Abstracts

GENERAL

E Darque-Ceretti, D Hélary and M Acouturier. An investigation of gold/ceramic and gold/glass interfaces. *Gold Bulletin,* 2002, **35**(4), 118–129.

The paper describes methods used to produce both ancient and modern gilded glass and ceramics. The results from a range of modern analytical techniques provides information on the physico-chemical and spectral properties of the gold films. JB

D Perlík. Vliv plazmy na metalografii a deinozaci železných archeologických nálezu. [The effect of plasma on metallography of archaeological iron objects]. *Sborník z konzervátorského a restaurátorského semináře, České Budějovice 2001* [Proceedings of a conservation and restoration seminar at Èeské Budìjovice, Bohemia]. Technické muzeum Brno 2001, 89–95.

The hydrogen plasma treatment carried out at 150–200°C for five hours does not influence heat treatment structures of steels according to these researchers. CPSA

BRITAIN AND IRELAND

J Bayley. Precious metal refining in Roman Exeter. *Proceedings of the Devon Archaeological Society,* 2001, **59**, 141–47.

Excavations in Frienhay Street, Exeter, in 1981 found a small group of most unusual glazed ceramic vessels in the fill of a roadside ditch within the early Roman town, dateable to the 2nd century AD. Examination and scientific analysis of the deposits on the vessels showed that they had been used for parting, that is the process of separating silver from gold. Author

S Blaylock. Excavation of an early post-medieval bronze foundry at Cowick Street, Exeter, 1999-2000. *Proceedings of the Devon Archaeological Society,* 2001, **59**, 1–92.

Report on excavations on the site of the 16th and early 17th-century bell- and cauldron-foundry of the Birdsall family. Earlier excavations on the site in 1978 and 1984 have only been published in interim reports, but identified foundry installations, evidence for bell-casting and a dwelling on the street frontage. These provide a context for the more recent work which exposed extensive areas of quarry pits for clay for mould making, which were spread over an area of some 4500m^2, and large quantities of broken cauldron mould recovered from the back-filled pits.

Author (adapted)

J Cattell, S Ely and B Jones. The Birmingham Jewellery Quarter: An architectural survey of the manufactories. London: English Heritage, 2002. 294pp, ISBN 1 873592 48 5.

The Jewellery Quarter was developed from the late 18th century and within 50 years had become an industrial zone, specialising in the production of jewellery and small metal goods. It continued to expand, reaching its largest extent in the early 20th century with over 50,000 workers. Today 6,000 still work in the jewellery and related metal trades; it is the main centre for gold jewellery production in Britain. There is no other comparable urban industrial quarter in Britain, still using historic buildings for their original purpose.

The book is based on a survey of the Quarter's buildings—houses, workshops, purpose-built factories and specialist structures such as the Assay Office. It traces how they came into being, as well as highlighting the main processes, tools and machinery involved in jewellery and small metalware production. A gazetteer of 141 of the most important buildings is included, illustrated by new photos, historic plans and engravings and maps and cut-away diagrams. JB

E Coatsworth and M Pinder. The art of the Anglo-Saxon Goldsmith. Fine metal work in Anglo-Saxon England: its practice and practioners. *Anglo-Saxon Studies series* 2, Boydell, 2002, ISBN 0 85115 883 8.

The book details the physical evidence for Anglo-Saxon goldsmiths and their work, including tools, manufacturing and decorative techniques. Technical aspects of goldsmithing are considered and the contemporary texts and illustrations are also reviewed. SL (modified)

G Hull. The excavation and analysis of an 18th-century deposit of anatomical remains and chemical apparatus from the rear of the first Ashmolean Museum (now The Museum of the History of Science), Broad Street, Oxford. *Post-medieval Archaeology,* 2003, **37**(1), 1–28.

Among the finds were a group of over 30 vessels, mainly crucibles of a variety of forms. XRF analysis by Chris Salter identified many zinc-rich deposits, lead-silicate glasses or glazes, probably gypsum, and an 'ingot' of sulphur. The processes carried out were not specifically identified, but seem to have been chemical rather than metallurgical. JB

R Matthews. The production of the proof sovereign. *Gold Bulletin,* 2002, **35**(4), 130–132.

The modern gold sovereign was introduced in 1817. Peak production was in 1911 and 1912 when over 30 million a year were produced by the Royal Mint in London. Since 1917

production of bullion sovereigns, ie coins whose value depends on their gold content, has been spasmodic, with none produced between 1982 and 2000. However proof sovereigns have been made every year since 1979. They are made from a 22 carat gold/copper alloy, using specially prepared coinage blanks and polished dies. Details are given of the production process, from continuous casting to blank punching and striking. JB

T M Mighall, P W Abrahams, J P Grattan, D Hayes, S Timberlake and S Forsyth. Geochemical evidence for atmospheric pollution derived from prehistoric copper mining at Copa Hill, Cwmystwyth, mid-Wales, UK. *Science of the Total Environment* 2002, **292**, 69–80.

This paper presents geochemical data from a blanket peat located close to a Bronze Age copper mine. The objective was to explore the possibility that the peat contained a geochemical record of the pollution generated by mining activity. Four peat monoliths were extracted from the blanket peat. Three different geochemical measurement techniques were employed and four copper profiles reconstructed, two of which are radiocarbon-dated. The radiocarbon dates at one profile located close to the mine confirm that copper enrichment occurs in the peat during the known period of prehistoric mining. Similar enrichment of copper concentrations is shown in one adjacent profile and a profile 30m away. In contrast, copper was not enriched in the other radiocarbon-dated monolith, collected approximately 1.35km to the north of the mine. Whilst other possible explanations for the copper concentrations are discussed, it is argued that the high copper concentrations represent evidence of localised atmospheric pollution caused by Bronze Age copper mining. The results suggest that copper may be immobile in blanket peat and such deposits can usefully be used to reconstruct atmospheric pollution histories in former copper mining areas. Authors (adapted)

T M Mighall, J P Grattan, S Timberlake, J A Lees and S Forsyth. An atmospheric pollution history for lead-zinc mining from the Ystwyth Valley, Dyfed, mid-Wales, UK as recorded by an upland blanket peat. *Geochemistry: Exploration, Environment, Analysis* 2002, **2**, 175–184.

This paper presents records of the atmospheric deposition of lead and zinc close to a former metal mining area as recorded by an upland blanket peat. The objective was to explore the possibility that the peat contained a geochemical record of the pollution generated by mining activity during the last four millennia. Four monoliths were extracted from the blanket peat to reconstruct the pollution history of lead and zinc mining. Three geochemical measurement techniques were employed, and five lead and zinc profiles have been reconstructed, two of which are radiocarbon-dated. In the dated monoliths lead enrichment occurs in the peat during the Roman period, while both lead and zinc concentrations increase from the medieval period until the early part of the 20th century. Similar enrichment of lead and zinc is shown in the remaining profiles. While other possible explanations are discussed, it is argued that the high lead concentrations represent evidence of atmospheric pollution caused by mining. Zinc, however, may have suffered from post-depositional mobility. The results suggest that lead is largely rendered immobile in blanket peat and can be used to reconstruct atmospheric pollution histories in former lead mining areas. Authors (adapted)

T M Mighall, S Timberlake, S H E Clark and A E Caseldine. A palaeoenvironmental investigation of sediments from the prehistoric mine of Copa Hill, Cwmystwyth, mid-Wales. *Journal of Archaeological Science* 2002, **29**, 1161–88.

This paper investigates the use of mine sediments to reconstruct the vegetational changes and atmospheric pollution history associated with prehistoric and mediaeval metal mining. Pollen, charcoal, plant macrofossils, fossil insects and chemical analyses are presented from radiocarbon-dated sediments contained within a prehistoric mine situated on the upper slope of Copa Hill. The results provide additional support to the hypothesis that prehistoric mining had a negligible impact on woodland and that deforestation took place after Bronze Age mining ceased, Although high concentrations of Cu, Pb and Zn were determined from sediments of prehistoric and Roman age, the patterns bear little resemblance to off-site atmospheric pollution records and to the archaeological evidence for metal mining. Interpreting geochemical data from mine contexts is problematic as numerous factors influence the distribution and concentration of metals. However, an on-site and off-site approach to investigate human-environment interactions caused by metal mining is advocated. Authors (adapted)

A J Powell, J G McDonnell, C M Batt and R W Vernon. An assessment of the magnetic response of an iron-smelting site. *Archaeometry* 2002, **44**(4), 651–665.

The magnetic response derived from an iron-smelting site was investigated by comparing magnetometry and magnetic susceptibility geophysical survey data and laboratory analyses of the magnetic characteristics of the furnace and slags. Magnetic analysis and microscopy (optical and SEM) of samples from the furnace lining and the slag deposits demonstrated the heterogeneity in the magnetic, morphological and mineral compositions of both materials. The comparison of the magnetic characteristics of the material with the geophysical survey data illustrated the importance of using both magnetometry and magnetic susceptibility survey techniques to rnaximize the information from an iron-smelting site. The furnace was dated archaeomagnetically to the 14th century AD. The results demonstrate that the magnetic analysis of iron-smelting sites is highly valuable, both to characterize sites and to improve the understanding of early ironworking technology. Authors

P Wilson and J Price (eds). Aspects of industry in Roman Yorkshire and the North. Oxford: Oxbow Books, 2002. 151pp, ISBN 84217 078 3.

This collection of papers was inspired by a day-school about crafts in Roman Yorkshire. Those with some relevance to metallurgy are: J Bayley, Non-ferrous metalworking in Roman Yorkshire (101–108): Reviews the evidence for primary extraction of lead, and secondary working of pewter, lead, silver, gold, copper and its alloys. Includes a gazetteer of 36 sites within and close to Yorkshire. H Cool, Craft and industry in Roman York (1–11): The evidence for manufacturing activities in Roman York is summarized. There are tools and metalworking waste from a number of sites, providing evidence of the production of objects from iron, copper alloys and precious metals. D Dungworth, Copper alloys in Roman Yorkshire (95–99): Examines the production and use of copper alloys, in many ways a similar pattern to that of the wider Roman world. P Halkon, The Roman pottery industry at Holme-on-Spalding Moor in its

landscape (21–33): Includes a brief mention of the iron smelting and smithing industry of the area. P Wilson, Craft and industry on the North York Moors in the Roman period (13–20): There is some evidence for both iron smelting and smithing. JB

EUROPE

T Abdinghoff and M Overbeck. *Archaeologia Austriaca* (Wien) 1998–1999, **82–83,** 536–541.

A study of the archaeology of early tall furnaces in Middle Europe. CPSA

P Abraham. Les mines d'argent antiques et médievales du district de Kaymar, In C Domergue and M Leroy (eds) *Mines et Metallurgie en Gaule. Recherches récentes.* = *Gallia,* 2000, **57**, 123–127.

T Anderson, A Duvauchelle, V Serneels and C Agustoni. Stone and metalworking on the Roman site of Châbles-les Saux (Ct. Fribourg, Switzerland). In Ancient European Crafts. Acts of the International Conference at Podsreda (Slovenia) in April 1999, eds M Feugère and M Guštin *Monographie Instrumenta* 12. M. Mergoil, Montagnac 2000, 103–108.

A smithy and quarry for mill stone production. CPSA

F Bessan. Fabbri e produzioni di armi nel medioevo: l'area friulana. In M Feugère and M Guštin (eds), *Iron, blacksmiths and tools: Ancient European crafts*, Monographies Instrumentum 12. M Mergoil, Montagnac, 2000, 35–41.

Iconography, punch marks. CPSA

A Beyrie, J-M Fabre, R Sablayrolles. Les hommes du fer du dieu Ageio. Exploitation antique du fer dans les hautes Baronnies (Haute Pyrénées). In C Domergue and M Leroy (eds) *Mines et Metallurgie en Gaule. Recherches récentes.* = *Gallia,* 2000, **57**, 37–52.

The inscription from Asque (*Ageio deo pagani ferrarienses*), mining sites, mines. CPSA

K Bielenin. Einige Bemerkungen zu den Rennofeschlacken der Schlackengrubenöfen. *Archaeologia Austriaca* (Wien) 1998–1999, **82–83,** 523–528.

The slag blocks from the Holy Cross Mountains furnaces represent an evidence of a perfectly mastered process. CPSA

B Cauuet. Techniques de boisage dans les mines d 'or gauloises du sud-ouest Massif Central, Mines et Metallurgie en Gaule. In C Domergue and M Leroy (eds) *Mines et Metallurgie en Gaule. Recherches récentes.* = *Gallia,* 2000, **57**, 129–146.

B Cech. Gold and silver production in the fifteenth and sixteenth century based on the archaeological excavation in the Gastein Tal, Austria. In M Feugère and M Guštin (eds), *Iron, blacksmiths and tools: Ancient European crafts*, Monographies Instrumentum 12. M Mergoil, Montagnac, 2000, 21–33.

Apart from the main topic, includes a blacksmith's workshop for pick production and reparation. CPSA

R Clayton. New developments in isotope archaeochemistry. A review of recent advances in transition and heavy metal isotope studies and their application in archaeometallurgy. *Prehistoria 2000,Revue de l 'Union Internationale des Sciences Préhistoriques et Protohistoriques, Université de Gent*, 2001, **1**, 51–61.

K Czarnecka. Iron smelting in the Pre-Roman and Roman periods in central Poland. In M Feugère and M Guštin (eds), *Iron, blacksmiths and tools: Ancient European crafts*, Monographies Instrumentum 12. M Mergoil, Montagnac, 2000, 89–91.

A Daňková (Mrs). Průzkum archeologických předmřtů před konzervací—železné předměty. [The research of archaeological iron objects]. Sborník z konzervátorského a restaurátorského semináře, České Budějovice 2001 [Proceedings of a conservation and restoration seminar at Èeské Budìjovice, Bohemia].*Technické muzeum Brno* 2001, 79–82.

A metallographic examination revealed cold hammering of a 14th century iron helmet, and of a 16th century steel sword from collections of the Museum at Pod brady, Bohemia. CPSA

I Daveau, VGoustard, J J Bahain. Un complexe métallurgique et mini è du Haut Moyen Age. Le site du Fourneaux à Vert-Sain-Denis (Seine-et-Marne). In C Domergue and M Leroy (eds) *Mines et Metallurgie en Gaule. Recherches récentes.* = *Gallia,* 2000, **57**, 77–99.

25,000 bell pits, 80 roasters, bloomery ironworks from 7th to 9th centuries AD. CPSA

P-M Decombeix, C Domergue, J-M Fabre, A Gorgues, Chr Rico, F Tollon and B Tournier. Réflexions sur l'organisation de la production du fer à l' époque romaine dans le basin supérieur de la Dare au voisinage des Martys (Aude). In C Domergue and M Leroy (eds) *Mines et Metallurgie en Gaule. Recherches récentes.* = *Gallia,* 2000, **57**, 23–36.

During three centuries (60/560 BC to 260 AD) 80 000 tonnes of ironwere produced in the region which yielded 33 *ferriers*: the Grand Ferrier, Montrouch (battery of 6 furnaces) was excavated. CPSA

N Dieudonné-Glad. L'atelier sidérurgique gallo-romain du Latté à Oulches (Indre). In C Domergue and M Leroy (eds) *Mines et Metallurgie en Gaule. Recherches récentes.* = *Gallia,* 2000, **57**, 63–75.

A 4th century AD bloomery with small amount of glassy slag debris, newly connected with possible steel making processes. CPSA

C Domergue and M Leroy. L'état de la recherche sur les mines et les métallurgies gauloises au Haut Moyen Age. In C Domergue and M Leroy (eds) *Mines et Metallurgie en Gaule. Recherches récentes.* = *Gallia,* 2000, **57**, 3–21.

Clérimois, mines at Mans and La Bussi; Vert-Saint-Denis (Pyrénées, furnace), Blessey (smithy), Bordeaux. CPSA

P Drda. Les arts du feu sur les oppida celtiques. [Pyrotechnological crafts in the Celtic oppida]. In Les Celtes et les arts du feu. *Dossier d'archéologie* No. 258, 2000, 18–23.

A smithy was discovered in the oppidum of Závist near Prague, Bohemia, dated to the early phase of the site (2nd century BC). Later (1st century BC), another smithy operated at gate B of the oppidum.The oppidum of Hrazany on the Vltava river yielded traces of smithing activities at the northern gate (PCB slags, block tuyeres). CPSA

C Dubois. Lercoul (Pyrénées ariègeoises). Un site sidérurgique du IIIe siècle de notre ère. In C Domergue and M Leroy (eds) *Mines et Metallurgie en Gaule. Recherches récentes.* = *Gallia,* 2000, **57**, 53–62.

Three bloomery furnaces, 400 tonnes of slag, iron mines, collier sites. CPSA

L-E Englund, L Grandin, E Hjärthner-Holdar, P Kresten and O Stillborg. Pre-Roman iron production at Södeåkra—an archaeometallurgic investigation. Geoarchaeological Laboratory. National Heritage Board (Riksantikvarieämbet). Uppsala, 1999, RAÄ 219 Närke, 21–23.

A large slag pit furnace with stone slabs, said to be pre-Roman, is discussed. The site comprises two slag heaps, yielding hearth bottoms with some metallic iron, low-carbon metal, steel and phosphoric iron. Short abstract concerning iron making and working. CPSA

L-E Englund and L Larsson. Iron production at Stomskil during Roman Iron Age—an archaeologic and analytic study, Lillkyrka parish. Geoarchaeological Laboratory. National Heritage Board (Riksantikvarieäm-bet). Uppsala, 1999, RAÄ 219, Närke, 10–12.

A rescue dig found a clay and stone-walled slag pit furnace with a slag block inside (103kg). Air inlets traced,induced draught, supposed prints of a horizontal layer of reeds as traces of the original slag pit blocking. Also a smithing area with an anvil stone, slag, flakes of hammerscale. Chemical analyses of the furnace slag. CPSA

L Eschenlohr. *Recherches archéologiques sur le district sidérurgique du Jura central suisse* [Archaeological investigations concerning the iron producing district of central Jura, Switzerland]. Lausanne 2001, 319 pp.

This is a fundamental contribution to the development of iron production in one of the European regions, rich in ores and yielding over 300 archaeometallurgical sites. However, the technology of ironmaking, as documented by archaeology and written sources, can be classified mostly as traditional, processed in low shaft furnaces (bellows-blown and, later, operated by induced draught). The archaeometallurgical merits of August Quiquerez (19th century) are appreciated. Eschenlohr's book is written with a highly interdisciplinary approach applying modern prospection, palaeobotanical, mineralogical, chemical and metallographical analyses. According to the author, the theme was inspired by the systematic investigation of a single site, that of Boècourt-Les Boulies (6th–7th centuries AD) but enormous work has been realized in the field of magnetic prospection. The bulk of sites are dated to the high Middle Ages. The evidence of metallurgical activity during the La Tène and Roman periods is scarce. More important activities began in the Early Middle Ages (6th–7th centuries AD; 70 smaller ironmaking sites: *ferriers*). The bulk of metallurgical sites is medieval (9th –12th centuries, about 200 ironmaking sites); this was the period of discoveries made by Quiguerez in 1860s with a specific type of induced furnace with inclined shaft. The 14th and 15th centuries are classified as a decline of the industry despite the fact that the final phase saw the introduction of water power. Comparison with development in other parts of Europe is restricted to the West, especially France. The region, about 80 km^2, yielded pisolithic ores, the main fuel was beech charcoal, and in lower regions alder, willow and fir as well. The siderurgical activities led to drastic deforestation. The author considers the main owner of the land, the church and especially the abbey of Franches Montagnes, to be the developer or supervisor of the industry. The book is perfectly equipped. CPSA

A Espelund. Luppenstudien in Norwegen. *Archaeologia Austriaca* (Wien) 1998–1999, **82–83,** 528–536.

M Feugère. Outillage agricole et quincaillerie antique de Valentine (Haute Garonne). In M Feugère and M Guštin (eds), *Iron, blacksmiths and tools: Ancient European crafts*, Monographies Instrumentum 12. M Mergoil, Montagnac, 2000, 169–178.

Implements from hoards. CPSA

S Fichtl. La ville celtique (Les *oppida* de 150 av. J-C à 15 ap. J-C). *Errance*, Paris 2000.

A blacksmith's workshop at the Raboul Gate from Mont Beuvray-Bibracte is briefly described. CPSA

P Fluzin, A Ploquin V Serneels. Archéometrie des déchets de production sidérurgique. Moyens et méthodes d'identification des différents éléments de la chaine opératoire directe. In C Domergue and M Leroy (eds) *Mines et Metallurgie en Gaule. Recherches récentes.* = *Gallia,* 2000, **57**, 101–121.

Identification of different types of iron slags: bloomery, reheating, smithing, hammerscale. CPSA

A Gaspari. Römische Schmiedewerkstätten auf der Hügel Ulaka in Innerkrain, Slowenien. *Archaeologia Austriaca* (Wien) 1998–1999, **82–83,** 519–523.

The excavations of W Schmid (1936-1948). Unpublished smithies added. CPSA

A Gaspari, M Guštin, I Lazar, B Zbona Trkman. Late Roman tools finds from Celje.Gradište at Zbelovska Gora and Sv. Pavel above Vrtvovin (Slovenia). In M Feugère and M Guštin (eds), *Iron, blacksmiths and tools: Ancient European crafts*, Monographies Instrumentum 12. M Mergoil, Montagnac, 2000, 187–203.

Fourteen hoards with iron tools. CPSA

J Gömöri. Az avar kori és Árpád-kori vas kohászat réfészeti emlékes Pannoniában. [Summary: The Archaeometallurgical sites in Pannonia in the Avar and early Árpád periods. Register

of industrial archaeometallurgical sites in Hungary]. *Ironworking*. Sopron 2000, **273.**

The monograph is an extended version of an earlier study by the same author but is complemented by a historical survey of the iron making and working in the territory of modern Hungary. The topics include; Archaeometallurgical sites of Hungary, collection of data [iron], the beginning of iron production in Hungary, Celtic iron production, Roman iron production and blacksmiths' working in Pannonia, Avar-Onogur (7th–9th century) and Frank-Bavarian-Slavic, (9th century) antecendents of Hungarian iron production in Pannonia; Furnace typology, iron production in the conquest period, Somogyfajz type workshops; Period of the Hungarian state foundation. Pit-workshops in the Árpád period. Imola type furnaces. Bloomery sites of Alpine origin in the Árpád period. From the ore until the bloom, mines, ore, ore-roasting, fuel, furnace building material, blowing; Experimental smelts, reheating hearths; Blooms and bars; Smithy workshops. Metallography of iron objects. CPSA

L Grandin and L-E Englund. Smithing residues from Kräggesta, Kolsva parish, Västmanland. Geoarchaeological Laboratory. National Heritage Board (Riksantikvarieämbet). Uppsala, 1999, RAÄ 219, Närke, 26.

L Grandin and L E Englund. Iron and copper working in the Skatan block—an archaeometallurgic analysis, Skåne. Geoarchaeological Laboratory. National Heritage Board (Riksantikvarieämbet). Uppsala, 1999, RAÄ 219, Närke, 24.

L Grandin and L E Englund. Archaeometallurgic material from Vittene—Archeaometallurgic analysis. Geoarchaeological Laboratory. National Heritage Board (Riksantikvarieämbet). Uppsala, 1999, RAÄ 219, Närke, 26–27.

D Griffiths and A Feuerbach. Early Islamic manufacture of crucible steel at Merv, Turkmenistan. *Archaeology international,* 1999/2000, 36–38.

Clay crucibles (up to 200mm high) for steelmaking at Erk Kala and Gyaur Kala at city of Merv. Wrought iron pieces and fuel were charged and heated in a presumably domed furnace the base of which was uncovered. It was blown from below through a special air-inlet channel. CPSA

A Harnièár, L Mihok, D Mlynárčiková and P Roth. Baníctvo medzi Hranovicou a Vernárom [Bergbau zwischen Hranovica und Vernár]. *Lietuvos Archeologija*, 1999, **18**, 47–53.

Mining of iron ores at Starý Vernár, 5 bloomery slags analysed. CPSA

G Henneberg and J P Guillaumet. Die Eisenwerkzeuge der Hallstatt – und frühen Latènezeit in Mitteleuropa. *Archaeologia Austriaca* (Wien) 1998–1999, **82–83**, 493–7.

Survey of Early Iron Age iron and wood working tools from Central Europe. CPSA

Z Hensel. Badania materialoznawcze ostróg œredniowiecnych z Kalisza. [Material science investigations of medieval spurs from Kalisz]. *Archeologia Polski,* 2000, **45**(1–2), 93–97.

26 medieval spurs from Kalisz, Poland, show mostly low-carbon, phosphoric metal. In five cases carburization processes were observed (up to 0.8%C). In one case traces of gilding were discovered. CPSA

E Hjärthner-Holdar, L Grandin and L-E Englund. Cast iron and wrought iron. Material from the smithy in Vantinge, Scania. Geoarchaeological Laboratory. National Heritage Board (Riksantikvarieämbet). Uppsala, 1999, RAÄ 219, Närke 28–29.

Medieval and post-medieval samples. CPSA

E Hjärthner-Holdar, L Larsson and L-E Englund. Iron and metal working at a manor during the Late Iron Age and Early Middle Ages, Husby, Glanshammar parish, Geoarchaeological Laboratory. National Heritage Board (Riksantikvarieämbet). Uppsala, 1999, RAÄ 219, Närke, 13–16.

M Horvat. Iron furnaces from Sela pri Dobu near Ivaèna Gorica (Slovenia). In M Feugère and M Guštin (eds), *Iron, blacksmiths and tools: Ancient European crafts*, Monographies Instrumentum 12. M Mergoil, Montagnac, 2000, 93–96.

Two furnaces, one overlying the other, Roman period. CPSA

J Hošek. Rozbor železných předmětů z hradištì Kal. [A metallographic examination of iron artefacts from hillfort Kal] *Z Dìjin Hutnictví* 30 [Contribution to the history of Metallurgy]. Rozpravy Národního technického muzea v Praze 172. Praha 2001, 17–27.

Nine iron artefacts (knives, arrowheads, fittings) from the 8th century AD hillfort Kal in NE Bohemia were metallographically investigated. Iron to steel welding, medium quality of objects. CPSA

J Hošek. Metalografický rozbor středověkých hrotů šípů do kuší. [Metallographic analysis of the set of arrowheads], *Z Dìjin Hutnictví 27* [Contributions to the history of metallurgy] Rozpravy Národního technického muzea v Praze, 1998, **156,** 15–25.

52 crossbow bolts were investigated from sites in NE Bohemia. Mostly wrought iron bundles. CPSA

J Hošek and J Prostředník. Rozbory středověkých železných předmětů a strusek z hradu Dolní Štěpanice. [A metallographic examination of medieval iron tools and slags from the castle Dolní Štìpanice]. *Lietuvos Archeologija*, 1999, **18**, 13–24.

Analyses of smithing slags from a medieval castle. An iron sheet with a rivet coated with brass and soldered by Sn-Pb solder. Metallography of horseshoes and fittings. CPSA

J Hošek, J Prostředník and J Benešová. Kovářská dílna na hradě Trosky.[The smithy workshop in the castle Trosky]. *Lietuvos Archeologija*, 1999, **18**, 25–35.

A smithy equipped with a hearth yielded PCB slags (analysed) and some artefacts (arrowheads, a knife, horseshoes etc) which were investigated metallographically (mostly ferritic and pearlitic metal). CPSA

E Iaroslavchi. Les fourneaux de réduction du minerai de fer chez les Daces. In M Feugère and M Guštin (eds), *Iron, blacksmiths and tools: Ancient European crafts*, Monographies Instrumentum 12. M Mergoil, Montagnac, 2000, 97–102.

Furnace sites, iron blooms in a survey. CPSA

M Jančo. Germánska dielňa z Berouna . [A Germanic workshop at Beroun, Bohemia]. In *Sborník Miroslavu Buchvaldkovi* eds P Čech and M Dobeš, Most 2000, 107–110.

Within a group of Germanic settlements on the territory of Beroun, central Bohemia, many traces of making iron in the early Romano-Barbarian period were discovered during rescue excavcations. Here a sunken-floored feature is presented, interpreted as a bloomery with the hearth of a freestanding furnace in the SW corner and a stone anvil nearby. It may, however, be a smithy where iron and non-ferrous metals were worked, as copper sheet fragments show. CPSA

H Jöns. Schuby und Süderschmedeby. Zwei spätkaiserzeitliche Eisengewinnungszentren am Heerweg. [Schuby and Süderschmedeby.Two Late Romano-Barbarian iron production centres at the Heerweg, Schleswig-Holstein]. 1999, *Offa* **56** (Festschrift Ole Harck), 67–80.

Schuby: lower parts of furnace slag pits, slag block with prints of brushwood and straw; Süderschmedeby: excavation of a smelting and smithing area with stone anvil and slag. CPSA

H Jöns and B Wollschläger. Frühe Eisengewinnung in Südwestmecklenburg—Ergebnisse einer interdisziplinären Forschungsprojektes 'Archäometallurgie' [Early iron production in south-west Mecklenburg,Germany—results of interdisciplinary research project]. *Bodendenkmalpflege in Mecklenburg-Vorpommern, Jahrbuch 1998* **46**, Lübstoff 1999, 93–125.

The research into the archaeometallurgy in Jodelund Süderschmedeby, WeserValley, Harz, Oberlausitz, Märkisches Sauerland, Dill-Gebiet and Schwäbisch Alb. In Südwestmecklenburg 140 sites with iron production traces were registered, with the floruit in the Romano-Barbarian period. The most important of these is Göhlen; the excavations in this locality with its slag-pit furnace clusters have already been presented several times. CPSA

R Krajíc, Z Kukla and R Nekuda. Středověký meč ze Mstěnic. [A medieval sword from the abandoned village Mstìnice, Moravia]. In *Z pravěku do středověku*. Brno 1997, 250–258.

A long gothic thrusting sword or rapier (15th century AD), from the abandoned village Mstìnice, Moravia, homestead XV was found to be made of a carburized iron rod; the point was martquenched. A brass inlay appears in the upper part of the blade. CPSA

R Krempuš. Krvavica bei Vransko in Slowenien, Höhensiedlung des 3. bis 6. Jahrhunderts. In M Feugère and M Guštin (eds), *Iron, blacksmiths and tools: Ancient European crafts*, Monographies Instrumentum 12. M Mergoil, Montagnac, 2000, 209–231.

Early Slav iron implements from a settlement. CPSA

P Kresten. Slag and metal from Kyrkesviken, Ängermanland. Geoarchaeological Laboratory. National Heritage Board (Riksantikvarieämbet). Uppsala, 1999, RAÄ 219, Närke, 29.

P Kresten. Ralby iron works. Magnetometry. Dannemora, Uppland. Geoarchaeological Laboratory.National Heritage Board (Riksantikvarieämbet). Uppsala, 1999, RAÄ 219, Närke, 31.

Late medieval features, surveying. CPSA

P Kresten. Analysis of a smithing slag from Develier-Courtetelle, Central Jura, Switzerland. Geoarchaeological Laboratory.National Heritage Board (Riksantikvarieämbet). Uppsala, 1999, RAÄ 219 Närke 31.

Mineralogy of 6th–7th centuries AD smithing waste. CPSA

B Kritž. Iron smelting furnaces at Cvinger near Dolnjsk Toplice. *Archaeologia Austriaca* (Wien) 1998–1999, **82–83,** 498–500.

A short account of 12 features held for iron smelting furnaces (not properly documented). Large quantities of slag observed in an area of 100 x 50m. CPSA

A Kronz. Phasenbeziehungen und Kristallisations-mechanismen in fayalitischen Schmelzsystemen. Untersuchungen an Eisen – und Buntmetallschlacken. [Phase interrelations and crystallization mechanisms in the fayalitic melting systems. Investigation into iron and non-ferrous slags]. Thesis, Johannes-Guttenberg Universität, Mainz, 1997, 275 pp.

A detailed treatise on chemical and mineralogical analyses of metallurgical waste products. It includes discussions of fayalitic melts and the theoretical outline of the bloomery process, phase relations in fayalitic slags (olivine, wustite, spinels etc, glass, trace elements in the matrix), crystallization and stability, thermodynamics of the reduction process, smelting technology in the Dietzhölztal (the role of the furnace wall) and slags as process indicators. The samples analysed originate in the research into the production in the Dietz valley, Germany. The book may serve as a helpful manual for all those who are interested in the smelting processs and for those who use analyses of slags appearing in the literature. CPSA (modified)

L Larsson. Currency bars from a 17th century AD smithy in a Dalkarlen block — a metallographic analysis, Norköping, Östergotland, Geoarchaeological Laboratory. National Heritage Board (Riksantikvarieämbet), Uppsala, 1999, RAÄ 219 Närke, 18.

Corroded 17th century AD bars. CPSA

L Larsson, L-E Englund, E Hjärthner-Holdar and O Stillborg. Archaeometallurgic analysis of slag and iron from the iron production site at Binga, Hassmo parish, Småland, Geoarchaeological Laboratory. National Heritage Board (Riksantikvarieämbet). Uppsala, 1999, RAÄ 219 Närke, 17.

Four Vendel period furnaces and a smithing hearth. Slags and iron analysed. CPSA

M Leroy, M Mangin, H Laurent, M Boukezzola and B Raissouni. La sidérurgie dans l'est de la Gaule. In

C Domergue and M Leroy (eds) *Mines et Metallurgie en Gaule. Recherches récentes.* = *Gallia a,* 2000, **57**, 11–21.

1000 sites (mines and siderurgie) in Bourgogne, Franche Comté, Lorraine; Districts of production: Morvan (200), Lorraine (152), Mâcon; Iron Age 2nd/1st centuries BC, beginnings of production districts? Roman period; Morvan in the north, Montley-en-Auxois, mining village; Rural smithies. Avenches, Autun, St. Aubin, Choisy (large smithy), environs of Alésia, Blessey-Salmais; The decline in late antiquity; The *loricaria* at Augustodunum, other *fabricae* for weapons as in the *Notitia Dignitatum.* CPSA

S Mäder. *Mado wo akeru* – Ein Fenster öffnen. Überlegungen zur Kategorisierung europäischer Klingen auf Grundlagen japanischer Begutachtungen. [Mado wo akeru - open a window. Thoughts towards categorizing European sword blades on Japanese criteria]. *Ethnographisch-archäologische Zeitschrift* (Berlin), 2000, **41**(1), 17–27.

A proposal for classification of European sword (and seax) blades according to Japanese swordsmith lore (*Kantai)* which requires a flat polishing of blades. Individual criteria and terminology are discussed. The method was tested on two Alamanian blades (a *spatha* and a *sax*) which were investigated in Japan. CPSA

Z Malisauskas and A Linèius. Pelkiu (limonitiné) gelezias ruda Lietuvoje [The marsh iron ore (limonite)in Lithuania]. *Lietuvos Archeologija*, 1999, **18**, 111–120.

Topography of bog ore deposits, analyses. CPSA

M Mangin. Vie rurale et artisanat du fer dans les campagnes d'Alésia. In M Feugère and M Gu tin (eds), *Iron, blacksmiths and tools: Ancient European crafts*, Monographies Instrumentum 12. M Mergoil, Montagnac, 2000, 7–11.

R Marichal. Outillage antique de Ruscino (Château-Rousillon, Pyrénées Orientales, F.). In M Feugère and M Guštin (eds), *Iron, blacksmiths and tools: Ancient European crafts*, Monographies Instrumentum 12. M Mergoil, Montagnac, 2000, 139–168.

Roman smithies and a hoard of iron objects (76 items). CPSA

L Mihok and R Vargová. Metalografická analýza železných predmetov zo stredovekej dediny Pavl'any-Krígovce. Metallographische *Z Dìjin Hutnictví* 30 [Contribution to the history of Metallurgy]. Rozpravy Národního technického muzea v Praze 172. Praha 2001

Metallography of 17 iron objects (15th century AD): horse shoes, knives, a sickle, a nail, fittings etc showing carburization, iron to steel welding and heat treatment of tools from the Medieval village Pavl'any–Krígovce. CPSA

L Mihok, A Pribulová and K Pieta. Spracovanie železa z nálezísk púchovskej kultúry: Liptovská Mara [Eisenbearbeitung nach den auf der Fundstelle Liptovská Mara gemachten Funde der Púchov-Kultur]. *Z Dìjin Hutnictví 28*, Rozpravy Národního technického muzea v Praze 161, Praha 1999, 5–12.

Analysis of smithing slags (sample 23 showed traces of tin bronze, resulting accidentally from contamination with non-ferrous metal in the workshop). CPSA

L Mihok, A Pribulová and D Bialeková. Sposob výroby slovanského meča zo Závady. Produktionsweise des slawischen Schwerts von Závada. *Z Dìjin Hutnictví 27* [Contributions to the history of metallurgy] Rozpravy Národního technického muzea v Praze, 1998, **156**, 5–14.

A carburized sword dated to the 9th century. CPSA

F Moosleitner. Eisendepotfunde aus Salzburg. *Archaeologia Austriaca* (Wien) 1998–1999, **82–83**, 500–511.

Hoards of iron objects from the Nikolausberg near Golling (blacksmith's tools); Hainbach-Nussdorf (scythe, scythe ring, ploughshare, axehead); Kaiserbrunn am Attersee (domestic and agricultural implements) shoes; in addition, a large hoard from the Römerschanze near Grünwald, Bavaria (not commented). CPSA

B Mušiè. Results of geophysical prospecting on Prehistoric and Late Roman sites associated with iron metallurgy. In M Feugère and M Guštin (eds), *Iron, blacksmiths and tools: Ancient European crafts*, Monographies Instrumentum 12. M Mergoil, Montagnac, 2000, 109–120.

Magnetic surveying of slag dumps at a Roman site (Cvinger near Meniška vas and Ajdovišèina above Rodik Slovenia). CPSA

J Navasaitis, A Sveiskauskaité and A Selskis. Lietuvos rudniušlaka sudétis ir savibés. [The composition and the features of bloomery slags in Lithuania]. *Lietuvos Archeologija*, 1999, **18**, 121–133.

Chemical and mineralogical composition of Lithuanian iron slags from the 3rd–4th centuries AD and from the 16th–19th centuries. CPSA

E Niederschlag, E Pernicka, T Seifert and M Bartelheim. The determination of lead isotope ratios by multiple collector ICP-MS: a case study of Early Bronze Age artefacts and their possible correlation with ore deposits of the Erzgebirge. *Archaeometry*, 2003, **45**(1), 61–100.

Lead isotope analyses of Early Bronze Age metal artefacts from the Aunjetitz (Ún tice) culture in central Germany and Bohemia were determined in order to find out whether they could be related to ore sources of the Erzgebirge. Historical mining began only in the 12th century AD, but despite the lack of convincing field evidence it has frequently been suspected that this region was already being exploited in prehistoric times. For the determination of the lead isotope ratios, the new technique of multiple collector ICP preparation with highly precise and accurate measurements. The results show that there is no evidence for prehistoric mining in the Erzgebirge, but the Rammelsberg deposit in the Harz Mountains might have supplied some of the copper. Mining of stream tin in the Erzgebirge. Authors

K Nováček. Nerostné suroviny středověkých Čech jako archeologický problém: bilance a perspektivy výzkumu se zaměřením na výrobu a zpracování kovů. [The mineral

resources of medieval Bohemia as an archaeological problem: the state and perspectives of research into metal production and working]. *Archeologické rozhledy*, 2001, **53**, 279–309.

The iron production expelled from Prague Old Town, the bloomery ironworks at Chýnice (central Bohemia). Reflections of various aspects of non-ferrous mining and metallurgy in Bohemia. Previously published results highlighting the cessation of iron working activities in the Old Town of Prague during the 13th century when bloomery ironworks of traditional type produced iron in the environs of Prague (in the west and south). CPSA

K Nováček. Výroba a zpracování kovù na sídlišti u sv. Petra na Poříčí v Praze. [Metalworking at the St. Peters settlement area in Prague]. *Archaeologica Pragensia* (Praha), 2000, **15**, 219–230, 233–41.

Non-ferrous and ferrous metallurgical evidence uncovered during rescue digs at Prague-Poříčí, at the Middle Ages a pre-urban site (PCB as well as bloomery tap slags). CPSA

L Orengo, E Frénée, P Fluzin. Un atelier du forge de l'âge du Fer au 'Bois du Jarrier 3' commune de la Celle-sur-Loire (F Nièvre). In M Feugère and M Guštin (eds), *Iron, blacksmiths and tools: Ancient European crafts*, Monographies Instrumentum 12. M Mergoil, Montagnac, 2000, 45–6.

Hearths and slags of the Hallstatt/Early La Tène periods. CPSA

L Orengo, J-M Bonnon, D Bevilacqua. L'emploi des bloc tuyères dans les forges antiques du centre de la Gaul (Auvergne, Lyonnais et Forez au deuxi è age du Fer et à l'époque romaine). In M Feugère and M Guštin (eds), *Iron, blacksmiths and tools: Ancient European crafts*, Monographies Instrumentum 12. M Mergoil, Montagnac, 2000, 121–36.

The application of brick-shaped tuyeres at iron forges from several sites. CPSA

S Pazda. Brzeski rejon starozytnego hutnictwa zelaza (4th-5th cent. AD). In *Kultura Przeworska I*, Lublin 1994, 241–261.

An iron smelting region (63) sites in the territory of Nysa (Klodska) and Odra rivers is discussed. Baszyce is a site with reheating hearths. CPSA

J Petrík, L Mihok, K Füryová and M. Soláriková. Archeometalurgická analýza trosky a železných predmetov z lokality Zalužany-Nemešany. [Archaeometallurgical analysis of the iron objects from Zalužany–Nemešany] *Z Dìjin Hutnictví* 30 [Contribution to the history of Metallurgy]. Rozpravy Národního technického muzea v Praze 172. Praha 2001, 21–33.

The PCB slag cakes analysed as well as two nails (ferrite and globular pearlite); the items come from an abandoned village (15th century) in N. Slovakia. CPSA

J Petrík and L Mihok. Východoslovenské sekery zo 14.až 20.storočia. East Slovakian axes from the 14th to 20th century. *Z Dìjin Hutnictví* 30 [Contribution to the history of Metallurgy]. Rozpravy Národního technického muzea v Praze 172. Praha 2001, 34–39.

Nine axeheads from museum collection analysed (iron to steel welding, heat treatment). CPSA

J Piaskowski. The development of the iron and steel technology on the territory of Poland in ancient and medieval times. *Proceedings 20th International Congress of the History of Science, Liège; Vol 15 Materials: Research, developments and applications*. Brepol, 2002, 195–210.

Summarises the author's metallographic examination of over 2200 iron objects from about 400 sites in Poland. Figures include frequency graphs of phosphorus and carbon contents or objects of different dates and a diagramatic classification of metallographic structures seen in Roman swords and medieval knives and spear-heads. JB

M Polfer. Eisenproduktion und Eisenverarbeitung in Nordgallien und dem Rheinland während der römischen Kaiserzeit. In M Feugère and M Guštin (eds), *Iron, blacksmiths and tools: Ancient European crafts*, Monographies Instrumentum 12. M Mergoil, Montagnac, 2000, 67–87.

Survey of production regions and places. CPSA

H Presslinger. Keltischer Stahl aus Linz. Metallkundliche Voruntersuchungen des Depotfunds on Gründberg, Stadtgemeinde Linz, Oberösterreich. *Archaeologia Austriaca* (Wien) 1998–1999, **82–83,** 511–515.

Preliminary metallographic examination of a kettle-hook, a tyre, tongs handle and a sword from the Celtic hoard at the Gründberg rampart (low carbon steels). CPSA

M Púpala, V Magula, Z Kukla and J Hošek. Rozbor kroužků užívaných při výrobě kroužkové zbroje. [Analysis of rings of mail coats], *Z Dìjin Hutnictví 27* [Contributions to the history of metallurgy] Rozpravy Národního technického muzea v Praze, 1998, **156,** 26–34.

One Roman and nine medieval rings, riveted and welded, made of annealed iron wire. One example was heat treated (martensite, bainite). CPSA

F Quesada, M Zamora, F Requena. Itinerant smiths in the Iberian Iron Age? (6th–7th centuries BC). In M Feugère and M Guštin (eds), *Iron, blacksmiths and tools: Ancient European crafts*, Monographies Instrumentum 12. M Mergoil, Montagnac, 2000, 15–19.

T Rehren, D Vanhove and H Mussche. Ores from the ore washeries in the Lavriotiki. *Metalla* (Bochum), 2002, **9**(1), 27–46.

About 250 washeries, used in ore beneficiation, have survived in this area to the SE of Athens; most date from the Classical period. In this semi-arid environment the industrial scale of the operation required careful management of water supplies. The surviving system of channels, platforms and basins serve the water management, with the beneficiation proper being carried out in a device, probably made of wood and now lost, situated in front of the water tanks. The paper focuses on the ore remains found in the washeries, the operational details of the

beneficiation process, and the quality of the concentrate. Two types of galena ore, containing 1000 and 2000 grams per ton of silver, were mined but remains are now weathered to cerussite. Several washeries had been used to process cupellation residues. Authors (adapted)

A Rustoiu. Outils en fer pour le travail des métaux non ferreux en Dacie préromaine (1st BC–1st AD). In M Feugère and M Guštin (eds), *Iron, blacksmiths and tools: Ancient European crafts*, Monographies Instrumentum 12. M Mergoil, Montagnac, 2000, 233–241.

Iron smithing tools used in bronze work. CPSA

M Sagadin. Late antique woodworking tools from Gradavov hrib near Kamnik (Slovenia). In M Feugère and M Guštin (eds), *Iron, blacksmiths and tools: Ancient European crafts*, Monographies Instrumentum 12. M Mergoil, Montagnac, 2000, 205–208 CPSA

A Schäfer and T Stöllner. Early Metal Production in the Central Lahn Valley, Hesse, Central Germany. *Uppsala October 4 –8 2001* ed S Forenius. The National Heritage Board Research Report RO105. Uppsala 2001, 16. CPSA

S Schreyer and M Graf. Rheinau ZH. *Archäologie der Schweiz*, 1995, **18** (1), 33.

Traces of smithies in a Celtic oppidum on the upper river Rhine. CPSA

R Schwab. Berlegungen zur Eisenversorgung des Oppidums von Manching basierend auf metallkundlichen Untersuchungen an Waffen und Geräten [Reflections concerning the supply of iron in the oppidum of Manching, Bavaria, based on metallographic investigations of weapons and tools]. Berliner Beiträge zur Archäometrie, 2000, 17, 5–44.

The oppidum at Manching depended on imported iron from its surroundings, the metal was rich in phosphorus. 14 further iron objects (supplementing the unpublished set investigated by Pleiner) were metallographically examined—mostly knives of different quality and construction (sandwich iron-steel-iron appeared several times, heat treatment of steel stated at 26%).The smithing activity appears in the northern part of the site where crafts were concentrated. CPSA

H Sedlmayer. Bewährte Simplizität. Zu einem Neufund aus dem Kastellvicus von Favianis/Mautern an der Donau (Österreich). In M Feugère and M Guštin (eds), *Iron, blacksmiths and tools: Ancient European crafts*, Monographies Instrumentum 12. M Mergoil, Montagnac, 2000, 179–186.

Socketed iron axeheads. CPSA

A Selucká, A Richtrová and M Hložek Konzervace žčelezného meče ULFBERHT [Conservation of an iron ULFBERHT sword]. Sborník z konzervátorského a restaurátorského semináře, České Budějovice 2001 [Proceedings of a conservation and restoration seminar at Èeské Budìjovice, Bohemia]. Technické muzeum Brno 2001, 65–68.

A grave find of the 9th century AD from Nemilany, northern Moravia with the swordsmith's inscription, with textile and wood from the scabbard. Welded-on steel cutting edges and mild quench hardening of the point were identified metallographically. CPSA

S Sievers. Vorbericht über die Ausgrabungen 1998–1999 im Oppidum von Manching. [Preliminary report on 1998–1999 excavations in the oppidum of Manching, Bavaria]. Contributions by R Gebhard, M Leicht, R Schwab, J Völkel, B Weber, B Ziegaus. *Germania*, 2000, **78**(2).

Smithing techniques with iron weapons (Schwab). Slag concentration in area 1g (Leicht). CPSA

J Stankus, A Sveiskauskaité, A Selskis, E Matulionis. Gelezis dirbniu cheminés analizés Duomenis [The data of chemical analyses of some iron artefacts of the 2nd 13th centuries]. ***Lietuvos Archeologija*, 1999, 18**, 101–9.

Chemical analyses as supplement to former metallographic examination on ancient and medieval irons. Carbon, phosphorus and manganese are discussed. CPSA

D Starley. Metallurgical analysis of medieval quarrel heads and arrowheads. *Royal Armouries Yearbook*, 2000, **5,** 178–186.

Eight projectile heads (three called arrows, five cross bow bolts) of unidentified German origin (14th century AD?) were investigated metallographically. Hard phosphoric iron was used, traces of carburization or composite iron-and-steel constructions are discussed without definite conclusions. CPSA

K Stránský, R Štěpán and A Rek. Analýzy železářských strusek z oblasti Železných hor. [Analysis of iron slag from the Železné Hory area]. *Z Dìjin Hutnictví 27* [Contributions to the history of metallurgy]. Rozpravy Národního technického muzea v Praze, 1998, **156,** 35–46.

Slags from medieval hammer-mills, as well as fining slags of the 18th century analysed. CPSA

K Stránský, A Rek and A Drechsler. Kotázce hmotnostní bilance pochodu přímé výroby železa z rud z laténských redukčních pecí. *Lietuvos Archeologija*, 1999, **18**, 36–42.

Microanalytic and mineralogical investigations of a bloomery slag and magnetite ore from the Celtic oppidum at Staré Hradisko, Moravia. CPSA

J Unger. Zivot na lelekovickém hradì ve 14.století. Antropologická a sociokulturní studie [The life in the 14th century AD castle of Lelekovice]. *Anthropologische und sociokulturelle St Brno* 1999.

During excavation of the ruin of the castle at Lelekovice near Brno traces of a sheltered smithy were discovered at the eastern rampart. Destruction of the hearth stone substructure, traces of the anvil position and smithing slags have to be mentioned. CPSA

N Venclová. Výroba a sídla v době laténské. Projekt Loděnice. [Production and settlement: The Loděnice project, central Bohemia]. Inst of Archaeol Prague 2001.

This monograph deals with the results of a long term research project in the La Tène period settlement in the region of the Loděnice basin, known especially due to the production of sapropelite bracelets, exported to a great part of Europe. Iron working was carried out in the area and is discussed.
CPSA (modified)

MIDDLE EAST

P T Craddock, S La Niece & D R Hook. Evidences for the Production, Trading and Refining of Copper in the Gulf of Oman during the Third Millennium BC. In Th Stöllner, G Körlin, G Steffens, J Ciemy (eds), Man and Mining—Mensch und Bergbau. Studies in honour of Gerd Weisgerber on occasion of his 65th birthday. *Der Anschnitt*, Beiheft 16, Bochum 2003.

The scientific examination of a small ingot of copper and copper sulphide discarded in the Bronze Age at Ra's al Hadd in Oman on the Gulf of Oman has provided useful information into the contemporary smelting processes. The ingot comprises two major components: fairly pure copper and matte, Cu_2S. The latter was also fairly pure, in particular, it contained only traces of iron. This is most unusual for matte but has been paralleled at the contemporary copper smelting site at al Maysar also in Oman, where matte with a low iron content was found. This was believed to be the result of smelting the copper ore brochantite rather than the more usual copper pyrites ores such as chalcopyrite or bornite. Some of the ingots and copper metal from al Maysar have very low iron contents, comparable with that of the Ra's al Hadd ingot.

It was postulated by the excavators of al Maysar that contemporary cuneiform tablets complaining of poor quality metal could have referred to ingots with a high level of matte inclusions rather than a high iron content. This is exactly what we have encountered here, providing a valuable insight into the quality of the copper traded in the ancient world. It also suggests that the copper was traded as metal rather than ore from the mines, but that purifying the metal was the responsibility of the smith in the settlements, confirming the evidence of the surveys of Thierry Berthoud and his colleagues. Authors

A Hauptmann, T Rehren and S Schmitt-Strecker. Early Bronze Age copper metallurgy at Shahr-i Sokhta (Iran), reconsidered. *Man and Mining, studies in honour of Gerd Weisgerber. Der Anschnitt*, Beiheft 16, Bochum, 2003, 197–213.

Between 2700 and 2500 BC, mixed sulphidic and oxidic copper ores were brought to the urban site of Shahr-i Sokhta in eastern Iran to be smelted in crucibles. The main ore component to be extracted was copper oxide with remnants of copper sulphide, following the co-smelting process. No deliberate attempt was made to roast the copper sulphide in order to exploit its copper content. After the smelt, the entire charge, comprising metal, matte and slag, was poured or tapped from the crucibles into a separate receptacle, where the metal/matte melt separated underneath the slag. The separation of copper metal was improved by its interaction with low-melting copper sulphides. Detailed analyses of texture and phase content of the slag provide information on the cooling process and the origin of various inclusions. The role of iron arsenide (speiss) from the site is discussed in the context of early arsenical copper. Lead isotope ratios of archaeometallurgical finds offer proof of a common, though probably complex, origin of ores, slags, matte and copper, and indicate a possible provenance of ores from the Iranian Malik-i Siah Mountains west of Shahr-i Sokhta. The scale of production indicates a domestic type of industry, while the technology being used appears more developed than that used throughout the Middle East, and can be seen as the beginnings of full slagging operations. Authors

K K A Lonnqvist. A Second Investigation into the chemical composition of the Roman Provincial (Procuratorial) coinage of Judaea, AD 6–66. 2003, *Archaeometry* **45**(1), 45–60.

An investigation of the chemical composition of the first Roman provincial coinage of Judaea, minted in AD 6–66, was conducted. A total of 103 copper-alloy coins were analysed by ICP-AES. It was determined that different copper alloys were used for the coinage, a leaded tin-bronze and a pure tin-bronze. The investigation also showed that the copper alloy was made to four different formulae with regard to the added alloying elements. Trace element profiles point to the existence of a shared pool of metal for Roman coins and metalwork. Author

M Momenzadeh. Mining archaeology in Iran. 1: an ancient gold mining site of Zartorosht (SW-Jiroft, SE-Iran). *Metalla* (Bochum), 2002, **9**(1), 47–53.

Since 2000 a project has been running on early mining and metallurgy in the central Iranian plateau. This report includes a preliminary description of one area of ancient mines, and the surviving stone hammers, 'anvils' and grinding stones (made of local rocks). There is no definite dating but the activity is believed to be pre-Islamic. JB

J Piaskowski. Scientific Contributions of mediaeval Arabic scholars into iron and steel metallurgy. *Bulletin of the Metals Museum* 2002, **35**, 41–47.

The works of medieval Arabic scholars in the studies of European historians of iron and steel are summarized. The earliest mention of Damascus steel was found in the Dead Sea Scrolls, *c*68 AD. The most important achievements of medieval Arabic scholars were describing the criteria used for the classification of iron alloys, the first measurements of relative density of silver, copper, lead, tin, iron and brass (compared with Au = 100 as the standard), and describing the methods of heat-treatment of steel in several cooling liquids. Author

M Ponting. Roman military copper-alloy artefacts from Israel: questions of organization and ethnicity. *Archaeometry* 2002, **44**(4), 555–71.

The published analyses of Roman military copper-alloy metalwork from Masada are complimented by additional ICP-AES analyses of material from Gamla enabling further discussion of alloying trends and presenting new insights into the organization of the Roman military and the cultural specificity of brass technology. Author

M Ponting. Keeping up with the Romans? Romanisation and copper alloys in First Revolt Palestine. *IAMS Newsletter*, 2002, **22**, 3–6.

Chemical analyses by ICP-AES of 1st century AD copper-alloy objects from Gamla, Tel Anafa and Yodefat are reported. Differences in finds assemblages are mirrored by differences in

alloy composition. Brass, an alloy with strongly Roman associations, was present only in the pagan assemblages while tin-bronze dominates the metalwork from Jewish sites. It is suggested that the populations of the Galilee declared their cultural affiliations through the materials they used as well as the objects they made and traded. Parallels for this behaviour are offered and reasons for the 'choices' are investigated.

Author (adapted)

ASIA

J Piaskowski. Technology of Gonjos-Separate Piece of Early Indonesian Daggers *(Keris).* *Bulletin of the Metals Museum* 2002, **35**, 48–63.

The technology of making Gonjos (a part of the Indonesian Keris dating from 13th–16th century AD) was not known. One was made of hard Indian steel ('Wootz'), but with a slightly lower carbon content (0.8-1.3%C) than necessary for making Damascened blades. One was forged from iron with low concentration of this admixture, and two of iron with 0.19 and 0.31% phosphorus with a 'Banded Structure'. Four Gonjos were made of numerous thin layers of selected grades of iron with low and high phosphorus contents. The arrangement of these layers produced the characteristic Indonesian pattern on the surface of Gonjos (and Keris). The phosphorus content was estimated using Oberhoffer's reagent. However, it has been observed that the reagent does not distinguish between phosphorus and arsenic. Thus some irons identified using this reagent as phosphorus-rich may contain arsenic.

Author (adapted)

T Rehren and O Papachristou. Similar like white and black: a comparison of steel-making crucibles from Central Asia and the Indian subcontinent. *Man and Mining, studies in honour of Gerd Weisgerber. Der Anschnitt*, Beiheft 16, Bochum, 2003, 393–404.

The paper presents an update of the archaeological evidence for the production of crucible steel in Central Asia and the Indian subcontinent, offering a systematic comparison and discussion. The ceramic tradition of these vessels apparently differs between the two regions. The Central Asian crucibles have a dense, almost white-firing fabric, are cylindrical and have a relatively large volume of 0.7–1.0 litres. The Indian and Sri Lankan vessels are made from a highly porous, black firing ceramic, have a range of shapes and relatively small volumes between 0.1–0.2 litres. The Central Asian crucibles data primarily to the 8th–12th centuries AD. The historical development of crucible steel production within the medieval city is discussed for Merv and Akhsiket. One site in Sri Lanka dates to the second half of the first millennium AD, all other known occurrences in South and East Asia date to the modem period, primarily to the 19th century. The metallurgical process used for the actual steel-making operation is, in the autochthonous sites, always the carburization of bloomery iron using organic matter; some later exceptions from India and China, probably influenced by European technology and involving pig iron, are discussed in the text.

Authors

D B Wagner. The earliest use of iron in China. In S M M Young, A M Pollard, P Budd and R A Ixer (eds) *Metals in Antiquity*, BAR Int Ser **792** (Oxford) 1999, 1–9.

In the light of new finds it seems that the technology of iron smelting diffused to China by the 8th century BC from the West via Scythian nomads in central Asia.The earliest weapons made of iron were probably display and prestige objects. CPSA

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