

# SAS Bulletin

## Society for Archaeological Sciences

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### SAS News

#### Archaeological Science: Past Achievements/Future Directions

An invited symposium jointly sponsored by The Society for Archaeological Sciences and the Society for American Archaeology will be presented at the 58th Annual Meeting of the SAA in St. Louis, April 14-18, 1993. The organizers are: R.E. Taylor, University of California, Riverside; J. Burton, University of Wisconsin; R. Sternberg, Franklin & Marshall College. The symposium date is Saturday, April 18.

This symposium will present reviews of major accomplishments of the various segments of archaeological science fields since the appearance of Brothwell and Higgs' *Science and Archaeology* (2nd edition, 1969) in terms of how interdisciplinary data generated as a result of natural science/archaeology interface have influenced current archaeological views and research agendas. Contributors will project the course of archaeological science studies over the next decade and offer predictions of how these studies will influence future archaeological investigations both in the field and in the laboratory.

#### Topics and Participants

Opening Comments: R.E. Taylor, University of California, Riverside.

Chair: Rob Sternberg, Franklin & Marshall College. John Weymouth, University of Nebraska, "Magnetic Prospection as a Non-Destructive Tool for Archaeological Site Evaluation"; Rinita Dalan, University of Minnesota, "You Can't Resist Them: Electrical and Electromagnetic Surveys"; W. Frederick Limp, University of Arkansas, "Viewing the Landscapes of the Past Through the Eyes of the Future"; Michael R. Waters, Texas A&M University, "The Role of Geoarchaeology in Archaeological Research"; Susan Mulholland, University of Minnesota, Duluth: "Phytolith Analysis in Archaeology and Paleoecology."

Chair: James Burton, University of Wisconsin, Madison. Steven M. Shackley, University of California, Berkeley, "Gamma Rays, X-Rays, Stone Tools, and the 'Sourcing' Myth: Are We Missing the Point?"; T. Douglas Price, University of Wisconsin, Madison, "Advances in Archaeological Bone Chemistry"; James M. Skibo, Illinois State University and Michael Deal, Memorial University of Newfoundland, "Food Residue and Pottery Function: A Critical Assessment"; Arleyn W. Simon, Arizona State University, "What Archaeometry Has or Has Not Done for Archaeological Ceramic Studies"; Jeffrey Dean, University of Arizona, Tucson, "Recent Advances in Archaeological Dendrochronology"; R.E. Taylor, University of California, Riverside, "Radiocarbon Dating: Past and Future Revolutions." □

#### SAS Business Meeting

The annual business meeting of the Society for Archaeological Sciences will be held in conjunction with the annual meeting of the Society for American Archaeology. The business meeting is scheduled for Thursday, April 16 at 5:30 pm. The place is yet to be announced. If you wish to have any items of business on the agenda, contact one of the officers (listed on the back page of this *Bulletin*). □

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## Laboratory Profile

### Museum Applied Science Center for Archaeology (MASCA)

The University Museum, The University of Pennsylvania, Philadelphia, Pennsylvania 19104

#### STAFF

Stuart J. Fleming, D.Phil. (Oxon), Scientific Director; Patrick E. McGovern, Ph.D., Archaeoceramics, Archaeochemistry; Henry N. Michael, Ph.D., Dendrochronology, Translation; Naomi F. Miller, Ph.D., Paleoethnobotany; Vincent C. Pigott, Ph.D., Archaeometallurgy; Dolores R. Piperno, Ph.D., Paleoethnobotany; Kathleen Ryan, M.A., Archaeozoology, Publications; Andrew D. Weiss, B.S., Microcomputer applications.

MASCA (Museum Applied Science Center for Archaeology) is the technical division of The University Museum at The University of Pennsylvania. When it was established in 1961, it was one of only two organizations worldwide that set as its research goal the development and application of modern scientific techniques to the solution of archaeological problems. Under the direction of Beth Ralph, MASCA initially built its reputation through contributions to major improvements in the radiocarbon dating method, including the development of the first calibration curves based on tree-ring dates. Researchers at MASCA also designed the cesium magnetometer, which could resolve the ground plans and unusual features of deep-lying sites.

Under its current scientific director, Stuart Fleming, MASCA's mission has changed and expanded so that it is now much more directly involved with The University Museum's field projects and exhibit preparation. In the laboratory, we stress a holistic approach to materials analysis which tries to establish the cultural, as well as the physical, context in which ancient manufacturing processes took place. Different applications of the physical sciences have provided an array of sensitive analytical tools for the characterization of materials, and MASCA projects now involve computer mapping and biological sciences as well. Many of our projects involve direct collaboration with others by means of a network of technical facilities and colleagues at various institutions, co-ordinated by Stuart Fleming. These programs support and are, in turn, partially supported by an internship program whose students are drawn from the Bradford University Archaeological Sciences Program in England. In addition, several of our projects receive outside funding from grants, contracts, and other contributions.

For further information and/or reprints concerning MASCA-sponsored research, please contact the scientific director.

#### ARCHAEOLOGICAL RESEARCH

##### *Archaeometallurgy*

Archaeometallurgical research at MASCA addresses problems concerning the origin, production, and use of metal, especially iron and the alloys of copper from excavated contexts across the Old World (primarily Southwest and Southeast Asia). The two analytical techniques usually employed are conventional optical metallography and PIXE (proton-induced x-ray emission) spectroscopy.

Optical metallography is used to characterize the history of manufacture of metal artifacts by documenting the structure of cast and worked metal. Its logical counterpart is the elemental analysis of the major and trace constituents of the metal. PIXE spectroscopy is a powerful tool for determining the composition of archaeological metal because it can precisely detect small quantities of constituent elements and is a virtually non-destructive technique. With PIXE spectroscopy (in collaboration with Charles P. Swann of the Bartol Research Institute of the University of Delaware, Newark) we are developing a large library of metallographic specimens, significantly reducing the need for subsequent 're-sampling' of collections for further archaeometallurgical research.

Groups of artifacts from excavated contexts are used to characterize traditions of metal production and what has been termed 'technological styles.' Intra- and interregional comparisons of technological styles enhance our understanding of metal artifacts as 'social products.' Typically, the Mesopotamian Metals Project has as its purpose to ascertain how the specialized craft of metallurgy, heavily dependent upon imported raw materials, developed within the context of early Mesopotamian proto-urban and urban society. The composition of more than 300 samples of copper-base artifacts from the sites of Nippur, Ur, Gawra, Fara, Billa, Khafajeh and Kish has been determined, and metallographic information is available for about a third of this corpus. The project has expanded to include sites in highland Iran (Hasanlu Tepe, Tepe Hissar and Tal-i Malyan). Tamara Stech (Bryn Mawr College) and James D. Muhly (University of Pennsylvania) collaborate in this ongoing research.

The late William Rostoker conducted the initial analytical research on the copper smelting slags excavated from central Thailand production sites. Through this research he was able to obtain substantial supporting evidence for his reconstruction of the 'co-smelting' process

involving the direct reduction of copper by oxide-sulfide interaction.

The Thailand Archaeometallurgy Project (co-directors V.C. Pigott and S. Natapintu) focuses on the archaeology of prehistoric copper production in the Khao Wong Prachan Valley in central Thailand. Some of the earliest documented evidence for prehistoric copper production in Southeast Asia comes from this valley where a series of sites ranging in date from the mid-3rd millennium B.C. to the early centuries of the historic period is currently under excavation. The combined results of fieldwork and laboratory analysis suggest that this large-scale production was undertaken by groups of independent specialists, practicing a simple oxide/sulfide co-smelting process, who worked within a village level society. Research in the fields of ore geology/mineralogy, production ceramics as they relate to archaeometallurgy is being conducted by geologist William Vernon (MASCA Research Associate; Dickinson College-emeritus). He is focusing on the materials excavated at the prehistoric metalworking sites of Phu Lon in northeast, Non Pa Wai and Nil Kham Haeng in central Thailand.

In addition to these two major projects, collections of metal artifacts from sites in Southwest Asia which have been or are under study include Tell Abu Duwari and Tell al-Rimah (Iraq), Tell es-Sweyhat, Tell Raqai and Tell Hadidi (Syria), the Luristan "bronzes" excavated by the Belgian Archaeological Mission (Iran), Gordion (Turkey), Baq'ah Valley sites (Jordan), Beth Shan (Israel). Less intensive studies of metals from the New World include arsenical copper artifacts and production debris of the Sican culture from smelting sites near Batan Grande (Peru), in collaboration with John Merkel (Archaeological Institute, London), and depletion gilded gold items from Sitio Conte (Panama).

Facilities: Reflecting microscope, metallographic sample preparation equipment, hardness testing unit, sample archive.

#### *Archaeoceramics*

The archaeoceramics section of MASCA seeks to reconstruct ancient pottery and silicate production processes by a variety of complementary analytical techniques, including petrography, instrumental neutron activation analysis (INAA), xeroradiography, scanning electron microscopy (SEM), and PIXE spectroscopy.

As one example of our current research on pottery, we are collaborating with many scientific and archaeological colleagues in one of the largest INAA projects ever carried out for the Old World. This study focuses on the trade connections and possible ethnic origins of the so-called Hyksos ("rulers of foreign lands"), a Semitic people who ruled Egypt from about 1750 to 1550 B.C. Approximately 1600 samples of Middle Bronze Age Canaanite Jars, Tell el-Yahudiyeh juglets, and other Syro-Palestinian, Egyptian, and Cypriote pottery types from sites up and down the

Eastern Mediterranean, as well as from the capital of the Hyksos, Avaris (Tell el-Dab'a) in the northeastern Nile Delta, have thus far been analyzed. Preliminary results, which run counter to some scholarly opinions, point to the Hyksos' main trading partner being city-states in southern Palestine, including Gaza, Ashkelon and Tell el-Ajjul, where the pottery was made from a very common red field clay. Over the course of the Middle Bronze Age, all of the Syro-Palestinian types came to be made of local Nile alluvium clay at Avaris. Importation of goods from southern Palestine in "Canaanite Jars", probably olive and pine oils and wine, remained at a high level throughout the period. Computer links enable Patrick McGovern, working most recently with Michael D. Glascock at the University of Missouri-Columbia research reactor and employing the programs developed at Brookhaven National Laboratory where we collaborate with Garman Harbottle, to exchange and store the INAA data, as well as run a battery of statistical programs, on the Museum's in-house VAX computer.

Separately, Stuart Fleming and Ron Hancock are using the SLOWPOKE Reactor Facility of the University of Toronto to develop an INAA data bank for the pottery production at the earliest settlements and urban centers in Greater Mesopotamia, including Tepe Gawra, Nippur, and various sites in the Solduz valley. The goal of this study is to define the scale and character of long-range trading activities over the period of the fourth to first millennium B.C.

Our most recent studies of silicates include a compositional analysis of some of the earliest glass and frit from the ancient Near East and a colorant study of glass and faience jewelry, palace tiles, and vessels from New Kingdom sites in Egypt—el-Amarna, Thebes, Tell el-Yahudiyeh—and from the Egyptian "colonies" of Serabit el-Khadem in the Sinai and Beth Shan in northern Palestine. Based on the statistical evaluation of the main silicate constituents and minor trace elements associated with the transition metal colorants, raw material sources and/or places of manufacture can be determined.

Facilities: Petrographic and stereozoom microscope, box furnace (maximum temperature of 1200°C), and disaggregation and sieving equipment.

#### *Archaeochemistry*

Organic chemistry is a rapidly growing adjunct to the archaeoceramics section that has benefited from the dedicated efforts of Rudolph H. Michel, who retired as an analytical chemist from the DuPont Company eight years ago and began a "second career" as a Research Associate at MASCA.

The INAA Hyksos study highlights the desirability of knowing not just where a pottery vessel was made, but also what it contained and what it was used for. Fourier transform infrared spectrometry (FTIR) and mass spectrometry are the principal tools that we have used to

identify some of the earliest instances of Royal Purple dye, wine, and beer inside pottery vessels. Dyed textiles in the Museum's collections can now be routinely analyzed for indigoid dyes. Many more fermented beverage samples, which have a wide-ranging cultural significance, have flowed into our lab following the 1991 symposium on "The Origins and Ancient History of Wine" at the Robert Mondavi Winery in the Napa Valley of California (proceedings to be published shortly by Gordon and Breach). The donation of a dedicated FTIR instrument from the DuPont Company enables us to process many of these samples very efficiently.

Facilities: Basic wet chemical laboratory, FTIR spectrometer.

## LIFE SCIENCES RESEARCH

### *Archaeobotany (macroremains)*

Archaeobotanical research at MASCA focuses on patterns of ancient land use for agriculture and industry, and resulting long-term changes in the landscape. A related concern is the reconstruction of ancient agricultural practices with a view toward understanding the diet of humans and their domesticated animals. As plants touch on all aspects of human life, our research is not limited to these matters; we address questions which can be answered with archaeobotanical assemblages that typically consist of charred seeds and wood, though mineralized samples are occasionally encountered and analyzed.

The geographical focus of archaeobotanical research at MASCA is the Near East, with particular attention to comparing agricultural and land-use systems in different environmental zones. The extent to which crop use reflects ethnic/cultural choices as opposed to ecological constraints of the crops is being explored by Naomi Miller with material already at hand: Gordion (Turkey) and Gonur (Turkmenistan) for arid continental regimes; Malyan and Godin (both in Iran) for intermontane valleys with fairly reliable rainfall; Kurban Höyük (Turkey), Hacinebi Tepe (Turkey), and Tell es-Sweyhat (Syria) for the edge of the Mesopotamian plain.

Gritille, in southeastern Turkey, has yielded a well-excavated aceramic Neolithic (PPNB-related) assemblage with a number of well-preserved crop remains. In contrast to most of the other botanical materials under analysis in our laboratory, the samples have high proportions of processed crops and other food remains, including relatively early examples of legumes (notably bitter vetch), flax, and six-row barley.

Fuel use is frequently a good indicator of the state of the vegetation near a site. As much of the archaeobotanical material available for study was originally burned as fuel (wood, dung, or brush), long archaeological sequences from several of these sites (especially Gordion, Kurban

Höyük, and Gritille) should allow us to trace long-term changes in environment and land use at one spot.

Facilities: Dissecting microscope (7.5x-75x), electronic scale, reflecting microscope; comparative collection of seeds and woods and voucher specimens, mostly from the Near East.

### *Phytolith studies*

Phytolith research by Dolores Piperno at MASCA is currently focusing on the study of prehistoric agriculture in the Neotropics, especially the origins and early diffusion of maize. The morphology and taxonomy of phytoliths in maize, its near relatives teosinte and *Tripsacum*, and wild tropical grasses are being evaluated. Phytoliths are proving to be abundant in archaeological and geological sites from the humid lowlands of Central and South America that possess considerable antiquity. Hence, they may provide important information on the age and characteristics of early forms of tropical forest food production.

Examination of the reproductive structures of maize, teosinte, and *Tripsacum* is showing that all of these taxa contribute surprisingly high numbers of phytoliths in their cobs and fruitcases. The fruitcase phytoliths of both teosinte and *Tripsacum* appear to be unique. Phytolith assemblages from maize cobs are less singular, but exhibit clear morphological differences when compared to teosinte and *Tripsacum*. Additional study of cobs from primitive maize races is in progress, but preliminary data indicate that phytoliths from the reproductive structures of teosinte will be useful in study of maize's early evolution.

The phytolith collection at MASCA also includes over 400 species of wild tropical grasses, including many bamboo representatives. The silica bodies of these grasses are being described, compared, and photographed in order to provide an extensive phytolith key for the New World tropical Gramineae.

Facilities: Biological microscope, scales, fume hood, etc.

### *Dendrochronology*

MASCA has been interested in dendrochronology since 1959—shortly after radiocarbon dates proved inaccurate. The only way known to correct radiocarbon dates is with precisely dated wood. Bristlecone pines growing in the White Mountains of east-central California proved to be the ultimate candidates for the task. They include the oldest living trees, some almost 5000 years old. Since their wood, with its high content of resin, preserves for thousands of years, the combination of wood from living trees and preserved wood from long dead trees, enabled the extension of the correction curve to 6700 B.C. (8,692 B.P.). With finds of appropriate runs of tree rings this date range may be ultimately extended to 11,000 B.P.

Much of the early work was done in collaboration with

the late C.W. Ferguson of the University of Arizona. In recent years, Henry Michael of MASCA has assembled additional runs of tree rings which may further extend the correction curve.

### *Archaeozoology*

Archaeozoology (faunal analysis) is an important adjunct to archaeological research in all areas of the world, providing data on diet, hunting, and animal husbandry practices. Projects conducted by Kathleen Ryan deal with archaeological materials as well as ethnoarchaeological data.

Research in India focuses on two interrelated historical problems: (1) the chronology and nature of the Urban and Post-urban Harappan sites in the Saurashtra region of Gujarat; (2) the nature of the economic system. Data gathered on plants and animals from several sites is providing some sense of the relative importance of these resources. Efforts are also being made to document the impact of seasonality as well as beginning a reconstruction of the ancient environment around the settlements.

In Ireland, the emphases are on (1) stock-raising systems in rural Ireland between the early and late Medieval period, and (2) the relative importance of domesticated and wild birds in the diet of urban dwellers.

The goal of our field study in Kenya is the documentation of a traditional cattle-herding system. The approach is explicitly ethnoarchaeological in that it is a study of the present in an attempt to illuminate the past and is designed to answer specific questions about slaughter, exchange, and redistribution of cattle in arid environments.

Facilities: Modern comparative specimens of the main domesticated species and a limited number of specimens of wild animals. Sample preparation equipment is available in the metals laboratory at MASCA for examination of bone and tooth sections.

### **MICROCOMPUTER APPLICATIONS IN ARCHAEOLOGY**

Microcomputer applications in archaeology at MASCA, based on Apple Macintosh computers, focus in part on computer-assisted surveying and mapping for archaeological sites and their contents. COMPASS (Computer Mapping Program for Archaeological Sites and Survey), developed by Andrew Weiss, integrates an electronic surveying instrument, data collectors, and Macintoshes into a system for collecting, manipulating, analyzing, and presenting spatial data from archaeological sites. A data collection program written in BASIC stores coordinate data from a total station and allows the archaeologist to add several types of descriptions to each measurement. The central Mac-based software components are Microsoft Excel, MacGridzo (a contour mapping package) and

MiniCAD+, a computer-assisted drafting package incorporating a linked database, spreadsheet, 3D modeler, and a powerful PASCAL-like internal programming language that can be used to customize the system by writing routines to plot survey data, register multiple maps (including pre-existing plans that are scanned and/or traced), calculate areas and distances, and select objects based on attached attribute data.

COMPASS is currently being used on several University Museum projects. 1) Copper production sites in central Thailand have been topographically mapped and systematically surface collected since 1986. Excavation data from these sites are being manipulated to compute volumes and densities of production debris with the goal of estimating the scale and mode of production. 2) At the Classic Maya site of Copán, a systematic tunnelling program into the central acropolis has revealed thousands of square meters of buildings, platforms, and plazas in four major building levels. Two seasons of surveying in the dark, narrow, twisting tunnels has produced almost instantaneous working plans in the field, and publication quality architectural plans at MASCA. This work will lead to functional analyses of the architectural layout, documentation of the construction micro-sequence, and estimates of material volumes and labor inputs for various construction episodes within the acropolis. 3) At the Old Kingdom site of Abydos, Egypt, COMPASS is used for overall site topographic mapping, location of surface architecture and features, incorporation of past seasons maps, spatial control within the excavation units, and the overall architectural layout. Excavation work includes square level maps, used as controls for detailed plans of brickwork, stratigraphy, and features. An important component of this work is integrating hand drawn detailed plans and section into the computer-based maps (Fig. 1). 4) At Tell es-Sweyhat, too, COMPASS is used in the field for overall site topographic mapping and the mapping of stone and mudbrick architectural remains, point-proveniencing of artifacts, and the direct recording of section profiles, and in the laboratory for the manipulation of computer generated architectural plans from scanned field plans.

Facilities: Various Apple Macintosh computers, color scanner, laser printer. Two Total Stations (EDM), data collectors.

### **PUBLICATIONS AND TRANSLATIONS**

The series *MASCA Research Papers in Science and Archaeology* (formerly *MASCA Journal*), edited by Kathleen Ryan, presents current research in archaeological science. The aim is to reach not only specialists in archaeological science but also archaeologists who might have little knowledge of the scientific techniques involved. This is a refereed series and is published annually.

Translations from Russian sources have enhanced our insights of Siberian archaeology and ethnography. More

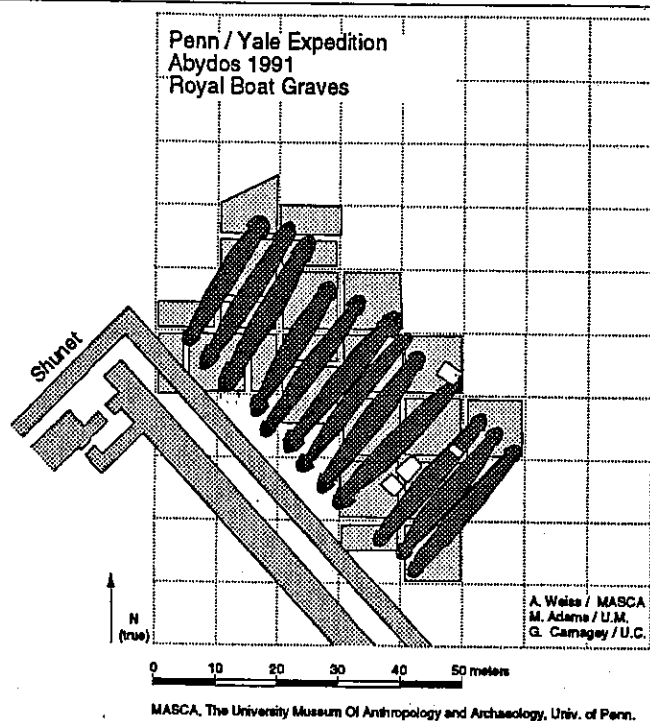


Figure 1. Computer-based map.

recently, translations by Henry Michael of major works dealing with the Bronze Age of Central Asia (*Altyn Depe*, published in 1988 by The University Museum) and the Transcaucasus (to be published in 1993 or 1994) have clarified the areal extent of early urbanization in Central Asia and will contribute to our understanding of early independent development of agriculture and herding in the Transcaucasus.

Facilities: Apple Macintosh computers and laser printer; we currently use Aldus Pagemaker software.

Contributed by Naomi F. Miller, The University Museum, The University of Pennsylvania, Philadelphia, Pennsylvania 19104. □

## News of Geoarchaeology

### Archeological Geology at the GSA Annual Meeting.

The Geological Society of America held its 1992 Annual Meeting on October 26-29, in Cincinnati, Ohio. Archeological geology was featured in a symposium, technical session, posters, and field trip. The field trip to archeological sites in northern Kentucky and southern Ohio was organized by Timothy Dalbey and Ken Tankersley.

The Archeological Geology Division Symposium entitled "Synergism: Archaeological and Geological Sciences" was hosted by Barbara Sherriff and William Johnson. Fifteen speakers were challenged to discuss how the interaction between the two disciplines has made both

stronger. As an archeologist and consumer of geoscience methodologies, I was especially interested to hear geologists talk about how geology had benefited from the collaboration with archeologists.

Several papers on dating, chemical finger printing, and stable isotopic chemistry presented an historical approach, showing how archeologists' need for more refined dating methods and analytical techniques led to new or improved methods which later became important in geological research. Bonnie Blackwell argued that amino acid racimization and uranium-series dating are more valuable geological tools as a result of working through problems in dating bone from archeological sites. Henry Schwartz pointed out the archeological stimulus for trapped electron dating and later success in using it to date geological features such as corals. James Aronson discussed the use in tephrostratigraphy of techniques initially developed to source obsidian. Christine White's and Allison Cormie and Henry Schwartz' papers discussed the archeological stimulus for using stable isotope geochemistry to obtain information on paleodiet and climate, and the great potential of that technique to give us paleoenvironmental information. Patrick Julig et al. discussed the use of neutron activation analysis to source chert and copper in the Great Lakes region. Barbara Sherriff introduced her paper with Sharon Thomson on distinguishing silicates from the Souris Gravel Pit with a personal perspective—that archeology had stimulated her interest in variation among silicate rocks and the difficulty of objectively distinguishing between them.

A second group of symposium papers emphasized the use of archeological sites or materials to date geological formations and rates of change. Jack Donahue discussed neotectonic movement in the Dead Sea valley, and Cheryl Ann Munson et al. presented research on archeological dating of earthquake-induced paleoliquefaction features seen in alluvial sections in southwestern Indiana. Daniel Stanley and Andrew Warne's paper on the Smithsonian Nile Delta coring project showed how archeological materials are helping to show rates of delta subsidence. Douglas Kellogg showed the importance of archeological sites along the rocky Maine coast in the recognition and dating of coastal erosion. Donald Johnson pointed out that early recognition of the importance of biomechanics on soil and slope formation processes was largely due to study of archeological stratigraphy, and argued that it should be reincorporated in our models of slope evolution. Whitney Austin spoke on using archeological sites to reconstruct alluvial history in Louisiana.

The effects of catastrophic and long term environmental change on people were also the subject of papers in the small technical and poster sessions. The paper by J. Kraft et al. presented the results of research on the changing configuration of the Lower Kuruk Menderes floodplain and delta, and impact on the city of Ephesus. Floyd McCoy et al. presented a poster on the use of ground-probing radar

to locate the Bronze Age site of Akrotiri under ash from the eruption of Thera. A paper by Donald Schwert offered a twist on this theorem: a vivid record of the impact of European settlement on the Roberts Creek basin in Iowa reconstructed from the change in insect species from high numbers of trout stream quality indicator species to a high number of dung beetle species.

Other interesting technical session papers featured were Rolph Mandel's discussion of the Akrotiri-Aetokremnos rock shelter in Cyprus where the extinct pygmy hippopotamus has been found in association with man. Sheena Beaverson presented a geoarchaeological interpretation of an archaic site on Lake Nipissing in Michigan. Curtis McKinney presented the results of applying a new uranium ratio to dates on one from the Midland site, Missouri, and has estimated a Clovis age for human cranial fragments, making it the oldest human skull in North America. Finally, Anthony Philpotts illustrated the use of petrofabric analysis to reconstruct ceramic techniques.

The remaining posters included the work of A. Mohamad Ghazi et al. on dietary reconstructions using trace elemental analysis of bones from A.D. 1200, Peru. James Harrell and V. Brown presented a petrological and geochemical survey of ancient quarries in eastern Egypt. Timothy Dalbey showed the results of an objective study of hornfels patination as a relative dating technique.

The Archeological Geology Division held their business meeting and award ceremony on Tuesday the 27th. The annual prize was presented to Fekri Hassan, who accepted with a special plea that we work together to save ancient monuments and sites from environmental and other disasters. Later the same evening, Herbert E. Wright was awarded the 1992 Distinguished Career Award by the Quaternary Geology and Geomorphology Division. The same division awarded the 1992 Kirk Bryan Award to R. Dale Guthrie for *Frozen Fauna of the Mammoth Steppe* (Chicago, University of Chicago Press, 1990.)

**Other News.** *Geoarchaeology* has gone to 6 issues a year for the same low subscription price. For information write to Subscription Department, John Wiley & Sons, Inc., P.O. Box 836, Bound Brook, NJ 08805, USA.

*Contributed by Robin Burgess, HQ AMC/CEVP, 507 A Street, Room 206, Scott Air Force Base, IL 60201, USA; tel 618-256-8322; fax 618-256-8376.*

## News of Archaeometallurgy

Volume 8 of *MASCA Research Papers in Science and Archaeology* has been issued in two parts. Part I is *Recent Trends in Archaeometallurgical Research*, edited by Petar Glumac. Part II is *Metals in Society: Theory Beyond Analysis*,

edited by Robert Ehrenreich. Both parts are available for a total of \$30 from The University Museum, Department of Publications, 33rd and Spruce Streets, Philadelphia PA 19104, USA. Domestic postage and shipping costs \$2.50 for the first publication and \$.75 for each additional one; abroad it is \$3.50 for the first and \$1.75 for each additional publication. Back issues of the *MASCA Journal* are available, the complete run (volumes 1-4) for \$70, single issues from volumes 1-3 (20 issues) are \$4.00 per issue, from volume 4 (4 issues) \$6 per issue. A listing of articles is available from The Subscription Manager, MASCA Publications, at the University Museum address. Visa and Mastercard are accepted. Telephone (215) 898-4090 or Fax (215) 898-0657.

The second edition of British Museum Occasional Paper 17, *Aspects of Early Metallurgy*, edited by W.A. Oddy was first issued in 1980. It has recently been reprinted (ISBN 0-86159-016-3, ISSN 0412-4815) and is available for £15 from British Museum Press, 46 Bloomsbury Street, London WC1B 3QQ.

British Museum Occasional Paper 79 has been published jointly by the Departments of Scientific Research and of Ethnography. It is *Aspects of Early North American Metallurgy* by M.L. Wayman, J.C.H. King, and P.T. Craddock, and reports the examination and analysis of native North American metal artifacts in the Museum of Mankind and of two iron objects collected in 1818 by the Ross expedition from the Polar Inuit now in the Natural History Museum, London. All the objects studied were collected at a relatively early date, and include metal from the northwest coast, three iron harpoon blades collected in Hudson's Bay in 1738, and 121 objects in the Squier and Davis Collection excavated 1845-57 from mounds chiefly in Ohio. The authors conclude from their study that a large amount of smelted metal was already in circulation among the native peoples of North America prior to their first contact with Europeans. BMOP79 (ISBN 0-86149-079-1, ISSN 0142-4815) is available for £17.50 from British Museum Press.

The proceedings of the seminar on the History and Archaeology of Lead Smelting held at Reeth, Yorkshire, 15-17 May 1992 have been published by the Historical Metallurgy Society. *Boles and Smeltmills*, edited by Lyn Willies and David Cranstone (ISBN 0-9506254-4-2) is available for £8 from the Peak District Mining Museum, Matlock Bath, Derbyshire DE4 3NR England. In addition to information on the bole, a kind of wind-blown hearth, there are papers on slags and refractory materials, fume condensation, woodland use, metalliferous flora, survey techniques, documentary sources, and the transition from silver to lead smelting.

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.*



## Obsidian News

### International Association For Obsidian Studies (IAOS)

Over the past two decades, obsidian studies have begun to draw increased attention in archaeological circles throughout the world. Obsidian hydration dating, though presenting more methodological pitfalls than was initially anticipated, holds considerable promise in the direct dating of archaeological and geological materials. Obsidian characterization (sourcing) research, now a routine component in many archaeological studies, shows great potential in the identification of prehistoric direct and indirect (exchange) procurement systems and procurement behavior. Additionally, characterization studies have begun to be used to investigate other sociocultural factors such as ethnic boundaries, social stratification, and the existence of intergroup alliances. There is also a lot more obsidian out there than anyone had previously realized—through geoarchaeological and geochemical investigations of the occurrence and distribution of these sources are still relatively few and far between.

This increasing interest in obsidian research hit critical mass in 1989 with the formation of the International Association for Obsidian Studies (IAOS). The goals of the IAOS are to develop standards for the recording, reporting, and analysis of obsidian-related data and to provide a central forum and source of information for the widely-scattered global community of researchers involved in obsidian hydration, characterization, and source research. Beginning with a membership that was drawn primarily from the western U.S., the association has now grown to include members from 16 states and six countries.

We are currently revising our extensive on-disk interdisciplinary obsidian bibliography (free to interested IAOS members) and should have a new version available to IAOS members about Christmas. A paper copy of the bibliography (over 2,000 references) will be distributed to all members early in 1993. Members also receive a regular newsletter and other obsidian-related benefits.

The next Annual Meeting of the IAOS will be held in conjunction with the Society for California Archaeology Annual Meeting, April 7-11, Pacific Grove, California. Current and past members along with any interested individuals are welcome to attend.

For additional information about the IAOS, please contact me at the address below or write MS. Lisa Swillinger, IAOS Secretary-Treasurer, Department of Anthropology, California State University, Chico, CA, 95929-0400.

*Craig E. Skinner, President, IAOS, 1414 NW Polk, Corvallis, OR 97330, Internet: [skinner@jacobs.cs.orst.edu](mailto:skinner@jacobs.cs.orst.edu), CompuServe: 76326,1676*

### Call for Obsidian Articles and Information

If you are engaged in obsidian-related research anywhere on the planet, we would like to invite you to submit short articles, brief research and project reports, thesis and dissertation research descriptions, reviews, abstracts, or announcements for publication in the quarterly IAOS Newsletter.

Submissions may be made (English) on paper or, preferably, on diskette (3-1/2" or 5-1/4" IBM PC - ASCII, WordPerfect, Wordstar, Word formats) and paper.

Send abstracts or reviews to Lisa Swillinger, Secretary-Treasurer, International Association for Obsidian Studies, Department of Anthropology, California State University at Chico, Chico, California 95929-0400, tel (916) 898-6256.

Send abstracts and annotations to Kim Tremaine at BioSystems Analysis, 1017 Front Street, Sacramento, California 95814, USA.

Send short reports to Mike Rondeau at CALTRANS, Office of Environmental Analysis, 650 Howe Avenue, Suite 400, Sacramento, California 92825, USA.

Send information on meetings and events to Dr. Steven Shackley, Phoebe Hearst Museum of Anthropology, 103 Kroeber Hall, University of California, Berkeley, California 94720, USA.

To submit articles to the IAOS Newsletter, inquire about the IAOS, or request a sample IAOS Newsletter, please write the IAOS Secretary or drop a note to Craig, Skinner, IAOS President (address at left).

### Excerpts from IAOS Newsletter, #6, Spring 1992

#### *IAOS Obsidian Bibliography, Version 1.1*

The latest version of the IAOS on-disk obsidian bibliography has been completed and is ready for distribution. There are now more than 2,100 obsidian and natural glass-related references listed in the bibliography file. For you IBM PC users, I have rewritten the user-friendly shell from which you can use the bibliography and have made a few other detail changes. The next version of the bibliography will emerge from the computers of Kim Tremaine and myself in another year or so. By and by, we'll have an IBM PC database version of the bibliography available for IAOS members—references, keywords, and eventually, short abstracts. This should transform what is now essentially a long list that can be searched for text strings into a full-fledged research literature database. I'm having a little trouble deciding on which database to use—if anyone has any suggestions or preferences, please get in touch with me. dBASE file format (.DBF) is the most universally supported but does not deal well with lengthy text fields (like abstracts). Whatever database we decide to



# INTERNATIONAL ASSOCIATION FOR OBSIDIAN STUDIES



## WHAT IS THE INTERNATIONAL ASSOCIATION FOR OBSIDIAN STUDIES?

The International Association for Obsidian Studies (IAOS) is an organization devoted to the multidisciplinary study of obsidian - obsidian hydration dating, obsidian characterization ("sourcing") studies, geoarchaeological obsidian studies, obsidian and lithic technology, and prehistoric obsidian procurement and utilization. In addition to disseminating new and interesting information regarding advances in obsidian research to interested archaeologists and other parties, the IAOS was established to: 1) develop standards for analytical procedures and to ensure inter-laboratory comparability; 2) develop standards for the recording and reporting of obsidian hydration and characterization results; 3) provide technical support in the form of training and workshops for those wanting to develop their expertise in the field, and 4) provide a central source of information regarding advances in obsidian studies and the analytical capabilities of various laboratories and institutions.

## WHAT COMES WITH IAOS MEMBERSHIP?

- Regular issues of the *IAOS Newsletter* - articles, announcements, abstracts, events, news, reviews
- The latest version of the on-disk IAOS Obsidian Bibliography (IBM PC) with over 2,100 obsidian-related references - references can be electronically searched or pasted into your own document
- A printed version of the IAOS Obsidian Bibliography
- Special price discounts on selected major obsidian-related publications
- Copies of available back issues of the *IAOS Newsletter*
- IAOS general mailings, announcements, software, and papers
- A vote and invitation to the Annual IAOS Meetings
- A chance to join the worldwide network of obsidian researchers

To be included as a member and receive all the membership benefits, you may apply as a **Regular Member** for \$20.00 per year, as an **Institutional Member** for \$50.00 per year, or as a **Lifetime Member** for \$200.00.

**Regular Members** are individuals or institutions who are interested in obsidian studies and who support the overall objectives of the IAOS. Regular members will receive the quarterly *IAOS Newsletter*, general mailings, announcements of meetings and conferences, and any software or papers distributed by the IAOS for the year. Regular Members are entitled to attend and vote in the Annual Meetings.

**Institutional Members** are those individuals, facilities, libraries, and institutions who are active in obsidian studies and wish to participate in inter-laboratory comparisons and standardization. If an institution joins, all members of that institution are listed as IAOS members, although they will receive only one mailing per institution. Institutional Members may receive assistance from, or collaborate with, other institutional members. Institutional Members are automatically appointed to the Executive Board. Institutional Members also automatically receive all other mailings sent to regular members.

If you would like to join the IAOS, please send a check or money order to:

Ms. Lisa Swillinger ■ Secretary-Treasurer, IAOS  
Department of Anthropology ■ California State University at Chico  
Chico, California 95929-0400

use, we plan to distribute a shareware database manager with it so that users will not have to buy any expensive software. We'll announce our progress in a future newsletter.

Apple Macintosh owners, take note! I also have available a text file of the IAOS Bibliography that has been converted to MacWrite format. If you would like a copy, contact me directly and I'll forward you a copy. My thanks to Clement Meighan for taking care of the IBM to Mac conversion. As always, if you find any notable omissions in the bibliography, please let me know. Craig E. Skinner

#### *IAOS Standardization Slide Set for Measuring Hydration*

Due to a lack of standards and occasional differences in hydration measurements produced by various laboratories, it has been difficult to gain and maintain the confidence of the archaeological community. Ensuring comparability of measurement (quality control), as well as standardization of data collection and reporting, should help to demonstrate that obsidian hydration can be a powerful analytic method. A slide set was developed at the inception of the IAOS for the purpose of ensuring that practicing technicians are producing obsidian hydration measurement results that can be reasonably replicated by others. At present, a handful of technicians have participated in this comparative exercise. We encourage new readers to take part in this cooperative undertaking. To obtain this slide set, please contact Lisa Swillinger (916) 898-6256. □

## Announcement

### The NOSAMS Facility

The National Ocean Sciences Accelerator Mass Spectrometry (NOSAMS) facility is one of the most sophisticated and technologically advanced radiocarbon-dating laboratories in the world. It is funded by the National Science Foundation and operated within the Department of Geology and Geophysics at the Woods Hole Oceanographic Institution. This facility is dedicated largely to serving the US ocean sciences community. The NOSAMS facility, located at McLean Laboratory on the Institution's Quissett Campus, analyzes seawater, seafloor sediment, ice and organic material by measuring the three carbon isotopes:  $^{12}\text{C}$ ,  $^{13}\text{C}$ ,  $^{14}\text{C}$ . AMS permits the most precise analysis currently available for investigations of many natural processes in which radiocarbon plays a central role. A few of these include: ocean circulation, the occurrence and duration of warm periods and ice ages, sea level changes, atmosphere/ocean exchange processes and

carbon cycling in the oceans. Knowledge acquired from such studies is used to understand the ocean's role in global climate change. While the primary mission of the facility is serving the ocean sciences community, samples from other discipline areas are welcome as any material containing carbon has the potential to be analyzed.

*Applications and accuracy.* The following chart is a guide to the various types and typical sizes of samples that can be analyzed by the NOSAMS facility. Please contact them regarding the analysis of sample types not listed.

<u>Material</u>	<u>Suggested Sample Size</u>
Seawater (inorganic carbon)	500 ml
Sediment (organic matter)	100-200 mg
Sediment (total carbonate)	20-200 mg
Carbonate shells	10-20 mg
Wood	5-20 mg
Organics (other)	variable

*Sample submission.* Prospective users of the facility are urged to contact either Glenn Jones, Director, or Diane Cook, Administrative Assistant, to receive an official sample submission form (address below, Rm. 238). Because user demand for radiocarbon analyses exceeds the ability of all AMS facilities to quickly satisfy that demand, samples are assigned to one of three queues according to set criteria (described in brochure).

*User Fees.* Fees for analyses are assessed on a set-fee schedule. Analyses of samples for research sponsored by the National Science Foundation and other US government agencies are fixed in price at the current rate of \$250 per sample. Fees for commercial and individual analyses are assessed on an individual basis depending on the amount and type of sample preparation, the number of samples and machine time.

*Sample status information.* An electronic bulletin board entitled NOSAMS.NEWS is updated biweekly on SCIENCEnet, the electronic mail box system provided by Omnet, a communications media company. Scientists use this mail box system for the exchange of information and ideas with colleagues throughout the world. NOSAMS.NEWS provides the scientific community with information regarding the status and developments at the NOSAMS facility.

*Excerpted (with minor modification) from a NOSAMS brochure.*

*National Ocean Sciences Accelerator Mass Spectrometry Facility, Woods Hole Oceanographic Institution, McLean Laboratory, Woods Hole, Massachusetts 02543, USA; tel (508) 457-2000 ext. 2585; fax (508) 457-2183; email WHAMS@RED.WHOI.edu.* □

## Book Reviews

**Metallography and Microstructure of Ancient and Historic Metals.** David A. Scott. The Getty Conservation Institute, The J. Paul Getty Museum, and Archetype Books, Los Angeles, 1991, xx + 155 pp., 20 color plates, 212 figures, glossary, references, index. \$49.95 + \$5.00 s/h (paper).

*Reviewed by Duncan Miller, University of Cape Town, South Africa.*

This book was announced in the *SAS Bulletin* 14(4) as the revised edition of the 1984 handbook by David Scott and Jim Black on the metallography of ancient art objects. This new volume is far more than a handbook, although it will serve as a most useful laboratory reference manual. Metallography depends on building up a visual memory of microstructures. Volumes with lavish illustration of typical and atypical microstructures are invaluable educational sources. There are very few texts that deal exclusively with archaeological metal materials and this book, aimed at the conservation scientist and conservator, fills an obvious gap in the archaeometallurgical literature.

The book is organized in clear sections, starting with five pages of superb color plates as an appetizer and inspiration to the reader. These are followed by 18 short chapters, each dealing with a different metallographic topic. They are logically arranged, clearly illustrated, and each is well cross-referenced to pertinent figures and explanations in other chapters. This makes the work particularly useful for quick reference because specific topics can be accessed successfully from many points in the book.

These chapters start with a very brief introduction to metallic atomic packing, stress-strain curves, the notion of hardness, and dislocations. This section is somewhat oversimplified, to the detriment of clarity, but does provide an introduction to fundamental concepts and terminology. The following chapter deals with cast structures and the manifestations of cold- and hot-working with good illustrations of non-ferrous examples. An excellent discussion of two-phase materials follows, and acts as a very accessible introduction to binary phase diagrams. These 14 pages, illustrated with simplified phase diagrams, micrographs, and annotated sketches of microstructures, are the most lucid introduction to the use of phase diagrams in metallography that I have encountered.

The next five chapters deal with specific metals or phases often encountered in ancient materials. A short chapter on tin bronzes is followed by notes on carbon steels, martensite in low-carbon steels and the tempering of martensite, and the structure and properties of cast iron.

These chapters are adequate introductions to these topics but any archaeometallurgist other than the beginning student will find their contents very familiar. The following chapter, on corroded microstructures, is fascinating but tantalizingly brief. The point is well made that a wealth of information lurks in corrosion products and their relationship to primary metal. From the point of view of the archaeometallurgist this topic warrants a book of its own.

The remaining nine chapters are in the form of a laboratory manual. The chapter on the use of reflected polarized light microscopy sensibly follows the one on corrosion, but surprisingly omits a description of oil immersion microscopy. The discussion of the estimation of grain size is illustrated helpfully with comparison charts for normalized steels and annealed, twinned, non-ferrous metals. Various technical aspects of metallographic sampling, specimen mounting and preparation, etching, microhardness testing, and the recording of results are dealt with in considerable detail. Recipes of the most useful etchants for a wide variety of metals are given with clear instruction for their use.

The appendices occupy most of the second half of the book. These include a series of clear sketches of common microstructural shapes and corrosion features, a very useful reference list of microhardness values for archaeologically common alloys and microstructures, a list of alloys used in antiquity giving their common names, and a glossary of terms and techniques used in ancient metal working.

The central value of this book lies in the presentation of 47 copiously illustrated metallographic descriptions. These cover a very wide variety of materials, described in such a way as to illustrate the principles introduced in the first half of the book. The educational value of this presentation is most gratifying. At first I found the lack of any apparent order in the sequence of descriptions puzzling, but the juxtaposition of descriptions of dissimilar alloys will encourage students to recognize microstructural generalities and metallurgical principles.

The section including commonly useful metal phase diagrams is a welcome compilation. The substantial glossary of technical terms might be useful to the beginner, but a metallurgist would find some of the definitions deficient to the point of being misleading (e.g. "Martensitic transformation. A product formed by rapid cooling of an alloy."). A short bibliography is followed by an exemplary index, compiled thoughtfully to help unify subjects covered in several different sections.

My only substantial reservation about this otherwise excellent work is that, in the attempt to simplify metallurgical concepts, much accuracy in definition has been lost. Nevertheless, as a reference work in the

laboratory or for teaching metallography this book has great practical value. I have some quibbles, mostly with the editing. Page 29, illustrating the microstructure of a Japanese steel sword and headed "The Microstructure of Tin Bronzes", is clearly out of place. Troostite, named after Louis-Joseph Troost (L.E. Samuels, *Optical Microscopy of Carbon Steels*, Metals Park, Ohio, American Society for Metals, 1980, p. 27) is misspelt throughout the book as "troosite". This is a very perplexing mistake. At first reading I noticed two other obvious spelling mistakes ("graticle" for "graticule" on p. 11, and "stain lines" for "strain lines" in the caption to Fig. 127 on p. 98). These are hardly confusing errors and do not detract from the value of the book as a teaching or laboratory aid. □

**Mechanics of Pre-Industrial Technology. An Introduction to the Mechanics of Ancient and Traditional Material Culture.** Brian Cotterell and Johan Kamminga. Cambridge University Press, New York, 1990, xv + 325 pp. \$54.95 (cloth); \$18.95 (paper).

*Reviewed by Raffaele Santillo, Architect/Engineer, Lund, Sweden.*

The criterion I personally use to evaluate a book as reader and/or as buyer is expressed in a sentence quoted from O. Neugebauer (1957): "As Hilbert once expressed it, the importance of a scientific work can be measured by the number of previous publications it makes superfluous to read." As my reader might not agree with this criterion, I have to pass to the authors' goals stated in the preface. Recognizing that "the audience of archaeologists did not know sufficient mechanics...nor was there much comprehension of mechanics terminology" they declare that "this book is not a history of technology, nor one of mechanical science, etc." and later... "This book, which illustrates the applications of mechanics in archaeology, should also serve a wider readership in disciplines such as cultural anthropology, engineering, history, and physics." The statements quoted above are in contradiction to such a great extent that the question soon arises: what and whom is this book for?

Given their ambitions, the authors are forced to rapidly gloss over subjects, to make passing reference to other papers, to wrap them confusingly in an unavoidable disorder, always putting the cart ahead of the horse and encouraging the reader to blindly swallow the contents.

For example, in Chapter Two, Basic Mechanics, they skip in a very restricted number of pages from space and time, mass, force and law of motion, to scalars, vectors, stellar mechanics with universal law of gravitation, power, tables of ancient units, etc.: a hodgepodge.

*Dulcis in fundo* of the chapter, the authors try to explain

the equilibrium of a matchbox with the following sentence: "For stable equilibrium, the potential energy of a mechanical system is a mathematical minimum", sic! This is 'abracadabra' even for a second year engineering student. The contents of various aspects are not in proportion as too many pages are dedicated to scribble chronicling ancient times, unworthy for the archaeologist and available in a secondary school book. After this scarcely useful and page consuming exercise, the authors usually either compress what they should explain or, even worse, abruptly pass to the definition without explaining the phenomena and the related parameters that, if conveyed into concepts, would support a definition. Thus the methodological approach is paralyzing and intolerable even with a good course in general physics (see Sears 1958). To avoid triggering the reader's protest after this kind of provocation, the writers catapult in formulas, abandoning the audience as if they were shipwrecked on a raft (e.g., pp. 288, 292).

The same disorder prevails in Chapter 4, Machines, where the inclined plane is preferred to the wedge in the explanation of a screw. Indeed, an inclined plane should be better viewed as an unavoidable method to escape the lifting of a load than a pure machine. In fact, as in the case of a luggage trolley in the airport, we must add up the downhill component of the load to the rolling or sliding opposing force. The total value is obviously greater than in a level route and the component is dominant with a 10 percent slope. For this reason, their Fig. 4.10 with a sledge sloping as an armored tank does not hold. The case of a barrel being parabuckled is different as the rope acts as the power of a lever with the fulcrum at a tangent; herein is the true machine that greatly facilitates the labor and makes the barrel roll uphill.

Chapter 5, Structures, begins with drawings a) and c) which visually do not 'stand up' from a statics point of view. Neglecting the lessons of the ancients, the page on the suspension bridge ends with an equation of a catenary unhelpful to the anthropologist. Next follows a statement which reads "the columns used in ancient architecture carried very little stress" and the calculation for the Aphaia Greek temple at Aegina follows. Here, among other various inaccuracies, the authors surprisingly neglect to speak about horizontal loads due to earthquakes, although later (p. 119) they remember this problem where it is not pertinent (see Arnold and Rettherman 1982). When treating the tomb of Atreus they erroneously call two elements lintel and relieving triangle when in fact the former is composed of two fixed slabs (the inner larger than 5x8 m and weighing more than 120 metric tons) and the latter is a charging prism (Santillo and Frizell 1984; Santillo 1986)!

Historically introducing beams, they do not understand that Galileo's reasoning was not directed toward the allowable stresses but aimed at the ultimate load design (see Benvenuto 1991). Going on, the authors face the stability of a beam: here suddenly the second moment of

area appears without reason and reasoning which, as in the case of combined compressive and bending stress in masonry, is superfluous for the quadrat and rectangular sections of antiquity (Timoshenko 1970: section 52, chap. 8). For this matter neither of the authors profit by the excellent intuitive drawings on the true resisting mechanisms contained in a book admired in their preface (Gordon 1968). "Geometric representation is vital to physical interpretation" and "...also aids greatly in making the transition of thought between the physical situation and the mathematical expression..." (Meriam 1980), advice that the authors ignore again in the section on arches.

In spite of the translated Hook anagram (p. 122), "as hangs a flexible cable, so inverted stand the contacting voussoirs" (an analogous device still in use in Egypt after 5000 years), they state on the previous page that "the shape of a stone arch is not a critical factor in its stability, provided that it is reasonably thick." Here they do not consider that a concentrated load on a rope marks a cusp as, for example, a medallion along a necklace (and so inverted stand the inverted...pointed...arch!; see also Salvadori and Heller 1975), and that the Romans built archivaults and not pure arches (which are not the same thing), the latter introduced by the Arabs (see Torroja Miret 1962). *Dulcis in fundo* we find domes, herein very erroneously allied with arches (see, again, Salvadori and Heller 1975). The authors liquidate, in less than one page and without a sketch showing the resisting mechanism, the widest spread structural typology in the world (kilns, furnaces, baths, churches, shell dams, clay houses, trulli, igloos; see also Santillo 1986; Frizell 1987)!

The same incapacity is also revealed when they try to explain the stability of a spoked dished wheel (pp. 204-205), stating that it can take loads on both concave and convex sides. Indeed, to avoid disassembling, the two wheels must take loads only on the convex sides and absorb the transverse rocking motions of the carriage in this way: compression is added to the pre-compressed spokes and traction is added to the iron tire and to the pre-compressed timber rims. This pre-stressing, so vital in this type of wheel as in vats and barrels, is obtained by first warming and thus enlarging the metal tire (previously hooped with an inner diameter slightly smaller than the outer timber rim) and then housing and letting it cool (in reverse analogy the bicycle wheel has a twin set of pre-tensioned rays). What kind of logical value does the formula 8.11 have if the authors neglect to take into consideration the previous loads due to the pre-stressing?

The basic data given about huge stones and colossi in antiquity concerning friction, human muscular pull and manpower (but so many thousands of men!), are either incongruous, erroneous, or not useful in the book's context. In this hodgepodge the erroneous "rolled solution" (the rollers would either sink or smash) is indifferently accepted together with the solution "slid on planks." Nor do they explain how or what the soldiers in Layard's drawing (Fig. 8.15) are maneuvering at the "stern" of the sledge. The 89th Archaeological Institute of America

meeting in New York gave me the opportunity to display a working model (now permanently displayed in the Italian Corps of Engineers Museum) of an analogous cam mechanism in which the sole 50-gram dead-weight of a timber rule (the mover) could displace on a table a miniature sledge (the follower) loaded with two solid bricks (Santillo 1988; 1989). Here in short the first trick: the cam mechanism (and not a lever!) increases two-fold the mechanical advantage and horizontally converts the vertical pull of the men in an enormous take-off force, which, added at the same time to the pull ahead, with the opposing force of friction at rest, is much greater than the sliding friction. This is why ancient huge blocks have opposite ends shaped in different inclined profiles (e.g., at Mycenae, Alatri, Central America, Egypt, Cambodia, etc.), one for the level route, and the other to move uphill! In special cases (e.g. statues in Egypt and Assyria) the inclined profiles are pre-arranged at the back of the sledge (Santillo 1991). Only at this point do the appropriate calculations become so simple (Santillo 1990) to permit saying: "things are easy, is the men's wickedness that make them difficult!" (Nervi 1962).

## CONCLUSION

The book is hardly readable and written according to the cut and paste technique, probably under the tyrannical publish or perish law. It contains an abundant bibliography which was certainly not examined by the authors. Lack of method and knowledge prevails; drawings are scarce. This book can only inspire repugnance in the scholars to whom the text is addressed with the following most probable results: archaeologists and anthropologists will be the more unaffected, students of engineering will feel depressed, and the practitioner technicians disgusted.

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## Books Received

The following is a lists of book recently received that will not be reviewed in the *Bulletin*:

*Early Antiquity*, by I.M. Diakonoff, with a foreword by Philip L. Kohl. 1991. Translated by Alexander Kirjanov. The University of Chicago Press, Chicago. \$49.95 (cloth).

*The Late Prehistory of the Eastern Sahel: The Mesolithic and Neolithic of Shagadud, Sudan*, edited by Anthony E. Marks and Abbas Mohammed-Ali. 1991. Southern Methodist University Press, Dallas. \$29.95 (paper).

*Rethinking the Neolithic*, by Julian Thomas. 1992. Cambridge University Press, New York. \$54.50 (cloth).

*The Rise of the Castle*, by M.W. Thompson. 1991. Cambridge University Press, New York. \$39.50 (cloth).

*Sennacherib's Palace Without Rival at Nineveh*, by John Malcolm Russell. 1992. The University of Chicago Press, Chicago. \$45.00 (cloth).

*Space, Time and Man. A Prehistorian's View*, by Graham Clark. Cambridge University Press, New York. xiii + 165 pp. \$39.95 (cloth).

Robert H. Tykott, *Department of Anthropology, Harvard University, Cambridge, MA 02138, USA; tel 617-496-8991; fax 617-495-8925; email Isotope@HarvardA.edu.* □

## Software Review

### Public Domain X Windows Image Processing Software

Ten years ago, I was invited by a colleague to visit Sandia Laboratories here in Albuquerque to see the results of some revolutionary image processing work that was being done there. We were led into a viewing room with a monitor screen that was clearly second in importance to a viewing window which looked into a large climate-controlled gallery in the center of which stood a towering, black, octagonal Cray computer. Everyone watched with awe as the Cray performed a digital convolution on a 3-band color image in "real time" (a few minutes, as I recall).

Thankfully, image processing and analysis of this sort of complexity is now within the reach of almost all scientists. For several years, the largely medically-oriented journals (for instance, *Science*) have advertised frame grabber/

software combinations designed to perform a few general image processing tasks quickly but in relatively inflexible combinations on DOS computers, at prices beginning at about \$2000 for the hardware, another \$1000-2000 for the hardware-specific basic software and, if one orders the programmer's toolkits and source code, as much as \$10,000+.

In just the last year or two, another level of image processing has virtually exploded onto the DOS scene, in the form of the many image manipulation or editing software packages designed primarily for editing photographic and other art as input to desktop publishing and other consumer graphics applications. A recent issue of *PC Magazine* reviews eight of the more popular of these programs, including Aldus PhotoStyler, Image-in-Color, Publisher's Paintbrush, and Picture Publisher, and ranging in price from less than \$200 to nearly \$1000. Rather than

requiring add-on image capture and storage boards, these packages store and process images in RAM, which DOS computers increasingly possess. Some of these packages have surprising capabilities when their ease of operation and cost are considered, but those of which I am aware are truly "hardwired," with two or three levels of pull-down menus containing all possible combinations of their options. One of PC's "picks," Publisher's Paintbrush, was bundled with a Hewlett-Packard color scanner we recently acquired, and although we have had fun playing with it, we were surprised that it was chosen as being exemplary of DOS image manipulation packages; it is fairly inflexible and in some ways even clumsy.

A true, flexible, and professional image analysis and processing software system, Khoros, which offers an available alternative for the scientist since it is distributed in the public domain, was released about a year ago by the Khoros Groups at the Department of Electrical and Computer Engineering at the University of New Mexico. Now in its later stages of release 1, and expecting to go into version 2.0 in the spring of 1993, Khoros is referred to by its developers as a "software environment for data processing and visualization." It is indeed more than a simple image processor.

Operating in the X Windows environment (in UNIX, and programmed in C), Khoros includes twenty libraries of functions ranging from utilities through input and output, to numerical analysis, image processing, image analysis, signal processing, and even some fundamental remote sensing and GIS functions. Khoros is designed around nearly 300 routines, with functions ranging from simple to complex, which can be called either from the X Windows command line or from within an ingenious GUI or menu system called (to continue the musical metaphor) Cantata. In Cantata, routines are represented by glyphs and are linked by paths in a workspace. Routines can be combined in virtually any combination and order, looped for recursion, and edited and saved. There are also separate and very versatile graphing and visualization routines which operate outside Cantata.

Since it operates in MIT's X Windows System (Version 11, release 4), Khoros is portable among a number of UNIX platforms including Sun 3 and 4 series graphics workstations (it was developed largely on Sun Sparc Station platforms), NeXT, Silicon Graphics, and yes, even CRAYs.

Khoros is enormously flexible, with enough pre-programmed routines to accomplish just about anything one runs across in any image processing and analysis textbook or reference. Most of the sometimes complex image processing procedures discussed by Scollar et al. (*Archaeological Prospecting and Remote Sensing*, 1990, Cambridge University Press) in their chapters on archaeological image enhancement and on the geometric transformation of archaeological aerial photographs can be accomplished easily using provided procedures. These

procedures can also be edited or new ones created—and even turned into custom glyphs. Version 2.0 will contain a GUI-driven "Application Builder" to build procedures and user interfaces visually and intuitively.

Khoros is available free via anonymous ftp (ask your university systems manager how to do this over Bitnet or Internet) from [pprg.eece.unm.edu\(129.24.24.10\)](ftp://pprg.eece.unm.edu/129.24.24.10). The source code and documentation are also available there. It all occupies about 230 megabytes and should take about 2 hours to transfer. The executable program and source code on tape, and printed documentation, can also be purchased for \$250 from the EECE Department, Khoros Room 110, University of New Mexico, Albuquerque, NM 87131. If you want to find out more about Khoros, a good way to begin is by subscribing to the Khoros usenet news group; mailing list requests should be sent to [khoros-request@chama.eece.unm.edu](mailto:khoros-request@chama.eece.unm.edu). The usenet mailing list is Khoros' mechanism for user support; you send in your questions and someone (often a Khoros Group developer) soon answers.

*Contributed by James I. Ebert, Associate Editor for Remote Sensing and GIS Editor.* □

## Workshop

### Geophysical Techniques for CRM

This workshop is designed to provide a practical application of electronic instruments and aerial photographic techniques available for identification, evaluation, and ultimately the conservation and preservation of cultural resources. Instruction will be given in the use of electronic survey equipment including a total station with data collector and associated computer mapping of the field data for historic architectural and archeological applications. Geophysical instruction will include the use of magnetometer, terrain conductivity meter, ground penetrating radar and their applications to non-destructive subsurface investigations. The major emphasis of the training will center on the field use of the equipment. Instruction will also be offered in the use and interpretation of aerial photographic techniques, and in the use of global positioning systems.

Geophysical techniques provide a means of non-destructive investigations for archeological surveys. Geophysics utilizes physical principles to study the earth through indirect interpretation of the earth's physical properties. Physical, electrical, and/or chemical measurements are used by the geophysicists to interpret the earth's physical characteristics. Active geophysical techniques are based on responses from an induced signal used to detect contrasts in different material properties. Such techniques include electromagnetics (EM), ground penetrating radar

Geophysics (continued on p. 19)



## Meetings Calendar

Susan Mulholland, *Archaeometry Laboratory, University of Minnesota-Duluth, 10 University Drive, Duluth MN 55812; email 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, #1, page 2.

- March 4-6. Symposium on the Arts and Technology. New London, Connecticut. M. Monce, Department of Physics and Astronomy, Connecticut College, New London CT, 06320, USA.
- \* March 8-12. 44th Pittsburgh Conference and Exposition: Analytical Chemistry and Applied Spectroscopy. Atlanta, Georgia, USA. See *Analytical Chemistry*, 12/15/92, 64 (24):1165-1166A for details.
- \* March 10-12. 4th Annual Ulam Math Conference. West Palm Beach, Florida. L. Hill, Manager, Conference and Special Events, Palm Beach Atlantic College, P.O. Box 24708, West Palm Beach, FL 33416, USA; tel 407-650-7700; fax 407-835-4342.
- \* March 12-14. 10th Annual Visiting Scholar Conference: Geographic Information Systems and the Advancement of Archaeological Method and Theory. Carbondale, Illinois. Herbert D.G. Maschner, CAI, SIUC, Carbondale, IL 62901, USA; tel 618-453-5031; email GE2610@SIUCVMB.
- 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.
- \* March 24-28. Association for Social Anthropology in Oceania: 22nd Annual Meeting. Hilo, Hawaii, USA. Larry Mayo, Department of Sociology and Anthropology, DePaul University, 2323 N. Seminary Avenue, Chicago, IL 60614, USA.
- \* March 25-26. International Multimedia Conference: Culture, Technology, Interpretation: The Challenge of Multimedia. Dublin. Multimedia Conference, 26 Temple Lane, Dublin 2, Ireland; fax 353-1-679469.
- \* March 28-April 2. 205th National Meeting, American Chemical Society. Denver, Colorado, USA. Meetings Department, American Chemical Society, 1155 16th Street NW, Washington, DC 20036-4800, USA; tel 202-872-4396; fax 202-872-6128.
- \* March 29-April 1. Annual Meeting of Physical Society of Japan. Sendai, Japan. Physical Society of Japan, Room 211, Kikai-Shinko Building, 3-5-8 Shiba-koen, Minato-ku, Tokyo 105, Japan.
- April 4-7. 1st International Conference on Mathematical Linguistics. Barcelona. C. Martin-Vide, Universidad de Barcelona, Facultad de Filología, Sección de Lingüística, Gran Via de les Corts, Catalanes, 585, E-08007 Barcelona, Spain.
- April 4-8. 25th International Symposium on Remote Sensing and Global Environmental Change - Tools for Sustainable Development; co-sponsored by The Consortium for International Earth Science Information Network (CIESIN) and the Environmental Research Institute of Michigan (ERIM). Graz, Austria. ERIM/International Symposium, P.O. Box 134001, Ann Arbor, MI 48113-4001, USA; tel 313-994-1200, ext. 3234; fax 313-994-5123. Includes an exhibition for remote sensing and GIS products, and training programs.
- April 5-8. CAA93 - Computer Applications and Quantitative Methods in Archaeology. Stoke-on-Trent, UK. Dr John Wilcock, Reader in Computing, Staffordshire University, School of Computing, The Octagon, Beaconside, Stafford ST18 0AD, UK; tel 44-785-52331, ext. 5446; fax 44-785-55334; email cmtjd@staffs.ac.uk. 15(4):22.
- April 5-8. Global Warming Science and Policy International Conference. Chicago, Illinois. Sinyan Shen, Natural Resource Management Division, Supcon International, One Heritage Plaza, Woodridge, IL 60517-0275, USA.
- \* April 6-10. Association of American Geographers, Annual Meeting. Atlanta, Georgia, USA. American Association of Geographers, 1710 16th Street NW, Washington, DC 20009, USA; tel 202-234-1450.
- April 11-16. Asociación de Lingüística y Filología de la American Latina, 10th International Congress. Veracruz, Mexico. Juan Lopez Chavez, Facultad de Filosofía y Letras, Torre de Humanidades I, 3er. piso, Cubículo 20, Universidad Nacional Autónoma de México, México D.F., México.
- April 12-16. Optical Engineering and Photonics in Aerospace Science and Sensing; sponsored by SPIE - The International Science for Optical Engineering. Orlando, Florida, USA. OE/Aerospace Science and Sensing '93, SPIE, P.O. Box 10, Bellingham, WA 98227-0010; tel 206-676-3290; fax 206-647-1445; Internet spie@mom.SPIE.org. 15(3):14.
- \* April 14-16. Annual Meeting of Seismological Society of America. Ixtapa-Zihuatanejo, Mexico. Program Chair, c/o Seismological Society of America, 201 Plaza Professional Building, El Cerrito, CA 94530, USA.
- \* April 14-17. American Association of Physical Anthropologists Annual Meeting. Toronto, Ontario, Canada. Gere Haas, tel 607-255-4419.
- \* April 14-18. 58th Annual Meeting of the Society for American Archaeology. St. Louis, Missouri, USA. SAA 808 17th Street NW, Suite 200, Washington, DC 20006.
- April 18-21. Canadian Quaternary Association/Applied Quaternary

- Research Meeting. Victoria. Environmental Geology Section, British Columbia Geological Survey Branch, 553 Superior Street, Victoria, British Columbia, Canada V8V 1X4; tel 604-387-6249; fax 604-356-8153.
- April 19-21. SIAM Conference on Mathematical and Computational Issues in the GeoSciences. Houston, Texas, USA. SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia PA, 191004-2688, USA; tel 215-382-9800; fax 215-386-7999; email meetings@siam.org.
- April 21-23. Scanning '93. Orlando, Florida, USA. Mary Sullivan, Scanning '93, P.O. Box 832, Mahwah, NJ 07430, USA.
- April 23-24. Society for Economic Anthropology Annual Meeting. Durham, New Hampshire, USA. Richard Blanton, Sociology-Anthropology, Purdue University, West Lafayette, IN 47097, USA.
- \* April 29-May 1. International Round Table on Highland-Zone Exploitation in Southern Europe. Brescia. Paolo Biagi, Museo Civico di Scienze Naturali, Via Ozanam 4, I-25128, Brescia, Italy.
- May 3-7. European Geophysical Society, XVIII General Assembly. Wiesbaden, Germany. EGS Office, Postfach 49, Max-Planck-Strasse 1, W-3411 Katlenburg-Lindau, Germany; tel 49-5556-1440; fax 49-5556-4709; email EARN U0085@DGOGWDG5. 15(4):20.
- May 3-9. Workshop on Ecological Systems. Waterloo. E. Reidt, The Fields Institute for Research in Mathematical Sciences, 185 Columbia Street West, Waterloo, Ontario, Canada N2L 5Z5; tel 519-725-0096; fax 519-725-0704; email workshop@fields.waterloo.edu.
- \* May 6-9. Canadian Anthropology Society Annual Meeting. Toronto, Ontario. Kenneth Little, Department of Anthropology, York University, North York, Ontario M3J 1P3, Canada.
- May 9-14. Society for Imaging Science & Technology, 46th Annual Conference. Cambridge, Massachusetts. William M. Aitken (General Chair), Polaroid Corporation, 565 Technology Square - 4, Cambridge, MA 02139-3586, USA; tel 617-577-2369; fax 617-494-5243. 15(3):15.
- \* May 12-15. International Symposium of Conservation of Urban Squares and Parks. Montreal. Pierre M. Valiquette, Coplanor Congres, Incorporated, 511 Place d'Armes, Bureau 600, Montreal, Quebec H2Y 2W7, Canada.
- \* Mid-May. INQUA Commission on Formation and Properties of Glacial Deposits Field Conference and GIS Workshop. Regina. DJ Sauchyn, Department of Geography, University of Regina, Regina, Saskatchewan S4S 0A2, Canada; tel 306-585-4030; fax 306-585-4815.
- 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.
- May 17-22. 3rd International Conference, Association for the Study of Marble and Other Stones Used in Antiquity. Athens, Greece. Dr. Yannis Maniatis, "Demokritos" National Center for Scientific Research, Institute of Materials Science, 153 10 Ag. Pareskevi, Attikis, P.O.B. 60228, Greece; tel 301-651-3111; fax 651-9430; email mandi@grathdem. 15(3):15.
- May 24-28. 15th International Symposium on Capillary Chromatography. Riva del Garda, Italy. Prof. Dr. P. Sandra, IOPMS, Kennedypark 20, B-8500 Kortrijk, Belgium; tel 32-56-204960; fax 32-56-204859. Scientific program will feature the latest developments in micro-separation techniques. Abstract deadline: 15 Dec. 1992.
- June 3-6. Optical Spectroscopic Instrumentation and Techniques. Albuquerque, New Mexico, USA. International Society for Optical Engineering, P.O. Box 10, Bellingham, WA, 98227-0010; tel 206-676-3290.
- 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.
- June 14-16. Lithic Analysis Conference. Tulsa, Oklahoma. George H. Odell, Department of Anthropology, University of Tulsa, Tulsa, OK 74104, USA; tel 918-631-3082. Theme: The Articulation of Archaeological Theory and Lithic Analysis.
- \* June 24-25. Soil Analysis Meeting. Atlanta, Georgia, USA. Dorothy Savini, Symposium Operations, American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103 USA; tel 215-299-5413.
- + June 26-July 1. 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 5-9. 5th International Conference on Fluvial Sedimentology: Modern and Ancient - Their Importance to Mankind. Brisbane, Australia. Continuing Professional Education, The University of Queensland, Queensland 4072, Australia; tel 61-7-365-7100; fax 61-7-365-7099.
- \* July 11-16. Optical Applied Science and Engineering, International Symposium. San Diego, California, USA. Society of Photo-Optical Instrumentation Engineers, P.O. Box 10 Bellingham, WA 98227-0010, USA. tel 206-676-3290.
- \* July 17-24. Geological and Landscape Conservation International Conference. Great Malvern, United Kingdom. D. O'Halloran, JNCC, City Road, Peterborough, PE1 1JY, UK; tel 0733-62626; fax 0733-893-971.
- July 24-26. Simulating Societies '93. Siena, Italy. Prof. Nigel Gilbert, Department of Sociology, University of Surrey, Guildford GU2 5XH, UK; tel 44 (0)483-509173; fax 44 (0)483-306290; email gng@soc.surrey.ac.uk. 15(4):22.
- \* July 26-31. 15th International Congress for Caribbean Archaeology. San Juan. Miguel Rodríguez, Program Chair, 15th ICCA,

- Instituto de Cultura Puertorriqueña, Apartado 4184, San Juan, Puerto Rico 00902. tel 809-724-1844; fax 809-724-8393.
- 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 Autónoma de México, Ciudad Universitaria, Coyoacan D.F. 04510, México; 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. 1-6. Geochemistry of the Earth's Surface, 3rd International Symposium. University Park, Pennsylvania. Lee Kump, Department of Geosciences, Pennsylvania State University, 210 Deike Building, University Park, PA 16802, USA; tel 814-863-1274; fax 814-865-3191.
- Aug. 8-20. Assembly of International Association of Geomagnetism and Aeronomy. Buenos Aires, Argentina. Comité Organizador, IAGA Assembly, Casilla de Correo 106, Sucursal 28, 1428 Buenos Aires, Argentina.
- Aug. 9-12. Joint Statistical Meetings. San Francisco, California, USA. American Statistical Association, 1429 Duke Street, Alexandria, VA 22314-3402, USA.
- Aug. 17-23. 7th International Conference on Hunting and Gathering Societies. Moscow, Russia. Linda Ellana, Department of Anthropology, University of Alaska, Fairbanks, AL 99775, 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; email ichs@cc.unizar.es. 15(4):21.
- 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.
- Aug. 31-Sept. 4. ECAART 3 - Third European Conference on Accelerators in Applied Research and Technology. Orléans. ECAART 3, CNRS-CERI, 3A rue de la Férollerie, 45071 Orléans cedex 2, France; tel 38-51-54-27; fax 38-63-02-71. 15(4):21.
- \* Sept. 6-10. 7th Meeting of the ICAZ Fish Remains Working Group. Leuven, Belgium. Wim Van Neer, Royal Museum of Central Africa, 3080 Tervuren, Belgium.
- Sept. 13-17. International Symposium on the Catalán Forge. Spain. Dr. Estanislau Tomas, Associació del Museu de la Ciència i de la Tècnica i d'Arqueologia Industrial de Catalunya, Via Laietana 39, S-09003 Barcelona, Spain; tel 319 23 00; fax 310 06 81. 15(1):1.
- \* Sept. 18-21. Annual Meeting, Association for Environmental Archaeology. Theme: Taphonomy and Interpretation. Durham, United Kingdom. Sue Stallibrass, Department of Anthropology, University of Durham, Science Laboratories, South Road, Durham DH1 3LE, UK; tel 091-374-3643/2; fax 091-374-3741; email JANET.SueStallibrass@UK.ac.durham.
- Sept. 19-24. 6th Nordic Conference on the Application of Scientific Methods in Archaeology. Esbjerg, Denmark. Vagn Mejdahl, The Nordic Laboratory for Luminescence Dating, Riso National Laboratory, DK-4000 Roskilde, Denmark. 15(2):1.
- \* Sept. 24-27. Botanical Society of Scotland conference: Plants and People: Economic Botany in Northern Europe 900-1000 AD. Edinburgh, Scotland. J.H. Dickson, Department of Botany, University of Glasgow, Glasgow G12 8QQ, UK; tel 041-339-8855 ext. 4364; fax 041-330-4447.
- \* Sept. 27-30. 8th Meeting of Working Group I on Bone Modification. Hot Springs, South Dakota, USA. L. Adrién Hannus, Archeology Laboratory, 2031 South Grange Avenue, Sioux Falls, SD 57105, USA.
- \* Sept. 27-Oct. 1. Accelerator Mass Spectrometry 6th International Conference. Canberra and Sydney, Australia. AMS-6, ACTS, GPO Box 2200, Canberra ACT 2601, Australia; tel 61-6-249-8105; fax 61-6-257-3256.
- 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.
- \* Nov. 5-21. International Circum-Pacific and Circum-Atlantic Terrane Conference VI. Guanajuato, Mexico. Fernando Ortega-Gutierrez; fax 52-5-548-0772.
- \* Nov. 7-12. Soil Science Society of America, Annual Meeting. Cincinnati, Ohio, USA. Soil Science Society of America, 677 S. Segoe Road, Madison, WI 53711, USA; tel 608-273-8080.
- \* Nov. 17-21. American Anthropological Association Annual Meeting. Washington, DC. American Anthropological Association, 1703 New Hampshire Avenue NW, Washington, DC 20009, USA; tel 202-232-8800.

## 1994

- 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 2-6. Association of American Geographers Annual Meeting. San Francisco, California, USA. Association of American Geographers, 1710 16th Street NW, Washington, DC 20009, USA; tel 202-234-1450.
- April 4-11. William Robertson Smith Congress. Aberdeen. William Johnston, Department of Hebrew and Semitic Languages, University of Aberdeen, King's College, Old Aberdeen AB9 2UB, Scotland, UK.
- \* April 11-13. International Conference, Wetland Archaeology and Nature Conservation. Bristol, UK. Margaret Cox, Somerset Levels & Moors Archaeologist, Depart-

ment for the Environment, Somerset County Council, County Hall, Taunton TA1 4DY, UK; tel 0823-255416; fax 0823-334343.

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, Society for American Archaeology. Anaheim, California, USA. Society for American Archaeology, 1511 K Street NW, Washington, DC, USA. tel 202-223-9774.

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.

July 5-9. 7th International Specialist Seminar on Thermoluminescence and Electron Spin Resonance Dating. Krems am Donau. Norbert Vana, Atominstitut, Schuttelstrasse 115, A-1020 Vienna, Austria.

July 10-16. 15th International Congress of Soil Science. Acapulco, Guerrero, Mexico. Dr. Roberto Nulez, Colegio de Postgraduados, Centro de Edafología, Km. 34, Carretera México-Texcoco, Montecillo, C.P. 56230, México; tel 52-595-557-1; fax 52-595-4-57-23.

\* Oct. 4-7. Annual Meeting German Geological Society. Heidelberg, Prof. Th. Bechstadt or Prof. R.O. Greiling, Geologisches-Paläontologisches Institut, Ruprecht-Karls-Universität, Im Neuenheimer Feld 234, D-6900 Heidelberg, Germany; tel 0-62-21-56-55-31. □

## CRM Short Courses

The University of Nevada, Reno offers a program of continuing education short courses in cultural resources management, in cooperation with the Advisory Council on Historic Preservation, the National Park Service, and the U.S. Forest Service. Don Fowler is the Program Director. Courses for 1993 include Geographic Information Systems in Archaeology, April 13-14, just prior to the Society for American Archaeology Meeting in St. Louis; Frederick Limp, instructor. Under a cooperative agreement with the Advisory Council on Historic Preservation, the university can also provide training in historic preservation tailored to the special interests of a particular organization.

*Cultural Resource Management, Division of Continuing Education/048, University of Nevada-Reno, Reno, NV 89557-0024 USA; fax (702) 784-4801.* □

## Geophysics (continued from p. 15)

(GPR), metal detectors, electrical resistivity, and seismic. Passive techniques are based on responses from the natural conditions. These techniques include magnetics, gravity, and self-potential (SP). Participants will be provided an opportunity to use the following geophysical survey techniques: magnetics, electromagnetics, ground penetrating radar, and resistivity. The course will provide an opportunity to learn about non-destructive geophysical techniques for archeological survey including advantages and disadvantages of such techniques.

**Participants:** Federal, state, and local cultural resources managers and specialists (e.g., archeologists, historians, architects, and contracting personnel) with specific responsibilities concerning the identification, evaluation, conservation, protection, and management of archeological and other cultural resources across the nation.

**Class size:** 15-20. **Program code:** 1899. **Title code:** REMOTE TECH ARCH

**Course dates:** June 7-11, 1993, 40 Hours (5 Days)

**Location:** Fort Laramie National Historic Site, Goshen County, Wyoming. This course is co-sponsored by the National Park Service and the USDA Forest Service. The historic site is located approximately three miles southwest of the town of Fort Laramie off U.S. Route 26. Fort Laramie played a critical role in the western expansion of the nation, first as a fur-trading center, and then as a military garrison.

Lodging for the course will be at the Kings Inn in Torrington, Wyoming. Transportation to and from the park will be provided. Additional information concerning lodging will be provided to course participants. For further details about the facilities and Fort Laramie National Historic Site, contact Steven L. De Vore (address below).

**Application:** There is no charge for course tuition. However, those wishing to attend must send a one-page nomination form to National Park Service, RMR-PR, ATTN: Steven De Vore, P.O. Box 25287, Denver, CO 80225-0287 by COB, April 1, 1993. NPS personnel must process a 5-part SF-182 Training Form through their Regional Training Office. A blanket SF-182 will be done for RMR personnel.

**Funding:** Benefiting Account. Questions should be directed to Steven De Vore, National Park Service, Rocky Mountain Regional Office, tel (303) 969-2882. □

## Coming Soon

Cumulative Index  
Resistivity Meters  
More on the Archaeometry Symposium  
Book Reviews

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**Editor:** Rob Sternberg

Dept. of Geosciences, Franklin and Marshall College  
Lancaster, PA 17604-3003, USA  
Office: (717) 291-4134 Fax: (717) 291-4186  
email: R\_Sternberg@Acad.FANDM.edu

**Archaeometallurgy:** Martha Goodway

CAL MSC, Smithsonian Institution  
Washington, DC 20560, USA  
Office: (301) 238-3733 Dept.: (301) 238-3700  
Fax: (301) 238-3709

**Meetings Calendar:** Sue Mulholland

Archaeometry Lab, University of Minnesota  
10 University Drive  
Duluth, MN 55812, USA  
Office: (218) 726-7957 Fax: (218) 726-6556  
email: SMulholland@UMNDul

**Book Reviews:** Robert H. Tykot

Department of Anthropology, Harvard University  
Cambridge, MA 02138, USA  
Office: (617) 496-8991 Fax: (617) 495-8925  
email: Isotope@HarvardA.Harvard.edu

## SAS Executive Officers 1991-1993

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email: EGarriso@UGa.BITNET

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Radiocarbon Laboratory  
University of California  
Riverside, CA 92521  
Office: (714) 787-5521 Fax: (714) 787-5409  
email: CPrior@UCRVMS

**Remote Sensing and GIS:** James I. Ebert

Ebert & Associates  
3700 Rio Grande Blvd., NW, Suite 3  
Albuquerque, NM 87107, USA  
Office: (505) 344-2345 Fax: (505) 344-2444  
email: Ebert@UNMB

**Bioarchaeology:** Delwen Samuel and Mark Nesbitt

McDonald Institute for Archaeological Research  
Cambridge University  
62 Sidney Street, Cambridge CB2 3JW  
United Kingdom  
Office: 44-223-333537 Fax: 44-223-333536

**Archaeological Chemistry:** Joseph B. Lambert

Dept. of Chemistry, Northwestern University  
Evanston, IL 60201, USA  
Office: (312) 491-5437 Dept.: (312) 491-5372  
email: Lambert@Casbah.acns.nwu.edu

**Geoarchaeology:** Robin L. Burgess

HQ AMC/CEVP  
507 A Street, Room 206  
Scott Air Force Base, IL 62225-5022, USA  
Office: (618) 256-8332 Fax: (618) 256-8376

## SAS Administration

**General Secretary:** R. E. Taylor

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Radiocarbon Laboratory  
University of California  
Riverside, CA 92521, USA  
Office: (714) 787-5521 Fax: (714) 787-5409  
email: RETaylor@UCRVMS

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### Deadlines for Submissions:

No. 1 November 15 No. 2 February 15  
No. 3 May 15 No. 4 August 15

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