

in historical documents, despite the fact that historical archaeology has shown clearly that historical documents, although almost exclusively produced by men, can provide valuable insights into gender relations that are evidenced in the material culture.

This critical bibliography is an essential resource for anyone undertaking research or preparing a teaching curriculum on gender archaeology, feminist archaeology, or archaeological theory and method and the team is to be congratulated for the speed at which the book was produced. The collection indirectly exposes the shortcomings of classical archaeology, however, by revealing its conspicuous lack of feminist theory and gender studies. On the positive side it also shows that there is still room for classical archaeology to make a significant contribution to this burgeoning area of the discipline.

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NEW DEVELOPMENTS IN ARCHAEOLOGICAL SCIENCE.

A JOINT SYMPOSIUM OF THE ROYAL SOCIETY AND THE BRITISH ACADEMY, FEBRUARY 1991, edited by *A.M. Pollard*. (Proceedings of the British Academy 77.) Pp. 295. Oxford University Press, Oxford 1992. £25. ISBN 0-19-726118-3.

In the past several years, several edited volumes on archaeological science have appeared, including *Science and the Past* (S. Bowman ed., London 1991) and *Scientific Analysis in Archaeology* (J. Henderson ed., Oxford 1989), as well as the proceedings of various meetings on the subject: *Materials Issues in Art and Archaeology III* (P.B. Vandiver et al. eds., Materials Research Society Symposium Proceedings Series 267, Pittsburgh 1992); *Archaeometry '90* (E. Pernicka and G.A. Wagner eds., Basel 1991); and *Archaeological Sciences 1989* (P. Budd et al. eds., Oxbow Monographs 9, Oxford 1991). Although careful study of their contents can provide an overview of current applications of scientific techniques in archaeology, these compilations are dominated by analyses of ceramic and metal artifacts. This emphasis reflects the now widespread application of materials science to archaeology, an integration that is perhaps even more common in classical archaeology and art history than in anthropological archaeology.

Divided into sections on site survey techniques, past human environments, artifact studies, evidence for food, and the study of human remains, *New Developments in Archaeological Science* presents a more balanced sampling of recent advances in the field, particularly those that have already produced valuable archaeological data, rather than on techniques still in the initial stages of development. In addition, this volume was designed to

bring these contributions to the attention of a non-specialist audience, so that archaeologists can better understand how the integration of scientific results with traditional archaeological data (from field survey, excavation, artifact typology, and ancient texts) produces a more complete picture of past societies than any single approach alone.

I. Shennan and D.N.M. Donoghue bring us up to date on remote sensing using satellite and airborne multispectral imaging systems. With resolutions down to 10 m, satellite images can profitably be used to identify settlements, ditches, and agricultural activity, as well as environmental features such as watercourses, soil patterns, and plant regimes. Significant advances continue to be made in data processing and image interpretation; these developments have improved land-based prospection methods as well. A. Aspinall notes that resistivity and magnetometry surveys have also benefited from the use of smaller (0.25 m) sampling intervals, but that ground-penetrating radar still has the greatest potential for unambiguous identification of subsurface features. Further advances will continue to be driven by developers' needs for site assessment prior to beginning construction.

The contribution by M.G.L. Baillie on dendrochronology and environmental change is the only paper that touches on dating methods. While the contribution of tree-ring sequences to radiocarbon calibration is widely known (Baillie shared the 1993 AIA Pomerance Award for Scientific Contributions to Archaeology; *AJA* 98 [1994] 280-81), dendrochronology may also be used to document environmental change. The construction of long, independent sequences in several parts of the world enables not only the identification of worldwide climatic events (e.g., the Thera eruption) through the comparison of frost rings, but also of more localized episodes by using regional grids of tree-ring data. Baillie further illustrates two cases (one Neolithic, one Roman) where the relationship between social change and contemporary environmental events warrants further consideration.

Reconstructing the landscape and related changes in Swedish society for the past 5,000 years is the objective of B.E. Berglund's interdisciplinary research efforts. Although the techniques and resources used—soil, vegetation, and hydrology maps, lake stratigraphy, shoreline changes, palynology, archaeological survey and excavation—are not innovative, the collaborative effort of 25 scholars from six departments/disciplines is noteworthy. Their integrated research emphasizes the wealth of data available for reconstructing past landscapes and can serve as a model for those studying the relationship between people and their environment. M.-A. Courty tells us more specifically how soil micromorphology reflects the human transformation of the landscape with fine chronological resolution. Microscopic analysis of soil thin sections can distinguish between natural accumulations and human activity areas including living floors, fireplaces, eating and cooking zones, rest areas, storage areas, and refuse dumps. Several examples from Europe and the Near East illustrate the importance of field sampling strategies and

careful interpretation of cultural processes from the resulting data.

The section on artifact studies begins with a review of lead isotope analysis in the Aegean by N.H. Gale and Z.A. Stos-Gale. This exceptionally clear paper recounts the ability of this method to discriminate among copper and lead ore sources in the Mediterranean world, while explaining the necessity of having sufficient samples from each potential ore source and of performing appropriate statistical analyses on the isotope data. Of interest is their preliminary observation that Laurion was the main source of Aegean LBA artifacts, whereas oxhide ingots (raw copper) are predominantly of Cypriot copper, even those from Sardinia. M.S. Tite's paper illustrates how scanning electron microscopy revolutionized the investigation of the production technology of pottery, faience, glass, and metallurgical debris. Careful visual examination, x-ray radiography, and petrography remain important for identifying temper material and forming methods, while microstructural analysis with the SEM can differentiate between burnishing, slips, paint, and glaze; quantitatively determine the chemical composition of the clay and/or temper; and estimate firing temperature and conditions. As an example, Greek black- and red-figured wares indicate careful selection of clay for an impermeable slip, which remains in a black reduced state through control of kiln atmosphere and temperature during firing.

The article on the Stonehenge bluestones by O. Williams-Thorpe and the late R.S. Thorpe is a brilliant example of the necessary role of thorough archaeological and historical research in the interpretation of scientific data. Petrographic and x-ray fluorescence analyses pinpoint their origin to several specific outcrops in southern Wales, supporting the common conclusion that their transportation hundreds of kilometers to Stonehenge required considerable manpower and social organization. The authors conclude, however, that glacial activity carried the bluestones to the Salisbury Plain, noting that they were not carefully selected from a single source; there is evidence from the 18th–19th centuries for stone clearing in the Salisbury Plain; the bluestones are structurally poor rock types and more durable rocks are available closer than southern Wales; and there is no archaeological evidence from other sites suggesting that bluestones had any particular value. They also conclude that the monolithic sarsen stones were locally available, thus making Stonehenge comparable to megaliths from non-glaciated Brittany and France, also constructed of stones transported no more than about 5 km.

C.R. Orton and P.A. Tyers examine how archaeologists compare proportions of different types of pottery in ceramic assemblages. Although this paper may be mathematically beyond most readers, the problem of whether to use sherd counts, diagnostic pieces, number of pots, weight, volume, etc., is familiar to most archaeologists. Having demonstrated that many of these measures are biased, the authors propose using estimated vessel equivalents, which can be compared using statistical

methods such as categorical data analysis. While there is still the practical problem of making their methods accessible to archaeologists working on pottery, proper statistical analysis is likely to detect patterns in fabric, form, or function that otherwise might have gone unnoticed.

R.P. Evershed et al. use gas chromatography/mass spectrometry to identify food residues in pottery. Lipid components absorbed into the ceramic can be detected at very low levels, and specific leafy vegetables may be differentiated from other plant or animal foods. A reference data base of "fingerprints" for decayed foods is in preparation, but the problem of general-purpose vessels, and of complex recipes, underscores the importance of careful sample selection and interpretation. A more general review of bioarchaeology by M.K. Jones emphasizes the examination of the entire human food web, including identifying plant and animal remains, coprolites, pollen and phytoliths, the microscopic analysis of dental wear patterns, and isotopic/chemical analysis of bone. Shifts in the variety of plant and animal species consumed can serve as the basis for models of the relationship between humans and the environment, which may be correlated with animal and plant domestication, the secondary products revolution, advances in fishing technology, and even the pollution of animal habitats.

The use of stable isotopes to reconstruct diet is described by N.J. van der Merwe, who first applied these methods to archaeology less than two decades ago. Carbon isotope ratios in bone ultimately distinguish between C_3 (trees, shrubs, and temperate grasses including wheat, barley, and rice) and C_4 (subtropical and tropical grasses including maize and millet) plants at the base of the terrestrial food chain. Both carbon and nitrogen isotopes show trophic level differences, as well as the contribution of seafood to prehistoric diets. Stable isotope analysis has already found applications in examining early rice agriculture in China, the spread of African cereals to Europe in the Iron Age, and the exploitation of marine foods by coastal Mediterranean populations. Regional differences in animal diets have also been used to trace the source of elephant ivory and rhinoceros horn. Finally, carbon isotopes in tooth enamel can be used to measure diet, even in hominid fossils millions of years old.

Newer still are biomolecular techniques used to identify DNA in archaeological remains, surveyed here by R.E.M. Hedges and B.C. Sykes. Plant and animal remains can be taxonomically identified, and lineage relationships between groups or individuals can be measured (are Etruscans indigenous to Italy?). DNA studies can document the domestication of specific animals and plants, and perhaps whether the genotypes of human populations reflect environmental or cultural adaptations. Mitochondrial DNA from modern humans has already provided evidence of our earliest common ancestor ("Eve"), and the ability to amplify small amounts of ancient DNA using the polymerase chain reaction suggests that further evidence is directly obtainable from carefully selected fossil material.

While not all of the techniques presented here will be (nor should they be!) utilized by every archaeologist or

project director, that is hardly the point of this volume. Rather, it is to disseminate the knowledge that these techniques are available to assist in answering specific archaeological or art historical questions. Archaeological sites are non-replenishable resources for studying the past, and it is our duty to preserve as much information as possible. In this regard, the scientific collection and preservation of human, faunal, and floral remains, and of soil samples for flotation, pollen/phytolith analysis, and micromorphological study, is of equal importance to that of potsherds and other artifacts that fill museum display cases. Archaeologists not only must recognize the potential value of these finds, but also need to integrate competently the results of their scientific analysis with other archaeological data. Many of the authors in this volume plead for greater interaction between, and theoretical direction from, both archaeologists and scientists. Analytical data must be assembled and interpreted according to archaeological precepts, rather than relegated to an appendix; but this interpretive commitment must be made by archaeologists, since most physical scientists or archaeometrists are no better versed in current archaeological method and theory than are most archaeologists in the natural or physical sciences. Likewise, interdisciplinary collaboration should begin in the research design stage to ensure that the sampling strategy and analytical techniques chosen are appropriate for the archaeological questions being asked. Unfortunately, many archaeologists in the United States feel poorly prepared for this level of interaction, and there are few students being trained in both science and archaeology to bridge this gap in communication.

As Colin Renfrew makes clear in the volume's final chapter, archaeological science is a firmly established discipline, at least in Britain where there are three university departments devoted to this specific subject. In the United States, however, archaeology itself is usually only part of broader anthropology or classics curricula, and it is difficult to obtain extended training in both science and archaeology. With only one tenured university post in archaeological science in this country (Harvard University), there is little incentive to enter this discipline, and even less promise that future developments will be made by American archaeologists. In lieu of significant changes to this picture, archaeologists will remain beholden to their scientific colleagues for "new developments" and must make extra efforts to maintain and promote interdisciplinary collaborations, and to keep abreast of scientific advances in archaeology.

New Developments in Archaeological Science is the best single volume on this subject available and would serve as an excellent resource for archaeologists planning an excavation project or studying the finds from one. Pollard should be commended for producing a highly readable text, with extremely few errors, in a very timely fashion. This volume should be required reading for all archaeology graduate students.

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THE EMERGENCE OF CIVILIZATION: FROM HUNTING AND GATHERING TO AGRICULTURE, CITIES, AND THE STATE IN THE NEAR EAST, by *Charles Keith Maisels*. Pp. xx + 395, figs. 65, maps 22, tables 14. Routledge, London 1990, paperback 1993. £15.99. ISBN 0-415-09659-6.

The emergence of civilization is a sublime theme that has occupied scholars' minds for many centuries. Charles Keith Maisels has contributed to this discussion with revised and new theories mainly based on a thorough study of the relevant literature, which includes ca. 1,000 references on 46 pages. Those wishing to explore this topic more deeply will find the extensive bibliography most valuable.

The first chapters deal with the interrelation of archaeology, anthropology, social science, and social succession. In the following chapters the favorable ecology of the Zagrosian Arc at the end of the last Ice Age, about 10 millennia ago, when *Homo sapiens sapiens* was for the first time able to take advantage of an interglacial warm period, is discussed. The Zagrosian Arc is defined by the Zagros-Kurdistan-Taurus mountains and their intramontane valleys, their extramontane foothills, and the steppe transition to the alluvium. The origin and growth of villages based on the archaeological evidence from this area until roughly the fifth millennium B.C. are discussed. A rising density of subsistence resources, particularly grains, led to a downward spiral of mobility until full sedentarization was possible at favored sites where only a few grass species (grain) could be exploited, but different animal species were hunted depending on the dominating species of a particular area. The environmental diversity of the Zagrosian Arc led to innovation at different times in different places as, for example, the domestication of various wild animals. Sheep, goat, cattle, pig, and dog are the most important domesticates, which were also secondarily exploited, i.e., not only for meat but also for milk, wool, and transportation.

The author correctly points out that in more favorable parts of the Near East, e.g., at Jericho and Çatal Hüyük, individual towns flourished much earlier than in Mesopotamia. He considers these cities, however, as merely the earliest experiments in concentrated living, which did not continue into historic times and were essentially harbingers of developments elsewhere. As an archaeologist working in Palestine, I cannot accept this postulate without further evidence. The author argues that in southern Mesopotamia a city-centered civilization arose in a semiarid plain, e.g., Uruk, Eridu, 'Usaila, and Tell al-'Ubaid, ca. 3000 B.C. and lasted for about three millennia, until it was absorbed into the classical Graeco-Roman world.

The very desirability of hydromorphic locations explains the early colonization and rapid cultural expansion upon the alluvium of Mesopotamia. Surpluses were required for exchange for pastoral and other subsistence products and kept as reserves in temples. The temples served as cores of the synoecism that crystallized into cities. In pre-state societies the producers were also the consumers, whereas in post-urban societies that was not the case. The ruling classes had a specific interest in production, because this guaranteed the base of power.