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Focus on Britain

IAMS bid to probe mining history in England's Westcountry

After more than 20 years of exploration and research centred largely on the Near East and Southern Spain, archaeologists and archaeo-metallurgists associated with the Institute for Archaeo-metallurgical Studies are now turning their attention to the British Isles, and in particular to the English Westcountry.

Plans are being made for a project to establish the origin and development of metal production in Cornwall and Devon, two counties which are presently experiencing a revival of mining operations, an industry which made them famous in the past.

The project is being initiated and co-ordinated by IAMS and the Institute of Archaeology, London, but its success will depend largely on the co-operation and active involvement of local historical societies, institutions, museums, mining companies, and individuals in an investigation basic to the history of the area and to the history of metals.

Beating the Bulldozer

Much has already been discovered and written about the industrial history of the two counties: for centuries stories were handed down by word of mouth from generation to generation. But the origins of mining and smelting in the Westcountry in ancient times are still shrouded in mystery. They would probably remain so but for the development in recent years of scientific methods of exploration, and an expertise by researchers that has grown from experience gained in the Near East and Western Europe where mining and metallurgical techniques dating back more than 6,000 years have been established.

The planned project for the Westcountry comes at a critical time for archaeologists. Whilst the mining revival in Devon and Cornwall is bringing employment to many local people and prosperity to the whole district, there is great danger that operations may destroy evidence of ancient workings.

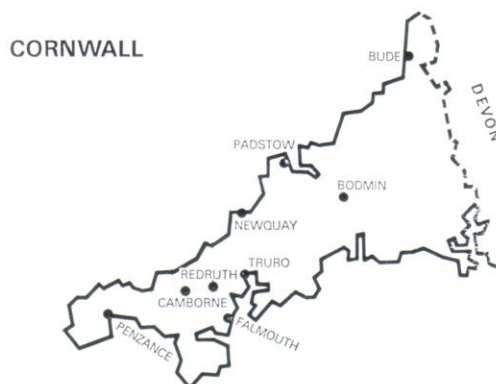
It is important that the archaeologists are ahead of the bulldozers, otherwise the veil that hides the face of England's metal history will never be lifted.

In Cornwall, a vast area north of St. Austell is being mined intensively for china clay. Here, about 10 years ago, a Bronze Age burial pit, dated to the 16th century BC, was excavated. Inside were found some pieces of tin slag which had apparently been placed there as part of a burial ritual.

These small pieces are the earliest tin slag so far found in Europe, perhaps even in the world, and form an important link in Cornwall's mining history. The site of their discovery at Caerloggas is in urgent need of further investigation before it disappears for ever.

Tin smelting sites in Cornwall are not easy to find. Whilst smelting for the metal is believed to have been carried out in the county for more than 4,000 years, the evidence on the ground is not very obvious. The early blowing houses have left very little slag as only richly-dressed ores were smelted. Furnaces were primitive and made of granite blocks which were afterwards put to other uses. The larger reverberatory smelters, introduced at the beginning of the

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Westcountry Probe

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18th century, were mostly on sites that have now been converted to other industrial purposes such as foundries or creameries. Some of the more recent, such as that in operation at Seleggan between 1887 and 1931, have been bulldozed to the ground, and today only a small amount of slag can be found where smelting was actually carried out.

It is known that tanners were at work in Cornwall as long ago as the 18th century BC. The first explorers from the Mediterranean, who settled around the river Hayle and in West Penwith at about that time discovered the secret — or brought it with them — that the mixture of sand and stone washed down by streams from the granite hills contained tin which, when blended with copper ore that they found in Ireland, turned to bronze.

From this they forged their weapons, made their domestic pots and pans, and found many other uses for the magic metal. They also quickly came to realize that in the peninsula of Cornwall they were sitting on the largest known deposit of tin in the whole of Europe. Phoenicians came to trade with them as early as 1500 BC; other merchants followed, and Cornwall prospered.

These early tanners worked on the surface, recovering the alluvial ore by panning the rivers, or “streaming” as it has always been known in the Westcountry.

Industrial Revolution

The Romans brought their own skill and knowledge to what was already a flourishing industry, but it was not until the middle of the 15th century that underground mining was begun. The coming of the Industrial Revolution three hundred years later brought a boom in Cornish tin and at one time more than 50,000 people were employed in the mines, both tin and copper.

Although the Romans had mined copper in other parts of Britain, the Cornish deposits were for centuries strangely neglected, and production of the metal in the county was almost negligible before 1650. In the hundred years between 1750 and 1850 the value of Cornish copper exceeded that of tin and was the main factor in the county’s prosperity. In 1824 the single parish of Gwennap yielded more than one-third of the world’s copper supply. The great Caradon mine, set on two hills north of Liskeard, on the borders of East and West Wivel, alone employed 4,000 workers, and several of the other larger mines had more than 1,000 employees.

The Cornish metal boom reached its peak in the late 1860s. Then the bottom fell out of the market. With the discoveries of large tin resources in Malaya and the development of copper mines in many parts of the world with cheaper labour and lower production costs, Cornish miners had to look across the seas for their livelihood.



“... skeletal fingers pointing to the sky”

The dramatic change in Cornwall’s fortunes has been described by many writers, but none more graphically than Daphne du Maurier in *Vanishing Cornwall*: “The great days were over. Companies folded up. Mines closed down. Hundreds, then thousands, found themselves out of work, without hope of employment ... there was no alternative to starvation for the miners but mass emigration. A third of the mining population left Cornwall before the end of the century, taking their skill to other continents. Back at home, their towns and villages were left unpeopled, the mines themselves deserted, no smoke coming from the tall chimney stacks, no sound of engines in the pumping houses, the land about them reverting once more to barren waste and scrub.”

Today, the ruins of the mines stand gaunt along the ridges, the crumbling chimney stacks pointing skeletal fingers to the sky. Only the creeping ivy helps soften the grizzled monuments to a once-prosperous industry.

Skilled Cornishmen

The rest of the mining world profited from Cornwall’s loss, for the ‘Cousin Jacks’ were highly skilled and few major mining enterprises have since been brought into being without their help and expertise.

Across the Tamar in Devon, much of the exploration for the new project will centre on Dartmoor. There, as on other wild and lonely areas which abound in the Westcountry, special attention will be paid to a possible connection between megalithic remains and ancient mining.

The project will provide an opportunity for further investigation into a suggestion that the chain of dolmen, stretching from the Iberian peninsula through Brittany to the English Westcountry and on into Ireland, marks the site of ancient metallurgical activities and the tombs of some of Europe’s earliest miners.

Sifnos, source of silver for Greece's coins

The Aegean island of Sifnos, well known to present-day tourists and once famous for its gold mines, may also have been an important source of silver from which the Greeks made coins in ancient times.

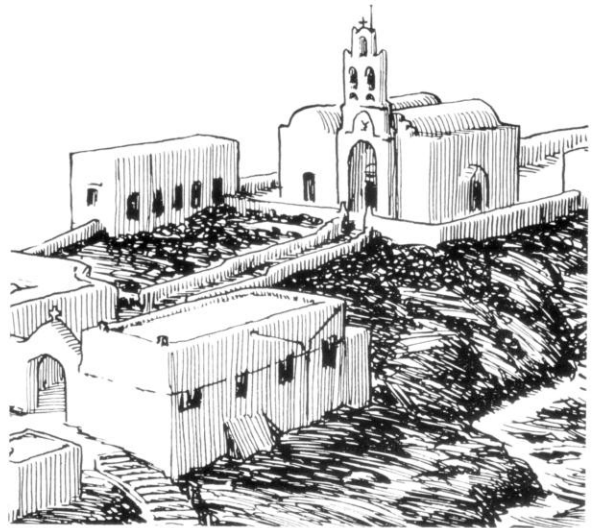
Over the past ten years, the German Max Planck-Institute for Nuclear Research, Heidelberg, has been carrying out exploration and research to discover where the Greeks obtained silver for minting. With the aid of lead isotope analysis, teams led by the late Professor Gentner, located a number of lead-silver-smelting sites throughout the Aegean, including some on the Cycladic island of Sifnos.

Last summer, Professor H.-G. Bachmann, a member of IAMS Scientific Committee and lecturer at the archaeo-metallurgy courses at the Institute of Archaeology, London, visited Sifnos at the invitation of the Max Planck-Institute to inspect the old mining and smelting sites.

Battle of Salamis

In the inner ring of the archipelago which circles the holy island of Delos, Sifnos was in ancient times colonized by Ionians from Athens. In 480 BC the islanders sent a ship to fight on the Greek side in the great naval battle of Salamis at which the invading Persian fleet under Xerxes was routed.

In those days the island's wealth came primarily from



its gold mines, from the proceeds of which it built a "treasury" (small temple) at the sanctuary of Delphi on the Greek mainland below Mount Parnassus, site of the Oracle of Apollo. Remains of the beautifully-sculptured frieze of the temple can still be seen in the Delphi museum.

According to legend, the Siphnians were required to give Apollo a golden egg every year: once they tried to fob him off with a gilded stone, and in anger he flooded their gold mines.

Indeed, in antiquity the Siphnians had quite a reputation for sharp practice. Today they are a singularly gentle and pleasant people who live in a line of almost connecting villages on the crest of a hill. Byzantine churches and monasteries are scattered everywhere. The island demonstrates the cubic type of architecture seen with small variations throughout the Cyclades, but here a projecting ledge over door and window adds to the attractive appearance of the houses.

A Smiling Island

The finest architecture is in the old island capital of Kastro, on the eastern shore: here one street passes over the roofs of one-storeyed buildings below and is joined by bridges to the upper storeys of the houses opposite.

Sifnos is a smiling island, its bare hills terraced on their lower slopes for cultivation or for olive trees. It is reputed to produce the best olive oil in the Cyclades and in consequence the local cooking is much better than average in the region.

Whilst the mines and smelting sites, source of the island's wealth in antiquity, are being probed by archaeologists and metallurgists, Sifnos is today better known as the home of the earthenware pots sold all over Greece (a speciality is highly decorative chimney pots) and as a retreat for holiday-makers, though it took some time before its attractions were fully recognized. The green hilly interior is surrounded on all sides by a picturesque coastline, indented with sandy bays and rocky coves.

Professor Bachmann is now working on his report and plans to summarize his observations and laboratory results in a forthcoming monograph to be edited jointly by the Heidelberg Academy of Sciences and the German Mining Museum, Bochum.



Pillars of aqueduct bridging Wadi Jeko at Fenan, Jordan

Ancient Jordan city may rival Timna's place in copper history

Whilst Timna, on the west bank of Wadi Arabah in Israel, has been extensively explored by archaeo-metallurgists over the past quarter of a century, there has been little research eastwards across the border in Jordan.

It is now believed that an area round the ruins of the ancient city of Fenan may eventually rival Timna in importance in the early history of metals.

Fenan is situated to the south of the more widely-known ancient city of Petra, which is about 60 miles north-east of Timna across Wadi Arabah inside Jordan.

By invitation of Dr. Lutfi A. Khalil of the University of Jordan, Amman, and with the support of the University's Institute of Archaeology, Professor H.-G. Bachmann, a member of IAMS Scientific Committee, has visited Wadi Dana and Fenan. He reports slag heaps amounting to about half a million tons, water reservoirs, aqueducts, remains of terraced fields and ruined buildings, all of which indicate the importance of the site.

"First analysis of some of the finds point to a technology which is closely related, if not identical, to that practised during the later periods in Timna," says Professor Bachmann.

"As yet the complete chronology of the Fenan mining and smelting sites is unknown. Most of the visible remains belong to Roman-Byzantine times, but metallurgical activities may go back to the 2nd millennium BC. It is a highly important area and calls for further research."

Rock of Moses

The surrounding area is rich in history. At nearby Petra, the terrace on which the city is built is pierced by Wadi Musa (the valley of Moses), one of the traditional places where the leader of the wandering Israelites struck the rock and water gushed forth. As at Timna, the valley is enclosed by sandstone cliffs veined with every shade of red and purple to pale yellow, and eroded into fantastic shapes.

The Greek name Petra ('rock') probably replaced the biblical name Sela. The site, at once accessible and secluded, appears to have been occupied from Paleolithic times as Acheulean-type tools have been found on the upper slopes. The Neolithic period is represented by a settlement on the road to the northern suburb of Al Barid where dwellings, flint arrowheads and other implements have been uncovered.



Ruins of a monastery at Fenan

Traditionally, Petra was the home of the Horites who were driven out by the Edomites, who in turn suffered defeat by Amaziah, King of Judah, who slaughtered survivors by casting them down from the rock. The Edomites were replaced by the Nabateans who made Petra their centre about 312 BC and later achieved a monopoly of the spice trade since they commanded the routes from Gaza and Damascus to the Gulf of Aqaba. Later Petra became the capital of a state which extended from Jordan to the Negev and to the Mediterranean coast of Al Arish in Egypt.

Smelting site in Wadi Dana, east of Fenan



Fenan: water channel leading to one of several cisterns within the city's boundaries

Petra continued to flourish for some time after the Roman occupation until changing trade routes led to the rise of Palmyra and caused its commercial decline. In the 12th century the Crusaders built a castle there. Otherwise the site was occupied only by wandering tribesmen and it was in this condition when rediscovered for the Western world by the Swiss traveller J.L. Burckhardt in 1812.

IAMS completes ten years work -and plans for future

This year marks the tenth anniversary of the foundation of IAMS as an international organization whose function is to promote, supervise and co-ordinate research into the origins and development of mining and metallurgy from earliest times.

The immediate objective of the Institute on its formation in 1973 was to ensure the continuation and expansion of archaeo-metallurgical work which had begun in the Near East in the 1950s and, in particular, expeditions in Wadi Arabah in Israel under Professor Beno Rothenberg, now director of IAMS.

Whilst IAMS continues to operate with its own Board of Trustees and Scientific Committee, it is now officially affiliated to the Institute of Archaeology, University of London.

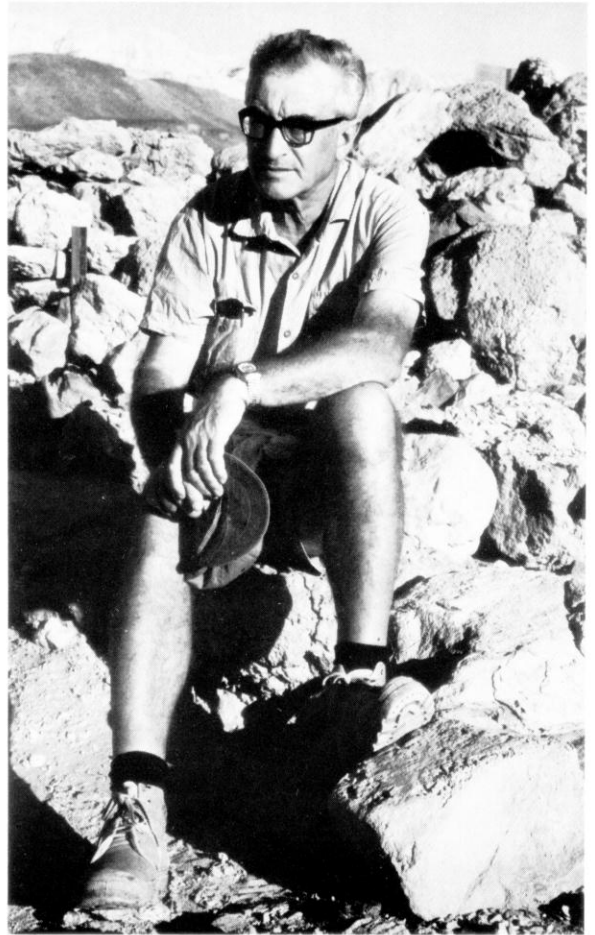
The following projects have been completed during the past ten years, are currently in operation or planned for the future:

Completed projects

- * *Arabah and Timna*: excavation of remains of earliest Egyptian copper mining and smelting in southern Israel, and discovery of Egyptian mining temple with more than 10,000 votive gifts and other small but precious finds, circa 13th century BC.
- * *Copper smelting*: discovery of furnace remains dating to 4th millennium BC — excavation of Bronze Age copper smelting sites — reconstruction of ancient furnaces in laboratory and on site — construction of mathematical model of basic metallurgical processes.
- * *Sinai*: largest archaeological survey undertaken of this desert area — 700 ancient mining and smelting sites identified, dating from late Neolithic to Roman period.
- * *Huelva project*: study of early Western European metallurgy — survey in southern Spain, followed by systematic excavation of mines and smelting sites.
- * *Rio Tinto*: excavations of copper and silver mining sites dating from 3rd millennium BC to the Roman period, establishing Rio Tinto as world's oldest mining area still in production.

Present projects

- * *Cyprus*: investigation into pre-Bronze Age mining history.



Professor Beno Rothenberg: his work in the Arabah pioneered the formation of IAMS

- * *Man and metals*: world-wide study of manufacturing techniques and impact of metal on cultural and economic developments.
- * *University courses*: a collective undertaking by IAMS and the Institute of Archaeology for teaching archaeo-metallurgy at London University — the world's only degree-awarding course in archaeo-metallurgy.
- * *Publications*: scientific papers, books, monographs, aimed to disseminate knowledge obtained from researches and excavations as widely as possible.

Future plans

- * *Iberia*: study of mining and smelting techniques throughout the Iberian pyrites belt and the impact of mining on history of the peninsula.
- * *Silver smelting*: investigations into the ancient processes for the recovery of metal from the complex silver, lead and copper ores of Western Europe.
- * *British Isles*: study of the early metallurgy ranging from Cornwall to Ireland, and the relationship between earliest mining and prehistoric remains and monuments, habitations and cults.

Archaeo-metallurgy in China

Professor R.F. Tylecote, IAMS trustee and member of the Scientific Committee, reports on a recent visit to China.

China has a long metallurgical tradition and from the Shang dynasty (1600 BC) has astounded the world by the scale of its operations. The casting of bronze 3-legged or 4-legged cauldrons weighing 875 kg should have raised a few eyebrows. The sheer size and weight exceeded anything in the Western World. By the Han Dynasty (200 BC-AD 200) they were having blast-furnace explosions and producing 'bears' weighing 20 tons.

Those in China interested in the history of metallurgy have been aware of what has been going on in the West by reading the relevant literature and attending conferences on the history of science and technology in various parts of the world. But the same cannot be said of the West which, perhaps because of the language problem, has not been keeping abreast of the work being done in China. We have relied on certain specialists such as Joseph Needham at Cambridge and Donald Wagner in Copenhagen to keep us informed.

It was exhilarating to find so much work going on and to see that it had developed in much the same way as our own — by metallurgists being presented with interesting problems by archaeologists, which could only be solved by experimentation and laboratory work.

Han Dynasty Furnaces

The leading institution in China responsible for archaeometallurgy is the Institute for the History of Natural Sciences which comes under the Academy of Sciences. So metallurgy finds itself in good company with astronomy, mathematics, nautics, architecture, etc. But China is a big country with a lot of regional autonomy — after all, one province alone has a population greater than that of the British Isles. Thus, the province of Henan, which straddles the Yellow River and has Shang sites such as Loyang and Anyang, has an archaeological service with many personnel who could be considered archaeometallurgists. This province contained most of the Han Dynasty blast furnaces and the sites of many of these are known.

The Beijing University of Iron and Steel Technology also has an archaeometallurgical group under Professor Ko, and this group is not only working on ferrous problems such as the structure of edge tools and weapons, but non-ferrous problems as well.

Since the Institute for the History of Natural Sciences has no laboratory accommodation it is necessary for them to make use of university and industrial facilities such as engineering research institutes and the factories themselves. In many areas such as the malleabilization of cast iron and repetition casting.

China has led the world. It is not surprising that appropriate modern industry has been co-opted to lend a hand in sorting out the problems of the archaeo-metallurgist.

Similar to work in the UK, China has been doing experiments on early copper smelting, based on the discovery of a Warring States (500 BC) copper smelting furnace in a copper mine at Tonglushan to the south of Wuhan. Extensive workings were uncovered during open pit mining and these are being preserved as an open-air mining museum.

China still has 40 open-hearth steel-making furnaces in operation and since we in Britain have now lost the battle to keep one as a museum piece, there is still a possibility that China may do so when the time comes.

Sleigh bell-Chinese style!

Early Chinese expertise in casting is widely recognized and large bronzes, especially bells, are particularly interesting (writes R.B. Wood in a recent issue of *Metals Society World*).

The Da Zhong Si (Great Bell Temple) on the west side of Beijing, in Peking, houses a particularly impressive specimen. The *Guinness Book of Records* does not give much detail on bells except to say that the never-functional Tsar Kolokol in Moscow is the biggest ever. At over 46 tons and 4.5 metres high by 3.3 metres maximum outer diameter, the Peking specimen must be among the world's largest half dozen. Moreover, it is in superb condition and is sound. The entire surface, inner and outer, is covered in Buddhist script (the Lotus and other sutras) involving 227,000 characters.

The bell was cast during the reign of the Ming emperor Yong Le, therefore some time between 1403 and 1424. The Qing (Ch'ing) emperor Yong Zheng (1678-1735) ordered it to be removed from its original site, also on the west side of Beijing, to its present home — hardly a simple task.

Apparently, the move was effected by flooding the road between the two temples and sliding the bell along the ice!

In the last year or so a number of other Buddhist temple bells have been collected to form a bell museum in the courtyard. The oldest is the Sung Dynasty specimen, cast about 1069, two centuries before Beijing fell to the Mongols under Kubilai. Another interesting exhibit is an iron bell cast during the Ming dynasty.

Oman: copper land of Magan?

Was Oman, the country strategically placed on the north-eastern edge of the Saudi-Arabian peninsula, the copper land of Magan, known from cuneiform tablets found in Mesopotamia?

It is known that Dilmun (the island of Bahrain in the Persian Gulf) was a major trading post in the 3rd millennium BC and it is possible that it was a port on the metal route from Oman through the Gulf. The Kingdoms of Ur and Sumer were barren of mineral resources and would have had to import their metal from somewhere. Did it in fact come from Oman?

The answers to these and many other questions which archaeologists and archaeo-metallurgists have been asking about this part of the world are likely to be forthcoming soon.

The Sultanate of Oman has been accessible to archaeologists only since Sultan Qaboos idn Said came to the throne in 1970. The new sultan introduced a number of reforms and abolished many of the restrictive practices enforced by his father, whom he replaced.

For a number of years the German Mining Museum, Bochum, has been carrying out large-scale excavations and surveys in the country with the support of the Ministry of National Heritage and financially aided by the Volkswagen Foundation.

Under the direction of Dr. G. Weisgerber, the 3rd millennium habitation site of Al Maysar, with its extensive copper smelting remains, has been excavated. The finds include numerous bun-shaped copper ingots. In addition, all major ore-bearing regions and the complete range of existing slag heaps have been surveyed. Results indicate that large-scale metal production, mostly copper, continued in the area up to the 6th century AD.

The Mining Museum team, with A. Hauptmann in charge of the technological aspects of Oman archaeo-metallurgy, has already laid down some of its conclusions in several publications. Professor H.-G. Bachmann of IAMS Scientific Committee worked with the survey in 1980 and again in 1982.

Whatever the final outcome of these investigations it is clear that Oman now has to be considered among the major metal suppliers of antiquity in the Near and Middle East.

Additional copies of this Newsletter can be obtained from IAMS secretarial office, Institute of Archaeology, University of London, 31-34 Gordon Square, London WC1H 0PY. Telephone: 01-387 6052.

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Bronze Age mines in Ireland

Moves to initiate an archaeo-metallurgical project in Ireland were made when Professor Beno Rothenberg, director of IAMS, and Robert Rice, trustee, visited the west Cork and southwest Kerry districts recently.

Unfortunately, Dr. John Jackson, an authority on the ancient history of the district who was to accompany them, fell ill, but a brief survey was made with the aid of maps and charts which he provided.

The area saw great activity during the Bronze Age and mine timber dating to 1500 BC has been discovered at Mount Gabriel, near Mizen Head. In one of his papers, Dr. Jackson refers to the discovery of grooved and ungrooved stone mining tools at the foot of Mount Gabriel and polished stone axes were found six miles away at Ballyrizard. No smelting slags have yet been found, probably because they are now covered by peat.

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