

# Radiocarbon (C14) Dating helps to solve riddle of Timna's Late Bronze Age smelting furnaces

In *IAMS Newsletter* No. 5, 1983, we published details of a newly discovered rock-cut smelting furnace in the Egyptian copper smelting camp Site 2 of the Ramesside period in the Timna Valley of southern Israel, which was dated to the twelfth century B.C. It was shaped like a tubular bowl or cup, cut into bedrock, and was found with one clay tuyère in its heavily slagged backwall *in situ*. Attached to this smelting hearth was a second rock-cut pit, which served as a receptacle for the slag tapped from the smelting hearth at the conclusion of the smelting operation. Next to the furnace was a heap of ring-shaped slag cakes, which must have been produced in it since no other smelting installation was located nearby. This furnace stood solitarily on a rock-ledge, separated from the Egyptian main camp by a narrow wadi.

Because of the great similarity to the other smelting furnaces of Site 2, which are typical for the end phase of the 14th–12th centuries B.C. Ramesside (Late Bronze Age) smelting installations of Timna, and because of the exclusively New Kingdom pottery found around the newly found furnace and in the slag heap, the rock-cut furnace was dated to approximately the twelfth century B.C.

During the excavation of this furnace a handful of unburned lumps of charcoal was found on its bottom. As this was the only time we had ever made such a find on the bottom of a smelting furnace, and as all other smelting hearth bottoms showed a thin cover of light-grey charred sand – never ashes and never unburned charcoal, we sent this carbon sample for C14 dating (see *IAMS Newsletter* No. 5, p. 7). We assumed, however, that there was little doubt regarding the twelfth century B.C. date of the furnace.

The result was a considerable surprise which we recorded in our overview of the Arabah Furnaces, published in *Furnaces and Smelting Technology in Antiquity*, ed. P. Craddock and M. J. Hughes, British Museum Occ. Papers No. 48, 1985: 'charcoal found in the furnace bottom gave a date of  $1210 \pm 100$  (BM 2242)', i.e. 7th–8th centuries A.D., and added the caution: 'Thus the Late Bronze Age date for Layer 1 type furnace of Site 2 may have to be revised after further investigations (added June 1984)'.

The problem which had arisen through this Early Islamic C14 date, instead of the expected Late Bronze–Early Iron Age date, involved not only the newly excavated furnace, but all the Timna Site 2 furnaces which had been generally

accepted as the typical Late Bronze Age smelting furnace (see R. F. Tylecote, *The Prehistory of Metallurgy in the British Isles*, 1986, p. 19). This new C14 date also threw doubt on all other sites and installations where the unique ring-shaped slag cakes had been found in the same archaeological context.

To radically explore this unexpected problem, especially in view of the fact that the definitive excavation reports were already finalized and forthcoming in *Researches in the Arabah*, Vol. 4, IAMS London, all the sites where ring-shaped slag was found, and the installations which produced them, were systematically sampled for charcoal and a series of samples sent to the British Museum Research Laboratory and to the National Physical Research Laboratory (Dr. Vogel), CSIR Pretoria.

Here are the first results: CSIR Anal. No. Pts 4121 –  $3090 \pm 60$ bp., calibrated date for the slag, produced in the rock-cut furnace, is fourteenth century B.C.; BM2382 Site 2, Layer 2 (the slag next to furnace V)  $3220 \pm 50$ bp., calibrated date thirteenth century B.C., i.e. New Kingdom dates for the Timna Site 2 furnaces.

However, Pts 4117 –  $1390 \pm 50$ bp., i.e. calibrated date 640 A.D. (Early Islamic) for slag at Roman Beer Ora, in addition to the similar date for the charcoal in the rock-cut Late Bronze Age furnace, created a new situation.

The radiocarbon dates vindicated our original New Kingdom (Late Bronze Age) date of the 'typical LB furnaces'. They also showed that during the Early Islamic occupation of the southern Arabah in the seventh century A.D., there was, apparently, an extensive secondary use of the ancient smelting camps and installations, both for copper smelting and/or casting (with the adaptation in Islamic Beer Ora of the useful Late Bronze invention of the ring-shaped tap slag and secondary, mechanical extraction of entrapped copper prills and ingots from the old slag heaps). There was also the use for non-metallurgical, more domestic purposes, such as the cooking hearth located in a New Kingdom smelter. The Early Islamic C14 date for charcoal in the Late Bronze Age furnace of Site 2 in Timna does not alter the date of the Late Bronze furnaces of Timna; it establishes the existence of an additional period of extensive activities in the Arabah during the Early Islamic conquest of the region. B.R.

## News from the director's desk

### Thanks to the Volkswagen Foundation

Intensive fieldwork since 1977 in the region of the Rio Tinto Mine in south-west Spain (see *IAMS Newsletter* Nos 1–3 and especially No. 8, 1986) produced unique archaeo-metallurgical material from the beginning of metal-working in southern Iberia during the early Copper Age, when copper and silver were produced at the scale of cottage industries, to the first full scale production during the Late Bronze Age. From then on its evergrowing dimensions led to the huge industrial copper and silver production of Ibero-Roman and Imperial Roman times. Preliminary analytical studies of the slag heaps of Rio Tinto – covering about 8km.<sup>2</sup> – were limited by the lack of sufficient funds, but produced a first picture of these

techno-historical developments. However, the proper understanding of the different processes used by the ancient metallurgists during the three–four thousand years of mining at Rio Tinto (and at many other sites investigated by IAMS's Iberian Research Group, see *IAMS Newsletter* No. 5, 1983), made additional field exploration, excavations and, foremost, intensive and sophisticated scientific studies, imperative.

Recently IAMS formed a new composite research group to undertake such a comprehensive South Iberian Archaeo-Metallurgical Research Project, under the overall direction of the Director. Co-directors are: Professor A. Arribas Palau (Palma University); Professor F. Molina Gonzales (Granada University), and Professor I. Keesmann (Mainz University).

Senior Research Associates are: Professor H. G. Bachmann (London and Frankfurt Universities); Dr P. Craddock and Dr I. Freestone (British Museum Research Laboratory); Dr N. Gale (Oxford University); Professor R. F. Tylecote (IAMS London); Phil. Andrews (Southampton, U.K.) and our Spanish, German and British team, most of whom have many years of devoted, highly professional active participation in the field. We wish to acknowledge with sincere gratitude the generous support of the Volkswagen Foundation (Hannover, Germany) which, together with the assistance by the mining companies, Rio Tinto Minera S.A., Madrid and Rio Tinto Zinc plc, London, has made this large scale new research programme a reality, in the field as well as in the laboratories.

#### New USA Trustees

The trustees of IAMS and its Director heartily welcome our new USA Trustees Ms Patricia Walker, Editor-in-Chief AMM Group, and Mr Tom Kennedy, President of the Copper Club, and also the new member of our Scientific Committee, Dr John Merkel of Harvard University. These new members of the 'IAMS family' will significantly strengthen the ranks of IAMS and lead to further growth of worldwide archaeo-metallurgical research.

#### Tylecote's new Prehistory of Metallurgy

Finally, Ronnie Tylecote's long awaited *The Prehistory of Metallurgy in the British Isles* is published (The Institute of Metals, London), much to the delight of his fellow archaeo-metallurgists worldwide and, even more so, his numerous students.

This is a completely revised edition of his *Metallurgy in Archaeology*, first published in 1962, which was for a long time one of the few books on the subject and quickly became a minor classic. This book presents a unique and updated introduction to the history of metallurgy since its earliest beginnings, with its main emphasis on the British Isles.

Professor R. F. Tylecote is one of the Founder-Trustees of IAMS and, since 1973, a member of its Scientific and Editorial Committees. He has taken active part in many of our research projects, in the rough deserts and in the laboratories. May we at this occasion join the many well-wishers to his 70th anniversary. Good Health and many more fruitful years of archaeo-metallurgy!

## Book Review

**Archaeologische Bronzen: Antike Kunst Moderne Technik.** (Archaeological Bronzes: Ancient Art, modern methods.) ed. H. Born. Staatliche Museum Preussischer Kulturbesitz, Berlin. 205 pp. Ill. (Text in German, summaries in English and French). ISBN 3 496 010290. DM 58.

This superbly produced and illustrated book covers most aspects of the scientific study and conservation of ancient bronze work. There are detailed and informed contributions by leading experts on the ancient techniques used to produce the bronzes and on the modern methods and apparatus used to study them. More specifically the areas covered are the production of metals in antiquity, the casting of bronze with especial reference to classical statuary, finishing with detailed contributions on the decoration and surface treatments such as gilding. There are particularly interesting sections on the deliberate patination and painting of bronzes in antiquity, backed up by the excellent colour plates that are a feature of this book generally. Corrosion and patinas, both ancient and modern, are discussed at lengths, both chemically and visually, together with contributions on the conservation of corroding bronze using case histories such as the Riace bronzes. Other subjects covered include restoration, illustration and radiography (including tomography), and the production of copies and electrotypes (together with a discussion of the scope for fraud and fakery that raises). The book concludes with a chapter on the analysis of bronze antiquities, itself set in an historic perspective.

Thus almost all the scientific and technical aspects of the

study of bronzes, except dating, are brought together, and this is one of the aims of the book. Born is concerned that the archaeologist, conservator and natural scientist should work in concert rather than independently. So often reports on the technical examination of a bronze, commissioned by the art historian in charge of the publication, are published as appendices completely undigested and divorced from the main text, sometimes even contradicting it. The often ephemeral information on the construction and decoration of a bronze surviving only on or in the surface patination is brought home very forcibly in this book, not least by the truly excellent photographs. Clearly, the conservators are in the best position to observe and record this information, but only if they are fully integrated into the investigative team and realise the full potential of what they are examining.

This is an excellent book for anyone involved with the study of ancient metalwork, there is much that is new – techniques, case studies on objects not always familiar to the English-speaking world and, above all, a fresh discussion of new ideas and approaches. All in all, a good book. *P. T. Craddock*

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