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METALConsn-info

Metal working group

Bulletin of the Research On MEtal Conservation

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BROMEC15

Editorial

Often when we describe the corrosion of copper based alloys exposed outdoor we refer to bronze statues placed in urban environments. Paul Bellendorf from the University of Bamberg is presenting here his research performed on brass memorial grave plaques. These artefacts often exposed within churches, either in an indoor or outdoor environment remind us that many copper based artefacts other than visible bronze statues are suffering from external pollutants and need to be investigated and conserved.

Olivier Tavozo student at the Institut National du Patrimoine – Conservation Department has decided to dedicate his final dissertation project to the restoration of jewellery, especially those made of silver. His interest points towards the cleaning of artefacts to recover the initial appearance while respecting conservation issues and the use of corrosion inhibitors to slow down or stop the alteration of artefacts in showcases.

The other French project presented by Virginia Costa concerns preventive conservation issues. Electrochemical techniques combined with RBS and XRD will be used to investigate the pollutants corroding silver, copper and lead based artefacts in museums and churches. Hopefully with this project we should get a better understanding of the cause of tarnishing on silver and active corrosion on copper and lead in French historical monuments.

Malta is still continuing its investigating work on the promising "E_{corr}-Drop Test" (EDT) monitoring technique as a possible spot test for metals. The work performed this time is on different certified copper based alloys. A database is under construction and the researchers involved are now planning to complete it by studying electrochemically any new alloy from artefacts conserved at the Malta Centre for Restoration (renamed recently as Heritage Malta – Conservation Division).

Márta Járó, working at the Hungarian National Museum is one of the most renowned conservation scientists specialised on the analysis and conservation of metal threads in textile. She is presenting here some on-going and new research projects that are a perfect illustration of the problems raised by these composite artefacts. We remind you that this topic will be discussed at the next ICOM-CC triennial meeting (The Hague) during a Short Duration meeting organised by the Metal WG in collaboration with several other ICOM-CC WGs. To prepare the meeting a questionnaire has already been sent to you by your Metal Working Group National Representative. This questionnaire has been added once again in the call for collaboration. Another questionnaire related to the EU PROMET project can be found under the same section.

As usual, we hope that you will find this issue as useful and as interesting as ever.

Editor
Christian DEGRIGNY
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 Brass memorial grave plaques from Franconia and Thuringia dating from the 15th to the 17th century – an interdisciplinary study of the monumental inventory and its endangering through environmental influences (***UoB***)

In the area of Franconia and Thuringia (Central Germany) we can still find a huge amount of important brass memorial grave plaques dating from the 15th to the 17th century. A lot of these plaques are up to now neither art-historically registered nor scientifically studied. The aim of our Ph.D. research project (November 2003 – October 2006) is to cover this gap. It is written at the University of Bamberg, chair of restoration science.

Our objective is not only to reveal the objects from an art-history point of view, but more particularly to solve important scientific questions. To achieve this, samples will be drilled from nearly 250 brass memorial grave plaques of those registered in the thesis and will be analysed by atomic absorption spectroscopy (AAS). The metal compositions obtained will help complete the extensive database of metal objects from the Middle Ages and early Modern Age, built up in the past by Prof. Riederer [1]. A preliminary review of AAS-analyses already gave some interesting results: for example an object realised in 1331 had an equivalent material composition as an object dated from 1551. Art-historians confirmed the similarity between these two objects.

Another main emphasis of this thesis lies on the environmental conditions of the different localities where the plaques are exposed. Environmental data recorded by the Department of Environment – especially the sulphur dioxide concentration – and the actual condition of the object will be correlated to each other. Additionally, temperature and relative humidity will be monitored on each site for at least 6 months. The data will be completed by X-ray diffraction analysis of the corrosion products formed. As an application, the brass memorial grave plaques from Erfurt Cathedral cloister are in a very poor condition. Almost the whole surface of nine very important grave plates is badly damaged. The objects are covered with up to several millimetres of thick green and brown corrosion layers. The very high sulphur dioxide concentration in Erfurt in the early 1980s was the main cause of this damage. The peak SO_2 value in Erfurt was measured in January 1982 with over 1.200µg/m^3. Today the SO_2-level in Erfurt is nearly zero.

Another important aspect of the thesis will be the study of the manufacturing of bronze memorial plaques, starting with the mining and processing of the raw material over the production of a model up to the casting and finishing of the grave plates.

1. Riederer, J., Die Berliner Datenbank von Metallanalysen kulturgeschichtlicher Objekte II. Objekte aus Kupferlegierungen des 17./18. Jahrhunderts, der Renaissance und des Mittelalters“, In: Berliner Beitraege zur Archaeometrie, Vol. 17, Rathgen-Forschungslabor Berlin, 2000, p. 143-216.

Contact: Paul Bellendorf (UoB)
Funding: Deutsche Bundsstiftung Umwelt (DBU)

Ongoing research projects

The conservation-restoration of jewellery (*INP-DR*)

The conservation-restoration of jewellery in museums is still very often entrusted to restorers (craftsmen or museum staff) who use techniques that are normally outside the field of conservation. As a consequence archaeological, historical and technical information are often lost.

Due to their alteration, the precious appearance of jewellery, which is a characteristic that gives them their signification and makes them understandable, has disappeared. The instinctive reaction in front of this loss is to restore the precious appearance to make the jewellery visually satisfying again.

A Byzantine gold and garnet necklace, a German tulip-shape silver clock from the 17th century and four French Art Nouveau jewels have been selected to demonstrate that it is possible both to recover the precious appearance of these different artefacts and therefore their signification and to also respect ethics of conservation.

Another way to preserve jewellery (especially those made of silver) is to reduce the frequency of cleanings, by protecting them from indoor atmospheric corrosion. An investigation has been carried out to assess the inhibitive properties of pyridine towards the corrosion of silver. The parameters affecting the corrosion of silver artefacts exposed in museum have been studied. It appeared that the tarnishing of silver occurring in display cases is due to the natural aging of the materials used for their construction, which produce polluting gas. In order to make a realistic assessment, the corrosion inhibitor has been tested on a reconstitution inside a polluting display case. X-ray diffraction analysis of corrosion products formed and gas sampling have shown that the reconstituted atmosphere was similar to the one investigated in polluting museum display cases. In these testing conditions pyridine has not shown any evidence of corrosion inhibition capacity towards silver.

Contact: Olivier Tavozo (INP-DR)
Funding: no external funding

Ongoing research projects

Metal threads in textiles - some case studies (***HNM***)

Gold threads in the Sicilian, later coronation vestments of the kings and emperors of the Holy Roman Empire and in the so-called cap of St. Stephen of Hungary - Results of the scientific investigations: scientific investigations, light and scanning electron microscopy (SEM) and energy dispersive X-ray microanalysis (EDS) were carried out to determine the manufacturing technique of the metal threads in the 10-14th century pieces of the coronation vestments and of the so-called cap of St. Stephen. Gold strips wound around a silk core were used to embroider the mantle and the cap. The embroideries of the yoke, cuffs and the border of the alba as well as of the stockings are also made of gold, but in these cases fine wires were applied. The high standard of purity of the gold alloys suggests the use of either a very pure raw material or use of a highly developed purification technique. The small gold tubes serving as part of the embroidery thread of the cuffs of the tunicella are unique in contemporary metal thread making. Two different gold thread types were identified on the shoes. The woven band at the heel was made with gold thread similar to that used in the embroidery of the gloves, while in the tablet woven bands at the bottom of the shoe sole, single-sided gilt silver strips wound around a silk core were applied. Gilt silver thread was used to weave the stola and the sword belt as well, but from the point of view of the base material and gilding method, they differ from each other. Gilt leather strips wound around a silk core decorate the different linings of the mantle as well as the woven bands of the stockings [1].

The history of a 17th century nobleman's dolman and mantle, based on the manufacturing technique of the ornamental metal threads: on the basis of the scientific examination of the metal threads of the dolman and mantle, in most cases, it was possible to "reconstruct" the manufacturing technique of the thread in question. While the metal threads of the base-fabric of the two garments, as well as those of the ornamental braids of the mantle, were made of precious metals (silver and gilt-silver), those in the lace pieces used in the alterations to the dolman were made from "baser" materials (brass and silver-plated copper). A repair to the dolman was made using thread made from aluminium alloy dating from the last third of the 19th century. Judging from the pattern and weaving technique, the base-fabric of the garments is lampas of Italian origin, from the first half or the mid 17th century. For weaving these textiles, single-sided gilt silver thread, probably "or de Milan" was used. The metal threads of the bobbin-lace pieces added to the dolman, "or de Lyon" (brass) and imitation-silver (silver plated copper) threads, were known from the end of the 16th century, but usually they were not applied for the ornamentation of aristocratic garments. The thread made from "silver of clay" (aluminium) used to conceal the patch on the dolman must have been one of the more expensive types of thread in the last third of the 19th century [2].

Manufacturing technique of the metal threads in the different pieces of the funeral garments/textiles of Cangrande I della Scala (died in 1329) was determined on the base of the scientific investigation data. Badly deteriorated, single-sided and double-sided metal coated, flat leather strips and silvergilt membrane threads were identified in the Middle-Eastern resp. Italian weavings. The materials of the single-sided gilt or silver plated leather strips, as well as the silvergilt membrane threads seem to be similar to those interwoven in the fabrics brought in connection with these textiles. In the case of the double-sided metal-coated leather strips gold on one side and gold-silver alloy on the reverse side was found. The composition of the reverse side metal coating show a strongly marked difference from the similarly double-sided metal coated, flat leather strips, analysed by now, where silver coating was applied. The analysis of further samples can probably help to reveal whether leather strips with electrum or a deliberately made, electrum-like gold-silver alloy coating were used only in a given workshop in a given time/period, or they were applied widely in the Middle East [3].

Metal threads used in the coronation mantle of the Hungarian Kings: scientific investigations were carried out to characterize these metal threads. The mantle was transformed from an 11th century, embroidered chasuble donated to the church of the Virgin Mary in Székesfehérvár (Hungary) by the first Hungarian King, St. Stephen and his wife, Gisela. Samples were taken both from the original chasuble and from pieces that have been confirmed as later additions, as well as from patches that were sewn to the mantle by way of mending. The metal threads could be divided into three main groups by manufacturing technology: threads made from gold strips, those made from silver strips gilded on one side, and those made of silver strips gilded on both sides. All are wound around silk core. The threads made of gold strips could be further subdivided into three groups on the basis of their composition [4].

[1]. Járó, Márta : Gold threads in the Sicilian, later coronation vestments of the kings and emperors of the Holy Roman Empire and in the so-called cap of St. Stephen of Hungary - Results of the scientific investigations) *in*: Nobiles Officinae. Die königlichen Hofwerkstätten zu Palermo zur Zeit der Normannen und Staufer im 12. und 13. Jahrhundert, Kunsthistorisches Museum, Wien, 31. März bis 13. Juni 2004, (Ausstellungskatalogue) Kunsthistorissches Museum, Wien and Skira editore, Milano, 2004, 311-318.
[2]. Járó, Márta: On the History of a 17th Century Nobleman's Dolman and Mantle, based on the Manufacturing Technique of the Ornamental Metal Threads. *Or de Milan*, *or de Lyon*, and *silver of clay* ornamentations on a ceremonial costume from the Esterházy treasury, Ars Decorativa, 22 (*Publisher*: Budapest Museum of Applied Arts), 2004, 27-45.
[3]. Járó, Márta: Fili metallici nelle stoffe di Cangrande (Metal threads in the Cangrande textiles) *in*: Cangrande della Scala. La morte e il corredo di un principe nel medioevo europeo (Catalogo della mostra), *Editors*: P. Marini, E. Napione, G.M.Vranini, Marslio Editori, Venezia, 2004, 112-121.
[4]. Járó, Márta: The Gold Threads in the Hungarian Coronation Mantle *in:* The Coronation Mantle of the Hungarian Kings, ed.: Bardoly, I., Hungarian national Museum, Budapest, 2005, 67-89.

Contact: Márta Járó, HNM.
Funding: no external funding

Ongoing research projects

Application of the EDT monitoring technique to assess the corrosion behaviour of certified copper based alloys in sodium sesquicarbonate and mineralised water (***HM/CD***)

This project is a continuation of the work performed in August 2004 by Claire Galea (BROMEC 11). Our objective within this project was to study the possibilities of the "E_{corr}-Drop Test" (EDT) monitoring technique as a spot test for the qualitative analysis of metals. The idea is to locally measure the corrosion potential (E_{corr}) taken from a metal artefact when a drop of solution (chosen to be non aggressive towards the material) is deposited on its surface and to monitor it with time.

Claire Galea showed that the EDT monitoring technique is able to give reproducible trends that reflect the composition of the metal. She worked principally on different brass alloys sampled from a batch of modern objects recovered from the Mediterranean Sea (around Malta). The electrochemical results showed that we can distinguish three groups of artefacts having slightly different EDT behaviours. All three groups showed that the polished metal was passivating in the presence of sodium sesquicarbonate. These results were confirmed by SEM-EDS investigation of the artefacts. The two first groups have indeed a slight difference in zinc concentration (Zn content in Group I is between 33 and 37% (in weight) and between 28 and 33% in Group II). The third group corresponds to artefacts that have tin as an additional element to zinc (% wt is around 1%)

Vera Ruvinskaya, intern at the Malta Centre for Restoration, performed similar measurements, but on 16 certified copper based alloys kindly provided by the partners of the following EU projects: IMMACO and BRONZART and the INSTN (Institut National des Sciences et des Techniques Nucléaires). Two solutions were used: 1% (w/v) sodium sesquicarbonate and "San Michel" brand mineralised water (chlorides: 71ppm, pH=6.8-7.3).

The first part of the project consisted of building a database of EDT monitoring plots (X/Y graphs depicting time versus E_{corr}) for the 16 certified copper based alloys in both sodium sesquicarbonate solution and "San Michel" mineralised water. The reproducibility of the results was tested for durations of 5 and up to 15 minutes. The different alloys were grouped in six families: arsenic copper, tin bronze, silver bronze, tin brass, lead bronze and quaternary bronze.

The results obtained show that often the six families of alloys have a reproducible and specific behaviour in the two solutions considered. Alloys within the same family tend though to give quite similar E_{corr} vs time curves, which makes the use of the EDT monitoring technique quite difficult. Obviously more data needs to be compiled to safely use this new spot test.

The "E_{corr}-Drop Test" monitoring technique is a tool that conservators can easily use when the considered artefact has an exposed metal area. Since most archaeological and historic artefacts are covered with corrosion layers that often cannot be locally cleaned, the electrochemical behaviour of corrosion layers on copper based alloys will have to also be studied.

Contact: Christian Degrigny (DSL – HM/CD)
Funding: no external funding

New research projects

 Impact of environmental conditions on the conservation of metal artefacts : an assessment based on electrochemical measurements (***IRRAP/LRMH/C2RMF***)

The objective of the project is to identify the pollutants present in the exhibition rooms, storage areas and display cases of museums and cathedrals in order to assess their effect on the different metal alloys constituting the artefacts. To achieve this, metal coupons (Ag, Cu, Pb) have been installed in specific locations of different Parisian museums (Louvre, Music, Petit Palais, Decorative Art, Army) and Cathedral Treasure Rooms (Reims, Notre Dame de Paris) for a period lasting from 6 to 18 months.

To determine the nature and thickness of the compounds superficially formed, resulting from the exposure to the different pollutants, a systematic electrochemical reduction study will be performed to define the ideal conditions of the analysis (choice of the anion, pH value, presence of a chelating agent).

To validate the approach and for a limited number of artefacts the results will be compared with RBS and/or XRD measurements. This project is a collaborative research between IRRAP (Institut de Restauration et de Recherches Archéologiques et Paléométallurgiques), LRMH (Laboratoire de Recherche des Monuments Historiques) and C2RMF (Centre de Recherche des Musées de France).

Contact: Virginia Costa
Funding: Ministère de la Recherche et de la Technologie (2 years)

New research projects

Study of the morphology and material of metal threads from Hispano-Moorish textiles (***HNM***)

Twelfth to fourteenth century, metal threaded, Hispano-Moorish textiles with Eastern type patterns were often copied in the other parts of Europe. On the other hand, the decorative motifs used in the Italian manufactures were often overtaken by the South Iberian masters by the end of the 14th century. This interaction causes, in some cases, problems in the determination of provenance on a stylistic basis of the similar patterned textiles of this period. A similar problem is raised by 15-16th century Italian and Ottoman fabrics (widely spread in Europe) decorated with metal threads.

Optical and scanning electron-microscopy, energy dispersive X-ray analysis and classical chemical methods are used to study the morphology and material of metal thread samples taken from well dated pieces of textiles with known provenance of the periods in question. The analyses gave the following results to date:

- in the medieval Hispano-Moorish weavings analyzed, mainly a characteristic type is found, leather gold, while in Italian silk fabrics, membrane gold threads were identified.
- the gilding method of the analyzed metal threads in 15-16th century Italian weavings was different from that found in the case of the Ottoman samples from the 16th century.

Contact: Márta Járó, HNM.
Funding: no external funding

Call for collaboration

Short Duration Meeting

Title: **Investigation and conservation of composite materials containing metals**

Proposed date and venue: **Monday 12 September, in the afternoon (1 hour). Time to be specified and during the ICOM-CC triennial meeting in the Hague.**

Joint meeting between the following WGs:
Metals; Glass & Ceramics; Paintings; Preventive Conservation; Natural History Collections; Ethnographic collections; Leather and related materials; Wood, Furniture, Lacquer, related materials and Textiles

Moderator:
Christian Degrigny, Metal WG coordinator

Questionnaire

WG:
ICOM number:
Name:
Education (curator, archaeologist, art historian, conservator, conservation scientist, student…):
Position:
Full address:

1. **Needs in the investigation and conservation of composite metal artefacts**
   - type of composite metal artefacts you deal with
   - investigation issues, if any
   - conservation issues, if any
     i. alteration of artefacts
     ii. conservation of artefacts

2. **Possible answers**
   - investigation aspects
     i. update on current approaches
     ii. new developments: innovative analytical methods
   - conservation aspects
     i. update on current approaches

ii. innovative approaches

3. Pending issues

- investigation issues
- conservation issues

4. How the ICOM-CC network could contribute?

- transversal discussion? Platform of discussion?
- Common research theme between WGs?
- Production of:
    i. Bibliography
    ii. Guidelines for the storage, investigation and conservation

All information would be available on the ICOM-CC website

Call for collaboration

 PROMET: Innovative conservation approaches for monitoring and protecting ancient and historic metal collections from the Mediterranean basin

One aspect of our project aims to survey how metal collections are treated in the Mediterranean region for uncontrolled indoor environments. To this end, a questionnaire has been developed to document the kinds of coatings and/or corrosion inhibitors that are currently used to stabilize and protect metal objects. This questionnaire was developed by a team of professional metal conservators and statistician from TEI of Athens and has undergone peer review from the members of our consortium. Members of the consortium translated the questionnaire from English into French and Greek to provide a greater possibility of respondents from the Mediterranean region. Furthermore versions in Spanish and Arabic will be available soon. We call on professional conservators working for a museum or conservation facility to complete the questionnaire, and only one response per museum is required.

In order for your contribution to be included in our project, the submission must be before the end of August 2005. From here a statistical analysis will be conducted by the TEI of Athens to determine the conservation practices in the Mediterranean region for stabilizing and/or protecting metals collections. The results will highlight the research priorities for the development of new coatings and corrosion inhibitors that are environmentally friendly.

So please download the questionnaire from PROMET website (www.promet.org.gr) and take the time to fill it out and submit it by email to the following address: asiatou@teiath.gr.

Alternately, questionnaires may be mailed to the following address:
Attention: Prof. Vasilike Argyropoulos (coordinator of PROMET)
TEI of Athens
Department of Conservation of Antiquities and Works of Art
Metals Laboratory
Agiou Spiridonos GR 12210- Egaleo
Athens- GREECE

General information

Websites

- **PROMET** website: http://www.promet.org.gr

- **ARTECH network**: http://server.icvbc.cnr.it/progetti_futuri/progetto_artech.htm

- **BIGSTUFF (Care of Large Technology Objects) 2004:**
http://www.awm.gov.au/events/conference/bigstuff/index.asp

- **CAMEO**: website containing chemical, physical, visual, and analytical information on over 10,000 historic and contemporary materials used in the conservation, preservation, and production of artistic, architectural, and archaeological materials
http://www.mfa.org/_cameo/frontend/

- **Cost Action G8: Non-destructive analysis and testing of museum objects.** http://srs.dl.ac.uk/arch/cost-g8. Abstracts and booklets from previous workshops can be downloaded as well as announcements of future activities (Short Term Scientific Missions deadlines, training schools…).

- **Cost Action G7: Artwork conservation by laser** http://alpha1.infim.ro/cost

- **e-Preservation Science**: http://www.e-preservationscience.org

- **European Cultural Heritage Network**: http://www.echn.net/

- **IR and Raman for cultural heritage** http://www.irug.org/default.asp

- **LabS-TECH network** http://www.chm.unipg.it/chimgen/LabS-TECH.html

- **Laboratoire Pierre Sue**: LPS PhD thesis related to the alteration of archaeological artefacts can be downloaded from http://www-drecam.cea.fr/lps/ (in French) and go to "Archéomateriaux et prévision de l'altération."

- **M2ADL** - Microchemistry and Microscopy Art Diagnostic Laboratory is now available at the following website: http://www.tecore.unibo.it/html/Lab_Microscopia/M2ADL/

- **Working Group Metals ICOM Committee for Conservation**
http://icom-cc.icom.museum/WG/Metals/

- **Online publications of Surface Engineering Journal .** Issue addressing specifically to Metal issues: **Surface Modification Issues in Art**, Volume 17, Issue 3, June 2001. Can be downloaded from:
(http://www.ingentaconnect.com/content/maney/se/2001/00000017/00000003;jsessionid=1xpmlw91522a3.victoria)

Future seminars and conference

- **2nd Congress Latino-American on metal conservation** (25-28 July 2005, Rio de Janeiro, Brazil), organised by the Museum of Astronomy and Sciences (MAST) and the

Latinoamerican Group of Metal Conservation (GLRM). For more information contact Marcus Granato (marcus@mast.br) or Johanna M. Theile (jtheile@abello.dic.uchile.cl)
- **14th Triennial Meeting of ICOM's Committee for Conservation, ICOM-CC** (10-16 September 2005, The Hague, Netherlands) organised by the ICN (Netherlands Institute for Cultural Heritage in collaboration with ICOM, ICOM-Netherlands; ICOM-CC, the Netherlands Museum Association (NWV), the Dutch association of professional Conservators and Restorers (VeRes) and the Congress and Study Centre (VNG). For more information visit the following website: www.icom-cc2005.org
- **LACONA VI** (Lasers in the conservation of Artworks) (21-25 September 2005, Vienna, Austria), 6th International Congress on the Conservation of artworks by laser, organised by the Federal Office for Care and Protection of Monuments Austria-Bundesdenkmalamt and the Academy of Fine Arts Vienna. For more information visit the following website: www.lacona6.at
- **RIPAM** (International meeting on Mediterranean Architectural Heritage) (26-28 September 2005, Meknès, Morocco), organised by the Faculty of Science, University Moulay lamail (Meknès, M), the Interregional Centre for Patrimony Conservation and Restoration (Marseille, F) and the European network PACT "Sciences and Cultural Patrimony". For more information visit the following website: www.fsmek.ac.ma/ripam2005
- **EAS-NYCFCSAS 2005** (Eastern Analytical Symposium- New York Conservation Foundation Conservation Science Annual symposia) 2005 (14-16 November 2005, New York, USA), organized by the New York Conservation Foundation. Topics considered: deterioration of metal pipes in 16-18th Century European organs and diverse studies on Heritage in metal. For more information visit the following website: www.nycf.org/eas.html
- **The Conservation of Archaeological Materials—current trends and future directions** (13-17 November 2005, Williamsburg, USA), organized by The Archaeological Discussion group of the American Institute of Conservation and the Department of Conservation at the Colonial Williamsburg Foundation. For more information contact Emily Williams (ewilliams@cwf.org): program or Deb Chapman (dchapman@cwf.org): general.
- **BIGSTUFF 2005** (Assessment, conservation and maintenance of large technology objects (1-2 December 2005, Canberra, Australia), organized by the Australian War Memorial as a follow-up to the BigStuff workshop run last year once again in Canberra. For more information contact Alison Wain (alison.wain@awm.gov).
- **Archaeometallurgy in Europe** (May or June 2007, Grado and Aquileia, Italy) organized by the Associazione Italiana di Metallurgia. For more information visit the following website: www.aimnet.it/archaeometallurgy2.htm

Abbreviations and acronyms

AAS: Atomic Absorption Spectroscopy
C2RMF:Centre de Recherche des Musées de France
EDS: Energy Dispersive Spectroscopy
HM/CD: Heritage Malta / Conservation Division
HNM: Hungarian National Museum
INP-DR: Institut National du Patrimoine – Département des restaurateurs
IRRAP: Institut de Restauration et de Recherches Archéologiques et Paléométallurgiques
LRMH: Laboratoire de Recherche des Monuments Historiques
RBS: Rutherford Backscattering Spectrometry
SEM-EDS or **EDXA**: Scanning Electron Microscopy – Energy Dispersive Spectroscopy
XRD: X-Ray Diffraction
UoB: University of Bamberg

Contacts

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Olivier Tavozo / INP (tavoz@caramail.com)

National representatives of the Metal WG coordinator

Argentina: Blanca Rosales, researcher, CIDEPINT, La Plata
Australia: David Hallam, senior conservator of objects at the National Museum of Australia, Canberra
Belgium: Patrick Storme, conservator and lecturer at the Hogeschool Antwerpen, Royal Academy of Fine Art, Antwerpen and Gilberte Dewanckel, conservator at IRPA (Institut Royal du Patrimoine Artistique), Bruxelles
Bulgaria: Petia Penkova, conservator, National Academy of Arts, Department of conservation-restoration, Sofia
Canada: Judy Logan, senior conservator, Canadian Conservation Institute, Archaeology section, Ottawa
Chile: Johanna Theile, conservator and lecturer, Facultad de Arte - Universidad de Chile Las Encinas, Santiago de Chile
Croatia: Goran Budija, conservator, Museum of Arts and Crafts, Zagreb
Czech Republic: Dusan Perlik, conservator, Museum of Central Bohemia, Roztoky
Denmark: Karen Stemann Petersen, conservator, The National Museum of Denmark, Copenhagen
Egypt : Wafaa Anwar Mohamed, conservator, Giza
Finland : Eero Ehanti, conservator, Maritime Museum of Finland, Helsinki
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USA: Paul Mardikian, senior conservator, Warren Lasch Conservation Centre, North Charleston & John Scott, New York Conservation Foundation, New York

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