evaluated by a unique set of *ad hoc* reviewers who submit their comments by mail. A panel of ca. 5 members then reads the applications and accompanying reviews, and meets once or twice yearly to make recommendations. On this basis final decisions are made. Obviously the background and perspective of panel members will influence the direction a competition takes and the establishment of a separate "archaeometry" category allowed the creation of a panel which included the necessary expertise and relevant perspectives.

As part of the Anthropology Program, archaeometric proposals are limited to those directed towards questions of anthropological significance. While individual projects often include more than one goal, both "technique development" and "laboratory support proposals" are considered by the archaeometry panel, while requests to apply existing technologies to specific archaeological questions are reviewed by its archaeological counterpart. Thus a radiocarbon laboratory's request to purchase new equipment or a biochemist's proposal to explore the dating potential of non-collagenous bone protein both fall within the scope of the archaeometry competition. On the other hand a request for radiocarbon dates to resolve the issue of when cotton cultivation began in coastal Peru would be considered by the archaeology panel. The Program's goal is to have each application evaluated by the most knowledgeable and potentially sympathetic panel, and since the relative availability of funds is approximately the same across anthropological panels, this distinction should not be a source of concern. The archaeometry panel meets once a year, usually in early April. Proposals should be submitted by the previous October 31 and funding is usually available by the following June. Applicants follow standard NSF grant application procedures and information may be obtained from Dr. John Yellen, Anthropology Program - Room 320, National Science Foundation, Washington DC 20550 (Bitnet: jyellen@nsf; Internet: jyellen@note.nsf.gov). Potential applicants should feel free to call Dr. Yellen directly (202-357-7804).

THE REVIEW PROCESS

Insight into how proposals are reviewed is valuable because it both reveals underlying competition goals and suggests how projects may best be formulated and presented. Although individual circumstances can vary widely, a typical proposal is evaluated for both technical competence and anthropological significance. *Ad hoc* reviewers are selected with both considerations in mind. If, for example, a researcher proposes to develop a new chemical means to source Southeast Asian jades, reviewers would be drawn from several categories. Technical experts would be selected to comment (hopefully) on whether the applicant had the expertise to develop this type of chemical analysis. Likewise the reviewer group would include a geologist or geochemist who understood the origins and chemical variability of jade materials. Finally archaeologists who could bring an anthropological perspective and Southeast Asian expertise to bear would also be included to consider whether there are significant anthropological questions which the technique might address. Panel members are likewise selected to provide a balance between archaeometric expertise and anthropological perspective. Three of the five panel positions are filled on a (normally) three-year rotating basis

by individuals who possess both specific technical expertise and experience in interaction with anthropologists. The remaining two places are reserved respectively for a New World archaeologist knowledgeable in Neolithic or post-Neolithic "complex" societies and an Old World archaeologist who specializes in pre-ceramic hunting and gathering groups. In 1991 the panel consisted of Drs. Herbert Hass, William Farrand, Linda Kleppenger, Prudence Rice and Arthur Jelinek. To maximize their chance of success, applicants should be aware of these goals and perspectives and present their research accordingly.

FACTS, FIGURES AND SPECULATION

In fiscal year 1988 (FY88) a one-time "big laboratory" competition was held and 13 proposals were submitted. In the following tables and discussion, with the exception of Table 1, proposals submitted in response to the special announcement and dollars expended for this award are excluded.

Table 1. Archaeometry Expenditures by Fiscal Year

Fiscal Year	Expenditures
1985	$ 660,825
1986	$ 736,934
1987	$ 732,918
1988	$1,006,616
1989	$1,047,653
1990	$1,046,449
1991	$ 967,856

As Table 1 indicates, expenditures increased rapidly from an initial $660,825 to approximately $1,000,000 three years later and they have been held at this level. This represents 13% of the FY91 Anthropology Program budget. (The 16 archaeometry proposals constitute 7% of the senior applications submitted in FY91; the Anthropology Program also provides curatorial support for systematic anthropological collections and plays an important role in funding doctoral dissertation research.)

As Table 2 indicates, the number of submissions has decreased from a high of 53 proposals in the FY85 inaugural year to a low of 16 in FY91. The second column shows how many proposals were submitted by first-time applicants, and comparison of the two indicates that the declining submission rate results not from diminished interest by a "hard core" of applicants but rather from decreased recruitment of new individuals. This pattern may indicate both the limited size of the existing potential applicant pool and the slow rate at which individuals are being trained in or attracted to anthropological archaeometry. With the exception of FY89 in which a number of relatively small grants were made, awards have ranged between 5-8 per year and no trend is apparent. The overall FY85-91 success rate (# awards/# proposals x 100) is 23%, but this measure *per se* is not particularly meaningful since its yearly variation is great and primarily determined by the number of new applicants. If one lumps together yearly increments for multi-year awards, average award size is $129,226 and the average award length is 23 months.

There is both value and hazard which attaches to analysis of what types of proposal fare well and poorly in the evaluation process. Value rests on the fact that a clear pattern does emerge, and this may help to understand

Table 2. Number of Submissions, New Applicants, Awards and Success Rates by Fiscal Year

Fiscal Year	Number Proposals	Number New	Number Awards	Success Rate
1985	53	53	6	11%
1986	41	17	8	20%
1987	25	15	7	28%
1988	25	13	5	20%
1989	22	7	9	41%
1990	26	10	7	27%
1991	16	2	5	31%

underlying decision criteria and to predict what kinds of projects are most likely to succeed. The danger lies in the possibility that creativity may be stifled. Individuals may shy away from submission of proposals which are not perceived as mainstream. This result would be most unfortunate, and at the outset it should be emphasized that a very broad range of projects has been supported. Subject areas include the following dating techniques: radiocarbon, K-Ar and Ar-Ar, uranium series, thermoluminescence, tree rings, ESR, tephrochronology, ostrich egg shell racemization, radiocalcium and rock varnish dating. The Program has supported a range of bone studies focused on isotopes, trace elements and organic components. It has also provided funds for the analysis of ceramics, metals, jade, amber, chert, obsidian and phytoliths.

Success rates, however, have varied markedly across areas. When compared to an overall rate of 23%, both ceramic and metallurgy projects have fared relatively poorly with success rates of 10% (3 awards from 29 applications) and 15% (3/15), respectively. Many, although not all, of these studies involved sourcing; the success rate of requests to source non-ceramic, non-metal materials is also a low 13% (2/15). Surprisingly none of the 9 obsidian hydration proposals submitted over the years have been funded. This pattern does not reflect an unspoken or informal NSF agenda, but rather results from individual decisions made by a large number of *ad hoc* reviewers and panelists over 7 years. *Post hoc* one may suggest several reasons for it. First, such projects can be extremely difficult

NSF (continued on p. 16)

Phytolith News

Society For Phytolith Research

We are pleased to announce the formation of a new society, The Society for Phytolith Research. The goals of this society are to disseminate new information in phytolith research and to promote interdisciplinary contacts among researchers. Dues have been set at US $10.00 per year for regular members and US $7.50 for students. Subscribers will receive *The Phytolitharien Newsletter*. Please make checks (US funds, please) payable to the Society for Phytolith Research. Please send your check to John G. Jones, Society for Phytolith Research Treasurer, Smithsonian Tropical Research Institute, Unit 0948, APO AA, Miami, FL 34002-0948, USA. For more information write to John G. Jones at the above address.

Call for Nominations - Preliminary Announcement

Two vacancies on the Board of Directors of the Society for Phytolith Research (SPR) will occur at the next annual business meeting: President-elect and Delegate-at-Large.

The office of President-elect is a term of one (1) year followed by one year as President and a third year as immediate past-President. The President-elect assists the President and performs the duties of the President if necessary. In addition, the President-elect takes notes at the annual business meeting and serves as the chair of the Nominating Committee. The President is the chief executive officer of the Society and presides over all meetings. The immediate past-President serves on the Board of Directors. A present President cannot serve as President-elect but the immediate past-President is eligible.

The office of Director-at-Large is a term of two (2) years. Of the two positions on the Board, one is up for election each year. Directors-at-Large are eligible for re-election. The Board of Directors is responsible for the management and control of the property and affairs of the Society.

All officers must be members of the Society. Please send nomination and/or volunteer information to the Nominating Committee:

Susan Mulholland, chair (President-elect), Archaeometry Lab, University of Minnesota at Duluth, 10 University Drive, Duluth MN 55812, USA; Bitnet: SMulholl@UMNDUL; Internet: SMulholl@ub.d.umn.edu; telephone 218/726-7957; fax 218/726-6556.

William Middleton, Department of Anthropology, 5240 Social Science Building, University of Wisconsin, Madison WI 53706, USA; Bitnet: WDM@WISCMACC.

Anita Buehrle, University of Toronto, Toronto, Ontario, Canada. □

Symposium Report

Phytolith Analysis in the 1990s: Applications in Archaeological Interpretation). Society for American Archaeology Annual Meeting, 8-12 April, 1992, Pittsburgh, USA.

Contributed by Susan Mulholland.

A SAS-sponsored symposium, *Phytolith Analysis in the 1990s: Applications in Archaeological Interpretation*, was presented at the 1992 Society for American Archaeology meetings in Pittsburgh by co- chairs Susan Mulholland and Amy Ollendorf (University of Minnesota). The nine papers dealt with various aspects of phytolith analysis as applied to archaeological problems. Several concentrated on systematic information in cultivated plants. "Identifying Rice (Oryza sativa), Poaceae, through Phytolith Analysis" by Deborah Pearsall, Elizabeth Dinan, and Marcelle Umlauf (University of Missouri) reported on the results of an on-going study of wild and domesticated Oryza and related general in Asia. "Phytoliths in the Reproductive Structures of Teosinte and Maize: Implications for Study of Maize Evolution" by Dolores Piperno (Smithsonian Tropical Research Institute; read by Deborah Pearsall) compared phytolith production in maize and teosinte. "Clues in the Search for the Millets of the Past: Opal Phytoliths and How They May Tell The Story" by Marsha Baenziger and Zhao Zhijun (University of Missouri) reported differences between Setaria and Panicum genera of millet.

Some extremely interesting research was reported on extraction procedures. "A New Procedure for Extracting Phytoliths from Soil" by Zhao Zhijun presented the results of analysis of sediment extraction procedures, including comparison of three heavy liquids. "Extraction of Phytoliths from Prehistoric and Contemporary Camelid Dental Calculus" by William Middleton (University of Wisconsin) reported on extraction of phytoliths from tooth calculus.

The remaining papers indicated some of the wide range of applications available. "Phytolith Analysis at Archaeological Sites for Recovery of Subsistence Data and Identification of Stains" by Linda Scott Cummings (Paleoresearch Laboratories) covered a wide range of studies including analysis of stains, grinding stones, agricultural fields, and knives. "A Preliminary Analysis of Past Vegetation in the Jama River Valley, Manabi Province, Ecuador" by Cesar Veintimilla and Deborah Pearsall (University of Missouri) presented a reconstruction of the vegetation, including slash and burn methods of land clearing. "Paleoenvironmental Implications from an

Phytoliths (continued on p. 19)

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Volume 1

PHYTOLITH SYSTEMATICS

Emerging Issues

edited by George Rapp, Jr. and Susan C. Mulholland, *University of Minnesota, Duluth*

The application of phytolith systematics to archaeology is limited by the shortage of data on many plant groups as well as the lack of adequate keys and comparative collections. Contributors to this new reference detail the importance of phytolith studies to solving archaeological problems related to human use of plants and the environmental context of human evolution and cultural change. With an annotated bibliography and numerous figures and tables, *Phytolith Systematics* is a comprehensive guide to these important plant groups.

CONTENTS: Phytolith systematics: an introduction, *S.C. Mulholland and G. Rapp, Jr.* Great expectations: a short historical review of European phytolith systematics, *A.H. Powers.* Developing a phytolith classification system, *D.M. Pearsall and E.H. Dinan.* A morphological classification of grass silica-bodies, *S.C. Mulholland and G. Rapp, Jr.* Toward a classification scheme of sedge (Cyperaceae) phytoliths, *A.L. Ollendorf.* Predicted world distribution of C_3 and C_4 grass phytoliths, *P.C. Twiss.* Preliminary identification of silica skeletons from Near Eastern archaeological sites: an anatomical approach, *A.M. Rosen.* Cereal grain phytoliths of southwest Asia and Europe, *L. Kaplan, M.B. Smith, and L.A. Sneddon.* Illustrated phytoliths from assorted food plants, *I.S. Cummings.* Classification of opal phytoliths formed in selected dicotyledons native to the Great Plains, *S.R. Bozarth.* Phytolith taxonomy in selected species of Texas cacti, *J.G. Jones and V.M. Bryant, Jr.* Silica deposition in subterranean organs, *A.G. Sangster and M.J. Hodson.* Darwin and design in phytolith systematics: morphometric methods for mitigating redundancy, *I. Rovner and J.C. Russ.* Annotated bibliography of phytolith systematics, *S.C. Mulholland, E.J. Lawlor, and I. Rovner.* Index.

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Volume 2

SCIENCE AND TECHNOLOGY IN HISTORIC PRESERVATION

edited by Ray A. Williamson, *Office of Technology Assessment, U.S. Congress*

For information on the Society for Archaeological Sciences, Please contact the Office of the General Secretary: Radiocarbon Laboratory, Department of Anthropology, University of California, Riverside, California 92521.

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Book Reviews

Materials Issues In Art And Archaeology.
E. V. Sayre, P. B. Vandiver, J. Druzik, and C. Stevenson, editors. Materials Research Society, Pittsburgh, 1988, xii + 321 pp., graphs, tables, b/w photos, references, index. $53.00 (cloth), $45.00 (members).

Reviewed by Garman Harbottle, Brookhaven National Laboratory.

Three years ago in Reno the Materials Research Society organized a symposium on Materials Issues in Art and Archaeology. In the preface to this volume the editors trace the history of the meeting to earlier occasions where the strong interaction of the materials sciences with archaeology, fine arts, and museum conservation work was explored. Apparently they have struck a responsive chord: after all, materials science (though not always going by that name) has been a critical factor in object and architectural conservation and, in archaeology, in elucidating ancient technology. Superimposed on these traditional studies there is now a host of new hi-tech equipment coming from the "professional" materials scientists and their laboratories. A symposium like this can report the result, and give us the present status. There was a second MRS symposium on this same topic in San Francisco in 1990, which I attended. Coming so close to the "regular" Archaeometry symposium in Heidelberg, one is tempted to ask whether there is a real difference in outlook between the two. I address this question at the end of this review.

"It remains to be seen whether the MRS people can better solve the problem that perpetually agonizes the "traditional" archaeometry practitioners, and that is, how to have effective communication between the hard scientists on the one hand and the archaeologists and art historians on the other."

The present volume is divided into three large parts, each with several subdivisions. Under Part I: "Structural and Compositional Analyses" we find, logically enough, Studies of Structure and Compositional Analyses. Then Part II, "Ancient Materials Technology" has subdivisions dealing with Silicates and Metals respectively. Finally, the link to conservation is explicitly set forth in Part III: "Processes of Deterioration and Conservation", but here the main emphasis is on glasses. Each subsection is headed by an invited paper that serves to review the field and set the stage for the contributions to follow.

In the first section, following P. Meyers' introduction, there are three interesting studies of the use of radiation to "see inside" objects. Cheng and Mishara, and Ellingson et al. report two aspects of radiography-tomography of museum objects and x-ray examination (including xeroradiography) of ceramics. Both these techniques, and the well-known neutron-induced autoradiography of paintings (Olin et al.), are well worked out, and the papers presented are only peripherally concerned with materials science. Ellingson et al., however, also present a useful comparison of three different ways to record the x-ray image, and the kinds of ceramic technical (structural) information that can be obtained.

The Smithsonian neutron autoradiographic study by Olin et al., though brief, demonstrates once again the enormous power of this hi-tech technique. Coupled with x-ray examination, so much can be learned of the painter's individual methods that the images almost define an infallible signature. This has produced surprises: one recalls that when the new Berlin autoradiography unit studied the single most popular paining in Germany - Rembrandt's *Man in a Golden Helmet* - the results strongly suggested that another hand had been at work!

The section on Compositional Analysis is headed by Ed Sayre's essay. He touches upon both technological history, as typified by his seminal glass studies with Ray Smith among others, and provenience *via* analysis (Greek black-glaze pottery, and the multivariate study of lead isotope ratios in the Sackler bronzes). This theme is taken up in the Reedy and Reedy paper on the re-evaluation of the lead isotope data in the literature. Reedy and Reedy concluded that, "The isotopic data base for lead/silver ores in the Aegean region is currently inadequate to support many of the archaeological conclusions that have been made with it." I suppose that this was the opening gun of *l'affaire* Reedy, which ended with a lot of people angry and upset. The main point remains, however, how to interpret lead isotope data with due regard to good statistical practice.

Pam Vandiver's nice introduction to the technology of ancient ceramics traces out the subtle interaction between the history of materials science, the application of modern instrumentation, and our understanding of the sweep of human intellect in the successive innovations that have marked ceramic development. This is what the symposium was supposed to be about!

A series of more specialized studies by Blackman, Freestone, and Rigby, Kilikoglou et al., Wiedemann et al., and Palmiter and Johnson deal with a number of aspects of archaeological ceramic science. I found the paper of Wiedemann et al. particularly interesting in that they employed several scientific methodologies (thermo-gravimetry, thermomagnetics, and "DCS", whatever *that* is) to come to the conclusion, certain to be controversial, that the famous Qin Dynasty "terra cotta" warriors from Xian

were probably not fired at all, but only hardened by drying. Can this be true?

Luis Torres' paper on Maya Blue summarizes all that has come out of a number of studies including his own on the preparation, properties and replication of this remarkably beautiful, technologically superb blue pigment from pre-Columbian America. Talk about innovation! Although it is made from an *organic* dyestuff adsorbed on palygorskite clay, it can withstand strong acids, alkalis, solvents, oxidizing and reducing agents and heat; truly, a supercolor! It strikes me that there is room here for materials science research dealing with how this color can be so resistant; also, could this combination, natural dye plus clay mineral, be used to create other resistant colors? Was it so used in antiquity?

There are two papers in this section on the technology of ancient glass by Julian Henderson. One of these, dealing with a second millennium glass bead found in Britain, exactly matched the materials science orientation of this meeting. Because this bead, though it was buried for 3300 years, was in excellent condition, "No incipient or actual weathering was observable." Doesn't this relate to the use of glasses as a form for disposal of fission products? Many years ago M. Kaplan pointed out that the waste-disposal people could learn something from the archaeologists, and this paper bears it out.

In the Metals Technology section the paper of Demortier again raised the question of the use of cadmium in ancient gold solders, a point that surely calls for additional PIXE studies.

Part III: "Processes of Deterioration and Conservation" is heavily weighted toward obsidian hydration dating studies and the need to understand the chemistry by which obsidian (and other glasses) in contact with water form hydration rinds. No less then seven papers take up this theme. Jon Ericson's opening review nicely covers the nature of the studies, the rate measurements, the material (i.e., composition) and environmental variables that affect the hydration rate. One must conclude: that the many factors in addition to temperature that change the rate probably all need to be controlled; that the more studies that are made, the more complex the process appears to be; and that the only hope of reducing obsidian hydration to a practical dating tool for archaeology rests with a detailed study of the materials science involved. Taken as a whole, the group of seven papers amounts to the best available statement of where obsidian hydration dating stands today.

The final section is made up of a group of studies on the general theme of deterioration. The work of Burn's group on the salinization of Egyptian antiquities, and his measurements at the Tomb of Nefertari demonstrate the importance of scientifically-based field work as the underpinning of conservation.

Does the volume endorse the proposition that materials science makes significant contributions to studies in archaeology and fine arts? Certainly - was there any doubt? My observation of recent Archaeometry and MRS Symposia suggests to me that the field of archaeological science has simply become so big and diverse that the materials science portion shows signs of spinning off. This is certainly ok but it remains to be seen whether the MRS people can better solve the problem that perpetually agonizes the "traditional" archaeometry practitioners, and that is, how to have effective communication between the hard scientists on the one hand and the archaeologists and art historians on the other. That is the nut that is so hard to crack, and this volume does not convince me that the MRS people have done a lot better than the archaeometry folk. □

Archäologie und Chemie - Einblicke in die Vergangenheit. Josef Riederer. Rathgen-Forschungslabor, Preußischer Kulturbesitz, Berlin, 1987, 276 pp., figures, tables, maps, bibliographies, indices. DM 12.00 (paper).

Reviewed by Kim Dammers, Göttingen, Germany.

This is a good, concentrated book. It was produced to accompany a museum exhibition, so the audience appears to be the educated layperson. It is very clearly and simply, but accurately, written. The organization is likewise exemplary. The 180 illustrations (25 in color) add to the attractiveness of the volume.

The subject is the application of chemistry (and physics) to the analysis of archaeological objects. The first part of the book explains the method, goal, and application of 29 analytical and 14 dating techniques, with about one page devoted to each. In the next section, materials analysis is presented in somewhat more detail with background information or a case study for each of 8 metals and 17 other materials (e.g., leather, glass). To a lesser degree, antique processes of working materials, especially as they are relevant to chemistry, are also introduced. The greatest attention here is paid to the metals, a specialty of the author. The categorized bibliographies (30 pages) provide a valuable help for any archaeologist or chemist first looking into one of the subfields. In fact, here, as in the text, there is something for all but senior archaeometrists.

There is no consideration of chemistry in the field; pH, phosphate analysis and other primarily field tests are not mentioned. Some stable isotope techniques are very briefly explained. Otherwise, all major methods of (laboratory) chemical analysis applied to archaeological objects are presented.

Although the one-page discussions are too short for use as a text (nor were they intended as such), even in a short archaeometry survey course, they are nevertheless the best cribs one can offer to students, and which can be a pleasant, speedy, clear introduction for other archaeologists and chemists. □

Book Reviews

Textbook Of Pollen Analysis (4th ed).
Knut Faegri and Johs Iversen (4th edition by Faegri, Peter Emil Kaland, and Knut Krzywinski). John Wiley & Sons, Inc., New York, 1989, x + 328 pp., figures, tables, identification key, glossary, references, indexes. $125.00 (cloth).

Reviewed by Vaughn M. Bryant, Jr., Texas A&M University.

I doubt there are more than a handful of professional palynologists in the world who have not seen, heard of, or purchased at least one of the four editions of this remarkable guide to the field of pollen analysis. Several generations of palynologists have relied on one of the editions of a *Textbook of Pollen Analysis* as their first introduction to pollen studies, as a textbook in a college course, or as a reference book on their library shelf. The first edition of this book was published in 1950 by Faegri and Iversen, two of the pioneers and early giants in the field of palynology. Iversen died before work began on this fourth edition, but he is still listed as one of the two primary authors because of his contributions to the first three editions. The first edition of the text was a bit thinner than the current 4th edition. Even so, one wonders how inflation could have taken such a heavy toll on the price difference between the two. The first edition, published 40 years ago, sold for $3.00. That is 1/42 of the current $125.00 cost, or an increase of almost $3.00 per year between 1950 and the present.

The focus of each of the earlier editions, and the current one as well, is Quaternary palynology. However, as the authors note, many of their chapters discuss applications that have relevance in many different fields of palynology besides Quaternary palynology. Many of the 12 chapters of the current edition are similar to ones that appeared in the earlier editions. Expanded discussions of earlier topics, new chapter names, a larger pollen key, the addition of new concepts in the field of palynology, and a larger page size format of the new edition makes it noticeably different from earlier editions.

The first few chapters include an introduction and other chapters with catchy titles and mottos on the beginning pages, such as "Where Does the Pollen Go?" Each chapter is nicely organized, and contains a mini table of contents on the first page. This makes finding any topic easy and quick.

The introduction presents a handy background for new students and a refresher course for those who have forgotten the details of how the field of pollen analysis developed and the major changes that occurred since 1916, when the discipline was introduced by Lennart von Post.

The second chapter, "Where Does the Pollen Go?" is the first one the archaeologist should read carefully. Often, archaeologists are concerned about the sources of pollen recovered in cultural deposits. They want to know if the pollen is an accurate reflection of past vegetation, if it can reveal human subsistence patterns, and if the pollen can reveal functional patterns of artifact use. In most cases, the answers to those questions and the validity of the recovered pollen information is directly linked to the reliability of the pollen sources. Chapter two answers these questions by taking a thorough look at what can happen to pollen grains between the time they are formed in flowers until they are deposited.

The next two chapters, "Where Pollen is Found" and "How Pollen is Recovered," are important chapters for Quaternary palynologists to read and study. Neither chapter directly discusses problems associated with pollen deposition or recovery from archaeological sites. The exception might be the discussions of lake, bog, and alluvial deposits. In some regions of the world, archaeologists might expect to find cultural deposits in these types of locations or might want to use paleoenvironmental data from those deposits to extrapolate conditions and possible cultural events at nearby cultural sites.

Chapter five, called "Finding the Grain," discusses the many techniques used by palynologists to separate fossil pollen from the surrounding matrix material. The discussion of techniques presents a good summary, but does not address one of the most important processing problems confronting most archaeological palynologists, namely: examining soils from archaeological sites. The chapter contains one brief paragraph that suggests how one should remove tiny insoluble particles, such as charcoal dust, but does not discuss the scope of the problem. The authors admit (p. 81) that charcoal dust can be a major problem in some samples and suggest removing it through filtration techniques. From my own experience, I have found that charcoal removal from archaeological soils is difficult. My only successes in removing charcoal have been accomplished by using a combination of sonication and heavy density fluids. What seems to work best is a sonication using a Delta-5 Sonicator followed by several separation steps using zinc bromide heavy density fluids. I no longer use filtration to remove charcoal because experiments using NITEX nylon screens with pore openings of 15 µm revealed that some small pollen grains, in the size ranges of *Salix* and *Castanea*, often pass through the screens with tiny grains of charcoal dust. I also found that nylon screens with smaller openings clog too quickly to be effective. Charcoal removal remains one of the major problems associated with successful pollen recovery from archaeological deposits.

How to arrange the pollen data in graphs, charts, and diagrams, and how to interpret the pollen data are the subjects of the next three chapters. These are important subjects but in general will be of more interest to

palynologists than archaeologists. Nevertheless, archaeologists should glance through these chapters and become familiar with some of the pitfalls that can confuse the interpretation of fossil pollen data. Potential interpretation errors can result from events such as local pollen over-representation, long distance pollen transport, differential pollen destruction, pollen recycling, human and animal influences, and pollen concentration values. These are all important concepts archaeologists should consider when interpreting pollen data from cultural deposits. Even in studies where trained palynologists have conducted pollen analyses, archaeologists should still make sure that all potential sources of pollen error were thoroughly considered and eliminated before interpretations of archaeological deposits were made.

Chapter nine is titled "Archaeopalynology." This was a new chapter and is the first time an edition of this book has treated the subject of archaeological palynology in detail. In the preface, senior author Faegri notes that Peter Kaland, one of the junior authors of the fourth edition, was primarily responsible for this chapter. Even so, the chapter leaves much to be desired. First, the chapter title is misleading. The term "archaeo" is defined in dictionaries as "ancient or primitive." The geologic time period, Archeozoic, is an example of the correct use of this prefix. When the same prefix is linked to "palynology," it suggests the study of "ancient or primitive" pollen. If one must combine the terms "archaeology and palynology," a logical, and accurate, new work would be *palynoarchaeology*. Second, the chapter's discussion focuses mainly on the problems archaeological palynologists will encounter while working on European sites. There are adequate discussions of how humans can alter a natural landscape and vegetation through forest clearing and the use of fire. The chapter also explains how cultural shifts to plant cultivation and animal husbandry can be identified in the pollen record. However, the chapter lacks adequate discussions of important topics such as: 1) how pollen can be used to identify subsistence patterns in sites utilized primarily by hunters and gatherers; 2) how pollen can be used to determine functional use of masonry rooms through an examination of fossil pollen trapped in floor surfaces; 3) clues pollen can offer about the functional use of pottery vessels, grinding stones, baskets, and lithic tools; 4) the range of data potentially available from pollen studies of human coprolites and latrine deposits; and 5) the types of data which pollen studies of human grave sites might offer. In spite of the chapter's weakness, it concludes with a good discussion of some of the major problems and potential pitfalls associated with pollen sampling at archaeological sites. The authors stress, and I would echo, the importance of consulting a pollen analyst *before* field excavations are completed. They also stress the importance of taking more pollen samples than will be needed. This policy, they note, is far better than realizing too late which samples should have been collected during field excavations.

The rest of the book contains a pollen key of European flora and a discussion about other types of microfossils palynologists sometime encounter during sampling and analysis. Although of great interest to palynologists, I doubt these subjects are of much importance to archaeologists.

The book is well written, easy to read, and an essential reference guide for anyone seriously studying palynology. There are chapters in the book that archaeologists should read in detail and other chapters that they should skim. Only in this way will archaeologists be able to judge critically the pollen data they read in reports or the data from their own excavations. The high cost of the current fourth edition may discourage some from buying a copy. If so, it would be worth the effort to make sure your nearby library has a copy that can be checked out and read. □

Archaeological Wood: Properties, Chemistry, and Preservation. Roger M. Rowell and R. James Barbour, editors. Advances in Chemistry Series 225. American Chemical Society, Washington, D.C., 1990, xii + 472 pp., figures, tables, plates, references, indexes. $79.95 (cloth).

Reviewed by Lee Newsom, Florida Museum of Natural History.

Rowell and Barbour have edited this highly practical book of contributions by 22 leaders of the fast-developing field of archaeological wood preservation. I enthusiastically recommend it to all who are directly or tangentially interested in archaeological wood. For the purposes of this book, archaeological wood is defined as

"Preservation measures have failed on a number of archaeological projects [due] to a lack of understanding of the chemistry, anatomical structure, and state of preservation of individual specimens of wood, and to the wholesale application of treatments to batches of wooden materials without considering carefully the suitability of treatment to a given artifact. This volume will go a long way toward correcting such shortcomings."

"any wood that gives information about human development, culture, or climate conditions, or that is used to study the aging process of the wood itself." This definition extends to wood from wet environments, including freshwater bogs and swamps, and salt water deposits; dry environments, including tombs and dwellings; and what are termed "variable environments," including historic buildings and outdoor artifacts exposed directly to the ravages of weather.

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The volume has 17 contributions, which begin with a chapter by Florian that covers the scope and history of work with archaeological wood, and culminate with chapters by Rowell and Peterson, respectively, that discuss future trends and new techniques still in experimental stages of research and design. The intervening chapters deal with the nature and chemistry of waterlogged and dry wood, preservation treatments, and problems encountered during storage and exhibit.

Florian (ch. 1, "Scope and History of Archaeological Wood") overviews the historical development of conservation treatments with a good explanation of how and why the popular PEG (polyethylene glycol) treatment works. She also makes it clear why PEG is not universally suitable. Florian sets the stage for succeeding chapters by discussing the ideal preservation environment, deviations from the ideal, and the destructive effects associated with exposure and removal of ancient wood from the burial environment.

Five chapters are grouped together under the heading "properties and chemistry" (of degraded wood). I found these exceptionally enlightening and well written. The contribution by Hoffmann and Jones (ch. 2, "Structure and Degradation Process for Waterlogged Archaeological Wood") is a good example of this. Displaying a keen knowledge of wood anatomy and ultrastructure, the authors explain the stages through which cellular dissolution proceeds and its differential progress through various cell types and tissues. The use of stains and florescence to track cellular swelling and the sequential stages of cell wall breakdown is effectively detailed, and these methods clearly provide a relatively simple and convenient way to assess the condition and potential for collapse upon drying of a given specimen of waterlogged wood. The photomicrographs in this chapter are excellent and complement the text well. For example, progressive breakdown of cell walls from the S2 and S3 layers through to the compound middle lamelae, as well as the movement of the "degradation front" across a given specimen are clearly and systematically described and illustrated. I was surprised to learn, contrary to my intuitive thinking, that in some hardwoods, e.g., ash, fibers actually degrade at a faster rate than parenchyma cells and vessel members. This type of information is critical to preservation efforts.

Wood conservators will find Hoffmann and Jones's comparative studies on the progress of structural and chemical damage very informative. Five common temperate woods were analyzed, including four hardwoods and one softwood, with resulting data that make a strong case for the need to identify the genus as well as the state of preservation of each artifact prior to initiating conservation measures. In addition, the comparative studies show that conservation must take into account the special problem of differential rates and patterns of decay within a single wooden artifact. Degradation typically seems to proceed inward from the outer surface of the artifact. Thus, tissue nearer the exterior of a piece may be significantly more degraded than wood farther removed from the surface. Treatment of such specimens with zones of highly versus slightly degraded wood is cited as a major challenge to conservation.

Several chapters deal specifically with dry wood. Interestingly, as Schniewind (ch. 4, "Physical and Mechanical Properties of Archaeological Wood") and other authors show, wood preserved in a dry state seems to undergo much less structural damage than wood from waterlogged environments. Dry wood is deceptive, however, and may appear better preserved than is actually true. This is thoroughly discussed by Nilsson and Daniel (ch. 3, "Structure and Aging Process of Dry Archaeological Wood").

Chapter 6 ("Biological Degradation of Wood"), authored by Blanchette, Nilsson, Daniel, and Abad, is a lucid account of the agents and action of biologically-induced wood decay, including fungi, bacteria, and insects. Also discussed is how to recognize each of these forms of attack.

Hedges's contribution (ch. 5) on the chemistry of archaeological wood is another that I found exceptionally informative. He begins with a readily comprehensible discussion of the chemical components of the cell wall and how they are integrated in sound wood. From this base, he proceeds to show how archaeological wood varies by explaining how the wall polymers differentially and progressively degrade under contrasting depositional environments. This chapter, as well as Barbour's (ch. 7, "Treatments for Waterlogged and Dry Wood"), describe a number of ways to assess the state of preservation of degraded wood. Barbour goes on to describe the behavior of various treatments for archaeological wood in terms of their end result, that is, whether they function as protective surface treatment, provide structural bulking through integration with the cell wall or filling the lumens, and so on. The problem of drying waterlogged wood is also discussed.

The introduction to preservation technologies given by Barbour is supported through case studies presented in several succeeding chapters. Hafors overviews work with the structural remains of the Swedish ship Wasa (ch. 8, "Polyethylene Glycol Preservation Method"). Chapters by Tran et al. and Schniewind discuss the results of work with monomers and resins (ch. 9, "Impregnation with Radiation-Curing Monomers and Resins," and ch. 13, "Consolidation of Dry Archaeological Wood by Impregnation with Thermoplastic Resins"). Ambrose gives an updated report on freeze-drying (ch. 10, "Application of Freeze-Drying to Archaeological Wood") that includes a discussion of work under natural conditions (frozen environments). Feist (ch. 11, Outdoor Wood Weathering and Protection) reviews the natural weathering process and discusses ways to treat

historic structures. Wermuth (ch. 12, "Consolidation Systems for Degraded Wood") and Rice (ch. 14, "Gluing of Archaeological Wood") deal with the problem of conserving complex large objects, including difficulties that arise when earlier conservation measures were undertaken. The case studies provide valuable insights and tests of different treatment methodologies. Museum curators will find Harvey and Freedland's (ch. 15, "Exhibition and Storage of Archaeological Wood") discussion very useful. Even lighting in museum exhibit areas can pose problems for the ongoing conservation of wooden artifacts.

The volume closes with chapters by Rowell and Peterson that explore future directions in wood preservation research. Rowell (ch. 16) discusses a set of techniques that theoretically work to chemically modify and repair or restore cell wall polymers. This treatment seems especially promising because it deals directly with the cause or source of structural failure in degraded woods by attempting to restore the tissue to a sound state rather than simply supporting the cellular structure.

Peterson's chapter ("New Directions in the Conservation of Archaeological Wood") is a general overview of work with archaeological wood. He includes a realistic discussion of the costs and time frame involved to conduct research on sites with quantities of preserved wood. To Peterson's list of "attributes that impart value to archaeological wood" I would add wood species. One correction should be made regarding Peterson's mention of the wooden tools from the Windover site in Florida. Whereas he gives the date of the artifacts as being older than 12,000 years, actually the peat deposit itself dates between 10,750 and 4,700 years before present, and the burials and associated wooden artifacts date between 7,000 and 8,000 years B.P. (G.H. Doran and D.N. Dickel, Radiometric chronology of the Archaic Windover archaeological site (8Br246), *The Florida Anthropologist* 41 (3): 365-380, 1988).

It is clear to me, after having read this volume, why preservation measures have failed on a number of archaeological projects. The failure is owed to a lack of understanding of the chemistry, anatomical structure, and state of preservation of individual specimens of wood, and to the wholesale application of treatments to batches of wooden materials without considering carefully the suitability of treatment to a given artifact. This volume will go a long way toward correcting such shortcomings. My one disappointment in this collection of papers is that, with the exception of a brief mention in Peterson's chapter, no coverage of sucrose treatments, which seem to be gaining wider acceptance, was given. Peterson mentions the applicability of sucrose technology for Third World countries.

This volume is a must for archaeologists and conservators who work with wood and other organic remains. They would benefit by having at least an initial background in organic chemistry and wood anatomy, basic knowledge that anyone working in organics conservation should have. □

Lubbock Lake. Late Quaternary Studies on the Southern High Plains.

Eileen Johnson, editor. Texas A&M Press, College Station, 1987, xii + 179 pp., 25 tables, 73 figures, 13 p. reference list, index. $49.50 (cloth).

Reviewed by Michael Clayton Wilson, Department of Geography, University of Lethbridge, Lethbridge, Alberta T1K 3M4, Canada.

Paleoindian studies have been blessed recently with sumptuous monographs about such classic sites as Lindenmeier, Agate Basin, and Horner, replacing incomplete early reports with long-sought descriptive data and new interpretations. In such a context, this uneven book about Lubbock Lake does not fare well and is better viewed as a progress report. At its best, it provides new insights; at its worst, it is a mass of partially digested data marred by misuse of fundamental concepts.

"Paleoindians and ancient faunas ... are the locality's main contribution to knowledge, along with the excellent geological/pedological sequence."

The locality was discovered in 1936 in excavations to restore Lubbock Lake after irrigation had lowered the water table. Intermittent studies from the 1930s to 1960s led to the Lubbock Lake Project (LLP) in the 1970s and 1980s, anchored at Texas Tech University and its museum, and to National Register designation and National Landmark protection. Remains at Lubbock Lake extend from Paleoindian to Historic times; artifacts once suggested to be pre-Clovis appear instead to have been worked down into turbated bedrock (p. 22).

An introduction by E. Johnson and V. Holliday is followed by chapters (the longest by far by the editor) about geology and soils (Holliday and B.L.Allen), cultural chronology (Holliday), flora (J.L. Thompson), pollen (V.M. Bryant, Jr. and J. Schoenwetter), invertebrates (H.G. Pierce), vertebrates (Johnson), paleoenvironments (Johnson), artifacts (Johnson and Holliday), cultural activities (Johnson), and a closing summary (Johnson and Holliday).

Only 68 of 120 radiocarbon dates are accepted, on wood, humic acid, humin, and charcoal; shell and bone sample dates were distrusted. Unfortunately, readers must refer to another article for a full table with rejected dates.

Holliday and Allen (ch. 2) describe five major strata including alluvial and lacustrine sediments along the valley axis with flanking colluvial and aeolian sediments. These document moist Late Pleistocene conditions, early Holocene aridity, and fluctuating late Holocene conditions. The authors show soils to be as important as the deposits in which they have formed, documenting landscape stability

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and often longer periods of time than do the deposits. Archaeologists had originally and erroneously defined paleosols here as "substrata;" Holliday and Allen abandon this and name the soils to minimize confusion. Regrettably, one name (Firstview) is the same as that of a culture of different age, causing confusion anyway. Even the book's organizers were confused by the Firstview Culture (ca. 8600 B.P.) and Firstview Soil (8500-6300 B.P.), despite efforts to clarify matters in Figure 2.7 (p. 21). It is not always clear that "Firstview Period" means the cultural period, despite its citation as such on p. 93.

Holliday (ch. 3, "Cultural Chronology" divides the Paleoindian *Period* into Clovis, Folsom, Plainview and Firstview *Cultures*, which become *subperiods* (p. 25). Equating "culture" with "subperiod" is fine, but in ch. 9 ("Artifact Assemblages"; Johnson and Holliday) the Paleoindian *Period* is divided into Clovis through Firstview *Periods* (e.g., captions, pp. 110-111). Johnson cites these "periods" in ch. 8 ("Paleoenvironments"), adding ambiguity by using them to organize paleoenvironmental data - an independent system. This shows a lack of concern for systematic procedures (e.g., Willey and Phillips 1958), and for the need to keep cultural and environmental time units distinct for correlation tests. Would Johnson talk of Old World "Paleolithic environments" instead of "Pleistocene environments"? Small wonder that index references to "Firstview Period" lead to the Firstview Soil, but fail to include the Firstview points on p. 107! Even worse, one of the "periods," the Archaic, is widely seen as a stage, not a period at all (Willey and Phillips 1958).

The end of the Paleoindian Period at Lubbock Lake is defined in terms of environmental changes because the cultural transition to Archaic is not represented. The poorly represented Archaic is subdivided on the basis of material culture, subsistence, and (again) environmental information into the predictable "Early, Middle, and Late," a linguistic tyranny that rules "objective" classifications. Despite claims that the LLP sought to study the influence of environmental changes on cultural adaptations, environmental conditions were allowed here to influence if not control decisions as to subdivision of archaeological periods and subperiods. This is circular reasoning, if the subdivisions are to be tested *against* environmental changes.

Early Archaic groups, much like Paleoindians, hunted bison; evidence for plant preparation (an earth oven) appears at Lubbock Lake in the Middle Archaic. The Ceramic Period yields the smallest sample of all, even lacking potsherds. The Protohistoric is rich in occupation debris, part of which is Apache. Historic goods record the Apache demise and the transition to Anglo-American settlement.

Thompson's analysis of plants (ch. 4) reveals how little is known of the pre-disturbance modern flora. Tall grasses reported by Coronado in 1541 gave way to shortgrass by the 1800s. Macrofossils include an unexpected halophyte from mesic Stratum 1; hydrophyte seeds in Stratum 2 may have blown in. Bulrush in the Firstview soil A horizon agrees with faunal and geologic evidence for a spring-fed marsh, with similar correspondences for Strata 3 and 5.

Pollen studies (Bryant and Schoenwetter, ch. 5) have been inconclusive. Contradictory interpretations may reflect varied lab and data-treatment procedures. Preservation is variable and large sediment volumes must be processed; counts of sufficient grains could take 40 hours per sample! Wendorf's "Lubbock Subpluvial" (ca. 10,600-10,300 B.P.) may have been based on samples from a younger zone or may signal a differential taphonomic process; either way it must be discarded.

Pierce's account of invertebrates (ch. 6) includes a valuable methodological discussion though, like Johnson (see below), he estimates paleoenvironments from "zones of sympatry" rather than species-by-species consideration of tolerances. Gastropods are abundant and diverse here, but life histories and tolerances are so poorly known that zones of sympatry are justifiable as a first approximation. High faunal similarity with Blackwater Draw opens possibilities for regional comparisons. Four taxa common elsewhere in Wisconsinan strata appear only in Stratum 1A, suggesting temperatures 10° cooler than present and moist conditions. Despite warming by Stratum 1B times, local woodlands remained; by Stratum 2 conditions were much as today. Strata 3 and 4 gastropods document early Holocene xeric conditions, the depauperate Stratum 4 fauna containing only the hardiest species. Moister conditions returned in Stratum 5 times.

"Herps" and mammals are treated by Johnson (ch. 7); fishes have been published elsewhere and birds remain unpublished. Lubbock Lake boasts the most extensive southern Plains late Quaternary vertebrate sample, with at least 128 species (all groups), 14 of them extinct. Johnson discusses distribution, fossil record, and identification criteria, though for some examples (e.g., anurans or *Sylvilagus* premolar patterns) illustrations would have aided comprehension. Reworking from older deposits is considered for large *Geochelone* (p. 66) but not for the purported latest geologic occurrence of *Holmesina* and first association with humans (p. 88). An admission (p. 121) that the Clovis "processing station" yielding the two *Holmesina* fragments was fluvially modified to an unknown extent on a point bar suggests caution if not skepticism.

Johnson's basic assumption is that modern biotic distributions are the key to paleoenvironmental reconstruction (p. 10), an accepted uniformitarian concept. It is made operational through derived "zones of sympatry" rather than species-by-species investigation of tolerances. Although the approach is justified where absence of data about modern tolerances precludes other methods, it has many limitations (see Graham and Semken 1987:7-8). Johnson's findings ironically constitute a strong argument

against the approach. Because no modern zone of sympatry could encompass all species in early assemblages, she arbitrarily divides paleofaunas into three elements, each providing its own zone of sympatry. The "zones of sympatry" are therefore influenced by the decision to assign a given species to one set or another. Why not five elements, or eight, or 128?

Johnson's literature search reveals puzzling gaps. Distributional discussions should credit Hoffman and Jones' (1970) extensive consideration of postglacial dispersal of plains mammals. The *Arctodus* map omits many finds mapped by Kurtèn and Anderson (1980:181), a key resource not cited but filled with data for other species as well. McDonald's (1980) *Bison* revision goes uncited despite discussion of synonymy of *B. antiquus* and *B. occidentalis* (p. 86). These lapses suggest spotty updating of a decade-old manuscript. The vertebrate fauna, like other data sets, suggest mild late Pleistocene winters, aridity by 8500 B.P., forest decline, and grassland expansion.

Johnson reconstructs environments in ch. 8 from all proxy data, concluding that environmental "zones" did not shift in space; rather, changed conditions brought a new ecological mosaic with new interaction systems. She names environmental "periods" after cultural complexes, giving the illusion that changes in both coincided. However, her data reveal environmental changes within "periods" as well. Some data invoked (e.g., dental abnormalities in bison, pp. 94-95) are not described and cannot be evaluated by the reader.

The faunal sequence is subdivided into "Local Faunas," named after cultural "periods": Clovis Local Fauna, Folsom Local Fauna, etc. (p. 91), indicating a complete lack of understanding of the local fauna concept. Local faunas should be named after their locality, not associated cultural complexes; the "Plainview Local Fauna" would be taken by paleontologists to be from the Plainview Site. Subdivisions of a local fauna are *faunules*. What Johnson describes are really faunules, showing continuity despite some changes, within a *single* local fauna: the Lubbock Lake Local Fauna.

It is distressing to see so little concern for systematic and taxonomic procedures. Imposition of cultural categories on the faunal sample gives two sequent "local faunas" that are virtually identical (Folsom and Plainview). It is evidently assumed that cultural units are established and inviolate; what happens when *those* names (like "Yuma") are superseded? Percentages of "extinct species" used to compare "local faunas" at Lubbock Lake include *Bison antiquus* as extinct (p. 91), despite acceptance (p. 86) that its "disappearance" was phyletic.

Over 40 "features" (ch. 9, "Artifact Assemblages", by Johnson and Holliday) represent camps, processing stations, and kill/butchering locales. Their definition as "features" (p. 100) violates archaeological terminology; features are "artifacts that cannot be removed from the ground, such as post holes and ditches" (Fagan 1985:89). Lubbock Lake is a *locality*, and the "features" listed are either *sites* or *components* of stratified sites. Artifact assemblages from these "features" reveal little that is new. Of over 2100 lithic items recovered by 1979, 6% were projectile points and other tools. Plainview points show resharpening and use as knives. Firstview incised bone items include a turtle plate and tubular bead. Diagnostics are rare in Archaic and Ceramic levels; a few Protohistoric potsherds are present. Reworking of tools in most periods to conserve lithic material is consistent with a local paucity of sources. The extent of selection of bone as a secondary raw material could relate to this.

Chapter 10 ("Cultural Activities and Interactions", by Johnson) notes that site activities centered on subsistence and the technology of making tools for procurement and processing, mostly of large mammals. Emphasis by Clovis peoples on mammoth gave way to bison hunting, with pronghorn as secondary prey; horses were preyed upon in the Historic Period. Stacking of bones and minimal marrow processing typify Paleoindian processing areas whereas later examples show jumbled distribution and intensive marrow processing. Chapter 10 provides a classification of cut lines and of degrees of bone destruction. More illustrations are needed, but not along the lines of the nearly illegible maps (e.g. Fig. 10.18)! Oddly, neither here nor in the discussion of carnivore effects is Binford (1981) cited.

An extensive description of muscles, tendons, and ligaments relies on in-text descriptions and a table to get the picture across. Much effort is made to specify correct muscle names and their origins and insertions (though plantar becomes "planter") as a prelude to discussion of butchering patterns. These patterns show similarities within and differences between periods and were modified when bones were conserved for use as tools. Johnson states that "Limited experimental butchering (artiodactyls, elephant) was conducted" (p. 143) and concludes that for mammoths, "from experimental experience the same seven to eight major butchering units as those in ungulates were practical" (p. 150). The experiments are not described and the statements sound glib: it requires more than "limited experiments" to conclude what was "practical" for a Paleoindian butchering a mammoth. Quarrying of mammoth bones for flake production is discussed, but the small Lubbock Lake sample adds nothing to evidence from other sites. Post-Clovis bone technology centered on "expediency tools" made from animals being butchered. Discussion of bone breakage is jargonistic, obscure, and repetitious: "This technique, when applied to fresh long bones, produces a spiral morphology. The morphology is helical in nature and is the shape of a curve through a series of planes as it circles around the diaphysis" (p. 152).

Mammoth procurement strategies (ch. 10) at Lubbock Lake are inferred by analogy from other sites, which suggest kills of mammoth family units. Small- and large-scale bison drive kills began in Clovis times. With the early Holocene increase in grasslands, bison numbers increased and kills rose from large-scale to "scores of animals." Paleoindian drive kills were largely in spring or late fall, as in Historic times. Johnson talks of "scheduling and seasonality

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practices," again misusing terms: seasonality is an attribute of the resource, while scheduling is the human response (Flannery 1968:74). Although large-scale kills were possible, some small-scale kills were always being made around waterholes, again in spring and fall, possibly by small kin groups. Small-scale kills are also noted for horse and camel, which makes one wonder if that indicates the absence of large herds of these species. Paleoindians at Lubbock Lake did not venture far into the grasslands after bison but concentrated efforts around water bodies (p. 158), unless this is an artifact of different environments of preservation. Later groups foraged more widely and brought carcass segments back for processing.

Readers would agree that Lubbock Lake is important, but it is appropriate to ask "Why?" The repeated statement that a major stratified cultural sequence is present is tempered by comments about inadequacy or ambiguity of Archaic and Ceramic assemblages. Obviously Johnson is primarily interested in Paleoindians and ancient faunas; they are the locality's main contribution to knowledge, along with the excellent geological/pedological sequence. Are stratified sites needed at all, with radiocarbon dates available to order cultural sequences? Yes, they are, because several Paleoindian assemblages remain ambiguously resolved by dates. Lubbock Lake is historically important in terms of Paleoindian studies, although its most often cited product was a Libby radiocarbon date (9883±350 B.P.; C-558) erroneously assigned to Folsom. This aside, the locality is among the best dated in North America; its Firstview dates, for example, cast doubt upon the earlier date for Olsen-Chubbuck.

The volume itself is curiously outdated by reference to *man* and *his* activities (e.g., Johnson, p. 88), which engenders the feeling that most activities involved males. Its cultural reconstructions do not rise beyond economic considerations and speculations about band-level organization; the people emerge either as busy automatons maximizing food procurement efficiency or as taphonomic filters interfering with a bone assemblage. A manifesto for studies of cultural adaptation, process, and "transformations," (p. 8) is abandoned by chapter 11, where "changes" and "trends" are discussed less explicitly. The statement (p. 8) that "Transformations occur... to achieve adaptation" implies that "adaptation" is a threshold or state, not a process. Whereas theory behind cultural reconstruction is offered but discarded, a theoretical basis for paleoenvironmental inference is never completely laid. Lacking this, the book is further marred by Johnson's misuse of concepts and by the circular reasoning built into designation of cultural, geological, faunal, and paleoenvironmental time units.

Typographical or grammatical errors are few; "equitable" is used to describe an *equable* climate (pp. 8, 98) and *Hemiauchenia* is misspelled (p. 83). Overall, the book is not easy to read, even accepting that some of the tedious descriptions are necessary precursors to the analyses attempted. Little thought was given to the reader and to visual packaging of information; there are no skeletal diagrams, for example, that rival in effectiveness Todd's (1987) depictions in the Horner report. The volume's entertaining high points include Holliday's and Allen's contributions on geology, soils, and chronology as well as Bryant's and Schoenwetter's insights into palynological problems and Pierce's discussion of gastropods. The low points are Johnson's lengthy, repetitive chapters, which would have benefited from review and editing. The book is in many ways valuable; however, given its appalling price, it is much less than it could — and should — have been. It even makes the ancient people of Lubbock Lake sound a bit boring, when they emerge at all from the facts and figures.

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Domestication of Plants in the Old World. The Origin and Spread of Cultivated Plants in West Asia, Europe and the Nile Valley.
Daniel Zohary and Maria Hopf, Oxford University Press, Oxford and New York, 1988. 249 pp., £40.

Reviewed by Mark Nesbitt (associate editor for bioarchaeology), British Institute of Archaeology, Tahran Caddesi 24, Kavaklidere, Ankara, Turkey.

Comprehensive syntheses of the archaeological and botanical evidence for the origin and domestication of crop plants tend to appear at long intervals: by A. de Candolle in 1886, K. and F. Bertsch, and E. Schiemann in the 1940's, and most recently Jane Renfrew's *Palaeoethnobotany* (London, 1973). Since Renfrew's book, much progress has been made by Zohary and others in elucidating the relationships of crops and their wild relatives, using careful genetic and morphological analysis of large numbers of living plants, and Zohary and Hopf's book is a clear, compact guide to this work. It contains relatively little that is novel, but summarizes a large and widely scattered literature. Progress in archaeobotany - the study of seed remains from archaeological sites - has been much more fitful. The use of rigorous identification criteria, largely pioneered by German archaeobotanists such as Maria Hopf, is more common now, but the importance of adequate sample sizes is still not widely understood. The discussion of archaeobotanical records for each crop in the book demonstrates clearly the need for larger data sets from a greater number of sites, particularly those of later periods.

"This book can be enthusiastically recommended as an overview of the changes in plant exploitation in the Near East and Europe in the last 10,000 years."

The first chapter outlines the types of archaeobotanical and botanical evidence available. This tightly compressed chapter could perhaps have been expanded. No mention is made of the problems of sampling and interpreting ancient seeds, nor of the development of the cheap and efficient water separation techniques in the late 1960's that have dramatically enhanced the retrieval of charred seeds from archaeological sites. A fuller account of the techniques of genetic analysis would have been helpful, and the limitations of using modern distribution data as evidence for the distribution of plants in the past (heavily relied on in this book) are not discussed.

In the following six chapters the evidence from archaeobotany and from studies of living crop plants and their wild ancestors for the domestication and spread of the main Near Eastern and European crop plants is authoritatively outlined. This part of the book can be strongly recommended as an up-to-date guide to what is known. The discussion of the relationship between the breeding system of the plant and its domestication is particularly illuminating. Numerous well-chosen illustrations of archaeological material are provided, but the drawings of living plants are from old publications and are sometimes of poor quality. The discussion of the spread and relative importance of each crop species after domestication is wide ranging, but reads occasionally as a list of obscure places at obscure periods. More discussion of how these patterns relate to cultural changes in antiquity - for example, via migrations and trade routes - would perhaps have made these clearer. However some important periods of change are pointed out in the chapter of conclusions: the spread of the original "package" of Near Eastern crops from the Near East to Europe; the domestication of crops such as opium poppy and oats outside the Near East; the beginning of fruit cultivation in the fourth and third millennia, and the importance of the first millennium B.C. as a time when new crops such as millet, cotton and sesame arrived in the Near East. There is an additional chapter concerning fruits gathered from wild plants.

The short final chapter of conclusions is preceded by 24 pages devoted to lists of plant remains from various sites. Although this is in principle a good idea, this chapter falls below the high standards of the rest of the book. Plant remains from each site are listed by archaeological level and classified as prevailing, frequent, few or rare. These lists make difficult reading. Either tables or narrative accounts would make the patterns of change through time clearer. Even allowing for the sparseness of archaeobotanical reports from some areas, too many very short preliminary reports are used and given equal weight with far more informative final reports. One example is the treatment of a preliminary report on the Turkish site of Can Hasan I. Here the original report is on only two out of the numerous samples found, and describes only 21 grains of cereal and 12 peas. Zohary and Hopf translate this into "Scarce remains: wheat (few); six-rowed barley (frequent); pea (frequent)." In fact, the excavator's reports make it clear that plant remains at Can Hasan I were very numerous, and the analysis of only 33 seeds is a completely inadequate basis on which to characterize the crops of a site. For the other sites in the list, the chronological periods concerned are sometimes given, sometimes absent, and some of the radiocarbon dates differ from those given in the original reports.

This book can be enthusiastically recommended as an overview of the changes in plant exploitation in the Near East and Europe in the last 10,000 years. A very full bibliography makes it easy to follow up information on particular crops. This is certainly an essential purchase for botanical and archaeological libraries, and if it becomes available in a cheaper, paperback form, will be a very useful desk-side companion for anyone interested in the subject. □

NSF (continued from p. 3)

to design because, most often, they require not only technical expertise but also a detailed understanding of both anthropological theory and regional data. A successful applicant, for example, might need to show mastery not only of neutron activation analysis but also of theories which link production and distribution to the rise of chiefdoms as well as the detailed chronology of Preclassic and Early Classic Mayan sites in Belize and the adjacent Peten. Such control can be difficult to achieve. Secondly, some types of ceramic and metallurgy projects are most readily justified in a history of technology context and it can be hard to make a convincing case for clear anthropological significance. Finally, projects which propose to analyze a regionally circumscribed set of materials do less well than others which are perceived to be of broader significance. Since hydration rates must be calibrated to specific sources, this may explain why an obsidian hydration request is less likely to be funded than one to produce a single radiocarbon curve calibration which presumably would have worldwide application.

Dating projects have fared relatively well with a success rate of 39% (28/72). Measured by number of awards, the five most successful groups supported through the competition have each received three and each has focused on dating. These include the Institute of Human Origins (K-Ar, Ar-Ar) the University of Arizona (accelerator radiocarbon dating), Southern Methodist University (radiocarbon dating), the University of Maryland (thermoluminescence dating of sediment), and the University of California, Berkeley/McMaster University (ESR dating). Four laboratories have received two awards: University of Washington (radiocarbon calibration), Carnegie Institute/University of Colorado (ostrich eggshell racemization dating), University of Arizona (tree-ring dating), University of Utah (paleosol isotope analysis) and University of Wisconsin (bone isotope analysis). If one looks for common threads which run through the projects, several - although not all apply to every case - may be suggested. First, the laboratories are usually uniquely qualified to apply or develop a particular technique or service. Secondly potential application is generally broad rather than of a more narrow regional focus. Finally, many of the projects include both technique development and analysis of specific samples of interest to the anthropological community.

Over the last seven years significant advances have been made in anthropological archaeometry. The National Science Foundation has assisted in this development, believes the funds awarded were well spent, and plans to continue support to the extent its limited budget allows. The archaeometry competition developed in direct response to researchers' requests. The Anthropology Program has maintained close ties with the archaeometric community and attempted to be responsive to its concerns. We look forward to the future continuation of this pattern. □

Announcement

Central American Institute of Prehistoric and Traditional Cultures Established

The Central American Institute of Prehistoric and Traditional Cultures at Belize was established under a charter from the government authorities in Belize as a scientific, educational, and non-profit organization for the purposes of promoting the preservation of ancient and traditional cultural ethos and materials, and to act as a center for the dissemination of knowledge and interest in the study of such cultures. These activities include scientific research and archaeological investigations, preservation for public benefit of archaeological monuments and historical landmarks, as well as academic and educational programs on all aspects relating to prehistory, ethnohistory, and the ethnographic present.

Studies in the areas of ancient and indigenous cults and ritual practices are particularly encouraged. Plans are on the way to establish, as part of the Institute, a center for shamanistic studies.

Twenty-seven acres of jungle terrain, kept as a natural preserve, have been dedicated for an ethnobotanical field station, which is to serve as a research facility, where plants of ethnomedicinal interest and ritual importance can be studied in their native habitat. The Institute also encourages work in wildlife and tropical resource management, to be pursued from indigenous and traditional points of view.

Although Mesoamerica constitutes the focal point of interest, as indicated by the Institute's name and location, nevertheless, research and academic pursuits, as well as educational programs, are not limited to any particular region or culture of the world. In addition, the Institute seeks cooperation with other scientific and cultural organizations established for a similar purpose.

Although presently, we are limited to issuing the *Chac Mol Newsletter* (available upon request at no charge), it is hoped that our plans to publish in the near future a regular journal, as well as monographs, will be realized fairly soon.

Like all institutions of this kind, we must depend on public and peer support. We extend warm invitations to new members to join our ranks!

Dr. Michael Ripinsky-Naxon has become the founding director of the Institute. He specializes in prehistoric and native religions, particularly in shamanism and sacred plants. His book, entitled *The Nature Of Shamanism*, is being published by the State University of New York Press in 1993. Two other books, *Flesh of the Gods - Souls of Men* (hallucinogens and ritual among the maya) and *Ancient Belize* (an archaeological volume edited by him) are also forthcoming. □

Meetings Calendar

Susan Mulholland, Archaeometry Laboratory, University of Minnesota-Duluth, 10 University Drive, Duluth MN 55812; e-mail SMULHOLL@UMNDUL; tel 218-726-7957; fax 218-726-6556.

New listings are marked by a *; new information for previous listings indicated by a +. More information on some meetings is given in previous bulletins as indicated, e.g., "15(1):2" for volume 15, number 1, page 2.

1992

July 3-5. Symposium on Subglacial Processes, Sediments and Landforms. Northern Ireland. George F. Dardis, Sedimentology and Palaeobiology Laboratory, AHEC, East Road, Cambridge, CB1 1PT, UK; fax 0223-352973.

July 6-10. 36th Annual Meeting of the Australian Mathematical Society. Perth, Western Australia, Australia. W.S. Perriman, School of Mathematics and Statistics, Curtin University of Technology, Bentley, Western Australia 6102, Australia; e-mail tsiewpf@cc.curtin.edu.au.

July 8-11. EUROBIC I: 1st European Bioinorganic Conference. Newcastle upon Tyne, England. Dr. John Gibson, The Royal Society of Chemistry, Burlington House, London W1V 0BN, UK; tel 071-437-8656; telex 268001; fax 071-437-8883.

July 12-18. International Working Meeting on Soil Micromorphology. Townsville, Queensland, Australia. Colin Chartres (IWMSM), CSIRO Division of Soils, GPO Box 639, Canberra ACT 2601, Australia; tel 61-6-246-5965; fax 61-6-246-5953.

July 13-17. 10th International Conference on Solid State Dosimetry. Washington, DC, USA. Dr. S.W.S. McKeever, 10th SSD Conference, Department of Physics, Oklahoma State University, Stillwater, OK 74075, USA.

Aug. 1-14. Meeting to Focus on Global Change. Washington, DC, USA. ASPRS, Don Hemenway, 210 Little Falls Street, Falls Church, VA 22046, USA.

Aug. 9-14. 15th International Conference on Organometallic Chemistry. Warsaw. Prof. Dr. S. Pasynkiewicz, Warsaw Technical University, Faculty of Chemistry, Koszykowa 75, 00-662 Warsaw, Poland.

Aug. 16-21. 9th International Biotechnology Congress. Arlington, Virginia, USA. Division of Biochemical Technology, American Chemical Society Meetings, 1155 16th Street NW, Washington, DC 20036, USA; tel 202-872-4402.

Aug. 22-27. 206th American Chemical Society National Meeting. Chicago, Illinois, USA. ACS Meetings, 1155 16th Street NW, Washington, DC 20036, USA; tel 202-872-4396.

Aug. 23-28. 21st European Congress on Molecular Spectroscopy. Vienna. E.M. Schaup, c/o INTER-CONVENTION, Austria Center Vienna, A-1450 Vienna, Austria; tel 43-222-2369-2647; fax 43-222-2369-648; telex 11 1803 icos a.

Aug. 23-28. 3rd International Congress of Human Paleontology. Jerusalem, Israel. Patricia Smith, Organizing Secretary, c/o International Ltd., P.O. Box 29313, 61292 Tel Aviv, Israel.

* Aug. 24-26. American Quaternary Association 12th Biennial Meeting. Davis, California. Carolyn Norlyn, University of California, Davis, CA 95616-8766, USA; tel 916-757-3331. 15(1):1.

Aug. 24-29. 2nd International Congress of Mayanists. Merida, Mexico. Comité Organizador del Segundo Congreso Internacional de Mayistas, Centro de Estudios Mayas, Instituto de Investigaciones Filológicas, Circuito Mario de la Cueva, Ciudad Universitaria, 04510 Mexico, D.F., Mexico.

Aug. 24-Sept. 3. 29th International Geological Congress. Kyoto, Japan. Secretary General, IGC-92 Office, P.O. Box 65, Tsukuba, Ibaraki 305, Japan; tel 81-298-54-3627; fax 81-298-54-3629; telex 3652511 GSJJ.

Aug. 30-Sept. 4. Australian Rock Art Conference; sponsored by Australian Rock Art Research Association and International Federation of Rock Art Organizations. North Queensland, Australia. AURA, P.O. Box 216, Caulfield South, Victoria 3162, Australia.

Aug. 30-Sept. 5. Diatom Research International Meeting; sponsored by International Society for Diatom Research and Nederlands-Vlaamse Kring van Diatomisten. Renesse, Netherlands. Conference Secretariat, AquaSense, Box 41125, 1009 EC Amsterdam, The Netherlands; tel 31-20-5922244; fax 31-20-5922249.

Sept. 1-7. 8th Congress of the European Anthropological Association. Madrid. María Dolores Garralda, Sección de Antropología, Facultad de Biología, Universidad Complutense de Madrid, Ciudad Universitaria, 28040 Madrid, Spain.

* Sept. 6-12. 8th International Palynological Congress. Aix-en-Provence, France. Rob Scaife, Department of Geography, University of Southhampton, Southhampton S09 5NH, UK.

* Sept. 7-10. 7th Annual Meeting of Language Origins Society. Cambridge, England. Leonard Rolfe, Department of Psychology, University of Lancaster LA1 4YF, UK.

Sept. 11-13. Environmental Change Meeting; sponsored by Association for Women Geoscientists. Denver, Colorado, USA. Leslie Anne Landefeld, Barranca Resources, 16150 W. 14th Place, Golden, CO 80401, USA; tel 303-278-1292.

Sept. 14-18. International Conference on Liquid Scintillation Spectrometry. Vienna. Dr. Franz Schonhofer, Austrian Society for Liquid Scintillation Spectrometry, Schopenhauerstrasse 71/11, A-1180 Vienna, Austria.

Sept. 14-18. 20th European Meeting of Statisticians. Bath. R. Sibson, School of Mathematics, University of Bath, Claverton Down, Bath BA2 7AY, UK.

Sept. 16-18. Biodeterioration of Archaeological Materials; sponsored by Science and Engineering Research Council/Biodeterioration Society. Portsmouth. Prof. E.B. Gareth Jones, School of Biological

Meetings Calendar

Sciences, Portsmouth Polytechnic, King Henry Building, King Henry I Street, Portsmouth PO1 2DY, UK; tel 0705-842032; fax 0705-842070. 15(1):22.

Sept. 20-27. Association of Preservation Technology. Philadelphia, Pennsylvania, USA.

Sept. 21-25. Paleoceanography and Global Change International Meeting. Kiel, Germany. ICP IV Organizing Committee, c/o GEOMAR Wischhofstrasse 1-3/ Building 4, D-2300 Kiel 14, Germany.

* Sept. 22-26. Congreso Latinoamericano de Antropología Biológica. Villa de Leyva, Colombia. Expedición Humana, Pontificia Universidad Javeriana, Santa Fe de Bogotá, C.C., Colombia.

* Sept. 24-25. Association for Environmental Archaeology, Annual Conference. Edinburgh, Scotland. Geraint Coles, Department of Archaeology, University of Edinburgh, 19 George Square, Edinburgh EH8 9JZ, UK; tel 031-650-4143. Theme: On the Edge - Human Settlement in Marginal Areas.

Sept. 25-27. 23rd Annual Binghamton Geomorphology Symposium: Geomorphic Systems. Oxford, Ohio. Bill Renwick, Department of Geography, Miami University, Oxford, OH 45056, USA.

Sept. 27-Oct. 1. American Institute of Professional Geologists Annual Meeting. Lake Tahoe, Nevada. Jon Price, AIPG, P.O. Box 665, Carson City, NV 89702, USA; tel 702-784-6691.

Sept. 28-30. Mediterranean River Environments. Cambridge, UK. Dr. J.C. Woodward, Department of Geography, Amory Building, Rennes Drive, University of Exeter, Exeter EX4 4RJ, UK.

Oct. 5-10. INTERKAMA 92 - 12th Market for Innovations in Measurement and Automation. Dusseldorf, Germany. Dusseldorf Trade Shows, Inc., 150 North Michigan Avenue, Suite 2920, Chicago, IL 60601, USA; tel 312-781-5180; fax 312-781-5188.

Oct. 21-24. Southeastern Archaeological Conference. Little Rock, Arkansas, USA. John H. House, Program Chair, P.O. Box 136, UAPB, Pine Bluff, AR 71601, USA; tel 501-535-4509. 15(1):23.

* Oct. 23-25. Disaster Prevention, Response, and Recovery: Principles and Procedures for Protecting and Preserving Historic/Cultural Properties and Collections. Cambridge, Massachusetts, USA. Susan Schur, Technology and Conservation, One Emerson Place 16M, Boston, MA 02114, USA; tel 617-227-8581. 15(1):1.

Oct. 26-29. Geological Society of America, Annual Meeting. Cincinnati, Ohio, USA. Geological Society of America, 3300 Penrose Place, Boulder, CO 80301, USA; tel 303-447-2020.

Oct. 31-Nov. 1. Two Cultures: Tradition and Change Symposium. Naples, Florida. The Collier County Museum, 3301 Tamiami Trail East, Naples, FL 33962, USA; tel 813-774-8476. Theme: Columbus Quincentennial and European Encounters in the Caribbean and Southeastern United States.

* Nov. 1-6. 1st Pan American Conference on Pre-Columbian Mathematics, Astronomy, and Modes of Thought. Universidad Francisco Marroquin, Guatemala City and Tikal, Guatemala.

Nov. 1-6. Soil Science Society of America Annual Meeting. Denver, Colorado. SSSA, 677 S. Segoe Road, Madison, WI 53711, USA.

* Nov. 5-8. Eastern States Archaeological Federation, 59th Annual Meeting. Pittsburgh, Pennsylvania. Richard L. George, Carnegie Museum Annex, 5800 Baum Boulevard, Pittsburgh, PA 15206, USA; tel 412-665-2600; fax 412-665-2751.

Nov. 12-14. Trade and Discovery: The Scientific Study of Artefacts from Post-Medieval Europe and Beyond. Duncan Hook, Department of Scientific Research, British Museum, London, WC1B 3DG, United Kingdom. Abstracts due by May 31, 1992.

* Nov. 12-15. American Society for Ethnohistory. Salt Lake City, Utah, USA. William Fowler, P.O. Box 6307-B, Vanderbilt University, Nashville, TN 37235, USA.

* Nov. 15-20. American Nuclear Society. Washington, DC, USA. Meetings Department, ANS, 555 N. Kensington Avenue, La Grange Park, IL 60525, USA; tel 312-352-6611.

Nov. 15-20. Optical Society of America Annual Meeting/OPTCON 92. Boston, Massachusetts, USA. OSA, 2010 Massachusetts Avenue NW, Washington, DC 20036, USA.

* Nov. 23-27. New Zealand Geological Society/Geophysical Society, Joint Annual Meeting. Christchurch. David Shelley, Department of Geology, University of Canterbury, Christchurch, New Zealand; tel 03-667-001; fax 03-642-769.

Dec. 2-6. American Anthropological Association, Annual Meeting. San Francisco, California, USA. American Anthropological Association, 1703 New Hampshire Avenue NW, Washington, DC 20009, USA; tel 202-232-8800.

* Dec. 6-12. International Conference, Environment and Archaeology. San Juan, Puerto Rico. Dr. Agamemnon Gus Pantel, Conference Chair, USDA Forest Service, Call Box 25000, Río Piedras, Puerto Rico 00928-2500, USA; tel 809-792-2456; fax 809-792-7882. Theme: Emerging Trends and New Techniques for Heritage Management and Sustainable Development in Tropical Forests.

Dec. 15-19. International Conference on Human Genetics in Celebration of the Birth Centenary of JBS Haldane. Calcutta. Partha P. Majumder, Anthropometry and Human Genetics Unit, Indian Statistical Institute, 203 B.T. Road, Calcutta 700 035, India.

\+ Dec. 27-30. Archaeological Institute of America. New Orleans, Louisiana, USA. AIA, 675 Commonwealth Avenue, Boston, MA 02215, USA.

* Dec. 28-31. Iraqi Geological Congress, International Meeting. Baghdad, Iraq. Geologists Union, Box 6244, Al-Mansour, Baghdad, Iraq.

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* Jan. 13-16. Joint Mathematics Meetings; co-sponsored by the American Mathematical Society. San Antonio,

Texas, USA. H. Daly, AMS, P.O. Box 5887, Providence, RI 02940, USA.

* Feb. 8-11. Geologic Remote Sensing Meeting. Pasadena, California, USA. Nancy J. Wallman, ERIM, Box 134001, Ann Arbor, MI 48113, USA; tel 313-994-1200 ext. 3234; fax 313-994-5123.

Feb. 11-16. American Association for the Advancement of Science, Annual Meeting. Boston, Massachusetts, USA. AAAS, 1333 H Street NW, Washington, DC 20005, USA; tel 202-326-6400.

Feb. 28-March 5. Digital-image Processing Meeting. Kona, Hawaii USA. C.V. Freiman, Engineering Foundation, 345 E. 47th Street, New York, NY 10017, USA; tel 212-705-7835.

* March 8-12. Pittcon '93. Atlanta, Georgia, USA. Alma Johnson, Program Secretary, Pittsburgh Conference, Department 5K, Suite 332, 300 Penn Center Boulevard, Pittsburgh, PA 15235-5503, USA; tel 800-825-3221; fax 412-825-3224. Abstract deadline: Aug. 5, 1992.

* March 14-17. Venezuelan Society of Geologists/American Association of Petroleum Geologists, International Meeting. Caracas, Venezuela. AAPG Convention Department, Box 979, Tulsa, OK 74101, USA; tel 918-584-2555; fax 918-584-2274.

* March 14-18. 7th Conference on Scientific Use of Statistical Software. Heidelberg, Germany. SoftStat, ZUMA, Postfach 12 21 55, D-6800, Mannheim I, Germany. 15(1):23.

April 11-17. 58th Annual Meeting of the Society for American Archaeology. St. Louis, Missouri, USA.

\+ May 17-19. Geological Association of Canada/Mineralogical Association of Canada, Annual Meeting. Edmonton. J.W. Kramers, Alberta Geological Survey, Box 8330, Station F, Edmonton, Alberta T6H 5X2, Canada; tel 403-438-7644.

* June 11-15. International Association for Impact Assessment, 12th Annual Meeting. Shanghai, China. E. Pendleton Banks, Wake Forest University, P.O. Box 7807, Winston-Salem, NC 27109, USA. Sessions on Cultural Resources and Remote Sensing.

July (dates unknown). Pithecanthropus Centennial: International Congress and Exhibition on the Environmental Context of Human Evolution. The Netherlands and Indonesia. Hans Beijer, Geological Survey of the Netherlands, P.O. Box 157, NL-2000 AD Haarlem, The Netherlands.

\+ July 28-Aug. 5. 13th Congress, International Union of Anthropological and Ethnological Sciences. Mexico, D.F., Mexico. Linda Manzanilla, Instituto de Investigaciones Antropológicas, Universidad Nacional Autonoma de Mexico, Ciudad Universitaria, Coyoacan D.F. 04510, Mexico; tel: 52-5-548-78-28; fax: 52-5-554-04-67, 548-36-67; bitnet: LMANZA@UNAMVM1. Theme: Cultural and biological dimensions of global change.

Aug. 9-12. Joint Statistical Meetings. San Francisco, California, USA. American Statistical Association, 1429 Duke Street, Alexandria, VA 22314-3402, USA.

* Aug. 22-29. 29th International Congress of History of Science. Zaragoza. XIX International Congress of History of Science, Facultad de Ciencias (Matemáticas), Ciudad Universitaria, 50009 Zaragoza, Spain; fax 76-565852; telex 58198 EDUCI-E; e-mail ichs@cc.unizar.es. Sections include: Astronomy in ancient cultures; Metallurgy in ancient China and India.

Aug. 23-29. 3rd International Conference on Geomorphology. Hamilton. Derek C. Ford, Department of Geography, McMaster University, 1280 Main Street West, CDN-Hamilton, Ontario L8S 4K1, Canada.

Aug. 25-Sept. 3. 49th Biennial Session of the International Statistical Institute. Firenze, Italy. ISI Permanent Office, 428 Prinses Beatrixlaan, P.O. Box 950, 2270 AZ Voorburg, The Netherlands.

* Sept. 13-17. International Symposium on the Catalán Forge. Spain. Dr. Estanislau Tomas, Associacio del Museu de la Ciencia i de la Tecnica i d'Arqueologia Industrial de Catalunya, Via Laietana 39, S-09003 Barcelona, Spain; tel 319 23 00; fax 310 06 81. 15(1):1.

Oct. 25-28. Geological Society of America, Annual Meeting. Boston, Massachusetts, USA. Vanessa George, GSA, Box 9140, Boulder, CO 80301, USA; tel 303-447-2020.

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Feb. 18-23. American Association for the Advancement of Science, Annual Meeting. San Francisco, California, USA. AAAS, 1333 H Street NW, Washington, DC 20005, USA; tel 202-326-6400.

* April 11-15. Materials Research Society, Spring Meeting. San Francisco, California, USA. Materials Research Society, 9800 McKnight Road, Pittsburgh, PA, USA; tel 412-367-3012. Symposium: Materials Issues in Art and Archaeology IV.

April 18-24. 59th Annual Meeting of the Society for American Archaeology. Anaheim, California, USA.

June 5-11. Geochronology, Cosmochronology and Isotope Geology (ICOG-8). Berkeley, California. Garniss H. Curtis, Institute of Human Origins-Geochronology Center, 2453 Ridge Road, Berkeley, CA 94709, USA; tel 415-845-4003; fax 415-845-9453.

June 19-24. American Nuclear Society Annual Meeting. Atlantic City, New Jersey, USA. ANS, Meetings Department, 555 N. Kensington Avenue, La Grange Park, IL 60525; tel 312-352-6611. □

Phytoliths (continued from p. 4)

Archaic Site in Southwestern Chiapas: The Phytolith Evidence" by Cynthia Pope (University of Texas) and John Jones (Smithsonian Tropical Research Institute) presented results from a similar study but focused on results available from quick (4-hour) processing methods. "Phytolith Problems in Transdanubian Archaeology" by Irwin Rovner (North Carolina State University) showed how the difficult question of resolving Festucoid (Pooid) phytolith shapes may be resolved by computer-assisted microscopy. □

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