Archaeology and Chemistry

by: Phyllis Young Forsyth

The close relationship now being fostered between archaeology and the sciences has resulted in a rapidly improving understanding of ancient societies. No longer working in isolation, archaeologists can turn to scientists for help in unravelling some of the long-standing puzzles of antiquity, and the co-operation between archaeologists and chemists has been especially productive in this regard. Indeed, a recent issue of Chemical and Engineering News (February 21, 1983) featured a special report on "Archaeological Chemistry" that makes clear how much is now being accomplished.

Not surprisingly, recent developments in dating techniques tend to receive a great deal of attention in the media; we are used to such terms as "radiocarbon dating" and "Thermoluminescence" (both examined in earlier issues of Labyrinth), and soon "amino acid dating" and "obsidian hydration dating" will become better known to the archaeology buff. The Chemical and Engineering News report deals clearly and concisely with these dating methods, but also includes other, less flamboyant examples of the union of archaeology and chemistry, one of which deserves some examination here; I refer to ancient metals and metallurgy, and what chemical analysis is now telling us about them.

One of the more intriguing problems of ancient history concerns the transition from the Bronze Age to the Iron Age. Simply put, why was it that, roughly around 1200 B.C., the Eastern Mediterranean world turned from implements of bronze to implements of iron? Some suggestions have recently been proposed by Robert Maddin, a professor of metallurgy at the University of Pennsylvania. Maddin, like others, realized that iron had no real advantage over bronze: not only is iron not as hard as bronze (an alloy of copper and tin), but it also corrodes and requires laborious forging. In its favor, however, was the fact that iron ore was more abundant than either copper or tin.

Perhaps, then, some event, man-made or natural, stopped the necessary tin from reaching the Eastern Mediterranean around 1200 B.C. We know that this period was in general a time of unrest and relatively widespread destruction, so an interruption in trade patterns would not be unexpected. Thus, with no tin coming in with which to make bronze, metalworkers would be forced to apply their talents to iron.

While Maddin admits this scenario is possible, he and his colleagues have now put forward a different theory: "We suggest the Iron Age occurred perhaps because people learned to harden iron, rather than [because of] any shortage of tin." This theory is based upon ancient metalworking techniques: forges were fuelled by charcoal, and as the smith worked his iron, carbon would have slowly diffused into the iron, and an alloy of iron and carbon is steel. Thus Maddin suspects that carbon steel was created by the ancient metalworkers, who simply allowed their iron to stay in the furnace longer, absorbing more and more carbon. They might not have understood the chemistry involved, but they would realize that the longer an implement stayed in the furnace, the harder it became.

To investigate this theory, Maddin is presently studying ancient iron artifacts in order to determine their carbon content. At the same time, he is also investigating another technique that might have been used in antiquity to harden iron: quenching, that is, the plunging of steeled iron into cold water. This practice is, indeed, mentioned in Homer's Odyssey, so there is good reason to believe it was a common practice by the 8th century B.C. So, Maddin has at least two clues at hand in his search for a greater understanding of iron in this early period of history. It is to be hoped that his current analyses of ancient iron artifacts will produce conclusive answers to this very old problem in the near future.