



SAS Bulletin

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From Moon-Sickles to Color-Pixels

Cameras, or at least the basic principles of them, have been around for a long time. Mozi (470-390 BC), a Chinese philosopher, is the first on written record to mention the idea behind the pinhole camera. Not long after, Aristotle (384-322 BC) discussed the crescent shape of a partially eclipsed sun projected on the ground through the holes in a sieve.

Jump ahead about 1300 years, when the Iraqi Arab scientist, Ibn al-Haytham (AD 965-ca. 1040), built the first camera obscura, which uses a pinhole to project an image of a scene outside onto a viewing surface. In his *Kitâb al-Manâ zir* (AD 1021), he wrote that, "the image of the sun at the time of the eclipse, unless it is total, demonstrates that when its light passes through a narrow, round hole and is cast on a plane opposite to the hole it takes on the form of a moon-sickle."

Jump ahead about 800 years to 1826, when Joseph Niépce created the first permanent photograph. He used a sliding wooden box camera that made use of the observation that a

silver and chalk mixture darkens under exposure to light. He took the first photograph by coating a pewter plate with bitumen and exposing the plate to light. The bitumen hardened where light struck. The unhardened areas were then cleaned off.

Finally, jump ahead about 150 years when, in 1961, Eugene F. Lally of the Jet Propulsion Laboratory published the first description of how to make still images in a digital domain using a mosaic photosensor (the purpose was to help astronauts with onboard navigation). Some 30 years later, we now have digital cameras and scanners that optically scan images and objects and convert them into digital images composed of picture elements, or "pixels," for short.

In this issue of the *Bulletin*, Ellery Frahm and colleagues use a flatbed photograph scanner to record thick sections of pottery sherds from Tell Mozan, Syria. The images are so crisp that Frahm and his associates can identify the petrographic composition of the sherds. And they prove it, too. They used an electron microprobe to test their identifications. The results were encouraging enough that they were able to extrapolate their findings to a much larger sample. Sure, it may have taken science 2500 years to develop the technology, but Frahm isn't complaining!

E. Christian Wells, Editor



Ibn al-Haytham depicted on the Iraqi 10,000-dinar note.

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Employment Opportunities

The **Washington State Department of Archaeology and Historic Preservation** is seeking a State Physical Anthropologist. The individual will act as the state's expert in determining the identification of non-forensic human remains, and will be responsible for the repatriation of both Indian and non-Indian remains. The applicant must have a doctorate in either archaeology or anthropology and have experience in forensic osteology or other relevant aspects of physical anthropology, and must have at least one year of experience in laboratory reconstruction, analysis, and reporting. A medical degree with archaeological experience may be substituted for a doctorate in anthropology or archaeology. This position is expected to start July 1, 2008. For further information visit <http://www.dahp.wa.gov/pages/AboutUs/Employment.htm>.

Awards, Fellowships, and Training

NERC PhD studentship 2008, Division of Archaeological, Geographical and Environmental Sciences, School of Life Sciences, University of Bradford. Rapid climate change in the early Holocene: Multiproxy records from Northern Britain and Ireland (Dr. Graeme T. Swindles, Prof. Julia Lee-Thorp, and Dr. Randolph Donahue). The magnitude and timing of rapid warming in the Holocene has been the subject of considerable recent interest, particularly in the context of future climate change. This project will focus on the generation of high-resolution palaeoclimate data from lakes and peatlands in Northern Britain and Ireland, spanning the period 11-6 ka BP. Northern Britain and Ireland are dominated by prevailing westerly airflow and are extremely sensitive to any changes in the strength of the thermohaline or atmospheric circulation. This project will investigate the nature and stability of millennial-centennial scale climate at this time and the terrestrial response to abrupt climate changes such as the 8.2 ka BP event. The data will be chronologically constrained and correlated precisely using high-resolution chronological methods including tephrochronology and ^{14}C wiggle matching to examine the regional coherency of climate change over this time period. The data will be compared to records from other archives such as speleothems, high latitude ice cores and marine records. The causes of the climate changes will be evaluated in terms of oceanic and atmospheric circulation and solar variability. The data will provide a robust environmental base for examining human responses to climate change during the Mesolithic occupation of the British Isles. The work fits in with emerging research foci within the Division and will have implications for ongoing archaeological work in Ireland, Scotland and Northern England. The Division of AGES has excellent research facilities including a state-of-the-art Stable Light Isotope Laboratory, X-ray, SEM, GCMS, and access to laser-ablation ICP-MS and a Bio-imaging Suite in the Analytical Centre, a dedicated laboratory for palaeoecology and tephrochronology, as well as a large human skeletal collection in the Biological Anthropology

Research Centre. Further information on current research interests can be found at: <http://www.brad.ac.uk/AGES/Research/index.php/AGES/Staff>. Please contact Dr. Randolph E. Donahue (r.e.donahue@bradford.ac.uk), Director of Postgraduate Research or Dr. Graeme T. Swindles (g.t.swindles@bradford.ac.uk). Application forms are available from Margaret Hey (m.hey@bradford.ac.uk), Division of AGES, University of Bradford, Phoenix Building SW, Bradford BD7 1DP; Tel: 01274 234213; Fax: 01274 235190. The deadline for submission of applications is Wednesday 14 May 2008.

Center for American Archeology Geoarchaeology Workshops, August 16-17, 2008. The Center for American Archeology is pleased to offer weekend hands-on workshops in geoarchaeology as part of our summer calendar. These intensive 2-day workshops are appropriate for undergraduate or graduate students, and professionals seeking to further their understanding of soils and geoarchaeology. Instruction will take place on the CAA campus in Kampsville, Illinois, and include informal lectures and hands-on experience describing, sampling, and interpreting soils and sediments in the field and in the laboratory. Special attention will be given to using soil and sediment data to better interpret the archeological record. Workshop instructor Dr. Gregory Vogel obtained his Ph.D. from the University of Arkansas Environmental Dynamics Program. He is the author of *A Handbook of Soil Description for Archeologists* and is Director of Research at the Center for American Archeology. For more information about Dr. Vogel please visit: www.projectpast.org/gvogel. Tuition for this workshop is \$200 for the weekend, including room (in one of the CAA's bunk-style dormitories) and basic field lunches (breakfast and dinner are not included). Rooms are available on the days immediately before and after workshop dates at no additional charge. Workshop instruction and exercises will focus on practical, field-based aspects of geoarchaeological analysis and interpretation. Topics to be covered include: describing soils in the field and laboratory, interpreting soil horizons and sediment types, bioturbation and other forms of soil mixing, identifying buried soils, soil/sediment/landform relationships, the importance of sedimentation rates, artifact depth-distribution analysis, overview of soil sampling and analysis techniques, and incorporating geoarchaeological information into archeological interpretations. To enroll in this workshop visit the CAA's main web page: www.caa-archeology.org. Participants will need to complete a registration form, adult medical form, and assumption of risk/permission to photograph form, and send in a 30% deposit to enroll. A confirmation letter and packet of additional information will be sent upon receipt of completed registration forms. A course syllabus and additional material will be provided upon arrival in Kampsville.

Prospection in Depth 2008, September 16-20, 2008, San Francisco. Presented by: The National Center for Preservation Technology & Training and The Presidio Trust. Week-long course \$399 (lodging included). Courses: (1) "A Workshop for Developing Advanced Geophysical Surveying and Interpretive Skills Archeology on a Deeper Level." Geophysical techniques

like radar, magnetometry, conductivity, and resistivity are fast becoming essential archeological skills. They can augment traditional documentation methods, target features for excavation, and minimize expense, site destruction and reconnaissance time. Our expert instructors will guide you in an intensive learning experience that integrates concepts, data collection, excavation, and interpretation. The historic military post, El Presidio de San Francisco, will be your testing ground. (2) "Scanning the Land: Skills Training in Geophysical Techniques." Armed with the Presidio's robust GIS database, expert instructors demonstrate the unique ability of geophysical equipment to identify buried sites and site features rapidly and non-destructively. NCPTT challenges traditional pedagogy by making you an active, engaged research partner! (3) "Moving the Earth: Learning by Testing." Most courses end with data collection. But what did it all mean? To learn what it is that caused the signals you must move the earth! Select anomalies will be excavated so that participants can learn just what features create their remotely sensed data. Join NCPTT and the Presidio Trust in an unparalleled opportunity to interpret remote sensing data through the lenses of archival, historical, and archaeological data gathered by the Presidio Archaeology Center over decades of research. (4) "Distance Learning: Geophysics from Home." Afterwards the results will be organized and presented on the Internet in cooperation with the Presidio Trust. You will have the leisure to match your survey notes against the photos, excavation records, and GIS data generated through your efforts and those of the NCPTT and Presidio Trust's archeological staff. Go to our website now to see results from 2006, and in February to see results from 2007. For more information, contact David Morgan (ncptt@nps.gov) or call (318) 356-7444. See: <http://www.ncptt.nps.gov/Archeology-and-Collections/Prospection-in-Depth.aspx?section=training>.

processing, and interpretation with on-hands use of the equipment in the field. The workshop this year will have a special focus on the soil magnetism and on the effects of plowing on geophysical signatures and site integrity. There is a tuition charge of \$475.00. Application forms are available on the Midwest Archeological Center's web page at <http://www.cr.nps.gov/mwac>. For further information, please contact Steven L. DeVore, Archeologist, National Park Service, Midwest Archeological Center, Federal Building, Room 474, 100 Centennial Mall North, Lincoln, Nebraska 68508-3873; tel: (402) 437-5392, ext. 141; fax: (402) 437-5098; email: steve_de_vore@nps.gov.

9th International Conference on ART2008, Non-destructive investigations and microanalysis for the diagnostics and conservation of cultural and environmental heritage, Jerusalem, Israel, May 25-30, 2008. The success of twenty years of Art conferences throughout Europe has set the background for Art2008. The main objective of Art2008 is to bring together experts in non-destructive evaluation and material analysis with professionals from the fields of preservation of cultural heritage, archaeology, art history and architectural researchers of ancient structures. Non-destructive methods of analysis have become a routine in many areas of technology, engineering and medicine. With a growing number of application areas, non-destructive analysis found its way into the world of art and archaeology. Its advantage over sampling is obvious in the cases of unique objects of cultural heritage. Continuous improvement of sensitivity and reliability has caused non-destructive investigations to become a preferred approach even in cases where microanalysis sampling is permitted. Many non-destructive techniques and evaluation methods applied in the natural sciences offer advantages to cultural heritage preservation. The synergy between experts will lead to the continuous development and adjustments of new scientific methods and their application in the fields of preservation, reconstruction and diagnostics of museum and archaeological objects. Conference topics: Techniques to measure and evaluate environmental damage and degradation processes (on stone, leather, parchment, paintings, wood, ivory, bone, metals, glass); Measurement of the extent of damage caused by corrosion; atmospheric pollution; biodegradation; Development of analytical techniques for the study of the composition and decay of museum objects (ion beam analysis; irradiation and diffraction techniques; radiography and tomography; fluorescence spectroscopy); Measuring the effectiveness of newly developed protection, preservation and conservation procedures (slowing deterioration and damage; innovative coating; proper storage conditions and controlled environment: temperature, humidity, lighting, gas composition); Techniques to identify materials, provenance of raw materials and production details of objects (origin and supplies; studies of ancient production techniques; identify trade routes); Authenticity and authentication of art and archaeological objects (questions of origin; identification of fakes and forgeries); investigation and verification of ancient recipes (ancient manufacturing techniques; classification of artifacts; carbon 14 dating; DNA methods applications); Special case studies

Conference News and Announcements

National Park Service's 2008 Archaeological Prospection Workshop. The National Park Service's 2008 workshop on archaeological prospection techniques entitled "Current Archaeological Prospection Advances for Non-Destructive Investigations in the 21st Century" will be held May 19-23, 2008, at the Kelly Inn, Fargo, North Dakota. Lodging will be at the Best Western Kelly Inn with the meeting room at O'Kelly Event Center at the Kelly Inn. The field exercises will take place at the Biesterfeldt Site (a protohistoric village site on the Sheyenne River). Co-sponsors for the workshop include the National Park Service, the Archaeological Conservancy, Minnesota State University-Moorhead, and the State Historical Society of North Dakota. This will be the eighteenth year of the workshop dedicated to the use of geophysical, aerial photography, and other remote sensing methods as they apply to the identification, evaluation, conservation, and protection of archaeological resources across this Nation. The workshop will present lectures on the theory of operation, methodology,

relating to the technology applied to artifacts and structures that emphasize ancient Israel's contribution to world heritage (Jewish, Christian and Islamic). The conference will be held at the Renaissance Hotel, Jerusalem. For more information: PCO and Secretariat, ISAS International Seminars, POB 574, Jerusalem, 91004, Israel; Tel: 972-2-6520574; Fax: 972-2-6520558; seminars@isas.co.il; <http://www.isas.co.il/art2008>.

American Geophysical Union, Joint Assembly, Session U02: New Insights into the First Americans: The Contribution of Geophysical Studies. Fort Lauderdale, Florida, USA from 27-30 May 2008. Recent developments in geophysical applications are transforming our understanding of First Americans sites across the Continent. At the core of global models of human dispersal and migration are questions like: When did they arrive? Who were they? What type of paleoenvironments did they need to adapt? Examples of important developments include: advances in dating methods in young materials, the impact of volcanic activity on humans, paleomagnetic studies, geophysical surveys of early archaeological sites, isotopic studies in sediments, bones and shell middens for paleoclimatic and paleodiet studies; also studies of molecular biology and genetics in conjunction with detailed paleoclimatic and paleoenvironmental records. This special session will provide a forum for interdisciplinary and multi-disciplinary presentations on the application of geophysical applications and/or combinations with other scientific disciplines to the study of old and new early American sites. We specially invite contributions for this session from researchers across the Americas from the different branches of geophysics on new results that advance our knowledge of the First Americans. Conveners: Silvia Gonzalez, Liverpool John Moores University, School of Biological and Earth Sciences, Liverpool John Moores University James Parsons Building, Byrom Street, Liverpool, L3 3AF, United Kingdom, Tel: +44 (0)151-231-2213 Email: S.Gonzalez@ljmu.ac.uk, Jaime Urrutia Fucugauchi, Universidad Nacional Autonoma de Mexico, Instituto de Geofisica, UNAM, Ciudad Universitaria, Delegacion Coyoacan, C.P. 04510, Mexico D.F., Mexico, Tel +52-55-56224227, Email: juf@geofisica.unam.mx.

IAVCEI General Assembly, August 18-25, 2008, Volcanoes and Eruptions: Tephra Studies-Tephrochronology (session 2-n). We would like to draw your attention to the following session on Tephra Studies and Tephrochronology that will be convened at the 2008 IAVCEI General Assembly in Reykjavik, Iceland. We especially encourage participation of those who integrate such tephra studies with understanding eruptive histories of volcanoes. This session will bring together scientists with active research interests and significant expertise in the collection, analysis, and interpretation of tephra deposits preserved in terrestrial soils, lacustrine deposits and ice caps as well as marine sediments. Tephra horizons define chronostratigraphic marker horizons of great precision and very extensive distribution that are valuable dating and correlation tools in both palaeoenvironmental and archaeological research. Decades of tephrochronological studies have produced a number of high quality but largely isolated data sets that if better

integrated could have important implications for a range of topics in the earth and environmental sciences. The increasing interest across many organizational and disciplinary boundaries in information about eruption frequency, volcanic hazard analysis, palaeoclimate, palaeoenvironmental conditions, and other key aspects of Quaternary history, underlines the importance of examining the status of tephrochronology and to improve cross-disciplinary collaboration, application, interpretation, and integration of results. This session will focus on (<http://www.jardvis.hi.is/page/I08-SYM2#2-n>): Tephrochronology as a tool for understanding eruption histories of volcanoes; Documenting eruption frequency, magnitude and characteristics using tephra fall deposits; Geochronology and correlation of volcanic ash; Innovations in data gathering protocols and analytical techniques; Problems associated with interpreting tephrostratigraphy records; Long-distance transport of volcanic ash; The use of tephrochronology in palaeoenvironmental research. Conveners: Gudrun Larsen, Institute of Earth Sciences, University of Iceland, glare@raunvis.hi.is; Andrew Dugmore, University of Edinburgh, Andrew.Dugmore@ed.ac.uk; Kristi Wallace, US Geological Survey/Alaska Science Center/Alaska Volcano Observatory, kwallace@usgs.gov; and Judy Fierstein, Volcano Hazards Team, US Geological Survey, jfierstn@usgs.gov. More information: <http://www.iavcei2008.hi.is/page/I08-intro>.

XII International Palynological Congress, Bonn, Germany 30 August-5 September, 2008 (<http://www.paleontology.uni-bonn.de/congress08/index.htm>). Special symposium: "Biodiversity patterns through time." We often ignore that ecosystems have a history in which environmental changes may have played a significant role in determining ecosystem composition, structure and diversity. To understand modern ecosystems, palaeoecological background information is important. Palaeoecological data based on pollen, plant remains and other proxies of dated sedimentary archives provide important and essential information to help understand the history of modern ecosystems. Further, to understand the dynamics and stability of modern ecosystems, especially in view of current global-change concerns, long-term records on vegetation and biodiversity history are needed. The symposium will address the following questions: How stable are ecosystems in space and time? How has plant diversity changed during the Quaternary, Tertiary and older time periods? How strongly did environmental impacts change ecosystems and biodiversity during the past? Interactions and contributions of palynologists and palaeobotanists working on Quaternary, Tertiary or older periods are welcome in this symposium. For more information, contact Hermann Behling, Department of Palynology and Climate Dynamics Albrecht-von-Haller-Institute for Plant Sciences, University of Göttingen, Untere Karspüle 2, 37073 Göttingen, Germany; Tel: +49 (0) 551 39 5728 (or 5733); Fax: +49 (0) 551 39 8449; Web: <http://www.palynologie.uni-goettingen.de>.

International Symposium on Biomolecular Archaeology, York, UK, September 14-16. The general aim of these informal symposia is to stimulate research in the

subject area and to encourage the exchange of information between researchers in different disciplines. Focus of the symposia series has been the application of biomolecular techniques to archaeological questions, this ideally in combination with “traditional” archaeological research methods. For more information, <http://www.york.ac.uk/depts/arch/ISBA3/index.html>.

9th International Conference on Ancient DNA and Associated Biomolecules, Pompeii, Italy, 19-22 October 2008. The conference is an excellent opportunity for ancient world enthusiasts to meet in a relaxing and stimulating environment. While we encourage you to strike out and explore Pompeii, Naples and its unique surroundings, we hope you will find it equally stimulating to navigate the meeting. For further information please visit the meeting website <http://www.ancientdna9.it/index.aspx>, contact info@ancientdna9.it. Deadline for abstract submission: 15 May 2008. Main Topics: Preservation, isolation and analysis of ancient DNA and other ancient biomolecules; Methods of extraction and purification of ancient biomolecules from ancient materials; PCR and sequencing of ancient DNA; Prevention and causes of sample contamination; Authenticity of putative ancient DNA; Hereditary and infectious diseases in past populations; Population genetics, DNA profiling, sexing, methods and application; Identification of species; Forensic applications; Evolution; Human migrations; Domestication; New and emerging technologies. For more information, contact: Marilena Cipollaro, Second University of Naples, Organising Secretariat: Scientific Communication, Via Quagliariello 35/E, I-80131 Naples, Italy; e-mail: info@ancientdna9.it; Tel. +39 081 2296460; Fax +39 081 2296037; <http://www.ancientdna9.it/index.aspx>.

Synchrotron Radiation Applied to Art and Archaeology, Barcelona, Spain, October 22-24, 2008. Archaeology and Archaeometry are two emergent fields in materials science with an increasing demand of access to SR-based techniques such as X-ray imaging, X-ray Diffraction, X-ray fluorescence and IR spectroscopy. Synchrotron radiation techniques provide powerful new ways to interrogate the records of our physical and cultural past. The purpose of the workshop is to discuss and explore the current and potential applications of synchrotron science to problems in Archaeology and Art conservation. Bringing together key members of the synchrotron community and experts in the disciplines of Archaeology, Archaeological Science, Art Conservation and Materials Science, the interdisciplinary workshop will report their latest research accomplishments, highlight ongoing projects, and catalyse new interactions between these fields. With this workshop we hope to stimulate the dialog between scientists from apparently distance areas of research, who are commonly interested in the development of applications of synchrotron radiation in the field of art and archaeology. The deadline for submission of abstracts is July 30, 2008. If you have any problems or queries please feel free to contact info@sr2a-2008.info, or visit the meeting website: www.sr2a-2008.info.

Geoarchaeology and Archaeomineralogy: Impact of Earth Sciences in the Study of Material Culture, Sofia, Bulgaria, 29-30 October 2008. Scientific Program: Archaeomineralogy and gemmology: mineral and rock artifacts throughout the centuries; mineral pigments and salts; biomineral materials; ceramics and natural glasses; jewelry; glyptic art; raw material supported strategy and the role of minerals and building stones in human culture; history of production, cutting and trade; Megalithic and stone-cut monuments; Metals, mining and archaeometallurgy; Geomorphology and geological processes related to cultural and historical objects and sites; Geophysical and remote methods in archaeology; Conservation and preservation of artifacts and cultural heritage. Contact: University of Mining and Geology “St. Ivan Rilski”, tel. +359-2 8060385; fax +359-2 9624940; e-mail rikostov@yahoo.com, or niktzankova@abv.bg; website: <http://www.mgu.bg/docs/CircularEN.doc>. Deadline for submission of papers – August 15, 2008. Deadline for payment of reduced registration fee is August 15, 2008. The support of the Organizing committee in cases for students, young scientists or for scientists from developing countries or less favored regions will include: waiving of the registration fee; accommodation in an inexpensive hotel (<https://webpace.utexas.edu/hudsonpf/binghamton.html>) will be held from Friday-Sunday, October 10-11, 2008 on the campus of the University of Texas in Austin (Texas, USA). A pre-symposium field trip is scheduled for October 8 and 9, and extends from the Texas Hill Country to the Gulf of Mexico. The goal of the 2008 Symposium is to bring together a diverse range of scholars to advance our understanding of geomorphology and environmental history in several key areas, particularly in paleohydrology, geoarchaeology, and fluvial adjustment to climate change. For additional information, please see the symposium web site <https://webpace.utexas.edu/hudsonpf/binghamton.html>.

2008 Pomerance Award Winner: Michael S. Tite

Michael S. Tite has been awarded the 2008 Pomerance Award for Scientific Contributions to Archaeology by the Archaeological Institute of America. The full-story can be found at <http://www.archaeological.org/webinfo.php?page=10101>. Professor Tite “received his B.A. at Oxford and then attended Christ Church for his D.Phil., where he studied thermoluminescence—a specialized technique used to date certain artifacts. During his early career at the University of Leeds and at Essex, he began to explore other areas of archaeological science and in 1972 published *Methods of Physical Examination in Archaeology*. This textbook was the first of its kind and remained widely used for almost 20 years. During his years as Keeper of the Research Laboratory of the British Museum, Tite made major contributions to the study of various types of glazes on artifacts from Egypt, the Near East, Rome, and throughout Europe. At this time, he also

organized the radiocarbon dating of the Shroud of Turin, helping to settle the issue of its true age. He then moved to Oxford as the Edward Hall Professor of Archaeological Science. While at Oxford, Tite directed and expanded the facilities and staff involved with scientific applications in archaeology while simultaneously continuing his own research on ceramics and other archaeological materials. Tite also served as the editor of *Archaeometry*, where he expanded the journal from a semi-annual to a quarterly production and made it more easily accessible than ever before. Michael S. Tite currently serves as an emeritus professor and fellow of Linacre College, where he continues to research production technology of early glass materials.”

Past Winners of the Pomerance Award include Patty Jo Watson (2007), Pamela B. Vandiver (2006), Jane Buikstra (2005), Ian Freestone (2004), Peter Ian Kuniholm (2003), Garman Harbottle (2002), Curt W. Beck (2001), Edward V. Sayre (1999), Nikolaas J. van der Merwe (1998), Martin J. Aitken (1997), W. David Kingery (1996), and Norman Herz (1995), among others.

The committee for the AIA Pomerance Award for Scientific Contributions to Archaeology invites nominations for the 2009 award. Eligibility is not restricted to members of the AIA, and candidates for the medal may be sought internationally with no geographical limitations. The recipient may be a professional or amateur scientist, or a team, whose interdisciplinary work with archaeologists merits recognition. Persons who have received the Gold Medal of the AIA are not excluded from eligibility. Completed nominations should be received by Institute Headquarters at the below address no later than May 15, 2008. Please send name(s) and a CV or statement about the nominee's contributions to the field to: Awards, AIA Pomerance Medal Committee, Archaeological Institute of America, 656 Beacon Street, 6th Floor, Boston, MA 02215-2006; FAX: (617) 353-6550 ; Phone: (617) 353-6550; E-mail: Awards@aia.bu.edu.

New Facility for the Wiener Laboratory

Sixteen years ago the Wiener Laboratory was established at the American School of Classical Studies at Athens (ASCSA) to focus on the interplay between the archaeological/anthropological sciences and the geosciences. Initial funding, and continuous support, has come from The Malcolm H. Wiener Foundation. That initiative was hugely successful – the Wiener Lab has become in integral part of ASCSA scholarship, a focus for research in the Aegean and Mediterranean region by anthropologists, archaeologists, geologists, geophysicists, geochemists, biologists, and others.

Success has lead to increasingly cramped facilities. There is simply little space left for expansion of the lab's library, work spaces, and offices. During the academic year it can be crowded with up to four fellows funded through the four

fellowships the lab annually provides, one faculty member via the newly created Malcolm H. Wiener Visiting Research Professorship, in addition to students, associates, and professors from universities and laboratories around the world.

A new facility is now planned thanks to a \$2 million contribution from the Malcolm H. Wiener Foundation, and a \$500,000 contribution from Dr. Charles Williams II. Additional donations have also come in response to the new Capital Campaign by the Trustees of the ASCSA to find matching funds for the new laboratory building, as well as other projects at the ASCSA. This is dramatic acknowledgment of the significant contribution the Wiener Laboratory has made to all aspects of the archaeological and anthropological sciences at the ASCSA, to other foreign schools in Greece, and to research faculty throughout the world. It is an investment in a brilliant future for the lab. Preliminary planning for the new building is underway, and suggestions are welcome. Contact: Prof. Floyd W. McCoy, 2008-9 Malcolm H. Wiener Visiting Research Professor; Dr. Sherry Fox, Director, Wiener Laboratory.

Fifty Years of *Archaeometry*

A. Mark Pollard
*Research Laboratory for Archaeology
and the History of Art, Oxford University*

The first issue of the journal *Archaeometry* appeared in spring 1958, subtitled the ‘Bulletin of the Research Laboratory for Archaeology and the History of Art, Oxford University,’ which itself had been founded by Christopher Hawkes and Lord Cherwell, under the leadership of E. T. (Teddy) Hall, in 1955 (Hawkes 1986). This first volume was ‘*not intended to by-pass the normal channels of publication*’: instead, its purpose was to ‘*provide a rapid means of circulating the results of completed research, to record partially successful projects which are not worthy of normal publication*’, and ‘*to give interim reports on some of the work in progress in the laboratory*’ (Hall 1958). It contained five contributions—two on the chemical analysis of Greek coinage, one describing the application of neutron activation analysis to samian ware and coinage, one on the use of directional measurements of the Earth's magnetic field as a dating technique for Chinese Yüeh (Yue) ware, and one on magnetic prospecting as a location technique for Romano-British kilns at Water Newton.

Despite the relatively modest aims of the bulletin, it is worth noting that this slim volume contained two particularly significant contributions—the presentation of data from the world's first archaeological geomagnetic survey (Aitken 1958), and the second report of the analysis of archaeological material by neutron activation analysis (Emeleus 1958; the first being Sayre and Dodson 1957). This latter was significant because it was J. Robert Oppenheimer, the ‘father’ of the atomic bomb, who had suggested to Sayre and Dodson in 1954 that NAA might be useful to carry out the chemical analysis of archaeological

ceramics for the purposes of determining their provenance, thus pre-dating its use in the field of geochemistry (Pollard *et al.* 2007, 131).

The journal developed rapidly under the joint editorship of Teddy Hall and Martin Aitken. The first contributions from non-Oxford authors were in volume 3 (1960), in which Charleston wrote on lead in glass, Thomsen wrote on Athenian silver coinage, and Simpson wrote on the implications of the analyses of samian pottery. In fact, these contributions were essentially continuing the policy established in the first issue, and carried out from the second, where archaeologists were invited to write a contextual introduction to the implications of the work carried out by scientists—a division of labour which, fortunately, given the stated aim of RLAHA to '*initiate the closer marrying of science and archaeology*', was increasingly to become redundant from the third issue onwards.

The content of the journal continued to expand. Although chemical analysis by optical emission and NAA, magnetic prospection and magnetic directional dating continued to be important themes, new ones were developed. Teddy Hall introduced the X-ray fluorescence spectrometer in 1960 as a new tool for the analysis of museum objects (Hall 1960). The measurement of thermoluminescence (TL) as a means of dating fired pottery was first mentioned in the journal in 1962 (Tite and Waine 1962), having been first suggested as a technique in the early 1950s, and preliminary results reported in 1960 (Kennedy and Knopff 1960). An electron probe microanalyser, now ubiquitous as a component of the electron microscope, was built in Oxford in 1960 (Roberts 1960), and was put to use by Hornblower (1962) for, amongst other things, attempting to date the gold diadem from the Royal Tombs at Ur by measuring the rate of diffusion of copper from the supporting copper rod into the gold of the leaves. The first discussion of the analysis of organic material was in de Silva (1963), who was interested in the identification of binding media for wall and easel paintings, using a combination of spot tests and paper chromatography.

This expansion of content caused changes to the format of the journal. It went from one to two issues per year in 1970 (volume 12), and two to four in 2001 (volume 43), along with a change of cover colour and of publisher, with an arrangement being made with Blackwell to publish the journal on behalf of the University of Oxford. When Teddy Hall and Martin Aitken retired in 1989 (Sayre and Tite 1990), editorship passed to Mike Tite (from volume 32 issue 2, 1990), as well as the Directorship of RLAHA. *Archaeometry* became associated with the *Gesellschaft für Naturwissenschaftliche Archäologie—Archaeometrie* and the *Society for Archaeological Sciences* in 2001, and the *Associazione Italiana di Archeometria* in 2003. Its editorial structure was revised in 2003 to give it four managing editors (representing Oxford plus these three organizations) and, in 2007, an international Editorial Board.

In this 50th anniversary year, there are yet more changes. It has moved to six issues per year, and has another new cover (and also a new publisher, at least in name, following the Wiley–

Blackwell merger). It has also entered the electronic age. In October 2007 it switched to electronic submission (accessible via the journal webpage), and to have electronic pre-publication of accepted papers via *Online Early*. Digitization of all back issues has just been completed, available from <http://www.periodicals.com/blackwell/a.html>. It is widely electronically abstracted, and is continuing to climb up the table of ISI Journal Citation Report Rankings.

There has been a conscious effort in the last few years to broaden the scope of papers accepted – perhaps inevitably, with specialist journals starting up, some of the original range of material (such as luminescence) has declined, but it is felt that there remains a need for a means of communicating new developments in specialist areas to a broader audience. In addition, although the original focus of the journal was on the applications of physics and chemistry to archaeology, the biological sciences have been so significant to archaeology in the last 20 years that the journal has increasingly welcomed contributions from these areas. In essence, therefore, the 'mission' of the journal remains the same – '*the closer marrying of science and archaeology*'. To that end, it is now an interdisciplinary science journal with the unifying theme of archaeology—the better understanding of the human past.

To mark this anniversary, a number of review articles have been commissioned, some of which are published in 50(2), and some of which will appear in a later issue. These are personal views of the development of a particular sub-theme of research within archaeometry, chosen on the basis of those themes that have most frequently appeared within the pages of the journal over the years, and to which papers in the journal have made a substantial contribution. A special 'virtual issue', consisting of a selection of about 20 of the most influential papers from the first 50 years, has been assembled, which is also available from the journal website.

So – fifty years and still going! Indeed, still developing and seeking to further the original purpose – '*the closer marrying of science and archaeology*'. There is still plenty to do and to look forward to in this period of vigorous middle age!

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Using Image Analysis Software to Correlate Sherd Scans in the Field and X-Ray Element Maps in the Laboratory

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Our research involves a novel combination of techniques to investigate the ceramic tradition at ancient Urkesh. Preparing and observing large numbers of samples for traditional ceramic petrography is expensive, time-consuming, and impractical in the field. Our alternative approach uses a flatbed scanner on-site to collect high-resolution images of sectioned sherds. We selected a portion of the scanned sherds for subsequent microanalysis. Element maps of these sherds were made using an electron microprobe (also called an electron probe microanalyzer). Image analysis software correlated the two image sets. The result is a promising way to analyze large numbers of sherds, crucial for understanding chronological and stylistic variations at this particular site and throughout the region.

The Site: Tell Mozan, Syria

Tell Mozan, located in the Khabur triangle of northeastern Syria, is the site of the ancient Hurrian city Urkesh (Figure 1). When the city was founded is unknown, but it was settled by the mid-fourth millennium BC, possibly earlier. The city remained active until 1350 BC when it was abandoned. Our team has excavated the site since 1983. The most important architectural complexes excavated so far include an inner city wall, a royal palace (circa 2250 BC), a deep stone-lined necromantic shaft next to the palace, and a massive temple

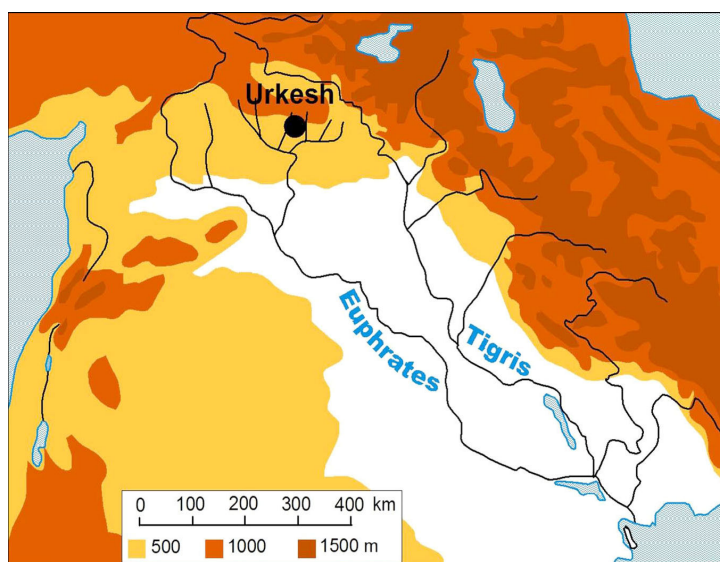


Figure 1. The ancient Hurrian city of Urkesh (Tell Mozan) sits near the foothills of the Taurus Mountains and lies in the Khabur River basin of northeastern Syria.

terrace with a monumental stone stairway. Descriptions of the site and full-text publications are available on the Urkesh website (<http://www.urkesh.org>).

Each excavation season has yielded between 40,000 and 60,000 pottery sherds and numerous whole vessels (more than 1000 from all seasons). The large body of ceramic data analyzed every season is integrated into the Urkesh Global Record, an HTML-based system for online publication of all observations and data collected during each season. The ceramic data are integrated at the level of the individual shape sherd and its description within its stratigraphic context. Descriptive statistics of the assemblage are generated instantly (Figure 2).

In earlier seasons, the fabric and inclusions of the wares were described in great detail but primarily using macroscopic categories. The ceramic shape catalog has been built up throughout the seasons and spans the city's occupational history. A large and well-categorized reference collection of several thousand sherds allows ceramic analysts to match the paste, shape, and decoration of new sherds against the parameters set for each type. This allows us to maintain full coherence within the system but also avoid the danger of "type creep" (that is, a gradual change in our ware classifications over time when not using a reference collection).

The Research Problem

In 2003, we began a more intensive study of technological changes over time in the ceramic wares. Our aim is to assess chronological and stylistic variations in clay choice, tempering materials, and firing techniques. To this end, we decided to supplement our macroscopic analysis with petrographic examination. Traditional ceramic petrography involves finely polishing very thin slices of sherds (exactly 30 microns thick) and using a polarizing microscope to identify the silicate minerals

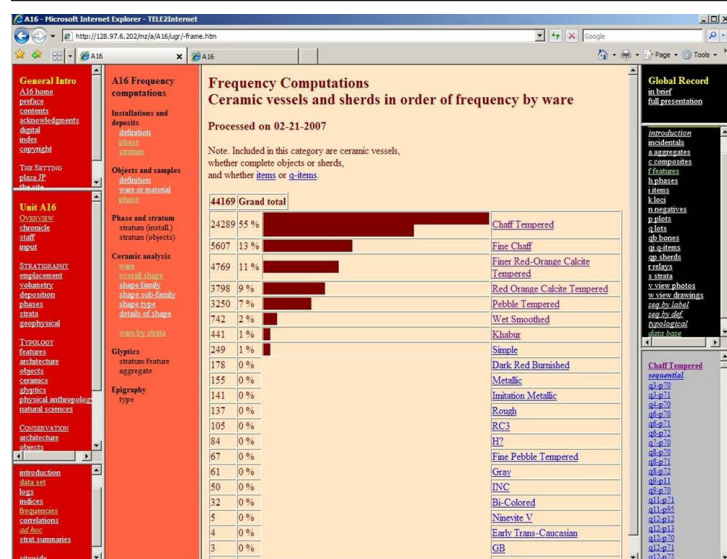


Figure 2. An example screen from the Urkesh Global Record shows how the software generates descriptive statistics of the ceramic assemblage from excavation area A16.

present. Preparing and observing large numbers of samples, though, is expensive and time-consuming. Our team has already recovered nearly a million sherds, so even a “small” sample size is still thousands of sherds. Preparing and examining hundreds of petrographic thin-sections was impractical, as was exporting so many sherds. Additionally, a petrographic microscope and polishing equipment are difficult to transport to the site and maintain. Traditional ceramic petrography also usually ignores the ceramic matrix and any small non-silicate minerals (which are ordinarily all grouped together as “opaques”), omitting potentially valuable information. We needed to develop a different approach.

Approach & Procedures

Our approach combines image analysis with X-ray microanalysis and element mapping. The image analysis process we followed was proposed by Giacomo Chiari (now of the Getty Conservation Institute, Los Angeles), who developed the procedures and software. Standard geologic procedures were followed for the microanalysis and element mapping.

About 500 sherds were selected based on numerous variables in the ceramic corpus. We chose sherds from different contexts (sections of the palace, the temple and ceremonial area, and the residential area), dates (we concentrated on four distinct time periods, or phases, of the habitation period), all major wares (from thin, fine forms to heavily tempered, utilitarian wares), and vessel parts (rims, body fragments, bases).

The sherds were cut on-site using a circular saw (a LEZACO marble cutter with a 110-mm carbide disc) purchased in Syria. The cut surfaces were polished using a sequence of three sandpaper grades (80, 150, and 220 grit) to remove the saw marks. The sherds were then washed carefully so that no

residue or debris remained. Their polished surfaces were scanned at a high resolution (2400 dpi; 0.01 mm/pixel) using a flatbed photograph scanner and a computer in the fieldhouse (Figure 3). A key advantage of this method is that we could process most sherds locally, without having to export them. The process was fast and low-cost, and the equipment was easy to transport and maintain.

Image-analysis software (Colormod) was used to identify different areas in the flatbed-scanner images on the basis of the pixels' colors. Clusters of pixels that fall within the same color range are grouped in a scale of grays, and their area coverage is tabulated (Figures 4 and 5). In our case, clusters of chromatically related pixels represent inclusions (mineral and organic) as well as different hues of the firing spectrum. Therefore, we can assess the relative abundances of the different components in the paste, and we can also examine the results of the firing process on the clay body.

To “calibrate” the sherd scans, the mineral inclusions and variations in clay composition were identified using electron microprobe analysis. Sherd samples from the various wares were sent to the University of Minnesota. The sherds were cut, mounted in epoxy plugs, and polished using standard procedures for preparing geologic samples for electron microprobe analysis. We examined the prepared sherds using a JEOL 8900R “SuperProbe” Microanalyzer equipped with five wavelength-dispersive spectrometers (WDS), an energy-dispersive spectrometer (EDS), and secondary-electron (SE) and backscattered-electron (BSE) detectors. We used a combination of electron microscopy and X-ray microanalysis to identify the mineral inclusions and establish the clay chemistry (Figure 6). After the mineral inclusions (both the deliberately added tempers and particles intrinsic to the clay) were identified, we utilized the WDS system to map the concentrations of ten geologically important elements, showing the abundance and distributions of different minerals as well as chemical variations in the clay (Figure 7). The resulting element maps allowed us to visualize the differences among wares (Figure 8). We also used them to identify the inclusions in our flatbed-scanner images, allowing us to extrapolate to the larger set of 500 scanned sherds.

Results & Interpretations

Combined petrographic and image analyses of representative sherd samples has allowed us to confirm categorizations of fabrics that had been established during the macroscopic analysis of our ceramics. These analyses have also provided a better understanding of the technological patterns behind these categories and have shed light on interesting aspects of the corpus that had been unnoticed or poorly understood:

1. *Chronological variations in the composition of calcite-tempered ceramic wares (a broad category which includes mass-produced table and storage wares in a variety of different forms and sizes).* Over the four studied



Figure 3. An example of a high-resolution scan (collected at 2400 dpi; reduced to 200 dpi here) collected using a flatbed photograph scanner in the field.



Figure 4. Part of a scanned image of a Khabur storage jar from Phase 5a.

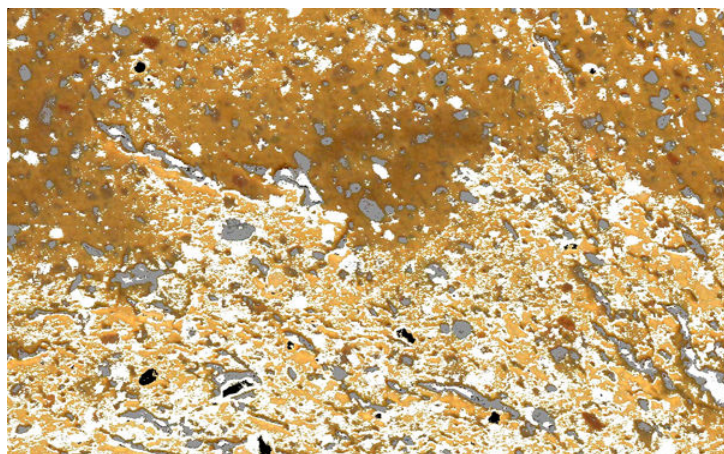


Figure 5. The same image from Figure 4 after partial processing using the Colormod software; clusters of pixels that fall within the same color range are grouped in a scale of grays.

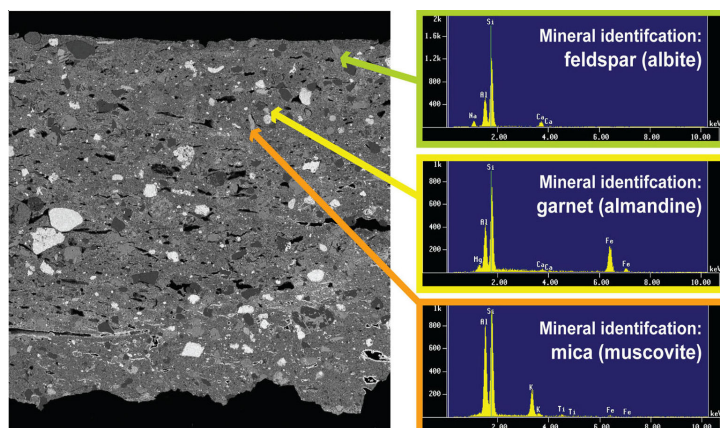


Figure 6. A backscattered-electron (BSE) image of a sherd and the EDS X-ray spectra of three mineral inclusions. This sherd comes from the same Phase-5a Khabur storage jar as shown in Figures 4 and 5. The field of view is 8-mm wide.

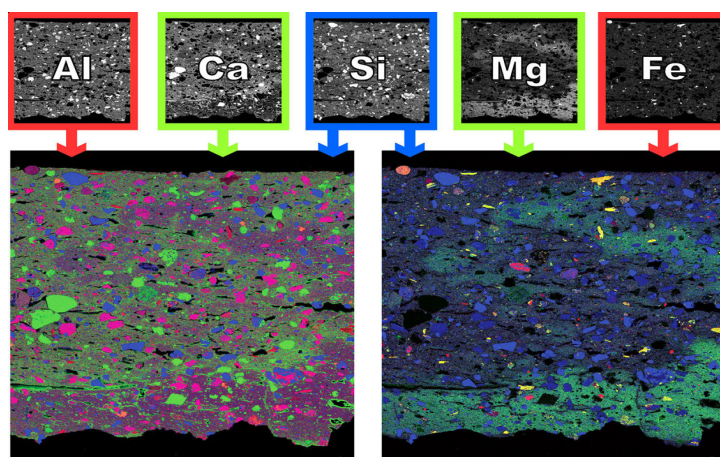


Figure 7. X-ray element maps (shown here overlaying three elements in red-green-blue maps) of the same area as Figure 6. These element maps, collected using the WDS system, show the abundance and spatial distributions of different minerals as well as chemical variations within the clay.

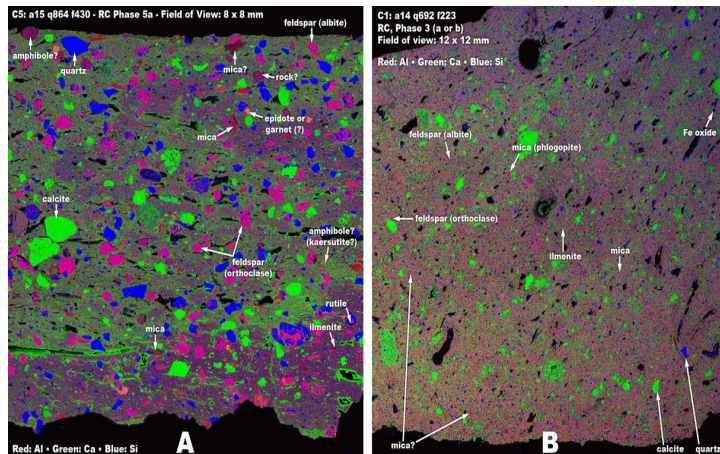


Figure 8. Red-green-blue element maps show the differences between wares. Map A corresponds to the Phase-5a Khabur jar in Figures 6 and 7. Map B shows a Phase-3 ware.

periods, from Phase 3 to Phase 5b, there is an increase in the abundance and sizes of inclusions other than calcite (e.g., quartz, feldspar) and a decrease in the amount of organic temper (Tables 1 and 2). The changes are particularly apparent in the Khabur storage jars of Phase 5a (Figures 4 to 8). Several explanations could account for the shift: special recipes developed for specific types of large vessels that are best made using tempered clays; differing availabilities of raw materials for tempering over time; and/or changes in the potters' technical know-how or preferences (or even a desire to experiment). All these possibilities deserve further exploration.

2. *Clearer distinctions among broadly related but distinct wares, such as the fine chaff-tempered (Figure 9) and fine calcite-tempered wares (Figure 10).* These two categories coexist for considerable periods of time, although in varying ratios. They are often difficult to distinguish macroscopically. Now we can measure the compositional differences between them and correlate these differences with specific vessel forms and sizes.

3. *Insights into the manufacturing, finishing, and firing processes.* Varying concentrations of the inclusions in different parts of the vessel (rim versus base) can be related to the potter's building technique during successive stages of throwing. Cracks and firing cores (with a characteristic "sandwich effect," Figure 11) are evidence for varying success in the firing kiln. Electron microscopy and X-ray microanalysis can be fruitfully extended to the examination of slips, paints, and other surface decorations (Figure 12).

Table 1. Modal analysis based on a sherd scan from a Phase-5a Khabur storage jar (the same ware shown in Figure 8A and Figures 4 to 7).

Mineral	Mean % Area	Sigma	Pixel Color Value Range		
			R	G	B
feldspar	7.30	0.03	145-186	132-183	107-155
calcite	5.04	0.03	190-255	162-254	116-221
quartz	2.53	0.02	068-113	061-099	034-074
mica	2.28	0.02	118-130	078-109	049-073
pore	0.46	0.01	053-094	041-072	012-047
Total	17.62				

Table 2. Modal analysis based on a sherd scan from a Phase-3 ware (the same ware shown in Figure 8B).

Mineral	Mean % Area	Sigma	Pixel Color Value Range		
			R	G	B
calcite	7.07	0.02	180-231	165-218	122-186
feldspar	1.01	0.01	160-183	149-176	127-152
quartz	0.58	0.01	067-096	056-085	028-063
pore	0.37	0.01	019-077	016-057	000-030
Total	9.04				

4. *Understanding the fourth-millennium Late Chalcolithic wares.* During recent seasons, we have started finding stratified mid-fourth millennium deposits of sherds (Figure 11) and cylinder seal impressions connected with the temple terrace. Our macroscopic ware descriptions from this period are now being integrated with the results of the image analysis and correlated with the microanalysis and element maps. This is allowing us to build an important database for research into the Late Chalcolithic pottery tradition at the site and throughout the region.

Acknowledgements

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Figure 9. An example of a fine chaff-tempered sherd.

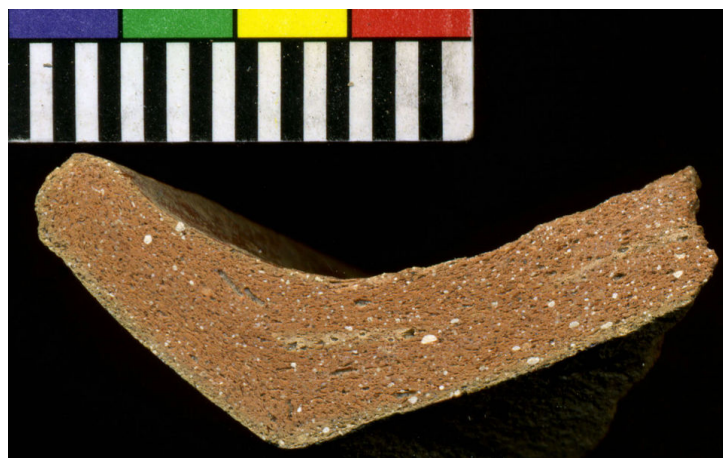


Figure 10. An example of a fine calcite-tempered sherd.

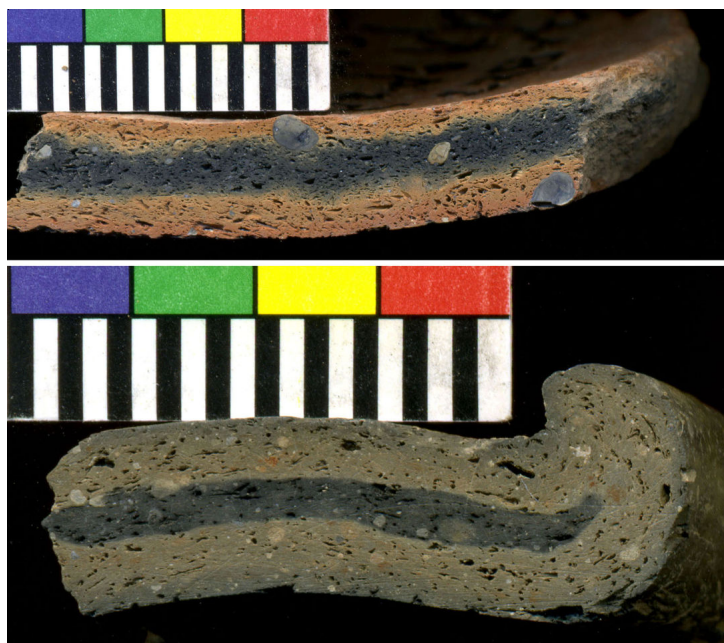


Figure 11. Two examples of fourth-millennium Late Chalcolithic wares that exhibit firing cores.

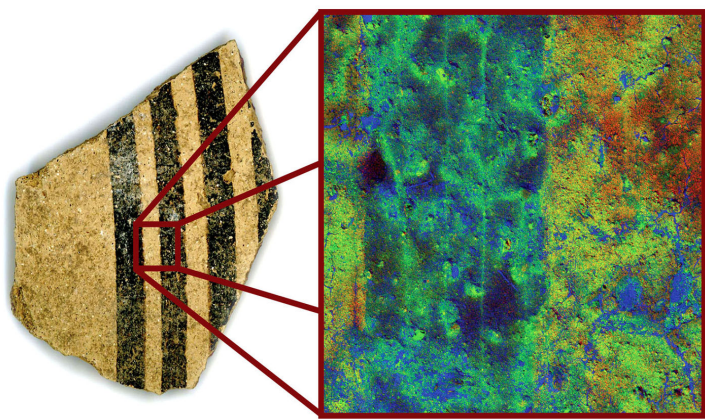


Figure 12. A red-green-blue combination element map shows the compositional differences between the slip and paint on this sherd from a Khabur storage jar. This image also reveals a series of parallel incised lines not apparent to the naked eye.

(probelab.geo.umn.edu). Travis Tenner assisted in preparing sherd specimens for microprobe analysis. Image analyses were done using Colormod Software by Dr. Giacomo Chiari of the Getty Conservation Institute. Dr. Michael Rauch of the Carnegie Institution assisted with processing and analyzing sherds during the 2006 and 2007 field seasons. This report benefited from comments from Giorgio Buccellati and Penny Frahm.

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**SAS R. E. Taylor
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Miriam Hinman

Isotopes, Collagen, and Degradation: New Evidence from Pyrolysis GC-MS and Solid State ^{13}C NMR

Miriam Hinman
Harvard University

Collagen is the most abundant protein found in calcified tissues and is used as a substrate in important applications such as radiocarbon dating and stable isotope reconstruction of diet and environment. In an archaeological context, collagen degrades, but the type and rate of degradation mechanisms on the molecular level are poorly understood. This study uses stable isotope mass spectrometry, amino acid analysis, protein sequencing, infrared spectroscopy, pyrolysis GC-MS, and solid state ^{13}C NMR to analyze the structure and alteration of the collagen molecule in different states of preservation. Major chemical transformations occur in samples with C/N_m greater than 3.1 (atomic C/N_a greater than 3.6). These data suggest that collagen degradation involves bacterially driven denaturation and deamination of R group nitrogen, followed by hydrolysis, deamination of peptide nitrogen, and formation of Maillard-type condensation products. The hydrolyzed peptide fragments, condensation products, and bacterial biomarkers are preserved in close association with each other by clay. These molecular changes have implications for use of collagen in diet studies and other archaeological applications.

Introduction

Collagen extracted from bones collected at archaeological sites provides dietary information about ancient humans, because the carbon and nitrogen isotopic composition of bone collagen reflects an animal's trophic level, marine versus terrestrial diet, and relative contributions of C3 and C4 plants (Neuberger and Richards, 1964; DeNiro and Epstein, 1981; Schoeninger and DeNiro, 1984). However, performing isotopic analysis on ancient collagen is problematic due to degradation.

One common indicator for the extent of collagen degradation is the atomic carbon-to-nitrogen ratio (C/N_a). Mass spectrometers measure a mass-based ratio, C/N_m , which is converted to an atomic ratio by multiplying by 1.1667 (White and Schwarz, 1989). Modern vertebrate collagen has C/N_m of 2.8. When C/N_m of archaeological collagen is greater than 3.1 (C/N_a greater than 3.6), the isotopic values generally fall outside the observed ranges for modern animals, meaning that the collagen has degraded sufficiently that it is no longer an accurate reflection of diet (DeNiro, 1985). These changes in C/N_m must be associated with changes in molecular structure. However, the nature of the collagen degradation products and pathways is still largely unknown. Infrared spectroscopy and amino acid analysis have shown loss of amide bonds and of net amino acid content in degraded collagen, but they do not reveal new organic constituents generated by the degradation process (DeNiro and Weiner, 1988; Tuross, 2002).

This study uses high resolution chemical techniques to compare the molecular structure of modern and archaeological collagen samples. The goal is to understand the molecular structural changes that occur during the degradation process and to relate the observed molecular changes to stable isotopic ratios.

Materials and Methods

This study uses modern pig collagen and 378 archaeological collagen samples from goats excavated at Pre-Pottery Neolithic sites in Israel and Jordan. Collagen samples were prepared by demineralizing bones in EDTA (Tuross et al., 1988). We determined elemental and isotopic composition by mass spectrometry; protein content by amino acid analysis and protein sequencing; and molecular structure by infrared spectroscopy, pyrolysis GC/MS, and solid state ^{13}C NMR. Pyrolysis involves heating at very high temperatures in order to vaporize molecular fragments of a solid sample so that those fragments may be separated by gas chromatography and detected by mass spectrometry. Solid state ^{13}C NMR uses the magnetic spin properties of atomic nuclei to detect the types of chemical functional groups present in a solid sample.

Results

In order to assess how changing C/N_m might affect isotopic ratios, we determined what type and magnitude of molecular change could cause the observed changes in C/N_m . Deamination to remove all free amino group nitrogen results in C/N_m of 3.1, while deamination of all non-peptide bonding nitrogen results in C/N_m of 3.3. Therefore samples with C/N_m greater than or equal to 3.3 are no longer protein. Those samples are also darker, less dense, and less cohesive.

We determined the mean carbon content (%C), nitrogen content (%N), carbon isotopic ratio ($d^{13}C$), and nitrogen isotopic ratio ($d^{15}N$) for collagen samples with C/N_m of 2.8 to 3.9. Percent C and percent N decrease as C/N_m increases; there is a significant difference in both measures between samples with

C/N_m of 2.8 to 3.1 and samples with C/N_m of 3.2 to 3.9. Infrared spectroscopy shows that clay likely accounts for the decreased organic content of degraded samples. Mean $d^{13}C$ values are also slightly depleted for collagens with higher C/N_m .

Amino acid analysis shows that archaeological collagen samples have a similar proportion of ASX, GLX, and GLY to modern collagen, slightly more PRO and ALA, and slightly less HPR and ARG. These differences in amino acid composition do not account for the differences in C/N_m . Meanwhile, the number of protein sequences recovered from archaeological samples was only 22%-64% of that recovered from modern collagen. In addition, whereas only 12% of ASX and GLX residues in modern collagen are deaminated, 48%-67% are deaminated in archaeological samples.

The pyrolysis GC-MS elution profiles demonstrate that intact archaeological collagen is similar to modern collagen and that the structure of archaeological collagen changes gradually with increasing C/N_m , although there are particularly significant changes for C/N_m greater than 3.1 (C/N_a greater than 3.6). Intact archaeological collagen shares all of the major pyrolysis products of modern collagen, while degraded archaeological collagen shares some major products but also yields new products (Figure 1). There are significant differences between samples with C/N_m of 2.8 to 3.1 and those with C/N_m of 3.3 to 3.9. Pyrolysis of collagen samples with higher C/N_m produces

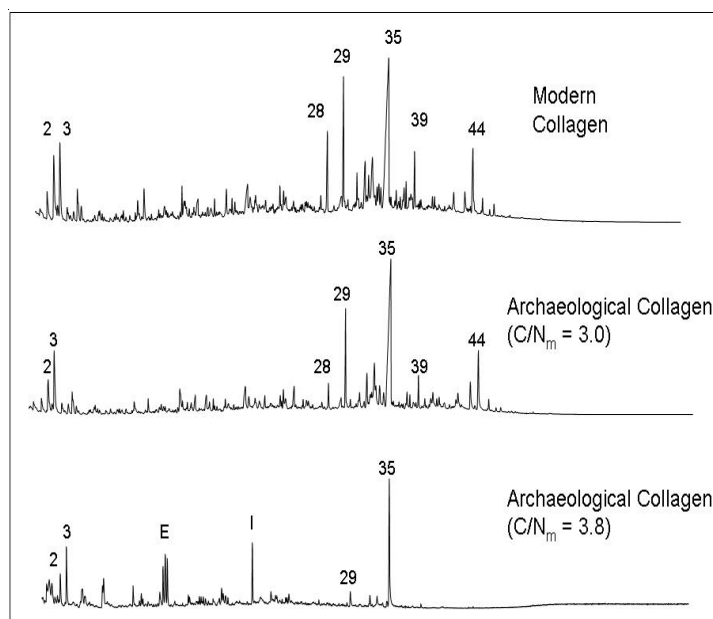


Figure 1. Pyrolysis GC-MS elution profiles of modern, intact archaeological, and degraded archaeological collagen. Ion count is plotted versus retention time. Major peaks in modern and intact archaeological collagen are labeled with numbers, while major peaks appearing in degraded archaeological collagen are labeled with letters. Nineteen samples with C/N_m ranging from 2.8 to 3.9 were pyrolyzed, but only modern collagen, an intact archaeological collagen sample, and the most degraded archaeological collagen sample are shown.

fewer amino acid dimers compared to single amino acids. Furthermore, branched alkanols appear in collagen samples with C/N_m greater than 3.1 (C/N_a greater than 3.6).

Solid state ^{13}C NMR reveals that degraded collagen maintains some characteristics of intact collagen but also contains additional functional groups (Figure 2). The NMR spectrum of modern collagen has a strong amide peak and peaks characteristic of amino acid substituents. NMR spectra of archaeological collagen samples with high C/N_m still reveal a prominent amide/carboxyl peak and amino acid substituent peaks, but there is also signal in the alcohol and olefinic/aromatic region. The extent of alteration from intact collagen can be quantified based on the NMR spectra by determining the ratio of signal area in the oxygenated carbon region to the total signal area. This NMR-derived alteration index ranges from 0.09 to 0.48 as C/N_m increases from 2.9 to 3.8. Thus NMR reveals the appearance of complex oxygenated carbon compounds in collagen samples with C/N_m greater than 3.1 (C/N_a greater than 3.6) and the increase in quantity of such compounds compared to protein as C/N_m increases.

Discussion

These analyses provide evidence that major structural changes have taken place in collagen with C/N_m greater than 3.1 (C/N_a greater than 3.6) and suggest a potential pathway

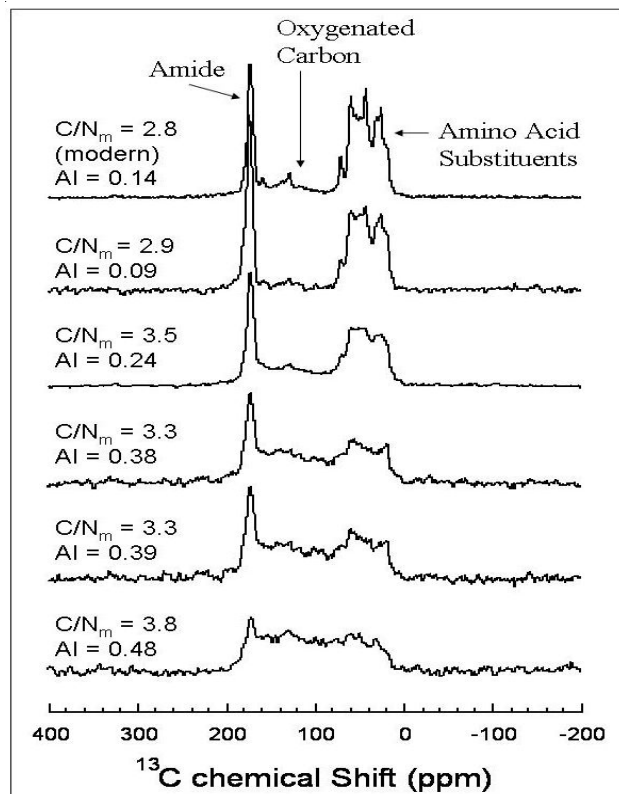


Fig. 2. Solid state ^{13}C NMR spectra of modern collagen and archaeological collagen with C/N_m of 2.8 to 3.8. AI = Alteration Index, the ratio of signal in the oxygenated carbon region to total signal.

for the degradation of collagen on archaeological sites. Theoretical calculations show that collagen with C/N_m greater than or equal to 3.3 has degraded such that it is no longer protein, decreased percent C and percent N suggests that such samples contain inorganic material like clay, and isotopic analysis shows depletion in ^{13}C . Since differences in amino acid composition do not account for changing C/N_m , degradation must be spatially heterogeneous.

Protein sequencing suggests that deamination of free amino groups may account for C/N_m increases up to 3.1 and that much of the protein in degraded collagen is so altered that it is no longer recognizable as protein. Based on pyrolysis GC-MS data, degradation also involves denaturation, hydrolysis of amide bonds, and deamination of formerly peptide-bonding nitrogen.

The NMR alteration index indicates the increasing proportion of oxygenated carbon compared to protein present in collagen samples with higher C/N_m . The suite of complex oxygenated carbon compounds present in the NMR spectra is consistent with Maillard-type condensation reactions between amino acids and sugars or, more likely, between amino acids and keto acids formed by oxidative deamination of amino acids (Ikan et al., 1996). The two specific branched alkanols that are pyrolysis products of degraded collagen samples are likely bacterial biomarkers of sediment bacteria driving collagen degradation in order to scavenge nitrogen. The alkanols may be fatty alcohol side products of bacterial fatty acid synthesis, possibly even using amino acids from degraded collagen as primers (Kolattukudy, 1971; Rock, 1978; Kaneda, 1991).

These molecular data suggest a possible process by which collagen degrades (Figure 3). Between C/N_m of 2.8 and 3.1 (C/N_a of 3.2 to 3.6), collagen undergoes denaturation, deamination of R group nitrogen, and the beginning of peptide bond hydrolysis. Starting at C/N_m of 3.2 (C/N_a of 3.7), collagen undergoes more complete hydrolysis, deamination of formerly

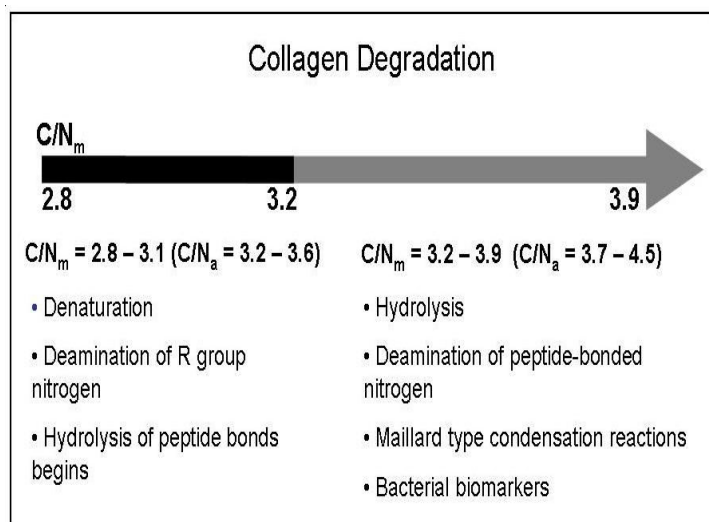


Figure 3. A degradation pathway for collagen on archaeological sites.

peptide bonded nitrogen, and Maillard-type condensation reactions of hydrolyzed amino acids and deaminated amino acids. The hydrolysis, deamination, and condensation reactions appear to be components of a concerted process driven by sediment bacteria, which leave biomarkers in degraded collagen.

Clay may contribute to the preservation of degraded collagen by holding together hydrolyzed fragments and condensation products. Since several different reactions take place simultaneously during collagen degradation, samples with identical C/N_m may not have undergone exactly the same degradation process. The molecular changes associated with collagen degradation suggest possible isotopic trends. Significant molecular changes are expected to affect the stable isotopic signatures of collagen samples with C/N_m greater than 3.1 (C/N_a greater than 3.6), and therefore such samples should not be used for diet studies or other archaeological applications. Predicting isotopic shifts may not be straightforward. In this study, formation of Maillard-type degradation products and incorporation of bacterial biomarkers in samples with high C/N_m appear to be associated with a slight reduction in d¹³C. Further analyses of the precise molecular changes during degradation and the processes by which they might occur are necessary to predict more specific isotopic shifts.

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Distribution of Skeletal Lesions within the East Smithfield Black Death Cemetery

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The Black Death of 1347-1351 was one of the most devastating epidemics in human history. It killed 30 to 50 percent of affected European populations and initiated or exacerbated dramatic social, demographic, and economic changes throughout the continent. During the epidemic, existing cemeteries were inadequate to accommodate the huge numbers of people killed by the disease. Several chroniclers commented on the near impossibility of providing normal burials for all the victims of the Black Death. Therefore, mass burial grounds, such as the East Smithfield cemetery in London, were dug to accommodate the overwhelming number of victims.

Excavation of East Smithfield revealed hundreds of individuals interred in both mass burial trenches and individual graves. This paper examines whether there are systematic differences, with respect to skeletal lesions and stature, between individuals interred in mass burial trenches versus those in individual graves within East Smithfield. In so far as skeletal indicators of poor health might indicate social status, this project tests the idea that social status determined burial location in East Smithfield.

Materials and Methods

The East Smithfield Black Death cemetery (c. 1349-50) was established in late 1348 or early 1349, and was used only for the duration of the epidemic in London. As there is no evidence that the cemetery was used after the Black Death ended in London in 1350 and given that Black Death mortality overwhelmed normal mortality during the epidemic, most if not

all people buried in East Smithfield were victims of the epidemic. The East Smithfield cemetery was excavated by the Museum of London Archaeology Services from 1986-1988; these excavations revealed several hundred skeletons buried in mass trenches and individual graves (Grainger and Hawkins 1988). Approximately 600 of the East Smithfield skeletons were recovered and are currently curated and available for study at the Museum of London. Previous researchers have suggested that the two grave types do not reflect social status, but rather fluctuations in the numbers of people dying during the epidemic, such that the mass graves were used when mortality was at its peak, and the individual graves were used when mortality slowed (Hawkins 1990). However, archaeologists were unable to determine the relative chronology of the digging or filling of the graves and burial trenches (1990). The possibility therefore remains that social status had an effect on burial location within East Smithfield – i.e. mass graves might have been used for individuals of lower socioeconomic status while individual graves were reserved for those of higher status and more means. As a preliminary attempt to identify systematic differences by burial location, this paper compares the frequencies of certain skeletal lesions in a sample of individuals from mass graves ($n = 271$) and individuals graves ($n = 189$). This combined sample represents a subsample of the excavated individuals who were well-preserved enough to allow for the scoring of age, sex, and presence of certain skeletal lesions or stress markers.

Skeletal Lesions

Studies have established a relationship between social status and the presence of skeletal lesions indicative of poor health or malnutrition (Cardoso 2007; Hatch and Willey 1974; Haviland 1967; Larsen 1997; Saunders and Keenleyside 1999; Sullivan 2005; Verano and Ubelaker 1992). However, such a pattern is not always seen in archaeological sites, as studies have found no significant difference between elite and low status individuals in terms of skeletal lesions and or stature (Cucina, et al. 1997; Paine, et al. 2007; Powell, et al. 1991; Robb, et al. 2001). The results presented here must be interpreted with caution, given that we cannot be certain about the relationship between social status and health in the sample.

The following skeletal lesions or stress markers were scored as measures of frailty (an individual's age-standardized relative risk of death compared to similarly-aged peers, (Vaupel, et al. 1979): porotic hyperostosis, cribra orbitalia, linear enamel hypoplasia, periosteal lesions (Figures 1-4, respectively), and short adult stature. For the purpose of this study, an individual is considered short stature if he/she is one standard deviation below the mean for his/her sex. Porotic hyperostosis, cribra orbitalia, enamel hypoplasia, and short stature are stress markers that can be retained into adulthood and generally reflect childhood episodes of disease or malnutrition, and periosteal lesions can be caused by trauma or infection at any time during life (Larsen 1997; Ortner 2003). Previous work has shown that these lesions are, in fact, associated with high frailty in general (e.g. Steckel and Rose 2002; Usher 2000) and in East Smithfield specially (DeWitte and Wood 2008).

Lesion frequencies in the two samples were compared using Chi-square tests; because the mass grave and individual grave samples sizes differed, the frequencies of lesions in the mass graves were standardized using the individual grave sample size as the “standard” population.



Figure 1: Linear enamel hypoplasia in adult dentition.



Figure 2: Periosteal lesion on an adult tibia.

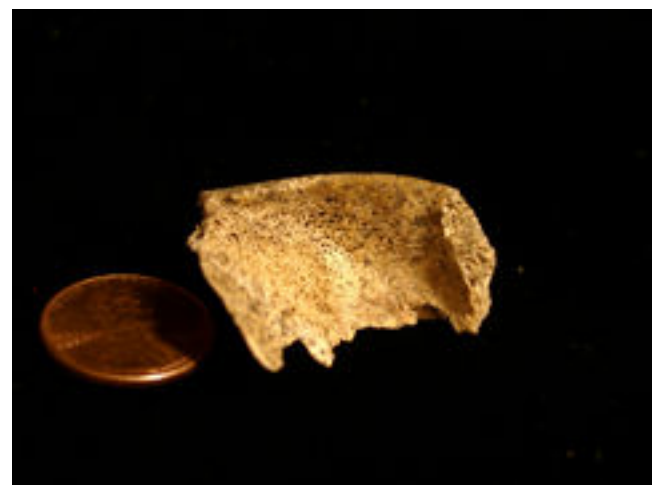


Figure 3: Cribra orbitalia on the roof of a juvenile orbit.



Figure 4: Porotic Hyperostosis on an adult cranium.

Table 1: Comparison of lesions frequencies in mass and individual graves. The * indicates the only significant difference.

	Mass Graves	Individual Graves	<i>p</i>
Tibial periostitis	77	81.8	0.44
Cribrā orbitalia	48*	58.1*	0
Porotic hyperostosis	24	21.6	0.55
LEH mandibular canine	22	23.5	0.72
Stature	76	79.2	0.33

Results

There are no significant differences between the two burial conditions with respect to frequencies of most of the lesions or the frequency of individuals of short stature (Table 1). The only exception is cribrā orbitalia, which is at a significantly higher frequency in the individual graves.

Conclusion

There are several possible explanations for the general lack of differences in lesion frequencies observed between the East Smithfield cemetery burial types (the one exception, cribrā orbitalia, will be considered separately).

First, differences in lesion frequencies existed between living low and high status individuals in London. However, the East Smithfield burial types really do reflect fluctuations in the numbers of individuals dying during the epidemic rather than status, and both burial types contain a similar mixture of high and low status individuals and thus similar frequencies of skeletal lesions.

Second, differences in lesion frequencies existed between living low and higher status individuals in London and status determined burial location; however, given that the Black Death was selective with respect to frailty (DeWitte and Wood 2008), the cemetery has an overrepresentation of individuals with lesions from all status levels, thereby blurring distinctions between status levels and thus burial types.

Third, East Smithfield contains individuals of only one social status, and burial types reflect fluctuations in the numbers of individuals dying during the epidemic rather than status.

Finally, East Smithfield contains individuals of low and higher status, but there were no skeletal differences between living low and high status individuals, so analysis of skeletal lesions will simply not reveal whether status determined burial location.

The exception to the general lack of differences between burial types is the higher frequency of cribrā orbitalia in the individual graves. The significant difference in cribrā orbitalia frequency is in the opposite direction from that expected if lesions are a sign of lower status and individual graves were associated with higher status. One potential explanation for the different frequencies of cribrā orbitalia, a lesion that forms during childhood, is that there is a higher proportion of juveniles in the individual grave sample; however, examination of the proportions of adults and juveniles in each sample reveals a significantly *lower* frequency of juveniles in the individual grave sample compared to mass graves (data not shown). Another possible explanation is that cribrā orbitalia in East Smithfield presents an example of an “osteological paradox” – i.e. individuals with cribrā orbitalia actually have low frailty given that they were strong enough to survive disease or malnutrition long enough to form the lesion (see Wood, et al. 1992).

If this were true, there might be a higher frequency of cribrā orbitalia among the occupants of individual graves because these individuals were of higher status and thus better able to survive stress. However, this is not likely the explanation, given that previous work has shown this lesion to be associated with high frailty within East Smithfield (DeWitte and Wood 2008). Perhaps further work should be done with additional skeletal lesions to determine if the observed difference for cribrā orbitalia is truly exceptional or rather if the lesion is one of several that varies by burial location.

In summary, the skeletal lesion and burial location data are insufficient, using these methods, to determine whether status determined burial location during the Black Death. Future investigation using available grave goods and/or data on diet from East Smithfield (i.e., information about social status independent from skeletal lesions) might prove more informative about the relationship (or lack thereof) between social status and burial location.

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Geoarchaeology

Jane A. Entwistle, Associate Editor

The popularity of tools such as Google Earth and in-car satellite navigation systems reflects a global geospatial data revolution. This unprecedented level of detail is also bringing a renaissance to field-based recording and data collection. Researchers are now able to use satellite- airborne- and ground-based survey equipment to collect high resolution geospatial datasets to record [landform] surface variability. Geospatial databases, mapping and spatial analysis tools (such as, for example, a Geographical Information System (GIS)) are now routinely used in many studies of landscape and provide a powerful analytical tool for the geoarchaeologist. These approaches offer major new opportunities to investigate the temporal and spatial variability of a range of properties and processes in contexts ranging from landscape organisation and stone architecture (Lambers et al., 2007) to cave and rock art (Robson-Brown et al., 2001; Diaz-Andreau et al., 2006). Consequently, new digital fieldwork technologies are heralding significant changes in the way we acquire, visualise and analyse data collected in the field (Jones et al. 2004).

Terrestrial laser-scanning (also known as ground-based lidar) is now increasingly used as a method of collecting spatial data, and when supported by digital photogrammetry, can render quantitatively accurate and visually impressive representations of natural and artificial features. Laser scan datasets and virtual images are increasingly used as a research tool in the geosciences. The archaeological community has also embraced these recent developments, with notable examples including studies of cave and rock art (Robson Brown et al., 2001; Diaz-Andreau et al., 2006), a Medieval tracing floor at York Minster (Lobb, 2007) and work by Lambers et al. (2007) modelling site layout and stone architecture.

These new technologies have widespread use beyond the creation of photo-realistic virtual copies of landscapes, and their archaeological features, offering the potential to improve our understanding of 3D spatial relationships. Georeferencing a dataset using differential GPS permits the generation of a geospatially accurate model that can be integrated with supplementary geospatial data (McCaffrey 2005), such as artefact distribution patterns and soil chemical data.

The use of soil chemical analysis as an interpretative tool to help locate, delimit and aid interpretation of space is well established (e.g. Holiday, 2007; Wilson et al., 2008). Of paramount importance to interpreting the soil record is a detailed knowledge of the local soil environment, such that variations in

chemical signatures can be more convincingly attributed to human activity. Soil variability within sites result from complex interactions between biota, climate, geology, time and topography, that all influence [post-depositional] pedological processes, as well as anthropogenic soil use and associated management practices. Each site has its own unique context and finding ways to both represent and unravel this multifaceted range of influences in order to interpret the soil chemical archaeological record remains a research challenge.

Approaches over the last c. decade include a consideration of soil chemical element depletion observed at sites, the calculation of soil element enrichment factors and the use of descriptive and other statistical procedures including cluster analysis, correlation, discriminant analysis and principal components analysis (Abrahams *et al.*, 2008; da Costa and Kern, 1999; Middleton, 2004; Terry *et al.*, 2004; Wells *et al.*, 2000, 2004; Wilson *et al.*, 2008). Recent work by Entwistle *et al.* (submitted) highlights an application integrating a photo-realistic 3D site model ('a virtual site model') with soil chemical data for an abandoned historic settlement site located in the Central Highlands of Scotland. Viewing the landscape in 3D enables a better appreciation of how any collected soil chemical data interacts spatially in a 'real-world' topographic setting.

Terrestrial laser scan datasets are an important new source of information for the archaeologist, with the potential to provide improvements not only in the recording of features and landscapes, but also their co-visualisation with other data. The high resolution and accuracy of the laser scan 'topographic' record, coupled with an ever increasing array of software for data manipulation & display heralds a new era in the way we acquire, visualise and analyse (geo)archaeological data; a technology-driven move from reporting in 2D static images to 3D interactive visualisation (Challis and Howard, 2006).

Finally such methods are also of significance in archiving sites of archaeological/historical importance where access to field sites is limited or restricted or where development activities and/or environmental processes may destroy remains. Laser scanning also has a role to play in the wider public dissemination of information as well as in education (see McCaffrey *et al.*, 2008).

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Remote Sensing and GIS

Apostolos Sarris, Associate Editor

In 2001, at the Astronautical Congress, UNESCO and the European Space Agency (ESA) launched an Open Initiative on space technologies for the conservation and monitoring of UNESCO sites (see the website: <http://www.unesco.org/science/remotesensing>). This initiative was followed by a partnership with space agencies, research institutions and universities aiming to provide technical support and assistance in the above fields to UNESCO member states. Having realized the potential use of these techniques in enhancing our understanding of the historic and natural environment, a series of international conferences were organized by UNESCO and focused on the application of remote sensing technology for the management of cultural and natural heritage.

The above coincided with new developments in satellite and aerial remote sensing that made the use of the technology much more attractive than in the past. A new generation of satellite platforms with upgraded spatial, spectral, radiometric and temporal resolution has been launched, while at the same time a more systematic or experimental usage of airborne sensors (such as Compact Airborne Spectrographic Imager (CASI), Airborne Thematic Mapper (ATM), Light Imaging Detection and Ranging (LiDAR)) has been initiated. Satellite radar sensors having the ability to penetrate vegetation and to either detect or map surface and subsurface architectural monuments started to be used in a more systematic way, especially in regions with heavy vegetation coverage (e.g., Central and South America, Asia, etc.). The recent high resolution satellite sensors offer a much better spatial resolution (for example d²1m for Kompsat, Ikonos and Quickbird) than the Landsat and SPOT imagery of the past and they can now be used in both mapping and searching mode. Other sensors, such as Hyperion offer the best spectral resolution, while Formosat provides 2m resolution images with the possibility of daily captures. Stereoscopic images either from the above sensors or from ASTER and SPOT satellites can also provide detailed information of the terrain through the creation of accurate digital elevation products. In more demanding cases, users can also employ airborne Lidar systems creating digital topographic layouts with a resolution of a few cm.

These advances were accompanied by the direct diffusion of the satellite imagery to the internet, having either global coverage (such as NASA's World Wind, Google Earth, Microsoft Virtual Earth) or a more localized coverage. This allowed more and more archaeologists and cultural resources managers to become even more familiar with the remote sensing technology and use it in everyday applications. Moreover this is the reason that we also experience an expansion of the applications of the specific technology in archaeological and historical research, as it can be seen from recent conferences and workshops (see below). The next frontier will be to adopt the so-called "reactive monitoring" policy of UNESCO to more customized applications, through the fusion of archaeological information (not just limited to World Heritage Sites) with other

satellite and environmental information. In this way we can have an integrated tool for the mapping, studying and management of archaeological landscape, that can help the decision-making for urban planning and the natural disaster management related to the protection and management of cultural resources.

International aerial archaeology conference (AARG 2008). The International aerial archaeology conference of 2008 will take place at Ljubljana (9-11 September 2008) and it is hosted by the Department of Archaeology of the University of Ljubljana. The conference has proposed sessions on Aerial Archaeology in the Mediterranean, New Projects; Postgraduate research, Airborne Thematic Mapping/Airborne Laser Scanning, An archaeology of natural places ... from the air, Aerial photography in context – recording landscape and urban areas, a.o. Closing date for abstracts is May 31, 2008. More information can be obtained by Prof. Dave Cowley (RCAHMS), 16 Bernard Terrace, Edinburgh, EH8 9NX, Scotland (dave.cowley@rcahms.gov.uk).

1st International Workshop on Advances in Remote Sensing for Archaeology and Cultural Heritage Management. The workshop, organized by EARSeL, IMMA and IBAM in collaboration to CNR, will take place in Rome, October 1-4, 2008. The topics of the workshop include among others: Aerial archaeology: from the historical photographs to multispectral and hyperspectral imagery, Active airborne sensors (lidar, SAR): data processing issues and applications, Satellite imagery for archaeology: data processing issues and study cases, Sub-surface reconstruction based on GPR, magnetic and electrical tomography for the archaeological research, Integration of space/air borne and ground remote sensing techniques for archaeology and cultural heritage, 3D visualization and Virtual reconstruction of landscape and sites, Landscape archaeology and palaeo-environmental studies based on Remote sensing, GIS and ICT, Rescue archaeology and management of cultural heritage : by means of Remote Sensing and GIS based methods, Integration of remote sensing and ground truth, a.o. Deadline for abstract submission is March 31, 2008. Abstract and queries can be addressed to: earsel-researchsig@ibam.cnr.it. More information can be obtained at <http://www.ibam.cnr.it/earsel/workshop/Workshop.htm>.

International School in Archaeology and Cultural Heritage: 3D Modeling in Archaeology and Cultural Heritage. The International School is jointly organized by the Swiss Federal Institute of Technology Zurich, the University of Siena, the B. Kessler Foundation in Trento and the University of California Merced. The School will take place at Monte Verita, Ascona, Switzerland during 9-14 May. The School will face the problem of the modern technologies in the heritage field, giving participants the opportunity to obtain a detailed overview of the main methods and applications to archaeological and conservation research and practice. The School will give the chance to participants to enter in a very short time the kernel of the scientific discussion on 3D technologies – surveying methods, documentation, data management and data

interpretation - in the archaeological research and practice. The preliminary program includes lectures on geomatics, satellite (multispectral and radar) remote sensing, aerial and terrestrial photogrammetry, laser scanning and visualization, lidar technology, 3d landscape analysis and geoarchaeology, GIS, VR and animation techniques, virtual ecosystems, a.o. The School will be open to about 60 participants at graduate level, to those carrying out doctoral or specialist research, to established research workers, to members of State Archaeology Services and to professionals specializing in the study and documentation, modeling and conservation of the archaeological heritage. Closing date for registration is March 31, 2008. More information can be obtained at <http://www.3darchaeology.org>.

6th International Conference on Science and Technology in Archaeology and Conservation. The conference is organized by the World Association for the Protection of Tangible and Intangible Cultural Heritage during times of Armed Conflict (WATCH), El Legado Andalusi and the Department of Antiquities of Jourdan, under the special patronage of United Nations World Tourism Organization, and it will take place in Rome, Italy during 8-14 December 2008. The main theme of the Conference is on Documentation and Risk Management of the Cultural Heritage focusing on natural occurring threats (weathering, flash floods, corrosion, and earthquakes) and anthropogenic caused threats, including those caused by wars and terrorism. Closing date for abstracts is March 30, 2008. More information is provided at <http://www.legadoandalusi.es/conference/en>.

International Summer School in Detecting and Mapping Buried Antiquities by Geophysical Prospecting. The international summer school will be carried out during the period of 15-28 June 2008 at the Bronze Age and Early Iron Age site of Mitrou, off the coast of Tanagra in Central Greece. The geophysical field school will provide theoretical instruction as well as practical training in all major geophysical methods applied in archaeological research. On the job training will be provided at the archaeological site of Mitrou. Training topics and instrumentation will include traditional 2-D resistance and magnetic survey, ground penetrating radar, 2- or 3-dimensional subsurface imaging by means of electrical resistivity tomography (ERT), magnetic susceptibility techniques, aerial and satellite remote sensing, GIS, etc. The field school is open to students and professionals from various disciplines ranging from archaeologists to earth scientists and engineers. Closing date for applicants is February 11, 2008 and more information can be obtained at <http://www.mitrou.org>.

The Newsletter of the International Society for Archaeological Prospection. Issue 14 of the electronic publication of The Newsletter of the International Society for Archaeological Prospection has been published in January 2008 and is accessible at the web site of the society (<http://www.bradford.ac.uk/acad/archsci/archprospection/>). The current issue includes the following: Editor's Note by Louise Martin; Geophysics and the IFA by A. Schmidt, C. Gaffney; Non-Destructive Evaluation of Historic Buildings: Zuccari

Palace in Rome (Italy) by P. M. Barone, E. Pettinelli, P. A. Annan, D. J. Redman; A Magnetic Survey of Crow Agency II, Montana, USA by S. L. De Vore; Archaeomagnetic Turkey-shoot in the Trent Valley by I. Hill, K. Challis, K. Jeffrey, C. Leech, N. Linford, D. Knight, B. Smith, D. Wardrop; Geophysical Survey in the Archaeologically Un-investigated Parts of Czech Oppida by R. Krivánek; Back to Bedlam: Archaeology, Geophysics and Great War training landscapes by P. Masters; Conference, Seminar and Course Announcements; Announcement; Journal Notifications.

Archaeological Ceramics

Charles C. Kolb, Associate Editor

The column in this issue includes eight topics: 1) AIA Honors; 2) Book Review; 3) Maya Blue; 4) New FAMSI Reports on Ceramics; 5) Previous Meetings; 6) Forthcoming Meetings; 7) Center for the Study of Architecture; and 8) Museum Opening and Exhibitions.

AIA Honors

The Archaeological Institute of America annually honors five archaeologists for their accomplishments and overall excellence in teaching, scholarship, contributions to the field, public service, and service to the AIA. The 2008 awardees are James Wiseman (Gold Medal Award), Catherine Sease (Conservation and Heritage Management Award), Frank McManamon (Outstanding Public Service Award), Jodi Magness (Excellence in Undergraduate Teaching Award), Sheila Dillon (James R. Wiseman Book Award), Michael Tite (Pomerance Science Medal), and Jeff Lamia (Joukowsky Distinguished Service Award). Three of the recipients deal with ceramic materials; see also: <http://www.archaeological.org/webinfo.php?page=10100,=10101,=10104,=10105>.

Mike Tite has recently "retired" but continues his research on glazes, glass, and ceramic materials. "Michael S. Tite received his B.A. at Oxford and then attended Christ Church for his D.Phil., where he studied thermoluminescence—a specialized technique used to date certain artifacts. During his early career at the University of Leeds and at Essex, he began to explore other areas of archaeological science and in 1972 published *Methods of Physical Examination in Archaeology*. This textbook was the first of its kind and remained widely used for almost 20 years. During his years as Keeper of the Research Laboratory of the British Museum, Tite made major contributions to the study of various types of glazes on artifacts from Egypt, the Near East, Rome, and throughout Europe. At this time, he also organized the radiocarbon dating of the Shroud of Turin, helping to settle the issue of its true age. He then moved to Oxford as the Edward Hall Professor of Archaeological Science. While at Oxford, Tite directed and expanded the facilities and staff involved with scientific

applications in archaeology while simultaneously continuing his own research on ceramics and other archaeological materials. Tite also served as the editor of *Archaeometry*, where he expanded the journal from a semi-annual to a quarterly production and made it more easily accessible than ever before. Michael S. Tite currently serves as an emeritus professor and fellow of Linacre College, where he continues to research production technology of early glass materials.”

“Catherine Sease has had a distinguished career as a conservator of archaeological materials, both in museums and in the field at archeological sites throughout the Mediterranean and Middle East. She received her Bachelor of the Sciences degree from the Institute of Archaeology, University College London where she also taught in the Conservation Department. Later, she accepted positions at the Metropolitan Museum of Art and the Field Museum of Natural History in Chicago. Currently, she works at Yale University’s Peabody Museum of Natural History as the Senior Conservator. In 1994, Sease was awarded a fellowship in conservation by the American Academy in Rome and in 1995 she served as the first chair of the Conservation and Heritage Management Committee of the AIA. In addition to her private work, she has also done consulting work for the US State Department where she was one of four specialists asked to go to Baghdad in October 2003 to assess the condition of the National Museum following the looting crisis in Iraq.”

“Jodi Magness received a B.A. in archaeology and history from the Hebrew University of Jerusalem and a Ph.D. in classical archaeology from the University of Pennsylvania. Before joining the faculty of the University of North Carolina in 2003, Magness spent ten years at Tufts University as a professor of Classical and Near Eastern Archaeology, and she also served as a visiting professor at a number of institutions. Magness is an active field archaeologist who has worked for many projects in Israel and is currently co-director of the excavations at Yotvata. Her studies focus on architecture, ceramics, gender studies, and ancient Jewish religious practice. Magness has also made many contributions to professional organizations, serving on the board of the AIA, the American Schools of Oriental Research, the W. F. Albright Institute of Archaeological Research, and the Southeast Conference for the Study of Religion. In addition, she has taken her teaching to the public, giving lectures for learned societies, religious congregations, and education television. Throughout her career, Magness has successfully conveyed her knowledge and passion for archaeology to both undergraduates and the public alike. She is uniformly praised by both students and colleagues as an enthusiastic, clear, and thoughtful teacher. Her colleagues note that whatever the class, students come away with heightened interest and a desire to learn more.”

“James Wiseman earned his Bachelor’s Degree from the University of Missouri and continued on to the University of Chicago, where he completed his Ph.D. Over the past 20 years, he has worked with NASA to bring Geographic Information Systems (GIS) and ground-based Remote Sensing methods to

the forefront of archaeology, helping other archaeologists realize their usefulness in the field. Wiseman also helped to establish the Center for Remote Sensing and the Department of Archaeology at Boston University — the first independent archaeology department in the U.S. There, he brought many regional and technical specialists together to provide an archaeological education to both undergraduates and graduate students alike. Wiseman also established and acted as the first editor of the *Journal of Field Archaeology* and also organized the first Joint Archaeological Congress in 1989 held in Baltimore. During all of this, Professor Wiseman also found time to be the president of the AIA and was able to bring the Institute to a state of prosperity.”

Book Review

Christopher A. Pool and George J. Bey III (editors), *Pottery Economics in Mesoamerica*. Tucson: University of Arizona Press, 2008. ix + 322 pp., 44 illustrations, 9 black-and-white photos, 16 tables, ISBN 978-0-8165-2577-5, \$55.00 (cloth). [Note: Charles C. Kolb, editor for this *SAS Bulletin* column, reviewed the manuscript of this volume for the University of Arizona Press in the spring of 2005 and recommended that it be published; the book was published on 10 April 2008.] This volume is a follow-up to a book published by the same author-editors in 1992, *Ceramic Production and Distribution: An Integrated Approach* edited by Bey and Pool (Westview Special Studies in Archaeological Research, Boulder, CO: Westview Press). The introductory essay and the concluding chapter of *Ceramic Production and Distribution* are frequently cited in the archaeological literature on ceramics, craft specialization, and artifact analysis; i.e., G. J. Bey III, “Introduction” (pp. 1-22) and C. A. Pool, “Integrating Ceramic Production and Distribution” (pp. 275-313). The editors are now senior scholars, still profess, and conduct significant research: Chris Pool, Associate Professor of Anthropology at the University of Kentucky, works in the Mesoamerican Gulf Coast, while George Bey, Associate Dean of International Education and Professor of Anthropology at Millsaps College, continues his archaeological research in the Yucatan.

The ten other chapters in the 1992 volume concern ceramics from Egypt, Peru, the Roman Mediterranean, Iroquoian New York State, and the American Southwest. Four contributions focus on Mesoamerica, among them chapters by Dean Arnold et al., Gary Feinman et al., and Barbara Stark who also contribute to this new compendium. The contributions to *Ceramic Production and Distribution* also include chapters by P. T. Nicholson and H. L. Patterson, “The Ballâs Pottery Project: Ethnoarchaeology in Upper Egypt” (pp. 25-47); K.L. M. Chávez, “The Organization of Production and Distribution of Traditional Pottery in South Highland Peru” (pp. 49-92); D. E. Arnold and A. L. Nieves, “Factors Affecting Ceramic Standardization” (pp. 93-113); E. B. W. Zubrow, “Formal Models of Ceramic Production” (pp. 115-129); K. M. S. Allen, “Iroquois Ceramic Production: A Case Study of Household-level Organization” (pp. 133-154); and E. Blinman and C. D. Wilson, “Ceramic Production and Exchange in the Northern

San Juan Region A.D. 600-900" (pp.155-173). The other chapters are by B. L. Stark, "Ceramic Production in Prehistoric La Mixtequilla, South-central Veracruz, Mexico" (pp.175-204); C. S. Pool and R. S. Santley, "Middle Classic Pottery Economics in the Tuxtla Mountains, Southern Veracruz, Mexico" (pp. 205-234); G. M. Feinman, S. A. Kowalewski, S. Banker, and L. M. Nicholas, "Ceramic Production and Distribution in Late Postclassic Oaxaca: Stylistic and Petrographic Perspectives" (pp. 235-259); and E. L. Will, "Production, Distribution, and Disposal of Roman Amphoras" (pp. 261-274). *Ceramic Production and Distribution* is long out-of-print and difficult to obtain. One reprint house has expressed interest in republishing the book with a new introduction. It is hoped that this can be accomplished soon.

The focus of the 2008 work is on the manufacture of ceramics (primarily pottery vessels), their distribution and consumption in prehistoric societies in Mesoamerica. The nine papers are based upon a symposium held at the Society for American Archaeology's 65th annual meeting in Philadelphia in 200 that was organized by Bey and Pool. Ceramics are one of the most important classes of artifacts recovered by archaeologists and anthropologists. Annually, new monographs are published by the dozen that present new information of pottery production, distribution, and consumption. How these data may be interpreted in relation to the social and cultural framework of prehistoric societies in Mesoamerica is the subject of Pool and Bey's new compendium. Nine chapters written by some of the best known and respected scholars in the field offer readers a new in-depth look at significant advances in ceramic studies in Mesoamerican during the past fifteen years. These scholars examine ethnoarchaeological studies and the Preclassic/ Formative, Classic, and Postclassic periods and cover geographic areas from eastern to central Mesoamerica. In a series of case studies, contributors address a range of new and developing theories and methods for inferring the technological, organizational, and social dimensions of pottery economics, and draw on a range of sociopolitical examples. Specific topics include the impacts and costs of innovations, the role of the producer in technological choices, the outcomes when errors in vessel formation are tolerated or rectified, the often undocumented multiple lives and reuses of ceramic pieces, and the difficulties associated with locating and documenting ceramic production areas in tropical lowlands. Pool and Bey have dedicated this book to the memory of three Mesoamerican scholars who contributed to our understanding of ceramic production, distribution, and consumption: Ana María Crespo, Alba Guadalupe Mastache, and Louana M. Lackey.

"Chapter 1: Conceptual Issues in Mesoamerican Pottery Economics" by Christopher A. Pool and George J. Bey III (pp. 1-38, 4 endnotes). Although the technological database on pottery production and distribution in Mesoamerica has grown rapidly, it is the sociocultural interpretations of these data that have matured and expanded, particularly in the realm of production and exchange systems and paradigms related to these phenomena. The Bey and Pool 1992 volume was influenced strongly by concepts of ceramic ecology but, like

the concept of ceramic ecology itself, concepts of sociocultural and behavioral interpretations have influenced, modified and metamorphosed earlier thinking. In 1992 Pool and Bey considered five topics that required further research, but these topics appear to have been narrowly conceived in the light of the Mesoamerican data available today. Synchronic treatments have given way to diachronic assessments that focus on changing technologies, modifications of style, and changes in organizational features on pottery economics. This introductory chapter in the 2008 volume provides a brief background and context for the book and presents the original theses and how these have become modified after nearly 20 years of new research. The authors consider ways that anthropologists have used to describe variation in craft production and cite relevant new literature.

They consider variations in craft production, including typologies, multi-dimensional classifications and characterizations, and units and loci as well as consumption and distribution. Theoretical frameworks (ceramic ecology; political economy; behavior, agency, and structure; and variability, change, and evolution) are also reviewed. In addition, they consider the four parameters Cathy Costin cited in her 1991 treatise (which was in press at the same time as Bey and Pool's 1992 volume). Hence, this offers the authors the opportunity to critique Costin's quadripartite approach, especially large-scale production and "intensity" of production. Costin's parameters have been slightly modified or elaborated in Costin's subsequent publications (1991, 1996, 2001, and 2005). One parameter that is often neglected is that all forms of the production units may be in operation at the same point in time depending on the particular ceramic goods being produced (domestic/utilitarian pottery, elite ceramics, religious/temple pottery, clay figurines, censers/incensarios and their ornaments (adornos), stamp seals, earspools, etc. The editors briefly look at the multivariate phenomenon of pottery consumption and cite some examples before moving to the complexities of ceramic distribution.

To the 1992 attributes associated with distribution, Pool and Bey add transportation technology and the character of facilities. Facilities are, of course, difficult to qualify and quantify in that multiple household tasks and craft activities may take place in the same loci at different seasons of the year, times of day, etc. (a point made by Michael Deal). In "Theoretical Frameworks" the authors correctly point out that archaeologists and ceramic ethnoarchaeologists are an eclectic and individualistic lot and they often draw upon concepts developed from diverse theoretical underpinnings to attempt to understand general and particular aspects of pottery production, exchange, and consumption. Pool and Bey then undertake the task of assessing various theoretical frameworks including classical economics, ceramic ecology, political economy, and behavior-agency-structure. The last 20 years have seen two explanatory approaches: behavioral and sociocultural. These are, however, not independent or exclusive. They also review "Evolutionary Archaeology" and Darwinian archaeology and are gentle rather than critical. Lastly, they summarize the contributions to this

volume and provide a concluding overview. This chapter provides a compelling introduction to the complex and multifaceted topic of pottery economics. This is an extremely valuable assessment and it will become much-cited like the Bey and Pool's 1992 chapters cited above.

"Chapter 2: An Ethnoarchaeological Perspective on Local Ceramic Production and Distribution in the Maya Highlands" by Michael Deal, Chair of the Archaeology Unit at Memorial University of Newfoundland (pp. 39-58, 7 figures, 2 tables, and acknowledgments). Deal uses ceramic ethnoarchaeological data from the communities of Chanal and Amatenango in the Tzeltal area of the Maya Highlands to formulate a generalized predictive spatial model in which he relates the various activities and loci of ceramic production and the spatial organization of the houselots. The author comments on the gaps and errors that can accrue in current reconstructions of prehistoric production and distribution when we apply evidence from contemporary ceramic production data. He also provides a salient cautionary tale about the overuse of ceramic ethnoarchaeological data and its applicability to prehistoric contexts. Deal presents useful spatial data (measurements to the nearest 0.5 m) and comments on the relationships between potters and consumers, noting middlemen and other intermediaries. This thoughtful essay integrates important information on ceramic production and distribution and is valuable to anyone interested in the dynamics of pottery economics.

"Chapter 3: Why Was the Potter's Wheel Rejected? Social Choice and Technological Change in Ticul, Yucatán, Mexico" by Dean E. Arnold (Wheaton College, Illinois), Jill Huttar Wilson (Brookings Institution, Washington, DC), and Alvaro L. Nieves (Wheaton College, Illinois) (pp. 59-85, 5 tables, 11 endnotes). Dean Arnold's longitudinal research at Ticul has been a beacon for researchers. His meticulous diachronic research should be emulated. In evaluating the fabrication time for distinct pottery-making techniques (vertical-half molding and the wheel), he and his colleagues documented the chronometric parameters but move to an explanation of the techniques and explicate how various factors affect the artisans' choices in selecting one fabrication procedure over the others. One household accepted the wheel and the authors provide a valuable assessment of this change. In this carefully presented essay, the authors provide essential ethnographic and ethnoarchaeological backgrounds, and reviews the four fabrication techniques that have been employed through time. The thrust of the chapter is that cultural context must be evaluated as a part of the study of technological choice and change. The costs of innovation, new (and perhaps unacceptable) motor habits, and the relationships between the physical properties of clays, vessel types and sizes, and fabrication technologies are significant and crucial variables. Illustrations of the fabrication techniques would add to their convincing presentation.

"Chapter 4: Ceramic Production at La Joya, Veracruz: Early Formative Techno Logics and Error Loads" by Philip J. Arnold

III (Loyola University, Chicago) (pp. 86-113, 2 figures, 5 tables, 6 endnotes). Philip Arnold provides the reader with a delightfully-written, thoughtful and thought-provoking anthropological and philosophical essay on technological choice – in this instance employing data from his work at La Joya, Veracruz. His contributions are always witty – "Honk if You're 'Pro Technological Choice'" and a pleasure to read and contemplate. The initial part of this chapter focuses on the role of the producer as an agent of technological choice, and proposes "techno logics" as a concept with attributes of rationality and planning. Likewise, the concept of "error loads" refers to the degree to which manufacturing mistakes are recognized and either rectified or tolerated (vessel forming is a prime example). He delves into the realms of choice, agents and agencies, strategies, unanticipated choices, and success or lack thereof. Arnold contemplates the point that the strategies of pottery fabrication may contribute to the "apparent" conservative character of ceramic manufacture. With these two concepts firmly defined, the author focuses on Early Formative pottery at La Joya. Formal attributes, surface decorations, and paste characteristics are also reported. He rightly points out that Mesoamerican ceramic studies have not generally embraced agency-oriented approaches and he notes that agency theorists have not been aware of what ceramic ecologists have been saying for 40 years. In sum, he Flip Arnold takes the position that technological choice is best viewed as the manufacturer's rational response to the context of fabrication. This is a very persuasive essay by a highly-recognized expert in the field.

"Chapter 5: Blanco Levantado: A New World Amphora" by George J. Bey III (pp. 114-146, 9 figures, 1 table, 6 endnotes). Bey focuses on the lack of the identification of pottery types and economic roles, noting that ceramic vessels often have multiple lives and uses. The amphora-like vessel that he documents is chronologically recovered from Late Formative, Classic, and Early Postclassic contexts in central and western Mexico and likely served as a storage and transport container for *miel de maguey* (in the Basin of Mexico/Teotihuacan Valley this unfermented sap extracted from castrated maguey plants is called *aguamiel* and the fermented product is *pulque*, an alcoholic beverage). Bey emphasized the evidence from Tula, Hidalgo during the Early Postclassic, 900-1200 CE. He considers the issue of the local production or importation of the ware, delves into the nature of amphorae in the Old and New World, and looks at regional variation in the Tula region as well as a probably workshop at Xicuco. Bey associates the ceramic amphora to the production of *miel de maguey* and pulque and uses Late Postclassic (Culhua Mexica/Aztec) codices, particularly the Codex Mendoza, for his ethnohistoric documentation. Bey concludes that the amphora type was produced in the rural areas of Tula, used to collect the sap and as a container for *pulque*. Lastly, he suggests avenues for future research. I was surprised that no ceramic petrographic studies or INAA (Instrumental Neutron Activation Analysis) have yet been undertaken (or at least reported) to confirm local manufacture. Thick Thin Orange amphorae from Classic period Teotihuacan might also have been used for these

beverages, but Lackey (1986) proposed a viable alternative that Bey may wish to examine; see “‘Thick’ Thin Orange Amphorae: Problems of Provenance and Usage,” Barry Isaac (ed.), *Research in Economic Anthropology, Supplement 2: Economic Aspects of Prehistoric Highland Mexico*, Greenwich, CT: JAI Press, pp. 207-219. Nonetheless, this is significant contribution by a senior scholar in the field who combines archaeological data with ethnohistoric and ethnographic evidence.

“Chapter 6: Pottery Production and Distribution in the Gulf Lowlands of Mesoamerica” by Barbara L. Stark (Arizona State University) (pp. 147-183, 9 figures, 9 endnotes). Stark examines the parameters of ceramic production and distribution in the region of Gulf Coast south-central and southern Veracruz, based on more than two decades of research. Initially, she examines ceramic economic systems and then moves to an assessment of ceramic vessel fabrication and distribution (excluding, correctly, figurines and other objects of fired clay). Stark reports the difficulties associated with locating and documenting pottery production areas in tropical lowlands, referring to Pool’s (1992) and John Clark’s (1990) cautions. In addition, she provides a valuable first-class review of both the production and distribution evidence from the Gulf Coast for pottery economic systems (the Coatzacoalcos Drainage and Southern Tuxtla Mountains, Maticapan and Tres Zapotes in the Western Tuxtlas, the Cotaxtla Drainage, and western Lower Papaloapan Basin). Distributions in southern Veracruz/Tabasco and in the Tuxtlas Mountains are reported prior to a discussion of diachronic economic changes related to marketing. Stark reports that there is no clear indication that Classic versus Postclassic distribution systems was markedly distinct from one another except in scale and intensity of production. She concludes that ceramics do not contribute significantly to inter-regional dependencies in the Gulf area, but that there were increasing change in the economic functions of Classic centers and this increase in specialization and market distribution is demonstrable in the Postclassic period. This is an excellent synthesis and a convincing essay by a respected scholar.

“Chapter 7: Household Production and the Regional Economy in Ancient Oaxaca: Classic Period Perspectives from Hilltop El Palmillo and Valley-Floor Ejutla” by Gary M. Feinman and Linda M. Nicholas (both Field Museum of Natural History, Chicago) (pp. 184-211, 12 figures, 1 table, and acknowledgments). Feinman and Nicholas have conducted research in the Valley of Oaxaca for over three decades and begin their chapter by discussing why the focus on pottery manufacture and distribution is significant to archaeology. They then move to a review of the literature on ancient Mesoamerican economies and emphasize data and examples for the Late Postclassic (Aztec) period. Next, a brief but salient background to the Oaxaca region leads to a discussion of marketing in Prehispanic Oaxaca and empirical findings on Classic period Oaxacan economy. The two excavated sites are detailed and they authors discuss the ceramic production evidence (utilitarian ceramics, figurines, spindle whorls, and handled censers). Feinman and Nicholas review the multi-craft

production seen at these sites and comment on the importance of integrated economic analyses that engage the evidence for multiple crafts and demonstrate the existence of a *multi-craft* economic system (shell and semi-precious stones) rather than a *ceramic* production and distribution system. This is a forceful and well-documented essay by senior scholars.

“Chapter 8: Pottery Production and Exchange in the Petexbatun Polity, Petén, Guatemala” by Antonia E. Foias (Williams College) and Ronald L. Bishop (Smithsonian Institution, National Museum of Natural History) (pp. 212-236, 6 figures, 6 endnotes). The authors combine archaeology and archaeometry to consider ceramic manufacture and exchange in the Petexbatun region of Peten, Guatemala and focus on the capital cities of Dos Pilas and Aguateca during the Late Classic period, ca. 650-830 CE. Although part of the same sociopolitical system, the authors seek to understand distinctions between manufacture and distribution association with monochrome and polychrome ceramics. Foias and Bishop begin with a review of the sister capital cities, the region, and political history, prior to a detailed consideration intraregional production, elite control and studies of polychrome and monochrome ceramics. There is a detailed presentation on the four ceramic pastes, the use of coefficients of variation, and a well-documented evaluation using INAA (Instrumental Neutron Activation Analysis) data on 547 specimens (see pp. 220-230). In general, polychrome vases were imported. Four data clusters are reviewed and the results explained. Methodologically, the combination of type-variety classification, modal standardization, and INAA revealed significant socioeconomic results. Ceramic craft specialization was low during the Late Classic and interregional exchange was significant in terms of political integration, supporting the hypothesis that interregional exchange was under elite control and supports the concept of a decentralized state model for the Classic Maya. This chapter clearly integrates archaeological and archaeometric information and is a model presentation.

“Chapter 9: Aztec Otumba, AD 1200-600: Patterns of the Production, Distribution, and Consumption of Ceramic Products” by Thomas H. Charlton (University of Iowa), Cynthia L. Otis Charlton (Independent Scholar), Deborah L. Nichols (Dartmouth College), and Hector Neff. (University of California at Long Beach) (pp. 237-266), 6 figures, and acknowledgments). These authors also combine archaeology and archaeometry assess ceramic manufacture, distribution and consumption in an Aztec city-state, Otumba, 1000-1600 CE. Ceramic stylistic and classificatory analyses are combined with INAA (Instrumental Neutron Activation Analysis) in the assessment of ceramics from the Early and Late Aztec and Early Colonial periods. Charlton, Otis Charlton, Nichols, and Neff briefly characterize the city-state, the long-term research project that produced the data, and craft production. Fired clay “industries” (not following Costin 1991, 2002; or Pool 1992) focuses on ceramic bowl production in the Late Postclassic (Late Aztec) period. The production and local distribution of long-handled censers (incense burners) is reported, and evidence from archaeological surveys and excavations are reported, including other fired clay objects (flutes, bells, rattles

or orbs, earpools, pestles, pipes, spindle whorls, stamps, miniature vessels, and lids). Pottery from Early and Late Aztec and Early Colonial periods (Red Wares and Black-on-Orange ceramics), and an Aztec period local ware (Otumba Polished Tan) are also documented. The latter part of this chapter includes a discussion of INAA analysis undertaken by Neff (pp. 258-262), a consideration of distribution and consumption, and general conclusions. Local fabrication and local consumption of the fired ceramic vessels and other artifacts is also reviewed. This essay is a comprehensive assessment of the subject by major scholars in the field and, like the preceding chapter, combines archaeological data with archaeometric evidence.

There are 668 "References Cited" (pp. 267-309), brief biographies of the authors and editors, "About the Contributors" (pp. 311-314), and an eight-page "Index" (pp. 315-322) that includes proper noun and topical entries as well as the figures, tables, and endnotes. There is a dearth of studies on ceramic craft production for central and eastern Mesoamerica and these essays help to redress this. This compelling volume succeeds in its goal to describe how ceramic production and distribution interact, and it documents how archaeological data, ceramic ethnoarchaeological studies, and archaeometry have taken scholars away from traditional typological approaches to ceramics and have infused sociocultural and behavioral explanations and paradigms. A compelling collection that clearly integrates and synthesizes a wide array of data, this book is the definitive text on pottery economics in Mesoamerica and an important contribution to the fields of anthropology, archaeology, ancient history, and the economics of pre-industrial societies. This volume is especially useful to Mesoamericanists but anyone interested in the archaeology and ethnohistory of craft production and specialization, the distribution of the finished products in human societies will benefit from reading this volume.

Maya Blue

Dean E. Arnold, Jason R. Crandon, Patrick Ryan Williams, Gary M. Feinman, and J. P. Brown, "The first direct evidence for the production of Maya Blue: Rediscovery of a technology," *Antiquity* 82(315):151-164 (March 2008). Abstract: "Maya Blue is a colour that is more than a pigment; it had roles in status, ritual and performance, being daubed onto pots and people before sacrifice. Here researchers use experimental and historical evidence to discover how it was made, including direct scientific analysis of Maya Blue on a pot thrown into the sacred well at Chichén Itzá. The results indicate that the formation of the colour was actually part of the ritual." Kudos is due to my long-time friend, Dean Arnold, and his colleagues. This report has received much publicity in the popular international press: *The New York Times*, *Los Angeles Times*, and *Chicago Tribune*, as well as by Reuters and Live Science.com, and as far away as India, in *New Kerala*. The association with human sacrifice is played up in these accounts, but please read the actual article and examine the scientific evidence and cultural interpretations.

New FAMSI Reports on Ceramics

Fournier, Patricia and M. James Blackman. (2006) *Production, Exchange and Consumption of Glazed Wares in New Spain: Formation of a Database of Elemental Composition through INAA*. Foundation for the Advancement of Mesoamerican Studies, Inc., Crystal Springs, FL. [translated from the Spanish by Eduardo Williams, 2008], <http://www.famsi.org/reports/06014/index.html>.

Powis, T. G. (2007). *An Archaeological Investigation of the Origins of Cacao Drinking: The Ceramic Evidence from the Gulf Coast and Pacific Coast of Mexico*. Foundation for the Advancement of Mesoamerican Studies, Inc., Crystal Springs, FL. <http://www.famsi.org/reports/06047/index.html>.

Werness, Maline Diane (2003) *Pabellon Molded-Carved Ceramics: A Consideration in Light of the Terminal Classic Collapse of Classic Maya Civilization*. M.A. thesis. University of Texas, Austin; additional materials included. Foundation for the Advancement of Mesoamerican Studies, Inc., Crystal Springs, FL. Abstract: A series of mini-collapses shook the Maya region during the Terminal Classic period (700-900 CE). By the end of the Terminal Classic, inhabitants had begun to leave and in some cases had already completely abandoned centers throughout the Maya area. A period of general decline ensued, bolstered by the decay of many sites that were both geographically and chronologically distinct. During this chaotic time of change, Maya potters shifted from making polychrome vessels and began producing a unique ceramic type known today as Pabellon Molded-Carved. <http://www.famsi.org/research/werness/index.html>.

Previous Meetings

The Mid-Atlantic Archaeological Conference held its annual meeting in Ocean City, Maryland, 28 February-2 March 2008. Seven papers of the 128 presented concerned archaeological ceramics; six were in a session "Pottery Typology in the Upper Delaware Valley," chaired by Roger Moeller. These six were: "Introduction" by Moeller; "Tired of Being Types or the Pot Sherd Says 'What?'" also by Moeller; a paper (title unavailable) by Michael Stewart; "'Whatchoo Talking 'bout Potsherd?': Insights into Upper Delaware Ceramic Grammars" by Greg Lattanzi; "Uncovering the Origins of Virginia's Abbot Zone Incised Pottery: An LA-ICP-MS Study" by Laura M. Steadman; and "The Role of Pottery for Hunter-Gatherers: If Only Binford Had Liked Ceramics" by Chris Espenshade. The seventh paper, "Ceramics Revisited — New and Improved: Three Revivals from the VDHR Collection," by Melba J. Myers was in a session on the conservation of and research on archaeological collections.

The Society for American Archaeology's 73rd Annual Meeting was held in Vancouver, British Columbia, Canada, 26-30 March 2008. More than 4,000 persons attended 261 oral sessions (four were "electronic" symposia) and 60 poster sessions. A total of 3,099 presentations were scheduled; 2,687

papers were read and there were 412 posters. In the electronic symposia, papers were posted on the SAA Web site prior to the meeting at which the symposiasts reviewed the key points of their contributions (rather than presenting them verbatim) and the authors and members of the audience discussed these presentations. I estimate that about 20 posters that were scheduled were not presented; more than 25 oral papers had been withdrawn prior to the meeting.

There were at least 97 presentations on ceramic materials in both the oral and poster sessions. Overall, about 3% of the presentations were on pottery or related clay artifacts (figurines, spindle whorls, etc.) and an astounding 9.5% of the posters focused on pottery-related materials (39 of 412) while there were 58 oral papers on ceramics materials (0.2%). It was unusual that no major symposia were devoted to ceramic materials which is a dramatic departure from earlier SAA meetings; one General Session consisting of volunteered papers was devoted to pottery. Despite these modest figures, there were important oral papers that given were in different sessions at the same time (alas). It certainly appears that poster presentations are the preferred — and growing — method of disseminating complex information; such presentational also allows the “audience” to ask questions and directly engage the presenter in relevant conversation.

Reading the abstracts is the only way to actually discern the number of papers on ceramic materials since some titles (at least six that I found) did not specify geographic location or chronology (one paper had neither in the title or the abstract). It is likely that I missed some in my review, so that the numbers of pottery-related presentations cited below may be regarded as minima. The numbers of oral and poster presentations are in parentheses.

Method and Theory (2). North America: General (1), American Southwest/Northern Mexico (20), Great Basin (1), California (1), Midlands/Plains (7), Northeastern North America (4), Southeastern North America (3), and Eastern North America (3). For Mesoamerica: Central Mexico/Meseta Central (12), Highland and Lowland Maya (14), and Valley of Oaxaca (1). Central America (Costa Rica, Panama) (2). For South America: General (1), Andean (Ecuador, Peru, Bolivia) (9), and Caribbean (3). Eurasia: Italy (2), Albania (1), Anatolia/Turkey (1), Southwest Asia (Jordan, Syria) (4), Central Asia (Caucasus) (1), and East Asia (China) (3). Oceania (Samoa) (1) and Africa (Sub-Saharan) (2).

Relatively few presenters had data derived from physicochemical analyses such as INAA, XRF, LA-ICPMS, and petrographic microscopy. Seven papers concerned ceramic figurines and one paper focused on the analysis of shell-tempered pottery in eastern North America. In a symposium, “Changing Politics, Economies, and Identities in Classic and Postclassic Central Mexico: Perspectives from Cerro Portezuelo,” that focused on the site of Cerro Portezuelo site located on the eastern shore of Lake Texcoco in the Basin of Mexico, three presentations considered ceramic materials: Janet

Montoya on the ceramic figurine collection; Destiny Crider on the ceramic assemblage from the Epiclassic and Early Postclassic; and Chris Garraty, Deborah Nichols, and Hector Neff on the Postclassic Aztec and Early Colonial pottery (read by Garraty). This session demonstrated the importance of the modern analyses of curated collections excavated fifty years ago. A General Session, “Studies of Clay Artifact Production in Mesoamerica and Middle America,” featured papers by Marc N. Levine, Leslie Cecil, Lane Fargher and Jamie Forde; James J. Sheehy; and Lisa Overholtzer and Michael Glascock. Another General Session, Craft Production and Craftsmanship in Southwestern Archaeology,” had oral presentations by Jill Neitzel; Arthur C. MacWilliams; Cynthia L. Herhahn; and David R. Abbott. One Poster Session focused on ceramics. “Innovations in Ceramic Analysis,” with contributions by Ursel Wagner, Rupert Gebhard, Werner Haeusler, Izumi Shimada and Fritz Wagner; Emily Stovel; and Melissa Chatfield and J. David Stienmier. Another group of posters (mostly non-ceramic), “Archaeometry and Artifact Studies in Mesoamerica and Middle America,” featured presentations by Adam C. Menzies; Nicole C. Little, Laura Kosakowsky, Jon Lohse and Robert J. Speakman; Brian R. McKee; Carl J. Wendt and Peter Stanslow; Craig T. Goralski; Karl P. Holland, Janine Gasco, Hector Neff and Michael Glascock; and William A. Locascio.

Forthcoming Meetings

WAC-6: Sixth World Archaeological Congress is scheduled from 29 June through 4 July 2008 in Dublin, Ireland. At this time there are no symposia or papers listed that concern ceramics, but there may be a few “scattered” presentations on the final program. Please visit <http://www.ucd.ie/wac-6/> and <http://www.worldarchaeologicalcongress.org/site/wac6.php>.

The 23rd International Congress on Caribbean Archaeology, sponsored by the International Association of Archaeologists of the Caribbean (IACA) and the City Historian’s Office of Havana City announce that the 23rd International Congress on Caribbean Archaeology will be held from the 19-26 July 2009 in Havana City, Cuba. Ceramic studies feature prominently in several of the proposed sessions. The following topics are included in the proposed agenda: New theoretical and methodological contributions to the study of Pre-Columbian cultures; Pre-agricultural and agricultural societies, new findings and interpretations; research on Pre-Columbian technologies; interpretation and reconstruction of every day’s life in the Caribbean Pre-Columbian societies; migrations, contact, interaction, transculturation and adaptation models in the pre-colonial and colonial periods; Caribbean archaeology and ethnohistory; physical anthropology, genetic and hereditary studies of human groups; taphonomic studies in archaeology; pre-Columbian cave art and furnishings; historical archaeology, new theoretical-methodological contributions, findings and interpretations; archaeology in the study of slavery, resistance, abolition and emancipation; urban archaeology, studies, findings and interpretations; archaeology of architecture;

research on historical technologies; mural painting: a resource for the archaeological research on historic buildings; preservation and restoration of archaeological evidence; subaquatic archaeology, new studies and findings; social archaeology in the Caribbean; research on archaeozoology and archaeobotany; archaeometry; industrial archaeology; research on sugar cane, coffee plantations and others; management of archaeological heritage in the Caribbean; public archaeology, museums and collections; theory in archaeology; historical research at the service of archaeology; archaeology in the digital era; archaeology of contemporary time; archaeological experiences in Caribbean places which are World Heritage Sites.

Participation is sought through proposals for conferences, posters, documentaries or videos, workshops or round tables. Requirements for participation: Every speaker must present an original, unpublished work relevant to the topics included and to those related to the Caribbean archaeological region. The summary of the papers will be sent in digital format (Microsoft Word file), in Spanish, English or French before 31st October. The full text of the papers should not exceed ten (10) pages and must be submitted before 31 March 2009 to facilitate appropriate translation and ensure its participation. The authors are required to indicate the audiovisual media needed for the presentation. The authors are required to enclose a brief CV to the papers. In order to facilitate assistance for the event, a tourist package has been developed with San Cristóbal as the facilitating travel agency, email: eventos@viajessancristobal.cu. For additional information, contact: Lic. Roger Arrazcaeta, President of the Organising Committee, Department of Archaeology, OHC, Mercaderes 15 entre Empedrado y O'Reilly. Habana Vieja, Cuba. Telephones: (537) 8 614469 / 8604298; Internet site http://museum-server.archanth.cam.ac.uk/IACA.WWW/Notice2_en.htm.

Ceramic Ecology XII, Current Research on Ceramics 2008 is a symposium proposed to be held at the annual meeting of the American Anthropological Association in San Francisco California, 19-23 November 2008. The Symposium Organizer and Chair is Charles C. Kolb (National Endowment for the Humanities). The papers in this international and interdisciplinary symposium, the 22nd in the annual series, reflect a number of approaches within the framework of Matson's concept of Ceramic Ecology, set forth in his volume, *Ceramics and Man* (1965). The following agenda has been proposed: Charles C. Kolb "Introduction to Ceramic Ecology XXII: Current Research on Ceramics 2008." Anabel Ford (Exploring Solutions Past ~ The Maya Forest Alliance and Director ISBER/MesoAmerican Research Center University of California at Santa Barbara) "The Implications of Volcanic Ash in Late Classic Maya Pottery at El Pilar, Belize." Marcie Venter (University of Kentucky) "Feasting and Solidarity: Ceramic Evidence from the Late Postclassic Tuxtla Mountains, Veracruz, Mexico." Dean E. Arnold (Wheaton College, IL), Hector Neff (California State University at Long Beach), and Bruce Bohor (United States Geological Survey, retired) "Maya

Blue: Where Did Its Palygorskite Constituent Originate?" Ana Lucia Gonzalez (University of Hawaii at Manoa) and Samuel Connell (Foothill College) "Revealing Variations on Ceramic Technology in the Northern Andes of Ecuador." Brenda J. Bowser (California State University at Fullerton) "Archaeological Evidence of Children's Craft Production: Testing Methodological Approaches to Learning in Pottery-Making Societies." Alexandre Livingstone Smith (Royal Museum for Central Africa – Bruxelles, Belgium) "Archaeology and Linguistics: A Comparative Overview of Pottery Traditions in Central Africa." Claire Corniquet (Université Libre de Bruxelles) "The Social Life of Pottery: Context and Scales of Practice." Tara Tarault (Montgomery College) "Akan Matrilineal Pottery Practice in Ghana, West Africa." Kostalena Michelaki (McMaster University) "Stentinello, Impressed and Buff Wares of Middle Neolithic SW Calabria, Italy: Exploring the Co-Existence of Multiple Operational Sequences." Julie A. Woods and Elizabeth S. Chilton (University of Massachusetts at Amherst) "Continuities and Changes in Native Ceramic Technologies in the Middle Connecticut River Valley, Massachusetts." Charles C. Kolb (National Endowment for the Humanities) "News from the Field and Laboratory." Marilyn Beaudry Corbett (University of California Los Angeles, Cotsen Institute of Archaeology) will be the symposium's "Discussant." Assuming that this volunteered session will be accepted for inclusion in the program, the abstracts of these presentations will be published in a forthcoming issue of the *SAS Bulletin*.

Center for the Study of Architecture

CSA, the Center for the Study of Architecture, <http://csanet.org>, is devoted to advancing the use of computers, computer technologies, and digital information technologies in the service of architectural history, archaeology, and related disciplines that explore our common heritage. Online articles concerning digitizing slides, pottery profiles and capacity calculations are available in the *CSA Newsletter*, <http://csanet.org/newsletter/#masterindex>: "Scanning 35 mm. Slides in the Office – First Rate Results Now Possible" by Harrison Eiteljorg II, 18(1) (Spring 2005); "Optical Plotting and AutoCAD® for Drawing Pottery" by Vinod Nautiyal, Sudhir Nautiyal, and Mohan Naithani, 13(3) (Winter 2000); "Who Needs Film?," by CSA Staff (?), 12(1) (Spring 1999); "Letter to Editor by Carol W. Campbell and a response by Harrison Eiteljorg II, 11(3) (Winter 1999); "Pottery Profiles - Yet Again" by Harrison Eiteljorg II, 11(1) (Spring 1998); "Raster and Vector Images - An Important Difference" by Susan C. Jones, 10(1) (Spring 1997); "A New Aid for Drawing Pottery Profiles" by Harrison Eiteljorg II, 9(4) (Feb. 1997); "Computerizing Pottery Profiles - Yet Again" by Alexis Menten, 9(1) (May 1996); "Drawing Profiles - Another Method" by Harrison Eiteljorg II, 8(4) (Feb. 1996); "Pot Volumes from Profiles: The Handheld Solution" by Richard C. Anderson, 8(1) (May 1995); "Figuring Vessel Capacity" by Richard C. Anderson, 7(4) (Feb. 1995); "Scanning Pottery Profiles" by Jeffrey Zorn, 7(4) (Feb. 1995); "Vessel Capacity from Pottery Profiles: Notice of an Upcoming Publication" by Louise Senior and Dunbar P. Birnie III, 7(3) (Nov. 1994); and "Pottery Profiles Again" by Louise Senior,

7(2) (August 1994). Neither “Pottery Profiles - Time and Costs,” 7(1) (May 1994) or “AutoCAD for Pottery Profiles,” 6(4) (February 1994) are currently available on the Web site.

Museum Opening and Exhibitions

New £10m Wedgwood museum unveiled: A museum featuring ceramics produced by Josiah Wedgwood is being unveiled. BBC23 January 2008 The £10m Wedgwood House of Treasures in Barlaston, Staffordshire, will house 6,000 Wedgwood artefacts, 75,000 manuscripts and 680 pattern books. It also features rare items including two of the four remaining First Day’s Vases, a Portland vase and Slave Medallions. The museum, which features pieces on display for the first time in years, will open to the public in August. Josiah Wedgwood was born in Burslem, Stoke-on-Trent, in 1730. First Day’s Vases is the name given to six vases thrown by Josiah Wedgwood on a potters wheel turned by his business partner Thomas Bentley at the company’s works in Etruria, Stoke-on-Trent. The Slave Medallions were created to support the movement for the abolition of the slave trade. http://news.bbc.co.uk/2/hi/uk_news/england/staffordshire/7204224.stm.

The History of Tea: The K. S. Lo Collection of the Flagstaff House Museum of Tea Ware from 19 March-17 November 2008 at the Flagstaff House Museum of Tea Ware (10 Cotton Tree Drive, Central, Hong Kong [inside Hong Kong Park]). The exhibition features more than 100 tea ware artifacts from the Tang dynasty (618-907 CE) to the 20th century and incorporates a history of tea along with domestic Chinese and Chinese export ware. Educational corners have been set up to enhance an enlightening and fascinating experience. Admission is free, 10:00 am-5:00 pm daily (closed on Tuesdays). See <http://hk.art.museum> for details.

Book Reviews

Deborah L. Huntley, Associate Editor

Demography in Archaeology (Cambridge Manuals in Archaeology). Andrew Chamberlain. Cambridge, 2006, xix +235 pp., 45 figures, 19 tables, index. Price: £18.99 (paperback). ISBN: 0-521-5651-3.

Reviewed by Suzanne L. Eckert, Department of Anthropology, Texas A&M University, TAMU 4352, College Station, Texas, 77843, USA

As with other books in the Cambridge Manuals in Archaeology series, *Demography in Archaeology* is a review of the current theories and methods focusing on a particular aspect of archaeological research; in this case, the reconstruction of populations from archaeological data. Chamberlain has successfully organized the diverse disciplines

interested in demographic inquiry (history, ethnography, physical anthropology, biomolecular archaeology, palaeopathology, statistics) into a manual that both archaeological students and professionals will find valuable. The book is organized into 7 chapters, each focusing on a specific aspect of demography.

Chamberlain begins the volume by outlining the principal concerns of demography and why these concerns would be of interest to archaeologists. After discussing the fluid nature of the concept of a “population”, he outlines the characteristics of populations important in demographic studies. He then briefly summarizes the research issues in archaeology that can benefit from a demographic approach including population pressure, population structure, health and disease, and migration; these issues help organize the remainder of the volume. A real strength of this chapter is that Chamberlain highlights three case studies that should be familiar to most students of archaeology (peopling of the New World, introduction of diseases by Europeans into New World populations, and prehistoric migration in Europe). Highlighting these studies early in the volume provides the reader with an immediate understanding as to how demography can help inform archaeological research.

The second chapter focuses on summarizing demographic concepts, theory and methods and is vital to understanding the rest of the volume. As Chamberlain provides an overview of such concepts as mortality, survivorship, the life table, fertility, and exponential population growth, he is careful to provide graphs and examples from archaeological research. Although these examples will help many archaeologists understand demographic analysis in a way that presenting straight mathematical formulas would not, it may be a bit daunting to those not comfortable with quantification and statistics.

Chamberlain’s third chapter provides a succinct overview of historical and ethnographic demography. Anthropologists and archaeologists will be familiar with issues and concerns surrounding data collected from the written record and spoken word, at the same time being informed on how demographers handle these sources of evidence. Further, many terms common to archaeological research but often not well-defined — family, household, migration, conflict — are discussed in ways applicable to the material record. Finally, this chapter furnishes an overview of differences in the population structure of hunter-gatherer and agricultural populations that archaeologists interested in long-term population trends in such groups will find informative.

The fourth chapter considers archaeological demography and covers a topic that most archaeologists will be familiar with, even if they have never read a demography text before this one. This chapter focuses a great deal on the various issues surrounding the sexing and aging of skeletons, as well as techniques used by archaeologists to estimate populations. However, these issues are initially couched within a palaeodemographic debate that many archaeologists may not be familiar with. Specifically, not only are there methodological concerns surrounding the sexing and aging of a skeleton, but

there are concerns about ensuring age-representation of a skeletal population as well as. Applying statistical procedures to cemetery populations that were designed for application to living populations can also be a problem. Overall, Chamberlain adeptly outlines the debate, the assumptions that palaeodemographers need to make about their skeletal populations, the ins-and-outs of age and sex determination, and the various non-skeletal techniques used to estimate populations archaeologically. In many ways, this chapter will be the most familiar and yet the most informative to archaeologists.

In the fifth chapter, Chamberlain briefly describes evolutionary and genetic palaeodemography. While the population structure of animal species, including non-human primates, is only briefly touched upon, more careful consideration is given to recent studies on the demography of fossil hominids as well as genetic studies of ancient populations. Chamberlain outlines the difficulties of inferring population structure from the hominid fossil record, and briefly discusses the most notable studies that have attempted to address these difficulties. He concludes the chapter with a discussion on the use of genetic studies from present-day populations to infer prehistoric population movements as well as the potential of studies of ancient DNA to model prehistoric population dynamics. However, this chapter is the weakest in the volume, as the reader is left with the sense that many of the conclusions outlined will quickly be outdated as more hominid fossils are discovered and advancements are made in molecular biology.

The sixth chapter provides a consideration of demography and disease. As with the previous chapters, Chamberlain is careful to define common terms. He then discusses methodological approaches and constraints focused on detecting four broad categories of diseases: infectious and epidemic diseases; metabolic, nutritional and deficiency diseases; neoplastic and congenital diseases; and trauma and homicide. He considers skeletal, dental, chemical and biomolecular, and demographic evidence. One strength of this chapter is that Chamberlain provides a particularly solid case for the integration of demographic evidence with other types of evidence to examine the impact of disease in prehistory. He concludes the chapter with a brief, but thought-provoking discussion, on the social and demographic impacts of disease including evidence of treatment, isolation of the sick, and evidence for compassion.

The volume ends with a consideration of the relevance of demography for archaeology as well as a look towards the future in palaeodemographic research. Chamberlain reiterates that a wide range of archaeological questions can be answered through demographic analysis and theoretical perspectives, as long as both archaeologists and demographers remain aware of the assumptions and pitfalls unique to applying demographic techniques to prehistoric populations.

As an introductory text and overview of palaeodemography, this book's strength is that it does an excellent job of providing a broad range of information. However, its strength is also its

weakness: Chamberlain covers so much information, that it is difficult for this book to stand alone. In some ways, it is too general to be of use to the expert palaeodemographer while it is too detailed for the novice. Most students of archaeology will require a companion text – be it one on statistics, osteology, or human evolution. A student familiar with the terms and issues of population estimation using settlement size in Chapter 4 will probably be at a loss when considering the terms and issues surrounding demography of non-human primates in Chapter 5, and vice versa.

This problem aside, *Demography in Archaeology* will be a welcomed addition to any library on archaeology. Chamberlain covers a wide range of palaeodemographic information – he defines and operationalizes numerous terms common to archaeological research, he evaluates recent debates on palaeodemographic reconstruction, outlines the methods and assumptions behind population studies, provides succinct explanations on statistical methods, and considers the influence of environmental change and various social dynamics on prehistoric population growth and decline. Overall, *Demography in Archaeology* is a well-written, informative book that should be of interest to any archaeologist concerned about questions of population structure and dynamics.

Upcoming Conferences

Rachel S. Popelka-Filcoff, Associate Editor

2008

11-17 May. Canadian Archaeological Association Annual Meeting, Trent University, Peterborough, Ontario, Canada. General information: <http://www.tuarc.trentu.ca/caa>.

12-16 May. International Symposium on Archaeometry in Siena, Italy. General information: <http://www.unisi.it:80/eventi/isa2008>.

25-30 May. 9th International Conference on ART2008, Jerusalem, Israel. General information: <http://www.isas.co.il/art2008>.

26-28 May. GAC-MAC-SEG-SGA Joint Annual Meeting, Quebec, Canada. General information: <http://quebec2008.net>.

2-7 June. Clay Minerals Society, Santa Fe, NM, USA General information: <http://www.sandia.gov/clay>.

4-8 June. Cod and Herring: The Archaeology and Early History of Intensive Fishing, Westray, Orkney, Scotland. General Information: www.mcdonald.cam.ac.uk/CodHerring2008.

5-7 June. American Quaternary Association Biennial Meetings, State College, Pennsylvania, USA. General information: <http://www.outreach.psu.edu/programs/quaternary>.

15-19 June. GPR2008: 12th International Conference on Ground Penetrating Radar, Birmingham, UK. General information: <http://www.gpr2008.org.uk>.

18-21 June. Landscape Evolution & Geoarchaeology, 13th Belgium-France-Italy-Romania Geomorphological Meeting-Porto Heli, Greece. General information: http://www.geoarch2008.gr/Con_EN_Homepage.htm.

22-27 June. 7th International Topical Meeting on Industrial Radiation and Radioisotope Measurement Application, Prague, Czech Republic. General information: <http://irrma7.fjfi.cvut.cz/scope.html>.

29 June-4 July. Sixth World Archaeological Congress, Dublin, Ireland. General information: <http://www.ucd.ie/wac-6>.

4-8 August. Denver X-ray Conference, Colorado Springs, Colorado, USA. General information: <http://www.dxcicdd.com>.

6-14 August. 33rd International Geological Congress, Oslo, Norway. General information: <http://www.33igc.org>.

17-22 August. 2008 IAVCEI General Assembly: Understanding Volcanoes, Reykjavik, Iceland. General information: <http://www.jardvis.hi.is/page/108-intro>.

17-28 August. 236th National Meeting and Exposition, American Chemical Society, Philadelphia, Pennsylvania, USA. General information: <http://www.acs.org>.

23-27 August. Sixth meeting of the Bird Working Group (BWG) of the International Council for Archaeozoology, Groningen Institute of Archaeology, Rijksuniversiteit Groningen, Netherlands. General Information: <http://www.alexandriaarchive.org/icaz/icazForum/viewtopic.php?t=887>.

30 August-5 September. 12th International Palynological Congress, 8th International Organisation of Palaeobotany Conference, Bonn, Germany. General information: <http://www.paleontology.uni-bonn.de/congress08/index.htm>.

11-16 September. 13th International Conference On Soil Micromorphology, Chengdu, China. General information: <http://icsm.imde.ac.cn>.

14-16 September. International Symposium on Biomolecular Archaeology, York, UK. General information: <http://www.york.ac.uk/depts/arch/ISBA3/index.html>.

22-26 September. ICOM (International Council of Museums) Committee for Conservation, New Delhi, India. General information: <http://icom-cc.icom.museum/TriennialMeetings>.

5-9 October. Annual Meeting of the Geological Society of America. General information: <https://www.acsmeetings.org/2008>.

8-11 October. Fluvial Deposits and Environmental History, 39th Annual Binghamton Geomorphology Symposium, Austin, Texas, USA. General information: <https://webpace.utexas.edu/hudsonpf/binghamton.html>.

19-22 October. 9th International Conference on Ancient DNA and Associated Biomolecules, Pompeii, Italy. General information: <http://www.ancientdna9.it/index.aspx>.

19-23 November. Ceramic Ecology XXII (as part of the American Anthropological Association meetings), San Francisco, California, USA. General information: <http://www.aaanet.org/mtgs/mtgs.htm>.

22-24 October. Synchrotron Radiation in Art and Archaeology, Barcelona, Spain. General information: <http://www.sr2a-2008.info>.

29-30 October. Geoarchaeology and Archaeomineralogy: Impact of Earth Sciences in the Study of Material Culture, Sofia, Bulgaria. General information: <http://mgu.bg.docs/CircularEN.doc>.

19-22 November. American Schools of Oriental Research Annual Meeting, Boston, Massachusetts, USA. General information: <http://www.asor.org/AM/am.html>.

15-19 December. American Geophysical Union Fall Meeting, San Francisco, California, USA. General information: <http://www.agu.org/meetings>.

6-10 April. 235th National Meeting and Exposition, American Chemical Society, New Orleans, Louisiana, USA. General information: <http://www.acs.org>.

2009

6-11 January. Society for Historic Archaeology Conference on Historical and Underwater Archaeology, Toronto, Ontario, Canada. General information: <http://www.sha.org>.

8-11 January. 110th Joint AIA/APA Annual Meeting, Philadelphia, Pennsylvania, USA. General information: <http://www.archaeological.org/webinfo.php?page=10096>.

22-26 March. Annual Conference on Computer Applications and Quantitative Methods in Archaeology, Williamsburg, Virginia, USA. General information: <http://www.caa2008.org>.

22-26 April. SAA 74th Annual Meeting, Atlanta, Georgia, USA. General information: <http://www.saa.org/meetings/index.html>.

22-26 March. 237th National Meeting and Exposition, American Chemical Society, Salt Lake City, Utah, USA. General information: <http://www.acs.org>.

23-26 June. 11th International Paleolimnology Symposium, Guadalajara, Jalisco, Mexico. General information: <http://www.paleolim.org/index.php/symposia>.

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