INTRODUCTION

From the perspective of today's materials scientists, the most obvious reason why a prehistoric society should adopt iron as its main resource for the production of tools and weapons would be iron's potential mechanical superiority over bronze. The ability to make steel by adding carbon to iron—and to increase the hardness of the alloy by quenching—would make iron superior to copper-base alloys for tools and weapons.

It cannot be assumed, however, that prehistoric metalworkers would have immediately recognized the potential advantages of iron. For example, societal factors, such as a metals industry unable to satisfy demand or an economy lacking access to a principal resource, could drive a community to develop an alternative ore because of accessibility or general availability. Such need-driven selection would not require the metalworkers to comprehend fully the metal's advantages or disadvantages.

This article considers the probable causes for the bronze-to-iron transition in central southern Britain. The investigation employs three potential scenarios formulated as questions (i.e., was the bronze-to-iron transition mechanical-property driven, resource availability driven, or societal driven?). The evidence of the metalworking tradition was deduced from the metallurgical examination of 503 iron samples from 23 sites (Figure 1). The periods under discussion are shown in Table I.

HISTORICAL BACKGROUND

The Iron Age of Britain is generally considered a period of instability and social unrest. Cross-channel contact between Britain and Europe was disrupted during the 7th century B.C. due to a realignment of trade patterns beyond Britain's control. More to the point, the city-states of Greece began establishing ports in southern Europe during this period to obtain metals, grains, timber, slaves and other products. The lure of exotic Greek goods, such as wine and pottery, caused central and southern Europe to shift its trade away from northern Europe.

As a result, many regions in northern Europe, including Britain, were forced into relative isolation.

Evidence of unrest in Britain is visible from the increased use of fortifications on small settlements and larger hilltop sites starting in the 7th century B.C. The hilltop sites, known as "early hillforts," were initially built in large numbers during this period, but most were either abandoned or destroyed during the 5th century B.C. The hillforts that survived the 5th century were refortified and remained in existence until the 1st century B.C. when the Romans invaded the island.

Archaeologists have speculated that the restructuring of the British landholding system during the Iron Age was a result of the upheaval in the trade routes. The wealth and authority of the elite of Britain were engendered by the control of imports during the Late Bronze Age. The disappearance of the trade routes resulted in a disruption of Britain's social structure, and a new system was required for the display of authority. The restructuring of the land-holding system suggests that the control of land was the new method used. The increase of fortifications implies a period of increased marauding. By the 5th century B.C., the situation stabilized, and a number of sites, known as "developed hillforts," came into preeminence.

British Iron Age society was predominantly agrarian. Most inhabitants lived on small, enclosed settlements, raising cattle, sheep, pigs and a variety of cereals. Ironworking was introduced into Britain in the 7th century B.C., with the earliest artifacts recovered from southwestern Britain and the Thames valley of southeastern Britain. Iron smelting seems to have been initially performed in southwestern Britain, as illustrated by a cluster of early furnace forms (bowl furnaces) and the existence of Britain's earliest large iron production center (Trevelig) in Cornwall. Iron smelting was probably introduced into southwestern Britain from northwest France along cross-channel trade routes.

WAS THE TRANSITION MECHANICAL-PROPERTY DRIVEN?

The first potential scenario for the bronze-to-iron transition in prehistoric Britain is that iron was adopted because of its superior mechanical properties. However, previous research on the blacksmithing technology in this region has shown that iron technology was very primitive throughout the British Iron Age. For the most part, blacksmiths knew of no techniques, such as carburization or quenching, to alter the properties of their tools and weapons.

Of the 150 Iron Age tools examined that should have been made from steel (e.g., knives, sickles, chisels, etc.), only 51 had carbon concentrations in excess of 0.5%. Chisels appeared to have been the only tools that were consistently produced from steel (Figure 2). Ten of the 15 Iron Age chisels sampled had high carbon contents, and two chisels and a wedge revealed quenched grain struc-
tions in excess of 0.3%.

Figure 2. The carbon concentrations of 13 Iron Age tool types. High-carbon iron had concentrations in excess of 0.3%.

Still, the high proportion of carburized chisels and the three quenched artifacts suggest that a small proportion of the Iron Age blacksmithing community did know of the properties of steel and the technique of quenching. The grain structures of two of the three quenched blades consist of a piece of steel welded to lower-carbon iron (Figure 4). This is the most advantageous structure for a blade and demonstrates the intentional use of steel and quenching.

Although one might initially conclude that the limited use of advanced heat treatments resulted from a hierarchy within the blacksmithing community, the archaeological evidence does not support this hypothesis for two reasons. First, quenched prestige items, such as swords, have not been found. If an elite class of blacksmiths was in existence during the period and making prestige products, they would have used advanced heat treatments. The fact is, however, the grain structures of prestige artifacts are basically similar to those of the other period tools, suggesting that advanced processing techniques were not known by a blacksmithing elite. Second, of the three quenched artifacts discovered, two were found on the hillfort of Danebury and one was recovered with other black-smithing debris from the small settlement Worthy Down. Again, if elite blacksmiths did exist, they would probably have lived and worked on developed hillforts rather than smaller settlements.

Based on the above observations, the blacksmithing community of Iron Age Britain probably consisted of a wide diversity of families, each having its personal secrets for the production of tools and weapons. This model is similar to that described by Biringuccio in the 16th century A.D.: "When, finally, I consider what this act (blacksmithing) is, it seems to me that everything in all kind depends only on experience, since these craftsmen are people without plan, and most of them are crude country people, and if they know how to do one thing they do not know how to do another."

Based on the metallurgical evidence, the bronze-to-iron transition in Britain was not a result of iron’s mechanical superiority. Therefore, societal factors must have caused British prehistoric society to abandon a centuries-proven material and adopt a new metal that still required extensive development.

**WAS THE TRANSITION RESOURCE-AVAILABILITY DRIVEN?**

The second potential scenario for the transition is that bronze was abandoned due to a lack of availability of its constituents, and that iron was adopted because of the greater abundance of ore sources. Supposedly, the demand for metal eventually rose beyond the quantity that Bronze Age society could produce due to the limited availability of copper and tin. However, this scenario does not fully account for either the large quantity of bronzework dating from the Late Bronze Age or the hoarding of ironwork in the Late Iron Age.

First, if the transition from a bronze-based technology to one based on iron was due to an import deficiency, the quantity of bronze available during the Late Bronze Age should have slowly dwindled as the quantity of iron slowly increased. Eventually, a critical turning point would have been reached, and the society would have abandoned bronze and relied solely on iron for the production of tools and weapons. However, this model is not reflected in the archaeological record.

The introduction of iron into Britain actually followed a period of intense hoarding that started during the Late Bronze Age. Large quantities of bronze objects were either buried for storage or thrown into bodies of water as ritual offerings during the 9th and 8th centuries B.C. During the 7th century B.C., the number of hoards and votive offerings suddenly decreased; they disappeared altogether at the end of the century. Iron is only sporadically represented within the archaeological contexts of the 7th century B.C., and does not become common until the late 6th century B.C., well after the decline in bronze usage. Thus, a smooth, deliberate transition does not seem to have occurred.

Second, the rationale devised to explain the expansion of bronze hoarding during the Late Bronze Age is negated by the appearance of iron hoarding during the Late Iron Age. It is believed that bronze hoarding increased during the 9th and 8th centuries in response to a crisis within the metals industry.