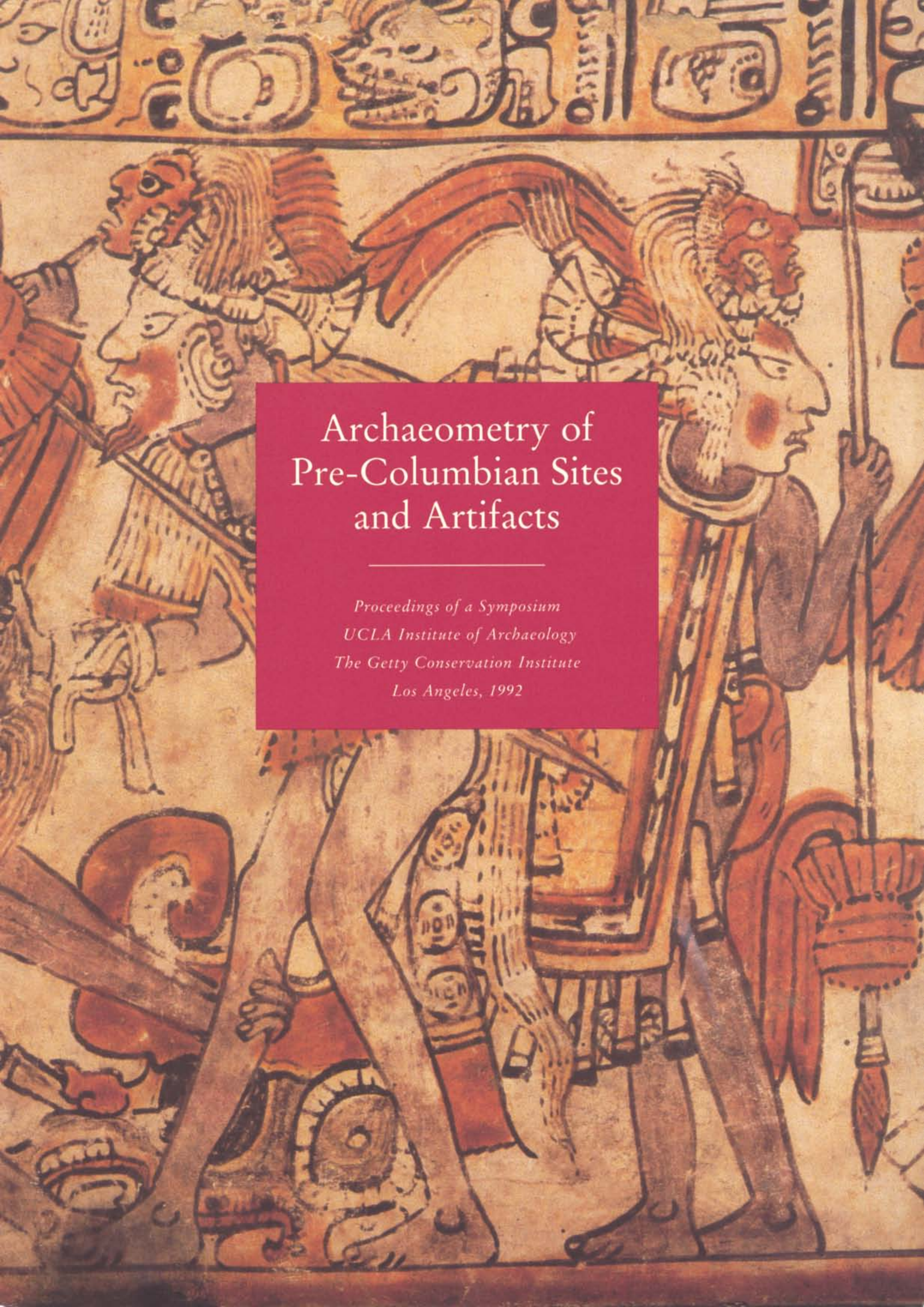

Archaeometry of Pre-Columbian Sites and Artifacts

Proceedings of a Symposium
UCLA Institute of Archaeology
The Getty Conservation Institute
Los Angeles, 1992

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Proceedings of a Symposium organized by the UCLA Institute of Archaeology and the Getty Conservation Institute
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March 23–27, 1992

David A. Scott and Pieter Meyers, editors

The Getty Conservation Institute

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Foreword

As part of its mission to preserve cultural heritage throughout the world, the Getty Conservation Institute maintains an ongoing interest in the preservation of archaeological objects and sites. The Institute was pleased, therefore, to help sponsor the 28th International Archaeometry Symposium, hosted in March 1992 by the University of California at Los Angeles, Fowler Museum of Cultural History and jointly sponsored by the UCLA Institute of Archaeology.

As part of the quincentennial celebration marking the arrival of Christopher Columbus in the Americas, the Getty Conservation Institute supported a session specifically devoted to Pre-Columbian materials, culture, and sites. The symposium's organizers, Timothy Earl, director of the Institute of Archaeology, UCLA; Pieter Meyers, head of Conservation at the Los Angeles County Museum of Art; and David A. Scott, head of Museum Services at the Getty Conservation Institute, brought together a wide array of interesting and seminal speakers on this theme. The twenty articles in this volume, selected from the wide range of topics covered at the conference, reflect the organizers' success in providing an overview of current research in the scientific examination of the material culture of ancient South and North America.

We hope the varied approaches to the study of Pre-Columbian materials presented here will stimulate interest in archaeometry worldwide and will call attention to the need for further study in this important and exciting field.

Miguel Angel Corzo
Director
Getty Conservation Institute

Preface

Simply defined, archaeometry is the application of scientific techniques of investigation and analysis to archaeology. Along with developing new methods of archaeological prospecting and dating techniques, the principal aim of this discipline is the investigation of the technology, composition, and structure of ancient materials—research that is of fundamental concern to conservation science.

In recent years a major increase of interest in archaeometry has taken place among the scientific community. The journal *Archaeometry* was originally started as an outlet for the work of the Research Laboratory for Art and Archaeology, University of Oxford, in the 1960s. Since that time, the growing interest in archaeometry has provided important information to assist curators, conservators, field archaeologists, and art historians. The titles of various conferences and journals indicate the field's related, interdisciplinary concerns; these include: *Materials Issues in Art and Archaeology, Archaeological Science,* and *Archaeological Chemistry.*

The International Archaeometry Symposium, a meeting that has been held in most continents of the world for three decades, continues to excite the interest of scholars and scientists involved in various aspects of the study of ancient materials. In March 1992, the 28th International Archaeometry Symposium was held at the University of California at Los Angeles, Fowler Museum of Cultural History. The conference was jointly sponsored by the UCLA Institute of Archaeology, and the Getty Conservation Institute, which organized a special session on Pre-Columbian materials. The organizing committee sought out speakers to ensure that a broad range of topics dealing with Pre-Columbian archaeometry would be presented. In addition, some of the scientists at the conference who presented poster sessions focusing on work in the Americas were also invited to present their research in the form of an article for this volume.

The opportunity to survey a number of different investigations linked by their concern for Pre-Columbian materials in one volume is comparatively rare. The twenty articles in this volume fall into five principal areas of examination: anthropology and materials science, ceramics, stone and obsidian, metals, and archaeological sites and dating. The contributions include a detailed study of pottery from the Maya region by Ronald Bishop; several studies of obsidian, geologically restricted material whose source can sometimes be determined by analytical techniques; and Ellen Howe's examination of the use of silver and lead from the Mantaro Valley in Peru. Izumi Shimada offers an extensive discussion of the important Sican site at Batán Grande in Peru, and John Merkel provides further information on the production of copper at this important smelting complex. Heather Lechtman's provocative analysis of the cultural aspects of materials science offers many examples from ancient Peru of the metals technology in the Pre-Hispanic period.

Luis Barba's study of archaeological sites in Mexico using surface methodologies offers an innovative, low-cost solution to the problems of recording and investigating archaeological remains without the necessity of undertaking excavations. Given the extraordinary diversity and number of archaeological sites in Mexico, this information is of significant practical value. Problems related to the conservation of archaeological information are also brought to light by Noreen Tuross, who discusses the preservation of molecular structure in partially fossilized or degraded material. Conservators would normally choose to consolidate such material with a synthetic resin to stabilize it or strengthen it sufficiently to allow it to be stored or lifted from the site. The fact that this conservation procedure may damage the preservation of DNA or other organic components is emphasized here.

This volume, with its range of topics and approaches to the study of Pre-Columbian materials, is presented in the hopes that it will provide a most interesting and educational experience and inspire further investigations that involve both archaeometry and conservation.

In addition to thanking my colleagues, Timothy Earl and Pieter Meyers, for their cooperation and expertise in helping to organize the conference, I would also like to acknowlege the invaluable work provided by the reviewers who gave of their time to evaluate the manuscripts submitted for publication: Warwick Bray, Department of Pre-History, Institute of Archaeology, University College London; S. Terry Childs, Center for African Studies, University of Florida; Thomas H. Day, Department of Pre-History, Research School of Pacific Studies, The Australian National University, Canberra; Christopher B. Donnan, director, Fowler Museum of Cultural History, University of California, Los Angeles; R.P. Evershed, Department of Biochemistry, University of Liverpool, England; Stuart Fleming, scientific director, MASCA, University Museum of Philadelphia; David C. Grove, Department of Anthropology, University of Illinois; Ellen Howe, Department of Objects Conservation, Metropolitan Museum of Art, New York; P. J. Julig, Geophysics Division, Department of Physics, University of Toronto, Canada; Heather Lechtman, director, Center for Materials Research in Archaeology and Ethnology, Massachusetts Institute of Technology; John Merkel, Department of Conservation, Institute of Archaeology, University College London; Andrew Oddy, Keeper of Conservation, British Museum, London; Jack M. Ogden, Independent Art Research, Cambridge, England; Stavros Papamarinopoulos, Athens, Greece; Gerwulf Schneider, Arbeitsgruppe Archaometrie, Institut fur Anorganische und Analytische Chemie, Freie Universitat Berlin, Germany; M. Steven Shackley, P.A. Hearst Museum of Anthropology, University of California, Berkeley; P. R. Smith, Department of Chemistry and Biological Chemistry, University of Essex, Colchester, England; Ken Thomas, Department of Environment, Institute of Archaeology, University College London; Mike Tite, director, Research Laboratory for Archaeology and the History of Art, Oxford, England; M. T. Wilson, Department of Chemistry and Biological Chemistry, University of Essex,

Colchester, England; and Lambertus van Zeist, director, Conservation Analytical Laboratory, Smithsonian Institution, Washington, D.C.

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David A. Scott

Anthropology and Materials Science

The Materials Science of Material Culture: Examples from the Andean Past

Heather Lechtman

In 1992 we commemorated the first confrontation between the peoples of Europe and the peoples of the Americas. I do not believe that in the Americas the commemoration was a celebration anywhere. Native Americans were not celebrating. The peoples of Latin America surely were not celebrating. Perhaps it is only in the universities, among anthropologists and humanists generally, that there is a quality of celebration—not for the historical event, but in the exhilaration that comes when we think we catch a glimpse of how people today or in the past confront the world and manage it. It is a celebration of the human condition as a social and quintessentially cultural condition. The year 1992 focused attention on how American peoples made worlds that worked for them. It focused, too, on how those worlds were destroyed by the European invasions and their aftermaths. As John Murra, the renowned ethnohistorian of Andean society, has said, the question for the Andean world must be: Why were we once so rich, and now we are so poor (pers. comm. 1980)? What did it take for Tawantinsuyu, the vast Inka empire, to stand as a first world state in 1532; what was lost in its passage to third world status? The richness that we celebrate as anthropologists, historians, and scientists is the many ways people have devised to know the world and to live in it. It is, ultimately, the richness of culture.

If culture is what we are after, how do we find it on a prehistoric landscape, the landscape that furnishes archaeologists with their primary data, a landscape barren of people? Albert Spaulding, in his 1987 Distinguished Lecture to the American Anthropological Association, gave us his appreciation of archaeology. Archaeology, he said, is prehistoric ethnography (Spaulding 1988). As ethnography, archaeology must attend to the fundamental concept that underlies all anthropological inquiry: the concept of culture, that set of learned expectations and understandings shared by human groups that makes intelligible the world they live in. Spaulding further insisted that archaeological theory and interpretation should match in complexity the complexity of human behavior; in other words, that archaeology should attend to the reconstruction of past mental activity as well as past physical activity—that we should not shy away from such an effort. How do we accomplish this challenge, when the prehistoric field which archaeologists confront to glean understanding of culture are environments that preserve only the physical artifacts of past human production, that part of social life we have come to call material culture, including items some scholars would call art?

I use the term *material culture* as it has generally come to be understood: first, as the inventory of artifacts produced and used by a society, and second, as connoting the physical manifestations of culture. For Henry Glassie, "Material culture embraces those segments of human learning which provide a person with plans, methods, and reasons for producing things that can be seen and touched" (1968:2). It entails cultural statements, physically embodied. Material culture is not merely a reflection of human behavior, it is an aspect of human behavior (Rathje 1977:37). Through the study of artifacts, present and past, we attempt to appreciate the belief systems of the communities that produced those artifacts. Some archaeologists—and I am among them—feel that it is within our reach to grasp the symbolic significance of the material remains of prehistory. That is, a major concern of material culture studies of prehistory must be not only with how peoples of the past actively constructed and represented the social world, but also with the symbolic relations between past artifacts and past peoples—how the artifacts signified for the people who used them (Miller and Tilley 1984:4–5).

In asking prehistoric ethnography to examine culture, it seems that we press archaeology to its methodological limits. But that is in large part because our attention to material culture has focused almost exclusively on the artifact and how it was used. Rarely have we considered the artifact as the end product of a series of technological activities, placing at the focus of our attention the technological behavior itself, not merely the end product of such behavior. Anthropologists, art historians, and most archaeologists have sought to understand items of material culture primarily as they function in society, investigating their use, their meaning, their sacredness, their power, their transfer or exchange. A few also appreciate artifacts, regardless of their size or setting, as the realization of production sequences, of technological performance (Hosler 1986, 1988a, n.d.; Lemonnier 1986). If we consider preindustrial production, for example, each object represents the culmination of a series of technical procedures in which materials of nature are transformed into items of culture. What many years of laboratory research have demonstrated is that such technological behavior—the rendering of the object—is in itself cultural, involving judgments, values, attitudes, skills, knowledge, and choices that inform the rendering intimately. It is not only that people make things through technology, but that they do so in culturally determined ways that markedly govern the outcome, whether that be a work of art or a fishhook.

The splitting of technological performance, or process, and its product into two separate analytical categories is unfortunate because the two cannot and should not be meaningfully divorced. Both the study of the technology of production of material culture and the study of the technological styles that characterize technologies of production attend to behavior, and it is in the domain of behavior that culture resides (Lechtman 1991). Furthermore, archaeology's methodological limits are considerably enhanced once technology shares center stage with the products of technology. We add to the anthropological tool kit the perspectives and the analytical repertoire of materials science and materials engineering. Our ability as archaeologists to reconstruct prehistoric technological sequences depends upon our ability as materials scientists and engineers (Hosler 1986, 1988b, n.d.).

Each artifact we excavate is not only the product of a series of technological actions, but also the source of precise information about the history of its own manufacture. The stages in the physical processing of any object are identifiable through laboratory investigations that have developed within the fields of materials science and materials engineering. Our ability to reconstruct such processing is based upon the characteristic of materials to record in their microstructures the history of the formation of those structures; that is to say, the history of their rendering. Thus, as I have argued for a long time, what we can and do excavate in archaeology are technologies (Lechtman 1977), the technical events that went into the manufacture of items irrespective of the social arenas in which they were used.

What is it, exactly, that we derive from a materials analytical investigation of artifacts, in particular of artifacts from prehistory? Fundamentally, as Hosler has shown, we learn about human decisions, the exercise of choice (Hosler 1986, n.d.). Each material presents to the artisan or to the engineer a spectrum of invariant properties, grounded in the physics of matter, which influence the way in which the material can be managed. Some properties constrain the material for certain uses; others are particularly suitable and exhibit a wide range of tolerance for development. What makes materials responsive to culture is the constancy of their physicochemical properties (Hosler 1986, n.d.; Smith 1975). The systematic laboratory investigation of artifacts to determine how groups of people have managed the properties of specific materials in the production of material culture has led some of us to suggest that technologies are themselves stylistic—that technological activities are culturally patterned systems of behavior that exhibit style (Lechtman 1977). The essence of technological style lies not only in the recognition of pattern in the technical events, but also in the recognition of the cultural pattern or patterns of which the style is an expression. Although we can in many instances determine the technological styles that underlay the production of particular sets of artifacts, as archaeologists it is far more difficult to argue from there to the cultural choices, values, attitudes, and ideologies that informed the technological behavior. Nevertheless, the task for us is to continue to examine and to describe the culture of technologies, because our goal is not to write a history of technology; it is to explore the anthropology of technology. And, for the archaeologist, that exploration happens to occur on a prehistoric landscape.

Let me offer, as an example of this materials-based approach, the results of some of my own work on Andean metallurgy and its products during the Pre-Columbian era. Unlike Old World metal technologies, which emphasized the mechanical properties of metals, Andean metallurgies focused elsewhere. Color was the single property of metal, whose achievement and manipulation stimulated the most innovative and sophisticated developments of the technology. In Europe and the Near East the manufacture of bronze and iron tools of war, agricultural tools, and wheeled conveyances provided avenues of utility enabling the metallurgical revolutions of the Bronze and Iron ages. In the Andes, the locus of attention of the metallurgy is not to be found in the realm of utility but in the realm of the symbolic. Metals carried and displayed the content or message of status, wealth, and political power and reinforced the affective power of religious objects. Thus Andean metallurgy received its greatest stimulus in the arena dominated by status and political display, and the objects that carried such normative power lay squarely within the aesthetic locus of Andean societies—objects such as elaborate ear spools and nose ornaments, pectorals, death masks, religious cult paraphernalia, architectural furnishings, and so forth. An underlying cultural value system that strongly influenced the visual manifestation of status and power was a color symbolism oriented about the colors of silver and gold. The thrust of Andean metallurgy lay in the development of metals, alloys, and fabrication procedures that would realize those properties essential to the proper cultural performance of metal objects. The property that metalworkers sought to control above all others was color, most specifically the colors silver and gold (Lechtman 1984a).

Once color becomes the focus of property development, we are dealing with the metallurgy of surfaces, because the color of a metal object resides at its surface (Lechtman 1984b). It may exhibit another color underneath. Almost all other metallurgical traditions achieved color change on metal objects by covering one metal with another, as in the gilding of copper through the direct application of gold leaf or a gold-mercury amalgam to its surface. The Andean tradition emphasized an entirely different approach. Artisans fashioned objects from copper-based alloys that contained in their structure the metal whose color was to appear at the surface of the piece. Objects that were to look silver in color were made of copper-silver alloys; those to appear golden were fashioned from *tumbaga*, the alloy of copper and gold. Whichever the desired color, the metal responsible for that color, as it would ultimately appear at the surface, had to be inside the object; it had to be a constituent of the alloy itself. The alloy was almost invariably an alloy of copper. In manufacturing such objects, smiths used chemical means involving naturally occurring corrosive minerals to remove from the surfaces of the objects those constituents of the alloy—such as copper or silver—that were unwanted there, leaving the desired metal in situ. Such procedures for producing a colored metal surface on a metal substrate have been termed *depletion systems.* They deplete the surface of the undesired metal, thereby enriching it in what will become the carrier of color (Lechtman 1988). The contrast between the Andean approach and those of most other metallurgies is striking. Systems that achieve color change by covering one metal with another hide what is underneath. Depletion systems transform surfaces by selectively developing at the surface certain properties of the material that lies beneath. Other systems cover and hide. Andean systems develop and enhance.

By the time of the Spanish invasion of Mexico, Central America, and South America in the sixteenth century, Andean alloys and their enrichment properties were in common use throughout the New World, having swept north from the Andes, where they had maintained their importance for almost two millennia. They