# SAS Bulletin
## Society for Archaeological Sciences

Volume 16 Number 2 April - June 1993

## SAS News

### SAS Election Results

The following officers were elected at the annual business meeting that took place on April 15, 1993 during the Society for American Archaeology meeting in St. Louis: *President* Ervan R. Garrison;*Vice President/President-elect* Patrick E. Martin; *Secretary/Treasurer*: Chris Prior. The new president will have a message for members in the next issue. Full addresses for the officers are given, as always, on the back page of the *Bulletin*.

We also wish to announce in these pages the addition of Richard Klein, editor of the *Journal of Archaeological Science*, to the executive board, and the continuing service of James Burton, now as Past President.

### SAS Vice-Presidents

SAS by-laws authorize the executive board to appoint vice presidents, who serve one-year terms and may be reappointed following annual reports to be given at the SAS business meetings. Vice presidents are appointed for specific tasks, and may organize a committee to assist in their planning. The addition of vice presidents obviates the need for consulars that have assisted the executive board in the past. SAS members are encouraged to suggest to the executive board areas of responsibility for which a vice president would be appropriate, and are also encouraged to volunteer to fill those positions!

The current vice presidents and committee chairs are: *Vice President for Intersociety Relations* Steven Shackley;*Vice President for Membership Development* Elizabeth J. Lawlor; *Chair, Standing Committee for Computer Networks and Information Sharing*, Foss Leach.

### SAS Bulletin Staff

The following members of the editorial staff are also listed on the back page for the first time, although the editor has benefited greatly from their assistance during the past year: *Assistant to the Editor* Jody Dalton, and *Layout* Carol Lau. □

### Advances in Archaeological and Museum Science Project

The purpose of the *Advances in Archaeological and Museum Science* (AAMS) series, published by Plenum Press in cooperation with the SAS, is to provide critical summaries of developments in specific areas of archaeometry, archaeological science, environmental archaeology, museum conservation and preservation science. One of the reasons that the series was initiated was the recognition that a quarter of a century had passed since the two editions (1963 and 1969) of *Science and Archaeology, A Survey of Progress and Research*, edited by Don Brothwell and Eric Higgs, had appeared. The Brothwell and Higgs volume represents the last comprehensive review in English of the results of the interaction between the full range of natural science-based analytical techniques and archaeological topics. Among other roles, the AAMS series was conceived of as providing the vehicle for a set of volumes providing a thorough updating of the topics included in the Brothwell and Higgs volume.

**Plenum (continued on p. 5)**

### In This Issue

# Conference Report
## Archaeometry '92 - An Addendum

### ANCIENT TECHNOLOGY AND PROVENANCE OF NONMETALS

Fifty-four papers, the largest fraction of papers at *Archaeometry '92*, dealt with nonmetals, amounting to 30% of the contributions. These included three oral sessions of twenty papers total, another thirty contributions in the poster session and three other papers which were included in the Precolumbian Archaeometry theme session and one on ceramics in a metals session. Thus, it was surprising to find that the previous review of the conference omitted this large, but somewhat unwieldy, topic.

*The oversight of this important topic in our conference review in Volume 15, Number 4 is hereby rectified!*

The oral sessions were composed of ten presentations on ceramics with three others in the theme session and one in metals, three on glass, two on marble and five on obsidians with one more on obsidian in the theme session (total of 24). The poster session contained seventeen on ceramics, five on glasses, three on obsidian, and one each on jade, turquoise, gemstones, carbonate stone and ink (total of 30). According to the American and British Ceramic Societies, ceramics cover clay-based, oxide and silicon ceramics, glasses, glazes and "fired-on" decorative or protective coatings, inorganic pigments, plasters and cements. Thus, it is surprising that papers on a greater range of materials were not given, but many topics are found in specialists' meetings, such as pigment analysis among those of art historians, glazes at Asian studies meetings, stone tool replication and use-wear studies at Paleolithic archaeology meetings. To maintain the healthy variety of subject matter, the archaeometry community should be making efforts to include some of these researchers, as well as more anthropologists interested in material culture and materials analysis.

By subject matter, all eight obsidian papers dealt with compositional grouping for provenance and sourcing, and most used x-ray fluorescence. The six other papers on stone considered identification and NDE (non-destructive evaluation), technology and iconography and corrosion. The eight glass studies dealt with corrosion, use, technology and provenance. The 32 ceramics papers were about equally divided between provenance and technology studies but a few were presentations of relatively new areas of investigation: strength and use, replication for sale and corrosion, or post-depositional change. Thus, the subject matter is becoming broader, involving more people with concerns from the conservation, materials science, and archaeological communities. In addition, student submissions were in evidence adding further breadth.

The most memorable papers for me were the ones which made me ask questions and re-examine what I do or how I do it or which filled in obvious blanks in our knowledge. A paper by the Maniatis group demonstrated micro-structural and compositional accuracy in replication of Greek slipwares. To provide alternatives to trade in illicit antiquities, replicas must be of faithful visual likeness, and in the cases where they have been publicly sanctioned and successful, an interdisciplinary approach of art historian, scientist, and factory researchers has been dedicated to the goal. In China, ceramic replicas of many famous wares are made to obtain foreign currency as well as protect cultural patrimony. Many are the equivalent of the ancient wares and hopefully will help stem one of the great problems of our era.

Sarah Vaughan, who is establishing a laboratory facility at the American School of Classical Studies in Athens, documented examples of the difficulty in distinguishing the mixing of clay and grit caused by natural processes with that involved in intentional clay preparation. She called into question the terminology in which value-loaded terms such as "tempering" are used to refer to aplastic inclusions for which there are no data to support intentional addition as well as the kinds of geological reference materials, analytical tests and arguments which support or negate the two cases of mixing.

Mike Tite related compositional to technological variation in his study of Southwest Asian Egyptian blue and green frits to declare that two colors had indeed been intentionally manufactured. Solvieg Schiegl has documented colorants in Egyptian wall paintings in which the green is only a weathered product of the blue frit colorant.

The L. J. Moens paper on interdisciplinary methodology for provenance determination of marble involved macrostructural textural information, microstructure and local variations in composition as well as trace compositional methods. He has elaborated further this interdisciplinary theme in his recently published conference proceedings on this provenancing. As the questions about ancient materials become more difficult to answer, more interdisciplinary methodologies will probably become standard and will undoubtedly make reviewing future Archaeometry conferences even more difficult.

*Contributed by Pamela B. Vandiver, Conservation Analytical Laboratory, Smithsonian Institution, Washington, D.C.* □

# Conference Report
## Geographic Information Systems (GIS) Symposium

The 10th Annual Visiting Scholar's Conference, sponsored by the Center for Archaeological Investigation at Southern Illinois University and focusing on *Geographic Information Systems and the Advancement of Archaeological Methods and Theory*, was held in Carbondale, Illinois on March 11-13, 1993. The symposium, organized by visiting scholar Herb Maschner and including nineteen invited presentations, provided an interesting overview of contemporary GIS uses and aspirations in archaeology. The presentations were preceded on March 11 by two all-day workshops, one given by Fred Limp (University of Arkansas) on GIS and Spatial Analysis, and another by Ken Kvamme (Arizona State Museum) and Goran Stancic (University of Ljubljana, Slovenia) on Idrisi (an educational raster GIS software package).

The presentations were uniformly interesting and (as befits a GIS symposium) lavishly and graphically illustrated. Despite the session's title, however, there was relatively little overt "theoretical" content, with the major exception being Maschner's own paper on sexual differences in landscape perception among hunter-gatherers. Otherwise, the two principal themes to emerge were analytical approaches aided by GIS visualization, and specific regional studies consisting largely of applications of one sort or another of catchment analysis.

The possibilities offered by GIS technology for implementing what is essentially visual or graphic analyses were explored by several authors in the context of gridded site surface data (Kvamme) and distributional archaeological analysis (James Ebert, Eileen Camille and Michael Berman, Ebert & Associates, Albuquerque). More general graphic and other analytical possibilities and near-future trends in archaeological GIS, including 3-D GIS, were examined by Trevor Harris and Gary Lock (Oxford University).

Most of the remainder of the papers focused on a specific site or sites and their spatial relationships with various sorts of resources, or the spatial relationships between sites themselves. As might be expected, the former was emphasized most by North American contributions: Fred Limp (University of Arkansas), Amy Ruggles and Richard Church (University of California, Santa Barbara), Robert Hasenstab (Rutgers University), Kathleen Allen (University of Pittsburgh), and Jay Johnson (University of Mississippi), and for the most part depended rather explicitly upon distance to resources. The "predictive modeling" bent (or language?) of only a few years ago has now been replaced largely with radii drawn around sites, and then modified with respect to "friction surfaces" calculated on the basis of energy expenditure. Thus, travel down a valley is calorically easier than travel up cliffs, and the explicit or implicit catchments around sites aren't circular, as they were in the 1970's, but shaped like amoebas draped upon the landscape.

Contributions by European archaeologists—as well as those about European studies given by North American archaeologists—were directed toward what one must assume to be political relationships among sites, indicated by connections between them such as roads and especially the ability for one to be seen, or not to be seen, from another. The recurrence of this last theme can be at least partially attributed to GIS terrain modeling capabilities, one of which is viewshed modeling; the theoretical basis behind such "visual archaeology" is intriguing to say the least—through perhaps no less explicable than "effort catchments."

Several notable papers deviated from these themes. Luke Della Bona and Linda Larcombe (Lakehead University, Ontario) used GIS to pinpoint areas where probable sites had never been searched for, and found them there; David Wheatley (Southampton) identified sediments where the settlements of "Wessex Man" should be found; and Frederick Cooper and Nancy Miller (University of Minnesota) used a single but apparently ideal Landsat TM (thematic mapper) scene and GPS (global positioning system) to structure several seasons of fieldwork in western Greece. James Farley and Anne Gisiger (University of Arkansas) advised that managing GIS databases was nothing to scoff at. Excellent and perceptive discussions were led by Mark Aldenderfer (University of California, Santa Barbara) and Stephen Shennan (Southampton).

The symposium was attended not only by the presenters, but a (to me) surprising number of other archaeologists. Many of these had come, I learned from talking with them, to "see how to do GIS." Some were students, many other were involved in private sector archaeological, CRM, and related work, and I can't help thinking that most were probably not very enlightened about how to "do" GIS. The most impressive of the presentations given at the symposium were made so chiefly because of their integration of digital remote sensing and high-end GIS, and their striking graphics—all of which currently require expensive software which only really runs efficiently on UNIX workstations. GIS and remote sensing packages are available for PC's, but have some serious limitations that make their practical use difficult. These packages are not cheap, either. Cost is relative, of course, but tell a CRM contract firm they're going to have to spend $40-$50,000 for a workstation and

GIS (continued on p. 7)

# News of Archaeometallurgy

## Meetings

The 1993 *Annual Conference of the Historical Metallurgy Society* has been set for the weekend of September 3-5 in Durham Castle in Durham, England. This is near the Scottish border and the focus of the meeting will be on the archaeometallurgy and historical metallurgy of northeast England. For information write Vannessa Fell at the Institute of Archaeology, 36 Beaumont Street, Oxford OX1 0NP, England.

The *International Symposium on the Catalan Forge* will be held soon after, on September 13-17 in Ripoll, Spain, just north of Barcelona. The local method of making bloomery iron in the Catalan Forge was a method that was followed elsewhere, including the United States. Museum and archaeological site visits are planned as part of the program. There will be sumultaneous translation of the papers, which will be given in Catalan, Spanish, French and English. For information and registration write Secretai General dei Simposi Estanislsu Tomàs i Morera, A.M.C.T., Via Laietana 39, 08003 Barcelona, Spain; telephone 93 319 23 00, fax 93 310 06 81.

The *Fourth Meeting of the Mining History Association* is announced for July 28 to August 1 in Deadwood/Lead, South Dakota. The Program Chair is James E. Fell, Department of History, Colby College, 312 Miller Library, Waterville, Maine 04901 USA.

The Mining History Association will host, along with the Colorado School of Mines, the *Third International Mining History Conference*, June 6-10, 1994 at the School's campus in Golden, Colorado. The last such conference was held in Bochum in 1989. Proposals for papers must be submitted before July 1, 1993 to the Mining History Association, P.O. Box 150300, Denver, Colorado 80215, USA.

Professor Emma Angelini of the Polytechnic in Turin writes that a meeting on archaeomaterials is being organized by the AIM, the Italian Association of Metallurgists. It will be held on the island of Elba and is planned for May 1994.

*Smelt 1994* is being planned for late May and early June in 1994, with a four-day conference scheduled between two six-day smelting sequences. Like *Smelt 1991* the focus will be on the replication of smelting in shaft furnaces of traditional design. For further information write Carl Blair, Coordinator, Smelt 1994, 215 Ford Hall, 224 Church Street S.E., Minneapolis MN 55455 USA.

There is some discussion that the site of a future meeting of the Comité pour la Sidérurgie ancienne of the International Union of Pre- and Protohistoric Sciences will be Kierspe in Westphalia, Germany.

The *Third International Conference on the Beginning of the Use of Metals and Alloys* (BUMA-3) will be dedicated to the memory of Professor Cyril Stanley Smith. It is scheduled for April 13-18, 1994, and will take place in the city of Sanmenxia in China. The program will include, in addition to oral and poster presentations, museum and site visits. The conference fee will be about US $200, and the official language will be English. Three post-conference tours are being planned, to Xian, Guilin and Gangzhou; to Zhengzhou, Dengfeng and Beijing; and to Houma, Taiyuan, Datong, and Beijing. To receive the second circular with specific information on the program, submission of papers, registration, accommodation and tours, write without delay to the Conference Secretariat, Professor Han Rubin, Institute of Historical Metallurgy, University of Science and Technology Beijing, Beijing 100 083, China.

## Courses

David Scott of the J. Paul Getty Museum will be teaching Metallography of Ancient Metals at the Institute of Archaeology, University College, London July 26-30, 1993. This is an introductory course in the methods and techniques of metallography as well as affording the opportunity to examine archaeological material. The fee is £375 or US $675 and the number of participants is limited to ten. To enroll write James Black, Coordinator, Summer Schools, 31-34 Gordon Square, London WC1H OPY England; telephone 071 387 9651, fax 0745 813484.

Jack Ogden will be teaching his course on ancient goldwork at the Indiana University Art Museum October 18-22, 1993. It will cover the raw materials, sources and uses of gemstones, decorative techniques, modern analytical techniques and the identification and examination of forgeries. The fee is £285 or US $500 and the course is limited to twenty participants. To enroll write the US contact for IAP (International Academic Projects) Summer Schools, John Masemen, 3400 Spring Street, Pompano Beach FL 33062 USA; telephone (305)-785-7512, fax (315) 941-6690.

## Publications

Volume 267 in the Materials Research Society (MRS) Symposium Proceedings Series has just been published. It is *Materials Issues in Art and Archaeology III*, edited by Pamela B. Vandiver, James R. Druzik, George Segan Wheeler and Ian C. Freestone. It is the proceedings of the 1992 symposium and contains 84 papers on recent work in ancient materials and their analysis and conservation. It runs to 1097 pages and can be ordered (ISBN 1-55899-162-

X, MRS code 267-J) for US $62 ($54 for MRS members, $70 foreign) from MRS Publications Department, 9800 McKnight Road, Pittsburgh PA 15327; telephone 412-367-3012, fax 412-367-4373. They accept Visa, MasterCard, Diners Club and American Express. In Europe, Africa and the Middle East orders may be sent to Clarke Associates-Europe Limited, 13a Small Street, Bristol BS1 1DE, United Kingdom; telephone 0272 268864, fax 0272 226437. Earlier volumes in this series are available at discount. *Materials Issues in Art and Archaeology I*, edited by E.V. Sayre, P. Vandiver, J. Druzik and C. Stevenson, MRS Volume 123 (ISBN 0-931837-93-6, MRS code 123-J) and *Materials Issues in Art and Archaeology II*, edited by P. Vandiver, J. Druzik, and G.S. Wheeler, MRS volume 185 (ISBN 1-55899-074-7, MRS code 185 J) are each now $30, $25 for MRS members, and $35 foreign. The fourth symposium in the Materials Issues in Art and Archaeology series is scheduled for the MRS Spring Meeting in April 1994 in San Francisco.

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.* □

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**Plenum** **(continued from p. 1)**

From the beginning, the General Editors wished to rely on two sources in the development of volumes for the AAMS series. The first source is volumes in which topics and coverage are proposed and defined by a proposal received from a potential editor or editors, which is initially reviewed by the General Editors, and then reviewed in more detail by one or more of the Consulting Editors. The second source is volumes whose topics and coverage are developed as port of an overall plan developed by the General and Consulting Editors. It should be noted that there is no difference between these two types of AAMS volumes with regard to the degree of attention to detail in the review process. Likewise, there is no distinction by any indication in the text of the volumes. The only difference is the mechanism by which the topic and organization of a volume is initially proposed.

The first published volume in the AAMS series, Phy*tolith Systematics: Emerging Issues*, edited by George Rapp, Jr. and Susan C. Mulholland, along with the second volume, *Science and Technology in Historic Preservation*, now under development under the editorship of Ray Williamson, are examples volumes whose topics were proposed by their respective book editor(s). The General Editors of the AAMS are moving forward with plans to develop an overall framework for a series of coordinated volumes that will provide a comprehensive updating of the interaction between natural science-based investigations and archaeology. The General Editors are initiating a planning process to first set out the general topics typically associated with archaeometry, archaeological science, and the other areas of focus for our series, then devise provisional working volume titles for books addressing these topics, and finally provide suggestions for the basic structure of the divisions within each volume. With these provisional titles and a proposed structure in hand, the General Editors and Consulting Editors will determine the order in which various volumes might then be developed and, as the final step, who might be invited to serve as volume editor(s).

There has been already developed a consensus as to the category of "dating methods" for one of these volumes. To provide a concrete stimulus for the initiation of a project to develop a comprehensive list of provisional book titles/topics for the invited volumes in the series, Martin Aitken and R. E. Taylor are currently moving forward with the planning process for a volume with a working title of *Chronometric and Allied Dating in Archaeology*. It should be emphasized and understood that this, as any book proposed in the series, will be handled as all other proposals are being evaluated. Once a list of chapter authors has been finalized, the topic of the proposed volume will be submitted for preliminary, independent, assessment by one or more of the Contributing Editors. If the assessment is positive, and the project moves forward, the completed book manuscript will be subject to a full and detailed review. In the case of the dating volume, the General Editor will be Edward Sayre. We should also emphasize that the series will continue to encourage the submission of proposals for contributed volumes as exemplified in our first two books in the series.

Below is the *first draft* of the topics (not titles) of a suggested series of seven volumes to provide the comprehensive updating of Brothwell and Higgs. Some discussion concerning this draft has already occurred at the annual meeting and on SAS-Net. We welcome further discussion.

*Advances in Archaeological and Museum Science - The Interaction Between Natural Science-Based Investigations and Archaeology;* Plenum Press in Association with the Society for Archaeological Sciences

**Volumes topics proposed**

Bioarchaeology/Zooarchaeology
Chemical and Materials Analysis: Inorganic
Chemical and Materials Analysis: Organic
Chronometrics
Data Analysis, Mathematical and Statistical Modeling
Geoarchaeology
Remote Sensing

*R. E. Taylor, General Secretary, Society for Archaeological Sciences* □

# Opinion

## Government Funding, Science, and the Public
## Philip Morrison, MIT

At a recent meeting in Cambridge, Massachusetts, Professor Philip Morrison of the Massachusetts Institute of Technology spoke eloquently of the changing relationships between government funding, science, and the public. His comments were focused specifically on the position of archaeology in this shifting situations; his words are reprinted here with his permission as some thoughts for your day.

"A kind of social contract has governed the intimate relationship between university research and the Federal government since World War II, embodied in NSF [National Science Foundation], NIH [National Institute of Health], DoE [Department of Energy] and for much of the time DoD [Department of Defense] as well, after the early start with ONR [Office of Naval Research]. The formal charter of this unprecedented scale of support was the famous paper of Vannevar Bush, *The Endless Frontier*, in which he spelled out the notion that basic research was a cheap way to unending benefits for the country.

"But the guard is changing. The first president since World War II who cannot recall that war is in office. Two great changes have come. Behind the remarks of Vannevar Bush was the clear experience of World War II itself, the remarkable effects on fighting the war that came from radar and the atomic bomb, both initially mainly the products of university science. Now the Cold War seems over, and the military demand – supported by the Congress of course out of a desire to take no risks – is in strong decline. American superiority in civil technology, facilely ascribed to our research leadership, is no longer an article of faith. This is plain in the press, the academy, and the Congress.

"What can replace those goals for research support? It seems likely that one path will be followed - the linking of research to profitable industry. 'Accountability' will take over from Vannevar Bush's implicit confidence in basic research. It is, however, by no means clear how much that will preserve basic research support at the university level.

"There is one more path – basic research in the natural sciences will need to become more prized and better understood by students, parents, press, and Congress. I expect that one of the best ways will be to engage more nonscience students in the sciences; links between humanities and natural sciences will be more and more sought, studied and examined. Archeology is surely a major example of that linkage, along with astronomy and cosmology, so close to the old existential questions of all thinking humans. Other sciences can play a role – physics is an expensive kind of philosophy – but more likely they will be judged by criteria closer to market success.

"This is the time to extend the physical sciences and engineering into problem domains closer to the central interests of the non-scientific, to the light they increasingly throw on human nature and destiny. I believe this will become apparent to all in academic life within the next five years, visible in the cold terms of outside dollars. Practical results, fine; but otherwise become relevant and interesting to a wider audience."

*Contributed by T. Douglas Price, Laboratory for Archaeological Chemistry, University of Wisconsin-Madison, Madison, WI 53706, USA* □

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## Reply to Rapp

This comment is in response to the remarks of George (Rip) Rapp, Jr. printed in Vol. 15, #4 of the *SAS Bulletin*. At the risk of sounding petulant or worse, ungrateful, I differ with Rapp regarding the functional relationship between archeology and archaeometry, and in the implications for the education of the archeologists in the future. As I understand his position, Rapp sees archaeometry as real science and archeology-without-a-hyphen (as in Geo-archeology, zoo-archeology, etc.) as not yet science. Let us get clear on what the word archaeometry means: archaeo = old, metry = measurement. The simple meaning of this morphemic combination is that archaeometrists *measure* that which is *old*. It says nothing about *why* one is measuring that which is old. Without the "why" context, measurement is merely description, and description by itself, like measurement by itself, is not science. It is a truism that one cannot have science without measurement but one can have measurement without science. In order for archaeometry to become scientific in the sense of explaining the phenomena of interest, it needs to be applied toward an explanatory end. This is what is meant by seeking the relevant facts, some of which archaeometry uniquely can provide. Another contribution of archaeometry to archaeology is in supplying observations which can function as clues in the formulation of an archeological hypothesis, just as observations from a variety of other sources (including staring out the window or into the fire) sometimes trigger the "aha! experience."

There is no doubt that archaeometrists work under strict scientific standards of accuracy and replicability, but the

problems of archaeometry are different from the problems of archeology. Archeology is the scientific study (i.e., explanation) of that which is old; more specifically *it is the science of the behavior of the physical remains of past cultural systems*, i.e., assemblages of objects that no longer participate in a dynamic cultural system. This means that while their problems are not the same, the subject matter of archaeology and archaeometry do overlap, and recently this overlap has resulted in extremely interesting results. But it does not mean that in order for an archaeological problem or project to be scientific it has to involve archaeologists with a qualifier in front of their title. If it is granted that archaeology-without-a-hyphen is a science, then it follows that archaeologists use the same "method" as any other scientists, hypothesis-testing against empirical observations.

While Rapp claims that archaeology is "a multidisciplinary amalgam requiring concepts and methodologies from a host of separate disciplines such as anthropology, ecology, geology, geography, art history, economics, and osteology," he also should not deny that *archaeological theory* is built up just as it is in any other science, from successful explanations of the facts of the archaeological records, i.e., scientifically acceptable accounts for observations on the behavior of the material remains of the past cultural systems. In formulating their hypotheses to accounts for these facts, archaeologists link their understanding of the organization and functioning of cultural systems with their understanding of the formations processes of the archaeological record. The linkage is accomplished uniquely by the *invention of archaeological theory*, not from the wholesale or piecemeal borrowing of theories and methodologies from other disciplines although the findings of other disciplines may be invoked during the linkage through arguments of relevance.

Improving the education of archaeologists to include a greater awareness of the potentially valuable contributions of archaeometry is indisputably necessary. But it has been my experience and that of many of my archaeological colleagues that more productive inter-disciplinary collaborations will ensue once our colleagues in other disciplines understand that archaeology is a science in its own right and not just an amalgam of ideas and techniques which we are slowly acquiring through specialized training and collaboration. Crossing disciplinary boundaries is easy when only techniques are involved; it is especially rare when one kind of scientist can share in the problem-solving game of another. For this to happen, better education of non-archaeological scientists as to the goals of archaeology is as much in order as the reverse.

*Rosalind L. Hunter Anderson, Vice President/Senior Archaeologist, Micronesian Archaeological Research Services, PO Box 22303, GMF, Guam 96921; tel 671-734-1129; fax 671-734-1132* □

# Position

**Contract Research**
Department of Anthropology, University of Auckland

A contract researcher is required to conduct research into the development of an Obsidian Hydration Laboratory at the University of Auckland. The researcher will be required to carry out basic research to determine experimental hydration rates, assist in the recovery of information on effective hydration temperatures, and develop hydration band measurement methodology using computer-assisted image analysis. Available facilities include PIXE/PIGME elemental characterization, a research grade Optiphot Nikon petrographic microscope with filar screw, a computer image analysis system and standard thin section preparation equipment.

The successful applicant should have extensive experience in OHD with preference given to those with background in experimental determination of hydration rates.

This research will begin prior to November 1993 and run in the first instance for 9 months, with a further 3 months depending on funding. The salary will be $NZ 28,125 for 9 months with an additional $NZ 2000 for return airfare.

Candidates should send applications with CV's to: Dr. Peter J. Sheppard, Department of Anthropology, University of Auckland, Private Bag 92019, Auckland, New Zealand; fax 64-9-373-7441; email PJS@ANTNOV1.aukuni.ac.nz . □

**GIS** **(continued from p. 3)**

software, $5-6,000 a year for users' fees and maintenance, or even $10-15,000 for a dedicated 486 and software, and they begin to balk.

The software cost and platform situation may well change in the near future, perhaps in the next three to five years, but this is a relative eternity in the digital world. A few archaeologists (mostly at academic institutions, many of which have gotten "deals" on hardware and software) are fortunate enough to have their own operational, "in-house" GIS capabilities, but, for the time being at least, most archaeologists, particularly in the private sector, probably really don't want to "do their own GIS," but rather to find someone to do this now-necessary adjunct to archaeology for them.

Conspicuously absent at the symposium were government archaeologists, another important category of GIS users and aspiring users within the profession.

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

# SAS Cumulative Index
## Volumes 4-15

*Karen L. Pletka, Department of Social Sciences, Michigan Technological University, 1400 Townsend Drive, Houghton, MI 49931-1295, USA; tel 906-487-2113.*

**CONTRIBUTORS**

**LAB FACILITIES AND CENTERS**

□

*Our earliest volumes 1-3 will be added to the Cumulative Index this fall. An electronic database of this index is currently being compiled on FoxBase+/Mac by Jody Dalton, and will also be available in the fall.*

*The Editor*

## SBAC Newsletter

After a hiatus of two years, *The Science-Based Archaeology Newsletter* has resumed publication. This newsletter of the Science and Engineering Research Council in the United Kingdom is an excellent publication concerning archaeological science in the United Kingdom, including news on publications, meetings, initiatives, and funding. The *Newsletter* is free of charge, and can be obtained by writing to: SBAC Secretariat, SERC, Polaris House, North Star Avenue, Swindon SN2, 1ET, United Kingdom, or to the new co-ordinator of the *Newsletter*: Sebastian Payne, Ancient Monuments Laboratory, English Heritage, 23 Savile Row, London, W1X 1AB, United Kingdom; tel 071-973-3378, fax 071-973-3001. □

# Book Reviews

## Archaeological Typology and Practical Reality: A Dialectical Approach to Artifact Classification and Sorting.

William Y. Adams & Ernest W. Adams. Cambridge University Press, 1991, 427 pp., 11 figures, 10 tables, 2 prefaces, 4 appendices, references, index. $64.50 (hardbound). ISBN 0-521-39334-5.

*Reviewed by Robert W. Preucel, Department of Anthropology, Peabody Museum, Harvard University*

How do humans classify their world? Is there a "fact of the matter" upon which we can ground our classificatory statements? Are all types created equal? These are just a few of the weighty issues raised in this remarkable book resulting from the collaboration between an archaeologist and a philosopher who also happen to be brothers. William Adams, the archaeologist, has conducted extensive fieldwork in the American Southwest and Nubia and is a ceramic specialist. His brother Ernest Adams, the philosopher, is particularly interested in mathematical information theory and numerical measurement systems. Together they have written the most comprehensive overview of typology and classification since Robert Dunnell published his *Systematics in Prehistory* over twenty years ago.

In their introduction the Adamses describe how this unusual project came about. On one summer afternoon in 1983 while hiking in the mountains of California, they began to discuss scientific typologies and came to the startling conclusion that they shared closely similar views, albeit from different perspectives. Both regard the concept of types as a complex conceptual issue and agree that different typologies need to be created to serve different purposes. William reaches this plateau after a direct assault on the classification of numerous ceramic assemblages while Ernest arrives via an epistemological route after crossing the logical positivism of Rudolf Carnap, Carl Hempel and Karl Popper and negotiating the historicist critique of science associated with Thomas Kuhn.

The volume is organized into four major sections. The first of these (Chapters 3-8) deals with the nature of types and typologies. Significantly, the Adamses view cognition at the core of typological enterprise. Following the lead of the linguist George Lakoff they admit "no sharp distinction between scientific thinking and other kinds of thinking." They then go on to show that scientific classifications are no different in principle from vernacular ones. What *is* different, they claim, is how and why these classifications are put into practice. For types to be considered scientific they must be precisely described, serve some scientific purpose, and be evaluated in terms of their success in achieving those purposes. This redefinition unfortunately begs the non-trivial question of just what differentiates scientific purposes from non-scientific ones.

The second section (Chapters 9-12) is devoted to "typology in action," a case study involving the analysis of Medieval Nubian ceramics. From 1959 to 1970 William Adams was part of the UNESCO archaeological salvage project excavating sites in Sudanese Nubia threatened by the construction of the Aswan High Dam. He relates how his original classification scheme developed from an emphasis upon temporally significant varieties to eventually encompass vessel form and decoration relevant to economic and stylistic questions. Subsequent modifications included defining pottery families, ceramics with similar fabric and construction techniques produced by the same people over a long period of time. The significance of this section is that it clearly shows just how types can evolve in accord with the changing needs of a research program, a point often lost on dogmatic typologists. Adams writes that although his early attempts at classification were identified as provisional, "inevitably some colleagues treated it as received wisdom, and some of them have faulted me for subsequently altering it" (p. 105).

*"the most comprehensive overview of typology and classification since Robert Dunnell published his Systematics in Prehistory over twenty years ago. ... Refreshingly iconoclastic and highly personal, this book is a welcome contribution to archaeological method and theory."*

The third section (Chapters 13-21) discusses the pragmatics of archaeological typology. Especially valuable is their discussion of the goals of typologies that distinguishes three *basic* purposes (descriptive, comparative, analytical), two *instrumental* purposes (ancillary, incidental) and several *multiple* purposes (combinations of basic and instrumental). According to them, the latter are perhaps the most common as there are very few typologies that serve only one purpose. They advocate taxonomic classification as the most effective way of dealing with multiple agendas. In the Medieval Nubian example, the family level is used to express spatial relationships, the ware group level to express chronological relationships, and the ware level to date sites and deposits (the initial reason for constructing the typology). Central to this

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classification is the necessity of having a clearly defined scale of goals. Thus while all of the Nubian types are useful for dating only some are appropriate for morphological or historical problems.

The fourth and final section (Chapters 22-26) addresses different aspects of the "typological debate" covering the period from the mid 20th century to the rise of the new archaeology. One recurring theme is whether types are natural (inherent in nature) or artificial (human constructs). They show that this debate grew out of the acknowledged successes of the classificatory phase when archaeologists began to move beyond space-time systematics to ask new questions of their data, and that it has recently taken a dangerous theoretical turn distancing itself from the "experiences and perspectives" of practicing field archaeologists. The Adamses enter into the debate by attempting to chart a course between foundationalism and relativism that privileges pragmatics. But in raising (correctly) the view that all types are both natural and artificial, they don't go far enough in exploring the consequences of this position for both theory and practice (for a discussion of this see Hilary Putnam, Richard Rorty, Richard Bernstein, and Harold Brown).

Refreshingly iconoclastic and highly personal, this book is a welcome contribution to archaeological method and theory. Among its greatest virtues are that it engages difficult conceptual issues by drawing on related fields such as cognitive science, experimental psychology, information theory and the new systematics of biology while at the same time being eminently readable. This being said, there are several issues which I feel are not given adequate attention. Foremost among these is how the practice of classification impinges upon theories of cognition (see *Women, Fire, and Dangerous Things: What our Categories Reveal about the Mind* by George Lakoff, University of Chicago Press, 1987). Also missing is a discussion of the role of classification and the "linguistic turn" embodied in poststructuralism. These lacunae notwithstanding, I highly recommend this book to all natural and social scientists interested in classification. □

### *Coming Book Reviews*

*Early Animal Domestication and its Cultural Context*

*Animal Use and Culture Change*

*Organic Contents of Ancient Vessels*

*A History of Metallurgy, 2nd Edition*

*Recent Trends in Archaeometallurgical Research*

*Metals in Society: Theory beyond Analysis*

*Radiocarbon After Four Decades*

*An Investigation of Image Processing Techniques at Pincevent Habitation No. 1*

## Ceramic Production and Distribution: An Integrated Approach.

George J. Bey III and Christopher A. Pool (eds.). Westview Press, Boulder and Oxford, Westview Special Studies in Archaeological Research, 1992, viii + 342 pp., 66 figures, 27 tables, acknowledgments, list of contributors, references. $65 (cloth). ISBN 0-8133-7920-2.

*Reviewed by Charles C. Kolb, Division of Preservation and Access, National Endowment for the Humanities.*

The genesis for this volume came from the editors' informal discussions held from 1987-1989 at Tulane University where Bey was a research fellow at the Middle American Research Institute and Pool was a graduate student. Bey completed his dissertation, *A Regional Analysis of Toltec Ceramics: Tula, Hidalgo, Mexico*, in 1987, while Pool finished his, *Ceramic Production, Distribution, and Resource Procurement in Matacapan, Veracruz, Mexico*, in 1990. Their educational backgrounds and orientation to ceramic materials and Mesoamerica helped to shape both the concept and organization of this work. The editors view the manufacture and dispersal of pottery vessels as dynamic, interactive, and interdependent subsystems.

This informative and provocative volume contains ten invited case studies prepared by 18 authors, an elucidating "Introduction" by Bey and a final chapter by Pool; entitled "Integrating Ceramic Production and Diversity." In the initial essay, Bey provides a review of the literature, an overview of ceramic production and distribution models (those of Matson, Kolb, Rice, and van der Leeuw, among others), a content summary of the ten succeeding chapters, and an analysis of "points of interaction." In the latter Bey compares and contrasts production and modes of distribution; the effects of consumer demand; the complex interrelationships between producers and distributors; and the effects of cultural seasonality on production. He also considers firing errors, ceramic recycling, and wasters. This insightful introductory essay sets the stage for Part One, "Contemporary Perspective," consisting of four chapters on present-day manufacture and distribution related as ethnoarchaeological studies or ethnographic analyses. Six chapters in Part Two, "Ancient

Reconstructions," provide archaeological examples ranging from tribal societies to archaic states.

Paul Nicholson and Helen Patterson discuss some results of an ethnoarchaeological study in Upper Egypt, the Ballas Pottery Project, which focuses upon the pottery-making village of Deir el-Gharbi located on the Nile west bank 628 km south of Cairo and about 40 km north of Luxor. Amphora-like "Ballas jars" for carrying and short-term storage of water are the only vessel forms manufactured and are shaped from a superior white-firing marl clay obtained from a local source exploited since at least ca. 3600 B.C. The stages of vessel production (mining, clay processing, kick-wheel forming of vessels, and kiln firing – using sorghum/millet waste as fuel) are related. Buller Rings (devices which are indicators of "heat work done") and thermocouples provide evidence that internal kiln temperatures reached a maximum of 855 °C after 175 minutes but that the position of vessels in the kiln had a major effect on fabric color, because of temperature variations of 100-150 °C between different parts of the kiln. The authors also report that kilns are usually demolished and completely rebuilt or re-sited every five to ten years. Contemporary pottery distribution relies upon middlemen who may be small traders or large-scale distributors using lorries to move the vessels to market; river transport is no longer employed. This specialized jar-producing Ballas industry conforms to Peacock's (1982) paradigm of a "nucleated rural pottery industry" but differs from Egyptian siltware industries in which numerous vessel forms are made, corresponding to his "individual workshop industry" model.

*"This informative, well-designed, and provocative volume offers Old and New World archaeologists both an introduction and an advanced orientation to the methods and theoretical underpinnings of the study of pottery economics in contemporary and ancient societies by focusing upon ceramic production and distribution as interrelated processes."*

The organization of production and mechanisms of distribution in three *altiplano* (highland) Peruvian pottery-making communities (Raqch'i, Machaqmarka, and Q'ea) situated in the region of the Department of Cuzco, and interactions with the northern Lake Titicaca Basin in the Department of Puno are related by Karen L. Mohr Chavez. Male and female potters from the three villages utilize local clays and tempers obtained from common sources to make a total of 15 vessel forms, although there is communal specialization. Chavez reports that by 1982 the potters' sexual division of labor began to change as demand for tourist market products increased. The seasonality of production and its relationship to internal distribution, the significance of distribution at annual Catholic festivals held outside the communities and at distant Sunday markets in the *altiplano* are detailed. She cogently argues that village pottery specialization results in a horizontal dependency with a given ecozone and vertical interdependency between ecozones because both potters and non-potters need ceramic and/or agricultural produce from other ecozones. Cooperation and interdependency are seen as occurring at household, village, and regional levels. In her excellent conclusion, ethnographic and historic data are related to the archaeological record and Chavez suggests relationships between village specialization, production and consumption, and the importance of annual regional fairs tied to religious festivals.

Dean E. Arnold and Alvaro Nieves examine factors affecting the concept of ceramic standardization, by using ethnographic data from Ticul, Yucatán, Mexico. They believe analysis requires four basic assumptions, namely, that standardization: (1) implies comparison with other ceramic assemblages; (2) requires a diachronic analytical approach; (3) is a process best understood as a continuum rather than a single event; and (4) ideally refers to the same tradition and products of the same population through time. Qualitative data on 449 vessels (three shapes made by three techniques) are used to calculate means and standard deviations of shapes and techniques, while sample sizes are evaluated by calculating coefficients of variance. The authors' preliminary findings suggest that three factors responsible for variability in ceramic production include manufacturing techniques, artisans' views of variability (e.g. vessel dimensions), and intended market. They also conclude that the coefficient of variation should be replaced by more standard methods in order that comparisons of vessels can be assessed by levels of significance.

Ezra Zubrow utilized cross-cultural data derived from the Human Relations Area Files to develop a mathematical paradigm about cognitive decision-making in ceramic manufacture. In this essay he is not concerned with the distribution of production but seeks simple formal modeling to better understand production behavior. Following a review of economic production theory he selects for analysis 60 ethnographic societies which have appropriate data on fabrication techniques. Unfortunately, no list is provided and his method of selection is unspecific. He also develops production scenarios derived from Dean Arnold's *Ceramic Theory and Cultural Process* (Cambridge University Press, 1985) about the number of days village potters require to produce varying numbers of vessels by coil, paddle and anvil, mold, and wheel techniques. Zubrow also examines the amount of time needed to produce varying numbers of vessels using different manufacturing techniques. He concludes that alternate production strategies for ceramic manufacture can be modeled using formal theory and believes that linear algebra provides a good method for understanding the interaction among different potters in different villages using the same and different techniques.

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The study of household-level Iroquoian ceramic production by Kathleen Allen employs archaeological and ethnohistoric data from six sites dated to ca. A.D. 1550-1630 and located in the Niagara Frontier region of western New York. She also uses Iroquoian ethnographic data and applies the coefficient of variance to the six ceramic assemblages, concluding that women were the primary producers and were nonspecialists. However, Allen could not determine if the women made vessels only for their own families, the household unit (i.e. the longhouse), and/or the matrilineage, or two or more of these groups.

Eric Blinman and C. Dean Wilson analyze ceramic production and exchange in the northern San Juan (Mesa Verde) region of the American Southwest, occupied by Anasazi peoples from A.D. 500-900. Production technology, organization, resource availability, pottery distributions, and specialized production of grey, white, and red wares from twenty sites are examined, and the role of regional exchange elucidated. They estimate that an Anasazi household needed to replace six vessels per annum, most of which were greyware cooking pots, and contend that scraping procedures in pottery manufacture became standardized but that there is no direct evidence of kilns, although vitrified sherd frequencies increased through time. Little is known about whiteware production during the A.D. 600-900 period but a "patchwork of sources" across the region is suggested, and this production was influenced by redware production which was regionally specialized and peaked around A.D. 800, at which time a region-wide disintegration of population aggregates began.

Pottery production in the Gulf Coast riverine region of La Mixtequilla, located in south-central Veracruz, Mexico, is characterized by Barbara Stark. The region was continually inhabited from at least the Early Preclassic period (1500-900 B.C.) through the Classic (A.D. 300-900) and Postclassic into colonial and historic times. Although a full-coverage regional survey was undertaken, the direct evidence of ceramic production is "spotty and scant" and consists of twelve "indicators" (deformed wasters, figurine molds, kiln fragments, raw clay lumps, etc.) in 39 of 563 collections. A spatial analysis was conducted which examined production indicators and pottery types and densities. No clear evidence of production could be discerned for the Preclassic, but for the Classic and Postclassic, she suggests that "some households supplemented their livelihood by specialized pottery production," tempered by competing manufacturers and a dispersed population. Production is apparently not as concentrated or intensive as at the Comoapan pottery-making center located near Matacapan but was less intensive than in the specialized communities in the Valley of Oaxaca referred to in the following Mesoamerican examples.

In a companion chapter, Chris Pool and Robert Santley describe the Middle Classic period (A.D. 300-800) and pottery economics at the site of Matacapan located in the Tuxtla Mountains, southern Veracruz. The site was established by Teotihuacan merchants from the central highlands and is an important regional center retaining strong ties to Teotihuacan, notably in architecture, ceramics, figurines, and other artifacts. The authors utilize the concept of ceramic ecology and integrate geological, chemical, and archaeological data to reconstruct aspects of resource procurement, manufacture, and distribution of Fine Orange ware. X-ray fluorescence spectrometry was conducted on 128 clay samples and 185 sherds. Manufacturing evidence, seen as wasters, kiln materials, and high densities of ceramics, suggests the small-scale production of Fine Orange throughout the Middle Classic, whereas Coarse Orange was produced in nucleated industries or manufactories. Fine Orange producers exploited nearby clay outcrops of the Concepción Formation. In Comoapan, a four-hectare area located south of the Matacapan ceremonial center, 36 kilns and ceramic dumps were located. Pool and Santley contend that each Middle Classic site in the Tuxtla region could have operated as the center of a local production-distribution system which exploited nearby clay resources and rarely engaged in the exchange of Fine Orange pottery with neighboring systems in the region.

Spatial variation in the scale of ceramic production of G3M, a reduced-fired utilitarian greyware (*ollas* and several bowl forms) made during the Monte Alban V phase (A.D. 900-1520) in the Valley of Oaxaca, Mexico is reported by Gary Feinman, Stephen Kowalewski, Sherman Banker, and Linda Nicholas. Three important centers are socio-politically associated with semi-autonomous polities or petty kingdoms, and seven of 16 Monte Alban V production locations are located in the Tlacolula (eastern) subregion. Utilizing thin-section petrographic analysis on 88 sherds, a thermal expansion experiment on 42 specimens, and the distribution of G3M vessel forms in 1,459 ceramic collections, 18 "paste groups" were discerned and verified using SEM and an EDS analyzer. The authors determine that the more commercialized potters from Tlacolula dominated locally and then penetrated the western subregion. They suggest a greater standardization in past recipes and in higher firing temperatures (620-850 ± 25 °C) – implying kilns, and an enhanced scale of production and transport efficiency. The authors conclude that economic considerations have a larger explanatory role than ethnicity in the observed patterns.

Elizabeth Will, known for her extensive research and publication on Roman amphoras, summarizes the production, distribution, and disposal of these large shipping containers originally designed for bulk quantities of wine, olive oil, *garum* (fish sauce), and other perishables. Amphora production covered eight centuries (3rd century B.C. to 5th century A.D.) and vessels are distributed at sites from Britain to India. Containers were usually produced in close proximity to sea or river ports, e.g. Brindisi, Cosa, and Pompeii. Until the end of the first century B.C., production and distribution of these containers and the products shipped in them were in the hands of private individuals, probably in part under state supervision. Manufacturing trademarks, factories and kiln sites, state controls, the role of the influential and entrepreneurial Sestii family of Cosa, the olive oil industry of Baeticia (a Roman province in southern Spain), the Monte Testaccio amphora dump on Aventine Hill, and the African amphora industry of the late Empire are briefly related. The distribution and disposal of amphoras was seen as a "balanced process" with provisions made at the port of importation for the reuse of these massive jars, which, empty, average 40 pounds. Disposal was the ultimate stage of distribution and included reuse as storage containers, building material (crushed for brickmaking, employed as rubble cores for walls and piers), coffins, grave decorations, coolers and ovens, and military missiles (when filled with poisonous snakes or burning pitch).

The volume concludes with Pool's thoughtful essay integrating conceptual frameworks and the contributors' writing in a reconsideration of parameters of production, consumption and variation, "points of interaction," manufacturing loci, assemblage variability, and spatial organization of production and exchange. He sees a need for inferential frameworks and sampling strategies capable of recognizing small-scale production, e.g. households. Ceramic studies, Pool observes, benefit from inter-disciplinary cooperation and that the spatial organization of production and consumption is a "fertile and indispensable area for investigation." Lastly, he notes that ceramic variability is still incompletely understood and that formal economic paradigms are useful for developing predictive models.

In reviewing these essays, I believe that there are several under-discussed variables, among them the construction, maintenance, and use of pottery firing loci, especially kilns, and the relationships between firing areas to fuel types, sources, and supplies. Several contributors might wish to review Matson's article, "Power and fuel resources in the ancient Near East" (*The Advance of Science* 23:146-163, 1966), a companion to his well-known ceramic ecology chapter in *Ceramics and Man* (Matson, ed., 1965). Dean Arnold's *Ceramic Theory and Cultural Process* (1985) also examines these parameters. A very useful concept, the distinction between "severely deformed" and "de facto" wasters, appears in Stark's contribution.

No single contribution thoroughly integrates all aspects of ceramic economics – an ideal difficult to achieve. The editors are to be congratulated for assembling these valuable case studies and for preparing superb introductory and concluding chapters. The illustrations are excellent, the 457 references useful, and the volume well edited and nearly error free; among the latter: producton (p. 129), ctivity (p. 818), speciali-zation (p. 184), ethno-graphically (p. 214), judgement (p. 217), relationsip (p. 283), analyis (p. 309), Univerisity (p. 318), and Greenwhich (p. 335). Because there are at least three different authors with the surname "Arnold" currently publishing about ceramic materials, the reference to "Arnold 1987" (p. 209) should be clarified as "Philip J. Arnold." Readers should be aware that the reference to D.E. Arnold's 1976 article, "Wanbind und Scherben-befund," (p. 45, 315) should *not* be attributed to Dean E. Arnold, who informs me he has never published in the German language. In Will's "Notes" (p. 274), two citations require author and year of publication designations in order to locate them in the references: Dressel 1891 and École française 1989. There are minor inconsistencies in the citations of the *British Archaeological Reports* (cf. Allen and Zubrow 1989, C.J. Arnold 1981, D.E. Arnold 1987), and a few errors have crept into the references (Feinman 1986: the publisher, JAI, is located in Greenwich, CT; Thwaites 1896: Burrows Brothers, rather than Borrows, published the *Jesuit Relations and Allied Documents*). A number of citations (e.g. Parker 1968, Pattray 1990) to chapters in larger works are without page numbers. Will's citation (p. 262) to Virginia Grace's work is not found among the references. Sigma Xi is The Scientific Research *Society*, not Association (p. 47). There are inconsistencies in the use of capital-ization, i.e. mesoamerica and prehispanic.

None of this detracts from the splendid contents of Bey and Pool's important book. This informative, well-designed, and provocative volume offers Old and New World archaeologists both an introduction and an advanced orientation to the methods and theoretical underpinnings of the study of pottery economics in contemporary and ancient societies by focusing upon ceramic production and distribution as interrelated processes. Every contribution is worthwhile reading, providing readers with clear methodological consider-ations, excellent examples, and relevant data. Despite its price (prepublication advertising indicated $40.00), the book is a significant resource on pottery economics for both Old and New World investigators and constitutes a valuable addition to the growing literature on ceramic analyses. It will join the important contributions in *Ceramic Ethnoarchaeology*, edited by William Longacre (Tucson: University of Arizona Press, 1991), and Philip J. Arnold III's excellent book, *Domestic Ceramic Production and Spatial Organization* (Cambridge University Press, 1992), in elucidating the complexities of pottery economics. □

# Book Reviews

**Recent Development in Ceramic Petrology.** Andrew Middleton & Ian Freestone (eds.). British Museum Occasional Paper 81. British Museum, London, 1991, vii + 410 pp., 25 b&w plates, 170 line drawings, tables. £17.50 (paper).

*Reviewed by Linda Ellis, Museum Studies Program, Department of Classics and Classical Archaeology, San Francisco State University.*

This publication is the result of a one-day seminar held at the British Museum in November 1987 and is a follow-up to a similar volume (British Museum Occasional Paper 32) published in 1982. This volume includes the majority of the papers which were presented at the seminar, together with an equal number of papers contributed by others who are actively involved in ceramic thin-section studies.

The goal of the editors was "to achieve a broad and representative coverage of the subject." Geographically, the 18 articles cover Europe (England, Ireland, Andorra, France, Germany, Spain, Italy), the Mediterranean (Cyprus), the Near East (Yemen), North Africa (Tunisia, Egypt), and the New World (Guatemala, Belize, Peru); and, chronologically, the ceramic materials range from the 7th millennium B.C. to the 16th century A.D. The papers presented include both "applied" and "methodological" studies. The articles are arranged alphabetically by author with a concluding paper by Freestone placed at the end.

Four contributions, which should attract most interest, dealt with methodology: N. Fieller and P. Nicholson ("Grain-Size Analysis of Archaeological Pottery; The Use of Statistical Models"); A. Matthew, A. Woods and C. Oliver ("Spots Before the Eyes: New Comparison Charts for Visual Percentage Estimation in Archaeological Material"); A. Middleton, M. Leese and M. Cowell ("Computer-assisted Approaches to the Grouping of Ceramic Fabrics"); and I. Whitbread ("Image and Data Processing in Ceramic Petrology").

Fieller and Nicholson describe the use of statistical models (specifically log skew Laplace distributions) in the analysis of grain-size data from petrographic analysis, using material from Egypt and Germany for illustrative purposes. For those researchers with a significant background in statistics, this article has much to offer. Matthew et al. have provided an extremely useful set of comparison charts which provide cheap, semi-quantitative estimation of mineral content in ceramics, wall plasters, and mortars. Also discussed are the psychological distortions of shape and size of particles under the microscope. Middleton et al. present a computer-assisted formula ("Gower's coefficient") for establishing initial ceramic fabric groups for large groups of material (Romano-British tiles illustrate the results). They advocate an "attribute analysis method" whereby all thin sections are surveyed for up to five attributes or features which may be useful in characterizing the fabrics. This method is recommended only as an initial, rapid sorting procedure "for self-contained projects involving a few sites" and not for large databases with very different ceramic types.

Whitbread's important paper, which unfortunately can only be briefly discussed here, describes with benefits and disadvantages the use of microcomputers in ceramic petrography and, in so doing, illuminates the issue of standardization of petrographic descriptions and vocabulary and the comparability of petrographic data for other researchers - perhaps a Pandora's box suitable for a future symposium! Still under development, Whitbread's system is useful for both qualitative and quantitative petrographic analysis and possesses three levels of sophistication: (1) computerization of petrographic information of individual samples as well as descriptions of fabric groups and archaeological and laboratory references, using dBASE III+; (2) computerization of grain-size and composition analysis with no direct interface with the microscope using the Grain Size Analysis program (GSA) written by the author; and 3) semi-automatic image analysis using a commercially available package IMAGAN2 with a video camera attached to the microscope. With this highest level of sophistication, an image of the thin section is displayed on the computer monitor and allows the researcher to study a much wider range of parameters for grain analysis (e.g. area, perimeter, maximum diameter, mean width).

Thirteen of the essays deal with the application of petrography, sometimes supplemented with chemical analysis, to the ceramic materials of specific geographic regions and chronological periods. These articles include: (1) provenance studies of ceramics through identification of clay sources or identification of the products of specific kilns (Betts, Gerrard and Gutiérrez, Mason, Morris, Williams and Arthur); (2) technological studies (Barnett, Ixer and Lunt, Jones); (3) integrated studies of technology and provenance (Peacock and Tomber, Sheridan); and (4) clarifaction of existing ceramic typologies or definition of fabric types (Allen, Echallier, Vaughan). Many authors also indicated that one of the main reasons for conducting petrographic analysis was that very little, if any, such work had been done on materials from the geographic area and chronological period under consideration.

The two papers on New World ceramics have been contributed by R. Ixer and S. Lunt ("The Petrography of Certain Pre-Spanish Pottery from Peru") and L. Jones ("Trends in Lowland Mayan Pottery"). The heartland of the

Inca Empire, in the Department of Cuzco, lacks technological studies of pottery types for the late pre-Spanish cultures, and the study by Ixer and Lunt is an initial petrographic analysis of ware types and clay sources. The excellent and well-written article by Jones focuses on petrographic analysis and temper identification of Mayan pottery from Guatemala and Belize. The sharp but justified and well-supported criticism of the "Type-Variety" system of ceramic classification in New World archaeology is a timely and pertinent discussion of how methodologies exert influence upon attitudes towards ceramic paste analysis.

The article by I. Betts ("Thin-section and Neutron Activation Analysis of Brick and Tile from York and Surrounding Sites") spans the Roman to the post-Medieval periods and focuses on the production and trade of bricks and tiles. Betts is to be commended for outlining his research questions immediately at the beginning of the article. The NAA, petrographic and archaeological data are also well integrated and clearly presented.

The articles by C. Allen ("Thin Sections of Bronze Age Pottery from the East Midlands of England") and E. Morris ("Ceramic Analysis and the Pottery from Potterne: a Summary") focus on Bronze Age ceramics from England and the latter article also covers the Early Iron Age. Both studies are the most problematic for this volume. Allen's essay is difficult to read because of excessive use of the passive voice and therefore could have benefitted from editing prior to submission. Morris' article deals extensively with excavation results and depositional history and would be better placed in an appropriate archaeological journal.

A. Sheridan's study ("Pottery Production in Neolithic and Early Bronze Age Ireland: A Petrological and Chemical Study") covers both issues of provenance and technology. Sheridan is sufficiently forthright to admit that the use of XRF to source clays yielded inconclusive results and issues a warning that XRF may not necessarily be a good method for sourcing of pottery manufactured for local consumption at the household or village level and that "the information gain from compositional analysis is not commensurate with the effort extended in its acquisition" (p. 323). She also reminds us that clay sources used in prehistory may have been exhausted, eroded away, or covered over.

The papers by J. Echallier and S. Vaughan both confronted issues relating to archaeological typology. Echallier ("Common and Pseud-Ionian Ware from Le Pegue (Drôme, France): An Analytical and Archaeological Problem") has indeed a dilemma - the petrographic data do not correspond to the archaeological typology which is based on local vs. imported ware groups. This interesting, "negative" case study clearly demonstrates that analytical studies such as petrography should not be undertaken with insufficient archaeological data nor be based on highly disputed typologies. Vaughan undertook her study ("Late Cypriot Base Ring Ware: Studies in Raw Materials and Technology") to clarify an old, widely accepted typological classification with inherent inconsistencies. Her successful and detailed results integrated archaeological data with petrographic, XRD, and SEM/microprobe analyses. Vaughan confronts an issue which is the nightmare of many provenance studies: the mixing of clays by potters. In addition to petrographic analysis of both clays and ceramics, Vaughan also produced fired test tiles made from a mixture of well-defined clay types. She found that "the closest petrographic parallels between samples of the ware and samples of fired clays are with the impure or artificially-mixed clays" (p. 366).

W. Barnett's paper ("The Identification of Clay Collection and Modification in Prehistoric Potting at the Early Neolithic site of Balma Margineda, Andorra") looks at the effect of clay modification (i.e. addition of tempers and mixing of clays) on provenance studies and explores the use of bivariate histograms for identification of such modifications. However, two questions raised by Barnett's work hopefully will receive more attention in the future: can temper be too much of an interference in sourcing of clays? What role does depositional variation within clay sources (and presumably sampling) have on the quality of data in provenance studies?

The contributions by C. Gerrard and A. Gutiérrez ("The Thin-Section Analysis and Macroscopic Characterization of Some Medieval and Post-Medieval Pottery from Northern Spain") and by D. Peacock and R. Tomber ("Roman Amphora Kilns in the Sahel of Tunisia: Petrographic Investigation of Kiln Material from a Sedimentary Environment"), while spatially and temporally distant, are both concerned with identifying the products of specific kiln sites. The research aims of Gerrard and Gutiérrez are clearly stated and include the investigation of intra-kiln and inter-kiln variation in ceramic petrography and ceramic production. They conclude with a final, but important, plea for the documentation of the few surviving traditional potting workshops in Europe so that ceramic petrographers may better recognize production techniques in ancient pottery. Peacock and Tomber conducted an archaeological survey in Tunisia to locate kilns producing Roman amphorae. Their petrographic analyses delineated the influence of geology vs. manufacturing technology in defining fabric types.

R. Mason's research ("Petrography of Islamic Ceramics") employs petrography to identify, classify, characterize and provenance Islamic ceramic types found in Yemen and derive from Yemeni kilns, as well as those Islamic wares from major ceramic production centers in Iraq, Egypt and Syria.

The article by D. Williams and P. Arthur ("Roman Amphora from Richborough 527: A Continuing Petrological Study") is a pleasant petrographic detective story about a particular type of amphora which may finally have found its origins in Italy.

# Book Reviews

The title of this volume, *Recent Developments in Ceramic Petrology*, is not as reflective of the content as the editors had desired. 'Recent development' may give the impressions that new instrumentation has become available, new procedures developed, or new methods have been adapted from other disciplines for ceramic studies. The contributions by Fieller and Nicholson, Matthew et al., Middleton et al., and Whitbread do indeed present such new techniques and methods. However, 13 studies in this volume are *applications* of well-established petrographic methodology to specific collections of ceramics, with conclusions and implications of importance to the cultural area and time period under discussion.

This content also raises another question: who is the intended audience? The immense geographical and temporal coverage offered by these studies goes beyond the interest of most archaeologists who will in all practicality only read one or two articles relevant to their area of specialty, if they are fortunate to discover - beyond the title - that there may even be articles of interest to them. Only those directly involved with petrographic analysis will read a substantial portion of this volume. Many of the articles in their present form would be better placed in regional archaeological journals and therefore reach a wider, more appropriate (and certainly appreciative!) audience.

Another problem resulting from this volume concerns terminology. There should have been a clarification and standardization of the use of the terms 'petrology' and 'petrography.' Some authors in this volume are indeed uncertain as to which term to use and resort to interchanging them as writing style dictates. On another level, there appears to be a preference for 'petrography' in North America and for 'petrology' in Great Britain and Ireland. However, what many researchers involved with ceramic analysis, and some authors in this volume, do not realize is that these are specialized and clearly defined terms which derive from the geological sciences. When incorporating methods from other disciplines into archaeology, archaeometry, or archaeological science, we must respect the scholarship of those scientific domains from whom we borrow. I fear that our colleagues in the geological sciences may be disturbed by careless use of their vocabulary.

Given the nature and evolution of ceramic analysis, 'petrography' is the more appropriate term for this volume. 'Petrology' is a branch of geology which is concerned with the origin, history, occurrence, and structure of rocks. 'Petrography' is the description and systematic classification of rocks and minerals with the use of a polarizing microscope. Some may feel that the use of 'petrology' is justified on the basis that a ceramic can be considered a 'stone.' However, we should keep in mind that ceramics are only partially composed of sedimentary rocks (clays), which may have been artificially levigated and mixed and artificially metamorphosed through firing. First and foremost, ceramics are products of technology, bringing together geological materials (clays and non-plastic inclusions), and in some cases organic materials (e.g. chaff, grain, shell), as well as the addition of slips, glazes, and a host of post-fire additions (e.g. graphite, colored minerals, fresco, asphalt), most of which would never be found together in nature, nor combined by nature. Whichever term one prefers, one way or another, the editors should have addressed the issue of terminology, if only to clarify for the reader their intent and reasoning.

Many of the articles - and Freestone's excellent concluding essay in particular - provide important insight into some theoretical and practical issues concerning ceramic petrography (e.g. the costs and benefits of certain types of analysis, the necessity for quantitative vs. qualitative analysis, the comparability of petrographic data). Unfortunately, these important issues are "buried" within the papers and their titles do not or cannot reflect the presence of such discussion. This volume could have been better developed to take full advantage of the participants' expertise and have them focus their papers more towards such issues, with the use of their own data to illustrate theoretical and methodological problems, rather than for them to spend valuable space explaining the archaeology of their respective materials. □

# Meeting Announcements

## International Symposium On Archaeometry

**First Announcement**

The 29th International Symposium on Archaeometry will be held at the Middle East Technical University, Ankara, May 9-14, 1994.

Symposium topics will include: the dating of organic and inorganic materials, ancient and historical technology (metals and nonmetals), artifacts, provenance studies, mathematical and statistical methods, prospection, and the study of human remains. The symposium will include a one-day theme session entitled "Science in Anatolian Archaeology." In this session invited speakers will present reviews of the most significant developments and presentations of submitted papers will also be included.

Those interested in attending the Symposium are requested to notify as soon as possible: Archaeometry '94, Ay Melek Ozer. Middle East Technical University, Department of Physics, 06531 Ankara, Turkey; tel 90-4-2101000; fax 90-4-2101281. Only those responding will receive a second circular with information on submission of abstracts, registration and accommodations. □

## Problem Solving in Mediterranean Archaeology

*A Colloquium at the 95th Annual Meeting of the Archaeological Institute of America; December 30, 1993, Washington, DC. Organizers: Geoffrey D. Purcell (The University at Albany, SUNY); Robert H. Tykot (Harvard University)*

The increasing application of scientific methods of analysis to problems of archaeological research has raised concern about the nature of the relationship between the two disciplines. This colloquium will examine this relationship within the context of Mediterranean archaeology through the presentation of research efforts which integrate scientific methods (e.g. analysis of ceramics, metals, marble) with archaeological fieldwork, textural interpretation, and art historical analysis. Each paper will illustrate, in non-technical terms, the way(s) archaeometry has been used to solve a particular archaeological problem (regarding, e.g., the economy, technology, socio-political developments), its advantages and limitations, and above all, its complementarity with these other methodologies. The proposed colloquium thus has three main objectives: (1) to illustrate that archaeometric analysis is complementary to, and dependent on, traditional approaches to archaeological problem-solving; (2) to explore the relationship between archaeologists, classicists, and archaeometrists, in order to better understand how "scientific archaeology" is done, and how it should be done in the future; and (3) to create a forum for the discussion of: (a) scientific applications in archaeology; (b) programs for training archaeologists to do laboratory analyses; and (c) the funding of archaeometric research efforts.

To meet these goals, we have been very careful in our selection of participants, and have focused on individuals who received their degrees in archaeology or the classics, rather than the physical sciences. Furthermore, our panel represents several of the major institutions (Wiener Lab, Athens; Smithsonian; Harvard University) where scientific analysis is an important part of the archaeology research program or academic curriculum.

We feel strongly that archaeological science is at its best when the laboratory analyses are a planned part of an overall research design from the project's inception, and the analytical data and their interpretation are truly integrated with other project results. Such integration is not often achieved in interdisciplinary collaborations between archaeologists and physical scientists. We hope that this colloquium will demonstrate that the archaeometric analysis of archaeological materials need not be an end in itself, but when combined with other categories of information can make a significant contribution to solving problems of interest to Mediterranean archaeologists. □

## Science and Archaeology: A Multi-Disciplinary Approach to Studying The Past

An international conference, sponsored by the Society for Archaeological Sciences, will be held at Harvard University, Cambridge, Massachusetts in September, 1994. Tentative dates are October 14-16 (Friday, Saturday, Sunday).

This international conference will focus on the need for increased communication and integration of research efforts by humanists, archaeologists, archaeometrists, and physical scientists in their reconstruction of past societies. The conference format will include six sessions over three days.

Papers will be accepted on the following topics: (1) Recent, original research that emphasizes a multi-disciplinary approach; (2) Case studies of successful interdisciplinary research efforts; (3) Practical aspects of doing archaeological science (e.g. research design, data interpretation); (4) Theoretical and paradigmatic constraints in doing archaeological science; (5) Education and training available/necessary for conducting multidisciplinary archaeological research; and (6) Resources and funding for archaeological science.

This conference is *not* intended to compete with the Materials Research Society or Archaeometry meetings; rather, the emphasis is *not* on reporting the latest results of your archaeometric analysis, but on *how you* [successfully?] *do* archaeological science. We very much want non-scientists (i.e. mainstream archaeologists) to participate in the conference, and to have their input into how archaeological science fits in (and should fit in) with the goals of archaeological research, university teaching, and the training of future archaeologists and scholars in related fields.

Each session will include ample time for discussion. It is essential that papers be prepared sufficiently in advance to allow circulation to the discussants for each section. It is our intention to publish the revised proceedings with a major press.

We ask at this time that those interested in participating respond by sending a proposed title and abstract (150-250 words) to one of the organizers below. Your response by Oct. 15 is essential so that we may apply for funding from major agencies such as National Endowment for the Humanities, Wenner Gren, etc.

Please contact either of the conference organizers below by Oct. 15th 1993 with your title/abstract, suggestions, criticisms, or need for further information.

*Robert H. Tykot, Archaeometry Laboratories, Harvard University, Cambridge, MA 02138 USA; tel 617-496-8991; fax 617-495-8925; e-mail Tykot@HUSC4.Harvard.edu*

*Geoffrey D. Purcell, Department of Anthropology, The University at Albany, SUNY, Albany, NY 12222 USA; tel/fax 518-442-4696; e-mail GP9420@Albnyvm1* □

# Meetings Calendar

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

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

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 19-22. VII Simposio de Arqueologia Guatemalteca. Guatemala City, Guatemala. Licda. Dora de Gonzalez, Museo Nacional de Arqueologia y Etnologia, Edificio 5, La Aurora, Zona 13, Guatemala City, Guatemala.

* July 19-25. Geological Sciences in Latin America International Meeting. Campinas and Ouro Preto, Brazil. M.M. Lopes, IG/UNICAMP, Box 6152, 13081, Campinas, Brazil; tel 55-192-39-7352; fax 55-192-39-4717.

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 Rodriquez, 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, De-partment 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. 23-25. International Symposium and Field Excursion to Archaeological Sites of Altai. "The Origins and Evolution of Ethnocultural Processes in Asia." Academician Anatoly Panteleevich Derevyanko, Institute of Archaeology and Ethnography SD RAS, Acad. Lavrent'yev Ave., 17, Novosibirsk-90, 630090, Russia.

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, Associacio del Museu de la Ciencia i de la Tecnica i d'Arqueologia Industrial de Catalunya, Via Laietana 39, S-09003 Barcelona, Spain; tel 319 23 00; fax 310 06 81. 15(1):1.

Sept. 18-21. Annual Meeting, Association for Environmental Archaeology. Theme: Taphonomy and Interpretation. Durham. 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 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. Adrien Hannus, Archeology Laboratory, 2031 South Grange Avenue, Sioux Falls, SD 57105, USA.

Sept. 27-Oct. 1. Accelerator Mass Spectrometry 6th International Conference. Canberra & Sydney, Australia. AMS-6, ACTS, GPO Box 2200, Canberra ACT 2601, Australia; tel 61-6-249-8105; fax 61-6-257-3256.

* Oct. 1-2. The Impact of Geographic Information Systems on Archaeology and Cultural Resource Management: A European Perspective. Ravello, Italy. Dr. Gary Lock, Institute of Archaeology, University of Oxford, 36, Beaumont Street, Oxford OX1 2PG, UK.

* Oct. 3-8. Conservation of Ancient Sites on the Silk Road. Dunhuang City, China. Neville Agnew, 4503 Glencoe Avenue, Marina del Ray, CA 90292, USA; tel 310-822-2299.

* Oct. 4-8. Arctic Airborne Contaminants and the Ecology International Meeting. Reykjavik, Iceland. Debra Steward, Technical Resources, 3202 Tower Oaks Boulevard, Rockville, MD 20852, USA; tel 301-770-3153; fax 301-468-2245.

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.

* Oct. 27-28. Palynology, Climate, and Sequence Stratigraphy of the Pliocene Meeting. Baton Rouge, Louisiana, USA. John Wrenn, Amoco Production Co., Box 3092, Houston, TX 77252, USA; tel 713 - 556-2297; fax 713-584-7468.

* Nov. 4-7. American Society for Ethnohistory Annual Conference. Bloomington, Indiana, USA. American Indian Studies Research Institute, Indiana University, 422 North Indiana Avenue, Bloomington, IN 47405, USA; tel 812-855-4086.

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.

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Feb. 18-23. American Association for the Advancement of Science, Annual Meeting. San Francisco, Califor-nia, 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 & 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, Department 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, CA, 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, Austria. 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.

* Aug. 14. International Sedimentological Conference. Recife, Brazil. 14th International Sedimentological Congress, Caixa Postal 7801 Cidaded Universitaria, 50739 Recife PE Brasil; tel: 081-271-82-40.

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 Fald 234, D-6900 Heidelberg, Germany; tel 0-62-21-56-55-31.

* Oct. 24-27. Geological Society of America, Annual Meeting. Seattle, Washington, USA. Geological Society of America, 3300 Penrose Place, Boulder, CO 80301, USA; tel: 303-447-2020.

* Nov. 30-Dec. 2. American Anthropological Association, Annual Meeting. Atlanta, Georgia, USA. American Anthropological Association, 1703 New Hampshire Avenue, NW, Washington, DC 20009, USA; tel 202-232-8800. □

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## Society for Archaeological Sciences



*Published quarterly by the Society for Archaeological Sciences.*

**Deadlines for Submissions:**

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

*Distributed to subscribers: $55.00/year individual (with Journal of Archaeological Science), $50.00 student (with JAS), $5.00 student (without JAS), $15.00 institution. Payable with major credit cards: provide card number and expiration date. ISSN 0899-8922.*

Printed on recycled paper