Microscopic Analysis in Archaeology

C. Stevenson and C. Prior, Guest Editors

The papers in this edition of the MRS BULLETIN were among those presented during a workshop entitled "SAS Interfaces '87: Microscopy for the Archaeologist." The workshop was sponsored by the Society for Archaeological Sciences at the 52nd annual meeting of the Society for American Archaeology held in Toronto, Ontario, May 1987. The Society for Archaeological Sciences is an interdisciplinary professional society for researchers involved in the broad spectrum of physical science applications to archaeology in order to promote interaction among scientists interested in different aspects of common research problems.

Archaeometry, i.e., "archaeological science," is concerned with the physical analysis of archaeological materials and the application of techniques from the laboratory sciences to the objectives and needs of archaeology. It includes such activities as compositional analysis, reconstruction of past technologies and processes, remote sensing, paleoenvironmental reconstruction, and of course, isotopic and other chronometric dating methods. Such techniques alone, however, yield results that mean little without appropriate application to anthropological problems. The chief concern of archaeologists is to choose the most appropriate analysis method to achieve results that are useful in interpreting cultural behavior. To that end, laboratory analysts need to be aware of the interests and concerns of archaeologists, and archaeologists need to be able to understand the technical advances in archaeometry to incorporate them into their research.

One of the principal aims of the Society for Archaeological Sciences is to sponsor interdisciplinary collaboration and cooperation in order to stimulate dialogue between field archaeologists and physical science specialists. In this spirit, the SAS holds its meetings and sponsors symposiums in conjunction with other professional societies to disseminate information on current research. "Microscopy for the Archaeologist" was just such a workshop—to demonstrate to archaeologists the various ways microscopic techniques and procedures have been applied to archaeological materials.

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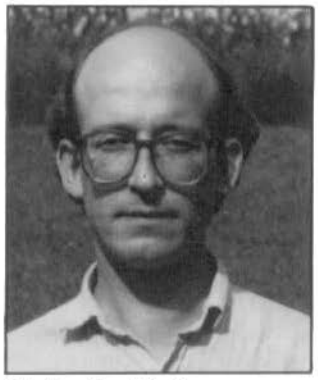
The articles in this issue were written for the nonspecialist in the same interdisciplinary spirit—to introduce materials analysts to the concerns of archaeologists and to show archaeologists what is analytically possible:

- T. Childs' article addresses some of the questions that can be resolved by the petrographic analysis of archaeological ceramics and presents results of the examination of ceramic materials recovered from Early Iron Age iron smelting sites from the Kagera region in northwestern Tanzania.
- M.L. Wayman reviews the problems of metal identification, geologic origin, manufacturing technology, and age in interpreting the microstructures of metal artifacts recovered from archaeological sites in the Canadian arctic region.
- S.C. Mulholland and G. Rapp discuss the problems associated with classifying silica cell phytoliths from grasses and explain how phytolith analysis can potentially help identify plants used by prehistoric peoples.
- The article by J.C. Russ and I. Rovner introduces the archaeologist to the potential applications of computer-based interactive image analysis to the surface characterization of artifacts.
- S.H. Berry and D.B. Bamforth discuss the application of microscopically observed microwear on prehistoric stone tools . . . in the form of edge damage, striations, and polishes . . . and assess the reliability of its use to make inferences concerning the function of the tools.

This set of articles also reflects the continued interest of the Materials Research Society in publishing the applications of materials analysis used in other disciplines. The recent publication of *Materials Issues in Art and Archaeology* (proceedings from the symposium at the 1988 MRS Spring Meeting, Reno) also demonstrates this interest and provides a representative sample of the range of materials analyses being used by archaeometrists.

The analytical approach presented in this newest issue of the MRS BULLETIN revolves around the use of microscopy to examine prehistoric cultural materials. In collecting these manuscripts, the intent was to demonstrate to the archaeologist the variety of applications available to study artifacts using this approach. At the same time we selected several articles that illustrate to the physical scientist how the archaeologist progresses from information on material items to understanding past human behavior. It is our opinion that the answers to many questions about why man evolved and developed complex forms of social organization will be, to a significant degree, assisted by the development and application of materials analyses to prehistoric cultural remains. □


Christopher M. Stevenson


Christine A. Prior

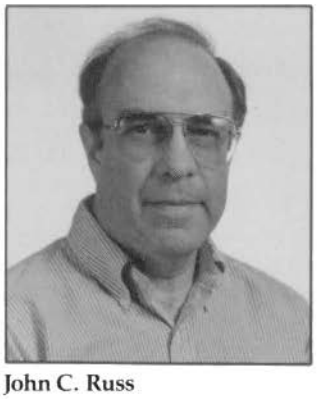

Sarah H. Berry


S. Terry Childs


Susan Mulholland


George Rapp, Jr.


Irwin Rovner


John C. Russ


Michael L. Wayman

Christopher M. Stevenson, Guest Editor for this issue of the *MRS BULLETIN,* directs the obsidian hydration dating laboratory at Archaeological and Historical Consultants, Inc., Centre Hall, Pennsylvania. His interests focus on the development and application of the obsidian hydration dating method and the documentation of societal evolution in prehistoric Polynesian societies.

Christine A. Prior, Guest Editor for this issue of the *MRS BULLETIN,* is a postdoctoral researcher in the Radiocarbon Dating Laboratory at the University of California at Irvine, Program in Social Ecology. She has conducted research in the dating and analysis of fossil bone using radiocarbon and other archaeometric methods. Her dissertation focused on the amino acid racemization dating of fossil bone, particularly as applied to the dating of the earliest human inhabitants of the Americas. She has been the associate general secretary for the Society for Archaeological Sciences since 1981.

Douglas B. Bamforth received his PhD from the University of California, Santa Barbara, in 1986, and is currently an assistant professor in the Anthropology Department at the University of Nebraska, Lincoln. His major technical interests are in the study of prehistoric stone tools, with a major focus on microwear analysis. He has worked on archaeological projects in Nevada, California, Texas, and West Germany; his current research focuses on early hunter-gatherer occupations of the Great Plains.

Sarah H. Berry is currently an archaeologist with the Directorate of Environmental Management for the 1st Strategic Aerospace Command at Vandenberg Air Force Base, California. Her research interests focus on the prehistory of the Chumash Indians.

S. Terry Childs is a postdoctoral fellow at the Center for Materials Research in Archaeology and Ethnology, Massachusetts Institute of Technology. She has investigated technological change, technological style, and the ritual and symbolism of technological processes through studies of both ceramics and metals. Some of her current research involves ethnographic and archaeological work on ancient iron and copper technologies in Zaire and metallography of the manufactured objects.

Susan Mulholland is associate director of the Archaeometry Laboratory and holds a senior scientist position on the Duluth campus of the University of Minnesota. Her research interests include application of phytolith analysis to archaeology, focusing on the classification, description, and distribution of phytoliths in grass species. Her PhD dissertation is based on detailed morphological analysis of phytoliths in grasses of central North Dakota.

George Rapp, Jr. is director of the Archaeometry Laboratory, professor of geology and archaeology (Duluth campus), and professor of ancient studies (Minneapolis cam-

pus) of the University of Minnesota. When he steps down as dean of the College of Science and Engineering (Duluth campus) on June 30, he will be half-time professor of geology and archaeology, quarter-time director of the Archaeometry Laboratory, and quarter-time professor of ancient studies. His research interests and publications apply natural science to the solution of archaeological and environ- mental problems. He has begun to devote a major portion of his research to the systematic study of phytoliths in grass species.

Irwin Rovner is an associate professor of anthropology in the Department of Sociology, North Carolina State University, specializing in archaeobotany and plant microfossil studies. He pioneered methods of plant silicophytolith microfossil analysis in the archaeological ecology of North America prehistory which are applied worldwide in geoarchaeological research.

John C. Russ is a research associate in the Department of Materials Science and Engineering, North Carolina State University. He specializes in stereological analysis of materials microstructure and is internationally recognized for development of image analysis software and stereological algorithmns for use with expert vision systems.

Michael L. Wayman is a professor of metallurgy at the University of Alberta in Canada. A physical metallurgist, his research interests focus on the relationship between the microstructures and properties of metals and alloys. In recent years much of his research has been spent on ancient metallurgy. He has been involved with projects on various aspects of prehistoric metal use in North America, including the use of native copper and various iron-based materials in the Arctic and in pre-contact central North America. He is also active in studies of ancient smelting technologies, including bronze-making in Iron Age Europe and early African iron smelting. □

MATERIALS ISSUES IN ART AND ARCHAEOLOGY

Materials Issues in Art and Archaeology is a collaboration among materials and conservation scientists, archaeometrists, and other professionals interested in the deterioration and preservation of ancient materials. It features 39 articles on topics ranging from geochemical characterization of 2,500-year-old marble sculpture to the soldering of gold in the 4th millennium B.C., and contains the proceedings of a symposium organized by the Materials Research Society in April 1988. Scholars from the Smithsonian Institution, Los Angeles County Museum of Art, British Museum, Oxford and Harvard Universities, and many other leading research organizations contributed to the book. The reader, as a result, gets a clear picture of how methods and analytical techniques of materials science have contributed to major advances in art history, archaeology, and conservation.

Editors: Edward V. Sayre (Smithsonian Institution); **Pamela Vandiver** (Smithsonian Institution); **James Druzik** (Getty Conservation Institute); and **Christopher Stevenson** (Archaeological and Historical Consultants, Inc.)

Part I: Structural and Compositional Analyses
Structure of works of art and historic artifacts; radiographic imaging technologies; archaeological ceramics; gamma spectroscopy; geochemical characterization of ancient marble sculpture; lead isotope analysis; FTIR microspectrometry; PIXE spectrometry; etc.

Part II: Ancient Materials Technology
Technology of silicates; ceramic technology/social evolution in Iran; Roman ceramic styles and techniques; Maya blue pigment; archaeothermometry; gem materials; technology of ancient metals; soldering of gold in antiquity; bronze age cauldrons; materials analysis of museum collections; etc.

Part III: Processes of Deterioration and Conservation
Glasses—natural, ancient, and modern replicas; obsidian hydration; glass hydration and corrosion; relative dating experiments; evaluation of processes in art and architecture; fading of pigments; salinization of ancient Egyptian temples; physicochemistry of Nefertari's tomb; protective coatings for stained glass; cellulose degradation studies; etc.

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