SAS Newsletter

Society for Archaeological Sciences

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Journal Review

Archeomaterials

A new journal devoted to the publication of "preindustrial materials and processes"

Editor: Tamara Stech
Address: Department of Materials Science and Engineering
University of Pennsylvania
Philadelphia, PA 19104 $35/year

For those of us who publish the results of studies on ancient materials a new journal with the mission as an "outlet for scholars studying a broad range of preindustrial materials and processes" is **indeed** welcome. Publication delays in existing respectable journals are unusually long, in some cases as long as three years! Hence, I am one of those who applauds the efforts of Dr. Stech not only to alleviate the intolerable delays in publication but also to provide such a medium.

With an excellent Board of Reviewers selected from among different disciplines and with the customary scholarship for which Tamara Stech is noted, I expect *Archeomaterials* (in spite of the omission of the "a" in the title) to be welcome and, hence, successful addition to the scholarly literature.

Archeomaterials is scheduled to publish two issues a year. The first issue, Fall 1986, begins with an editorial statement in which Stech describes the mission (scope) of the journal, which will include "minerals, metals, plant and animal products, clays, vitreous materials—and the way in which they were manipulated." I agree with her assessment that the hybrid "Archaeomaterials" is "abominable." What would have been wrong in using the title "Ancient Materials and Methods?"

Her statement of the philosophical approach to the application of the physical and biological sciences to archaeological matters (and subsequent publication) is extremely relevant for those who intend to publish in *Archeomaterials* and I recommend that all prospective authors take due note!

The first issue has another notable statement in it: the one by Dr. Cyril Stanley Smith. Professor Smith's thoughts on the relation between atomic-scale imperfections and structure-sensitive properties are, by now, well known and appreciated. Their inclusion here, although they do not add much to the avowed philosophical framework of the journal does, nevertheless, add a scholarly dignity to the initial issue. Smith is the principal nucleating agent for studies that incorporate the application of the physical sciences to understanding the relation among materials (mainly metals), their manipulation and the culture in which they were manipulated. It is entirely fitting that some of his ideas occupy the first article in the very first issue of a journal devoted to an area of scholarship he helped spawn.

The remaining articles are also by eminent scholars such as Bennet Bronson (contributing a erudite article on Wootz steel), Gordon Bronitsky (with a valuable discourse on the gap between laboratory and ceramics theory), Birget Faber Morse and Robert B. Gordon (here concerned with a metallographic examination of some Precolumbian Mexican copper and silver) and by William Rostoker, (one of our most knowledgeable metallurgists concerned with ancient materials telling us of the metallurgical problems with cast iron cannon).

All of these articles are excellent and serve as a admirable entree to the journal.

The format is a 7 inch by 10 inch page using good quality glossy paper with what I expect has good long-lasting characteristics. Using glossy paper is most necessary since many of the articles to be published will have metallographic and scanning electron microscopic photomicrographs in them. In fact, the Morse-Gordon article has some photomicrographs; these show up quite well. On the other hand, the Rostoker article has a reproduction of a woodcut taken from Mallet (his reference Mallet, 1856) used to show cast structures (columnar grains) that do not show up well at all. This may, however, be due (and I expect it is) to the quality of the original Mallet macrograph rather than the quality of the paper in *Archeomaterials*.

All in all, *Archeomaterials* is a welcome addition to the literature, one greatly needed and long overdue. I wish it well.

Robert Maddin, Honorary Curator of Archaeological Sciences, Peabody Museum, Harvard University

New Publications

Anyone who wishes to have recent publications of interest to SAS members listed in the *Newsletter* should send full reference in SAA style to the Editor. We will also consider reviewing publications if a request is made and if two copies are provided.

Tobey, Mark Hathaway
1986 Trace Element Investigations of Maya Chert from Belize. *Papers of the Colha Project Volume 1.* Center for Archaeological Research, The University of Texas at San Antonio, San Antonio, TX 78285-0658, $7.50

Laboratory Profile

Archaeological Metallurgy at Yale

Teaching and research in metallurgy began at Yale in 1855 with the appointment of George J. Brush as professor of metallurgy, the first in North America. Professor Brush's lecture notes and the large collection of metallurgical treatises he made while a student at Freiberg are retained in our laboratory. Because an important part of the study of materials science in the midnineteenth century was the examination of hand specimens, Professor Brush collected samples from most of the important metallurgical establishments in North America to make the Metallurgical Museum of Yale College. This remains one of the largest surviving collections of historic metal specimens in America and is an important resource for the study of the development of metallurgical technology in the United States (Gordon 1982). The first archaeometallurgical research done at Yale was Professor Champion H. Mathewson's study of the Precolumbian bronze artifacts found at Machu Picchu, Peru, by Hiram Bingham in 1912 (Mathewson 1915). Professor Mathewson was a pioneer in the use of metallography for the study of ancient artifacts and the methods that he developed are now widely used in archaeometallurgical research.

The focus of our present research is the laboratory study of artifacts to reveal both the technology by which they were made and the ways in which they were used. Our special interest is the development of methods of interpreting material evidence to reveal the levels of skill attained by metal workers in both ancient and historic times. Even into the early years of the twentieth century there are few reliable records of how metallurgical artificers carried on their work; consequently, material evidence can be of as much value to students of industrial, business, and labor history as it is in the study of ancient technology. Since much of the evidence of metallurgical skills is to be found in the microstructures and in the physical properties of metal artifacts, we make much use of metallography and methods of mechanical testing suitable for artifacts.

Research Techniques

Metallography reveals the inhomogeneities that are common in the metal of ancient and historic artifacts and shows the presence of nonmetallic inclusions, which may be unreduced ore or samples of the slag or of the refractories used in the smelting furnace. Both the microprobe and the reflected-light petrographic microscope can be used to good advantage in the study of nonmetallic inclusions. Often much more valuable information can be obtained from the slag or other inclusions in artifacts than from the metal itself. For example, most impurities from the ore are concentrated in inclusions, where they are easier to identify than in the metal.

The strength properties of the metal in utilitarian artifacts are the most important indicator of the skills of their makers. Except for material recovered from large structures, full-scale mechanical tests are impractical on archaeological materials while hardness tests, which can be made on small samples, are a poor indicator of strength and ductility. To evaluate the mechanical properties of artifacts, uncommon methods are needed and we have developed techniques for making tensile tests on very small specimens. These permit us to study the relation of strength and ductility to microstructure in wrought iron and to determine the properties of historic iron artifacts. For example, we recently completed tests that show the superior quality of the wrought iron used in Decimus Burton's 1849 Palm House at Kew Gardens, London.

Evidence of how artifacts have been used is found in their internal structure and in the surficial markings that they carry. Study of "use-wear" markings is now a familiar technique in the study of lithic materials; we are developing a corresponding set of techniques for metal artifacts. The extensive research that has been done on metal cutting technology provides a theoretical framework for the study of surficial markings on metal artifacts. We have found that these markings are useful in the study of how ancient tools were made and used (Gordon 1985; Rutledge & Gordon 1987) and for revealing late medieval metalworking technology (Gordon 1987).

Current Research

Mechanism of the Bloomery Process. Iron has been made by direct reduction of ore in bloomeries throughout the Old World as well as in colonial America. An extraordinarily wide range of furnace designs and operating procedures has been recorded in archaeological field work and the products of the various bloomeries show great variation of chemical composition and microstructure. Some scholars argue that particular microstructural and chemical variants reflect deliberate operational decisions made by the bloom smelters. Others, including ourselves, argue that the range of variation inherent in a non-equilibrium process such as bloomery smelting as well as variations caused by differences in the raw materials must be accounted for before any inferences can be drawn about the skills of the operators. We are presently studying both these aspects of bloom smelting by examination of slag and metal specimens from an experimental bloomery built and operated by David Harvey at Colonial Williamsburg and from several African bloomery furnaces.

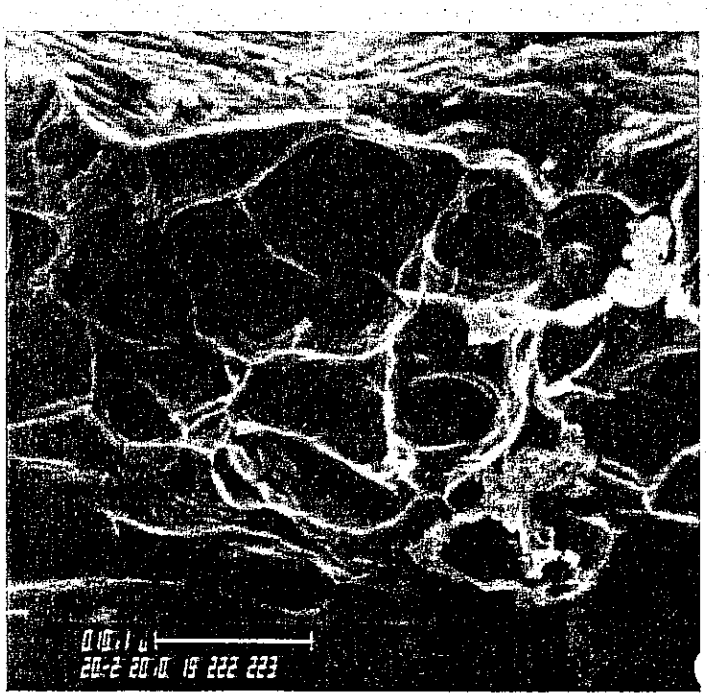

Figure 1. Fracture surface of ductile wrought iron. The dimples characteristic of ductile fracture are initiated at the slag inclusions.

Quality of Wrought Iron. Wrought iron made in the bloomery or by more modern methods consists of metal and slag fibers; it is what is now called a composite material. Because the commercial use of wrought iron ended well before materials scientists began to study composites, there is little published research on the relations between the strength properties of wrought iron and its structure and composition. Our research shows that the ductility of wrought iron (the most useful index of its quality) can be evaluated from the structure of fracture surfaces examined under the scanning electron microscope, as illustrated in Figures 1 and 2. Ductility in wrought iron is strongly influenced by the form and distribution of the slag and by the partitioning of the phosphorus between the slag and the metal. Both of these factors can be controlled by the smelter and the smith and we are investigating the degree to which this has been done in a range of artifacts from different times and places.

African Iron Age. Bloomery iron smelting fell into disuse in many areas of Africa within living memory; in some areas of the Ivory Coast smelting was active as late as 1982. Africa therefore provides some excellent opportunities to study how a relatively demanding technology is managed within small-scale, nonliterate societies, and how the technology is accommodated within various structures of social beliefs and action. The opportunity to conduct such studies will lapse with the passing of the present generation of former iron smelters, most of whom are now elderly. We are nearing completion of a study of induced-draft iron smelting in Malawi, east Africa, between 1890 and 1930 which draws upon field interviews, archival documents, archaeological excavations, and laboratory study of the material remains of the industry.

American Manufacturing Technology. Students of American business and labor history have long been interested in so-called "armory practice," the manufacture of interchangeable mechanisms with machine methods. The usual interpretation of nineteenth century documentary evidence is that the introduction of self-acting machinery after about 1820 eliminated most of the hand work in manufacturing, beginning the process of "deskilling" workers and opening the way for the mass production methods that were fully developed in the early twentieth century. The national armories, after the initiative of Eli Whitney, are supposed to have led the way in these developments. Study of surficial markings and the microstructures of manufactured artifacts, principally a sequence of gun locks from the Springfield Armory National Historic Site, shows that this interpretation is not supported by the material evidence. The evidence shows that there was not a replacement of skilled handwork by machine-made interchangeable parts, but, rather, a growth of increasingly sophisticated handwork skills, which were able to attain a higher standard of accuracy and reproducibility than the machine tools of the time. The implication is that the work experience in nineteenth century manufacturing establishments was one of acquiring new skills rather than yielding skills to the use of machinery.

R. B. Gordon
D. J. Killick
Kline Geological Laboratory
Yale University
P.O. Box 6660
New Haven, CT 06511

Figure 2. Fracture surface of wrought iron that showed no ductility in a tensile test. There are no dimples and the ferrite grains have cleavage facets. This is a sample of iron excavated from Governor's Land, Virginia, and date 1680 to 1710.

References

Gordon, R.B.
1982 The Metallurgical Museum of Yale College and nineteenth century ferrous metallurgy in New England, *Journal of Metals* 34(7):102-110.

Gordon, R.B.
1985 Laboratory evidence of the use of metal tools in Machu Picchu and environs, *Journal of Archaeological Science* 12:311-327.

Gordon, R.B.
1987 Sixteenth-century metalworking technology used in the manufacture of two German astrolabes, *Annals of Science* in press.

Mathewson, C.H.
1915 A metallographic description of some ancient Peruvian bronzes from Machu Picchu, *American Journal of Science* 40: 525-616.

Rutledge, J.W., and R.B. Gordon
1987 The work of metallurgical artificers at Machu Picchu, Peru, *American Antiquity*, in press.

Call for Nominations

Jeffrey Dean, President Elect and Chair of the Nominations Committee has issued a call for nominations to fill the offices of Vice President/President Elect and Assistant Secretary Treasurer/Secretary Treasurer Elect. The signatures of ten SAS members and a letter of acceptance from the nominee are required by the committee. Please send nominating petitions to

Jeffrey Dean
Laboratory of Tree-Ring Research
University of Arizona
Tucson, AZ 85721.

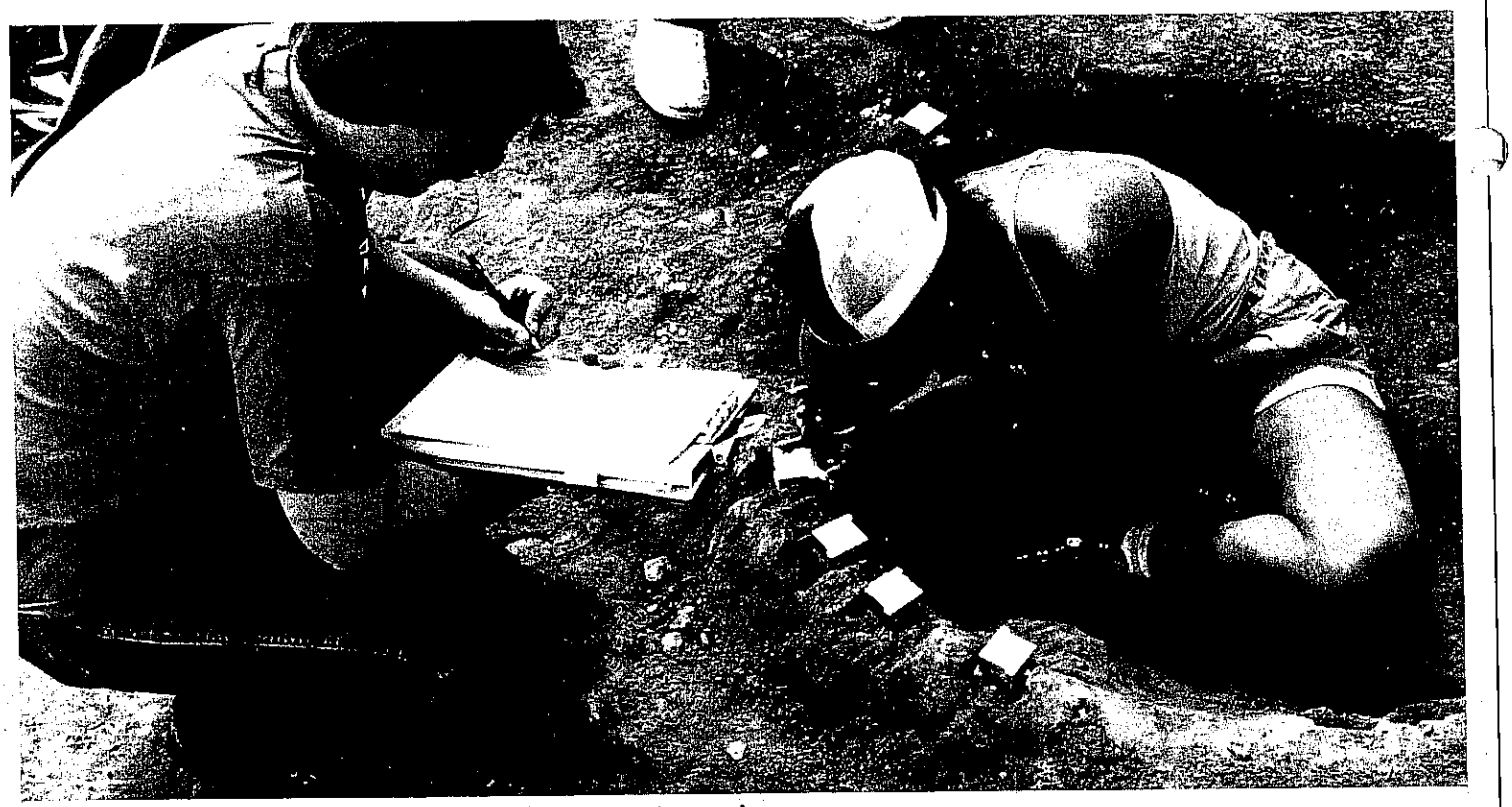

Figure 3. Dating Methods students taking archaeomagnetic samples

Meeting Announcements

Taos Workshop on Remote Sending in Archaeology

Southern Methodist University will hold its 1987 Workshop in Archaeological Science at the Fort Burgwin Research Center in Taos, New Mexico from July 13 through August 12. The 1987 offering focuses on remote sensing in archaeology. The workshop is designed to afford students intensive, hands-on training from leading experts in the subject. The workshop may be taken for six hours undergraduate or graduate credit from Southern Methodist University, or as a noncredit course. Noncredit partipants may take the full course, or either of the two-week sections. Dr. James Ebert will lead the first two weeks on aerial remote sensing, and Dr. John Weymouth the second two weeks on surface and subsurface remote sensing.

Workshop Schedule

Weeks 1 and 2
July 13-24

Dr. James Ebert
Aerial Remote Sensing in Archaeology

Basic Theory and Method; Aerial Photography and Photointerpretation: Terrestrial Photogrammetry; Nonphotographic Remote Sensing; Field Logistics and Sample Design: Site Discovery, Mapping, and Documentation; Predictive Modeling; Geographic Information Systems.

Weeks 2 and 3
July 27–August 7

Dr. John Weymouth
Surface/Subsurface Remote Sensing in Archaeology

Overview of Method and Theory; Magnetometry; Data Processing and Analysis; Field exercises; Soil Resistivity; Soil Conductivity; Resistivity Data Processing and Analysis; Subsurface Radar Technology.

August 10-12
Dr. Patricia Crown

Participants taking the Workshops for six hours credit stay to complete course requirements.

Instructors

James Ebert is a widely-recognized expert in the theory and application of aerial remote sensing in archaeology. Formerly with the National Park Service's Cultural Resource Remote Sensing Division, he is now a private consultant in forensic, archaeological, and anthropological remote sensing and photogrammetry. He has had extensive photogrammetric and photointerpretive experience throughout North America and Africa.

John Weymouth is Professor of Physics and Archaeometry in the Departments of Physics and Astronomy, and Anthropology at the University of Nebraska. His expertise is in archaeometry, with an emphasis on the geophysical applications of magnetometry. He has worked extensively in the North American Great Plains and River Basin areas, as well as in the Southeast, the Southwest, and in Japan.

Program Information

All participants will be housed at the Fort Burgwin Research Center during their stay. Fee for credit participants is $1,706, including room, board, and six hour tuition. Noncredit student cost for room, board, and course fee is $1,300 for the four week period, or $700 for each of the two week periods. Please direct inquiries to:

Dr. Patricia Crown, Director
Workshops in Archaeological Science
Fort Burgwin Research Center
Room 5, Perkins Administration Building
Southern Methodist University
Dallas, TX 75275
(214) 692-3657

Workshop Report

The Fort Burgwin Workshops in Archaeological Sciences

Workshops in Archaeological Sciences are held annually at the Fort Burgwin Research Center of Southern Methodist University, located near Taos, New Mexico. Workshops introduce participants to advanced techniques in some aspect of archaeological science taught by experts in the field, and are designed to provide comprehensive classroom, laboratory, and field training enhanced by an outdoor setting. These workshops gather experts with unusually high qualifications and teaching abilities together at one locale for access by students and professionals around the country. The workshops can be taken for six units of credit through Southern Methodist University, or as noncredit courses. They are limited to 15 participants to insure individual attention and training.

The Workshop topic for the summer of 1986 was Dating Methods. Four experts in the field taught consecutive one week mini-courses on archaeomagnetic dating, radiometric and thermoluminescence dating, obsidian hydration dating, and dendrochronology, respectively. Ten participants, ranging from graduate students to contract archaeologists and university professors, attended one to four weeks of the course. During the first week, Dr. Jeffrey L. Eighmy (Director, Archaeometric Laboratory and Associate Professor, Department of Anthropology, Colorado State University), taught participants the theory behind archaeomagnetic dating and trained them in sample collection (Figure 3) and statistical interpretation. Dr. C. Vance Haynes (Professor, Department of Anthropology, University of Arizona), reviewed the theory behind radiometric and thermoluminescence dating methods during the second week of the course. Participants pretreated samples for radiocarbon analysis and learned proper acquisition and care of samples in the field (Figure 4) and laboratory. Dr. Joseph Michels (Associate Dean for Research and Graduate Studies and Professor, Department of Anthropology, Pennsylvania State University), taught participants to prepare slides and calibrate dates for obsidian hydration analysis. In this one week session, participants produced forty-two dates from Taos area obsidian artifacts. During the last week of the course, Dr. Jeffrey S. Dean (Professor of Dendrochronology, Laboratory of Tree-ring Research, University of Arizona) trained participants in methods used in tree-ring dating: from coring of modern specimens, to species identification, and dating with the use of hand, lenses, and dissecting microscopes.

Figure 4. Dr. Vance Haynes and students taking radiocarbon sample

The course provided a highly successful beginning for the Workshop series, and set the stage for the 1987 program which will focus on aerial, surface, and subsurface remote sensing in archaeology. Those wishing further information about the workshops should contact Dr. Patricia Crown or Dr. James Judge at the Fort Burgwin Research Center, SMU, Dallas, TX 75275, (214) 692-3657, and see also "Workshop Announcement" in this issue of the *SAS Newsletter*.

News of Archaeometallurgy

- The Programa de Estudios Prehistóricos (CONICET) in Buenos Aires, Argentina, has published the second volume of *PREP Informes de Investigación* (1985), which contains the analyses of more than thirty metal artifacts from sites in the tropical lowlands of Argentina dating from the Regional Development Period of Northwestern Argentina (100-1450 AD). Beatríz Ventura, in "Metalurgia: un aspecto poco conocido en la arqueología de las Selvas Occidentales" (pp. 5-81) related analyses to probable contacts with Andean regions based on the metals, alloys, and stylistic elements present. Native copper, bronze, tin, and gold-silver-copper alloys were used with a variety of smelting and processing techniques (forging, annealing, rolling, polishing, riveting, and repoussé). This volume also includes a technological study of a gold artifact from one of the sites, "Estudio metalúrgico de una pieza arqueológica," by Tulio Palacios and José Horacio Rodríguiz (pp. 83-97). For more information, write Mary Jo Figuerero, Programa de Estudios Prehistóricos, Bartolome Mitre 1970 5"A", 1039 Buenos Aires, Argentina.
- In 1982 and 1983 David Killick of Yale carried out a field research project in Malawi, east-central Africa, on recent iron smelting which included the location and measurement of standing furnaces, the mapping and partial excavation of seven recent smelting sites, archival work on the demise of the industry in the 1930s, and a series of tape recorded interviews with former iron workers. This project was coordinated with an experimental reconstruction of one of the tall induced-draft furnaces of the region, arranged and recorded by Donald Avery of Brown and Nicholas van der Merwe of Cape Town. From the study of the large collection of ores, blooms, slag, and ethno-

graphic and archaeological artifacts, it appears that 1) the lateritic ores used are of exceptionally low grade. Successful iron smelting is only possible because reactions do not proceed to equilibrium; much of the quartz gangue passes unchanged through the furnace; 2) a complete sequence of solid-state bloom formation is represented. The blooms aggregate as almost carbon-free iron but substantial carburization occurs during the long residence time (up to three days, according to the interviews) at the base of the furnace. Much of the carbon content is subsequently lost in forging. Failures of smelting practice were attributed by the iron workers to acts of sorcery by rivals. Protective charms against sorcery were placed in the furnaces but none had any metallurgical function. The fear of ensorcelment by other iron workers apparently inhibited communication among them, which suggests an explanation for the remarkable range of variation in shape and size observed in the standing furnaces.

- A second project, recently completed, was a reexamination of slags and other fused residues excavated near Agadez, Niger, West Africa, by Dr. Danilo Grebenart of the CNRS, Aix-en-Provence. Some of the dates reported for these possible furnace structures are more than a millenium earlier than any other dates for metallurgy in sub-Saharan Africa. Work by Killick, Gordon, and van der Merwe shows that most of the materials associated with radiocarbon dates older than 3000 years: 1050 B.C. (uncalibrated) are fused soil or ceramic and cannot be positively associated with any metallurgical process. However, the oldest dated structure, which has three radiocarbon dates in the range 3600-4200 years: 1650-2350 B.C. (uncalibrated) contains a fayalite/sutite/hercynite/leucite slag with only 40 ppm copper. Although they do not dismiss out of hand the possibility that iron smelting may have taken place at this early date, they are skeptical. There is as yet no other evidence of iron in this region until ca. 2500 years: 550 B.C., and they suspect the use of old wood or charcoal. Further fieldwork at this site may provide thermoluminescence samples with which to distinguish between these possibilities. The most common metallurgical residues in this region are very unusual red melilite slags, produced during the remelting of the native copper of the region in small shaft furnaces. The native copper occurs in dolomitic sandstones and marls, and the residual gangue remaining after concentration has fused to produce the slags. In spite of their relatively high viscosity, the local smelters appear to have had little difficulty in inducing the copper to separate from them, as the samples analyzed contain only 0.5 to 7 percent copper. All dated examples of these are more recent than 1050 B.C. (uncalibrated).
- Traditional iron-smelting practices in China (including those of the Great Leap Forward) have been detailed in "Dabieshan: Traditional Chinese iron-production techniques practiced in southern Henan in the twentieth century" by Donald B. Wagner. It is Number 52 in the *Scandinavian Institute of Asian Studies Monograph Series* (London and Malmö, 1985), published at £ 5.50 by Curzon Press Ltd., 42 Gray's Inn Road, London AC1 (ISBN 0-7007-0177-Z).
- The proceedings of the conference in Oxford in 1983 on "The Archaeologist and the Laboratory," edited by Patricia Phillips, (London, 1985) has been published by the Council for British Archaeology, 112 Kennington Road, London SE11 6RE, as *CBA Research Report No. 58* (ISBN 0-906780-45-4).
- An English-language summary of the *Newsletter of the Hungarian Industrial Archaeology and Archaeometry Working Groups*, "Industrial Archaeology and Archaeometry News" is edited by Marta Jaro and is published by the National Centre of Museums, H-1476 Budapest 100.
- Robert Smith, conservator at the Tower of London, is doing mechanical testing of Mons Meg, a famous fifteenth century welded cannon.
- The extensive holdings on metallurgy in the library of the Franklin Institute have recently been acquired by Lehigh University.
- Another Bloomery Symposium sponsored by the Workshop on the Industrial Archaeology of Iron Making will be held at Colonial Williamsburg on March 7 through 9, and will include demonstrations of iron smelting and forging, contributed papers, a gallery tour, and a film festival. For information call David Harvey at (804) 229-1000 extension 2656, or write him at

  James Anderson Shop
  Colonial Williamsburg Foundation
  P.O. Box C
  Williamsburg, VA 23187

  To be put on the mailing list for the Workshop, write

  Ned Heite
  Box 53
  Camden, DE 19934

- The first comprehensive history of the early mining and trade in tin, "Tin in Antiquity: Its Mining and Trade throughout the Ancient World" by Roger David Penhallurick has just been published by the Institute of Metals (London, 1986) as *Book 325* (ISBN 0-904357-81-2) for £ 29.95/U.S. $48.00 in cloth, £ 23.96/U.S. $38.30 to members of the Historical Metallurgy Society. Copies of the 1986/87 Book List are available from

  Keith Wakelam, *Marketing Director*
  The Institute of Metals
  1 Carlson House Terrace
  London SW1Y 5DB, England.

- Publications of the Institute of Metals are now available in the United States from their North American Publications Center (Brookfield Publishing Co.), Old Post Road, Brookfield VT 05036. Tylecote's *The Prehistory of Metallurgy in the British Isles* is $34.95, and Barraclough's *Steelmaking before Bessemer* (two volumes) is $89.00. Brookfield's telephone number is (802) 276-3162.
- The Society of Jewelry Historians now has a North American branch. For information on the society and its activities in the United States, write

  Jean Appleton
  Fashion Institute of Technology
  227 West 27th Street
  New York, New York 10001

- A laboratory manual of 28 experiments illustrating early developments in metallurgy, *Erze and Metalle:ihre Kulturgeschichte im Experiment* by Hasso Moesta (Berlin and Heidelberg, 1983) is published by Springer-Verlag (ISBN 0-387-11799-7).
- *The Journal of Metals*, in observance of the 100th anniversary of the invention of the Hall-Heroult process of aluminum reduction, published in its November, 1986, issue (Volume 38(11):18-19) "Hall and Herould—a comparison" and "Hall-Herould: 100 years of process evolution" (Volume 38(11):27-33) both by J.P. Greer.
- The Italian Ministry of Culture and the Italian Metallurgical Society (S.M.I.) have sponsored a text on metallographic interpretation by Massimo Leoni, *Elementi di metallurgia applicata al retauro delle opere d'arte: Corrosione e conservazione dei manufatti metallici* (Florence, 1984), published by OpusLibri, via della Torretta 16, 50137 Firenze, Italy.

- A 32-page booklet on "Bronzeworkers in the Athenian Agora" prepared by Carol C. Mattusch and showing remains of bronze casting was published in 1982 by the American School of Classical Studies at Athens. It is Number 20 in the series of *Excavation of the Athenian Agora Picture Books* (ISBN 87661-624-4). Copies can be obtained from the

  American School of Classical Studies at Athens
  c/o Institute for Advanced Study
  Princeton, NJ 08548

- Heather Lechtman of MIT spent several weeks in Guayaquil, Ecuador, last January giving a course at the Museo Antropológico in the metallurgical study of artifacts to 22 students, both from archaeology and from science and engineering, and setting up a laboratory in the museum; she returns there this Spring. She will also survey the collections and design a laboratory for a similar course at the Museo Chileno de Arte Precolombino in Santiago, Chile, on a Fullbright fellowship, and will prepare a laboratory manual in Spanish, with examples from local artifacts completely worked up. For obvious reasons there will be no CMRAE program this summer.
- Henry Unglik of Parks Canada has examined a number of samples from the UNESCO "Save Carthage" project. The samples, of copper, brass, bronze, iron, and slag, came from the northern edge of the Roman city and are dated to the late Roman-Christian occupation, fifth through seventh century A.D. The brasses were quarternary alloys with 10 to 15 percent zinc and less than 3 percent tin and 5 percent lead. About 20 percent of the copper-alloy objects showed evidence of hot working. The iron objects were hot forged but not quenched, and the slag suggested iron smelting by the bloomery (direct) process. For more information, write Henry Unglik at the Conservation Division, National Historic Parks and Sites Branch, Parks Canada, Ottawa, Ontario K1A 1G2.

If you have news of archaeometallurgy, please call Martha Goodway at (202) 287-3733, or write her at CAL MSC, Smithsonian Institution, Washington, DC, 20560.

Conference Report

Penrose Conference on Archaeological Geology
St. Simons Island, Georgia, December 6–11, 1986

Penrose Conferences are sponsored by the Geological Society of America to encourage an open and frank exchange of ideas in an informal atmosphere. The Penrose Conference on Archaeological Geology, cosponsored by the Society for American Archaeology, the Society for Archaeological Sciences, and the Association for Field Archaeology was convened by Norman Herz (University of Georgia) and Charles Vitaliano (Indiana University). The goals of the conference included: a consideration of the nature of past research; identification of important problems for future research; and a look at some of the new techniques of archaeological geology. In this multidisciplinary group of 54 participants, 35 were primarily affiliated with the geosciences, and most of the rest were archaeologists. The meeting gave this group the opportunity to discuss the goals and problems that are common and peculiar to their respective disciplines.

The meeting included nine half-day sessions and an all-day field trip. The opening session dealt with Site Reconstruction, Geomorphology, and Environmental Influence. This session explored the co-evolution of environment, both geological and ecological, and patterns of human habitation. Understanding human habitation patterns and their relationship to environmental factors will help in the future search for additional sites. Contributors to this session were Holmes Semken (University of Iowa), David Sanger (University of Maine), Jonathan David (Desert Research Institute), Arthur Bettis III (Iowa Geological Survey), Floyd McCoy (Lamont Doherty Geological Observatory), John C. Kraft (University of Delaware), William I. Woods (Southern Illinois University), Michael R. Waters (Texas A&M University), and Philip C. LaPort (City University New York).

The session on Lithic Artifacts included presentations by Don H. Tarling (Plymouth Polytechnic University), Jean F. DeMouth (California Academy of Sciences), George E. Harlow (American Museum of Natural History), Kenneth L. Verosub (University of California, Davis), Anne F. Rogers (Western Carolina University), and Barbara Luedtke (University of Massachusetts). These talks demonstrated the variety of tried-and-true as well as exotic techniques that are applied to provenience studies of lithics; the consideration of archaeological context, mineralogic, petrologic, magnetic, and XRF analyses. The session closed with a spirited discussion considering the difference between chert and flint.

The session on Site Sedimentation, Stratigraphy, and Climatology again demonstrated the importance of geoarchaeological research to both disciplines, geology and archaeology. Site stratigraphy is of obvious importance in considering the sequence of occupations at a site, and some strata, such as the Mazama ash, are significant in their ability to provide regional marks of absolute time. Human habitation also can alter the sedimentological record at a site, so the challenge is to discriminate among the anthropomorphic, geologic, and climatic effects. Donald A. Davidson (University of Strathclyde), Jack A. Donahue (University of Pittsburgh), John Gifford (University of Miami), Wilton N. Melhorn (Purdue University), Frank L. Stanonis (University of Southern Indiana), Lisa Wells (Stanford University), Russell G. Shepherd (University of Kentucky), Yossi Mart and A. Raban (Israel National National Institute of Oceanography), Michael McFaul (Laramie Soils Service), William R. Farrand (University of Michigan), Michael R. Waters, and Julie Woodward (IEP, Inc.) presented talks during this session.

The underrepresentation of presentations on radiocarbon dating in the session on Dating Techniques gave several discussants the bravado to question the "sanctity" of the C-14 method. All techniques have their strengths and weaknesses, so should C-14 always be the standard for comparison? Besides C-14 dating, the other methods discussed were archaeomagnetism, thermoluminescence, U-Th series, tephrachronology, and rock-varnish dating. Talks were given by Robert Sternberg (Franklin and Marshall College), Jerry J. Stipp (University of Miami), Thomas W. Stafford, Jr. (Carnegie Institution, Geophysical Lab), Kathleen H. Cole (University of Georgia), Dorothy B. Vitaliano (U.S. Geological Survey), John W. Whitney (U.S. Geological Survey), Kenneth L. Verosub, and Kenneth Tankersley & Nelson R. Shaffer (Indiana University).

Lewis Larson, State Archaeologist of Georgia, led the all-day field trip to Sapelo Island, another of the Georgia barrier islands. Sapelo has been occupied for over 3,000 years

by Native Americans, the Spanish, British, and French. Archaeological remains vary from the shell rings of Indian origin to the more recent tabby (lime, sand, shell, and water) architecture. The present inhabitants share the island with the University of Georgia Marine Institute. At Bourbon Field, Jeff Wynn and John Weymouth gave very sober field demonstrations of geophysical prospecting with proton precession magnetometry, electrical resistivity, and electromagnetic conductivity.

The session on Metal Artifacts featured presentations by George Rapp, Jr. (University of Minnesota-Duluth), Eiler Hendrickson (Carlton College), David B. Wenner (University of Georgia) and N.J. van der Merwe (University of Capetown), Don H. Tarling, Gunther A. Wagner (Max Planck Institute, Heidelberg), and J.L. Hollowell (Elkton, MD). This session again demonstrated that archaeological geology involved complementary research in experimental archaeology (stone cutting), field studies (ancient sources of metal) and laboratory analysis (provenience-neutron activation, magnetic properties; age-TL).

The session on Ceramics included discussions of technology, provenience, and chronology. Participants were Gordon Bronitsky (University of New Mexico), Daniel A. Cutrone (Santa Fe Springs, CA), Vanda Vitali (University of Toronto), Kenneth Tankersley and Nelson R. Shaffer, Dean E. Arnold (Wheaton College), and Alison E. Rautman (University of Michigan). Lively discussions on two issues gave the geologists and archaeologists further opportunity to exchange perspectives. First, a plea was made for archaeometrists to bear in mind the cultural implications of their findings, reflecting the current perspective in North America of archaeology as social science. The counterpoint was made that human artifacts can also be used to investigate significant non-cultural phenomena, such as the earth's magnetic field. The second discussion concerned the funding of one dig through the selling of artifacts to individuals, who would be liable to loan them periodically to scientific institutions for further study. Although this provided funding for the excavation, it clearly represents an unusual and controversial approach to the management of cultural resources.

A long day was concluded with an evening session on Geophysical Applications. Geophysical surveying can serve as a cost-effective way of identifying favorable areas for excavation. This session provided an overview of the available geophysical methods, results from detailed surveys using a single method, and results from a study where complementary surveys were conducted. The speakers were Jeffrey C. Wynn (U.S. Geological Survey), John W. Weymouth (University of Nebraska), Melanie Stright (Minerals Management Service), Robert Sternberg, and J.L. Hollowell.

The final session dealt with Applications of Stable Isotopes. The versatility of this approach was evidenced by applications to studies of provenience, diet, climate, and environment. Norman Herz, Edgar Hare (Carnegie Institute, Geophysical Lab), Thomas W. Stafford, Jr., Kent Sprague (University of Georgia), and Kenneth Tankersley and Nelson R. Shaffer made presentations.

Other participants in the meeting were Catharine Carson (Ball State University), Tony Morgan (Quaternary Investigations), Jodie O'Gorman (Mankato State University), Sandra E. Whitney (University of Georgia), and Geary Zern (Cultural Resource Surveys, Inc.)

The conference demonstrated that some constant themes wind through the diverse interests of geoarchaeologists and archaeological geologists. The various geological/geochemical/geophysical techniques can be of great importance in understanding aspects of human culture. On the other hand, the activities of people have in some cases provided important records of natural phenomena, and in other cases have even influenced the geological record itself.

Rob Sternberg
Franklin and Marshall College

Meetings Calendar

This issue we are beginning a new feature—a list of meetings in various disciplines that may be of interest to our readers. I have compiled this list primarily by culling items from lists published in the following journals: *Geotimes; Geological Society of America News and Information; Transactions, American Geophysical Union; Physics Today; Analytical Chemistry; Chemical and Engineering News; BioScience; Notices of the American Mathematical Society; Anthropology Newsletter.* My primary interest is in archaeological geophysics. I hope that I have included most meetings of interest to archaeological scientists from other areas. I would appreciate any feedback on the usefulness of these listings, especially if any disciplines or specializations have been overlooked (e.g., engineering). Further details on these meetings are generally available in the journals listed above. I would be happy to provide any additional information at my disposal. Contacts for more detailed information have also been included with most listings.

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March 16-20. American Physical Society, March Meeting. New York. W. W. Havens, Jr., APS, 335 E. 45th St., New York, NY 10017.

March 18-21. Northeastern Anthropological Association, 27th Annual Meeting. Amherst, MA. H. Martin Wobst, NEAA Program Chair, Department of Anthropology, University of Massachusetts, Amherst, MA 01003 (413) 545-2221.

March 22-26. Computer Graphics 1987. Philadelphia, PA. Computer Graphics '87, National Computer Graphics Association, 2722 Merrilee Drive, Suite 200, Fairfax, VA 22031 (800) 225-6242.

March 25-28. Southern Anthropology Society Annual Meeting. Atlanta, GA. Tom Collins, Urban Studies, Memphis State University, Memphis, TN 38152.

March 23-27. Workshop on Scientific Software. Institute for Mathematics and its Applications. University of Minnesota, Minneapolis, MN.

March 26-28. Southwestern Anthropological Association Regional Meeting. Bakersfield, CA. Phil Silverman, Program Coordinator. (805) 833-2368.

March 29-April 4. Erosion, Transport & Deposition Processes Workshop. Jerusalem. A. Yair, Physical Geography, Institute of Earth Sciences, Hebrew University, Jerusalem 91904, Israel (972-2-584670).

March 30-31. South-Central Section, Geological Society of America (GSA). GSA has a section on Archaeological Geology, and often has relevant sessions or presentations. Waco, TX. Edna Collis, GSA, Box 9140, Boulder, CO 80301 (303) 447-2020.

April 3-5. Central States Anthropological Society, 63rd Annual Meeting. Columbus, OH.

April 5-10. Denver, CO. 193rd American Chemical Society National Meeting. Includes symposia on: Application of Nuclear Techniques to Archaeology; Archaeological Chemistry-Organic Substances in Art and Archaeology (Contact Ralph Allen, Department of Chemistry, University of Virginia, Charlottesville, VA 22901). Barbara Hodsdon, 1155 16th St., NW, Washington, DC 20036. Program in Chemistry and Engineering News, 2/9/87.

April 6-12. Late Quaternary Sea Level: The Marine and Terrestrial Record; GSA Penrose Conference. Ferry Reach, Bermuda. James L. Carew, Department of Geology, College of Charleston, Charleston, SC 29424.

April 6-8. 11th U.K. Geophysical Assembly. Durham, U.K. UKGA-11, Department of Geological Sciences, South Rd., Durham DH1 3LE, U.K.

April 9-14. 12th General Asssembly European Geophysical Society Strasbourg, France. A.K. Richter, Max-Planck-Institut fur Aeronomie, Postfach 20, D-3411 Katlenburg-Lindau, FRG (49-5556-411).

April 13-16. European Union of Geosciences, biennial meeting. Strasbourg, France. William Lowrie, Institute fur Geophysik, HPP P5, ETH Honggerberg, CH-8093, Zurich, Switzerland.

April 16-18. Society for California Archaeology, Annual Meeting. Fresno, CA. Greg Greenway, Forest Archeologist, Sierra National Forest, 1130 O St., Fresno, CA 93721 (209) 487-5163.

April 20-23. American Physical Society, Spring Meeting. Crystal City, VA. W.W. Havens, Jr., APS, 335 E. 45th St., New York, NY 10017.

April 22-26. Canadian Archaeological Association, 20th Annual Conference. Calgary. M.C. Wilson, Department of Geology and Geophysics, University of Calgary, Calgary AB T2N 1N4 Canada.

April 27-May 1. 9th Australian Symposium on Analytical Chemistry. Sydney. J. Eames, 9 AC Secretary, P.O. Box 137, North Ryde, N.S..W. 2113, Australia.

April 26-29. American Ceramic Society. Includes 4th Seminar on Ceramics in History and Archaeology (see *SAS Newsletter,* 10:1). Pittsburgh.

April 30-May 1. North-Central Section, GSA, St. Paul. Edna Collis, GSA, Box 9140, Boulder, CO 80301 (303) 337-2020.

May 2-4. Rocky Mountain Section, GSA. Edna Collis, GSA, Box 9140, Boulder, CO 80301 (303) 447-2020.

May 6-10. Society for American Archaeology, 52nd Annual Meeting. Toronto. Timothy Kaiser, Department of Anthropology, University of Toronto, Toronto, Ontario, M5S 1A1 Canada. Details in *American Antiquity,* 4/86.

May 11-19. Spring College in Materials Science on Metallic Materials. Trieste, Italy. ICTP Condensed-Matter Secretary, P.O. Box 586, Miramare, Strada Costiera, 1-34100 Trieste, Italy (22401).

May 18-22. American Geophysical Union, Spring Meeting. Baltimore. AGU, 2000 Florida Ave., NW, Washington, DC 20009. (202) 462-6903.

May 20-22. Cordilleran Section, GSA. Hilo, Hawaii. Edna Collis, GSA, Box 9140, Boulder, CO 80301 (303) 447-2020.

May 24-29. 35th Conference on Mass Spectrometry and Allied Topics. Denver. Judith A. Watson, American Society for Mass Spectrometry, P.O. Box 1508, East Lansing, MI 48823 (517) 337-2548.

May 25-27. Geological Association of Canada and Mineralogical Association of Canada, Annual Meeting. Saskatoon. W.O. Kupsch, Department of Geological Sciences, University of Saskatchewan, Saskatoon S7N 0W0 Canada (307) 966-5696.

June 1-5. International Astronomical Union Symposium No. 133: Mapping the Sky-Past Heritage and Future Directions. Paris, France. S. Debarbat, Obs. de Paris.

June 7-11. 70th Canadian Chemical Conference and Exhibition. Quebec. Roberta Clair, Program Manager, Chemical Institute of Canada, 1785 Alta Vista Drive, Suite 300, Ottawa, Ontario, K1G 3Y6 Canada (613) 526-4652.

June 14-18. American Astronomical Society, 171st Meeting. Vancouver. Harvey Richer, University of British Columbia.

July 31-Aug. 4. International Quaternary Union. Ottawa. Alan V. Morgan, Department of Earth Science, University of Waterloo, Waterloo, Ontario, N2L 3G1 Canada.

August 9-13. American Institute of Biological Science, 38th Annual Meeting. Participating societies: Botanical Society of America; Ecological Society of America; International Society for Ecological Modeling. Columbus, OH. Charles C. King, Ohio Biological Survey, Columbus, OH 43210 (614) 422-9645. Details in *BioScience,* 2/87.

August 9-22. International Union of Geodesy & Geophysics. Vancouver. Secretariat, Venue West Ltd. 801-750 Jervis St., Vancouver, British Columbia V6E 2A(Canada (604) 68105226. Program in *Transactions, American Geophysics Union,* 68:5.

August 20-22. X-Ray Powder Diffractometry (International Union of Crystallography). Perth, Western Australia. E.H. Nickel, Division of Minerals and Geochemistry, CSIRO, Private Bag PO, Wembley, W.A., Australia 6014.

August 30-September 4. 194th American Chemical Society, National Meeting. New Orleans. Barbara Hodsdon, 1155 16th St., N.W., Washington, DC 20036.

September 9-11. Remote Sensing Society, Annual Meeting. Nottingham, U.K. P.M. Mather, Remote Sensing Unit, the University, Nottingham, NG7 2RD U.K. (0602-587611).

September 11-17. Paleoenvironmental Interpretation of Paleosols; GSA Penrose Conference. Warm Springs Indian Reservation, Oregon. Greg J. Retallack, Department of Geology, University of Oregon, Eugene, OR 97403.

September 21-23. Pyrometallurgy. London. Institution of Mining & Metallurgy, 44 Portland Place, London, W1N 4BR U.K.

September 21-25. Natural Glasses. Prague. V. Bouska, Faculty of Science, Charles University, Albertov 6, 128 43 Prague 2, Czechoslovakia.

September 23. Symposium on the Use of Reference Materials in the Metals Analysis Laboratory. Savannah, GA. Norma Bottone, Union Carbide Corp., Parma Technical Center, 12900 Snow Rd., Parma, OH 44130 (216) 676-2313.

September 23-October 1. Rocks, Fossils & History, Symposium. (International Commission on the History of Geological Sciences). Pisa, Italy. Nicoletta Morelio, Instituto di Storia Moderna e Contemporanea, Via Balbi 6, 16126 Genoa, Italy.

September 27-October 2. 5th International Flint Symposium. Bordeaux, France. Michel Lenoir, Institut du Quaternaire, Batiment de Geologie, Avenue des Facultex, Universite de Bordeaux I, 33405, Talence Cedex, France.

September 28-October 1. Symposium on Accuracy in Trace Analysis- Accomplishments, Goals, Challenges. Gaithersburg, MD. Kathy Stang, National Bureau of Standards, A353 Physics Building, Gaithersburg, MD 20899.

October 11-15. Society of Exploration Geophysicists, Annual Meeting. New Orleans. Marvin R. Kewitt, Amoco Production Company, Box 591, Tulsa, OK 74102 (918) 660-3377.

October 14-17. American Institute of Professional Geologists. Lexington, KY. Larry R. Rhodes, Rhodes & Associates Inc., 2627 Regency Road, Lexington, KY 40502 (606) 278-9465.

October 19-22. Clay Minerals Society, Annual Meeting. Socorro, NM. George S. Austin, Bureau of Mines & Mineral Resources, New Mexico Institute of Mining & Technology, Campus Station, Socorro, NM 87801 (505) 835-5125.

October 26-29. Geological Society of America, Annual Meeting, Phoenix, AZ. With associated societies, including Paleontological Society. Includes following field trips: Archaeological Geology of Paleo-Indian Sites in Southeastern Arizona; Late Pleistocene Alluvium and Megafauna Dung Deposits of the Central Colorado Plateau; Late Holocene Alluvial Processes, Southern Colorado Plateau. Jean Kinney, GSA, Box 9140, Boulder, CO 80301 (303) 447-2020.

November 18-22. American Anthropological Association, 86th Annual Meeting. Chicago. AAA, 1703 New Hampshire Ave. NW, Washington, DC 20009. Call for papers, *Anthropology Newsletter*, 1/87.

December 7-11. American Geophysical Union, Fall Meeting. San Francisco. AGU Meetings, 200 Florida Ave. NW, Washington, DC 20009 (202) 462-6903.

December 27-30. Archaeological Institute of America, 89th General Meeting. Includes colloquium on Archaeometallurgical Perspectives: Challenging the Old Picture with Recent Findings. New York. AIA, P.O. Box 1901, Kenmore Station, Boston, MA 02215. See *SAS Newsletter*, 10:1.

January 10-14, 1988. 171st Meeting of the American Astronomical Society. Austin, TX. David Evans, University of Texas.

February 11-16, 1988. American Association for the Advancement of Science, 154th Annual Meeting. Boston. AAAS Meetings Office, 1333 H St. NW, Washington, DC 20005 (202) 326-6450.

Society for Archaeological Sciences Ninth Annual Meeting

held in association with the

Society for American Archaeology

Thursday, May 7 to Sunday, May 10, 1987, Royal York Hotel, Toronto, Ontario, Canada

Preliminary SAS Program and Listing of SAA Archaeometry/Archaeological Science Symposia and General Sessions

May 7

Thursday Morning

SAA General Session (1) — Library
Bone Chemistry
Chair: R. G. V. Hancock
Participants: K. Spielmann, M. J. Schoeninger and K. Moore; D. Pate; R. G. V. Hancock, M. D. Grynpas and K. P. H. Pritzker

SAA Symposium — Alberta
Geoarchaeology of the Andean Coast: Recent Advances
Chairs: D. H. Sandweiss and J. B. Richardson III
Participants: A. K. Craig; J. T. Hsu, M. E. Mosley, C. O. Clement and J. E. Tapia; D. H. Sandweiss, H. B. Rollins and J. B. Richardson III; L. E. Wells and J. S. Noller; H. B. Rollinson

SAA Symposium (7, part 1) — Confederation 4/5/6
Ceramic Technology: An International Symposium
Chair: G. Bronitsky
Participants: A. Van As; Y. Maniatis; Y. Shimizu; C. Wang; J. M. Schuring; V. D. Gogte; U. Wagner, F. E. Wagner and J. Riederer; S. Aburto, E. Flores and M. Jimenez

Thursday Noon

Society for Archaeological Sciences Executive Board — Prince Edward

Thursday Afternoon

SAA Symposium (7, part 2) — Confederation 4/5/6
Ceramic Technology: An International Symposium (continued)
Participants: A. Vince; G. Bronitsky; D. Arnold; J. M. Vreeland; D. Adan-Bayewitz; M. Maggetti; J. M. Skibo and M. B. Schiffer

SAA General Session (15) — British Columbia
Studies in Taphonomy
Chair: L.A. Pavlish
Participants: A. V. Jopling, L. A. Pavlish and Z. Zhang; J. M. Moe; T. R. Whyte; D. M. Gurfinkle; V. D. Horwitz; G. Haynes

SAA General Session (15) — Confederation 4/5/6
Early Man in the New World
Chair: W. N. Irving
Participants: W. N. Irving; W. A. Cockrell; W. J. Mayer-Oakes and A. W. Portnoy; R. S. MacNeish

Thursday Evening, 6:00 p.m.

Society for Archaeological Sciences Annual Business Meeting — Nova Scotia

May 8

Friday Morning

SAA/SAS Symposium (23) — Confederation 3
Radiocarbon Update: Progress and Problems in Radiocarbon Dating
Organizer and Chairperson: Renee Kra

8:00 a.m. Roelf P. Beukens
Radiocarbon Dating with Accelerator Mass Spectrometry

8:20 a.m. Austin Long, A. T. Wilson, B. H. Gorde, D. J. Donahue, A. J. T. Jull, and T. W. Linick
Bone Dating at the Arizona Tandem Mass Spectrometer Facility

8:40 a.m. R. E. Raylor, P. J. Slota, Jr., W. Henning, W. Kutschera, and M. Paul
Radiocalcium (41C) Dating: Current Status and Potential Applications in Archaeology and Paleoanthropology

9:00 a.m. Erle Nelson
Accelerator Mass Spectrometry, Radiocarbon Dating and Archaeology: Present and Future Impacts

9.20 a.m. F. E. Smiley
Old Wood and Early Agriculture in Northeastern Arizona: Approaches to the Interpretation of Radiocarbon Dates

9:40 a.m. R. G. Cresswell
Iron Comes of Age

10:00 a.m. Renee Kra
Solving Your Dating Problems with the New Radiocarbon Data Base Project

10:20 a.m. J. J. Stipp and M. A. Tamers
Radiocarbon Dating in Practice: One Lab's View of Participants and Intercommunication

10:40 a.m. Minze Stuiver
A Discussion of Radiocarbon Age Calibration

11:00 a.m. Discussants: Frank Hole, Minze Stuiver

SAA General Session (25) Library
Archaeozoology
Chair: D.R. Huelsbeck
Participants: D. J. Rapson and L. C. Todd; D. K. Hanson; P. J. Ford; E. Webb; R. J. Hamilton; B. A. Smith; K. M. Holland and C. G. Turner; V. L. Butler; D. R. Huelsbeck; S. L. Collins; F. Mena; R. L. Lyman

Friday Afternoon

SAA Symposium (31) Territories
Lithic Sourcing and Procurement Strategies
Chairs: D. J. Ives and L. Lavin
Participants: B. E. Luedtke; P. Pagoulatos and K. Burgerson; B. A. Calogero; L. Lavin; G. P. Nicholas; K. B. Tankersley; D. J. Ives; L. Banks; A. D. Darlington, and J. Francis
Discussants: R. Knudson and C. Munson

SAA General Session (32) Quebec
Issues in Archaeological Theory
Chair: D. K. Charles
Participants: R. Cavallaro and E. C. Gibson; F. R. Pickin; C. C. Boyd; A. Cannon; K. K. Charles; J. Habicht-Mauche, J. Hoopes and M. Geselowitz; N. L. Benco; D. J. Killick; N. A. R. Lang

SAA Symposium (35)
Approaches to Dating North American Rock Art
Chair; T. Conway
Participants: I. N. M. Wainwright; R. Dorn and D. S. Whitley; C. Cleland and T. Conway, D. Lundy, R. J. Salzer
Discussant: J. Swauger

May 9

Saturday Morning

SAA General Session (39) Confederation 3
Computer Applications
Chair: M. T. Mulholland
Participants: M. T. Mulholland; H. L. Dibble; P. Reilly; K. M. Cleland, D. W. Read and I. Shimada

SAA Symposium (40, part 1)
Exchange Systems in North America: Connections and Interfaces
Chairs: T. G. Bauch and J. E. Ericson
Participants: P. H. Shelley; D. Meltzer; R. L. Carlson; J. E. Ericson, C. King and C. Singer; F. W. Eddy; R. H. McGuire; R. J. Bradley; D. T. Reff; G. Harbottle and P. C. Weigand; C. A. Pool and R. S. Santley; H. J. Shafter and P. A. McAnany; P. D. Sheets
Discussants: C. Irwin-Williams and J. A. Sabloff

SAA General Session (43) Confederation 3
Methods of Archaeological Research and Analysis
Chair: J. Schoenwetter
Participants: J. Schoenwetter; A. C. D'Andrea; R. A. Dalan, J. K. Stein, J. M. Musser Jr. and C. A. Ringstad; F. J. Vento and P. T. Fitzgibbons; R. C. Dunnell; K. M. Wilson Wang, J. E. Smeaton, K. M. Matsui, L. Bond and G. Burns; R. G. Kelsay, J. T. Taschek and J. W. Ball; J. I. Ebert, E. L. Camilli and L. A. Wandsnider

Saturday Afternoon

SAA Symposium (40, part 2)
Exchange Systems in North America: Connections and Interfaces (continued)
Chairs: T.G. Baugh and J.E. Ericson
Participants: C. Claassen, C. L. Nagle; B. J. Bourque; N. L. Trubowitz, J. K. Johnson and S. O. Brookes; J. L. Gibson; M. T. Smith; A. F. Ramenofsky; T. G. Baugh and F. W. Nelson; S. C. Vehik; J. D. Rogers; D. L. Toom
Discussants: G. B. Griffin and J. T. Milanich

SAA General Session (50) British Columbia
Ceramic Analysis
Chair: K. D. Vitelli
Participants: M. B. Hagstrum; W. Longacre, K. Kvamme and M. Kobayashi; R. C. Henrickson; C. A. Stimmell; P. L. Crown and R. L. Bishop; R. B. Mason; P. A. Teltser; E. F. Henrickson; P. A. Gilman; B. J. Mills; H. W. Jarvis; K. D. Vitelli, K. B. Tankersley and N. R. Shaffer; V. Vitali, L. D. Levine, E. G. Herrickson, R. G. V. Hancock and R. C. Henrickson

May 10

Sunday Morning

SAS Symposium (53) Canadian
Interfaces '87: Microscopy for the Archaeologist
Chair: J.E. Ericson

8:00 a.m. Jonathon E. Ericson
Introduction

8:10 a.m. Fred Wiseman
Archaeological Pollen Analysis

8:40 a.m. George Rapp, Jr. and Sysan C. Mulholland
Phytolith Analysis in Archaeology

9:10 a.m. Cheryl Claassen
Shellfishing Seasonality: Problems of Recognizing Annulae

9:40 a.m. Break

9:50 a.m. Michael L. Wayman
Optical Metallography: Metal Artifacts Though the Looking Glass

10:20 a.m. Break

10:30 a.m. Suzanne P. DeAtley
Ceramic Technology Revealed Through Microscopy

11:00 a.m. Sarah Berry and D.B. Bamforth
Microwear Analysis in the 1980s

11:30 a.m. Christopher M. Stevenson
Methods of Obsidian Hydration Rim Enhancement and Measurement

SAA General Session (56) Quebec
Lithic Studies
Chair: C.J. Phagan
Participants: P. A. Hicks; J. P. Nass, C. J. Lebo, W. C. Prentiss, M. L. Douthit and E. J. Romanski; S. McBrearty; J. J. Lindly; K. D. Kornbacker; E. E. Smith; C. J. Phagan; E. R. Elstien; A. W. Portnoy; L. A. Wandsnider

SAS Newsletter
Society for Archaeological Sciences

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Deadlines for Submissions

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

SAS
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Address Correction Requested