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SAS News

1993 SAS Election: Nominations Call

In the Spring of 1993, the SAS will hold elections for the Offices of President-elect and Secretary-Treasurer, for two year terms of office. At the end of the two year (1993-1995) period, the President-elect will succeed as SAS President for a two-year term (1995-1997). According to the SAS By-laws, the SAS Executive Board serves as the Nominating Committee and is authorized to nominate at least one name for the Office of President-elect and one name for the Office of the Secretary-Treasurer by February 1 of the year in which the election is to be held. The By-laws also stipulate that any current SAS member receiving a minimum of ten (10) nominations from current SAS members, communicated to the SAS President on or before February 1, shall be placed on the ballot along with the individual(s) nominated by the Executive Board. All prospective nominees must indicate in writing their willingness to serve as an officer of the Society.

The SAS Executive Board, acting as a Nominating Committee, hereby solicits nominations for the Offices of President-elect and Secretary-Treasurer either in form of a formal nomination made by ten SAS members or in the form of informal suggestions as to SAS members that the Board might nominate. Formal nominations or suggestions should be communicated to the SAS President on or before February 1, 1993.

1993 SAS Meeting: St. Louis, Missouri

The 1993 meeting of the Society for Archaeological Sciences will take place in conjunction with the meetings of the Society for American Archaeology (SAA) at the Adam's Mark Hotel in St. Louis, Missouri, April 14-18, 1993. In addition to the meeting of the SAS Executive Board and the Annual General Business Session, there will be at least one joint SAA/SAS symposium. For SAS members who are not also members of the SAA, information concerning hotel reservations and other registration details may be obtained from the Office of the SAS General Secretary. □

News of Archaeometallurgy

The Archaeometallurgy column in the *JOM, the Journal of the Mining, Metals, and Materials Society*, being conducted by Vincent Pigott, presented "Iron versus bronze for edge tools and weapons: a metallurgical view" by J.E. Rehder in the August 1992 issue (volume 44, number 8, pp. 42-46). Rehder compares the different mechanical properties of steel and bronze, which he concludes are responsible for the bronze-to-iron transition of prehistory. In an earlier column by Robert M. Ehrenreich, "Considering the impetus for the bronze-to-iron transition in prehistoric Britain" (volume 42, number 7, July 1990, pp. 36-38), Ehrenreich stated that "metallurgical analyses would indicate that the general state of bronze technology during the Late Bronze Age was actually more advanced than the level of iron technology throughout most of the Iron Age." He concluded that "Based on the metallurgical evidence, the bronze-to-iron transition in Britain was not a result of iron's mechanical superiority." Rehder emphasizes the importance of cold working as an often overlooked hardening mechanism in both metals.

Archaeometallurgy (continued on p. 10)

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A Partnership

George (Rip) Rapp, Jr., Archaeometry Laboratory, University of Minnesota

This paper addresses the partnership between archaeology on one hand and archaeometry (or archaeological science) on the other. Some individuals make a distinction between archaeometry (as the application of physics and chemistry to the solution of archaeological problems) and archaeological science (as the application of geology, biology, botany and related sciences to archaeological problems). I make no such distinction. Hence, in this paper the application of all natural sciences and technology to archaeology will be termed archaeometry.

The question of partnership is the *integration* of archaeometry into archaeology, i.e., the inclusion (or exclusion) of this subdiscipline into the main stream. On this point there is an, albeit far from perfect, analogy from geology. Geology became rock science rather than earth science 100 years ago when it excluded atmospheric, ocean, and most of hydrologic science from its domain. These other earth sciences went their own way and only very recently with questions of environmental pollution and global warming has their been any integration.

We offer here remarks made by Rip Rapp in the plenary address given at the annual meeting of the Archaeological Institute of America in 1989.

This paper presupposes that archaeology is either a discipline in its own (intellectual) right or it is an interdisciplinary amalgam but is not a mere technique for supplying raw data to behaviorists. Archaeology had its origins in the antiquarian, added the humanistic, then the behavioral components and most recently added archaeometry in its effort to understand and explain ancient lifeways. Few would deny this progression.

This paper further assumes that the following statements are an accurate base on which one can make judgments about possible futures for archaeology:

1. The archaeological record as we know it is vanishing; hence doing archaeology in the 21st century can be expected to be different from doing archaeology in the 20th century.
2. Excavation archaeology is destructive of our vanishing cultural resource base, hence nondestructive methods and analyses must be pursued wherever and whenever possible.
3. In order to explain cultural and social change archaeologists observe, meas-

ure and analyze cultural and environmental remains, hence (as a very minimum) archaeology students must learn to observe, measure and analyze *all* the relevant evidence.

4. Archaeology is not a discipline with a single set of related paradigms but rather 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. One might even suggest that the designation *archaeologist* requires an adjective or prefix, e.g., classical archaeologist, geoarchaeologist, or anthropological archaeologist.
5. Archaeometry will play an ever increasing role in the analysis and interpretation of archaeological remains.

What and where is archaeometry in 1989? What is its relevance to archaeology? The best known example of the application of physics to archaeology is radiocarbon dating. Radiocarbon dating is a very bad prototype for the relationship of archaeometry to archaeology! An excavator can send a carbon sample to a service lab and (given appropriate collection methods) utilize the results in a straightforward manner. Nearly all of the rest of archaeometry is not congruent with this paradigm. Most relationships require an active partnership.

There are increasing numbers of examples where archaeometrists work alone on the solution of archaeological problems. At the Thera Congress this past September, archaeometrists reported on dating the Minoan eruption of Thera through the analysis of sulfur in ice cores from Greenland. (Greenland ice cores are not the normal provenance of archaeologists.) There will always be information of importance to archaeology forthcoming from archaeometrists working in relative isolation but I maintain that such cases should and will be only a small percentage of the archaeometric input into archaeology, and that cooperative (i.e., partnership) arrangements will prove to be the most productive.

Early humans not only made artifacts, but they also altered the geomorphic, zoological and botanical landscapes. This human activity of landscape alteration was as much a part of early culture as religious activities. This has now been recognized, and most archaeological surveys and excavations integrate environmental with all other

investigations. Likewise most archaeometric studies of the provenance of artifact materials are well integrated into basic archaeological investigations.

Other areas of archaeometric research have not been as fully integrated. Today we view technological advancement as the *sine qua non* of progress (certainly engendering cultural change). Was it not always at least partially so? Although I have done some research on the topic (Rapp 1989) we do not know the times and places ancient craftsmen developed the capability to smelt sulfide ores. Smelting sulfide ores—a complex process—became necessary because the metal smiths were running out of the chemically simpler but much less abundant oxide copper ores. Even if we were to uncover ten times the textual material for the second and third millennium B.C., it is unlikely that we would be able to answer the question of the origin of sulfide smelting without archaeometry. Yet most of experimental archaeometry (as distinct from artifact analysis) lies well outside the current scope of archaeology (including lack of availability of NSF funding).

These examples should suffice to illustrate what this paper is concerned with. My appeal, to both archaeologists and archaeometrists, is to integrate before archaeometry goes its own way. This separation would weaken both archaeology and archaeometry.

I return now to the future of archaeology. Given the fact that today's archaeology students will do most of their productive work in the 21st century, we should not educate these students to do 20th century archaeology. We should not want to emulate the generals who are now fully prepared to fight the previous war. My central point here is that archaeometry must share directly with other subdisciplines in archaeology the responsibility of defining the scope of archaeology and determining the archaeological curriculum.

Before we turn to the education of "mainstream" archaeologists, let us consider the problem of the graduate education for archaeometrists. Alas, there is no consensus on appropriate paths for those who have one foot in dirt archaeology and one in natural science. There are a few Ph.D. programs that allow this interdisciplinary path. However, there are individuals who maintain that one must first earn not only a narrow natural science Ph.D. but also a solid scholarly reputation in a scientific discipline before trying interdisciplinary research. Parenthetically, there is a limited consensus that it is very difficult to complete the Ph.D. in a social or humanistic field and then move into archaeometric research because natural science generally requires up to six years of sequential learning in basic science and mathematics. This leaves the question of interdisciplinary graduate education still open as well as the more general need for scientific literacy on the part of all types of archaeologists. Geologists study chemistry and physics as an essential part of their education. Consequently geologists have long been able to borrow the

instruments and techniques designed by chemists and physicists and use them to study the earth. Archaeology needs archaeometry to achieve the same borrowing efficiency to study cultural remains.

Can we attain the integration of archaeometry into mainstream archaeology (including more natural science for nearly all archaeologists) with the current educational structure? Put another (more dramatic) way, how long can archaeology continue in its current mode? With sites vanishing and the cost of thorough excavations and even surveys becoming more and more prohibitive, archaeologists could, unlike geologists, run out of at least prehistoric archaeological remains in less than 100 years. In less than 100 years there will be 20 billion people on the earth. The necessary intensive agriculture will churn and re churn all but the most inhospitable land. Already archaeologists are beginning to turn from excavation to survey, from artifact studies to artifact-ecofact relationships, and from materials to models.

In the current university education and research context in the United States, archaeology is mainly incorporated into anthropology or classics departments. I submit that there are very real constraints to the integration of much archaeometry into anthropology or classics departments. In anthropology departments, graduate students must contend with cultural, social, linguistic and physical anthropology as well as with archaeology. This leads to strength in the behavioral component of archaeology but undesirable weakness in all other components of modern archaeology. I must add that a few departments (where archaeology tends to dominate the other anthropological specialties) have accomplished some real integration of archaeometry into the curriculum. The Universities of Arizona, Michigan, Washington and Wisconsin are examples.

In classics departments archaeology is not only narrowly proscribed but the requirements in Greek and Latin prevent the student from undertaking significant environmental or technical studies. (And how many classics departments—besides Indiana University—cover the Paleolithic of Greece.) I might add that it is equally hard to get any geoarchaeology into geology departments. All interdisciplinary effort goes against the grain of current university departmental structures. In enumerating some of the problems of archaeometry in anthropology and classics departments I have not even mentioned the lack of scientific laboratories.

In the integration of more archaeometry into university archaeological education I believe there are several scenarios that will be followed concurrently (we are a pluralistic society):

1. There will be a general continuation of the current structure; inertia guarantees this. Perhaps the curricula will broaden in most institutions.

2. We will establish additional archaeology departments, following in the footsteps of the rest of the modern world and Boston University in the United States.
3. In some universities we will integrate archaeology and archaeometry into interdisciplinary graduate programs such as the Center for Ancient Studies at the University of Minnesota.

In this paper I do not propose a large scale restructuring of university archaeological education in the United States. I do suggest that the establishment of more archaeology departments and formal graduate interdisciplinary programs would facilitate the integration of archaeometry into mainstream archaeology. In my opinion the most nearly ideal integration of archaeometry into archaeology has been accomplished in the Department of Archaeology at the Postgraduate and Research Institute at Deccan College, Pune, India where geoarchaeology, zooarchaeology, paleoethnobotany, and archaeological chemistry (all taught by regular faculty with graduate degrees in the natural sciences) are combined with the traditional anthropological archaeology, ethnography, etc. in a truly integrated department.

I am familiar with the arguments in this country concerning where Ph.D. graduates from archaeology departments will teach. This question is real but beyond the scope of this paper.

So far this paper has stressed problems. On the brighter side I will shift for a moment to some of the recent very real accomplishments in the integration of archaeometry into archaeology. I will mention three: first, the establishment of the new scientific laboratory at the American School of Classical Studies in Athens; second the establishment of the chair in scientific archaeology at Harvard; and third, the Pomerance award for scientific contributions to archaeology of the Archaeological Institute of America. However, I must point out that the driving force for each of these came from outside the central archaeological profession, i.e., Malcolm Wiener at the American School in Athens, Landon T. Clay at Harvard, and Leon Pomerance at AIA.

Finally, I want to make the following two proposals to strengthen the partnership (neither is wholly original with me, for example see Wiseman 1989):

1. We need to establish full partnership throughout the planning, execution, interpretation, and publication of each archaeological project. Parenthetically, William McDonald and I, representing archaeology and archaeometry respectively, on the Messenia Expedition and the Nichoria excavation had such a

partnership, but this is not the norm. We are all familiar with the many examples of archaeometric analyses of excavated material relegated to a barely referenced appendix. In publishing the Nichoria excavation we put all of the scientific analyses up front in volume 1 (Rapp and Aschenbrenner 1978) to underpin all later archaeological interpretations. It appears that this has yet to establish a trend.

2. Because graduate education and research will influence, if not direct, the course of archaeology in the coming decades we need to seek solutions to the integration of the humanistic, behavioral, and natural science components of archaeology into something more holistic. The establishment of additional archaeology departments and interdisciplinary graduate programs would help.

Thank you for your attention to this gentle polemic.

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Archaeometry Offer

The special offer for back issues of the journal *Archaeometry* announced in the last issue of the *SAS Bulletin* omitted an address! The address to order is: Archaeometry, Research Laboratory for Archaeology and the History of Art, Oxford University, 6 Keble Road, Oxford OX1 3QJ, England. □

Laboratory Profile

Archaeometric Laboratory, Department of Chemistry, University of Toronto

Archaeometric work in the Chemistry Department, University of Toronto, was initiated late in the 1970's. At that time it had become clear that many antiquities and excavation sites world-wide, and especially in the Third World, are undergoing extensive, progressive and irreversible deterioration. The University of Toronto group is concerned with identification of principal physico-chemical processes which are responsible for this deterioration. The work was propelled from the onset by the genuine interest of the archaeometric group, with some of its members shown in Figure 1. The field of archaeological sciences is almost ideally suited for such studies because specialists in it are well versed in relevant disciplines. However, the problems of the degradation of ancient monuments, and especially their global nature, received an inadequate attention in the past, and only relatively few specialists in archaeological science choose to pursue their studies in this direction. Thus, the Proceedings of the last two International Symposia in Archaeometry, which displayed remarkable advances and versatility of archaeological scientists, failed to include a single article on the nature of the deterioration of ancient monuments. Even the subdiscipline which deals with such deterioration is not adequately labelled as yet. Most properly it should be referred to as Environmental Archaeological Science because most of such deteriorations occur as a result of the impact of modern environment upon excavated antiquities. Since such notation is lengthy, one can refer to it as Environmental Archaeometry, for "Archaeometry" and "Archaeological

Science" are often used interchangeably, although strictly speaking the two terms are not synonymous. The former notation is sometimes accepted in Europe; for example, the E.C. (European Community) Environment R&D programme is now actively soliciting new research proposals in what it refers to as Environmental Archaeometry. It was pointed out, however, that there is a problem with this term because it sounds too much like "Environmental Archaeology", a well advanced discipline, which is a bird of an entirely different feather, dealing as it does with the nature of the environment of ancients, and in deducing archaeological, cultural and historical information from such data. For lack of a better word, it has been suggested (Burns et al. 1989; Burns 1991, 1992) that one refers to the subdiscipline which deals with studies of fundamental environmental processes which are now, or may become, responsible for deterioration of our culture heritage anywhere in the world as *eco-archaeometry*.

By way of an example of the eco-archaeometric approach employed by the University of Toronto group, one may consider recent studies of the salinization of large areas of archaeological monuments in the Nile Valley (Fig. 2). This phenomenon had not been expected by any party involved and caused a serious concern in archaeological circles; square kilometers of antiquities were severely affected. In this case, the computer modeling of environmental processes showed that salinization was due to the flow of saline water from the nearby irrigated fields toward the monuments, where practically all of it evaporates (Billard and Burns 1980). Although this work (Billard and Burns 1980) explained the dynamics of salinization, it did not address itself to the question as to why the evaporating water under the monuments was very saline in the first place. This question is important, however, because the rate of salinization of monuments is proportioned to the ground water salinity. In order to find the answer for this question, the atomic absorption (AA) and the inductively coupled plasma (ICP) techniques were used, and it was shown that the high water salinity was due to high ($89 \pm 3\%$) evapotranspiration of water over the irrigated fields (Burns et al. 1990). Such findings justified designing large engineering projects to desalinize the area and redirected efforts of excavating archaeologists.

In another example, concern was expressed about the recent rapid deterioration of the most beautiful yet extremely fragile tomb of Queen Nefertari, Valley of the Queens, Upper Egypt. It was both essential and challenging to identify reasons why such a fragile monument survived up to the present day. Only an exact answer to this question could optimize designs of conservation work which would



Figure 1. The eco-archaeometric group at the Department of Chemistry, University of Toronto, Front row, left to right, N.N. Dookeran, J.E. Smeaton and K.M. Matsui, graduate students. Back row, Professor G. Burns (holding the dog), Drs. T.C. Billard, R.M. Potter and L.K. Cohen, research associates.

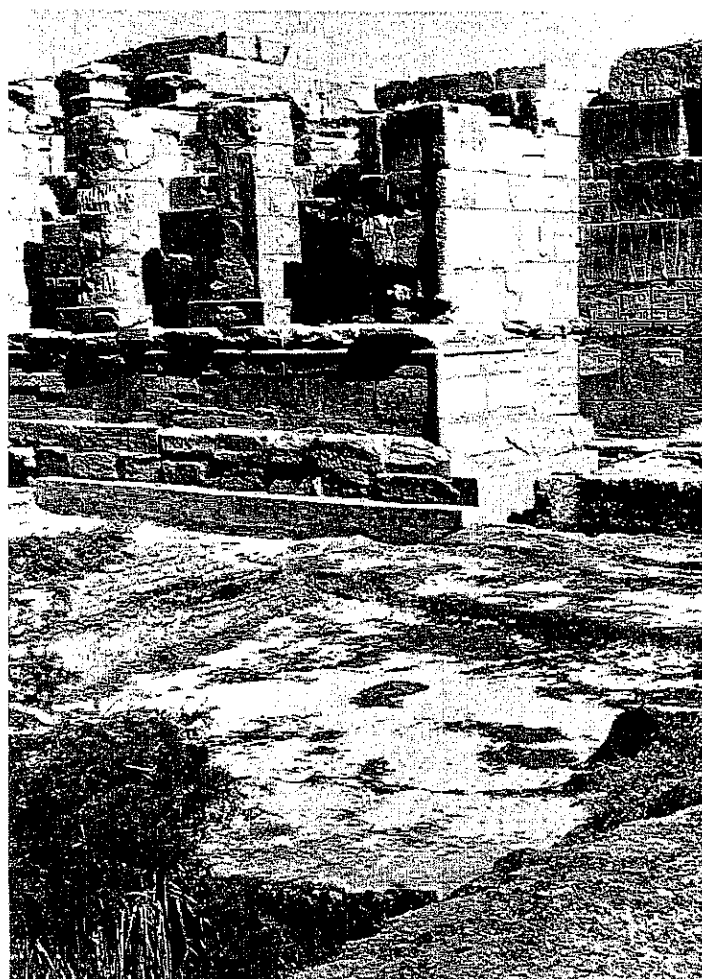


Figure 2. Ubiquitous salt deposits at the now abandoned excavation site at the Karnak Temples complex, Upper Egypt.

insure the continued survival of the tomb. In this case the eco-archaeometrist had to sear the hat of a microclimatologist; a computerized hydrothermograph was installed in the locked tomb, and it was determined that the internal temperature and humidity of the tomb appear to have been essentially constant throughout millennia of its history. Thus, the temperature in the unperturbed tomb remained constant within $\pm 1^\circ\text{C}$ during 8.5 months. This means that the tomb survived up to the present day only because of the extraordinary stability of its climate. However, both temperature and humidity were found to be easily perturbed by human activities (Burns et al. 1989). These findings redirect the efforts of conservators who are to insure that in the future human activities in the tomb are minimized to such an extent that they would not affect the microclimate of the tomb.

In the historically important tombs of Beni Hasan, Middle Egypt, the problem is a rapid development of a grey disfiguring crust which all but destroyed this significant cultural treasure. The cause for this phenomenon was

unclear; consequently, optimal methods of salvage of these monuments had not been arrived at. In a series of experiments, using first X-ray photoelectron emission spectroscopy (XPS), then electron microprobe (EM) and finally proton induced X-ray emission (PIXE) spectroscopy, it was shown that the crust is due to a combination of solid state diffusion and gas convection processes, aggravated by local microclimatic conditions (Burns and Wilson-Yang 1991).

One can see from these few examples that the eco-archaeometric work is not centered around one particular piece of equipment, such as NAA, ICP or any other. Rather, a student in eco-archaeometry may find it necessary to learn about, and use, a variety of advanced pieces of equipment. In this respect, a student in eco-archaeometry receives education and experience that is radically different from many students in "hard" sciences, who tend to work using a piece of modern equipment which is so complex that it is unreasonable for them to branch out in any way. Although narrow specialists are in demand by the modern society, there is also a great need for well rounded, broadly educated individuals who are more concerned with solving problems, as opposed to understanding the intricacies of some well-defined aspects of modern technology.

The eco-archaeometric work at the University of Toronto is complementary to that of archaeologists and conservators. It is cost-effective, because it tends to identify optimal paths for conservation of monuments and puts the conservation work on a firm scientific base. Furthermore, it helps archaeologists to insure that the cultural heritage that is so dear to them is protected.

Work in the Archaeometric Laboratory is most interested in striking collaborative agreements with other groups or agencies. Not only would it be happy to assist others in identifying fundamental processes responsible for deterioration of archaeological monuments and sites in Egypt and elsewhere, but it will be also pleased to share its projects and generate joint studies.

The most intriguing, exciting and in some cases time-consuming challenge in eco-archaeometry is to perceive for each particular monument the nature of the most important problem that leads to deterioration. Once the problem is identified, it is then to be pursued, using the equipment, technique or method, tailor made for the problem. To reflect this peculiarity of the eco-archaeometric approach, a miniature schnauzer, Tiffani, was chosen to be the mascot of the group (Fig. 1). As it turns out, she has the uncanny ability to identify the initial problem, which in her case is usually a squirrel. Once she identifies her problem she invariably chases it up a tree. With perfect accuracy she always barks up the tree in which her squirrel is chased. Never in her long career did she bark up a wrong tree. Professor Burns thinks that he is the only one in the group who could match Tiffani's performance, but the rest of the group thinks otherwise.

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Positions

University of Arizona Culture, Science and Technology Program

Tenure track Assistant Professor in the Cultural, Social and Behavioral Context of Engineering and Technology. Appointment in the College of Engineering with Joint or Adjunct appointment (i.e., Anthropology, Sociology, History, etc.). Ph.D. required. Send c.v., publications list, summary of research interests and names of three references to Search Committee, c/o Professor D.R. Uhlmann, University of Arizona, Tucson, AZ 85721. Closing date for applications is December 15, 1992. Applications by women and minority candidates encouraged. The University of Arizona is an Equal Opportunity/Affirmative Action Employer (EEO/AAE).

Harvard University, Department of Anthropology

Assistant Professor of New World archaeology starting July 1993. The successful candidate shall have a completed Ph.D. and evidence of on-going, significant research. The specific geographic area and/or time period of this research is open, but the Department is particularly interested in candidates with technical expertise, e.g., human osteology, environmental archaeology, archaeometry, or the like. Harvard particularly encourages applications from women and members of minority groups. Applications will be accepted until February 1, 1992, and should be directed to Professor Nikolaas van der Merwe, Department of Anthropology, Harvard University, Peabody Museum, 11 Divinity Avenue, Cambridge, MA 02138. EEO/AAE.

Boston University, Remote Sensing and Archaeology

Boston University announces a new tenure-track faculty position at the level of assistant or associate professor in remote sensing and archaeology, effective September 1, 1993. The professorship is named in honor of the W.M. Keck Foundation, whose award to Boston University has made the appointment possible.

The Ph.D. is required. The ideal candidate will be an archaeologist with both research and instructional background in remote sensing; he/she will have had significant field experience; successful teaching experience at the college level; and capabilities for leadership. The archaeological background of candidates may be either in Old World or New World archaeology, prehistoric or historical, and/or in an archaeological science. Send nominations or applications, including a vita and the names and addresses of three referees, by December 1, 1992, to the following address: Professor James R. Wiseman, Faculty Search Committee, Boston University, Department of Archaeology, 675 Commonwealth Avenue, Boston, MA 02215. EEO/AAE.

Savannah River Archaeological Research Program (Aiken, South Carolina, USA). University/Laboratory Cooperative Program - Student Research Participation.

Research opportunities are available at U.S. Department of Energy facilities for undergraduate students majoring in engineering, natural sciences, mathematics, computer science, or the social sciences. Participants collaborate with researchers on individual projects at the cutting edge of research and development using state-of-the-art equipment not usually found in most campus laboratories.

Ten-week appointments during the summer. Stipends are \$200/week for sophomores, \$225/week for juniors, and \$250/week for seniors. Certain travel expenses reimbursed.

Apply by 19 January 1993 to: Student Research Participation Program, Science/Engineering Education Division, Oak Ridge Institute for Science and Education, Attention: Pat Pressley, P.O. Box 117, Oak Ridge, TN 37831-0117; tel 615-576-1083. □

Cyril Stanley Smith (1903 - 1992)

Cyril Stanley Smith died peacefully at his home in Cambridge, Massachusetts, on August 25, 1992, after a long illness. He was born on October 4, 1903, in Birmingham, England. He had an early interest in experimental science. He was allowed by his parents to have a home laboratory, and worked for a year as lab assistant at King Edward's Grammar School in Camp Hill before entering the University of Birmingham in 1921 with advanced standing. There he briefly considered studying philosophy before receiving the BSc degree in 1924.

An article in a French magazine extolling the Bell Telephone Laboratory inspired him to look for a job in the United States but immigration restrictions led instead to graduate study at the Massachusetts Institute of Technology, where in 1926 he was awarded the Doctor of Science degree. He remained at MIT as a research associate in the x-ray laboratory, working under John Norton of the Physics Department, before obtaining a summer job in 1927 with the American Brass Company in Waterbury, Connecticut. This became a permanent position, in which his main task was alloy development. He became head of the Copper Alloys Research Laboratory and received some 20 patents. He married Alice Kimball in 1931 and they had two children. He returned to England to spend a year at Cambridge (1933-34) and another in London (1955-56). The occasion of his last visit to England was the annual conference of the Historical Metallurgy Society in 1984, which met a few miles from his birthplace in Birmingham.

When the war came he went to Washington to work with the War Metallurgy Committee, and in 1943 was invited to join the Manhattan Project at Los Alamos, New Mexico, to direct the preparation of fissionable metal for the atomic bomb. The decision to go to Los Alamos was not easy for

him. He told me that he went that evening to the tranquil and inspiring surroundings of the Lincoln Memorial to think it through. The years at Los Alamos were recorded by Alice Kimball Smith, who had received her doctorate in history from Yale¹. Professor Smith was awarded a Presidential Medal of Merit by President Truman for his work on the atomic bomb.

In January 1946 he founded and became first director of the Institute for the Study of Metals at the University of Chicago. This was the first academic interdisciplinary research organization in America dealing with materials. President Truman appointed him to the original nine-member General Advisory Committee to the Atomic Energy Commission that was chaired by Robert Oppenheimer. He subsequently resigned from this committee in 1952.



Photo: The MIT Museum

He served on the President's Science Advisory Committee under Dr. James Killian and Professor George Kistiakowsky, on the Advisory Committee for the Oak Ridge National Laboratory, and was a member of the Committee on Science and Public Policy of the National Academy of Sciences. The ten years from 1966 to 1976 he

served on the Council of the Smithsonian Institution.

He was the first chairman of the board of governors of *Acta Metallurgica*, a member of the founding board of editors of *Metallography*, the journal of the International Metallographic Society (now *Materials Characterization*), and a member of the editorial board of the *Bulletin of Atomic Scientists*. He was a founder and an early president of the Society for the History of Technology.

In 1961 he left Chicago to return to MIT, where he became Institute Professor with appointments in the departments of humanities and metallurgy, in order to "encourage the understanding of human history and human activity through the scientific investigation of the material record of the past." At MIT he established the Laboratory for Research on Archaeological Materials in 1967. Its success led to the founding with Professor Heather N. Lechtman ten years later of the Center for Materials Research in Archaeology and Ethnology (CMRAE), a consortium of eight Boston-area universities and museums devoted to research and graduate education in archaeometry.

Meanwhile his wife had a distinguished academic career, and became Dean of the Institute of Independent Study, later called the Bunting Institute, of Radcliffe College at Harvard University.

Professor Smith was a member of the National Academy of Sciences, the American Philosophical Society, the American Academy of Arts and Sciences and the Académie Internationale d'Histoire des Sciences as well as holding honorary membership in the Institute of Metals, the Akademie der Wissenschaften, the Indian Institute of Metals and the Institute of Metals of Japan. He received two John Simon Guggenheim Memorial Foundation fellowships, one in 1955 a historical study of the interrelation between pure science, applied science, and technology using the development of metallurgy as a particular example. The subject of the second, in 1978, was "A structural metaphor for matter and history."

He received many honors such as the Francis J. Clamer Medal of the Franklin Institute in 1952, the Pfizer Medal of the History of Science Society and the Gold Medal of the American Society of Metals in 1961, The Douglas Medal of the American Institute of Mining, Metallurgical, and Petroleum Engineers in 1963, the Leonardo da Vinci Medal of the Society for the History of Technology in 1966, the Platinum Medal of the Institute of Metals in 1970, the Sorby Medal of the International Metallographic Society in 1977, and in 1991 the Gamant Award from the American Institute of Physics for "pioneering the use of solid state physics in the study of ancient art and artifacts to reconstruct their cultural, historical, and technological significance."

Some of his papers on this subject were collected in a volume whose title, *A Search for Structure*, summarized the thrust of his work². He wrote a number of books and monographs³ and edited an unprecedented series of technolog-

ical treatises given reliable translation into English⁴. All these are essential tools in the practice of archaeo-metallurgy.

He was a prolific and thought-provoking correspondent. Those fortunate enough to receive letters from Cyril have been known to frame rather than file them. He had a gift for inspiring people. He encouraged Theodore Wertime in the writing of *The Coming of the Age of Steel*⁵; later Professor Smith joined the technological expeditions led by Wertime in 1962 and again in 1977 in search of traditional technology in Iran. Wertime with James Muhley organized a festschrift for Cyril's 80 birthday, *The Coming of the Age of Iron*⁶, for which I was technical editor. A student of his at Chicago, Radomir Pleiner, was inspired to found the Comité pour la Sidérurgie Ancienne under the UNESCO-sponsored International Union of Prehistoric and Protohistoric Sciences.

His lectures at MIT emphasized a sensual and aesthetic understanding of materials. He often brought an object to his class to be experienced and understood on many levels. He shared his own experiences of materials, as when he would tell the story of his going out into the desert outside Los Alamos, finding ore, and smelting copper on a bet with Enrico Fermi. He became Institute Professor emeritus in 1969, but continued to lecture on the history of materials and to inspire others.

His thought has had a penetrating influence on popular culture. The television series and book, *The Ascent of Man* by Jacob Bronowski, was influenced by his view of the history of metallurgy, as was the volume in the Time-Life series on *The Emergence of Man*, *The Metalsmiths*⁷, for which he was the consultant.

Professor Smith is survived by his wife, Alice Kimball Smith; a daughter, Anne Smith Denman, chairman of the Department of Anthropology at Central Washington University, Ellensburg, Washington; a son, Stuart Marchant Smith of Del Mar, California, a marine geologist at the Scripps Institution of Oceanography in La Jolla; a sister, Mary Smith of Sutton Coldfield, England; and four grandchildren.

The Cyril Stanley Smith Memorial Fund has been established at MIT to foster studies relating ancient and contemporary art and science in the materials field.

Notes

1. Alice Kimball Smith, *A Peril and a Hope*, Chicago 1965. Alice Kimball Smith and Charles Weiner, *Robert Oppenheimer, Letters and Recollections*, Cambridge USA 1980.
2. *A Search for Structures: Selected Essays on Science, Art, and History*, Cambridge USA and London (MIT Press) 1981. A bibliography of his publications to 1980 is given on pages 391-399. See also his "Retrospective Notes on a

Cyril Stanley Smith (1903 - 1992)

- Changing Profession" in *Archaeomaterials* 1 (1) Fall 1986, 3-11.
3. Professor Smith's books and monographs include:

Of Typecasting in the Sixteenth Century, New Haven (Carl Rollins for the Columbiad Club of Connecticut) 1941.

Robert Gomer and Cyril Stanley Smith, editors. *Structures and Properties of Solid Surfaces*, Chicago (University of Chicago Press), 1953.

A History of Metallography: The Development of Ideas on the Structure of Metals before 1890, Chicago (University of Chicago Press) 1960. Reprinted with additions, Cambridge USA and London (MIT Press) 1988.

Four Outstanding Researches in Metallurgical History, Philadelphia (American Society for Testing Materials) 1963.

(Editor) *The Sorby Centennial Symposium on the History of Metallurgy*, New York (Gordon and Breach) 1965.

From Art to Science: Seventy-two Objects Illustrating the Nature of Discovery, Cambridge USA (MIT Press) 1980.
 4. Translations edited by Professor Smith include:

(With Martha Teach Gnudi) *The Pirotechnia of Vannoccio Biringuccio*, New York (American Institute of Mining and Metallurgical Engineers and Yale University Press) 1942. Reprinted Cambridge USA (MIT Press) 1966.

(With A.G. Sisco) *Bergwerck-und Probierebüchlein*, New York (American Institute of Mining and Metallurgical Engineers) 1949.

(With A.G. Sisco) *Lazarus Ercker's Treatise on Ores and Assaying*, translated from the German edition of 1580, Chicago (University of Chicago Press) 1951.

(With A.G. Sisco) *Reaumur's Memoirs on Iron and Steel*, Chicago (University of Chicago Press) 1956.

(With John G. Hawthorne) *On Divers Arts: The Treatise of Theophilus*, Chicago (University of Chicago Press) 1963. Reprinted New York (Dover) 1979.

(Editor) *Sources for the History of the Science of Steel, 1532-1786*, Cambridge USA (Society for the History of Technology and The MIT Press) 1968.

(With John Hawthorne) *Mappae Clavicula, A Little Key to the World of Medieval Techniques*, Philadelphia (American Philosophical Society) 1974.

(Editor, with W. Rozanski) *Officina Ferraria, A Polish Poem of 1612 Describing the Noble Craft of Ironwork* by Walenty Rozdzienski, Cambridge USA (Society for the History of Technology and MIT Press) 1976.

(Editor) *Kodo Zuroku, Illustrated Book on the Smelting of Copper* by Masuda Tsuna, Norwalk, Connecticut (Burndy Library) 1983.
 5. Theodore A. Wertime, *The Coming of the Age of Steel*, Chicago (University of Chicago Press) 1962.

6. Theodore A. Wertime and James D. Muhley, *The Coming of the Age of Iron*, New Haven and London (Yale University Press) 1980.
 7. Jacob Bronowski, *The Ascent of Man*, London (British Broadcasting Corporation) 1973; Boston (Little Brown) 1974.
- Percy Knauth, *The Metalsmiths*, New York (Time-Life Books) 1974.

Contributed by Martha Goodway, Conservation Analytical Laboratory, Smithsonian Institution, Washington, D.C. 20560, USA.

Archaeometallurgy (continued from front page)

The Editorial Board of *Industrial Archaeology and Archaeometry News* invites contributions from their foreign colleagues, particularly short and topical reports on your activities and information on forthcoming events. The mailing list is also being updated. If you have any items, or if you wish to subscribe, write Katalin T. Biro, editor, Hungarian National Museum, Department of Information, H-1425 Budapest 9., Pf. 124., Konyves Kalman krt. 40.

A bibliography of more than two thousand items relating to ancient iron making in France has just been announced. The *Bibliographie Mines et Métallurgie anciennes, Volume I - Le Fer*, compiled under the direction of Michel Mangin, is available in hard copy for 80FF or on disk for 40FF (specify Macintosh (Word 4) or PC, 3- or 5-inch) from Michel Mangin, Institut d'archéologie, Faculté des Lettres, 30 rue Mégevand, 25030 Besançon cedex, France. A supplement covering items from 1989-1992 will appear in 1993. The forthcoming volume will cover the nonferrous metals.

A comprehensive study of iron making in Gaul during the Roman period and the middle ages has been published by Michel Mangin, Ingo Keesmann, Wolfram Birke and Alain Ploquin. *Mines et Métallurgie chez les Éduens, Le District sidérurgique antique et médiéval du Morvan Aulois*, covers 140 mining sites as well as 200 smelting sites and gives chemical analyses relating slags to ores. It is No. 456 in the *Annales Littéraires de L'Université de Besançon*. No. 38 of the *Série Archeologie*, has 365 pages and is available for 370FF through Diffusion Les Belles Lettres, 9 Boulevard Raspail, 75006 Paris, France.

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

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Conference Report

Archaeometry '92: 28th International Symposium on Archaeometry. Los Angeles, California, 23-27 March 1992.

Archaeometry '92 was held at the Fowler Museum of Cultural History, on the campus of UCLA. The members of the local organizing committee were: Pieter Meyers (chair), Los Angeles County Museum of Art; David Scott, The Getty Conservation Institute; Timothy Earle, University of California, Los Angeles. A diverse program was ensured by the 218 delegates from 26 countries. The symposium included 77 oral presentations and 110 posters by 377 co-authors (none concurrent, thankfully) in the following sessions: Study of Human and Animal Bones; Study of Organic Materials and Residues; Dating of Organic Materials; Dating of Inorganic Materials; Mathematical Methods and Data Management; Ancient Technology and Provenance of Metals; Ancient Technology and Provenance of Nonmetals; Prospection and Geoarchaeology. These sessions are reviewed below. The theme session on Precolumbian Archaeometry is not reviewed here, but papers from this session will be published. There will not, however, be a publication of proceedings containing other papers from the symposium.

The meeting was the usual success, with pleasant weather during the week (after the torrential downpour that welcomed us).

When we were not busy with the technical presentations, the social events kept us talking about archaeometry the remainder of our waking hours. We were wine and dined with receptions at the UCLA Institute of Archaeology, The Los Angeles County Museum of Art, The J. Paul Getty Museum, and the Symposium Banquet.

Following are reports on the various sessions.

DATING

Rob Sternberg, Department of Geosciences, Franklin and Marshall College

The dating papers were, as is customary for the Archaeometry Symposia, divided into two groups: dating of organic materials, and dating of inorganic materials. The first group was represented by seven papers, including three oral presentations and four posters. The ten papers in the inorganic dating sessions included four oral presentations and six posters. Also, six papers dealing with inorganic dating were placed in other sessions.

The papers can roughly be categorized as follows: new dating methods (2 papers); conventional applications of established methods (8); extensions/refinements of established methods (7); use of established methods with new

materials/applications (6). A few representative papers in each of these areas are briefly discussed in the following comments.

New dating methods. Development of new methods is often dependent on instrumentation. Freeman reported on the use of diffused atmospheric nitrogen depth profiles in chipped lithics, using secondary ion mass spectrometry (SIMS). Hancock et al. discussed the chronological differentiation of northeastern North American archaeological sites using copper artifacts, using instrumental neutron activation analysis (INAA) to distinguish between native copper and European copper and brass. This paper was actually presented in the Metals session. I found it to be an interesting method of relative dating, which we should not forget can solve some archaeological problems as well as absolute dates.

Conventional applications. These eight papers, some involved with more than one method, dealt with ^{14}C dating (3), thermoluminescence (2), electron spin resonance (2), uranium series (1), and obsidian hydration (1). Of course, most significant advances in archaeological chronologies come from diligent application of established methods. Among the papers in this category, Tiemei et al. dated the Jingniushan paleoanthropological site with uranium-series and ESR; if the *Homo sapiens* bones are contemporary with the geologic strata actually dated to 255 ka, this would represent the earliest *Homo sapiens* ever found in China. The paper by Ziolkowski and Krzanowski, examining the radiocarbon chronology of the Central Andes through the compilation of over 1,200 dates, also represents a trend that I think will become increasingly important—the ability to make new inferences from large databases of information which will become publicly available in accessible computerized formats.

Extensions/refinements of established methods. Use of improved instrumentation in extended time periods or new geographic areas expands the scope of the various methods. Becker extended the European dendrochronological record back to 11,370 years B.P., into the Late Glacial period. Wolfman and Dodson described the use of archaeomagnetism in South America, a geographic region where this method had been little used previously. Gale described how uranium-series dating can now be done by counting atoms via mass spectrometry, rather than by measuring the emitted alpha particles, enabling the technique to be used with samples as old as 500,000 years.

New materials/applications. This area included several interesting papers, especially in new applications of radiocarbon dating. Berger et al. showed some beautiful slides of Chinese textiles to illustrate the ^{14}C dating of medieval Chinese carpets. Hedges and Tiemei discussed

how accelerator ^{14}C dating of carbonized rice husks used in the temper of Chinese pottery not only directly dated the manufacture of the pottery, but also yielded the earliest record of rice cultivation in China, and perhaps in the world. Berger et al. dated the oldest yet Irish mortared house by ^{14}C dating of charcoal remaining in the mortar. Another paper which demonstrated the power of techniques that can handle small samples was given by Beukens et al., who derived atom mass spectrometry (AMS) ^{14}C dates from organic material preserved within native copper tools by copper salts. Finally, since I am an archaeomagnetist, one of the papers I found most intriguing was by Beyer, who suggested that buildings at Monte Albán in Mexico were oriented to magnetic north using a magnetic compass, thus providing an architectural archaeomagnetic indicator.

My apologies to the other authors whose papers I have not specifically mentioned. The papers cited above give some flavor for the many interesting aspects of chronometric dating methods typically covered at the Archaeometry Symposia.

CHARACTERIZATION OF NON-METALS

Jim Burton, Laboratory for Archaeological Chemistry,
University of Wisconsin

The majority of the 1963 volume, *Science in Archaeology*, edited by Brothwell and Higgs, discusses the analysis of organic remains: pollen, wood, fiber, bone, shell, coprolites, hair, blood, skin, and other preserved tissues. The analyses of lithics, ceramics, metals, and glass were assigned collectively to a single section. In the proceedings of the 25th International Symposium on Archaeometry, published a quarter century later, this pattern had reversed with only a single section devoted to the analysis of organic material and bone. Henderson's *Scientific Analysis in Archaeology*, published the same year, contains no discussion of biological remains.

Although in this year's symposium we still have only two sections, one devoted to Human and Animal Bones, the other to Organic Materials and Residues, there appears to be a trend toward renewed recognition of organic remains as a viable subject for archaeometric analyses.

Study of Human and Animal Bones

Oral session. Douglas Price opened the session, reporting on the use of strontium isotopes to identify immigrants at the archaeological site of Grasshopper, a 14th century pueblo in east-central Arizona. Isotopic $\text{Sr}^{87}/\text{Sr}^{86}$ ratios of tooth enamel, reflecting the isotopic signature of the geology of place of residence during childhood, when the enamel developed, were compared to isotopic ratios of bone, reflecting the geology of adult residence. Individuals with large differences between bone and tooth ratios were interpreted as immigrants into the region.

Erv Taylor presented recent work on the identification of burned bone by looking at the amino acid ratios of collagen and non-collagenous proteins. Current diagnostic criteria are mostly visual and highly subjective, but Taylor's work, with Ed Hare, suggests that the GLY/GLU ratio may be used to assess objectively the extent of thermal alteration.

Stan Ambrose presented two methods for treating collagen to obtain biological isotopic measurements of carbon and nitrogen in fossil bones. Treating finely particulate bone for a short time in relatively strong (1-molar HCl) acid and a contrasting method, soaking larger particles in weaker acid for several days, gave similar collagen yields, but the stronger acid produced collagen with lower carbon and nitrogen concentrations and more salt. The weaker acid treatment was recommended for cases with marginal collagen preservation. Reliable isotopic data were derived from Neanderthal samples, indicating a predominantly meat diet, and from Upper Pleistocene archaeofauna.

Mark Pollard closed the session on bones with the results of a study with A. M. Child and R. D. Gillard on the effects of a collagenase-producing soil bacterium, *Pseudomonas Fluorescence*, on bone. Although the effects were dependent upon soil temperature and pH, a strong effect was found on the racemization rates of amino acids from the collagen. Some samples had D/L ratios indicating a racemization "age" of 50 years after less than three months.

Posters. Glyn Davies and Barbara Ottaway examined archaeological bone tools metrically as well as typologically and included experimental data that go beyond typology to assess technological and functional attributes of the artifacts. Metric analysis of Neolithic spatula-type tools found three groups, not related to species or element, which were believed to be functional categories.

B. Dogan described his metrical analysis of domestic and modern wild pig bones. His work suggests it may be possible to evaluate where and when pig domestication first occurred.

T. A. Elliott examined the uptake of uranium and strontium by bone under a variety of experimental conditions, as well as examining their distributions in archaeological bone. He found that diagenetic addition of these elements can produce homogeneous distributions, such that homogeneity can not be reliably used as evidence against post-depositional contamination.

N. Kayaturk and S. Demirci reported trace element analyses for a suite of fossil bones from archaeological sites in Turkey. X-ray diffraction studies, measuring both interior and exterior concentrations, and monitoring the Ca/F ratios, were used as tests for bone quality.

Julia Lee-Thorp, N. J. van der Merwe, and J. S. Raymond traced the contributions of various food sources through succeeding periods of southwestern Ecuadorian prehistory

through stable carbon and nitrogen isotopic analysis. Their results suggest that terrestrial C_3 foods were dominant in the Early Formative, that marine foods became significant during the Machalilla Phase, and that maize didn't assume importance until the Guangala Phase and decreased in importance later.

Reiner R. R. Protsch von Zeiten reported radiocarbon-collagen dating and morphological data from thirty-four cemeteries for Merovingian populations from the second to the ninth centuries A.D. in Southern Germany. He used morphological data to differentiate between the tribes of the Franks and Alamans, and radiometric data to establish the time of habitation of each tribe.

B. Rohl, Z. A. Stos-Gale, D. Miles, and N. H. Gale used the difference in strontium isotopic composition between sea water (0.70906) and most terrestrial environments (>0.71000) to distinguish between elephant and walrus ivory. They also reported efforts to distinguish marbles on the basis of strontium and neodymium isotopes.

G. Turner-Walker examined through a variety of chemical and physical methods the postmortem alteration of bone, including changes in the microstructure and the physico-mechanical properties as well as changes in composition. A key factor in the condition of archaeological bone is the ratio of organic and mineral components. The organic component, principally collagen, slowly degrades in alkaline burial environments, while the mineral component, principally hydroxyapatite, slowly dissolves in acidic environments.

Study of Organic Materials and Residues

Oral Session. Barry Fankhauser, presenting for Tom Loy, began the session, discussing Loy's work on amplification, using the polymerase chain reaction (PCR), of DNA residues from prehistoric stone tools. PCR amplification of residue from a chert biface bearing hair and blood attributed to *Bison bison* was examined by electrophoresis. He was able to match the electrophoresis bands, without sequencing the DNA base pairs, to bands produced from tissue extracts of modern and extinct bison and other bovids.

P. H. Bethell, R. P. Evershed, and L. J. Goad applied gas chromatography with mass spectrometry (GC/MS) to identify heavily degraded fecal material, not identifiable with conventional means. They reported success through determining the presence of 5b-stanol derived from the mammalian gastrointestinal tract, specifically 5b-cholestanol and 5b-stigmastanol from cholesterol and sitosterol, respectively. They also offered an apt name for such studies, "molecular archaeology".

Francis McLaren reported on continuing work with J. Evans and G. C. Hilman, using infrared spectroscopy to analyze charred plant residues for compounds characteristic of specific genera. This study focused on the

identification of *Prunus* species among charred stoned fruits of Palaeolithic age through the recognition of diagnostic hydrocyanide bonds in infrared spectra. One exemplary aspect of the authors' work is an emphasis on developing methods that, while reliable, are also inexpensive and accessible to archaeologists.

R. D. Gillard, with S. M. Hardman and D. Watkinson, applied scanning electron microscopy, energy-dispersive X-ray analysis, and Fourier transform infrared spectroscopy to the examination of natural fibers preserved by the replacement of their original organic matrix by an inorganic one. Metal corrosion products, particularly iron and copper salts from iron and bronze respectively, create surface casts and solid, three-dimensional replacements, sometimes preserving a great deal of textile structure. Experimental studies of the mechanisms for such replacements were also discussed.

Michael Marchbanks described ceramics from Tiwanaku, Bolivia, then illustrated a computer program to perform cluster analyses and principal component analysis of multivariate data. Marchbanks examined lipids of quinoa, llama, and corn by GC/MS and believes that similar lipids from extracts of Tiwanaku ceramics indicate llama sacrifice and chicha rituals.

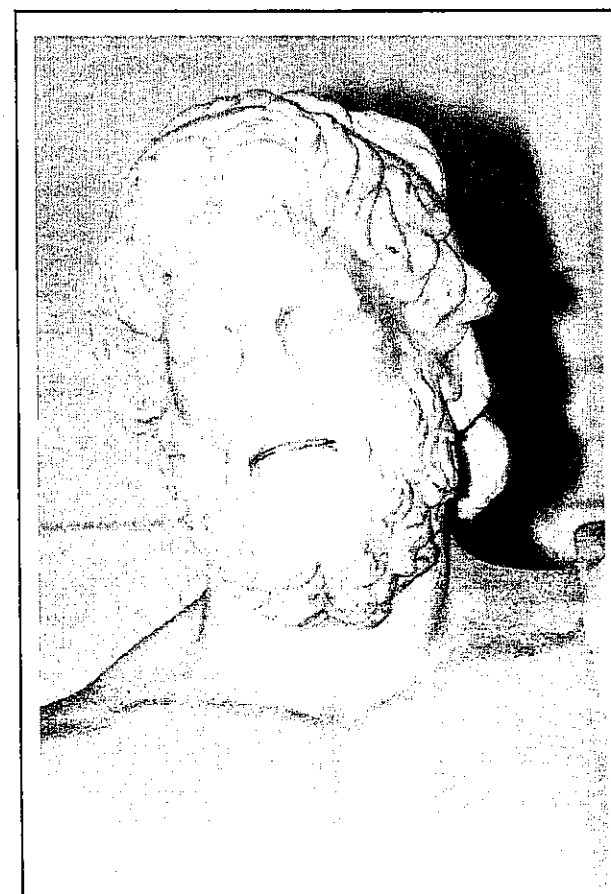
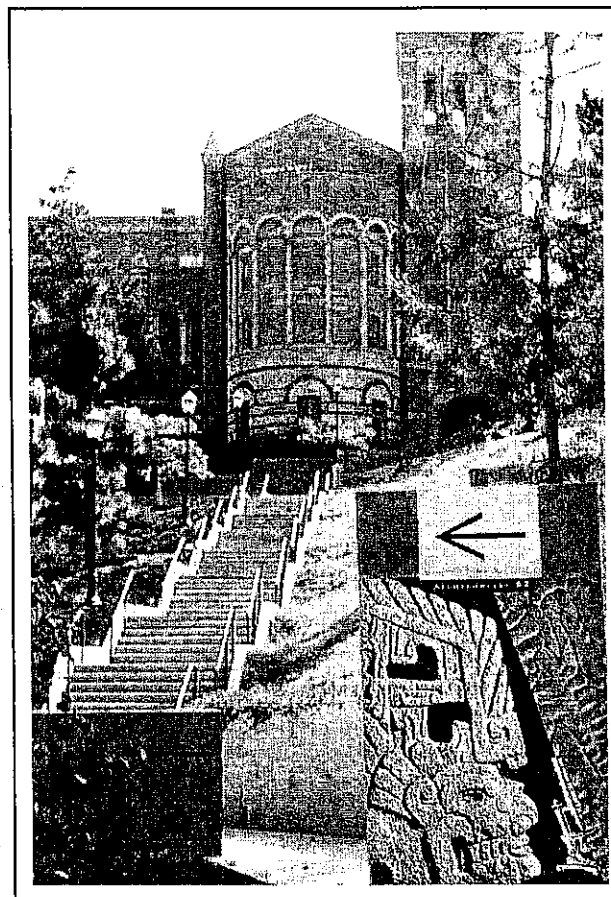
Tanya Oudemans reported on progress in trying to determine vessel function through analysis of solid organic residues. The work, with J. J. Boon and R. E. Botto, used various analytical methods but focused primarily on pyrolysis techniques. Analyzing the mass spectra of pyrolysis products, they could identify polynuclear aromatics (e.g. naphtha and phenanthracenes from soot), free fatty acids, cholesterol, and products indicative of proteins, aliphatic lipid networks, and polysaccharides. Using ^{13}C NMR they were able to resolve further the polysaccharides and aliphatic lipids. Their work also suggests that surface chars may represent the last use of the vessel and are not complicated by residues from earlier use.

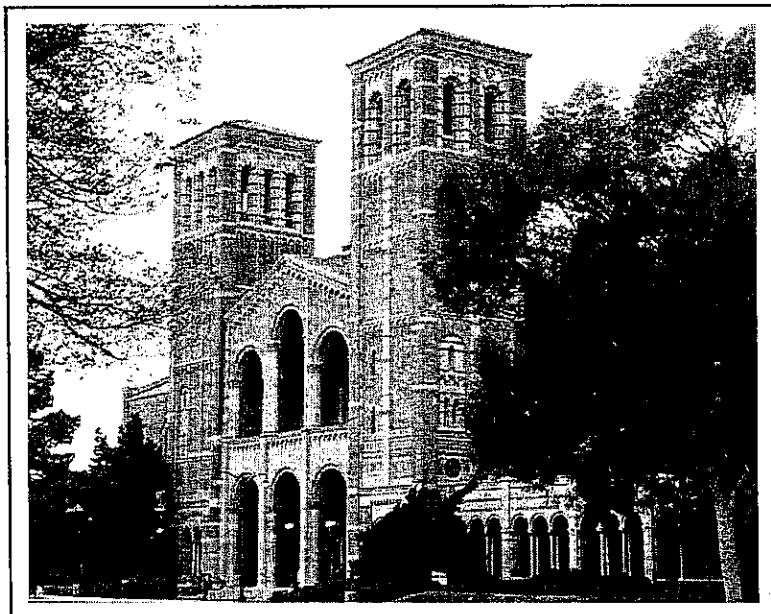
The session ended with the work of L. R. Sibley and K. A. Jakes, who examined coloration in feather shawls from Etowah, a Mississippian mound site in northwest Georgia. Results of microscopy, scanning electron microscopy, X-ray microanalysis, and microspectroscopy revealed the presence of iron and copper salts used as colorants. For specimens that lacked evidence for iron ochres or heavy metal mordants, the use of vegetal dyes, obtained by trade, was suggested.

Poster Session. L. Barba and A. Ortiz applied a variety of organic and inorganic analytical techniques to the floor of an inhabited house. They identified residues of albumin, fatty acids, and carbohydrates, which were distributed in patterns related to the domestic activities in that part of the house. Residues in ceramic vessels were also compared to their use.

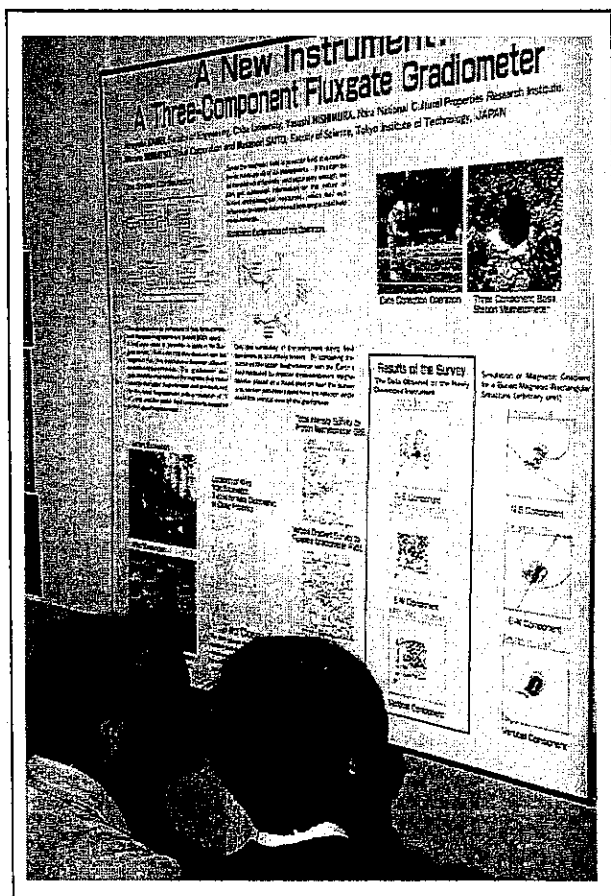


Upper left: SAS officers gather by the SAS table. From left to right - Rob Sternberg (Bulletin Editor), Jim Burton (President), Chris Prior (Secretary/Treasurer), Ero Taylor (General Secretary). Upper right: The poster points the way to the Symposium location at the Fowler Museum of Cultural History on the campus of UCLA. Lower left: Attendees enjoying themselves at the generous reception provided at the J. Paul Getty Museum, while a non-delegate looks on, obviously saddened that he cannot participate (lower right). Photos by Rob Sternberg.





Upper left: Pieter Meyers (Symposium chair, and trumpeter extraordinaire), Los Angeles County Museum of Art, enjoys a lighter moment before the Symposium banquet. **Upper right:** Royce Hall, one of the four original UCLA campus buildings, completed in 1929. **Lower left:** One of the many interesting posters in the technical sessions. **Lower right:** Participants enjoy coffee outside the Symposium hall. You may find Gar Harbottle, Michael Tite, Yannis Maniatis, Ron Farquhar, Ronald Hancock, Jacqueline Olin (but not Waldo). Photos by Rob Sternberg.



Conference Report

C. Heron and K. Evans described a project to explore vessel function in Neolithic pottery from the Northern Isles, U.K. GC/MS was used to identify organic residues. Critical to the study was the development of rapid extraction methods so that large numbers of samples could be analyzed, permitting one to address problems of multiple use, degradation, and contamination. Cooking experiments provided additional data on selective adsorption.

S. Charters, R. P. Evershed, L. J. Goad, and P. Blinkhorn analyzed by GC/MS the lipid residues from several hundred potsherds from Northamptonshire (U.K.). They found differential accumulation and preservation of residues in various vessel parts, but also found differences in the residue patterns correlating with different vessel styles, enabling them to begin to relate form to function.

Barry Fankhauser examined foods, modern pottery with known uses, and experimental pottery made for laboratory studies using high-pressure liquid chromatography to identify fatty-acid and amino-acid residues. Excavated pottery was also analyzed. The effects of aging and of the methods of cooking were examined. While fatty acids showed rapid degradation, residues of free amino acids were found to be relatively stable.

L. A. Garza-Valdes, using catalytic tests and immunoelectrophoresis, identified human blood residues on a jade celt. Although art connoisseurs believed the piece to be a "fake", AMS dating of the residue yielded an age of 1535 ± 240 years.

K. Jakes described a comparative collection of fibrous plants at Ohio State University that is part of a research program dealing with prehistoric textiles. In addition to herbarium specimens, the collection contains fibers processed in ways used by prehistoric people, carbonized fibers comparable to those in recovered prehistoric textiles, micrographs of fiber sections, SEM micrographs of selected fibers, and infrared spectra. The collection's database is intended to establish criteria by which prehistoric textile fibers can be identified and by which processing, use, and storage conditions for the textiles may be inferred.

J. M. P. Cabral, J. P. Leal, and J. Marcalo used laser-desorption Fourier-transform ion cyclotron resonance mass spectrometry to identify solid residues from amphorae.

R. C. A. Rottlander examined data from the analysis of fat residues of Roman oil lamps. Although their use spread out together with olive cultivation, residue analysis only partly supports this.

S. Wales, J. Evans, A. R. Leeds used solvent extraction, infrared spectroscopy and gas-liquid chromatography to

examine coprolites for evidence of plants that are morphologically unrecognizable. They found that plant waxes with diagnostic potential can survive the digestive tract.

S. Wisseman, M. Proefke, K. Rinehart, D. Lawrence, and R. Evenhouse presented further data from their continuing analysis of a mummified child from the Faiyum, Egypt. GC/MS and tandem fast-atom bombardment mass spectrometry indicated bitumen was added to coniferous resins used in embalming, explaining the anomalously older radiocarbon date for the wrappings. Computed tomography scans of the entire mummy were converted to 3-D images revealing a wealth of new detail about the embalming processes.

ARCHAEOMETALLURGY

David Killick, Department of Anthropology/Department of Materials Science and Engineering, University of Arizona

Forty of the 185 papers or posters presented at Archaeometry '92 were concerned in whole or in part with prehistoric or historic metals. This represents a marked increase in the proportion of papers on this topic from the previous Symposia in Toronto (1988) and Heidelberg (1990), and reflects the rapid expansion of research in this field. Five papers by Childs (Native copper technology and society in North America), Hagstrum (Intersecting technologies: ceramic tools for Inka metallurgy), Howe (The production and use of silver and lead during the late prehistory of the Mantaro Valley, Peru), Lechtman (The materials science of material culture: examples from the Andean past) and Merkel et al. (Investigation of prehistoric copper production at Batan Grande, Peru) were invited for the theme session on the archaeometric studies of pre-Columbian America. As only papers pertaining to pre-Columbian America will appear in the published proceedings of the Symposium, requests for further information on other presentations should be directed to the individual authors.

As at previous meetings, the presentations reflect the differing research interests of archaeology and art history, though there is much common ground in such areas as the development of analytical techniques, the inference of provenance and the reconstruction of manufacturing technology. Many of the presentations report refinement of existing techniques or development of new ones. Among these are fundamental studies of alloy systems and of corrosion that provide essential controls for the interpretation of archaeological artifacts (Budd et al., The surface enrichment of arsenic in prehistoric copper-arsenic alloys: a corrosion phenomenon; Garza and Williams, Surface analysis of a Han dynasty "black" mirror using x-ray photoelectron spectroscopy; McDonnell and Weimer,

The effects of phosphorous in early archaeological irons; Northover and Rehren, The oxidation of bronze; Sun Shuyum et al., The laboratory investigation of formation of "Hei-qi-gu" or black lacquer coat on bronze mirrors). Great progress has also been made in determining the provenance of non-ferrous metals around the Mediterranean by both chemical and isotopic techniques. Many more ore sources have been characterized (Hauptman et al., Early copper produced at Feinan, Wadi Araba, Jordan; Kilikoglou et al., Chemical and mineralogical characterization of Late Bronze Age lead from Thera: local production or import?; Raduncheva et al., Eneolithic copper ores and artifacts from Bulgaria and their relation to Ai Bunar and other regional copper deposits) and more appropriate methods of data analysis developed (Gale and Stos-Gale, Statistical methods for the interpretation of lead isotope data in archaeological provenance studies; Pernicka et al., Analytical evaluation and statistical exploration of the Stuttgart database of prehistoric metal analyses; Yener et al., Stable lead isotope characterization of Anatolian metal ores from mining regions bordering the Black Sea). With much more source data now available, it is apparent that several sources cannot be distinguished by lead isotope ratios alone, so the current approach is to use both chemical and isotopic composition to pry them apart. This dual approach has also been employed by the Toronto team in provenance studies of metals and ores from both prehistoric and historic sites in North America (Farquhar et al., Lead isotope and N.A.A. of historic lead artifacts from eighteenth-century sites in Illinois, U.S.A.; Hancock et al., Chronological differentiation of northeastern North American archaeological sites using copper artifacts; Pavlish et al., Provenancing pre-Columbian cultural materials in the Great Lakes Region of Eastern North America).

There has been much recent interest in the technology and use of the more exotic metals and alloys in prehistory. Among the presentations on this topic were studies of copper-antimony alloys in the Near East (Maclean et al., Hasanlu lion pins: observations on the role of antimony in bronze-making in Iron Age Iran; Northover et al., Exotic alloys in prehistory), cupronickel smelting in China (Mei and Ko, Further studies in ancient cupronickel smelting in China), the use of platinum in South America (Scott, The technology of ancient Ecuadorian metals), and elaborate surface treatments of copper alloys in Peru and Ecuador (Lechtman; Scott).

Another trend that is evident in these studies, when compared to papers from previous Archaeometry Symposia, is that the integration of laboratory studies with archaeological theory and data is much improved. Although there were still some presentations of analytical data without any statement of the problem under investigation, these were in a distinct minority. Some notably well-integrated projects among these presentations are the papers by Hauptmann et al. on early mining in Jordan, Merkel et al. on copper smelting in Peru, and Childs on the uses of native copper in North America.

MATHEMATICAL METHODS AND DATA MANAGEMENT

Garman Harbottle, Department of Chemistry, Brookhaven National Laboratory

The session on Mathematical Methods brought forth an unusual diversity of papers and posters. The work of Bartel and Schneider applied Wille's method of formal concept analysis to the grouping of coarse and fine Neolithic pottery from Thessaly. The method offers the possibility of using non-parametric (i.e., stylistic and other qualitative measures) as well as the more usual compositional data in characterizing archaeological materials.

A second, also new technique was that of First Order Predicate Logic, applied by Dreyer to the hoary problem of the characterization of obsidian sources. He showed that the use of Predicate Logic leads nicely into the construction of expert systems, which take as input XRF analyses of artifacts. This interesting example calls to mind Vanda Vitali's discussion of expert systems at the Toronto Conference.

A third paper, presented by the East Kilbride group of Bray et al., concerned the use of ICP-MS, a very powerful analytical tool, in the analysis of steatite outcrops in the cold and foggy north of Scotland. It is worth noting that while steatite has been successfully chemically characterized in some geological contexts by measurement of the rare earth patterns (obtained by NAA), in other regions the method has broken down owing to failure of the Provenience Postulate—the inter-source variance is simply not great enough compared to intrasource. At Brookhaven in the mid-1970's NAA was tried on Iranian steatite and there also failed. Thus the present success of the East Kilbride group was unusually good news.

The final paper of this group, on the errors that inevitably creep into systems where one is applying multiple comparisons each with its own t-test, was instructive. Klepinger and Imrey extended their study to show that "the multiple comparison problem arises when any test of statistical significance, or combination of such tests, is applied within the context of a single scientific investigation", and then told us how to deal with the problem.

The posters in this session were excellent. Of particular interest were those of the Manchester group (Taylor et al.) and the Gales.

Before lunch on Tuesday, two papers on related topics were presented to the session on Ancient Technology and Provenience of Metals; these were Rehren and Temme on "Precolumbian Gold Processing at Putushio..." and Rovira's "A New Set of Prehispanic Goldwork Analysis from the Museo de America (Madrid)". The first offered the results of a most interesting field study of the archaeological evidence for different forms of gold metallurgy in use in South Ecuador over a span of 2500 years, while the second

brought home to this writer and to many other delegates the excellent insights that can be obtained in archaeo-metallurgical studies that utilize extensive and historical museum collections. It is to be hoped that both these complete papers will soon be published.

PROSPECTION AND GEOARCHAEOLOGY

John Weymouth, Dept. of Physics, University of Nebraska

On the topics of prospection and geoarchaeology there were 9 oral papers and 25 scheduled posters (two or three posters did not show). As in the past the largest number of papers, 19 in all, dealt with geophysical methods or applications using magnetometry or soil resistivity. There were five papers on radar development and applications (if we consider them in a separate category), three papers on geomorphology, three on remote sensing, three others covering related dating topics and one on phytoliths.

The papers this year covered a broader range of topics than at previous meetings with a greater emphasis on technical developments, data analysis and the applications of several different techniques to site evaluation. It is interesting to compare the distribution of topics with that of Archaeometry '90 held in Heidelberg. At that symposium there were 34 papers on geophysical applications, two on radar and one on remote sensing. Most noticeable at Archaeometry '92 was the number of papers on developments in radar instrumentation and data interpretation. Clearly this is a tool that is finding wider use in archaeological site studies. Also noticeable was the increase in papers using more sophisticated methods of analyzing both total field and gradient magnetic data.

Of the many very good papers one might mention a few of particular interest. In a paper by Goodman and Mishimura the authors made model calculations of features in a Japanese burial ground to produce synthetic radargrams in order to compare with radar data. A poster by Kamei, Nishimura, Komatsu and Saitoh described a three-component fluxgate gradiometer which not only measures the magnetic gradient but also provides information on the magnetic field vector. (Japanese prospectors are doing a lot of very interesting work.) A poster by Noel, Xu and Walker presented some material on their continuing work on development a resistance tomography system. Tabbagh, Hesse, Decriaud and Grard presented a poster showing their work on measuring soil dielectric permittivity in situ as a function of frequency using an AC or DC electric quadrupole. Two papers dealt with the interpretation of magnetic data using autocorrelation with anomalies calculated from models.

It is clear that the field of archaeological prospection is very much alive and becoming more sophisticated. It is also encouraging to note that, although it was not reflected in the papers but in the audience responses, geophysical methods are becoming more widely appreciated in the United States.

Announcements - Publications

Ancient Monuments Lab Reports

Ancient Monuments Laboratory (AML) Reports are reports of investigations in archaeological science and conservation, undertaken by AML staff and by consultants and contract workers funded by AML. They range from short notes to substantial papers; typically they are a few pages long. Most of them report work carried out on material from a specific site as part of the post-excavation work on that site. AML Reports form part of the site archive and will generally appear, in part or in whole, in the published excavation report. However, there are often long delays in publishing excavation reports, and the AML report series serves to make specialist reports available in advance of full publication.

Copies of AML Reports on microfiche may be obtained on request from the address below. The only exceptions are those reports relating to geophysical surveys which are not being made available as they could help treasure hunters locate archaeologically productive areas. Individuals requiring copies of geophysical surveys for academic research are requested to write to the Archaeometry Section at the AML.

There will be no charge for single copies of reports but it may be necessary to make a charge for multiple copies or for single copies of a large number of reports.

*Ancient Monuments Laboratory, English Heritage,
23 Savile Row, London W1X 1AB, UK; tel 44-071-
973-3300*

New Book Series

The University of Arizona Press has established a new book series: *Culture and Technology*. The series will publish books such as the University of Arizona titles: *The Portable Radio in American Life*, by M.B. Schiffer, 1991; *The Culture of Korean Industry*, by C.S. Kim, 1992; *Technological Perspectives on Behavioral Change*, by M.B. Schiffer, 1992.

The aim of the series is to provide a showcase for anthropological studies of technology without any limits on geography or time. The series will consider recent technology, historical and industrial technology, and ancient technology. The glue holding the series together will be an anthropological viewpoint that human culture, behavior, perceptions and social organization are core considerations in technological practice, innovation, and change. The series will comprise scholarly monographs as well as books for a more general readership, with an emphasis on the latter. Authors are encouraged to write for as broad an audience as possible. Preference will be shown for monographs with one or two authors, although carefully edited multi-author works will not be ruled out.

Culture and Technology (continued on p. 22)

Meetings Calendar

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

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

1992

- * Dec. 1-4. Conference on Magnetism and Magnetic Materials. Houston, Texas, USA. Courtesy Association Inc., 655 15th Street, NW, Suite 300, Washington DC 20005, USA.
- * Dec. 2. Association of French Sedimentologists/Geological Society of France. Paris, France. Georges Busson, Laboratoire de Geologie du Museum, 43 Rue Buffon, 75005, Paris; tel 1-40-79-34-78; fax 1-40-79-37-39.
- Dec. 2-6. American Anthropological Association, Annual Meeting. San Francisco, California, USA. American Anthropological Association, 1703 New Hampshire Avenue NW, Washington, DC 20009, USA; tel 202-232-8800.
- Dec. 6-12. International Conference, Environment and Archaeology. San Juan, Puerto Rico. Dr. A.G. Pantel, Conference Chair, USDA Forest Service, Call Box 25000, Río Piedras, Puerto Rico 00928-2500, USA; tel 809-792-2456; fax 809-792-7882. Theme: Emerging Trends and New Techniques for Heritage Management and Sustainable Development in Tropical Forests.
- * Dec. 7-11. 5th International Symposium on Artificial Intelligence. Cancun, Mexico. Hugo Terashima, ITSEM, Centro de Inteligencia Artificial, Sucursal de Correos "J", Monterrey, N.D. 64849, México; tel 52-83-58-2000 ext. 5143; fax 52-83-58-1400; email isai@tecmtvym.bitnet.
- * Dec. 10-12. Australian Archaeological Association Annual Meeting. Valla Beach, New South Wales, Australia.

J. Peter White, Prehistoric and Historical Archaeology, University of Sydney, Sydney, N.S.W., 2006, Australia.

- * Dec. 13-16. International Computer Science Conference 1992. Hong Kong. Ernest Lam, Department of Computer Science, Hong Kong Baptist College, Hong Kong; tel 852-339-7081; fax 852-338-8014; email ernest@bc750.hkbc.hk.
- * Dec. 14-18. Compugraphics '92: 2nd International Conference on Computational Graphics and Visualization Techniques. Lisbon, Portugal. Compugraphics '92, c/o HP Santo, Conference and Program Chair, Department of Civil Engineering, IST-Advanced Technical Institute, Technical University of Lisbon, Av. Rovisco Pais, 1, 1096 Lisboa Codex, Portugal; tel 351-1-848-2425 or 351-1-847-3421/34, ext. 2351; fax 351-1-89-7650/9242; email dl663@eta.ist.pt.
- * Dec. 15. Archaeological Geophysics Meeting. London. Mrs. Jenny Allsop, Geoarchaeological Coordinator, British Geological Survey, Keyworth, Nottingham NG12 5GG, UK; tel 44-(0)602-363280; fax 44-(0)602-363200; email K_KG@UK.AC.NERC-Keyworth.Vaxa. Programme will contain papers which include examples of a wide range of geophysical techniques applied to a variety of archaeological sites where later archaeological investigations/excavations have been used to assess the ground truth of the initial surveys.
- Dec. 15-19. International Conference on Human Genetics in Celebration of the Birth Centenary of JBS Haldane. Calcutta. Partha P. Majumder, Anthropometry and Human Genetics Unit, Indian Statistical Institute, 203 B.T. Road, Calcutta 700 035, India.
- Dec. 27-30. Archaeological Institute of America. New Orleans, Louisiana, USA. AIA, 675 Commonwealth Avenue, Boston, MA 02215, USA.
- Dec. 28-31. Iraqi Geological Congress, International Meeting. Baghdad, Iraq. Geologists Union, Box 6244, Al-Mansour, Baghdad, Iraq.

1993

- * Jan. 3-7. American Astronomical Society, 181st Annual Meeting. Phoenix, Arizona. AAS Registration, Sullivan and Associates, 6009 N. 10th Place, Phoenix, AZ 85014-1946, USA. The Historical Astronomy Division will meet with the AAS. Besides two regular sessions on Jan. 4, the HAD Council is organizing a one-day session for Jan. 3 to address critical problems in ethnoastronomy and archaeoastronomy. Contact David DeVorkin, tel. 202-357-2828.
- * Jan. 6-10. Society for Historical Archaeology Conference on Historical and Underwater Archaeology. Kansas City, Missouri, USA. William B. Lees, Kansas State Historical Society, 120 W. 10th Street, Topeka KS, 66612-1291, USA.
- * Jan. 10-15. 1993 European Winter Conference of Plasma Spectrochemistry. Granada, Spain. Alfredo Sanz-Medel, Department of Physical and Analytical Chemistry, Faculty of Chemistry, University of Oviedo, C/Julian Claveria, s/n-33006 Oviedo, Spain; tel 34-85-10-34-71 or 34-85-10-34-74; fax 34-85-23-78-50.
- Jan. 13-16. Joint Mathematics Meetings; co-sponsored by the American Mathematical Society. San Antonio, Texas, USA. H. Daly, AMS, P.O. Box 5887, Providence, RI 02940, USA.
- * Jan. 26-27. 7th International Forum on Process Analytical Chemistry. Houston, Texas, USA. InfoServices Inc., Conference Division, 3000 Dundee Road, Suite 313, PO Box 153, Northbrook, IL 60065, USA; tel 708-291-9161; fax 708-291-0097.
- * Jan. 31-Feb. 5. Symposium on Electronic Imaging: Science and Technology. San Jose, California, USA. Conference Manager, IS&T, 7003 Kilworth Lane, Springfield, VA 22151, USA; tel 703-642-9090; fax 703-642-9094.
- Feb. 8-11. Geologic Remote Sensing Meeting. Pasadena, California, USA. Nancy J. Wallman, ERIM, Box 134001, Ann Arbor, MI 48113, USA;

Meetings Calendar

- tel 313-994-1200 ext. 3234; fax 313-994-5123.
- * Feb. 10-12. International Conference on Energy, Environment and Electrochemistry. Karaikudi, Tamilnadu. KC Narasimham, Conference Convenor, Central Electrochemical Research Institute, Karaikudi-623 006, Tamilnadu, India; tel 91-04565-3161-2368 or 2064; fax 91-04565-2088.
 - + Feb. 11-16. American Association for the Advancement of Science, Annual Meeting. Boston, Massachusetts, USA. AAAS, 1333 H Street NW, Washington, DC 20005, USA; tel 202-326-6400. Sessions (and organizers) include: Lessons from the Younger Dryas (Wallace Broecker); Little Ice Age (Malcolm Hughes); The end of Eve? Fossil evidence from Africa (Milford H. Wolpoff); The origin and dispersal of maize in the Americas (Nikolaas J. van der Merwe).
 - * Feb. 21-25. Experimental Methods for Materials Science Research. Denver, Colorado, USA. William Hofmeister, Department of Materials Science and Engineering, Box 1593, Station B, Vanderbilt University, Nashville TX, 37235, USA.
 - Feb. 28-March 5. Digital Image Processing Meeting. Kona, Hawaii, USA. C.V. Freiman, Engineering Foundation, 345 E. 47th Street, New York, NY 10017, USA; tel 212-705-7835.
 - * March 4-6. Symposium on the Arts and Technology. New London, Connecticut. M. Monce, Department of Physics and Astronomy, Connecticut College, New London CT, 06320, USA.
 - March 8-12. Pittcon '93 - 44th Pittsburgh Conference and Exposition on Analytical Chemistry and Applied Spectroscopy. Atlanta, Georgia, USA. Alma Johnson, Program Secretary, Pittsburgh Conference, Department 5K, Suite 332, 300 Penn Center Boulevard, Pittsburgh, PA 15235-5503, USA; tel 800-825-3221; fax 412-825-3224. Abstract deadline: Aug. 5, 1992.
 - March 14-17. Venezuelan Society of Geologists/American Association of Petroleum Geologists, International Meeting. Caracas, Venezuela. AAPG Convention Department, Box 979, Tulsa, OK 74101, USA; tel 918-584-2555; fax 918-584-2274.
 - March 14-18. 7th Conference on Scientific Use of Statistical Software. Heidelberg, Germany. SoftStat, ZUMA, Postfach 12 21 55, D-6800, Mannheim I, Germany. 15(1):23.
 - * April 4-7. 1st International Conference on Mathematical Linguistics. Barcelona, Spain. C. Martin-Vide, Universidad de Barcelona, Facultad de Filología, Seccio de Linguística, Gran Via de les Corts, Catalanes, 585, E-08007 Barcelona, Spain.
 - April 4-8. 25th International Symposium on Remote Sensing and Global Environmental Change - Tools for Sustainable Development; co-sponsored by The Consortium for International Earth Science Information Network (CIESIN) and the Environmental Research Institute of Michigan (ERIM). Graz, Austria. ERIM/International Symposium, P.O. Box 134001, Ann Arbor, MI 48113-4001, USA; tel 313-994-1200, ext. 3234; fax 313-994-5123. Includes an exhibition for remote sensing and GIS products, and training programs.
 - April 5-8. CAA93 - Computer Applications and Quantitative Methods in Archaeology. Stoke-on-Trent, UK. Dr John Wilcock, Reader in Computing, Staffordshire University, School of Computing, The Octagon, Beaconside, Stafford ST18 0AD, UK; tel 44-785-52331, ext. 5446; fax 44-785-55334; email cmtjd@staffs.ac.uk. See this issue for more information.
 - * April 5-8. Global Warming Science and Policy International Conference. Chicago, Illinois. Sinyan Shen, Natural Resource Management Division, Supcon International, One Heritage Plaza, Woodridge, IL 60517-0275, USA.
 - * April 11-16. Asociación de Lingüística y Filología de la American Latina, 10th International Congress. Veracruz, Mexico. Juan Lopez Chavez, Facultad de Filosofía y Letras, Torre de Humanidades I, 3er. piso, Cubículo 20, Universidad Nacional Autónoma de México, México D.F., México.
 - April 11-17. 58th Annual Meeting of the Society for American Archaeology. St. Louis, Missouri, USA.
 - April 12-16. Optical Engineering and Photonics in Aerospace Science and Sensing; sponsored by SPIE - The International Science for Optical Engineering. Orlando, Florida, USA. OE/Aerospace Science and Sensing '93, SPIE, P.O. Box 10, Bellingham, WA 98227-0010; tel 206-676-3290; fax 206-647-1445; Internet spie@mom.SPIE.org. 15(3):14.
 - * April 18-21. Applied Quaternary Research Meeting. Victoria. Environmental Geology Section, British Columbia Geological Survey Branch, 553 Superior Street, Victoria, British Columbia, Canada V8V 1X4; tel 604-387-6249; fax 604-356-8153.
 - * April 19-21. SIAM Conference on Mathematical and Computational Issues in the GeoSciences. Houston, Texas, USA. SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia PA, 191004-2688, USA; tel 215-382-9800; fax 215-386-7999; email meetings@siam.org.
 - * April 21-23. Scanning '93. Orlando, Florida, USA. Mary Sullivan, Scanning '93, PO Box 832, Mahwah, NJ 07430, USA.
 - * April 23-24. Society for Economic Anthropology Annual Meeting. Durham, New Hampshire, USA. Richard Blanton, Sociology-Anthropology, Purdue University, West Lafayette, IN 47097, USA.
 - * May 3-7. European Geophysical Society, XVIII General Assembly. Wiesbaden, Germany. EGS Office, Postfach 49, Max-Planck-Strasse 1, W-3411 Katlenburg-Lindau, Germany; tel 49-5556-1440; fax 49-5556-4709; email EARN U0085@DGOGWDG5. Symposia include: Applied, environmental and archaeological geophysics (organized by S. Papamarinopoulos and J.M. Reynolds); Environmental magnetism (F. Heller and B. Maher); Natural hazards - earthquakes, landslides, hydro/meteorological. Abstract deadline: 1 Jan. 1993.

- * May 3-9. Workshop on Ecological Systems. Waterloo. E. Reidt, The Fields Institute for Research in Mathematical Sciences, 185 Columbia Street West, Waterloo, Ontario, Canada N2L 5Z5; tel 519-725-0096; fax 519-725-0704; email workshop@fields.waterloo.edu.
- May 9-14. Society for Imaging Science & Technology, 46th Annual Conference. Cambridge, Massachusetts. William M. Aitken (General Chair), Polaroid Corporation, 565 Technology Square - 4, Cambridge, MA 02139-3586, USA; tel 617-577-2369; fax 617-494-5243. 15(3):15.
- May 17-19. Geological Association of Canada/Mineralogical Association of Canada, Annual Meeting. Edmonton. J.W. Kramers, Alberta Geological Survey, Box 8330, Station F, Edmonton, Alberta T6H 5X2, Canada; tel 403-438-7644.
- May 17-22. 3rd International Conference, Association for the Study of Marble and Other Stones Used in Antiquity. Athens, Greece. Dr. Yannis Maniatis, "Demokritos" National Center for Scientific Research, Institute of Materials Science, 153 10 Ag. Pareskevi, Attikis, P.O.B. 60228, Greece; tel 301-651-3111; fax 651-9430; email mandi@grathdem. 15(3):15.
- * May 24-28. 15th International Symposium on Capillary Chromatography. Riva del Garda, Italy. Prof. Dr. P. Sandra, I.O.P.M.S., Kennedypark 20, B-8500 Kortrijk, Belgium; tel 32-56-204960; fax 32-56-204859. Scientific program will feature the latest developments in micro-separation techniques. Abstract deadline: 15 Dec. 1992.
- * June 3-6. Optical Spectroscopic Instrumentation and Techniques. Albuquerque, New Mexico, USA. International Society for Optical Engineering, PO Box 10, Bellingham, WA, 98227-0010; tel 206-676-3290.
- June 11-15. International Association for Impact Assessment, 12th Annual Meeting. Shanghai, China. E. Pendleton Banks, Wake Forest University, P.O. Box 7807, Winston-Salem, NC 27109, USA. Sessions on Cultural Resources and Remote Sensing.
- * June 14-16. Lithic Analysis Conference. Tulsa, Oklahoma. George H. Odell, Department of Anthropology, University of Tulsa, Tulsa, OK 74104, USA; tel 918-631-3082. Theme: The Articulation of Archaeological Theory and Lithic Analysis.
- July (dates unknown). Pithecanthropus Centennial: International Congress and Exhibition on the Environmental Context of Human Evolution. The Netherlands and Indonesia. Hans Beijer, Geological Survey of the Netherlands, P.O. Box 157, NL-2000 AD Haarlem, The Netherlands.
- July 5-9. 5th International Conference on Fluvial Sedimentology: Modern and Ancient - Their Importance to Mankind. Brisbane, Australia. Continuing Professional Education, The University of Queensland, Queensland 4072, Australia; tel 61-7-365-7100; fax 61-7-365-7099.
- July 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. See this issue for more information.
- 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, Coyoacán D.F. 04510, Mexico; tel: 52-5-548-78-28; fax: 52-5-554-04-67, 548-36-67; bitnet: LMANZA@UNAMVM1. Theme: Cultural and biological dimensions of global change.
- * Aug. 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. Sections include: Astronomy in ancient cultures; Metallurgy in ancient China and India; Tra Meccanica e Architettura (organized by E. Benvenuto and P. Radelet - de Grave, Stradone S. Agostino, 37, I-16123 Genova, Italy; fax 39-10-3538905).
- 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. Topics: Recent developments concerning ion and electron accelerators; Applications in materials characterization and modification; emphasis on applied research and industrial aspects.
- Sept. 13-17. International Symposium on the Catalán Forge. Spain. Dr. Estanislau Tomas, Associació del Museu de la Ciència i de la Tècnica i d'Arqueologia Industrial de Catalunya, Via Laietana 39, S-09003 Barcelona, Spain; tel 319 23 00; fax 310 06 81. 15(1):1.
- Sept. 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.
- 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.

Meetings Calendar

1994

- Feb. 18-23. American Association for the Advancement of Science, Annual Meeting. San Francisco, California, USA. AAAS, 1333 H Street NW, Washington, DC 20005, USA; tel 202-326-6400.
- * April 4-11. William Robertson Smith Congress. Aberdeen. William Johnston, Department of Hebrew and Semitic Languages, University of Aberdeen, King's College, Old Aberdeen AB9 2UB, Scotland, UK.
- April 11-15. Materials Research Society, Spring Meeting. San Francisco, California, USA. Materials Research Society, 9800 McKnight Road, Pittsburgh, PA, USA; tel 412-367-3012. Symposium: Materials Issues in Art and Archaeology IV.
- April 18-24. 59th Annual Meeting of the Society for American Archaeology. Anaheim, California, USA.
- June 5-11. Geochronology, Cosmochronology and Isotope Geology (ICOG-8). Berkeley, California. Garin H. Curtis, Institute of Human Origins-Geochronology Center, 2453 Ridge Road, Berkeley, CA 94709, USA; tel 415-845-4003; fax 415-845-9453.
- June 19-24. American Nuclear Society Annual Meeting. Atlantic City, New Jersey, USA. ANS, Meetings Department, 555 N. Kensington Avenue, La Grange Park, IL 60525; tel 312-352-6611.
- * July 5-9. 7th International Specialist Seminar on Thermoluminescence and Electron Spin Resonance Dating. Krems am Donau. Norbert Vana, Atominstytut, 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. □

Culture and Technology (continued from p. 18)

The series will show a preference for manuscripts of 300 to 350 pages or less, all told. It is anticipated that each volume will employ the scholarly apparatus—notes, references, bibliography, index and the like—appropriate to its subject, approach, and anticipated readership. Some volumes are expected to be published in trade editions.

Proposals for manuscripts which may be appropriate should be sent to the series editor, Professor W. David Kingery, Program on Culture, Science and Technology, 338E Mines Building 12, The University of Arizona, Tucson, AZ 85721. The aim of the series is to publish one or two books per year. □

Announcements Meetings and Courses

Computer Applications and Quantitative Methods in Archaeology (CAA93).

5-8 April 1993, Staffordshire University, Stoke-on-Trent Campus, UK

Call for papers. Papers or posters will be welcomed on all aspects of computers and quantitative methods in all areas of archaeology. However, this year the themes will be specifically archaeological, and *not* predominantly technological in nature. As in previous years, the conference will include workshops and demonstrations to illustrate relevant hardware, software and applications.

Persons interested in organising complete archaeological theme sessions should contact the organisers immediately. Suggested themes are as follows: archaeological periods—prehistoric/lithic, classical Mediterranean/Bronze Age, Iron Age/Roman, Post-Roman/Medieval, industrial archaeology; dating/chronology; landscape studies and spatial relationships; survey and recording techniques for excavations; strategic planning issues/management of archaeological information systems; recording techniques for the conservation/presentation of standing buildings; cultural development studies; artefact studies; teaching aids for the study and presentation of archaeology; integrated publication aids in archaeology.

The Second Circular, including a preliminary program and a registration form with details of costs, will appear in January. Practical information concerning the conference and details on travelling arrangements will be included in this announcement.

There will be a pre-Conference archaeological trip organised in the Peak District of Derbyshire on Sunday 4th April 1993.

A small number of bursaries covering all or partial costs are available from the CAA Committee on detailed presentation of personal circumstances to the organisers.

For more information, contact Dr. John Wilcock, Reader in Computing, Staffordshire University, School of Computing, The Octagon, Beaconside, Stafford ST18 0AD, UK; tel: 44-785-52331, ext. 5446; fax 44-785-55334; email cmtjdw@staffs.ac.uk.

Simulating Societies '93 - Approaches to Simulating Social Phenomena and Social Processes. 24-26 July 1993, Siena, Italy.

Call for papers and participation. Although the value of simulating complex phenomena in order to come to a better understanding of their nature is well recognised, it is still rare for simulation to be used to understand social

processes. This symposium is intended to present original research, review current ideas, compare alternative approaches and suggest directions for future work on the simulation of social processes. "Social process" may be interpreted widely to include, for example, the rise and fall of nation states, the behaviour of households, the evolution of animal societies, and social interaction.

It is expected that about a dozen papers will be presented to the symposium and that revised versions will be published as a book. We are now seeking proposals for papers and for participation. Contributions from a range of disciplines including sociology, anthropology, archaeology, ethology, artificial intelligence, and artificial life are very welcome.

Proposals for papers are initially invited in the form of an abstract of no more than 300 words. Abstracts should be sent, along with a brief statement of research interests, to the address below by 15th March 1993. Authors of those selected will be invited to submit full papers by 1st June 1993. Those interested in participating, but not wishing to present a paper, should send a letter indicating the contribution they could make to the symposium, also by 15th March 1993.

The organisers of the Symposium are Cristiano Castelfranchi (IP-CNR and University of Siena, Italy), Jim Doran (University of Essex, UK), Nigel Gilbert (University of Surrey, UK) and Domenico Parisi (IP-CNR, Roma, Italy). The symposium is sponsored by the University of Siena (Corso di laurea in Scienze della Comunicazione), the Consiglio Nazionale delle Ricerche (Istituto di Psicologia, Roma) and the University of Surrey.

Proposals should be sent to: Prof. Nigel Gilbert, Department of Sociology, University of Surrey, Guildford GU2 5XH, United Kingdom tel 44-(0)483-509173; fax 44-(0)483-306290; email gng@soc.surrey.ac.uk.

Cultural Resource Management Program, The University of Nevada, Reno.

Courses in a number of locations around the U.S. have been announced for Fall, 1992 through Summer, 1993. The program is a cooperative undertaking with the Advisory Council on Historic Preservation, the Bureau of Land Management, the National Park Service, and the U.S. Forest Service. Courses include "Current Archaeology: An Overview", a 10-day course from 5-15 January, in Reno, Nevada, with topics including faunal analysis (Stephanie Livingston), paleoenvironmental analysis (Peter Wigand), obsidian sourcing and dating (Richard Hughes), dating techniques (R.E. Taylor), GIS (W. Frederick Limp), and geomorphology (Fred Nials). Fee for the full course is \$950. Contact: Cultural Resource Management, Division of Continuing Education/048, University of Nevada, Reno, NV 89557-0024, USA; fax 702-784-4801. □

Announcement

Society of Bead Researchers

The Society of Bead Researchers was formed in 1981 to foster research on beads of all materials and periods, and to expedite the dissemination of the resultant knowledge. Membership is open to all persons involved in the study of beads, as well as those interested in keeping abreast of current trends in bead research. The Society presently publishes a biannual newsletter, *The Bead Forum*, and an annual scholarly journal, *Beads*. Contents of the newsletter include current research news, requests for information, responses to queries, listings of recent publications, conference and symposia announcements, and brief articles on various aspects of bead research.

There are four levels of membership: Individual (\$15 per year), Sustaining (\$35), Patron (\$75) and Benefactor (\$150). All levels receive the same publications and benefits; the Sustaining, Patron and Benefactor categories are simply intended to allow those who are in a position to donate larger amounts to the Society to do so. Back issues of *The Bead Forum* (Nos. 1-19, through 1991) are available to new members for \$1.00 US per issue postpaid, and back issues of *Beads* (Volumes 1-2, through 1990) are available for \$12.50 US per issue plus \$2.00 US. Checks and money orders (U.S. funds only, please), made payable to the Society of Bead Researchers should be sent to: Lester Ross, SBR Secretary-Treasurer, 56489 El Dorado Drive, Yucca Valley, CA 92284, USA.

Articles and other material for *The Bead Forum* and *Beads* are invited and should be sent to Karlis Karklins, SBR Editor, Canadian Parks Service, 1600 Liverpool Court, Ottawa, Ontario K1A 0H3, Canada. □

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