## **News and Notes**

## Foundation of an Institute for Archaeometallurgy in Bochum.

A donation from the "Volkswagen-Stiftung" has made it possible to establish an Institute for Archaeometallurgy in connection with the German Mining Museum at Bochum. This is the first institute in the Bundesrepublik to combine natural sciences and archaeological research. Its aim is to combine the teaching and research aspects of early metallurgy.

The Institute will be able to carry out the analysis of finds such as ores, slags and metals. VW has a considerable interest in archaeometallurgy and has donated as a start 1 million DM for an electron microscope to be served by two assistants. The Institute will establish a Council consisting of five well-known natural scientists and archaeologists. To begin with the Institute will have five assistants headed by the mineralogists Dr Andreas Hauptmann. He has worked on many archaeometallurgical research projects in Germany and abroad and has published many papers on the subject.

The Institute's affiliation to the Mining Museum is not fortuitous. As most of our members will know this museum has for some time taken an active interest in prehistoric and historic metal production and the results of this research have been published in its journal, "Der Anschnitt".

#### **EXCAVATIONS**

## A copper smelting site at Almyras near Alambra, Cyprus

The tapped slag of Almyras corresponds perfectly with the "Type B" slag (blocky type) defined by Koucky and Steinberg<sup>7</sup>. The authors date this type of slag in "Cypro-Archaic through Hellenistic", which is nicely confirmed by the slags of Almyras and their dating."

Mineralogical and chemical analyses of slag samples exported for destructive analysis are in progress. As well as the determination of phases, inclusions and main components, an extensive programme of trace element analysis has been initiated. So far, results can only be presented from geological samples.

As Almyras has yielded the complete chain of copper production, we hope to contribute new data on the unsolved problems of trace element partitioning during copper smelting<sup>8</sup>. The information gained from analytical work on Almyras material has the potential for new

impetus in the research of ancient copper working on Cyprus. Our analytical work on the 1988 finds formed the basis for the prospecting of the mine related to Almyras and the preliminary results were successfully applied in 1989.

Following the promising results of the 1988 geological survey, a large test trench was driven along the N-S slope of Almyras Hill, 30 metres west of the actual excavation area. With the kind support of the Geological Survey Department of Cyprus, remnants of a small but exceptionally rich copper deposit bearing clear signs of ancient open cast mining were uncovered. Three whole rock analyses of samples taken from this deposit yielded 9.7%, 13.8% and 15% copper<sup>9</sup>. This important discovery confirmed last years assumption that the copper ores must have been mined very near the smelting furnaces and that a copper deposit was the actual raison d'être for Almyras.

In situ evidence for mineral dressing was found in trenches 27, 28, 30 and 33, i.e. in the upper part of the site. The remains are directly sitting on bedrock and consist of patches of finely ground gossan with rounded limonite coated grains of pyrite of various sizes below 1 cm. These patches are always covered with a fine layer of secondarily built malachite.

One more furnace was discovered in the NE-corner of Trench 22 during the 1989 season. The whole installation was covered by huge blocks of havara which had smashed the furnace into pieces but had preserved it as an almost complete unit. Furnace lining and tuyère fragments, which most probably belong to this furnace, were found in Trench 22 and Trench 33. Of special interest are the fragments of furnace lining which indicate the existence of tuyères and their position relative to the furnace walls. The furnace fragments are heavily slagged and vitrified on the inside and represent the joints between the furnace and the tuyère. The thickness of the furnace wall was 3.5 cm and the thick slag deposit on the tuyère occurs on the part which was set inside the furnace. (from information supplied by Dr S Swiny).

# Recent Excavations of Bloomery Furnaces in the Somogy County, Hungary.

South of Lake Balaton, near Somogyfajsz, new slagbearing sites have been discovered that are connected with bog iron ore deposits. Geomagnetic survey and excavations led by J Gömöri (carried out by members of a working group for industrial archaeology) revealed 16 embanked furnaces and three iron blooms. The furnaces are similar to those from Olomucany in Moravia. Their manipulation gate were blocked by special tuyere clay panels. Their date is estimated to be the 10th century AD. The iron works appear to have been located in the lands of Duke Fajsz, as confirmed by the place name.

The other site, Somogyvámos, yielded 22 underground bloomery furnaces arranged in a battery (hearth dia, 30-40 cms). The excavations were carried out by L

Költö, Museum of Kaposvár. Radio-carbon dating indicates the early Middle Ages (935 AD). Until now this region in SW Hungary has not been investigated in terms of archaeometallurgy, and so these discoveries are very important.

J Gömöri, Sopron.

# A Medieval Metal Workshop Excavated at Trondheim, Norway.

The clearing of the site called Mellageret in Trondheim, where the new concert hall is to be erected, revealed a large metal workshop from AD 1100-1300. Rescue operations showed that three metals, iron, copper and lead, were treated there by smithing, hammering, and probably also by melting, refining and casting. At that time, Trondheim was called Nidaros, a famous pilgrim city attracting people from all over Europe, the power being centred on the king and the archbishop. Since a great number of bloomery furnaces of this period have been found in the mountains, the smithing of iron and the resulting waste (smithing slag) may reveal data on the provenance, transportation, and organization of medieval ironmaking. The investigation is continuing.

A Espelund, Trondheim

# Ancient Smelting Furnaces found at Les Martys, Montaigne Noire Area, Southern France.

Following the discovery of a smelting furnace at the large Roman iron-production site of Les Martys (Aude), Professor Claude Domergue carried out an excavation in April 1989. This brought to light four further furnaces, all built of granite blocks lined with clay. The internal dimensions of these shaft furnaces were ca 100 x 50 cms. They are the first smelting furnaces, presumably Roman, to have come to light on this site, situated in an area well known for its huge slag heaps which have been reused for industrial purposes since the 19th century.

H Cleere, London.

# Medieval Mines and Smelting Furnace at Kópháza, Hungary.

At the village of Kópháza, situated close to the Austrian border in W Hungary, scattered funnel-shaped mining pits (Pingen) were discovered in 1989 in a forested landscape in an area of 30,000 m². Their diameters ranged from 2 to 12 m with a maximum depth of 1.5 m; 227 pits were mapped. One of them was excavated, revealing a narrow shaft 1 m wide which was followed to a depth of 6.7 m. No timbering was observed. Limonite concretions with goethite as the major component were reported. X-ray diffraction also revealed amorphous hydroxides, quartz and montmorillonite.

A smelting site was excavated about 152 m from the mining pit field, unfortunately badly damaged, with the

remains of a possibly free-standing shaft bloomery furnace, reinforced with stones. Radio-carbon dating gave 1190  $\pm$  120 AD for the mine, and 990  $\pm$  for the furnace. The research team consisted of J Gömöri, J Ivancsics, J Verö and E Csongor.

J Gömöri, Sopron

#### **SCIENTIFIC ACTIVITY**

#### Reconnaissances and survey:

### Ancient and Medieval Iron Smelting on the Island of Elba.

The importance of Elban iron ore in antiquity and in later periods has been well demonstrated by recent systematic reconnaissance organized by the University of Pisa and carried out by Alessandro Coretti, of the staff of the Scuola Normale Superiore, Pisa. The main task was to record and map the slag heaps over the whole island, most of which have been severely damaged, destroyed or completely removed in course of reworking by modern industry. About 100 sites have been recorded, of which about one-third could be dated approximately by associated finds, especially pottery. No explicitly Etruscan finds have so far come to light (no systematical large scale excavations have yet been carried out) but during the Roman Republican period (2nd - 1st centuries BC) sites were definitely being used in small bays, which provided anchorages at the mouths of streams where the Rio Marina ore was shipped by boat from the east coast of the island and iron smelting activity began. Charcoal was brought from the upper valleys. It seems that these coastal bloomeries were directed by a centralized administration.

A different pattern emerged in the Middle Ages (12th - 14th centuries AD), during the period of Pisan domination. The smelting sites are to be found in valleys and the slopes of small streams, close to renewed fuel resources. The iron smelters presumably came seasonally from Pisa and the mainland to the interior of the island; they collected iron ore at Rio Marina and spread all over the island to look for wood for charcoal burning and for suitable places to operate bloomery furnaces (assumed to be open smelting hearths) in short production periods.

The project involves investigation of the slag samples collected. The first results are forthcoming (Symposium of Archaeometallurgy in Bologna 1988, Geoarchaeological Review).

A Coretti, Pisa.

#### Early Bloomery Slags on the Coast of Tuscany

During systematic archaeological reconnaissances in the coastal area of Tuscany, coordinated by the Medieval Department of the University of Siena, there were discovered numerous slag deposits. Not regarding the famous slags at Populonia, there are worth mention those at the estuaries of the Cornia (Livorno) and Ombrone (Grossetto) rivers. The sites accompanied by bloomery slag follow the river banks upstream. The

surveying and excavation works yielded all necessary samples needed for further evaluation: slag lumps, charcoal residues, pottery and the like. The registration of sites and finds is enabled by developing a special file system which can be transmitted to computerizing processes.

At the present moment it seems to be evident that at least a fifth of the sites identified, the total number of which may be estimated as fifty, can be dated by pottery finds to the Middle Ages. The production period relates to the Pisan activity; the "fabbri" of Pisa, ironworkers, were engaged in iron smelting at the end of the 13th century AD.

The above mentioned slags are closely connected, without any doubt, with the iron ore deposits of the island of Elba. It is to be stressed that within the exploration process the relation to the raw material resources of that island has to be studied in detail. Anyhow, the investigations show that the ancient and early ironmaking activity played an important role in the economic history of the region.

R Francovich (Siena).

#### **METALLOGRAPHY**

### Further Pattern-welded Swords from Illerup and Nydam.

Recently, sixteen fragments of Roman swords have been examined, six from the Illerup and ten from the Nydam moor deposit. The swords from Illerup have been investigated metallographically and by chemical analysis. The chemical and metallographic analysis of the Nydam swords is not yet complete, and this may give rise to some interim erroneous conclusions regarding the smithing technique. Surfaces of some of the finer swords have been polished to show the original intentions of the swordsmith. A replica of one of the Nydam swords has been made by H Denig, a master smith from Kaiserslautern.

R Thomsen, Varde.

#### **EXPERIMENTS:**

Smelting of Iron and Forging of Japanese Swords at the Musée Du Fer, Nancy, France.

The Musée d'Histoire du Fer at Nancy - Jarville-le-Malgrange (C. Forrières, Laboratoire de Restauration des Métaux) organized on 1-15 June 1989 a unique meeting of metallurgists, blacksmiths, physicists and an archaeologist (Ph. Andrieux) connected with the manufacture of traditional Japanese swords by a group consisting of two master swordsmiths (Mr Ono Masami, the Kanemasa, 66), Wakita Ryosui, university educated, 53, one scabbard maker (Mori Masaharu) and one sword polisher (Imasi Michiharu).

Powdered Mauretanian hematite (grain size below 1 mm) was smelted with pine charcoal (fractions 2-5 cms) in a vertical brick-built furnace erected in the Museum

Park (height 120 cms dia. 20 cms), operated by box bellows producing 600 1/min. of air. After 12 hours the process was stopped and next morning an iron sponge, weighing over 10 kg, was removed from the furnace. The blacksmiths identified the iron and steel parts destined for making the sword blade. In addition, a model of a Holy Cross-Mountains furnace (Poland, Romano-Barbarian period, height 150-160 cms) was tested with the assistance of Master Ono and directed by Philippe Andrieux: 15 kg of heavy iron sponge conglomerate was produced; Master Ono split it and identified a steel nucleus inside.

Sword forging, with a commentary by A Thouvenin of the Laboratory of the Musée du Fer, followed after the careful collecting, fritting (sintering) and subsequent welding together of all the iron particles and pieces, using clay paste and burnt straw in the reheating process. The making of the blade involved the homogenization of steel and multiple refolding (piling) of the material. Selective quenching of the cutting edge necessitated protective surface layers of sand, charcoal and clay, which avoided the formation of minute air bubbles on the immersed metal. A very important stage was the fine polishing.

As an integral part of this magnificent demonstration an exhibition was set up in the Gallery of the Museum, showing 12 ancient Japanese swords, the work of famous schools of the period before 1575: Bizen, Mino, Shosu, Yamashire, Yamat. This visit of the Japanese sword smiths has inspired archaeometallurgists in many ways. We are grateful to Philippe Andrieux for kindly providing us with information about this unusual performance.

#### Experimental Iron Smelting and Smithing Documented by the Departement of Prehistory of Zürich University, Switzerland.

On the occasion of an exhibition on the trade of the smith and the development of iron technology at the Technorama in Winterthur, Switzerland, an iron-smelting experiment was carried out by the smiths guild ELIGIUS of Schaffhausen. Students of the Department of Prehistory participated. The Sulzer Company and the Department of Road Traffic of Winterthur as well as the Department of Metallurgy of the Polytechnicum in Zürich assisted with equipment and technical advice.

The shaft furnace, about 1.3 m high, was constructed by ELIGIUS and was operated by one of its members. 17 kg of Austrian Erzberg ore, 76 kg of charcoal, and a steady airflow were applied. After 10 hours, a bloom weighing 8 kg was removed from the furnace. Temperatures measured during the process reached 1200°C. Smithing experiments on this bloom have failed so far, but a knife was forged from the bloom produced by ELIGIUS during an earlier experiment. A video-film was produced by the University Television Service which documents both smelting and smithing.

Preliminary analyses of ore samples and the bloom

were carried out at the Centre d'analyse minérale of the University of Lausanne. Results show an overall 7-10% of metallic iron in the bloom. Trace-element analysis of various slag samples show clear correlation between the ore and the product smelted, notably in respect of Ba, Co, Cr, Mn, V, Zn and Zr. In this regard, the experimental product of smelting Austrian Erzberg ore can readily be distinguishable from other ancient iron slags found on various sites from the late Hallstatt period onwards in Switzerland.

Marianne Senn-Luder - W. Fasnacht, Zurich.

## Recent Finds from Switzerland Concerning the Roman Iron Trade.

Local and regional primary iron production was the only one source of iron supply in Roman Switzerland. Generally, the densely populated molasse plateau and the settlements in the Rhine valley had to be furnished with the raw material from the mountainous iron bearing districts.

Iron trade must have existed in Roman Switzerland. Recently, the gravestone of a merchant of Augst BL (Augusta Raurica) has been identified as depicting iron ingots. It shows two typical bipyramidal ingots ("Spitzbarren") and stacks of quadrangular bars; one of these stacks is being weighed on a balance (Max Martin, Roemermuseum und Roemerhaus Augst, Augster Museumshefte 4, August 1987, p. 66 sqq.). Fragments of such bars have recently been detected in the blacksmiths workshops of the Roman villa of Dietikon (Zürich and the vici of Baden AG and Zurzach AG (publications in preparation).

Important findings of bipyramidal ingots have been in the Bernese lake district. There seem to have been transport losses along a river route which led from the iron deposits of the Jura in the west to the settlements of the central plateau (Hans-Markus von Kaenel, Ein Depotfund von 16 doppelpyramidenfoermigen Eisenbarren in Schwadernau BE, in: Archaeologie der Schweiz IV/1981, 1). Other bipyramidal ingots of a rare, flat rhomoid form have been found deposed in a commercial building at a road crossing of Kaiseraugst AG (Augusta Raurica). No connection with blacksmithing could be stated; the finds must be regarded as trade goods (U Mueller, Die roemischen Gebaeude in Kaiseraugst-Schmidmatt, in: Archaeologie de Schweiz VIII/1985, 1).

Another type of ingot has been identified during the recent excavations at Zurzach AG and Baden AG. They are cut-off pieces of flat iron bars with a strong resemblance to the blades of sword-shaped currency bars of the later La-Tène age. Even the cut-off shoulder piece of a sword-shaped bar has been found in a Roman age scrap deposit of Zurzach.

C Doswald, Brugg

#### The Problem of the Iron Age in the Phillipines.

Based on the limited evidence of iron artefacts and the associated pottery, it h as been argued that a "Phillipine Iron Age" began sometime around 500-200

BC. Phillipine ethnographic and ethnohistorical records indicate that iron was supplied by Chinese traders in exchange for forest products, gold, salt, beads, etc. and that local blacksmiths processed iron for agricultural and household implements. Surpluses were traded to other groups, promoting the continuous diffusion of iron

Ten iron samples from the Phillipine National Museum and seventy-five samples from the Guthe-Michigan collection were examined metallographically. Microhardness testing was carried out, as well as qualitative and quantitative analysis. Descriptive and exploratory statistics were used to construct a generalized typography. The Guthe collection showed variability in morphology, metallurgical treatment, and function, projecting a pattern of regional variation among artefact types. The metallography suggested an improvement in iron technology over time. There are no indications of mass or standardized production of iron implements, suggesting local production on a small scale.

It may be concluded that there is no real Iron Age in the Phillipines but that there were iron-using societies in certain areas beginning ca 370 BC. The study of iron technology constitutes a mechanism by which an improved understanding of the socio-cultural complexity of pre- and protohistoric cultures in the Phillipines and Southeast Asia may be achieved.

The above abstract is based on the Ph.D. dissertation by E Z Dizon: "An Iron Age in the Phillipines?: A critical study", University of Pennsylvania 1988 (University Microfilms International, Ann Arbor, Michigan, USA, Order Number 8816166).

E Z Dizon, Manila.

#### **CONFERENCES**

The International Symposium "Archaeometallurgy of Iron: From Bloom to Knife" was held on 18th - 22nd September 1989 in Kielce-Ameliówka in Poland. It was sponsored by the Archaeological Museum in Kraków, with the scientific participation of the Comité pour la sidérurgie ancienne de l'UISPP. Other Polish institutions/Technical Museum Warsaw, The Board of Miners in the Kielce region gave general support to this valuable meeting, which was the result of the enormous efforts of Dr Elzbieta Nosek, the Secretary of the Symposium, who overcame the many difficulties and obstacles that beset Poland at that time.

The object of the Symposium was to present results in the experimental archaeometallurgy of iron; in addition general topics and reports on new discoveries concerning early iron making and working were discussed. Following the opening remarks by representatives of local authorities and by the secretary of the CPSA, the following papers were read: K Bielenin (Kraków): Ancient metallurgical centre at the Holy Cross Mountains: balance and perspectives; P Crew (Gwynedd): Comparative data from 27 bloomery iron experiments; G McDonnell (London): A model for

the formation of smithing slag; W Fasnacht - Marianne Senn (Zürich): Experimental iron smelting and smithing documented by the Department of the University of Zürich; R Pleiner (Prague) - Vera Souchopová (Blansko): Comments on experimental smelts in early medieval embanked furnaces in Blansko; G Sperl (Leoben): Twenty five experiments on ancient iron: results; Hede Svane (Oslo): Norwegian currency bars: typology and technical composition; L E Englund (Stockholm): Early ironmaking in Kind, Sweden; P Benoit - Nicole Sportes (Paris): La sidérurgie cistercienne en Bourgogne du Nord: aspects archéologiques et analytiques; B Scott (Belfast): Cutting-edges in early artefacts; J Piaskowski (Kraków): The technology of iron implements on the territory of Poland in the late La Tène and Roman periods; M Mangin (Besançon): La sidérurgie aux époques romain et médieval dans l'est de la France; R Maddin (Mashpee): Eighth century BC iron from Kinneret (Israel); V Pigott (Philadelphia): Some current thoughts on early iron metallurgy; E Nosek (Kraków): Comments on forging high-phosphorus iron; J Gömöri (Sopron): Some iron blooms and bars from Hungary; Ph. Andrieux (Ville juif): Le comportement thermique des bas fourneaux selon des arrangements et de la conduite; A Espelund (Trondheim): Towards a classification of the bloomery process; A Anteins (Riga): Zur Geschichte der Rennöfen in Lettland; Janet Lang (London): An iron dirk from Cyprus; O Voss (Copenhagen): The Danish slag-pit furnace; E Tholander (Roenninge): instead of the announced paper on the occurrence of nickel in some ancient steels the author restricted himself to comments on smelting and smithing experiments organized at Nowa Slupia and Starachowice 20-21 Sept. (below); C Domergue: (Toulouse): Les fours de réduction du fer de Les Martys.

Fulfilling the title of the symposium, "From Bloom to Knife", the meetings was enriched by practical experiments in the presence of the participants, organized at Nowa Slupia, in the grounds of the Museum devoted to the excavations of bloomeries in the Holy-Cross-Mountains (now a branch of the Technical Museum in Warsaw). Trials were conducted on a La Tène period domed furnace (Burgenland Unter pullendorf 2 model (with three bellows) which worked for 6 hours and consumed 26 kg of hematite ore and some 50 kg of charcoal (preheating and final coal charges included, ore/fuel ratio was 1:1). The smelt was conducted by Ph. Andrieux assisted by K Bielenin, R Pleiner and a team of volunteer blowers succeeding one another on the bellows. P Crew demonstrated the smithing of a bloom made in an earlier experiment at Nowa Slupie, using an oblong hearth (ca 40 x 80 cm, charcoal fuel, fan blown). The bloom weighed 11 kg, reduced to 6.5 kg after cold removal of slag. The smithing took 2.5 hours and 25 reheats, resulting in a partially consolidated billet of 3 kg (53% loss). Next day H Denig (Kaisenslautern) demonstrated some of the stages in pattern-welding techniques for making sword blades at the Steel Works at Starachowice. This could not be completed because of lack of time and improvised conditions, but valuable information was obtained.

During the smelt at Nowa Slupia there were opportunities to see the excellent exhibition devoted to the research activity and results in the Holy Cross Mountains and to visit the latest excavations by K Bielenin at the site Nowa Slupia 12 (a slag-pit furnace field, 2 x 3 rows, ca 70 furnace residues, Romano-Barbarian period). After the visit to the Starachowice Steel Works the excursion continued to the famous Eneolithic flint mines at Krzemionki Opatowskie, and to the Cistercian Abbey at Wachock.

The symposium in Poland brought together 45 scholars from 14 countries (Poland, Czechoslovakia, Hungary, USSR, United States of America, England, Northern Ireland, France, Federal Germany, Switzerland, Austria, Denmark, Sweden, Norway and Italy). To sum up the spendid symposium at Kielce-Ameliówka was notable for its complete success and for its friendly atmosphere, which helped to stress the importance of international cooperation in this field. At the end, expressions of gratitude were transmitted to Mme Nosek, and tribute was paid to the immense work of exploration and research of Professor Bielenin in the Holy Cross Mountains.

R Pleiner, Prague.

In Sweden a centre for research in archeometry has been founded by a group of archaeologists and scientists and is located in the Physics Department of the Chambers University of Technology and the University of Gothenburg. It is called the Scandanavian Archaeometry Centre/Skandinavist Arkeometricentrum. The interests represented by the Centre are very broad. ranging from conservation to archaeoastronomy, and include ancient metals, metallurgy and numismatics. The group's newsletter, SAC-News, was first issued in May 1989 and is written in a mixture of English and the Scandanavian languages, with the centre-page spread reserved for a short contribution. A new journal, Archaeology and Natural Sciences (ANS), will be published by the centre in English. The provisional board of SAC is headed by Peter Fischer. For information write him at Sims-Laboratoriet, Chalmers Techniska Hogskola, 412 96 Goteborg, Sweden, telephone 031-81 01 00-1247.

In France the "Institut pour l'histoire d'aluminium" was founded in 1986 with the support of the French association of aluminium producers and fabricators. The Institute has set up a Documentation Centre, offers study grants for work in the history of aluminium, and publishes a journal, the *Cahiers d'histoire de l'aluminium*. The annual subscription for two issues is 80 francs outside France. For information write the Secretary General, Ivan Grinberg, 203 rue du Faubourg Saint-Honore, 75008 Paris, France, telephone (1) 45 61 61 93.

The Asian Institute of Gemological Sciences have recently begun publication of a lavishly illustrated quarterly, the *Gemological Digest*. A one-year subscription by surface mail is US\$29, 3 years \$79; by air \$39 or \$106. They also offer courses and mine tours.

For a catalogue write the Asian Institute of Gemological Sciences, 987 Silom Road, Rama Jewelry Building 4th floor, Bangkok 10500, Thailand, telephone 233-8388-9, 236-0257, 236-8870, 235-1254-5, cable GEMMART, telex 22518 HOGROUP TH, fax 236-7803.

Volume 12 in the series "Bibliographies of the History of Science and Technology" edited by Robert Maulthauf and Ellen Wells and volume 446 in the Garland reference library of the humanities is *The History of Metal Mining and Metallurgy: an Annotated Bibliography* by Peter M Molloy (New York 1986). It is available for \$57 (ISBN 0-8240-9065-9) from Garland Publishing Inc., 136 Madison Avenue, New York 10016, New York, telephone 212-686-7492.

Also published in 1986 Volume 13 in the same series is *Bronze Age, Greek and Roman Technology: A Select, Annotated Bibliography* by John Peter Oleson, volume 646 in the Garland reference library of the humanities (\$73, ISBN 0-8240-8677-5), which has items on prospecting and mining (pp. 55-63), metallurgy (pp. 76-99) and metalworking (pp. 253-273).

The Archaeometallurgy Column in the *Journal of Metals* being conducted by Vincent Pigott presented part 2 of "King Solomon's Mines, A 20th Century Myth" by James D Muhly in December (pp. 36-37). "A modern reincarnation of ancient slags" by William Rostoker in April (pp. 70-71) and a two-part series on "Replicating America's earliest bloomery process" by David Harvey in June (pp. 46-47) and July (pp. 44-46).

The book Heartland Blacksmiths: Conversations at the Forge by Richard Reichelt (Southern Illinois University Press, Carbondale and Edwardsville 1988) contains an interview with Daryl Meier (pp. 61-76) on modern pattern welding.

Ned Heite reports from Iceland that some smithy slags have appeared in fill on a 1226-1550 priory site excavated in the summer of 1989.

Professor Birgit Arrhenius of the University of Stockholm has been appointed a Research Collaborator at the Smithsonian's Conservation Analytical Laboratory where she will continue her study of the techniques of Merovingian jewellery. Her monograph Merovingian Garnet Jewellery: emergence and social implications was published in 1985 by Almqvist and Wiksell International, Stockholm (ISBN 91-7402-160-5).

Professor Robert Maddin has been awarded a Senior Humbolt Fellowship to spend a half year in Andreas Hauptmann's laboratory at the German Mining Museum in Bochum. He will examine Roman mining tools in German collections for evidence of carburization.

A 2nd Symposium of Archaeological Sciences was held in October 21-26 1988 at the University of Science and Technology of China in Hefei. If you have any news of this meeting or any other archaeometallurgical news to contribute please call Martha Goodway at 310-3733 or write her at CAL MSC, Smithsonian Institution, Washington DC 20560, fax 301-238-3667.

### RESEARCH ACTIVITY IN FRANCE

#### Regional research and reconnaissance

Ancient and Early Mining and Bloomery Production in Eastern France: Recent Results 1981-1989.

For the past ten years a research programme has been developed in three regions of eastern France: Burgundy, Franche-Comté and Lorraine. The studies are being carried out by 24 teams and concern non-ferrous as well as ferrous metallurgy. Iron mining and the documenting of bloomery sites are the subjects of continuous work. The study of the Iron Age period as a complex of problems is beginning, especially in the Lorraine.

The programme of chemical analysis is supervised by the Centre de Recherches Pétrochimiques et Géochimiques (1986) and has so far involved about 500 analyses of ores, slags, furnace linings etc., (see A Ploquin - J L Remy: Data Base for Mining and Metallurgical Archaeometry in France, in: Coll. Int. di Archeometallurgie, Bologna 1988, in press). The object of this complex research project is the collection of all the available data on the principal production districts using different ores, mining systems (for Burgundy: M Mangin - W Birke: Le fer en Bourgogne, in: Mines, Ferriers et fourneaux à l'époque romaine dans le Morvan septentrional, in: Mineria y metallurgíen las Antiguas civilizaciones Mediterraneas y Europeas, Madrid 1985, in press) and relations between mines and bloomery sites, settlements and roads (Morvan and Haut Auxois; Berthelange near Besançon and "Le Finage" near Dole). Since 1983 sixteen Roman and early medieval shaft furnaces have been excavated (11 in Burgundy). Their typology and function are being compared with published finds from central and northern Europe.

A general archaeological map of mining and metallurgical sites will be published. The first stage is the reconstruction of the Gallic iron production in the western Roman provinces. The situation in the Iron Age and the Middle Ages will be the subjects of later research stages. Preliminary results from these projects were presented at the Symposium of the Comité pour la Sidérurgie ancienne at Kielce-Ameliówka, 18-22 Sept. 1989.

M Mangin, Besançon.