Although I have been following this project closely, I am still blown away by the quality of this volume and would urge anyone at all interested in archaeometallurgy to read it closely. I think that it is particularly notable for its exemplary integration of field survey, excavation, documentary and oral history, experimental archaeology and archaeometry.

The volume describes the discovery, during survey of a valley to be flooded by construction of a large dam, of two features of interest. The first was the site of the crucible steel production famously described by Coomaraswamy in 1904. Juleff found that the descendants of those steelworkers still possessed some blooms, crucibles and ingots of crucible steel, and an excellent metallographic study of these by Michael Wayman is included here as an appendix. The second feature was the discovery of an entirely new type of iron-smelting furnace. As reconstructed by Juleff (and the data presented here allow no doubt as to the accuracy of her reconstruction) these were low subrectangular structures, 1.5 - 2 m in length, 0.4-0.8 m wide and (particularly suprising) only 0.5 m high. Large numbers of these were found, invariably placed near the crest of west-facing hills, with the front long wall, bearing a single line of up to a dozen tuyeres, facing downslope. Juleff argued that these were wind powered furnaces utilizing the force of th seasonal monsoon (July to September), which (as she shows in an innovative chapter packed with wind-velocity measurements) achieve sustained wind speeds of 40 km/h, with periodic peaks up to 60 km/h.

Since Juleff was not an archaeometallurgist (at least not yet!) and there was no precedent for the technology that she proposed, her reconstruction encountered intense scepticism from the archaeometalurgical community. She countered this in the most effective way - by building full-scale replicas and smelting iron in them successfully on four separate occasions, using only the force of the monsoon wind. There can be no doubt that she is correct and that the Sri Lankan furnaces, for which available dates run from the seventh through the eleventh centuries AD, are a significant new chapter in the history of metallurgy. Mathematical modelling of the windflow patterns by David Wilson, an aeronautical engineer, explains why these furnaces work. A complex pattern of boundary layer separation occurs where the pasees over the lip of the front walls, producing a low pressure zone that draws air in through the tuyeres. This is NOT a natural draft furnace - Wilson's calculations suggest that the pressure drop achieved in these 0.5 m furnaces is equivalent to that in natural draft furnaces 3 to 6 m tall.

This is the kind of publication that sets new standards for an entire field. The quality of the fieldwork is very high, it is superbly documented, and it is all woven into a complex and extremely coherent argument. Furthermore, unlike much contemporary archaeometallurgy (and I am thinking here particularly of European and Latin American archaeometallurgy) this study stands out for its wide-ranging use of comparative material - African, European, Near Eastern, Indian and Japanese. In summary, this is about as good as it gets in our field.

Archaeological Sciences 1995. Proceedings of conference on the application of scientific techniques the study of archaeology, Liverpool, July 1995. Edited Anthony Sinclair, Elizabeth Slater & John Gowlett. Oxb Monograph 64, Oxford, 1997. 448 pp. $120 (cloth). ISBN 900188 04 X.

Reviewed by Robert H. Tykot, Department of Anthropolo, University of South Florida, Tampa, FL 33620 USA

This volume is the proceedings of the 5th Archaeologi Sciences conference, a biennial meeting held in Britain sir 1987. This is the second of the proceedings to be published Oxbow; another was published in the British Archaeologi Reports series (Slater & Tate 1988; Budd et al. 1991). Wh the conference has rotated through various British venues, nationality of the participants and the subjects of the resea presented is international. The participants at this particu conference were heavily biased towards the USA, Cana and western Europe.

As with proceedings of other conferences, including longer-standing International Archaeometry Symposia, contributions are a mixed bag in terms of subject matter, qual and significance. *Archaeological Sciences 1995* includes papers, ranging in length from mere abstracts to a maxim of a dozen pages including references and illustrations. T concise nature of the papers is in keeping with the origi presentations and, as an overview of a wide range of curr scientific applications in archaeology, should make the volu appealing to readers with broad interests who prefer not to bogged down in full journal article-length detail. For su readers, an introduction and/or epilogue which discussed range and significance of the papers, current and future tren etc., would have been useful; the editors chose to contrib only a half-page preface instead. Many of the articles wo be suitable for use in graduate or advanced undergradu courses as examples of scientific applications in archaeolo in conjunction with text/lecture material on the principles the various techniques.

The papers are effectively organized into sections methodology or material: Petrography (3 papers); Glass (Ceramics (7); Metallurgy (9); Chronological (9) a Dendrochronological (3) Studies; Ancient Environments (1 Remote Sensing (2); Human Remains (5); and Hum Evolution/Hominid Artifacts (9). It is not possible here discuss the individual papers in any detail.

Compared to *Archaeological Sciences 1989*, the m noticeable change is in the inclusion of the large number papers on ancient environments, a topic of resurgent inter in archaeology. In general, the organizers of the conferer were broadminded in their definition of archaeological scien in some circles, the study of biological remains, unl technologically sophisticated, would not have been includ Papers in the environmental section include studies of pol and phytoliths (Tipping et al.; Madella), microfauna and fl (Clapham et al.; Pantazidou et al. [2 papers]; Turner-Wal

& Scull), landscape and environment (Caple & Dungworth; Endfield; Krahtopoulou; Clare; Gonzalez et al., Ivaschenko; Sazanov), dental microwear (Mainland), and phosphorus or heavy metals in sediments (Jenkins; Willies & Maskall). Most of these studies exemplify the importance of understanding the environmental context when we interpret archaeological remains and the human behaviors they represent.

Among the papers on human remains are three dealing with bone chemistry, including stable isotope analysis of carbon and nitrogen for dietary information (Richards & van Klinken), dentine degradation (Lucy & Pollard), and using amino acid racemization in teeth to determine age at death (Carolan et al.). I found these to be among the most original and significant papers in the volume, and they presage an increased emphasis on bioarchaeology in the later 1990s. Two other contributions focus on cranial morphology (Panagiaris et al.) and skeletal taphonomy and preservation (Tiley-Baxter).

More varied and somewhat out of place are the papers on human evolution and hominid artifacts, which range from studies of lithics (Crompton; Crompton & Gowlett; Weber; Cormack; Andresen et al.) to morphology and functionality of jaws, teeth, and locomotive adaptation (Quinney & Collard; Spears & Crompton; Crompton & Yu). They are out of place in the sense that the only 'scientific' or techno-analytical component of these studies is the computer - either for statistical manipulation, or for generating models, e.g. on the mechanical significance of thick enamel (Spears & Crompton). It's not that archaeological science is all about black-box instrumental analysis, but for the most part these studies aren't explicitly scientific, i.e. with experimental laboratory-based testing of specific hypotheses.

Chronological studies, always important to archaeology, focus in this volume on methods less well-established than radiocarbon and radiopotassium dating, although two papers mathematically combine C14 dates and stratigraphic sequence to refine age estimates (Farid Khan & Gowlett; Curl & Latham). Alternative dating methods to radiocarbon are important because carbon-containing materials aren't always available or suitable in many contexts. The chalk figure of a horse at Uffington, for example, is dated using optically stimulated luminescence (Rees-Jones & Tite). Several other papers also use luminescence or uranium-series dating on a variety of materials (Barnett; Shepherd; Brown et al.; King); the usefulness of amino acids for dating organic materials is still being investigated (Csapo et al.; Csapo-Kiss et al.); and dendrochronology remains the most precise technique when wood samples are available (Bonde; Bonde et al.; Groves).

The remaining papers fall in the category of materials analysis. Stone is the subject of only three papers, including an historical overview of implement petrology (Davis), a novel and useful approach to non-destructive obsidian characterization using back-scattered electron imaging on an SEM (Kayani & McDonnell), and petrographic provenancing of Stonehenge dolerites (Ixer). Studies of glass comprise technology (Merchant et al.; Blek & Gilmore; Nicholson) and conservation issues (Early & Watkinson; Mills & Cox). An important contribution is Nicholson's on the results of recent excavations at Tell el-Amarna where kilns and a workshop for glass and faience have been uncovered.

The papers on ceramics are split between petrographi (de Domingo & Johnston; Eiland; Joyner; Williams & Jenkin and chemical (Brodie; Hughes et al.;Whitbread et al.) studie These papers are limited in their geographic representatio with five on Greece and Italy, one on Roman pottery in Britai and the last on Parthian ceramics in the Near East. Two of th chemical studies use atomic absorption, and the other neutr activation analysis. AAS has been widely superceded by IC spectroscopy, while NAA is expected to become less availab in the coming decade due to the closure of many researc reactors. Perhaps the most important paper in this group is th cautionary tale by Whitbread et al. who attempt to establish representative 'control group' of local ceramic fabrics b analyzing a kiln and its associated pottery.

The papers on metallurgy cover compositional analysi technology of production and decay, and sourcing. They inclu studies of alloy composition (Bayley & Butcher; Bean), bronz production and possible tin sources in south India (Srinivasan silver refining (Bayley & Eckstein), early Islamic ste manufacture (Griffiths et al.), documenting punchmarks usir the SEM (Mortimer & Stoney), the possibility of dating gol copper-silver alloys (Seruya & Griffiths), copper sourcing usir lead isotope ratios (Joel et al.), and trace element fingerprintir of gold using laser ablation ICP mass spectrometry (Taylor al.). While this last paper is only a preliminary report, demonstrates the efficacy of this technique to produ quantitative trace element information in an almost no destructive manner.

Two papers on remote sensing are also included, one using techniques appropriate to specific geological ar architectural circumstances (Shell) and the other on theoretic aspects of resolution on data interpretation (Schmidt Marshall).

While it was undoubtedly a massive effort to extract all the conference papers in a timely manner - and the editors a to be commended for publishing the proceedings within tw years of the conference - there are too many inconsistenci in format that could have been addressed. Many papers ha abstracts, but some have none at all, and two 'papers' are fact only half-page abstracts. For two papers with the san first author, the abstract for the first is just two lines in lengt for the second paper, the abstract is 24 lines in length! Th extent of typographic errors are equally variable, indicating th proofreading was largely left in the hands of the authors rath than the editors. The paper by Kayani and McDonnell particularly rife with distracting errors. In some cases a blan left-hand page is included so that papers begin on the righ hand page; in other cases the papers begin on the left. T table of contents is not necessarily accurate; for example, t author 'Brodle' should be 'Brodie'; M.S. Tite has been left o as the second author of the paper by Rees-Jones; and t sequence of the two papers by Pantazidou et al. have be switched.

The volume is printed in the large A4 format, with text two columns. This is the now-standard format of all Oxbo publications, and the quality of the text and illustrations is ve good. Photomicrographs, remote sensing images, and oth figures are sharp and fully detailed. The cloth binding

adequate but my copy is already torn a bit at the spine; large volumes such as this one need a heavier duty binding. The price is undoubtedly a limiting factor for individual purchase, even at a 20% conference discount, although the price is not out of line relative to other publications of similar length and narrow target audience.

In conclusion, this volume is reasonably representative of the broad range of scientific applications in archaeology in the last decade of the 20th century, save for the wide array of recent work on biological remains, especially bone chemistry and residue analysis. While the sheer number of contributors alone attests to the vitality of and continued interest in scientific studies, it is equally clear that science-based archaeological research is not a standard or principal component of many archaeological projects, but something often done as a discrete effort from excavation and classificatory/typological analysis and publication. For the most part the papers in *Archaeological Sciences 1995* are useful contributions to the literature, but won't change the reasons why many archaeologists find archaeometry to be boring. In some cases it may be the overly narrow focus of some scientific research; in others it may be lack of 'middle range theory' which connects the analytical data to the broader humanistic interpretation of archaeological issues of current interest. Hopefully the 21st century will see more widespread integration of scientific studies into archaeological research design and interpretation.

References

Budd, P., B. Chapman, C. Jackson, R. Janaway & B. Ottaway (eds.). 1991. *Archaeological Sciences 1989. Proceedings of a conference on the application of scientific techniques to archaeology, Bradford, September 1989.* Oxbow Monograph 9, Oxford.

Slater, E.A. & J.O. Tate (eds.). 1988. *Science and Archaeology, Glasgow 1987. Proceedings of a conference on the application of scientific techniques to archaeology, Glasgow, September, 1987.* BAR British Series 196. British Archaeological Reports, Oxford.

Space and Time Perspective in Northern St. Johns Archaeology, Florida. John M. Goggin, University Press of Florida: Gainesville, 1998. Southeastern Classics in Archaeology, Anthropology and History Series. xx + 147 pp., 9 figures, 12 plates, 2 appendices, bibliography, map. $29.95 (paper). ISBN 0-8130-1634-7.

Reviewed by Nancy J. Mactague, Aurora University, Aurora, IL 60506 USA

Considered by James J. Miller, chief of the Florida Division of Historical Resources Bureau of Archaeological Resources, to be one of "the three founding monographs of modern Florida archaeology," Goggin's 1952 publication, **Space and Time Perspective in Northern St. Johns Archaeology, Florida**, has been reprinted by the University Press of Florida as part of the Southeastern Classics Series. The series editor is Jerald T. Milanich, whose most recent works include *Florida Indi and the Invasion from Europe* and *Laboring in the Fie of the Lord: Spanish Missions and Southeastern Indic* In his Foreword to the 1998 edition of **Space and Ti Perspective** Milanich states that the purpose behind reprinting of Goggin's work is to make this "timeless treasu affordably available to today's students and scholars. With exception of a few additional pages of front matter, the 1 edition is a replica of the 1952 original.

This relatively short book contains only eighty page: text supplemented by two appendices, one listing sites ke to a map and the other listing artifacts. The book summari data gathered from four hundred thirty-two archaeological s spanning approximately two thousand years' of occupatio a variety of groups. It does suffer from two shortcomi common to early, fundamental research in archaeology. F it is descriptive and classificatory rather than interpret Second, its dating is relative. Reliable absolute dating was possible, as this book was written before the use of radiocar dating.

Its major strengths include its instrumentality in development of historical archaeology, and its high leve accuracy. Goggin's work was so accurate that only mi revisions have been found necessary over the course of past fifty years. Written before the term "Native Americ came to be politically correct, Goggin's book is "modern" in concern with the ecological impact of human occupation. as forward thinking was Goggin's inventing of underw archaeology as a method for learning about Florida's submer sites.

Goggin begins by defining the boundaries of the North St. Johns Region and introducing the reader to the human physical geography of the area under consideration. describes the topography, mineral resources, and the ma and terran plant and animal life. He explains the changes occurred over time in sea level and climate. He discus contact between the Native Americans and Europeans, star with the early 1500s and continuing through the beginnin British occupation circa 1750. He concludes his overview v the disappearance of the Timucua tribe and the appearanc the Seminoles. In providing the ethnological background, Go defines the terms he uses to name the tribes, locates th geographically and discusses their language and style pottery. He speculates on population size and briefly descr the social and religious hierarchy.

He begins his discussion of the archaeological histor the area with the year 1605 when mounds of oyster sh were discovered and studied. He continues by discussing eighteenth century, including 1765-1766, the period during wh the British paid more organized attention to shell mounds burial sites. He also includes the contributions made by promi Florida archaeologists of the nineteenth and twentieth centu and concludes with a summary of his own publications.

He explains the process of developing the chronolog the area and defining the eras during which different cult flourished. Goggin also explains how he combines the find of several researchers to develop his chronological seque Using material remains—primarily pottery—as the basis,