New project to solve metal mysteries of Iberia

Following the successful completion of a seven-year programme of investigation into the metallurgical history of the Huelva Province of Southern Spain, the Institute for Archaeo-Metallurgical Studies has begun a new project to cover the Iberian Pyrite Belt as a whole.

The main object of the project is to study the development of mining in this mineral-rich area from the beginning of metallurgy in the 4th-3rd millennium BC to medieval times, and to assess the significance of such development to the cultural, political and industrial evolution of the Iberian Peninsula, and the impact which it had on the rest of Western Europe and the Near East.

The Huelva project, which was proposed by the late Sir Val Duncan, chairman of Rio Tinto-Zinc and one of the founder-trustees of IAMS, produced a first picture of 5,000 years of mining and metal production (B. Rothenberg and A. Blanco Freijeiro, Studies in Ancient Mining and Metallurgy in S.W. Spain, London, 1982) and showed metal as a primary factor in major historical developments. In particular, it demonstrated the importance of metal as an incentive in 3rd millennium BC “megalithic” urbanization and in the colonization of Southern Iberia two thousand years later by metal-seeking Phoenicians, Greeks, and finally, Romans.

Decisive role

To gather the archaeo-metallurgical samples, to date them reliably and to assemble them in their various cultural and historical contexts, was a long and exacting task. But once the process and logistics were understood, at least in broad outline, the decisive role of metal in the history of Huelva became apparent.

However, to apply a similar research approach to the Iberian Pyrite Belt as a whole would have demanded very extensive research, many years of archaeological field work and considerable finance. A different strategy was therefore adopted.

Instead of the long route via archaeological survey and excavation, and to avoid the danger of duplication of effort, it was decided to link up with other projects currently being pursued in areas of the country where ancient mining and metalworking centres are located.

For example, excavations are presently being undertaken by Spanish archaeologists, led by Professor Arribas of the University of Majorca, of settlements of metal-workers of the 4th-3rd millenium BC in the province of Almeria. The Spaniards have promised close co-operation with IAMS.

Other teams of archaeologists are already excavating Bronze Age sites in Southern Spain continued on page 8
Metal-working in the "Dark Age" of the Near East

Evidence of metal-working in the Timna valley in Israel's Negev Desert during a little-known period in the 2nd millennium BC is one of several recent discoveries of IAMS's field operations.

Nearly a quarter of a century of exploration in the Wadi Arabah, the rift valley which divides Israel and Jordan from the Dead Sea to the Gulf of Aqaba, established up to the middle of last year more than 300 sites of ancient mining and smelting in the area.

Yet, a "new-look" over the past few months has resulted in significant further discoveries which will help complete a jigsaw puzzle of metal history for which the first pieces were fashioned more than 6,000 years ago.

In the middle of the dried-up river bed which joins Timna to the Arabah, a small hill remained unexplored in the great activity of the 1960s and 1970s which led to the identification of three major periods of early copper metallurgy in the area: the Chalcolithic period (4th millennium BC); the 14th-12th centuries BC when the Egyptians operated an important copper-producing industry in Timna; and in Roman times in the 2nd century AD.

Last autumn a team led by Professor Beno Rothenberg decided to take a look at the neglected hillock and scrambled to its top. There they found copper slag of a type which appeared different from that which is strewn in large heaps throughout the valley, a workshop containing some unusual crushing implements, mining hammers, crushed ore — and fragments of pottery the like of which had not previously been found in the Arabah.

The pottery has since been identified as belonging to the Middle Bronze Age 1 of the Levant, or the "Dark Age of the Near East", and is reminiscent of some of the bell-shaped vases of the Beaker culture which developed in the Iberian peninsula in the 2nd millennium BC and spread through the whole of Europe.

This is the first time that extractive metallurgy of this period has been identified in the Near East and its discovery is of considerable archaeological significance.
shrine was found high up on the mountain where an immense fallen rock had created a cave. Inside the cave was a mazzebah, or standing stone, carefully erected on a small altar. At its foot were complete, but broken pieces of a Mideanite jar, suggesting that the site was a place for worship or burial, of the Mideanites who were known to have worked with the Egyptians in the development of Timna’s copper industry in the 14th-12th centuries BC.

Revisiting this shrine, the IAMS team looked around for further evidence of ancient worship and decided to investigate a large stone standing in the valley some 500 metres to the east. They climbed to its flat top and found its surface cut with lines radiating from the centre like the rays of the sun. At its foot were found copper slag, fragments of pottery and flint tools dating to the Chalcolithic period.

Fascinated by this massive stone and its strange markings, the team kept watch at dawn one morning and as the sun climbed above the rim of mountains above the valley, they saw that its first rays struck the stone in its centre.

Only a few kilometres from Timna is Wadi Amram, a great amphitheatre in the white sandstone, dominated by red Nubian pillars which resemble the columns of an ancient temple.

Here, above the floor of the amphitheatre which is still strewn with Roman pottery, the hills are pock-marked with caves and adits. It was already

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known that the Romans extracted considerable quantities of copper ore from the Arabah and that this was smelted at a central treatment plant at nearby Beer Ora – the well is still in use today – which was within easy reach of an acacia forest for fuel. But until last year the Romans’ mining methods had been only superficially investigated.

The IAMS team discovered a shaft on the top of a steep mountain which they followed for a distance of 10 metres to find that it connected with a large gallery, surprisingly empty of sand and the usual accumulation of rubble.

This is the first clear evidence of shaft-and-gallery mining by the Romans in the district. The mine was obviously a large one, extending to several levels, and its further exploration should provide an interesting investigation into Roman mining techniques in this part of their empire.

In any comparison between the Roman and Egyptian industries in this part of the world, it must be remembered that for Egypt the Arabah was a major source of copper and that the mines were operated by specialists who were sent there solely for that purpose.

The Romans, on the other hand, were military conquerers and colonists: they had many things to do other than mine copper. Moreover, Rome already had larger and more accessible sources of supply, notably Cyprus and southern Spain, and it is unlikely that much of the metal which its legions produced in the Arabah was exported: most of it was for local use and there was little call for an elaborate organization or complicated techniques.
New pavilion tells story of mining in Bible lands

A new pavilion, exhibiting the archaeo-metallurgical finds of the Arabah Expedition over the past twenty years under the leadership of Professor Beno Rothenberg, has been opened at the Haaretz Museum in Tel Aviv.

Entering the building, which has been named the Nehushtan Pavilion, the visitor finds himself in an underground shaft-and-gallery system showing mining technologies from earliest Chalcolithic to Roman times in the Arabah, with special emphasis on the large-scale Egyptian mining in Timna in the 12th century BC.

Next, the visitor is confronted with a large transparency of the Timna Valley and the reconstruction of a copper-smelting camp with furnaces from the 4th millennium BC to Roman technology. Here also are samples of tools, raw materials, slag and metal ingots, all shown against a background of a smelting community at work as reflected by the Timna discoveries.

Technical details are available in a series of showcases demonstrating various types of tuyères, crucibles, moulds, copper ingots, and the complex logistics of sustaining an ancient mining industry in a vast desert area extending from Arabia to the Nile Delta and to Southern Palestine, including the Negev, and to the shores of the Red Sea and the Mediterranean.

Finally there is a section devoted to the Timna Mining Sanctuary, introduced by another large transparency, a model of the excavated site and reconstructions of its main phases – Chalcolithic, Egyptian, New Kingdom and Midianite. Here too are displayed some of the most important of the thousands of priceless objects which were found during excavation.

The Nehushtan Pavilion was officially opened on October 18 in the presence of the Mayor of Tel Aviv, Mr Shlomo Lahat.

The first major exhibition of archaeo-metallurgical discoveries in Bible lands was mounted at the British Museum in 1970-71 and created great interest in the archaeological world. The Tel Aviv exhibition follows a similar presentation.

Mining Magazine

The May 1983 issue of Mining Magazine includes a four-page illustrated article on the results of IAMS's investigations into the ancient metallurgy of the Huelva province of SW Spain. Mining Magazine is published at 15 Wilson Street, London EC2.
12th Century BC copper smelter uncovered intact in Timna Valley

For the first time, after many years of search, an ancient copper-smelting furnace, more than 3,000 years old, has been found virtually intact in the Negev Desert of Israel.

The discovery was made in the Timna Valley, site of one of the world's earliest large-scale copper-producing industries, by an IAMS team while completing a programme of excavation begun in the Wadi Arabah nearly twenty years earlier.

When Professor Beno Rothenberg's Arabah Expedition started investigations in 1964, one of the sites selected for special attention was a small valley, enclosed by rugged hills, between the granite table-mountain Har Timna and a cluster of ancient mining camps under the towering cliffs to the West.

Surveyors marked it on their maps as Site 2, but it quickly became more popularly known as the Mushroom Camp after the solitary mushroom-shaped rock of red sandstone which dominated its landscape. Around this rock great heaps of copper slag were dispersed over a wide area, indicating one of the most important smelting sites in the whole of the Arabah.

During the years that followed, the remains of several smelting furnaces were discovered among the slag heaps, together with a workshop and storage pit containing ore and crushing and grinding tools.

These and other finds built up a picture of a highly integrated operation which reached its peak between 1300 and 1150 BC. Rich malachite was recovered from mines in the valley and from the foot of the cliffs; the ore was mixed with fluxes and smelted in charcoal-fired furnaces to produce a high-grade metal.

Archaeo-metallurgists were astonished at the smelting technology which reached a degree of sophistication which was little improved upon in medieval Europe 2,000 years later.

The Timna furnaces were lined with clay and fitted with tuyères to inject an air blast, whilst in front of each smelter there was a stone-flanked tapping pit.

However, because the furnace remains were fragmentary, several important questions of design and operation remained unanswered, especially in regard to the use of tuyères and bellows to heat the charcoal-burning furnace to the required temperature. Now, with a complete furnace available for study, scientists are able to get a better understanding of how precisely the ancient smeltermen produced their copper.

Cut into bedrock

A unique feature of the recently-discovered furnace is that it was cut straight into bedrock. The
original furnace bottom, about 40 cm in diameter, was found to be well preserved. Furnace walls had been lined with clay mortar but, as with previous discoveries at Timna, the lower part of the lining had broken away.

The back wall, 50 cm high, showed heavy slagging on its upper part, and the position of a tuyère and bellows was clearly to be seen. The tuyère must have protruded about 25 cm above the surface of the rock into which the furnace had been cut. Only one tuyère was used in this furnace, and this was probably the general practice of the time.

The original furnace was probably at least 60 cm high, its uppermost edge being formed with a line of stones set in mortar around the rim of the rock-cut hearth. One of these stones was found in situ, with its clay lining as part of the furnace wall and cemented together with the tuyère.

The slag pit, 60 cm in diameter, was about 10 cm lower than the hearth bottom, and some 20 cm beneath the tap-hole of the furnace.

The tapped slag solidified as a circular slab, with a cast-in hole in the middle to enable it to be removed by a rod or hook and tossed to an adjoining heap.

Radio-carbon tests on charcoal samples collected during the excavation have not yet been completed, but there would seem to be little doubt that the rock-cut furnace dates to a period between the Late Bronze Age and the Early Iron Age, probably the 12th century BC.
which are of fundamental importance to the understanding of the period, and they too have agreed to collaborate to the fullest.

Important Copper Age settlements and metal production sites are also under investigation in Portugal and the results of these examinations will be made available to IAMS.

The appearance in Iberia of arsenical copper in the Early Bronze Age and the dramatic increase in the use of this metal is one of the major puzzles to be examined by the IAMS investigators. The coming of tin-bronze – one of the enigmas of world history – its sources and methods of manufacture, distribution and trade, will be closely examined as Iberia was one of the major producers of tin in ancient times.

**Rio Tinto**

Rio Tinto, with 16 million tons of ancient smelting slag, was undoubtedly the largest and one of the earliest metal producers of the ancient world. It was a major source of metal for local inhabitants as well as for foreign trade from the Late Bronze Age to Late Roman times.

Systematic excavation of this huge production site of gold, silver, copper and iron was part of the Huelva project, and the work is still going on. With its well stratified and mostly undisturbed industrial remains, sometimes more than 20 metres deep, Rio Tinto offers further opportunities for archaeo-metallurgical research.

It is here that so many problems common to Western European metallurgy can be solved. The large collection of carefully excavated and identified samples offers unique material for scientific reconstruction of the ancient processes, the understanding of which is fundamental to the comprehension of metal’s role in early history – and not without significance for the modern metallurgist.

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**Trustee appointed**

A.J. Wilson, who has been closely associated with the work of IAMS since its inception in 1973, has been appointed to the board of trustees.

Arthur Wilson spent twenty years in Africa with the RST group of copper mining companies, of which he was a vice-president. For the past ten years he has been active in mining journalism and has written several books relating to the world of metals. He is a director of Cerro Metals (UK) Ltd, a ring-dealing member of the London Metal Exchange.

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**Silver metallurgy in Greece**

In a recent article in *The Illustrated London News*, Paule Spitaels, co-director of Belgian excavations at Thorikos in southern Attica’s Laurion hills, describes discoveries that show that silver, a major factor in Athens’ rise to wealth and power in the 5th Century BC, was being exploited there as early as the 3rd millennium BC.

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Edited and produced by A.J. Wilson  
Printed by Cheney and Sons Ltd, Banbury, Oxon