A Pyrotechnological Art

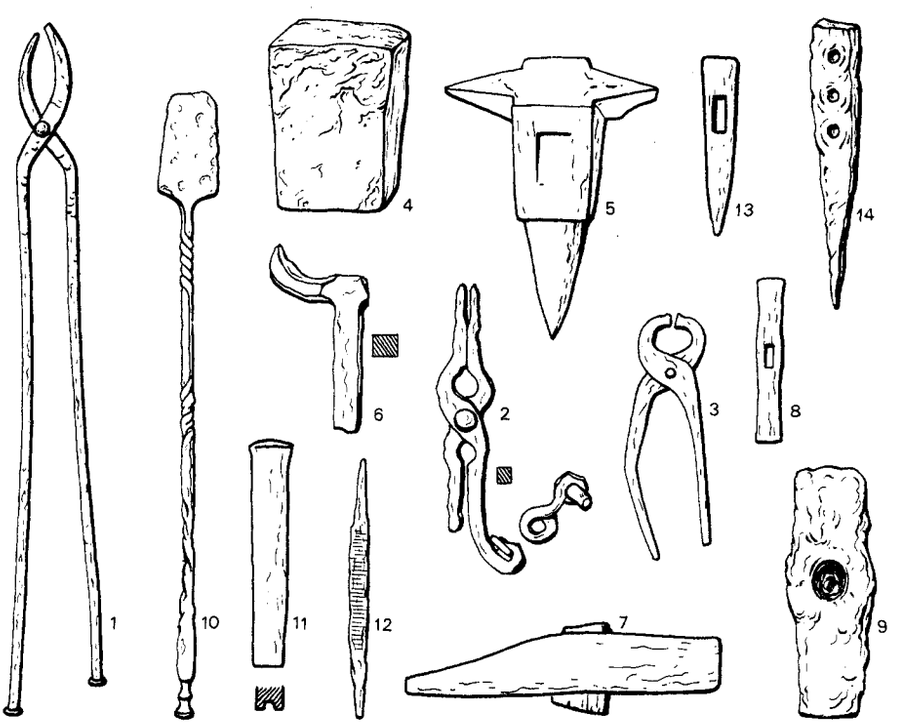
The Coming of the Age of Iron. THEODORE A. WERTIME and JAMES D. MUHLY, Eds. Yale University Press, New Haven, Conn., 1980. xx, 556 pp., illus. $22.50.

This collection of papers deals with the technological, and many of the social, implications of the discovery, production, and use of iron from earliest times until the full development of iron technology in Europe, Asia, and Africa. Such great scope required the authors to deal with certain technological accomplishments (especially in metallurgy) and the social setting of a variety of cultural periods earlier than the Iron Ages in various parts of the world. Even the pre-Columbian New World receives attention, although iron technology there was introduced only by Europeans arriving in the 15th and 16th centuries after Christ.

A major theme that runs throughout the book is the relationship of technology to society—indeed, to individual humans. As Heather Lechtman puts it (p. 269), "Metallurgy is as much a cultural phenomenon as it is a series of physical and chemical phenomena." Denise Schmandt-Besserat, in a cautious yet fascinating essay, evokes the theme for the earliest times in her account of the use of iron ores for pigments, beginning as early as about 300,000 years ago at Terra Amata, near Nice, France, where pieces of ocher were found in Abbevillian-Acheulean context. Although the pigments must have been used for artistic, magical, or religious purposes, including cosmetics, it was not until Aurignacian times (29,000 to 22,000 B.C.) that there is direct evidence for function in the form of painting on stone slabs and bone fragments. Schmandt-Besserat also makes the intriguing suggestion that the groundstone industry may have arisen first not in sedentary farming communities for the preparation of food but in the early Upper Paleolithic for the preparation of pigments for cosmetics, whatever might have been the symbolism involved in their use. The magical or religious associations of metals and metallic ores, and their colors, are touched upon by several authors in the volume, including Schmandt-Besserat with regard to Paleolithic cave art, Lechtman on the Chavin religion and the spread of metallurgy in the north and central Andes, and Joseph Needham on literary traditions of metallurgical innovation in the Far East.

Iron technology, as the authors demonstrate in a variety of ways, could not merely have developed from the manufacture of copper and bronze artifacts, because the concepts and techniques are quite different. Even though an occasional bloom of iron resulted from the use of iron ores as fluxing material in the smelting of copper, the complex processes of carburization of iron, of tempering, of quenching, of laminating iron layers for sharpness, and in general of the development of steel were not hinted at by bronze metallurgy. Because the technology simply was not transferable, Tamara S. Wheeler and Robert Maddin argue, the discovery of iron technology must have been made by a smith working at a forge. That is, since the chemistry of the effect of the addition of carbon to iron in certain proportions was not understood until the late 18th century after Christ, only direct experience in the manufacture of iron tools (deliberate experimentation, according to Wheeler and Maddin) could lead to the production of steel and to the widespread use of carburized iron. James A. Charles also stresses the importance of the smith to early societies.

James D. Muhly, in one of the most thought-provoking essays in the volume, offers persuasive arguments for viewing the "extraordinary development of metallurgy" during the third millennium B.C. in southwest Asia and the Mediterranean "as a response to developments within the area of Greater Mesopotamia" (p. 27), especially such major cultural phenomena as the invention of writing and the emergence of urban society. Muhly makes effective use of a number of written records of the second millennium B.C. to help outline the metallurgical developments in Eurasia that set the stage for the introduction of iron technology, including a helpful summary of what is at present known about the source of tin used to make bronze following the earlier manufacture of arsenical bronze. His clear presentation of the problems involved in sourcing metals



Late La Tène (first century B.C.) metalworking implements. *1–3*, Tongs, from St. Georgen, Austria; Manching, Germany; and Llyn Cerrig Bach, Anglesey. *4–6*, Anvils, from Plavecké Podhradie, Slovakia; Szalacska, Hungary; and Manching. *7–9*, Hammers, from Stradonice, Bohemia; St. Georgen; and Sanzeno, North Italy. *10*, Hearth spoon, from Manching. *11*, Rivet snap, from Stradonice. *12*, File, from Manching. *13*, Drift, from Stradonice. *14*, Nail iron, from Staré Hradisko, Moravia. Drawn to different scales. [From R. Pleiner's paper in *The Coming of the Age of Iron*, after various authors]

(which may have been repeatedly remelted in association with metals from a variety of sources), helps the reader to understand why the earliest and principal sources of tin are still a matter of debate, although it is known that tin from Cornwall was available to the Aegean world by the 16th century B.C.

Muhly, as do other commentators, accepts Anthony M. Snodgrass's argument that in the 12th and 11th centuries B.C. political and economic factors combined to provide the incentive for the discovery and spread of iron technology in the Mediterranean. That is, the disruption of the long-distance trade in copper and tin, which was brought about by the collapse of the Mycenaean civilization and the general unrest in the Mediterranean world and which led to a critical shortage of bronze, provided the incentive to metalworkers to find a substitute for bronze. Iron, familiar as a by-product of bronze metallurgy and already used for more than a millennium for jewelry and ceremonial purposes, was available as an almost ubiquitous raw material.

Another theme that may be detected in the book is the variability of human invention seen in the different paths of metallurgical evolution. The essays in this collection demonstrate conclusively that metallurgical developments occurred in quite different stages in different parts of the world, and at different times. Several of the authors stress the importance of studying first the technological and cultural evolution of individual regions, rather than following simple models of universal evolution. Dennis Heskel and Carl Clifford Lamberg-Karlovsky, for example, offer Tepe Yahya, Iran, as a case study in refutation of such theories, including Colin Renfrew's evolutionary scheme of copper-to-bronze manufacture. Lechtman's essay on the Andes in pre-Columbian times, where iron technology was not developed at all, provides a more dramatic example of the importance of the regional approach.

Technical aspects of metallurgy constitute part of all papers, and are the principal component in some of them. One essay in the latter group is a lucid, concise discussion by Ronald F. Tylecote of metallurgical furnaces and processes. Neither Tylecote nor any of the other authors makes much, if any, allowance for a possible lack of technical knowledge among the readers; there is not even a technical glossary. Some archeologists, therefore, are likely to find parts of the book difficult reading. But the volume admirably repays the reader for any such difficulty with valuable, perceptive discussions and commentaries on some of the most significant technological and cultural changes of the human past.

The essays were written in honor of the distinguished scholar Cyril Stanley Smith, and they constitute, as their authors hoped, "a fitting tribute to a most uncommon man named Smith." The book belongs in every archeological and metallurgical library.

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Structuralist Ethnography

The Flow of Life. Essays on Eastern Indonesia. JAMES L. FOX, Ed. Harvard University Press, Cambridge, Mass., 1980. xii, 372 pp., illus. $30. Harvard Studies in Cultural Anthropology, 2.

The Flow of Life derives its inspiration from a pioneering study in comparative structuralism by the Dutch anthropologist F. A. E. van Wouden. Van Wouden's 1935 study of systems of marriage exchange and symbolic classification in Eastern Indonesia foreshadowed the structuralism of Claude Lévi-Strauss and others, notably Rodney Needham of Oxford. *The Flow of Life* collects essays by 15 anthropologists—English, American, Dutch, French, Australian, and Indonesian—who have done field research in Eastern Indonesia and bring this work to bear on the argument of van Wouden. In a fashion typical of much of the best social anthropology, they do not so much "test hypotheses" as explicate ordering principles, exploring their power and implication with reference to the ethnographic data. In this way, as P. E. de Josselin de Jong puts it, quoting Rivers, one illuminates "abstract problems by means of concrete facts."

The essays are divided into two sections, framed by the editor's introduction and conclusion. The first section treats social organization, the second symbolic structure—the two levels that van Wouden and, indeed, much of anthropological structuralism struggle to connect.

The first section is introduced by an essay by Needham, whose own fieldwork on the island of Sumba carried forward van Wouden's initial work and then stimulated some of the more recent researches on other islands of the region that constitute the bulk of the volume. Needham endeavors to lay bare the fundamental principles that account for variation in Sumbanese society: identity, duality, inequality, asymmetry, and complementarity. The result is a lucid and impressive comparative analysis that, while meticulously attending to the ethnographic variety, succeeds in revealing a suggestive order beneath that variety. Each subsequent essay focuses on findings from its author's recent fieldwork—on Flores, Roti, Timor, Seram, among the Kedang—that bear on principles like those elucidated by Needham, van Wouden, Lévi-Strauss, and other structuralists; topics include marriage alliance, state structure, moieties, and descent.

The volume's title derives from a phrase which Clamagirand describes for the Ema as "the flow of life which circu-

Dancing at a communal feast held by the Ema of Timor after the first harvest of dry rice. [From B. Clamagirand's paper in *The Flow of Life*]