SAS Bulletin

Society for Archaeological Sciences

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SAS News

SAS Annual Business Meeting

The annual business meeting of the Society for Archaeological Sciences will be held this year at the **Archaeometry 92 Symposium** in Los Angeles (additional information for this conference is contained in the Meetings Calendar). We hope to have this meeting during the poster session/lunch break on Wednesday, March 25 between 10:30 and 2:00. We will announce the exact time and place of this meeting at the symposium.

SAS Symposium at the SAA

The SAS is sponsoring a symposium, entitled Phytolith Analysis in the 90s: Applications in Archaeological Interpretation, at the annual meeting of the Society for American Archaeology, to be held from April 8-12 in Pittsburgh, Pennsylvania, USA. The symposium, organized and chaired by Susan C. Mulholland and Amy L. Ollendorf, is tentatively scheduled for Saturday morning, April 11. Papers to be presented are:

Deborah Pearsall, Elizabeth Dinan, & Marcelle Umlauf - Identifying rice (Oryza sativa), Poaceae, through phytolith analysis;

Dolores Piperno - Phytoliths in the reproductive structures of teosinte and maize: Implications for study of maize evolution;

Marsha Baenziger & Zhijun Zhao - Clues in the search for the millets of the past: Opal phytoliths and how they may tell the story;

Zhijun Zhao - A new procedure for extracting phytoliths from soil;

William Middleton - Extraction of phytoliths from prehistoric and contemporary camelid dental calculus;

Linda Scott Cummings - Phytolith analysis at archaeological sites for recovery of subsistence data and identification of stains;

Cesar Veintimilla & Deborah Pearsall - A preliminary analysis of past vegetation in the Jama River valley;

Cynthia Pope & John Jones - Paleoenvironmental implications from an Archaic site in southwestern Chiapas: The phytolith evidence

Irwin Rovner -Phytolith problems in Transdanubian archaeology.

New Addresses for SAS Personnel

Please note the new address for James Ebert, associate editor for remote sensing, given on the back page. Jim has also added GIS to his beat. Also note the corrected address for SAS secretary/treasurer Chris Prior, who has moved to the Radiocarbon Laboratory at the Univeristy of California, Riverside.

SAS Electronic Mailbox and Filestore SAS-Net and SAS-Depot

Members of SAS will be pleased to learn that these services have now been finally established. It has been prompted into life by the marvelous pioneering examples set by the Conservation Information Network in Canada, and the Archaeological Information Exchange Network which was founded at Southampton University.

The reborn "SAS Bulletin Board", henceforth renamed SAS-Net and SAS-Depot for its two components, is described. If you have previously sent notice that you want to be included, we intend to get you on the new subcription list. To be safe, you should re-notify us.

As access to Internet has grown in the last couple of years, it is now much easier for people inside cooperative networks like Bitnet to communicate and exchange information with colleagues around the world through electronic mail incurring only trivial costs. In addition, the advent of FTP and Telnet now permit rapid and inexpensive movement of large bodies of data from one part of the world to the other. The Society has established two associated services for the benefit of members which take advantage of these developments.

SAS-Net (continued on p. 6)

Technical Report: Selecting a Magnetometer

Bruce Bevan

Geosight, P.O. Box 135, Pitman, NJ 08071 (tel 609-589-9294)

Magnetometers are iron finders. They readily detect the iron in metallic artifacts. They also detect the smaller amount of iron in some igneous rock, in brick or fired earth, and in the soil itself.

If you are interested in buying or renting a magnetometer, the following discussion might help you make a decision about which might be best for you. The instruments are grouped into three categories. Audio-indicating magnetometers are excellent for making a quick search for iron-containing objects. Numerical output magnetometers are necessary for creating a map which quantifies the magnetic field. Magnetic susceptibility meters allow the features which cause the magnetic field to be directly located.

Magnetometry is one of the most widely used methods of geophysical prospecting. (Among several fine reviews, see John Weymouth, Geophysical methods of archaeological site surveying, Advances in Archaeological Method and Theory, vol. 9, Academic Press, 1986, 311-395). But which magnetometer should one use for a specific project? Bruce Bevan provides some practical advice to answer this question.

Audio-Indicating Magnetometers

These are the least expensive of the magnetometers; they cost about US $600. These instruments typically look like a staff about one meter long. They contain a speaker which emits a tone whose pitch or amplitude changes with the proximity to iron or brick.

These instruments can help an archaeologist by pinpointing objects just below the bottom of an excavation, and therefore allow a preview of what will be encountered. Should it be important to check an area for modern trash or unexploded bombs, an audio-indicating magnetometer also can help.

Unlike metal detectors, which can locate non-ferrous metal such as copper, essentially these instruments will detect only iron-containing materials. However, some iron artifacts, such as stainless steel, and some iron-containing minerals, such as the limonite in bog iron, can be undetectable with a magnetometer.

These instruments are often called magnetic locators and they can be purchased from stores which sell instruments for surveyors. The locators from three different manufacturers (Schonstedt, Chicago Steel Tape, and Fisher) are available from: Forestry Suppliers, Inc., P.O. Box 8397, Jackson, Mississippi 39284, USA, phone 800-647-5368.

Similar instruments are built by Lietz and SECO Manufacturing Co. I have used a Schonstedt GA-52B magnetic locator for about eight years now and it has worked well.

Numerical Output Magnetometers

These instruments are more sensitive than the audio-indicating magnetometers. The digital readings from these magnetometers can be plotted to show the pattern of changes in the magnetic field; analysis of the resulting map can suggest the mass, depth, shape, and location of the buried features.

Magnetometers detect the remanent (or permanent) magnetic field about an object; they also detect how an object warps the earth's natural magnetic field. The fundamental parameter which is measured is magnetic flux density, with a unit name of nanotesla, abbreviated as nT (this unit is called the gamma in older publications).

There are many different types of magnetometers, and they are categorized by technical names which distinguish a fundamental aspect of their operation. Four principal types are: proton precession, Overhauser, alkali-vapor, and fluxgate magnetometers. For an introduction to the physics of these different instruments, check a modern text such as Introduction to Geophysical Prospecting, 4th edition, by Milton B. Dobrin and Carl H. Savit (McGraw-Hill, 1988). Any of these instruments can be suitable for archaeological surveys.

The most common of these instruments is the proton magnetometer. The sensor for this instrument is usually a cylinder about 15 cm long; an electrical cable connects it to a box (which may be 20 cm long) where the measurements are displayed.

Proton magnetometers, like the other numerical output magnetometers, cost in the range of US $3000-20,000. The least expensive are also the simplest to operate; they usually have just one button to push. These simple magnetometers might be best for you if you wish to make fewer than about 2000 measurements at your site, and if you survey only about a site per year.

One of these inexpensive magnetometers is the Elsec Type 770 from: Littlemore Scientific Engineering Co., Railway Lane, Littlemore, Oxford OX4 4PZ, England, phone 0865-747437. Another is the model M200 from: Geotech Ltd., 20-101 Amber Street, Markham, Ontario L3R 3B2, Canada, phone 416-513-1444.

Gem Systems and Geoscan Research, with addresses below, also sell simple and inexpensive magnetometers. The model MP-2 magnetometer from Scintrex is no longer manufactured, although the company has a few remaining. I bought one of these in 1980 and found it to be rugged and reliable.

If you make more than a few thousand measurements each year, one of the somewhat more complicated and expensive magnetometers will be best. These instruments will have at least a dozen buttons to control their operation; they will store your measurements in silicon RAM for later transfer to a computer. This computerization will allow you to make measurements faster and also let you have a computer program generate your maps.

Computerization will also allow you to make more accurate corrections for the natural changes in the earth's field during the time of your surveys. Unless you are searching for historic iron artifacts, you will probably need to monitor the temporal change in the magnetic field; a second, stationary magnetometer may be needed for this.

One of the least expensive of the computerized proton magnetometers is the model G-856 from: EG&G GeoMetrics, 395 Java Drive, Sunnyvale, California 94089, USA, phone 408-734-4616. This magnetometer uses an LED for its numerical display; while LEDs require somewhat more battery power than LCDs, they are known to be reliable and have a long life. Almost all other magnetometers use LCDs; while these may be reliable, many LCDs from a decade ago have malfunctioned. Each measurement is stored with the date, time, and a sequence number. You must write down this sequence number for the start and end of each line of measurements you make; in particular, you must be careful to note the sequence number when you break a line of measurements to go around a tree or a building. I have done surveys with G-856 magnetometers since 1982 and, except for an early failure of a memory backup battery, they have worked fine. The Elsec Type 820 magnetometer from Littlemore is similar to this GeoMetrics G-856.

The most recently-designed magnetometers allow the operator to display and record the coordinates of each measurement point, along with the measured field; you might refer to these coordinates as X and Y or east and north. This greatly simplifies the task of recording the location of the measurements correctly.

One proton magnetometer which stores the locations of its measurements is the model MP-3 from: Scintrex, 222 Snidercroft Road, Concord, Ontario L4K 1B5, Canada, phone 416-669-2280. An EDA Instruments proton magnetometer, the Omni model, is similar to the MP-3 above; it is also now manufactured and sold by Scintrex.

Furthermore, Scintrex also manufactures the cesium type of alkali-vapor magnetometers which were formerly sold by Varian. Like proton magnetometers, cesium magnetometers measure the total flux density of the earth's field. For many years, cesium magnetometers were significantly faster and more precise than other magnetometers; however, the Scintrex V-91 does not have digital storage or transfer of its measurements, which reduces its speed to that of one's writing.

The most accurate type of field magnetometer may be the Overhauser type. This magnetometer is similar to the proton magnetometer, but it is fundamentally faster and requires less power. Several models of Overhauser magnetometers are manufactured by: Gem Systems, Inc., 52 West Beaver Creek Road, #14, Richmond Hill, Ontario L4B 1L9, Canada, phone 416-764-8008.

The Overhauser magnetometer which I have is a model GSM-19FG. This instrument can make measurements as fast as two per second and it can store over 30,000 measurements. The measurement accuracy is at least as good as 0.2 nT and the recorded precision is 0.01 nT.

In its slower mode of operation, making one measurement every three seconds, this magnetometer can send its measurements and their location coordinates immediately to a computer. I can operate my magnetometer so that each measurement is contoured and displayed as a map on a computer in real time. This allows me to extend my magnetic survey to follow an interesting anomaly. In the days when magnetometers did not have digital storage of their measurements, I would write down the values in a matrix form and get an initial idea of the patterns which were being found. However, digital storage meant that I could tell little about the findings of the survey until later in the day when the data were transferred to a computer and displayed as a map. Now, real time mapping allows me to see what I'm finding as I do a survey.

This magnetometer, like several of those discussed above, can be operated as a magnetic gradiometer, by subtracting the measurements at two closely-spaced sensors. Gradiometer measurements are sometimes helpful for archaeological surveys. They provide excellent correction for the diurnal variation of the earth's magnetic field. They also reduce the effect of magnetic objects which are distant; this can clarify magnetic maps made in the vicinity of buildings which contain iron or brick. The Scintrex Omni and also the Gem gradiometers make their pair of measurements simultaneously (some of the others make their measurements sequentially); this allows them to minimize the effect of passing cars.

Fluxgate magnetometers are usually gradiometers and they also measure one vectorial component of the magnetic field. Typically, this type of magnetometer measures the vertical gradient of the vertical component of the magnetic field. The audio-indicating magnetometers discussed above are just this type of magnetometer.

A family of fluxgate gradiometers has been designed with special emphasis on archaeological applications. This is the FM series from: Geoscan Research, Heather Brae, Chrisharben Park, Clayton, Bradford, West Yorkshire BD14 6AE, England, phone 0274-880568, with a sales representative at: Geoscan Research USA, P.O. Box 383, Sea Ranch, California 95497, USA, phone 707-785-3384.

These instruments allow a trade-off between speed and accuracy. They can measure and store as fast as ten measurements per second; however, if an accuracy of about 0.2 nT is needed, it may require five seconds or more for each measurement. The instruments can store as many as 16,000 measurements.

The coordinate storage for the instruments is designed to measure square grids which are 10, 20, or 30 m on a side; larger areas can be surveyed square by square. It will be possible, but more cumbersome, to survey an area of, say, 5 m by 100 m. The instruments are ideal for large, open areas.

This gradiometer may be difficult to operate in brushy areas, for the instrument must be kept close to vertical. While there is a large amount of interpretation information available for total field magnetometers, there is less help for gradiometers, although in principle gradiometer maps can sometimes be converted to total field maps.

Magnetic Susceptibility Meters

These instruments make measurements which are closely related to those from a magnetometer. The advantage of these measurements, compared to those from a magnetometer, is that they can be easier to interpret and they can sometimes define more sharply the shape of a buried feature.

Magnetometers are passive instruments; they measure the magnetic field generated by a feature and also the magnetic field of the earth itself. Magnetic susceptibility meters are active instruments; they generate their own magnetic field and then measure how a feature modifies this field.

Magnetometers measure the field caused by the sum of induced magnetization (the magnetic conductor effect) and remanent magnetization (the permanent magnet effect). Magnetic susceptibility meters measure only induced magnetization. In principle, if measurements are made with both a magnetometer and a magnetic susceptibility meter, induced and remanent magnetization can be distinguished from each other.

A map made with a magnetometer over a buried magnetic feature will show both high and low values associated with that feature; this is because the magnetic field from the feature adds to the earth's field in some areas and subtracts from it in others. A map of magnetic susceptibility made over the same feature will show only high values; this can make the map easier to interpret. In fact, total field magnetic maps are sometimes converted to maps of effective magnetic susceptibility in order to interpret them. Magnetic susceptibility measurements are particularly suitable for mapping the distribution of fired earth at a shallow depth.

In the designation of the International System (SI), magnetic susceptibility is a pure number, with no unit name. A typical susceptibility for fired earth or brick will be in the vicinity of 0.001; I sometimes refer to this as one part per thousand (1 ppt), although this usage is not strictly correct. A value of susceptibility in the older cgs units can be converted to a value in SI units by multiplying it by 4π.

There are several magnetic susceptibility meters available for archaeological surveys; their cost is roughly US $4000. One of these is an electromagnetic induction meter, the model EM38 from: Geonics, Ltd., 1745 Meyerside Drive, Unit 8, Mississauga, Ontario L5T 1C5, Canada, phone 416-670-9580. This instrument can measure the apparent susceptibility of the soil to a depth of about 0.5 - 1.0 m; the larger EM31 instrument has a greater depth of measurement. These instruments can also measure the apparent electrical conductivity of the earth. I have used these instruments since 1980 and have found it valuable to be able to make two measurements with one instrument; one must be careful of measurement drift and electrical noise at some sites.

While the EM38 described above looks similar to a carpenter's level, other susceptibility meters look like metal detectors. One of these is the model MS2 from: Bartington Instruments Ltd., Spendlove Centre, Enstone Road, Charlbury, Oxford OX7 3PQ, England, phone 0608-810657. This instrument has a coil which is about 0.2 m in diameter and it measures susceptibility to a depth of about 0.2 m. A similar instrument is the model 3101A from: Bison Instruments, Inc., 5708 West 36th Street, Minneapolis, Minnesota 55416, USA, phone 612-926-1846.

Conclusion

If you are an excavator, you might consider keeping an audio-indicating magnetometer in the field; this will probably be more suitable than a metal detector for examining the bottom of your excavations for further features below.

If you are searching for kilns, furnaces, or iron artifacts, a simple and inexpensive magnetometer will probably be suitable if you intend to make fewer than several thousand measurements.

If you wish to map buried earthworks, you will probably need a pair of computerized magnetometers, for these features can cause quite weak anomalies.

If you intend to make many thousands of measurements, you will wish a high speed magnetometer, possibly the Gem or the Geoscan Research instruments.

If you are mapping concentrations of fired earth at a shallow depth, you should consider a magnetic susceptibility meter.

You might plan to rent your instrument before you decide to buy one; most of these manufacturers will rent or loan their instruments.

My discussion has emphasized what I have found to be missing or unclear in the manufacturers' specifications for these instruments. Be sure to examine the specifications for: battery type and life, speed of measurement, and suitability for the geographic location of your work.

The opinions above are my own, and you are welcome to add yours. I hope to give a comparable review of resistivity meters; please contact me if you have any input.

Science-Based Archaeology (in U.K.)

The post of Coordinator was created by the Science-Based Archaeology Committee (SBAC) of the Science and Engineering Research Council (SERC) in 1987, implementing one of the main recommendations of the Review of Science-Based Archaeology (the Hart Report) two years earlier. Dr. Mark Pollard, then at University College, Cardiff, and since last year Professor of Archaeological Science at Bradford University, occupied this vitally important new post with great distinction for three years, and his report for the period 1987-1990 has recently been published by SERC.

It is a lavish production, consisting of a folder containing six separate pamphlets - the main text plus appendices on studentships, short courses, and research grants awarded by SBAC, SBAC membership, and the work of the English Heritage Ancient Monuments Laboratory. The main report begins with accounts of the various elements that make up the science-based archaeology reviewing and grant-giving procedure and goes on to describe the role of the coordinator. There is a perceptive analysis of the present position, and Professor Pollard ends with his recommendations for the future.

His first recommendation is that SBAC should find some mechanism for participating in the fund for applied science established by the Forum for Coordination in the Funding of Archaeology, from which it has hitherto remained aloof, seeing its role as that of funding primary scientific research.

He goes on to emphasize the role of the Ancient Monuments Laboratory of English Heritage in assuming an active role in setting and maintaining standards in the provision of scientific support for rescue excavations, *however funded* (our italics). He also sees an important role for the AML in making good scientific advice available to those responsible for defining the terms under which rescue projects are carried out (i.e., the archaeologists involved in the implementation of planning controls).

The British Academy is urged to make its policies and funding decisions more widely available to the whole of the archaeological community. Professor Pollard also suggests that the Academy, in conjunction with other bodies, should review the disturbing imbalance in academic funding for research and studentships between archaeology and archaeological science.

His fourth recommendation is that SBAC should continue to encourage the involvement of non-university and polytechnic archaeologists at all levels of its operations and to ensure that the views of field archaeologists are represented at its meetings. This is coupled with a recommendation that SBAC should make representations to the Science Board of SERC to increase the number of studentships available for science-based archaeology. Finally, he recommends that a new coordinator should be appointed to continue as a focus for information dissemination. It is understood that this proposal has been accepted and that the post is to be advertised.

Copies of this perceptive and informative report are available from Mrs. Jane Nicholson, SBAC Secretariat, SERC, Polaris House, North Star Avenue, Swindon SN1 2ET, United Kingdom.

From British Archaeological News, 9(3), May 1991 (H F Cleere and P A Marchant, Editors; Council for British Archaeology, 112 Kennington Road, London SE11 6RE, United Kingdom; tel 071-582 0494; fax 071-587 5152.

Electronic Mailbox and Filestore
SAS-Net and SAS-Depot

SAS-Net (continued from p. 1)

Electronic Mailbox Network (SAS-Net)

This will function as a mail re-distribution service. For example, if you wish to make a general inquiry about some problem or aspect of your academic work which you think another SAS member may be able to help with, then write a short note and send it by e-mail to SAS-Net. Your note will be relayed to all other registered members, and one or more may respond directly to you or back to SAS-Net. It is also a suitable place to send notices such as advertisements for jobs relating to archaeological science, and engage in discussion on topics of mutual interest. There is no cost to register, but you must be a member of SAS.

Filestore Depot (SAS-Depot)

This is a place where you can leave material which you think other SAS members may be interested in gaining access to on an individual basis, such as major pieces of software (either code or binary files), databases, compilations such as bibliographies, regional ^{14}C date lists, etc.

How do these Services Work in Practice ?

To contribute some item to SAS-Net, simply prepare a message in your computer, and send it to the internet address for SAS-Net (srgibfl@wnv.dsir.govt.nz). The manager of the service checks incoming mail to see that it is suitable for re-distribution and then relays it to all registered members. Some points to notice: Firstly, people who are not members of SAS may send an item, and this may be distributed if the manager thinks that members would be interested, but it will contain a banner saying that it is from a non-member. This restriction is to try and keep junk-mail down to a minimum. Secondly, SAS-Net is not a large group of people, but if and when the volume of material rises to an unacceptable level so that some of it effectively becomes junk-mail, the manager will introduce a keyword system to re-distribute only to a smaller selection of members. This is why the registration form requests keywords which specify your interests in archaeological science.

To contribute something to SAS-Depot, use your FTP software to connect onto the node which is used for this purpose (grv.dsir.govt.nz or 131.203.8.2) using the appropriate userid/password which is dump/dump, and then send the file you have prepared (software or datafile). You must include a short note with the file which gives your name and address, a brief description of what it is, and a statement that you either hold the copyright, or that it is shareware. The manager checks any file which turns up for viruses and then places it in the open SAS area, so that members may download the file if they wish.

To get something from the SAS-Depot, use your FTP software to connect onto the node which is used for this purpose (grv.dsir.govt.nz) using the appropriate userid/password which is anonymous/guest, and then change to the SAS sub- directory. This is accomplished with the command:

FTP> cd [.SAS] <return>

There is an index which you can browse through which contains a brief description of the files present. Any material of interest can be uplifted with appropriate FTP commands.

People unfamiliar with FTP should consult a local advisor; however the Manager of these SAS services will be able to respond to most questions if you send an e-mail message requesting specific help.

Registration form

If you wish to be a member of SAS-Net and SAS-Depot, please send the following details to the electronic mail address srgibfl@wnv.dsir.govt.nz and you will be added to the list. Note that you must be a financial member of the Society for Archaeological Sciences to register.

1: Name:
2: Postal Address:
3: E-mail Address:
4: Does your site possess FTP software ?
5: Keywords: (specify your range of interests in archaeological science)

Some Bitnet and Earn users are still not connected to Internet, and if you are therefore unable to mail to the present address for SAS-Net, please send your registration details to one of the following Bitnet addresses:

jhburton@wiscmacc.bitnet	James Burton
archsci@fandm.bitnet	Rob Sternberg

News of Archaeometallurgy

Meetings

The meeting of the Comité pour la Sidérurgie Anciènne held last August in Budalen, Norway, in the mountains above Trondheim was a great success for which Arne Espelund and the people of Budalen deserve much credit. A reconstruction of a typical Norwegian furnace as described by Evenstad in 1782 was built into the side of a hill and fueled with wood, and the iron produced was forged. One evening a concert was held in the village church, one of five Y-shaped churches in Norway, and another evening the participants joined the villagers in traditional dancing.

An International Symposium on the Catalan Forge has been announced for 13-17 September 1993 in Ripoll, Spain. This city is north of Barcelona and holds the most extensive remains of the Catalan process of iron and steelmaking, which developed in the Eastern Pyrenees from the Middle Ages onward. The symposium is being sponsored by the Comité pour la Sidérurgie Anciènne, the ASM International, the Government of Andorra, the Cellule du Patrimonie Industriel of the French government, the Municipal Corporation of Ripoll, the Museu de la Ciéncia i de la Técnica de Catalunya, and the Associacio d'Enginyers Industrials de Catalunya (A.M.C.T). A first call for papers has just gone out. For further information write the Secretaria del Simposi, Dr. Estanislau Tomás, A.M.C.T., Via Laietana 39, 08003 Barcelona, Spain.

Two Iberian mining tours are being offered for 1992 by Atalaya Tours, one an eight-day tour in May of Río Tinto and prehistoric and Roman mines in the Iberian pyrite belt for about £570, and the other a ten to twelve-day tour of the mines of Andalusia for about £700. For further information write Atalaya Tours, Ceinionfa, Penglais Terrace, Aberystwyth, SY23 2ET Great Britain; tel (0970) 625077.

Publications

The Archaeometallurgy column in JOM, The Journal of the Minerals, Metals & Materials Society, being conducted by Vincent Pigott presented "Bronze casters and gold workers during Denmark's Bronze Age" by Professor Janet E. Levy of the University of North Carolina at Charlotte in August (pp. 66-68).

In 1989 the SAS Bulletin 12(1) carried an announcement that the Department of Archaeology of the Natal Museum was compiling an annually updated bibliography on "Precolonial Metalworking in Africa, particularly Southern Africa." The responsibility for maintaining and updating this bibliography has now been taken over by Dr. Duncan Miller at the Department of Archaeology of the University of Cape Town. The bibliography has been expanded considerably and now includes far more references to central and north Africa, although it is by no means exhaustive. The printed version runs to 60 pages but it is also available in MS-Word 5 in a variety of disk formats to be specified on ordering. Either print or disk version can be ordered at a cost of US $15 from Duncan Miller, Department of Archaeology, University of Cape Town, Rondebosch 7700, Republic of South Africa, telephone (021) 650-2351, fax (021) 650-2352.

A revised edition of the 1984 handbook by David Scott and Jim Black on the metallography of ancient art objects has just been announced. It is The Metallography and Microstructure of Ancient and Historic Metals by David A. Scott, published jointly by the Getty Conservation Institute and the J. Paul Getty Museum. The book has 212 pages, 20 color plates and 212 figures, and covers preparation of samples as well as interpretation of microstructures of metals such as tin, bronze, wrought iron, cast iron, and alloys of gold and silver. It is available from the J. Paul Getty Book Distribution Center, P. O. Box 2112, Santa Monica, California 90406, telephone (310) 453-5352 or fax (213) 453-7966, for US $49.95 plus $5.00 for handling and shipping. California residents add state tax of $4.21. Payment can be made by Mastercard or Visa.

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

Martha Goodway, CAL MSC, Smithsonian Institution, Washington DC 20560; phone 301-238-3733; fax 301-238-3709.

Short Courses

The University of Nevada, Reno, Cultural Resources Management Program, has announced several courses, including: Introduction to Stone Tool Technology, May 25-30, 1992, Inyo National Forest, $475; Geomorphology in Archaeological Analysis, April 27-May 1, 1992, Reno, $450. The program is a cooperative undertaking with the Advisory Council on Historic Preservation, the Bureau of Land Management, and the National Park Service. For further information, contact CRM, Division of Continuing Education, MS 048, University of Nevada, Reno, NV 89557; tel 702-784-4046; fax 702-784-4801.

Book Review

The Ceramic Legacy of Anna O. Shepard. Ronald L. Bishop and Frederick W. Lange, editors. University Press of Colorado, Niwot, CO, 1991, xi + 473 p., figures, plates, references, index. Hardbound, ISBN 0-87081-195-9, $39.95 (cloth).

Reviewed by David Killick, Archaeometry Laboratories, Department of Anthropology, Harvard University, Cambridge, MA 02138. (Now in the Department of Anthropology, University of Arizona, Tucson, AZ 85721.)

Anna O. Shepard (1903-1973) was not the first person to undertake scientific studies of Native American pottery technology, but she played so large a role in defining aims and methods in this field that she is universally acknowledged as its founder. She was the dominant figure in preindustrial ceramic technology from 1936, when she established her reputation with her pathbreaking study of pottery from Pecos, until 1967, when, disillusioned by archaeology, she defected to the United States Geological Survey. Her classic text, **Ceramics for the Archaeologist,** has gone through eleven printings since it first appeared in 1956: though its sections on method are now outdated, those on aims, experimental design and interpretation remain without peer.

Shepard left her personal papers to the University of Colorado Museum. In the mid 1980's Ronald Bishop and Frederick Lange studied these papers and distributed copies to a group of scholars, who convened in 1988 to review Shepard's achievements and to reflect on subsequent developments in ceramic studies. This book contains the edited proceedings of the conference.

The six papers in the first section are devoted to assessments of Shepard's career and influence. Raymond Thompson provides a professional biography with particular focus on her relationships with the Carnegie Institution of Washington, which supported her work for most of her career; Frederick Matson recalls the first conference on ceramic technology, held in 1938, in which he and Shepard both participated; and Joe Ben Wheat describes how the Southwestern taxonomic system for pottery (to which Shepard was adamantly opposed) came into being. There are also two fine assessments of Shepard's work in the Southwest (by Linda Cordell) and in Mesoamerica (by Robert Rands), while Bishop mines Shepard's professional correspondence to good effect in tracing the development of her thought.

This section is highly recommended to all who dwell at the interface of the physical sciences and archaeology. The problems that Shepard encountered in trying to integrate the disciplines are still with us, and these perceptive analyses of her experiences will provide much food for thought. Shepard was a fine archaeometrist long before anyone had thought it necessary to coin the term, and also appears to have been a Popperian before Popper! She was a skilled petrographic microscopist and chemist, had a deep knowledge of geology, and throughout her long career constantly strove to upgrade her technical skills. These were harnessed to the study of a well-defined set of questions about the technical capabilities of the societies she was investigating, their interaction with other societies, and the search for evidence of craft specialization and regional exchange. For all these reasons, she strongly disliked doing technical studies on pottery without a specific archaeological or ethnographic problem to investigate.

In spite of her reputation, all the contributors to this volume agree that Shepard's work has had little lasting influence on the conduct of archaeology in either the Southwest or in Mesoamerica. Several convincing reasons for this neglect are offered. Shepard's uniquely privileged position appears to have been a factor; although she was an employee of the Carnegie Institution of Washington, she was permitted to live and work in Boulder as a full-time researcher, free of teaching or administrative duties. This meant that she trained no students to carry her work forward, and had little opportunity to interact with, and thereby influence, the Carnegie archaeologists for whom she did ceramic analyses. Nor did she often have opportunity to examine the sites or the regions from which the pottery came, so she could rarely become acquainted at first hand with the geological context, site stratigraphy and sampling strategy. Her personal correspondence makes it clear that she did not trust the judgement of most archaeologists in these matters.

Shepard was a rigorous and uncompromising scientist, and under these circumstances produced reports thickly hedged about with qualifications. These did little to convince archaeologists of the necessity of her work. Cordell notes also that archaeologists in the Southwest chose to overlook Shepard's work because her demonstration that there had been specialization in, and extensive trade of, pottery in the prehistoric Southwest subverted both the direct historical approach (then the dominant paradigm) and also assumptions underlying the use of pottery as a relative dating tool. Her work was therefore relegated to appendices and politely ignored.

Her personality also appears to have contributed to her isolation; her personal correspondence shows her to have been arrogant, prone to making derogatory remarks about her colleagues, and entirely devoid of a sense of humor.

The second section of the book looks at what has been accomplished since Shepard left the field. The same small cadre of scholars have dominated ceramic studies in the Americas for the last fifteen years, and Bishop and Lange have rounded up all the usual suspects for this volume. The great majority of recent ceramic studies have dealt with questions of provenance, and have relied almost entirely on chemical methods, particularly neutron activation analysis, to the virtual exclusion of petrography (and indeed of geology as a whole). There is no critical analysis of this development in the volume, but I suspect that Shepard would not have approved. Her modus operandi in this matter was to start with the geological context and work outward, bringing several independent lines of evidence to bear on the problem.

This section also contains chapters on ceramic technology by Prudence Rice and Dean Arnold. Both have done distinguished work, but these papers are little more than footnotes to earlier writings. The standout in this section is a most interesting chapter by Veletta Canouts on Shepard's attempt in the 1940's to formalize the description of ceramic designs by introducing techniques of symmetry analysis from crystallography. In this, as in so much else, she was far ahead of her time.

The final section expands the horizons to consider the relationship between archaeology and archaeometry. All the commentators agree that the degree of integration of these disciplines has improved little since Shepard's time, and cite numerous examples of extensive (and expensive) analytical work done for no good archaeological reason. Patricia Crown and Lambertus van Zelst separately blame archaeologists for not making the effort to involve themselves in the design and implementation of archaeometric studies. All too often, they argue, archaeologists simply want a few numbers to lend a veneer of science to their publications - an attitude aptly characterized by Crown as the "nuke those sherds!" approach. Van Zelst goes further and condemns what he sees as ambivalence, or even antipathy, to archaeometry among archaeologists. He notes that collaborating scientists receive little credit from their peers for doing archaeometry, and warns that archaeologists will be the only losers if scientists abandon such work for lack of interest from the archaeological community. Crown argues very plausibly that the solution to the latter problem lies in requiring all students to take an archaeometry course. Jeremy Sabloff blames the structure of American academia for the lack of mutual comprehension and calls for joint faculty appointments between science and archaeology as a solution.

In conclusion, this book succeeds in honoring Anna Shepard for her considerable achievements without placing her on an artificial pedestal. It also provides a very stimulating discussion of the problems inherent in doing meaningful archaeometric research, and as such can be read with profit by any archaeologist or archaeometrist. The editing, indexing and proofreading of the book are excellent, while the text and period photographs are printed on acid-free paper and solidly bound: in short, this is a much better production job than one gets from most academic publishers these days.

The Directory of Graduate Programs in Archaeological Geology and Geoarchaeology (7th ed., Nov., 1991) is available free of charge to students or faculty advisors from Rip Rapp, Archaeometry Lab, University of Minnesota, Duluth, MN 55912; tel (218) 726-7629; fax (218) 726-6556; BITNET: GRAPP @ UMNDUL; INTERNET grapp@ub.d.umn.edu .

Conference Reports

British Academy - Royal Society Discussion Meeting on New Developments in Archaeological Science; The Royal Society, London, 13 - 14 February 1991.

Reviewed by Mark Nesbitt & Delwen Samuel, University of Cambridge.

This conference was the seventh in a series of joint meetings with the British Academy on archaeological science held at the Royal Society since 1969. A wide variety of techniques was surveyed, with the exclusion of dating which was covered by posters. Dating will also be discussed in the next joint symposium, on "The origin of modern Homo sapiens and the impact of science-based dating" in February 1992. Despite heavy snowfalls, over 200 people attended, and the combination of good time control and a professional projectionist ensured refreshingly smooth running. There was a surprising lack of younger speakers, and of representatives from centres such as London, Sheffield, and Southampton.

Some talks focussed on the impact of new analytical methods (e.g. in biochemistry) and others on new interpretations that can now be made as substantial bodies of data become available (e.g. in dendrochronology). Most speakers resisted the temptation to become bogged down in methodological detail, and concentrated on illustrating results. New techniques of presentation are also starting to reach the archaeological world, with many clear, specially-prepared multi-colour graphics in use. The days of the fuzzy, grey graph (or worse, large tables of data in tiny print) may be numbered.

The symposium began with an excellent demonstration by Dr. Mike Baillie (Queen's Univ., Belfast) of how to present elegant ideas elegantly. He likened the long (7000 years +) tree-ring chronologies from Belfast and Germany that are now in routine use for dating to a "tree-ring kit without a set of instructions", and then drew on a wide range of historical, archaeological and palynological data to try to discover just what ring patterns and overall patterns of bog-oak growth and death might mean in terms of environmental change. The studies of the Neolithic "colonisation" of Britain - distinct changes seem to be happening at about 4000 B.C. - and on the effects of volcanic eruptions are very exciting, as is the concept of looking at prehistoric change over periods of a few calendar years rather than hundreds of radiocarbon years.

Continuing the theme of "Prehistoric human environments", Prof. B. Berglund (Univ. of Lund) described a 10 year project, with 25 staff in six university departments, studying all aspects of the landscape of south Sweden over the last 5000 years. As we admired the resulting sequence of detailed land-use maps and reconstruction drawings, it became obvious that this is the kind of approach that we should all be taking. While the generous support of the Swedish National Bank certainly helped this project, the reasons for its success (and the failure of so many other "interdisciplinary" projects) must also relate to efficient organisation and the location of all the team members in one small city.

Dr. M.A. Courty (CNRS) ended the morning with a convincing demonstration of how soil thin sections can tell us about the formation of archaeological deposits. Judging by a gorgeous colour section of a coprolite filled with grass-phytoliths, there is even more potential in this work if allied with analysis of bulk samples.

After lunch the theme was artifact studies, with three talks on characterising metal and stone, where the novelty lay less in the techniques used, than in their careful application to archaeological questions. Dr. N. H. Gale (Univ. of Oxford) presented a close look at Bronze Age trade in the Aegean, where metal objects have been sourced using mass spectometry analysis of isotope ratios. A key element in his work has been detailed sampling of ores in the field. Dr. Paul Craddock (British Museum) described an interdisciplinary approach to early mining and smelting in Europe, stressing the importance of experimental and ethnographic work. This detailed and diverse approach allowed a strong argument for independent innovation of techniques throughout Europe. This is, of course, in sharp contrast to the long-established concept of transfer of metallurgy technology from the Near East to Europe. A similarly wide-ranging approach to an old idea was taken by Dr. O. Williams-Thorpe (Open University) to the origin of the Stonehenge bluestones. The heroic transport on rafts of these stones from Wales to the Salisbury plain has been a tenet of British archaeology for so long that, as the lengthy discussion afterwards made clear, the well-buttressed argument that these stones are just glacial erratics will take some time to sink in.

There were two technical talks in this session, with Prof. M.S. Tite (Univ. of Oxford) on the role of scanning electron microscope in studying the microstructure of ceramics, and Clive Orton (Institute of Archaeology, London) on the statistics of counting potsherds.

On Thursday morning we returned to bioarchaeology, with Dr. R.P. Evershed (Univ. of Liverpool) on the use of gas chromatography to separate the components of potsherd residues, and mass spectrometry to identify the molecules involved. Although this kind of work has been going on for some years, previously results have been limited to a handful of sherds per site. The Liverpool project, as well as looking in detail at important aspects of biochemistry such as post-deposition degradation, is looking at large numbers of early medieval sherds. Prof. Martin Jones (Univ. of Cambridge) then surveyed the wide range of techniques now used in looking at human diet and exploitation of vegetation. Instead of looking at just a few components in great detail, it is becoming possible to integrate these sources of information, to look at food-webs as whole systems.

Two lectures made up the session on site survey techniques. Dr. I. Shennan (Univ. of Durham) took the broader perspective of remote-sensing of landscapes. Multispectral waveband scanners on the French "Spot" satellite and on airplane surveys are picking up very subtle changes in vegetation and, therefore, in underlying features. The raw data is often available cheaply, and the computers that allow it to be easily handled now cost £5000 or so, compared to twenty times that five years ago. As Dr. Shennan's work in the Fens shows, this is technology that is now up and running. Mr. A. Aspinall (Univ. of Bradford) looked at geophysical techniques better suited to relatively small areas such as archaeological sites. Techniques such as radar are giving very pretty vertical sections, but a great deal more fieldwork is needed to decide what these actually mean stratigraphically.

The final session concerned the analysis of bits of human body. Prof. N.J. van der Merwe (Harvard) described some very nice case studies using carbon isotopes to investigate early primate diet in Africa, and the spread of maize in North America. In regions were C4 plants grow or are grown, this is clearly a useful technique, but the potential of isotopes of other elements, which might be of use in other areas, is still unclear. Dr. P.E. Hare (Carnegie Institution) discussed the use of amino acids from ancient bone in dating and diet studies. To end the conference papers, Dr. R.E.M. Hedges (Oxford Univ.) looked at the very new field of studying ancient DNA. Efforts at present concentrate on extracting sufficient material for sequencing; any assessment of this work as applied to archaeology will have to wait on these.

In his closing remarks Professor Colin Renfrew (Univ. of Cambridge) made a couple of important points that attracted disappointingly little discussion from the floor. He drew attention to the closer integration between scientists and archaeologists, and contrasted the major developments in archaeological science over the last 30 years with the almost total lack of change in excavation techniques over the same time period. The talks at this conference certainly made clear that working in teams has led to genuine integration on specific projects. All the projects described featured a clear statement of archaeological aims deriving from close collaboration with excavators. While it is true that a lot of new work is driven by the availability of new technology, this is not in itself a bad thing. If a new, more powerful technique is applied, there is a good chance it will turn up something previously unsuspected, with attendant important implications for interpretation. A major theme of this conference was the astonishingly good preservation of organic materials from the past, for example DNA in charred seeds or lipids in potsherd walls.

A point which was not raised is the risk that the current readiness to support the development of new techniques may divert funds from applying existing techniques to archaeological endeavours. To achieve the type of excellent synthesis presented by Prof. Berglund, dedicated and often tedious analysis of basic data is essential. One can also compare the paucity of large scale seed and bone reports from British excavations to the excellent work coming from other European countries.

The contrast between the high quality of working going on in the laboratory and the usually casual nature of excavations is dismaying, and this seems to be a major weak point in overall strategies. It's dismaying that techniques developed twenty or more years ago, such as flotation and radiocarbon dating, are still not fully exploited. This has little to do with money, but involves questions of organisation and communications that fell outside the scope of this highly stimulating conference.

News of Geoarchaeology

Meeting News. At the 1991 Annual Meeting of the Geological Society of America in San Diego, the Archaeological Geology Division sponsored a symposium entitled "Archaeological Geology of the Archaic Period (8-3 ka) in North America." This symposium featured papers by Sanger and Belknap, Chapdelaine and LaSalle, Larsen, Stright, Hajic and Bettis, Saucier and Smith, Ferring, Albanese and Frison, and Waters. The symposium organizer was E. Arthur Bettis III, Iowa Department of Natural Resources, Geological Survey Bureau.

Fellowships. The Albritton Fund, established in the memory of Claude C. Albritton, Jr., is offering fellowhips to graduate students engaged in field or laboratory work in earth science and archaeology, beginning Spring 1993. For information, contact: Reid Ferring, P.O. Box 13078, University of North Texas, Denton, TX 76203; phone (817)565-2694. Contributions to the Fund can be sent to the GSA Foundation.

Contributed by Robin L. Burgess

Conference Reports

Modern Tools in Archaeometry, SAC Symposium, Gothenburg, Sweden, 23-25 May 1991.

Reviewed by Peter M. Fischer, SAC Chairperson, Department of Physics, Chalmers University of Technology, S-412 96 Gothenburg, Sweden, phone 46 31 723431, fax 46 31 723436.

The symposium was arranged by the Scandinavian Archaeometry Center (SAC) and held at the Chalmers University of Technology, Gothenburg, Sweden. It was the first meeting organized by the recently founded SAC. Therefore it was particularly pleasant to welcome archaeologists and scientists from all the Nordic countries, other European countries and USA. The oral presentations included the following topics: ancient DNA studies, acoustics, technology, recording, archaeoastronomy, analysis, prospecting, dating and measures.

The very interesting introductory lecture was given by the Swedish scientist S. Paabo, at present professor at the Institute of General Biology, Munich, Germany. Paabo has performed pioneering research in ancient DNA. The lecture reflected his research during about the last decade. He demonstrated the survival of DNA in ancient tissues, and showed that it was possible to clone and sequence DNA from a ca. 2,500 year-old mummy. Furthermore Paabo discussed future archaeological applications of ancient DNA research. Related research was presented by P. Persson. Persson's investigations are concentrated on the identification of human DNA in bones. His skeletal material derives from burials from the Rossberga Megalith monuments in Sweden, which were erected about 5,000 B.P. Persson pointed out the theoretical possibility to determine kinship relations by studies of the genetic codes held by ancient DNA.

P. Astrom and M. Kleiner recorded research based on Astrom's ideas from the beginning of the seventies. In their inspiring paper it was pointed out that it may be possible to record sound into a clay surface by purely mechanical/acoustical means at a level high enough to permit detection under ideal circumstances. Different procedures to discover sound in ancient ceramics were discussed.

R. Malinowski's paper on ancient mortars contributed to the discussion why these mortars show a high degree of durability, often better than ancient burned bricks and modern concrete. Factors influencing the durability of, e.g., Levantine Neolithic mortars from ca. 7,000 B.C., include lime burned at low temperature (650-700°C), reactivity of limestone particles, influence of heavy compaction, and surface treatment by polishing.

R. Sablatnig, C. Menard and P. Dintsis' paper on a method for pictorial acquisition of archaeological objects included perhaps a solution of problems which challenge many archaeologists: the construction of a picture data base, automatic classification of shards, in pairs shard mosaicking assemble, assembling parts of pots from shards, and reconstruction of pots with the help of existing part-assemblies. Their method is mainly based on a structured light method using four lasers and four CCD cameras. H. Borrman and M. Rydmark gave a paper on computerized image processing of radiographs. Their studies were done in forensic medicine which in many ways is quite related to archaeology. The objective interpretation of bone structures and identification of different bones by sets of radiographs have certainly a great potential for archaeological applications.

In C. Roslund's investigations of the remarkable Ale's Stones (ship-setting) in Scania, an EDM was used for accurate measurements in all dimensions. The stone setting is shaped as two opposing parabolas. The focus of one parabola was found to be marked in ancient times. Its size and orientation could have rendered it possible to be used as an interpolating device for finding the precise time of summer solstice from observations of the rising midsummer sun 2,000 B.P.

C. Mortimer presented the results of archaeological, chemical and technical analyses of early medieval copper-alloy brooches from fifth- and sixth-century England. Mortimer pointed to the interesting fact that the Anglican cruciform brooches underwent considerable stylistic changes and show diversity and continuity/conservatism, whereas the Scandinavian type moves towards standardization and mass-production. Furthermore the position of brass in early-medieval cast artifact manufacture is considered. P. Northover (co-author C. Salter) presented their research on advanced image processing and digital mapping as a powerful tool for quantitative analysis in the SEM and Electron Microprobe. Imaging and quantification of microstructures of ceramics and metals are current projects at the SIMS-laboratory of the Chalmers University of Technology, host of the Scandinavian Archaeometry Center. Undersigned P. Fischer (co-authors A. Lodding - head of the SIMS-lab - and H. Odelius) introduced the results of semi-quantified SIMS-analyses of micro-inclusions in Middle and Late Bronze Age Cypriot ceramics. Analyses of micro-inclusions were suggested as a potential in provenance studies. H. Bollingberg (co-author U. Lund Hansen) described the important roll of automatic optical emission spectroscopy (OES) which after 35 years of development is in a more flourishing condition than ever before. This is partly due to continuing improvements on the excitation sources and partly to modern electronics and computer technique. The DC-arc OES instrument gives a more detailed information than a multielement analysis with laser technique. Anyhow, the advantage of analyzing the artifacts directly with a laser technique which needs nearly no preparation makes this method suitable in many cases. Trace element analyses of some bronze artifacts from the Roman import to Scandinavia were presented. D. Liversage presented a study based on the Stuttgart analyses of mainly Hungarian copper and bronze artifacts dated from the earliest use of copper to the transition to Hallstatt A. There was found a clear pattern of change through time and site.

N. Abrahamsen and N. Breiner gave a review of the potentials and problems of archaeomagnetism for magnetic dating and surveying. The rapid change of the magnetic inclination in Denmark between 1,300-1,600 A.D. resulted in datings of Danish hearths. Furthermore examples of mapping of iron-age slags and medieval tile kilns in Denmark were presented. A second paper given by N. Abrahamsen, T. Sigurdsson and J. Frandsen recorded the positive results of combined surface magnetic survey and georadar measurements in search of the farm buildings of the medieval Kalo Castle in Denmark. For the georadar survey, light-weight, portable equipment was used. I. Hedley and J.-J. Wagner presented the results of an electrical resistivity and magnetic survey of an Swiss Iron Age hill fort with an estimated settlement area of around 7,000 m^2. Afforestation and modern metal junk caused considerable problems. However, the conclusions of the geophysical survey are in broad agreement with the results from a series of test pits dug on the site. E. Lund demonstrated the Topometer, a surveying device of his own design. The instrument is mainly based on mechanical components using a steel tape. It offers the possibility of fast and accurate direct-mapping. A plan of a stone cist both in the horizontal plane and section was shown as an example.

M. Rowe, J. Russ and M. Hyman gave a fascinating example of advanced ^{14}C measurements applied to ancient rock paintings. His report described the progress of their new extraction technique which allows radiocarbon dates to be obtained from rock paintings and paintings on limestone walls in which organic matter was added to the paint as binder. Utilizing a statically-operated, low-temperature, low pressure plasma, organic matter from the paints was extracted and ^{14}C analyzed by an accelerator mass spectrometer. This technique was applied to portions of pictographs from the Lower Pecos region of southwest Texas. The dates obtained are in accord with that expected on the basis of archaeological inference (between 3-4,000 B.P.). A. Brathen gave a short introduction to the possibilities of dendrochronology exemplified by results from his own research on Swedish timber. He pointed out the necessity to store old timber from buildings when substituted by modern wood in order to acquire sufficient dendrochronological data.

R. Rottländer presented his research on ancient measuring units. He counter-proofed the erroneous opinion that ancient measures have an accuracy of at best 1%. A spread of maximal 0.2% within each measure is ascertained. The "Nippur-Ell" seems to represent a measure from which a multiplicity of other ancient measures could have emanated. During the symposium he was pleased to discover in an antique shop an early Swedish measure which happened to strengthen some of his statements.

The material presented and discussed at the SAC symposium was practically all fresh, highly topical and of a pioneering spirit. The juxtaposition of widely different scientific disciplines, in an exchange of experiences between specialists provided strong and lasting stimulus to further efforts in modern archaeometry.

Position Announcement

Winterthur Museum, Garden and Library, a world renowned museum of early American decorative arts and horticulture, invites applications for a Museum Scientist. The responsibilities address three key areas: conserving the Museum's extensive collections, teaching in the Winterthur/University of Delaware Art Conservation Program (ACP), and engaging in productive professional activities, including research.

The Museum Scientist will be responsible for the use, maintenance and scheduling of the analytical instrumentation, specifically light and SEM (Phillips 501 scanning electron microscope) microscopy; process analytical requests from staff and students, develop collaborative research projects with conservators and curators, as well as teach microscopy in the ACP. A Ph.D. in biological or physical science is required plus 8-10 years experience. Specialization in some area of microscopy (SEM, pigment, fibers, wood, metallography) preferred; experience in other analytical techniques (e.g. XRF, FTIR, etc.) desirable. Sallary commensurate with experience.

If interested, send resume stating salary history by April 1 to Human Resources Division, Winterthur, Winterthur, Delaware 19735, USA.

Meetings Calendar

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

New listings are marked by a *; new information for previous listings indicated by a +.

1992

* Feb 26-27. The Origin of Modern Humans and the Impact of Science-Based Dating. London, UK. C.A. Johnson, The Royal Society, 6 Carlton House Terrace, London, SW1Y 5AG, UK.
* Feb 26-29. Interdisciplinary Conference on the Columbian Quincentenary. Baton Rouge, Louisiana. Arnulfo G. Ramirez, Louisiana State University, Baton Rouge, LA 70803, USA.

+ March 9-13. PITTCON '92 (43rd Pittsburgh Conference & Exposition on Analytical Chemistry and Applied Spectroscopy). New Orleans, Louisiana, USA. W. Richard Howe, Exposition Chairman, Pittsburgh Conference, 300 Penn Center Blvd., Suite 332, Pittsburgh, PA 15235, USA. Includes symposium: Exploration and preservation of ancient art with chemistry (archaeometry), arranged by G.L. Vassilaros; keynote address - Neutron Activation Analysis: Its Impact on Archaeology: Some Case Studies, by J. Yellin, Hebrew University.
+ March 23-27. International Archaeometry Symposium. Los Angeles. Dr. Pieter Meyers, Los Angeles County Museum of Art, 5905 Wilshire Boulevard, Los Angeles, California 90036, USA. Includes over 200 papers and posters in sessions on: Study of human and animal bones; Dating of organic materials; Dating of inorganic materials; Mathematical methods and data management; Ancient technology and provenance of metals; Ancient technology and provenance of non-metals; Study of organic materials and residues; Pre-Columbian archaeometry; Prospection and geoarchaeology. Social events: Welcome and pre-registration, Fowler Museum of Cultural History, Sunday 4-8; Reception at Fowler Museum, presented by Archaeological Institute, UCLA, Monday 6-9; Reception at LA County Museum of Art, Tuesday 7-10; Reception at J. Paul Getty Museum, Wednesday, 7-10; Symposium banquet, Thursday, 6:30-12.

* March 23-27. AGU Chapman Conference on Climate, Volcanism, and Global Change. Hilo, Hawaii. Stephen Self, Department of Geology and Geophysics, University of Hawaii at Manoa, Honolulu, HI 96822, USA.

March 27-29. Computer Applications and Quantitative Methods in Archaeology. Aarhus, Denmark. Torsten Madsen, Institute of Prehistoric Archaeology, Moesgard, Dk-8270, Hojbjerg, Denmark (tel 45-86272433, ext. 225; fax 45-86272378).

April 8-12. Society for American Archaeology, Annual Meeting. Pittsburgh, Pennsylvania. Society for American Archaeology, 1511 K St., NW, Suite 716, Washington DC, USA; tel: 202-223-9774.

* April 27-May 2. Materials Research Society Spring meeting. San Francisco, California, USA. Merry Geil, MRS, 9800 McKnight Road, Pittsburgh, PA 15237, USA; tel 412-367-3003.
* May 11-15. American Geophysical Union Spring Meeting. Montreal, Canada. Brenda Weaver, AGU, 2000 Florida Ave., NW, Washington DC 20009, USA; tel 202-462-6903.

May 17-23. International Work-Group for Palaeoethnobotany. Kiel. Dr. Helmut Kroll, Institut für Ur- und Frühgeschichte, Olshausenstrasse 40, D-2300 Kiel 1, Germany; tel: 0431-880-2338.

* June 8-13. 4th International conference on Ground Penetrating Radar. Rovaniemi, Finland. Pauli Hanninen, Geological Survey of Finland, Neulaniementie 5, SF-70210 Kuopio, Finaland; fax 358-71-205-215.
* June 9-11. 6th International Working Conference on Scientific and Statistical Database Management. Switzerland. James C. French, Institute for Parallel Computation, School of Engineering and Applied Science, Thornton Hall, University of Virginia, Charlottesville VA 22901, USA; e-mail: french @virginia.edu.
* June 18-21. ABC: America Before Columbus - Columbian Quincentenary Conference; sponsored by the New England Antiquities Research Association. Providence, Rhode Island. Suzanne Carlson, 2 Oxford Place, Worcester, MA 01609; tel 508-752-3490; fax 401-949-5342. This conference will review evidence of pre-Columbian trans-oceanic contact.
* June 22-26. 5th International Meeting on Statistical Climatology. Toronto, Canada. F.W. Zwiers, Numerical Modeling Division, Canadian Climate Centre, 4905 Dufferin St., Downsview, Ontario, Canada M3H 5T4.
* June 22-26. International Conference on Environmental Change; sponsored by Ente Colombo '92. Genoa, Italy. General Secretariat, c/o Ente Colombo '92,

Via Sottoripa 5, Palazzo Sera Gerace, 16123 Genova, Italia; tel 10-284111; fax 10-292693.

* July 3-5. Symposium on Subglacial Processes, Sediments and Landforms. Northern Ireland. George F. Dardis, Sedimentology and Palaeobiologiy Laboratory, AHEC, East Road, Cambridge, CB1 1PT, UK; fax 0223-352973.
* July 6-10. 36th Annual Meeting of the Australian Mathematical Society. Perth, Australia. W.S. Perriman, School of Math and Statistics, Curtin University of Technology, Bentley, WA 6102, Australia; email: tsiewpf@ cc.curtin.edu.au.
* July 8-11. EUROBIC I: 1st European Bioinorganic Conference. Newcastle upon Tyne, UK. Dr. John Gibson, The Royal Society of Chemistry, Burlington House, London W1V 0BN, UK; tel 071-437-8656; telex 268001; fax 071-437-8883.
* July 13-17. 10th International Conference on Solid State Dosimetry. Washington, DC. Dr. S. McKeever, 10th SSD Conference, Department of Physics, Oklahoma State University, Stillwater OK 74075, USA.
* Aug. 9-14. 15th International Conference on Organometallic Chemistry. Warsaw. Prof. Dr. S. Pasynkiewicz, Warsaw Technical University, Faculty of Chemistry, Koszykowa 75, 00-662 Warsaw, Poland.
* Aug. 9-19. 27th Congress of the International Geographical Union. Washington, DC. Anthony R. de Sousa, Secretary-General, 27th International Geographical Congress, 1145 17th St., NW, Washington, DC 20036, USA.
* Aug. 23-28. 21st European Congress on Molecular Spectroscopy. Vienna. E.M. Schaup, c/o Inter-Convention, Austria Center Vienna, A-1450 Vienna, Austria; tel 43-222-2369-2647; fax 43-222-2369-648; telex: 11 1803 icos a.

\+ Aug. 24-Sept. 3. 29th International Geological Congress. Kyoto, Japan. Secretary General, IGC-92 Office, PO Box 65, Tsukuba, Ibaraki 305, Japan; tel 81-298-54-3627; fax 81-298-54-3629; telex 3652511 GSJJ. Includes symposia: Glacial history of the Earth; Global warming and its impact on environments. Quaternary Studies symposia include: Interactions of climatic, glacial and sea-level changes during the last climatic cycle; Human dispersal in the changing world since the last ice age; Quaternary environmental changes. Geochronology symposia include: Methods of dating geologically very young materials; Thermochronology using fission-track technique.

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

* Sept. 4-6. 4th Nordic TAG (Theoretical Archaeology Group) Conference. Helsinki. TAG/Ari Siiriainen, Department of Archaeology, University of Helsinki, Meritullinkatu 1 A 4, 00170 Helsinki, Finland, siiriainen@cc.helsinki.fi (Internet), siiriainen@ finuh (Earn/Bitnet). Theme of the conference: The Archaeologist and His/Her Reality: Time and Change.
* Sept. 14-18. 20th European Meeting of Statisticians. Bath. R. Sibson, School of Mathematics, Univestity of Bath, Claverton Down, Bath BA2 7AY, UK.
* Nov. 12-14. Trade and Discovery: The Scientific Study of Artefacts from Post-Medieval Europe and Beyond. Duncan Hook, Department of Scientific Research, British Museum, London WC1B 3DG, UK. Abstract deadline: 5/31/92.

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

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

* May 15-19. Geological Association of Canada/ Mineralogical Association of Canada, Annual Meeting. Edmonton. J.W. Kramers, Alberta Geological Survey, Box 8330, Station F, Edmonton, Alberta, Canada T6H 5X2; tel 403-43807644.

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

* Aug. 9-12. Joint Statistical Meetings. San Francisco, California. American Statistical Association, 1429 Duke St., Alexandria, Virginia 22314-3402, USA.
* Aug. 25-Sept. 3. 49th Biennial Session of the International Statistical Institute. Firenze, Italy. ISI Permanent Office, 428 Prinses Beatrixlaan, PO Box 950, 2270 AZ Voorburg, Netherlands.

Sept. 10-17. 13th Congress, International Union of Anthropological and Ethnological Sciences. Mexico, D.F., Mexico. Linda Manzanilla, Instituto de Investigaciones Antropologicas, Universidad Nacional Autonoma de Mexico, Ciudad Universitaria, Coyoacan, D.F. 04510, Mexico. Theme: Cultural and biological dimensions of global change.

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

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