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News of Archaeometallurgy

Sue Cackett, curator of material science at the Science Museum, London, died on April 11th. She had been ill for a number of months. She was a member of the committee of the Historical Metallurgy Society for whom she arranged a number of conferences, and also of the historical group of the Glass Manufacturers' Federation. Her brother, Andrew Cackett, resides at 3 Stubbygrove Cottages, Bells Yew Green Road, Frant, Tunbridge Wells TN3 9BG, England.

The 1992 Annual Conference of the Historical Metallurgy Society will be held September 25th to 27th at the University of Bath. The subject will be "Historical Metallurgy in the West of England." For information write Joan Day, 3 Oakfield Road, Keynsham, Bristol BS18 1JQ, England. Joan has kindly taken over the organization of the conference since the death of Sue Cackett.

The Archaeometallurgy column in the *Journal of Metals* being conducted by Vincent Pigott presented "Ancient metal-mirror making in South India: analyzing a mysterious alloy" by S.G.K. Pillai, R.M. Pillai and A.D. Damodaran in the March 1992 issue, pages 38-40.

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

Martha Goodway, MRC 534, Smithsonian Institution, Washington DC 20560 USA; tel 301-238-3733; fax 301-238-3709. □

In This Issue

Archaeometallurgy
Announcements

Cotsen Proze

MacSciTech

Conference Reports

Paleoethnobotany

Egyptology

Fall Reading

Owls, Caves, & Fossils

Human Skull

Athlit Ram

Pre-Industrial Iron

Early Irish Ironworking

Meetings Calendar

General Announcements

Macintosh Scientific Users Group Formed

SAS members should be aware of the formation of a Macintosh Scientific Users Group, *MacSciTech*. At present the national group is dominated by engineers and physicists. I urge all SAS members who use Macs to join. Membership benefits include a quarterly newsletter, free scientific and developer's CD disks, and access to the group's area on America Online (a commercial on-line service) where members can discuss current software, hardware, and research, all for \$50.00 (\$30.00 for students). Also available is access to the software library where members can upload and download scientific software and demos.

MacSciTech can be reached at 49 Midgley Lane, Worcester MA 01604 or via America Online by using the keyword SciTechMac.

Tim Church, Box 184, 7303 Montgomery Boulevard, NE, Albuquerque, NM 87109. □

The Cotsen Prize Imprint

The UCLA Institute of Archaeology announces an endowment to its Publications Unit in memory of Jo Anne Stolaroff Cotsen, which will provide support for the publication of outstanding research and scholarship. Archaeologists are invited to write the Institute for information on how to submit a manuscript for consideration as the next Cotsen Prize imprint.

The Institute of Archaeology also takes great pride in announcing the availability of the inaugural Cotsen Prize Imprint: *Landscape Archaeology As Long-Term History - Northern Keos in the Cycladic Islands from Earliest Settlement to Modern Times*; J.F. Cherry, J.L. Davis, and E. Mantzourani; *Monumenta Archaeologica* 16, 512 pp., \$50.00 (ISBN: 0-917956-72-9).

UCLA Institute of Archaeology Publications, 405 Hilgard Avenue, Los Angeles, CA 90024-1520, USA; tel 310-825-7411. □

Conference Reports

Ninth Meeting of the International Work Group for Palaeoethnobotany. Kiel, Germany, 18-23 May 1992.

Contributed by Mark Nesbitt (Associate Editor for Bioarchaeology), 14 Kirkby Close, Cambridge CB4 1XP, UK.

The International Work Group for Palaeoethnobotany (IWGP) held its first meeting in Czechoslovakia in 1968; since then, the locations of the triennial meetings have been more-or-less equally divided between eastern and western Europe. At earlier meetings most of the papers concerned central and eastern European waterlogged or charred plant remains. It is probably fair to say that the IWGP really came of age at the meeting in Groningen in 1983, when a truly pan-European group of archaeobotanists attended, a really substantial book of proceedings came out within a year and, most importantly, many papers went beyond tables of data to look at issues such as taphonomy, sampling and ethnoarchaeology. This year's meeting in Kiel, a port and university town on Germany's Baltic coast, was blessed by highly efficient organization (by Helmut Kroll of the Institute of Archaeology, Kiel University, with a host of colleagues and students assisting), gorgeous sunny weather, and a good programme of speakers.

"This was one of the best conferences I've been to, and I would strongly recommend the next one to anyone interested. While, for obvious reasons of distance, North American archaeobotanists rarely come to this meeting, it would be an excellent way with keeping in touch with European work."

The five days of talks gave the opportunity to hear the full spectrum of approaches to archaeobotany as practiced in Europe. Many talks took the traditional approach of presenting a list of species, with a picture of each seed type, and a final, brief, strictly phytosociological interpretation of the weed ecology. I found two aspects of this work worrying: the tendency to lump all the results from a site together for ecological and economic interpretation, rather than considering them sample by sample - "taphonomy" was a rarely heard word at this meeting - and, secondly, there was little discussion of what the archaeobotanical results actually meant in terms of human behaviour: what was the archaeological relevance of the work?

The talks on the first day were at the opposite extreme from this approach. On the subject of ethnographic and

ecological models, Glynis Jones (Sheffield, UK) used her studies of traditionally irrigated fields in northern Spain to look at how we can recognise irrigation from archaeobotanical weed floras. In an elegant demonstration of multivariate statistics, shade tolerance was shown to be a key characteristic of weed species of irrigated fields (rather than water needs) - and this is a character we could use to identify such weed species in other areas.

R. Pasternak (Kiel) talked about traditional agriculture in Jordan, with modern examples of how cross contamination of cereal and pulse harvests occurs on the threshing floor. Mark Nesbitt (Cambridge, UK) looked at why emmer and einkorn wheat are still grown in northern Turkey, and why they have disappeared elsewhere. Mordechai Kislev (Bar-Ilan, Israel) discussed medieval finds of *Cordia myxa* from Ashkelon, using documentary sources and his own ethnographic work in Cyprus to show how they are used for making bird-lime. Both modern Cyprus and ancient Ashkelon lie on important migration routes for birds.

The increasing amount of archaeobotanical data available is stimulating interest in use of databases. The most elaborate was described by Philippa Tomlinson (York, UK). This major project is well into storing all the seed (and some pollen and charcoal) records for the many hundreds of archaeobotanical reports available for Britain. G. Paskevici (Kiev) showed results for a similar database for the Ukraine, and Martin Dick (Basel, Switzerland) showed how results from one site could be handled. These talks excited a lot of interest, and Philippa Tomlinson (Environmental Archaeology Unit, University of York, Heslington, York YO1 5DD, UK) has now started a newsletter on archaeobotanical databases. One question concerns the reliability of results; there is a risk that once unreliable identifications enter a database they will be treated uncritically by users.

Statistics did not feature largely in the conference, but one particularly clearly presented example of their use was given by Otto Brinkkemper (Leiden, Netherlands), grouping samples according to similarities in species composition. Sampling and recovery was another rare subject: Ursula Thanheiser (Vienna, Austria) gave a preview of a cunning electrostatic device that removes organic materials (seeds, bones, etc.) from loose matrices. This is ideally suited for sorting flotation heavy residues, and for material in sandy matrices.

The use of chemical analysis is a rapidly developing field of archaeobotany. On Tuesday morning, Francis McLaren (London, UK) discussed her use of infra-red spectrometry to compare spectra from Palaeolithic fruit stones, from Douara cave in Syria, with modern species of plums. This technique, which has already given excellent results with ancient rye and wheat remains, obviously has

great potential for other classes of plant remains. In this session (designated as "varia" in the programme), we also heard new results from aceramic Neolithic Nevalı Cori, Turkey (R. Pasternak, Kiel), and admired wonderful colour photos of waterlogged seeds from Samos, Greece (D. Kucan, Wilhelmshaven). The highlight of this morning was the presentation of early Neolithic seeds (ca. 8000 BP) from Nabta Playa, in the Egyptian desert. Careful identification by K. Wasylikowa (Krakow, Poland) and Lucyna Kubiak-Mertens (Poznan) has shown a wide range of wild seeds present, including wild millets and sorghum. There is no evidence for crop-husbandry, and, contrary to other reports, no barley or wheat has been found.

In the afternoon a milling crowd of enthusiastic archaeobotanists took over a laboratory to show each other their odd and/or unidentifiable seeds. I was particularly interested to find that the same unidentified crop (or gathered plant) I have from eastern Turkey has also turned up in Greece and Yugoslavia (but it's still unidentified!). Mordechai Kislev demonstrated his computerised key to grass caryopses; based on length, breadth and thickness measurements for species occurring in the Levant, this is a very useful tool for narrowing down the field, but must be used with a reference collection.

On Wednesday and Thursday two particularly interesting (and well-presented) talks dealt with non-seed materials. Werner Schoch (Adliswil, Switzerland) demonstrated the use of simple, cheap chromatography to identify ancient resins, and then discussed results from ancient Swiss artefacts with regard to ethnographic records of tree-tapping of resin (from *Pinus*, *Picea* and *Betula*) and experimental archaeology. Klaus Oegg (Innsbruck, Austria) described the identification of artefacts (arrowheads, knife, axe-shaft), clothes, charcoal and food remains (wheat spikelets, sloe fruits) found near the ice-body recently discovered in the Austrian Alps. The stomach contents still await analysis.

The IWGP has a good record for attracting speakers from what was behind the "Iron Curtain": this year, G. Paskevic (Kiev) spoke about medieval plant remains from the Ukraine, and G. Levkovskaya (St. Petersburg) looked at the (late, ca. 2000 B.C.) arrival of agriculture in the Baltic zone of Russia. Ksenija Borojevic (Novi Sad, Yugoslavia) covered Iron Age agriculture from Bosut Tell in Yugoslavia, while from Poland Romuald Kosina (Wroclaw) compared medieval wood finds in Wroclaw to surrounding vegetation, and Marek Polcyn (Poznan) analysed an intriguing mixture of rye and common millet from a medieval jar, from the beautiful island site of Ostrow Lednicki. Cvetana Popova (Sofia, Bulgaria) presented Early Bronze Age plant remains from Bulgaria. Because much of this work is otherwise only published in Cyrillic language journals of limited circulation, the IWGP proceedings are a valuable outlet for this work.

The last two days of the conference were devoted to the special theme of the Middle Ages. I missed the final talks (and the archaeological excursion on Saturday), but those I

did hear contained all too few references to the documentary evidence, which can complement archaeobotany so well. A rare exception was a stimulating talk by Hansjorg Kuster (Munich), in which changing finds from medieval Konstanz were related to documentary evidence for land-ownership around the city. One conclusion was that 11th century documentation could not be used for 13th century plant remains.

There were too many talks concerning European and medieval archaeobotany to be listed individually, but the strong contingent from Scandinavia, working at the other climatic extreme to the Near Eastern specialists, gave a good geographical balance.

One especially impressive project is a survey of crop cultivation in Switzerland, integrating evidence from the large number of sites being worked on by Stephanie Jacomet and her students at Basel University. From further afield, Mukund Kajale (Deccan College, India) looked at the history of garlic, in the light of a new discovery in India dating to 150 B.C. - A.D. 250. One encouraging trend is the consolidation in more countries of archaeobotany as an integral part of archaeology, and I particularly enjoyed meeting new archaeobotanists from Greece, Italy and Spain.

I returned to England greatly inspired, if rather overwhelmed at seeing 105 archaeobotanists (usually a rare breed) in such a short time. This was one of the best conferences I've been to, and I would strongly recommend the next one to anyone interested. While, for obvious reasons of distance, North American archaeobotanists rarely come to this meeting, it would be an excellent way with keeping in touch with European work. □

Sixth International Congress Of Egyptology, International Association of Egyptology (IAE). 1-8 September, 1991; Turin, Italy.

*Delwen Samuel (Associate Editor for Bioarchaeology),
McDonald Institute for Archaeological Research,
University of Cambridge, UK.*

The wide range of Egyptology was reflected in the number of delegates present in Turin: somewhere between 1300 and 1500. While such large numbers can overstrain the conference organisation, they also make these triennial meetings an excellent opportunity to meet many scholars. The conference was hosted by the Egyptological Museum of Turin, the largest collection of its kind outside Egypt, who have promised prompt publication of the conference proceedings.

Egyptology has a reputation for being conservative, a characteristic well demonstrated at this Congress. It was graphic in the examples given by out-going President W.K. Simpson (Yale) in the closing ceremony, of fields in Egyptology with exciting new developments: art history, philology, sculpture, architecture. Egyptology still has not

Conference Reports

explicitly embraced archaeological science or even shown much interest in it. Few of the leading Egyptologists present attended lectures dealing with archaeological science. Nonetheless, there was an encouraging current of scientifically-influenced thinking and archaeological science in a number of papers.

Conservation is generally quick to apply new technology. G. Rutherford (California) presented engineering solutions for the protection of tombs vulnerable to flood damage, but without an assessment of the likely cost or availability of materials. A conference sponsor, the Bancario San Paolo, is supporting development of stable fluorine compounds to protect stone buildings and monuments from pollutants; this may have an application in Egypt. Dr. Fathi Saleh (University of Cairo) explained use of a tool, ultrasound imaging, which may prove valuable for recording threatened sites. This technique is well suited to detecting regular surfaces, such as stone tomb walls.

"Egyptology still has not explicitly embraced archaeological science or even shown much interest in it. Few of the leading Egyptologists present attended lectures dealing with archaeological science. Nonetheless, there was an encouraging current of scientifically-influenced thinking and archaeological science in a number of papers."

Given the pressing need for conservation of ancient Egyptian remains, as emphasized at both the opening and closing ceremonies, this area did not receive as high a profile during the conference as it deserves. Both individual objects and whole regions are threatened. The archaeology of the Delta region is being lost at a rapid pace, and a planned huge irrigation project in Northern Sinai is threatening the entire archaeology of this little-studied region.

Dr. S  ve-S  derburgh (Stockholm) discussed the archaeology of an area already flooded. He described the application of multivariate analysis to determine chronology of Nubian sites, and linked evaluation of archaeological data through computer-aided analysis to the motivations behind the Pharaonic conquest of Nubia.

R. and D. Klemm, of the Geological Survey of Egypt, gave a fascinating elucidation of the technological development of gold prospecting and processing from prehistory through to Roman times, showing the ancient Egyptians' skill at locating and working gold-containing deposits.

T. de Putter (Belgium) presented a well argued re-examination of the "Semna problem", an anciently recorded series of exceptionally high floods ranging between 4.31-9.41 metres higher than normal, over the years 1842-1787 B.C. Vercoutter, one of the doyens of Egyptology,

originally postulated a temporary dam, but later Barbara Bell hypothesized a climatic aberration. Searching for a possible mechanism, de Putter used various strands of evidence, including comparative modern climatic data, to suggest that random variation in the angle of the earth's axis was responsible.

An enjoyable paper was E.R. Nielsen's (Copenhagen) discussion of honey in medicine. She surveyed medical texts to determine how honey was used anciently, and compared and explained the therapeutic effects honey is now known to have. I was intrigued to hear that the World Health Organization now recommends honey in place of sugar for rehydration mixtures given to babies and young children suffering from severe diarrhea, because it is more rapidly absorbed.

Willeke Wendrich's (University of Leiden) discussion of basketry called explicitly for a scientific approach. She emphasized: that classification should be a tool, not an end in itself; that data should be assessed with reference to a specific research question; and that each step in the analytical process should be verifiable.

There were no zooarchaeological papers, and Natalie Baum (Belgium) was the only speaker to deal solely with archaeobotanical remains. She presented evidence for diversification of agriculture at Douche. Some mention of archaeobotany was made in passing by the author of this review, who discussed the application of scanning electron microscopy and chemical analysis to determine bread and beer ingredients. Further mention of archaeobotany appeared in a poster describing the seeds found at Predynastic to early Dynastic (c. 3000-2500 B.C.) grave excavations of Mishat Abu Omar (Ursula Thanheiser, University of Vienna).

I was unable to attend most of the physical anthropology papers, but this subject was well represented amongst the posters. A team from the University of Turin and the University of Sienna (M.E. Rabino, A. Panichi, M. Reddavid, M. Girotti, R. Melleri, L. Albano) are working on extraction of DNA from mummies. Their aim is to examine environmentally influenced genetic characteristics of populations (for example, the incidence of thalassemia), but they have had difficulty obtaining clean samples.

Another team from the University of Turin and University of Nevada (M. Prato, T.D. Garetto, J.K. Pecotte) compared age at death, taking gender into account, for several different dated populations, concluding that general health tended to be stable over time, and the average life expectancy was greater than for contemporary Mesopotamian populations.

Blood groups from a late Christian Nubian population were compared to the modern local population near Aswan by a team from Turin (M.G. Franceschi, S. Tofanelli, G.

Egyptology (continued on p. 12)

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Book Reviews

Owls, Caves, and Fossils: Predation, Preservation, and Accumulation of Small Mammal Bones in Caves, with an Analysis of the Pleistocene Cave Faunas from Westbury-sub-Mendip, Somerset, UK.

Peter Andrews, with scanning electron microscopy by Jill Cook. The University of Chicago Press, Chicago, 1990, viii + 231 pp., illustrations, preface, appendix, references, and index. \$39.95 (cloth).

Reviewed by John C. Barry, Department of Anthropology, Harvard University.

Peter Andrews is a palaeoanthropologist at the British Museum of Natural History who I know best for his work on Miocene apes from Kenya and Turkey. He has always had a broad range of research interests, however, and this book represents the coming together of two other very different strands: his excavations of a Middle Pleistocene cave deposit in southwestern England and his studies of the taphonomy and palaeoecology of small vertebrate assemblages.

"Owls, Caves, and Fossils is a valuable contribution bridging palaeontology and archaeology, and with his careful dissection of the stratigraphic succession Andrews has a textbook example of palaeoecological technique."

Owls, Caves, and Fossils is organized as seven chapters plus a preface, appendix, references, and index. The book is well-illustrated with line drawings, conventional black and white photographs, and, most notably, scanning electron micrographs illustrating the types of damage done to bones and teeth by predators. The preface and first chapter present the objectives of the study and an introduction to small mammal taphonomy. Chapters two and three discuss the predators of small mammals, the biases their selective feeding habits introduce into bone assemblages, and the modifications predators produce on bone assemblages. Chapters four through six shift the focus to the Westbury Cave, discussing its stratigraphy and contained sequence of small mammal faunas. Chapter seven gives Andrews' palaeoecological and climatic interpretations and, finally, the appendix contains brief accounts of the predators and data on their diets as determined from analysis of scats and pellets. This information, plus the micrographs and extensive data on bone modification, is very valuable, as are the discussions of taphonomic processes and bone

accumulation in caves.

Because they often have limited habitat preferences, small mammals (rodents, bats, insectivores, and lagomorphs) should be sensitive indicators of ancient habitats and therefore useful in palaeoecological reconstructions. Nevertheless, as noted by Andrews, these taxa are frequently neglected because the modes of their preservation are not well understood. In particular, it is clear that selectivity by the predators of small mammals, which are mostly owls, diurnal raptors, and small carnivores, will greatly bias the relative and absolute abundances of species in fossil assemblages. In addition, differential destruction of the remains due to mastication and digestion is known to vary between predators and this will further distort the preserved fossil record. Andrews' contention is then that in some cases, and particularly in caves, small mammal bone accumulations are the feeding debris of a single predator and the predatory species can be identified by its signature on the bone assemblage. That is, the degree and type of breakage and digestion, together with the relative proportions of preserved skeletal elements, is characteristic for each predatory species - or at least a small set of predators. If this is true, then the predator can be identified and the biases it introduced into the assemblage can be considered in the course of palaeoecological inference.

Andrews begins by collecting data on the diet of modern predators of small mammals and carefully describing and categorizing the damage they do to bone and teeth. He recognizes that the degree of destruction is gradational from low to high levels, but argues that a series of modification indices allows predators of small mammals to be grouped into five categories. With this reference framework he next evaluates the taphonomic biases of the faunas of successive stratigraphic horizons in Westbury Cave. He concludes that some horizons contain minimally-biased samples of the surrounding contemporary small mammal communities and these can be used to infer the local vegetational and climatic conditions at the time of deposition. He ends by concluding that the Westbury mammals record a climatic sequence that began with warm interglacial conditions, subsequently became cooler and drier, then returned to equable interglacial conditions, and finally changed to a cold and dry climate approaching full glacial conditions. If he is correct, the Westbury faunas may then document either an unknown cold phase at the end of the Cromerian Interglacial or a warm phase in the early Anglian Glacial stage.

Owls, Caves, and Fossils is a valuable contribution bridging palaeontology and archaeology, and with his careful dissection of the stratigraphic succession Andrews has a textbook example of palaeoecological technique. In addition, the classification of predators and extensive use of Jill Cook's micrographs to illustrate the types and levels of

bone damage will make it possible for other researchers to use this book as a standard in their own work. There are, however, limitations. The approach only works well with extant predators and the taxonomic habitat index in particular (used to infer prey habitats) becomes increasingly problematic with pre-Pleistocene faunas where a large proportion of small mammal taxa are only distantly related to living species. Further, the problems of the mixed assemblages formed by more than one predator and potential geographic and temporal variation in diet limit the precision of his palaeoecological inferences. These, however, are the problems of palaeoecology in general and do not invalidate Andrews' work. □

Atlas of the Human Skull.

H. Wayner Sampson, John L. Montgomery, and Gary L. Henryson. Texas A & M University Press, 1991, ix + 200 pp. \$49.50 (cloth), \$29.50 (paper).

Reviewed by Lane A. Beck, Peabody Museum, Harvard University.

The authors designed this book as a supplemental text for medical courses and as a reference book for professionals in the medical and anthropological fields. As an anthropologist, I can only evaluate its potential in the latter area.

This book is the third text published in recent years to use photographs to illustrate aspects of human osteology. The other two (D. G. Steele and C. A. Bramblett, *The Anatomy and Biology of the Human Skeleton*, Texas A & M University Press, 1988; and T. D. White, *Human Osteology*, Academic Press, 1991) are designed as main texts for introductory courses in that field and cover the entire human skeleton. They also include fairly extensive text to supplement the illustrations. By contrast, this book is limited to cranial materials and the keys to the photographs are the only text provided.

The organization of the book includes five main divisions and four appendices. The five main sections are the articulated skull (54 pages), disarticulated bones (73 pages), muscle attachments (19 pages), anthropological landmarks (7 pages), and radiological landmarks (17 pages). The four appendices are articulations (1 page), classification of bones (1 page), neural and vascular foramina (4 pages), and ossification centers (1 page). An index forms the final section.

The orientation of this book towards members of the medical profession is clearly visible. For example, the designation of the vomer as a landmark rather than as a bone is appropriate to radiology but not to basic skeletal anatomy. Similarly, much greater attention is given to the neural and vascular systems than to the muscular system. The emphasis is appropriate to surgical training whereas the musculoskeletal system and functional anatomy are more important to anthropologists.

When I first examined the book I was looking forward to seeing a detailed photographic atlas of the cranium. I initially was encouraged in my expectations. The quality of the photographs is very good. Additionally, the non-traditional orientations of the skeletal elements provides unusual and highly useful perspectives on specific aspects of the skull. Many of these views would be helpful to students who are having difficulty visualizing some of the more complex areas of the cranium. The side-by-side placement of the photographs and their legends makes the book easy to use.

The legends for the photographs include a listing of many of the soft-tissue structures associated with specific landmarks. As mentioned above, this is primarily true for foramina which transmit major arteries or nerves. Although one division of the book is dedicated to muscle attachments, the information included there is limited.

The inclusion of eight X-rays is a positive aspect seldom found in basic osteology texts. The mental transition from recognition of features on an opaque, three-dimensional skull to the translucent, two-dimensional image of a radiograph is difficult. The included X-rays provide basic guidelines for that transition.

My full examination of the book left me somewhat disappointed. I had expected to find more information on the skull in this book than is offered in some of the texts which cover the entire skeleton. Instead, I found less information than is included in the two books mentioned above. Two features in particular are lacking which, if present, could have made this an exceptional text for use in anthropology. These areas concern variation and ossification.

The human cranium is a highly variable structure. The landmarks created in the association between bone and soft tissue have a great diversity of expression. For example, the structure which transmits the supraorbital nerve and artery can range from a notch to several foramina. This book lists it only as a single foramen. A similar range of variation is found for many skeletal landmarks. The atlas fails to mention any level of variability. Some reference to this issue is needed. At a minimum, the legends could have stated the range of variation for some of the more common features.

The second area with which I was dissatisfied concerns patterns of ossification. In the atlas the only reference to growth and development is a single table (Appendix 4). This table provides a listing of the number of centers of ossification for each bone, the age of their appearance, the age of their fusion, and whether the center is formed in membrane or from a cartilaginous precursor. The chart does not distinguish between prenatal and postnatal ages. For the student unfamiliar with osteology, events occurring during fetal development could be misread as occurring after birth. No illustrations are provided to identify where the centers of ossification are within each bone. Thus, the student can read that the maxilla ossifies from six centers but has no idea what those six centers are or how they are positioned relative to one another.

Book Reviews

Related to ossification is the larger process of growth and development. The skeleton does not grow as a single unit. Different parts reach their mature form at different ages. For instance, the ossicles of the ear reach their adult shape and their adult size long before the skeletal elements which form the jaws complete their development. This allometric pattern of growth means that the shape and relative proportions of the bones change during the course of development. Some mention of this issue is needed. Illustrations of the changes in some of the more variable bones would be a wonderful addition to this book.

In conclusion, I am uncertain as to what contribution this text offers in terms of the anthropological literature. Although the photographs are of good quality and the layout and design of the book are easy to work with, it provides little in the way of information on the skull beyond what is included in broader texts dealing with the total skeleton. The only unique feature not included in broader texts is the X-ray charts. However, the other texts provide much more information on variation, ossification, and basic analytical approaches which go beyond the simple identification of bones and landmarks. While the information contained in this volume may be appropriate to a supplemental text in the medical field, I do not see it as adequate to the text or reference needs of anthropology. □

The Athlit Ram.

Lionel Casson and J. Richard Steffy (eds.), Elisha Linder (Principal Investigator). *The Nautical Archaeology Series*, #3. Texas A & M University Press, 1991, 112 pp., 53 b&w photos, 30 drawings, map, bibliography, index. \$72.50 (cloth).

Reviewed by John A. Gifford, Rosenstiel School of Marine & Atmospheric Science, University of Miami.

It is an almost trite truism that archaeology is the science of discovering what people did in the past, and it is equally true that as a result of recent research we now know more about ancient Hellenistic and Roman warships than at any time in the past 2000 years.

This is attributable to two successes: that tour de force of experimental archaeology, the reconstruction of a full-scale replica trireme during the 1980s (see *The Athenian Trireme*, J. S. Morrison and J. E. Coates, Cambridge University Press, 1986), and in equal measure to the accidental discovery in 1980, just off the Israeli port of Athlit, of a 465 kg bronze ram, the only surviving example recovered from the seabed to date (two smaller examples have since been brought to the world's attention, but neither was documented as an underwater discovery).

The Athlit Ram is a 91-page monograph summarizing the past decade's investigations regarding its composition, classification, provenience, and (most importantly) its contents: the only traces we possess of bow timbers from a large ancient warship. Two third-century Phoenician oared light galleys were discovered off Marsala, Sicily in 1968; one was excavated and published by H. Frost (*Lilybaeum [Marsala]. The Punic Ship: Final Excavation Report*. Academia Nazionale dei Lincei, Rome, 1981), but its wooden ram was of a detachable type and therefore not informative about those which were integral structural components of larger warships.

"The discovery of the Athlit Ram, as presented in this monograph, contributes a very great deal to our knowledge of the second category [warships] of ancient Mediterranean ships."

The monograph's seven chapters deal with the ram's discovery (E. Linder), a description and interpretation of the bow timbers found inside the ram (J.R. Steffy), a metallurgical analysis of the ram (S. Eisenberg), the ram's provenience and date (W. Murray), a discussion of the evolution of rams in first-millennium B.C. Mediterranean naval vessels (L. Casson and Linder), a preliminary attempt to estimate the size of the ship bearing the Athlit Ram (Murray), and a discussion of the influence of rams on naval tactics (Casson). There is a short appendix describing the radiographic study of the ram's internal structure by means of a cobalt-60 gamma radiation source (Breitman et al.).

Chapter 1 is a straightforward documentation of the ram's accidental discovery in three meters of water north of the Israeli naval base now occupying the Crusader fortress of Athlit, some 20 kilometers south of Haifa. It is one of the few instances where such an important discovery was made during the course of an archaeological survey, rather than by untrained divers. Given the nature of the seabed in the area, the ram probably was repeatedly exposed and then reburied by shifting bottom sediments during the past 2000 years; only a tiny corner was visible to the finder, and even that subsequently was buried by more than half a meter of storm-deposited sand prior to the ram's recovery in late 1980.

It was transported to the National Maritime Museum in Haifa, where basic conservation began immediately. At the time, as the only ram from an ancient warship ever recovered, its importance suggested the round-table conference that was held at the Museum in 1981, at which experts discussed the topics that guided the subsequent research and also form the subjects of this monograph.

Chapter 2, on the included timbers, is rightly the largest and most important of the volume. What was discovered inside the ram is in many ways more important than the bronze ram itself: 16 timbers in various but generally poor

states of preservation, representing the bulk of the warship's bow structure. As Steffy, the world's expert in ancient Mediterranean nautical architecture, observes, "it was at least [fortunate] that what did survive constituted the most important timbers we could hope to study on an ancient warship."

Steffy undertakes this study in a model of thorough description, analysis, and deductions about how Hellenistic shipwrights constructed the bow of a vessel whose primary purpose was to serve as an "oar-driven torpedo," as Lionel Casson describes a ram-armed galley; as Steffy notes, it might also be thought as a floating "hammerhead" designed to deliver a fatal smashing blow to the enemy vessel anywhere around her waterline, where irreparable broken planks and burst seams meant inevitable flooding and removal from action (though not actual sinking to the bottom). Steffy's chapter provides the first solid insights into ancient Mediterranean warship construction.

The dissection of the bow timbers, almost inextricably cemented inside the ram casing by two millennia of marine corrosion, is recounted in absorbing detail. After conventional x-raying failed to reveal clearly the arrangement of these unique constructional elements, a cobalt-60 neutron source was applied successfully (as described in the Appendix), and armed with these detailed remote sensing records of the ram's internal filling, Steffy cut the wood out in a series of semi-surgical operations.

His analysis, from the standpoint of naval architecture, of the 16 bow timbers centers on the fact that the ship functioned so as to maneuver and bring to bear on an enemy vessel the near-instantaneous deceleration of some 40 to 60 tons of force, all brought forward through the ship's hull structure and concentrated in the ram's flat face, about 0.2 square meters in area. Thus the ram's role was not to pierce the enemy hull, which might only produce a small hole and possibly result in an inextricable collision (or worse), but rather to destroy the enemy ship's seaworthiness as clearly and quickly as possible without damaging your vessel in the process. Tactics and close-range maneuvering must have been critical in such encounters, and have decided the outcome of many a naval engagement (as we do know from contemporary accounts).

Chapter 3, the metallurgical analysis by Eisenburg, leaves the writer, although not an archaeometallurgist, somewhat disappointed. The chapter does not seem to address directly the basic questions that any interested reader might ask, and most of it is devoted to arguing, not convincingly, that the ram was sand cast.

In Chapter 4, Murray reviews all the relevant comparanda (mostly from coins) that might determine the date and provenience of the ram from the four symbols that were cast on its surface. He deduces that the Athlit Ram represents the remains of a Hellenistic warship lost through unknown causes off the coast of what was then Phoenicia, a hotly-contested region in the second century B.C.

In a short chapter (5), Casson and Linder review iconographic evidence for the evolution in shape of the ram

between the early first millennium B.C. and the early first millennium A.D.

Murray then returns to discuss the possible size of the ship that bore the ram, through an analysis of the socket cuttings at the Octavian Campsite Memorial, located overlooking the ancient site of Nikopolis and published by Murray and P.M. Petsas (Octavian's Campsite Memorial for the Actian War, *Transactions of the American Philosophical Society* 79[4], 1989). These sockets held the actual bronze rams pulled from captured (and rammed) vessels of Anthony and Cleopatra's fleet, defeated in the Battle of Actium, and here dedicated by Octavian to Neptune and Mars in thanks for his victory. The sockets also serve as a unique database of ram sizes, whose distribution Murray compares to the outline of the Athlit ram in its cowl region. His conclusion is contrary to that of other nautical experts, namely that the Athlit example is not from one of the amazingly large oared ships of the later Hellenistic period (the so-called "eights" or "tens," from the combination of rowers and banks of oars), but rather represents a vessel just slightly larger than the trireme, either a "four" (quadrireme) or a "five" (quinquireme).

Finally, Casson (chapter 7) expertly summarizes the history of the influence of rams on naval tactics during the unexpectedly long time span of their use (estimated to range from the ninth century B.C. to the sixth or seventh century A.D.), and clarifies for the first time the precise connotation/denotation of the Classical Greek verbs *diaphtheirein*, to "knock out of action" (or more graphically to hammer out of action) and *katadyein*, to "leave awash" as might be said of a warship that had been hammered to death.

While a great deal has been learned about the shipbuilding traditions of merchant vessels in the Greco-Roman world through underwater excavation of the past three decades, almost nothing of warships has been found or studied, primarily because of the fundamental difference in the way the two vessel types were ballasted (merchant ships full of heavy cargoes and warships lightly ballasted with rowers and some warriors). The discovery of the Athlit Ram, as presented in this monograph, contributes a very great deal to our knowledge of the second category of ancient Mediterranean ships. □

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Book Reviews

Pre-Industrial Iron: Its Technology and Ethnology.

William Rostoker and Bennet Bronson. Archaeomaterials, Philadelphia, Monograph Number 1, 1990, x + 232 pp., 116 figures, 60 tables, five appendices, bibliography, glossary, index. \$55.00 (hardbound).

Early Irish Ironworking.

B. G. Scott. Ulster Museum, Belfast, Publication Number 206, 1990, xi + 237 pp., 59 figures, 13 tables, 78 plates, two appendices, references, two indices. £25.00 (hardbound); paperbound, no price stated.

Reviewed by Michael N. Geselowitz, Center for Materials Research in Archaeology and Ethnology, Massachusetts Institute of Technology.

Monographs on archaeometallurgy, particularly of iron, remain scarce. Results of studies are usually relegated to the conference paper and subsequent edited volume, or occasionally to the specialist journal. It is therefore exciting news when two monographs devoted to the archaeometallurgy of iron by leaders in the field appear in the same year. The two books under review here are almost exactly the same in size and cost, yet represent very different approaches to the topic of pre-industrial iron, and, although some weaknesses need to be pointed out, each largely succeeds in its own way.

Pre-Industrial Iron was completed by William Rostoker and Bennet Bronson shortly before the former's death, and represents perhaps an appropriate closure to his lifetime of contributions to the archaeometallurgy of iron. It is essentially an attempt to summarize current knowledge of the nature of pre-industrial iron production, and it has two explicit goals, which carry with them specific approaches. The first approach is interdisciplinary, in which Rostoker, a metallurgist, and Bronson, an anthropologist, "treat the subject of iron and ironmaking in a way which encompasses both of (their) perspectives of what is important" (p. ix) with a goal of coming to "a mutual understanding of (their) disparate fields" (p. ix).

The second stated purpose of the book is "to construct a stronger foundation upon which better history can be written" (p. ix), rather than to actually produce a history which, as the authors point out, might be better done "by those professionally trained to do so" (p. ix). Therefore, the approach to the organization of the volume is technological, starting with two introductory chapters that generally define the scope of the inquiry and then proceed step by step

with the materials and processes necessary to produce the different types of iron and steel. Cases from archaeology, ethnology and history are brought in as each is exemplary to the technique at hand.

The second goal is completely achieved, and this achievement will mean that this book will stand as a classic work for some time to come. Given the complexity of the topic, the clarity of the text is remarkable, and the figures and tables greatly add to the presentation of the material. Every aspect of pre-industrial (and even early industrial) ironmaking has been gathered into one place and is well covered. An up-to-date bibliography will enable the scholar to pursue any topic of interest in greater detail. In my opinion, this book should become the standard technical reference for the archaeometallurgist interested in iron. At the same time, any archaeologist, ethnologist or historian interested in ironmaking but without the technical background could gain that background by careful reading of this book, provided she or he has some general knowledge of chemistry and physics. The book is perhaps not as linearly organized as an introductory metallurgy textbook, but the glossary at the end should help such a non-technical reader follow the various concepts.

Unfortunately, the book does not succeed as well in its other goal. While the case studies are interesting and informative, the discussion is limited to their technical aspects. Only in the last chapter, entitled "Economics and Geography" and which takes up only 13 pages, are the social aspects of ironmaking finally discussed. As the title suggests, although the cases are again drawn largely from ethnographic non-industrial societies, their treatment is completely formalist. If there is a true interdisciplinary aspect in this work, it must be between the engineer and the economist; social anthropological thought is sadly lacking. For example, the aspects of religion, ritual and magic that go into iron production are not indexed and are only in one paragraph of the entire work, in this concluding chapter where they are referred to as "pseudoscience" (p. 177). We are simplistically told that "although these rituals must have stemmed from the desire to control phenomena which were not understood, the mystery surrounding iron manufacture probably served the more practical ends of discouraging competitors and persuading consumers to pay a higher price" (p. 177).

A very different work is *Early Irish Ironworking*, which is not a survey drawing on case studies, but a single case study presented in glorious detail. Brian Scott has almost single-handedly advanced the archaeometallurgy of Irish iron over more than two decades, and this book is likewise a definitive statement of his accomplishments as he prepares to retire from the Ulster Museum. Perhaps, because it focusses on a single case, it comes across, unlike *Pre-Industrial Iron*, as a truly interdisciplinary work. The task was perhaps made easier by the fact that it is not a collaboration but the work of a single scholar who has been

steeped in both archaeological and metallurgical research.

Scott's definition of archaeometallurgy is "to identify and define the roles of metals in early society, drawing together and synthesizing all the available sources of information" (p. 2), and this is what he does for Irish iron. The categories of evidence include raw materials, acquisition sites, production sites, by-products, finished products and, unusually, language and literature. After providing the general archaeological setting, Scott presents the materials background of his task in a short section (pp. 9-21). While this section will not replace *Pre-Industrial Iron* for the specialist, it is perhaps the best brief description of the metallurgy of iron for the layperson that I have seen. The only weakness is a lack of coverage on cast irons. This omission is understandable as cast irons were not produced in early Ireland, but they are occasionally mentioned in the text and their inclusion would have made this section the perfect resource for the non-specialist reader. Even so, I recommend it to all persons who wish to understand what the study of ancient iron is all about, whether or not they have an interest in Ireland as a geographical area.

Scott next outlines the current overall view of the origins and early development of iron production, which again is an excellent summary. He then proceeds to summarize the specific picture for Ireland period by period, and ends with evidentiary chapters. Scott explains his choice of this organization in his preface (p. viii), but I still found it awkward. Nevertheless, what emerges by the end of the volume is a clear picture of the origin and early development of iron production in Ireland, and although Scott tends to use formalist terminology when discussing economics (e.g., p. 29), like Rostoker and Bronson, we never lose sight of the social aspects of that production. This book is archaeometallurgy at its best.

Thus both books succeed admirably, *Early Irish Ironworking* more so, perhaps because its scope is more limited or because of its single author. Both works are essential reading for all those interested in either the history of iron technology or the archaeology of technology in general; *Pre-Industrial Iron* is bound to become a standard reference for this group of individuals. *Early Irish Ironworking* can be used by this group as a powerful case study in the history and archaeology of technology to be presented to students. It can further be commended, despite its technical focus, to all scholars interested in the prehistory and early history of Europe, and to any scholar who has not previously been interested in archaeometallurgy but is now looking for a doorway into this multidisciplinary subfield. □

Following is a second review of *Early Irish Ironworking*. These two reviews arrived via independent paths; since they vary in scope and approach, we are publishing both for your comparison.

The Editor

Early Irish Ironworking.

Reviewed by Mark E. Hall, University of California, Berkeley.

First, I guess I should warn the reader that Brian Scott and I have been good friends ever since I appeared at the Conservation Lab of the Ulster Museum in Belfast in 1987. At that point in time, I was looking for a PhD topic in archaeometallurgy; Brian showed me one and sure enough, I'm still working on it today. I'm not sure whether I want to thank him or curse him for that one.

There is a second warning too. Brian and I even collaborated on a few of the artifacts appearing in Chapter 5. So, you may be suspicious when I tell you this is an excellent book on Irish ironworking. You'll probably be even more suspicious when I tell you that not only is it an excellent book on Irish ironworking, it is also a wonderfully well written and produced book that should be on the shelf of all archaeometallurgists. In fact, this book has something in it for archaeologists, archaeometallurgists, Celtic linguists, and metallurgists.

The first chapter is ambitious in scope; personally I find it too ambitious. In it, the author sets out to introduce the reader to issues in the study of prehistoric and proto-historic Irish metallurgy, the chronology of the Irish Iron Age(s), the fundamentals of iron metallurgy, and the techniques of the blacksmith. This chapter should have been expanded and divided into several other chapters. For example, the archaeologist would have been better served by having a separate chapter on the fundamentals of iron metallurgy and the techniques of the blacksmith (for example, see Condit, Review of *Early Irish Ironworking*, *Archaeology Ireland* 5(2):28, 1991). Archaeologists and others who work outside of the British Isles could also use more of an explanation of the issues in Irish archaeology.

I am dismayed by the chronological scheme developed in the first chapter. Now, in addition to contending with the elusive Early Christian period, the equally nebulous Early Medieval period, and the A-B-C Iron Age system, we have the Early and Later Iron Ages. Ideally, this would not be bad, but the division and sub-divisions are solely based on the use of iron by Irish society (p. 8). There is more to a chronological scheme than just a single class of artifacts!

The second chapter, with its look at the origins of ironworking and the spread of iron technology, is quite thought-provoking. This chapter should have a broad appeal to archaeologists and archaeometallurgists since it reviews the theories and models concerning the origin and spread of iron technology throughout the Near East and Europe. Readers may disagree with some of the ideas presented here, but I feel one of the trademarks of a good book is that it causes people to think and question.

I like the second chapter for the human and social elements that Brian adds to the discussion about ironworking. Too often explanations in archaeometallurgy ignore individual choices and individual innovation. One

idea that is presented by Brian is that smiths were working for some sort of profit and this desire for a profit led to metallurgical developments. Muhly (The nature of trade in the LBA Eastern Mediterranean: the organisation of the metals trade and the role of Cyprus; In J. Muhly, R. Maddin, and V. Karagheorgis, eds., *Early Metallurgy in Cyprus 4000-500 BC*, pp. 251-270, Pereides Foundation, Nicosia, 1982) advanced this idea for the complex societies of the Eastern Mediterranean and Near East; this is the first time I've seen it advanced for the less centralized societies of Late Bronze Age and Iron Age Europe. Brian goes even further by suggesting that the success of iron over bronze for tools and weapons was due in part by marketing by the blacksmiths (p. 38).

Chapters 3, 4, and 5 present the metallurgical analyses of the Irish iron artifacts. Most every artifact was cross-sectioned to obtain a sample; larger artifacts, such as axes and swords, had sections of the cutting edge removed for samples. Each sample was polished and etched. Each artifact is illustrated with the area yielding the sample denoted, a macro of each section, a graph showing the microhardness down the section, and photographs of relevant microstructural features. The chemical composition of each artifact is reported in a table at the end of each chapter. A few artifacts were analyzed by Chris Salter using a microprobe to examine the distribution of arsenic and phosphorus in the sample. The quality of the line drawings and photographs in this volume are excellent and justify the cost of the book. Furthermore, the amount of data presented leaves the reader asking few questions or wanting more data. I found no faults with the interpretation of the microstructures.

Brian reviews the evidence for iron use during the Early Iron Age A (EIA A) in Chapter 3. Scott's EIA A dates from the 7th century B.C. to the 3rd century B.C. The few iron artifacts dating to this period are found in association with Hallstatt C and D material along the Bann and Shannon rivers (pp. 45-47). Five of these artifacts were sampled by Brian; the metallography shows evidence of secondary carburization and fold-welding steel to iron. Some would argue the evidence points to iron and steel being associated with invaders and/or migrations from the Continent. Brian does not totally dismiss this explanation, but also offers other explanations. He notes that iron technology could have been discovered by Irish smiths and the Hallstatt types adopted by contact with the Continental smiths.

In the EIA B (3rd century B.C. to 5th century A.D.), iron tools and weapons become more common in Ireland. The metallographic study in Chapter 4 describes a variety of tools and weapons excavated and found throughout Ireland. Scott's overall conclusions, which seem supported by the metallographic data, are: 1) the Irish could make serviceable tools and weapons out of carburized iron, low- and medium-carbon steel; and 2) Irish smiths were using a limited number of manufacturing techniques.

Chapter 5 reviews the iron technology during the Later Iron Age A (ca. A.D. 500 to A.D. 900). Excavations have yielded a wider range of iron artifacts than from earlier time

periods; thus, a greater variety of tools and weapons are presented here than in previous chapters. The ironworking technology is similar to that seen in the EIA, but the numerous artifacts from different types of sites indicates a higher level of iron production.

Every archaeologist working in the field should have a look at Chapter 6. Part of this chapter is devoted to what furnace remains and smelting slags look like. Brian adds a cautionary note that vitrified or glassy materials do not always constitute a smelting slag; too often these unknowns are listed as "smelting slag" or "slag" in site reports. To further emphasize his point, Brian reviews the evidence for metalworking at a variety of excavated sites in Ireland. Great archaeologists are not always great archaeo-metallurgists!

I'm not qualified to properly assess Chapter 7. I can not read nor understand a word of modern Irish, let alone Old or Middle Irish. Chapter 7 presents a series of references to ironworking in Old and Middle Irish literature. The written record shows that there were several types of smiths in Irish society; the smith was a person of respectable status; and there is a limited vocabulary of metallurgical terms in Old and Middle Irish.

All in all, this is quite a good book. There is a lot of data presented, the production is excellent, and I feel the book should be used by other authors and publishers as an example. The writing style is lively and the content is sure to provoke thought and discussion. What else can one ask for in an archaeometry book? □

Egyptology (continued from p. 4)

Paoli). Using haemagglutination inhibition and absorption-elution, the conclusions were that the genetic population remained stable over the Christian to Islamic cultural transition in lower Nubia.

The University of Turin and the Turin Egyptian Museum (F. Belliardo, G. Artuffo, G. Bertolo, E. d'Amicone) co-operated on a project to determine the contents of a sealed Cyprian jar (Turin Museum Suppl. 5120). Results from GC/MS, IR and NMR indicated olive oil. A surprising finding was the high proportion of unsaturated fatty acids, and absence of free glycerides. This was attributed to complete sealing of the contents, and thus total lack of oxidation.

Finally, what was for me the most exciting moment of the conference. Fathi Saleh (University of Cairo again) described the search for the ancient Egyptian musical scale. One flute in the Cairo Museum was restored to playable condition and under the supervision of M. Effat, Egypt's greatest flute player, exact replicas were made of five others. Their frequencies were recorded and analysed by computer. Three different scales were found from these six flutes, varying widely in date and provenance, but all had one identical note. Then Dr. Saleh provided a recording of Mr. Effat playing the original, restored flute. The audience was transfixed, for the sound was lovely. Suddenly, the past was immediate. □

Meetings Calendar

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

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

1992

- Sept. 1-7. 8th Congress of the European Anthropological Association. Madrid. María Dolores Garralda, Sección de Antropología, Facultad de Biología, Universidad Complutense de Madrid, Ciudad Universitaria, 28040 Madrid, Spain.
- Sept. 6-12. 8th International Palynological Congress. Aix-en-Provence, France. Rob Scaife, Department of Geography, University of Southampton, Southampton SO9 5NH, UK.
- Sept. 7-10. 7th Annual Meeting of Language Origins Society. Cambridge, England. Leonard Rolfe, Department of Psychology, University of Lancaster LA1 4YF, UK.
- * Sept. 9-11. International Conference on Energy, Environment, and Electrochemistry. Karaikudi. K.C. Narasimham, Division of Electrochemicals, CECRI, Karaikudi 623 066, India; tel 04565-3161; fax 04565-2088.
- * Sept. 9-12. 11th International Conference on Ethnomedicine. Heidelberg. Dr. Martina Hofbauer, Postfach 10 31 67, D-6900 Heidelberg, Germany. Theme: Medicines and Foods - The Ethnopharmacological Approach.
- Sept. 11-13. Environmental Change Meeting; sponsored by Association for Women Geoscientists. Denver, Colorado, USA. Leslie Anne Landefeld, Barranca Resources, 16150 W. 14th Place, Golden, CO 80401, USA; tel 303-278-292.
- Sept. 14-18. International Conference on Liquid Scintillation Spectrometry. Vienna. Dr. Franz Schonhofer, Austrian Society for Liquid Scintillation Spectrometry, Schopenhauerstrasse 71/11, A-1180 Vienna, Austria.
- Sept. 14-18. 20th European Meeting of Statisticians. Bath. R. Sibson, School of Mathematics, University of Bath, Claverton Down, Bath BA2 7AY, UK.
- Sept. 16-18. Biodeterioration of Archaeological Materials; sponsored by Science and Engineering Research Council/Biodeterioration Society. Portsmouth. Prof. E.B. Gareth Jones, School of Biological Sciences, Portsmouth Polytechnic, King Henry Building, King Henry I Street, Portsmouth PO1 2DY, UK; tel 0705-842032; fax 0705-842070. 15(1):22.
- Sept. 20-27. Association of Preservation Technology. Philadelphia, Pennsylvania, USA.
- Sept. 21-25. Paleoceanography and Global Change International Meeting. Kiel, Germany. ICP IV Organizing Committee, c/o GEOMAR Wischhofstrasse 1-3/ Building 4, D-2300 Kiel 14, Germany.
- Sept. 22-26. Congreso Latinoamericano de Antropología Biológica. Villa de Leyva, Colombia. Expedición Humana, Pontificia Universidad Javeriana, Santa Fe de Bogotá, C.C., Colombia.
- Sept. 24-25. Association for Environmental Archaeology, Annual Conference. Edinburgh, Scotland. Geraint Coles, Department of Archaeology, University of Edinburgh, 19 George Square, Edinburgh EH8 9JZ, UK; tel 031-650-4143. Theme: On the Edge - Human Settlement in Marginal Areas.
- * Sept. 25. 3rd Symposium of Paleopathology: The Health of Pre-Columbian Americans. Richmond, Virginia. Betsy Baird, Medical College of Virginia, Department of Pathology, MCV Box 662, Richmond VA 23298, USA; tel 804-786-9746.
- Sept. 25-27. 23rd Annual Binghamton Geomorphology Symposium: Geomorphic Systems. Oxford, Ohio. Bill Renwick, Department of Geography, Miami University, Oxford, OH 45056, USA.
- Sept. 27-Oct. 1. American Institute of Professional Geologists Annual Meeting. Lake Tahoe, Nevada. Jon Price, AIPG, P.O. Box 665, Carson City, NV 89702, USA; tel 702-784-6691.
- Sept. 28-30. Mediterranean River Environments. Cambridge, UK. Dr. J.C. Woodward, Department of Geography, Amory Building, Rennes Drive, University of Exeter, Exeter EX4 4RJ, UK.
- Oct. 5-10. INTERKAMA 92-12th Market for Innovations in Measurement and Automation. Dusseldorf, Germany. Dusseldorf Trade Shows, Inc., 150 North Michigan Avenue, Suite 2920, Chicago, IL 60601, USA; tel 312-781-5180; fax 312-781-5188.
- Oct. 21-24. Southeastern Archaeological Conference. Little Rock, Arkansas. John H. House, Program Chair, P.O. Box 136, UAPB, Pine Bluff, AR 71601, USA; tel 501-535-4509. 15(1):23.
- * Oct. 23-24. Interdisciplinary Symposium: Athens and Beyond. Hanover, New Hampshire. Hood Museum of Art, Dartmouth College, Hanover, NH 03755, USA; tel 603-646-2426.
- Oct. 23-25. Disaster Prevention, Response, and Recovery: Principles and Procedures for Protecting and Preserving Historic/Cultural Properties and Collections. Cambridge, Massachusetts, USA. Susan Schur, Technology and Conservation, One Emerson Place 16M, Boston, MA 02114, USA; tel 617-227-8581. 15(1):1.
- Oct. 26-29. Geological Society of America, Annual Meeting. Cincinnati, Ohio, USA. Geological Society of America, 3300 Penrose Place, Boulder, CO 80301, USA; tel 303-447-2020.
- Oct. 31-Nov. 1. Two Cultures: Tradition and Change Symposium. Naples, Florida. The Collier County Museum, 3301 Tamiami Trail East, Naples, FL 33962, USA; tel 813-774-8476. Theme: Columbus Quincennial and European Encounters in the Caribbean and Southeastern United States.

Meetings Calendar

- Nov. 1-6. 1st Pan American Conference on Pre-Columbian Mathematics, Astronomy, and Modes of Thought. Universidad Francisco Marroquin, Guatemala City and Tikal, Guatemala.
- Nov. 1-6. Soil Science Society of America Annual Meeting. Denver, Colorado. SSSA, 677 S. Segoe Road, Madison, WI 53711, USA.
- Nov. 5-8. Eastern States Archaeological Federation, 59th Annual Meeting. Pittsburgh, Pennsylvania. Richard L. George, Carnegie Museum Annex, 5800 Baum Boulevard, Pittsburgh, PA 15206, USA; tel 412-665-2600; fax 412-665-2751.
- Nov. 12-14. Trade and Discovery: The Scientific Study of Artefacts from Post-Medieval Europe and Beyond. Duncan Hook, Department of Scientific Research, British Museum, London, WC1B3DG, UK. Abstracts due by May 31, 1992.
- Nov. 12-15. American Society for Ethnohistory. Salt Lake City, Utah, USA. William Fowler, P.O. Box 6307-B, Vanderbilt University, Nashville, TN 37235, USA.
- Nov. 15-20. American Nuclear Society. Washington, DC, USA. Meetings Department, ANS, 555 N. Kensington Avenue, La Grange Park, IL 60525, USA; tel 312-352-6611.
- Nov. 15-20. Optical Society of America Annual Meeting/OPTCON 92. Boston, Massachusetts, USA. OSA, 2010 Massachusetts Avenue NW, Washington, DC 20036, USA.
- Nov. 23-27. New Zealand Geological Society/Geophysical Society, Joint Annual Meeting. Christchurch. David Shelley, Department of Geology, University of Canterbury, Christchurch, New Zealand; tel 03-667-001; fax 03-642-769.
- Dec. 2-6. American Anthropological Association, Annual Meeting. San Francisco, California, USA. American Anthropological Association, 1703 New Hampshire Avenue NW, Washington, DC 20009, USA; tel 202-232-8800.
- Dec. 6-12. International Conference, Environment and Archaeology. San Juan, Puerto Rico. Dr. A.G. Pantel, Conference Chair, USDA Forest Service, Call Box 25000, Río Piedras, Puerto Rico 00928-2500, USA; tel 809-792-2456; fax 809-792-7882. Theme: Emerging Trends and New Techniques for Heritage Management and Sustainable Development in Tropical Forests.
- Dec. 15-19. International Conference on Human Genetics in Celebration of the Birth Centenary of JBS Haldane. Calcutta. Partha P. Majumder, Anthropometry and Human Genetics Unit, Indian Statistical Institute, 203 B.T. Road, Calcutta 700 035, India.
- Dec. 27-30. Archaeological Institute of America. New Orleans, Louisiana, USA. AIA, 675 Commonwealth Avenue, Boston, MA 02215, USA.
- Dec. 28-31. Iraqi Geological Congress, International Meeting. Baghdad, Iraq. Geologists Union, Box 6244, Al-Mansour, Baghdad, Iraq.
- 1993
- Jan. 13-16. Joint Mathematics Meetings; co-sponsored by the American Mathematical Society. San Antonio, Texas, USA. H. Daly, AMS, P.O. Box 5887, Providence, RI 02940, USA.
- Feb. 8-11. Geologic Remote Sensing Meeting. Pasadena, California, USA. Nancy J. Wallman, ERIM, Box 134001, Ann Arbor, MI 48113, USA; tel 313-994-1200 ext. 3234; fax 313-994-5123.
- Feb. 11-16. American Association for the Advancement of Science, Annual Meeting. Boston, Massachusetts, USA. AAAS, 1333 H Street NW, Washington, DC 20005, USA; tel 202-326-6400.
- Feb. 28-March 5. Digital Image Processing Meeting. Kona, Hawaii USA. C.V. Freiman, Engineering Foundation, 345 E. 47th Street, New York, NY 10017, USA; tel 212-705-7835.
- March 8-12. Pittcon '93 - 44th Pittsburgh Conference and Exposition on Analytical Chemistry and Applied Spectroscopy. Atlanta, Georgia, USA. Alma Johnson, Program Secretary, Pittsburgh Conference, Department 5K, Suite 332, 300 Penn Center Boulevard, Pittsburgh, PA 15235-5503, USA; tel 800-825-3221; fax 412-825-3224. Abstract deadline: Aug. 5, 1992.
- March 14-17. Venezuelan Society of Geologists/American Association of Petroleum Geologists, International Meeting. Caracas, Venezuela. AAPG Convention Department, Box 979, Tulsa, OK 74101, USA; tel 918-584-2555; fax 918-584-2274.
- March 14-18. 7th Conference on Scientific Use of Statistical Software. Heidelberg, Germany. SoftStat, ZUMA, Postfach 12 21 55, D-6800, Mannheim I, Germany. 15(1):23.
- * April 4-8. 25th International Symposium on Remote Sensing and Global Environmental Change - Tools for Sustainable Development; co-sponsored by The Consortium for International Earth Science Information Network (CIESIN) and the Environmental Research Institute of Michigan (ERIM). Graz, Austria. ERIM/International Symposium, P.O. Box 134001, Ann Arbor, MI 48113-4001, USA; tel 313-994-1200, ext. 3234; fax 313-994-5123. Includes an exhibition for remote sensing and GIS products, and training programs.
- April 11-17. 58th Annual Meeting of the Society for American Archaeology. St. Louis, Missouri, USA.
- * April 12-16. Optical Engineering and Photonics in Aerospace Science and Sensing; sponsored by SPIE - The International Science for Optical Engineering. Orlando, Florida, USA. OE/Aerospace Science and Sensing '93, SPIE, P.O. Box 10, Bellingham, WA 98227-0010; tel 206-676-3290; fax 206-647-1445; Internet spie@mom.SPIE.org. Geophysical Sensing Program includes conferences on: Ground Sensing; Underground and Obscured Object Imaging and Detection; Terrestrial/Close-Range Photogrammetry (papers solicited in archaeology); Integrating Photogrammetric Techniques with Scene Analysis and Machine Vision; State-of-the-Art Photogrammetric Mapping; Geographic Information Systems. Abstract deadline: 14 September 1992. Manuscripts due: 15 March 1993.

- * May 9-14. Society for Imaging Science & Technology, 46th Annual Conference. Cambridge, Massachusetts. William M. Aitken (General Chair), Polaroid Corporation, 565 Technology Square - 4, Cambridge, MA 02139-3586, USA; tel 617-577-2369; fax 617-494-5243. Abstract deadline: 1 Dec. 1992. Includes programs in: Image Conservation and Restoration; Electronic Photography; Earth Resource Imaging; Radiography.

May 17-19. Geological Association of Canada/Mineralogical Association of Canada, Annual Meeting. Edmonton. J.W. Kramers, Alberta Geological Survey, Box 8330, Station F, Edmonton, Alberta T6H 5X2, Canada; tel 403-438-7644.

- * May 17-22. 3rd International Conference, Association for the Study of Marble and Other Stones Used in Antiquity. Athens, Greece. Dr. Yannis Maniatis, "Demokritos" National Center for Scientific Research, Institute of Materials Science, 153 10 Ag. Pareskevi, Attikis, P.O.B. 60228, Greece; tel 301-651-3111; fax 651-9430; email mandi@grathdem. Theme: Technology, Provenance, Use and Authentication of Ancient Marble and Other Stones. Abstracts and registration due Jan. 15, 1993.

June 11-15. International Association for Impact Assessment, 12th Annual Meeting. Shanghai, China. E. Pendleton Banks, Wake Forest University, P.O. Box 7807, Winston-Salem, NC 27109, USA. Sessions on Cultural Resources and Remote Sensing.

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

- * July 5-9. 5th International Conference on Fluvial Sedimentology: Modern and Ancient - Their Importance to Mankind. Brisbane, Australia. Continuing Professional Education, The University of Queensland, Queensland 4072, Australia; tel 61-7-365-7100; fax 61-7-365-7099.

July 28-Aug. 5. 13th Congress, International Union of Anthro-

pological and Ethnological Sciences. Mexico, D.F., Mexico. Linda Manzanilla, Instituto de Investigaciones Antropológicas, Universidad Nacional Autónoma de México, Ciudad Universitaria, Coyoacán D.F. 04510, México; tel: 52-5-548-78-28; fax: 52-5-554-04-67, 548-36-67; bitnet: LMANZA@UNAMVM1. Theme: Cultural and biological dimensions of global change.

Aug. 9-12. Joint Statistical Meetings. San Francisco, California, USA. American Statistical Association, 1429 Duke Street, Alexandria, VA 22314-3402, USA.

Aug. 22-29. 29th International Congress of History of Science. Zaragoza. XIX International Congress of History of Science, Facultad de Ciencias (Matemáticas), Ciudad Universitaria, 50009 Zaragoza, Spain; fax 76-565852; telex 58198 EDUCI-E; e-mail ichs@cc.unizar.es. Sections include: Astronomy in ancient cultures; Metallurgy in ancient China and India.

Aug. 23-29. 3rd International Conference on Geomorphology. Hamilton. Derek C. Ford, Department of Geography, McMaster University, 1280 Main Street West, CDN-Hamilton, Ontario L8S 4K1, Canada.

Aug. 25-Sept. 3. 49th Biennial Session of the International Statistical Institute. Firenze, Italy. ISI Permanent Office, 428 Prinses Beatrixlaan, P.O. Box 950, 2270 AZ Voorburg, The Netherlands.

Sept. 13-17. International Symposium on the Catalán Forge. Spain. Dr. Estanislau Tomas, Associacio del Museu de la Ciencia i de la Tecnica i d'Arqueologia Industrial de Catalunya, Via Laietana 39, S-09003 Barcelona, Spain; tel 319 23 00; fax 310 06 81. 15(1):1.

Sept. 19-24. 6th Nordic Conference on the Application of Scientific Methods in Archaeology. Esbjerg, Denmark. Vagn Mejdahl, The Nordic Laboratory for Luminescence Dating, Riso National Laboratory, DK-4000 Roskilde, Denmark. 15(2):1.

Oct. 25-28. Geological Society of America, Annual Meeting. Boston, Massachusetts, USA. Vanessa George, GSA, Box 9140, Boulder, CO 80301, USA; tel 303-447-2020.

1994

Feb. 18-23. American Association for the Advancement of Science, Annual Meeting. San Francisco, California, USA. AAAS, 1333 H Street NW, Washington, DC 20005, USA; tel 202-326-6400.

April 11-15. Materials Research Society, Spring Meeting. San Francisco, California, USA. Materials Research Society, 9800 McKnight Road, Pittsburgh, PA, USA; tel 412-367-3012. Symposium: Materials Issues in Art and Archaeology IV.

April 18-24. 59th Annual Meeting of the Society for American Archaeology. Anaheim, California, USA.

June 5-11. Geochronology, Cosmochronology and Isotope Geology (ICOG-8). Berkeley, California. Garniss H. Curtis, Institute of Human Origins-Geochronology Center, 2453 Ridge Road, Berkeley, CA 94709, USA; tel 415-845-4003; fax 415-845-9453.

June 19-24. American Nuclear Society Annual Meeting. Atlantic City, New Jersey, USA. ANS, Meetings Department, 555 N. Kensington Avenue, La Grange Park, IL 60525; tel 312-352-6611. □

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