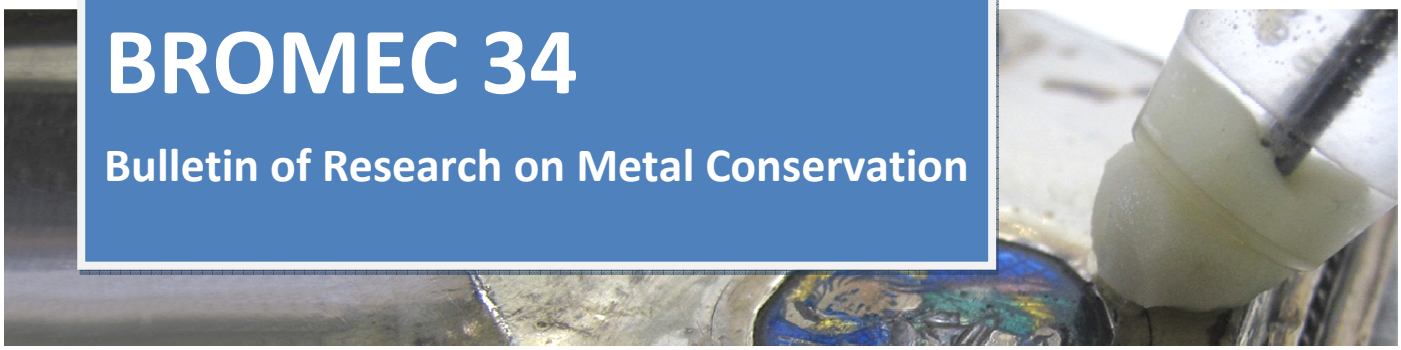
BROMEC 34

Bulletin of Research on Metal Conservation



April 2013

Editorial

This edition highlights innovative European research addressing some common challenges which confront metallic heritage collections. More particularly when options for analysis, conservation or restoration of metal-composite artefacts are restricted. The abstracts emphasize a range of approaches for ancient and modern metals concerning marine, terrestrial or atmospheric environments. In the light of decreasing funding avenues, the resourcefulness demonstrated by the research abstracts – whether it is financial, organisational or collaborative – is noteworthy. All projects featuring in BROMEC provide funding information; giving potential researchers some ideas of how to source their own financial support.

In this edition, research on *in situ* or post-excavation conservation treatments for iron- or copper-alloy organic composite archaeological artefacts feature twice. The first is a call for collaboration initiated during a master's dissertation from France, and the second is a newly launched Greek-French project. Another French project studies a particular corrosion of bronzes excavated from a river. It highlights the importance of controlling and maintaining relative humidity during conservation and museum display. Four innovative projects from Switzerland outline the application of diagnostic, electrochemical and microbiological techniques for material analyses or conservation-restoration treatments. Two of these again focus on problems resulting from organic-composite and/or multi-component metal objects. The title image depicts the application of a tool under development: an electrolytic pen for locally removing tarnish from gilt silver. Finally a consortium from the Czech Republic is analysing the composition and corrosion of excavated archaeological silver. This will be followed by reproduction of this jewellery by contemporary silversmiths.

New details for upcoming conferences are given for: Iron and Steel 2013: Rust, Regeneration and Romance; the 7th International Congress on the Application of Raman Spectroscopy in Art and Archaeology (RAA 2013); the 18th International Conference on Ancient Bronzes; BUMA VIII: International Conference on the Beginning of the Use of Metals and Alloys; Big Stuff 2013; and ICOM-CC's Metal 2013. Notably, early (i.e. discounted) registration for Metal 2013 is open until the end of June and accommodation information for the conference in Edinburgh is now online.

New announcements include a PhD thesis on the dechlorination of marine archaeological iron (see also BROMEC 29 and 32) and an introduction to the ICOM-CC Enamel Working Group.

New links for website resources include the American Institute for Conservation (AIC) Metals Conservation Wiki, presentations from Big Stuff 2007, the British Museum's Library Catalogue, and abstracts from last year's Bronze Conservation Colloquium.

We hope you find this edition informative and enjoyable!

James Crawford

Anglophone editor & translator:

James Crawford
jamesbcrawford76@gmail.com

Francophone coeditor:

Michel Bouchard
mbouchard@caraa.fr

Francophone translators:

Nathalie Richard
n.richard.elmesti@videotron.ca

Elodie Guilminot
elodie.guilminot@arcantique.org

Marc Voisot
horloger@pendulerie.com

Hispanophone coeditor:

Emilio Cano
ecano@cenim.csic.es

Hispanophone translators:

Diana Lafuente
diana.lafuente@gmail.com

Inmaculada Traver
lacirujanadelarte@gmail.com

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Cover image: Local cleaning with an electrolytic pen of the foot of a gilded silver monstrance, St Maurice Abbey Treasure, 13-14th c. Picture Atelier de restauration. © Abbaye de Saint-Maurice. Refer to abstract by Degrigny, "The St Maurice project: development of an electrolytic pen for cleaning tarnished gilt silverware with wooden cores".

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Survey on the stabilization of marine iron-organic composite artefacts [1] (UP1PS)

Call for collaboration

Contact: Virginie Ternisien (virginie.ternisien @ gmail.com) (MAC Lab, UP1PS)

Funding: No external funding

In preparation for a PhD, the following work is being performed within a Masters degree by research in heritage conservation-restoration at Université Paris 1 Panthéon Sorbonne. Research focuses on desalination (removal of chlorides) of marine archaeological iron-organic composite artefacts which cannot be separated into their component parts.

My dissertation will be based on a literature review as well as on testimonials from conservators dealing with similar artefacts. Based on current research, the use of cathodic polarization in a non-buffered neutral electrolyte appears to be the most favoured method of desalination of composite iron-organic marine artefacts, while maintaining the integrity of the artefact. By testing different stabilization treatments and evaluating their efficiency, my objective is to define the issues to address during my PhD.

If you have undertaken desalination of similar composite artefacts, I seek your collaboration by answering the following questions. They are largely inspired by an open letter from Hawley[2] to record suggestions made by conservators about the treatment of inseparable composite waterlogged wood-metal artefacts.

- Could you provide details of the desalination treatment you applied and their effects on the artefact (organic and iron parts)?
- Would you consider the treatment successful? If not, what would you suggest are the reasons for the failure? What were your expectations? What would you have changed in the treatment protocol?
- What is your recommended research focus for effective desalination of these kinds of composite artefacts?
- What are your thoughts and comments on electrolytic stabilization?
- If you know someone who has, or is currently, undertaking similar research, would you be willing to provide their contact information?

Thank you for completing the survey, I am happy to share the results with you by email. Your assistance is greatly appreciated to help direct the focus of future research. If you are interested in being a part of this project, please feel free to make contact by email since I am in the process of identifying a suitable research facility where I can undertake the PhD research.

1. Original language version*; submitted by author in English.*

2. Hawley, J. 1984. WOAM Newsletter March 11.

New approaches and applications of electrochemical techniques and corrosion inhibitors for in situ monitoring of shipwrecks and treatment of recovered marine metal-organic composite artefacts [1] (TEIA, NTUA, AA)

New research project

Contact: Vasilike Argyropoulos (bessie@teiath.gr) (TEIA), George Batis (NTUA), Elodie Guilminot (AA)

Funding: Archimedes III, January 15 2013 – January 20 2015, € 83 000

This project aims to establish an integrated approach for the *in situ* maintenance of metal components found on shipwrecks and the treatment of metal-wood composite artefacts when removed from underwater sites for museum display.

The work plan involves developing a monitoring program to document *in situ* the condition of iron and copper alloy elements of shipwrecks. A test rack of coupons of standard composition will be placed near a selected shipwreck and E_{corr} and surface pH measurements will be conducted periodically in the Aegean Sea. At the same time E_{corr} measurements will be carried out on selected shipwrecks in the Aegean. The intention is to evaluate its effectiveness and usefulness as a condition monitoring tool for the underwater environment of Greece. The developed methods will be tested *in situ* on modern shipwrecks found off the coast of the island of Paros. The possibility of *in situ* condition monitoring of the shipwrecks could lead to the development of an integrated preservation plan for shipwrecks using cathodic protection.

The research also plans to develop appropriate methods of dechlorination of metals in contact with organic materials (wood, textile, leather) via the application of electrochemical techniques (*local electrolysis*), followed by the testing of new non-toxic corrosion inhibitors during water removal from the organic parts of the artefact. Local electrolysis will be performed on the metal part using a sponge-like material which contains the electrolyte: ensuring the organic part does not make contact with the alkaline electrolyte. The proposed prototype method is commonly used during monument conservation for dechlorination of steel rods in reinforced concrete, and is yet to be applied to conservation of marine composite artefacts. If successful, this approach would offer a simpler, more cost-effective method to dechlorinate metal parts of composite artefacts. The treatment of the organic part of the artefact would be completed using traditional dewatering and consolidating methods, with the help of the said corrosion inhibitors. The new treatment approach will be tested on composite artefacts raised from the 1868 shipwreck known as *Patris*, found near the island of Kea.

Finally, the project will produce a Good Practice Guide for conservation professionals on the state of the art methods applied to stabilize such artefacts.

1. Original language version; submitted by author in English.

MAIA: Microbes for Archaeological Iron Artefacts [1] (LAMUN, SNM)

New research project

Contact: Edith Joseph (edith.joseph@ unine.ch) (LAMUN), Daniel Job (LAMUN), Pilar Junier (LAMUN), Marie Wörle (SNM)

Funding: Swiss National Science Foundation (SNSF) Ambizione grant PZ00P2_142514/1, 3 years (01.01.2013-31.12.2015)

Archaeological iron artefacts experience serious post-excavation problems when contaminated with salts. Evidence of this ongoing corrosion can be observed in the form of flakes, cracks and finally the loss of shape of an object. Usually, the simplest intervention adopted for the stabilization of archaeological iron artefacts is by immersion in alkaline solutions. This method is based on the slow diffusion of the chloride ions from the objects into the solution. This approach is extremely labour intensive and time-consuming. Also, there is no direct evaluation that chlorides have been fully extracted; only the extracted soluble chlorides are measured.

The aim of this project is to develop and evaluate novel desalination methods. In order to improve extraction of chlorides, we will consider two aspects of a treatment: significantly retarding corrosion, for example by removing oxygen or using alkaline solutions, and increasing the porosity of the corrosion crust by the formation of low molar volume compounds. Here we propose to exploit the unique properties of some microorganisms for the stabilization of archaeological iron. Three different strategies will be adopted; either leading to the formation of stable compounds of low molar volume or using translocation properties. First, we will test some species of fungi that have been reported for their ability to transform metal compounds into metal oxalates, known to be chemically stable compounds of low molar volume. The same approach will be exploited to precipitate magnetite (Fe_3O_4), another very stable compound of low molar volume. Finally, in order to enhance the removal of chlorides from the iron object, we propose the testing of the possible translocation of chlorides by fungi. Based on the results achieved, we could contribute to the development of a synergetic microbial consortium specially designed for the removal of chloride ions and the simultaneous formation of stable iron compounds. Particular attention will be devoted to the efficiency and impact on metallographic structure of the proposed treatment to overcome the problems associated with the treatments presently in use[2]. Archaeological iron samples will be also included in the studies in order to validate the new method. This research presents innovative aspects in biogeochemistry of microorganisms and conservation science. A key factor supporting its potential success is the creation of an interdisciplinary research partnership, which brings together experts from the fields of chemistry, microbiology and metal conservation.

1. Original language version; submitted by author in English

2. Scott, D.A., Eggert, G. 2009. Iron and steel in art: corrosion, colorants and conservation. London: Archetype publications Ltd.

Fabrication, corrosion and conservation of the silver jewellery from Lumbe's Garden, Prague Castle [1] (IAASCR, ICT)

New research project

Contact: Estelle Ottenwelter (ottenwelter@arup.cas.cz) (IAASCR), Jiří Děd (ICT)

Funding: Czech grant agency (project P405/12/2195)

The archaeological collection of silver jewellery (9th century AD) from Lumbe's Garden necropolis, Prague Castle, is being investigated within the framework of a 3-year project. The conservation-restoration laboratory of the Institute of Archaeology of Prague is collaborating with the Institute of Chemical Technology to identify:

1. materials and manufacturing technologies
2. corrosion mechanisms/typologies
3. suitable post-excavation treatments.

To help achieve the first objective the silver jewellery will be characterized to further identify the various methods of manufacture: eg. granulation, filigree, casting, hammering, soldering, fire-gilding. X-radiography and metallographic examination will identify the internal structures, and metalworking methods. Surface and core analyses via scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDX) and X-ray fluorescence (XRF) will be applied to identify the metals, alloys, solders and coatings. Replicas will be produced by a silversmith to test the subsequently proposed hypotheses on the methods of manufacture. Analyses of the replicas will also be performed.

Metallographic examinations of fragments will determine the morphologies/mechanisms of the corrosion damage (e.g. intergranular).

X-ray diffraction (XRD) will provide composition of crystalline corrosion products; allowing their differentiation.

Lastly it is intended to highlight evidence of the negative effects of chemical treatment methods which were performed during the last decades (e.g. stripping of corrosion products from the metal core, dissolution of solder and loss of granules). Recommendations of treatments suitable for these kinds of objects, including electrochemical methods (in collaboration with Francoise Urban and Virginia Costa) will be made.

1. Original language version; submitted by author in English.

The MIFAC-Metal project: a methodology for studying and analyzing microstructures and corrosion profiles of heritage metals: application to metallographic samples from Swiss collections [1] (HEACR, Empa)

Ongoing research project

Contact: Christian Degrigny (christian.degrigny@he-arc.ch) (HEACR), Marianne Senn (marianne.senn@empa.ch) (Empa)

Funding: HES SO

The conservation and restoration of archaeological and historical metallic artefacts require a thorough understanding of their constituent materials and alterations to limit the risk of new deterioration and to apply remedial treatments which will stabilize corrosion processes, ensure cohesion of the constituent materials and allow the uncovering of the *limits of the original surface*[2] of the object. The invasive and/or destructive nature of metallographic methods and some chemical analyses limit their application to cultural heritage materials. Nevertheless, in the past numerous samples have been taken from metallic archaeological and historical artefacts in Swiss collections and are presently distributed around the diverse institutions of this country.

The conclusion from the analyses showed both their great disparity and – for most of them – their specificity. For the MIFAC-Metal project we have reconsidered a representative selection of these samples (32) to combine the examination of their microstructure with the analysis of their corrosion profile. For this we developed a method to describe and analyze the samples; homogenizing the collected information and ensuring their accessibility for conservation-restoration professionals.

The selected examination techniques are mainly those which are usually accessible by conservation-restoration laboratories, particularly traditional metallography, scanning electron microscopy combined with energy dispersive X-ray spectroscopy and Raman spectrometry. The results are compiled in digitized files which combine the comprehensive documentation of the initial object and the samples; highlighting the most interesting aspects of the inventoried structures.

The copper alloy samples (mainly tin bronzes, with or without lead) date from the 16th century BC to the end of the 18th century AD. Iron alloys, mainly steels ranging from the 3rd-2nd centuries BC to the 20th century AD, are best represented. The corrosion profiles depend naturally on the exposure conditions (atmospheric, burial). The few samples taken from aluminium and zinc alloys are not very oxidized.

The catalogue of files (in English) may be obtained on request via the contact address below. To facilitate access we plan to put the catalogue online. This educational resource for conservation-restoration professionals will possibly be expanded by new contributions; particularly for historical metals (brasses...) and modern metals (nickel and aluminium alloys...), which are underrepresented in the current catalogue.

1. Translated by M. Voisot and J. Crawford. Original version submitted by author in French; refer to BROMEC 34 French version.

2. Bertholon., R., 2000. La limite de la surface d'origine des objets métalliques archéologiques: PhD thèse. Université Paris I Panthéon-Sorbonne.

CLAMTEC project: development of software for the analysis of historic metals using their E_{corr} plots [1] (HEACR)

Ongoing research project

Contact: Christian Degrigny (christian.degrigny@he-arc.ch) (HEACR)

Funding: HES SO

CLAMTEC follows on from the 2009 SPAMT-Test project, which was created for technical/scientific object and clock conservator-restorers as a tool for qualitative analysis of composition. Similar in purpose to "spot tests", it aimed to develop a single, simple and low-cost analysis which provides an initial indication of the composition of metal alloy objects under study or conservation[2]. The working principle of the SPAMT-Test tool is available in BROMEC 30, in which we mentioned the limiting nature of the reference database of 250 E_{corr} versus time plots: it was difficult to affirm which plots in the database most closely matched those plots established from samples of unknown composition.

The objective of the CLAMTEC project has been to limit this problem through development of a plot comparison software ("DiscoveryMat") based on calculations of the distances which separate them. It also allows the automatic collection of data (per second); making data acquisition more reproducible. The sum of the distances between the 15-minute plots obtained from three solutions (Henniez mineral water, potassium nitrate and sodium sesquicarbonate) applied to the unknown material and to those of a reference material in the database, constitute the cumulative distance (or closeness) used by the algorithm of the software. The references in the database are ordered according to these distances; the most plausible propositions being those which feature the smallest differences. According to their knowledge of the analysed materials (construction technology, colour, use, degradation...) the analyst must then assess the suggestions made by the software.

The new CLAMTEC tool consists of: the measurement hardware (comprising a multimeter interfaced for the automatic collection of potentials), the "DiscoveryMat" software, and the SPAMT-Test reference database. It has been tested on a set of representative objects from the Musée International d'Horlogerie (MIH) collection of La Chaux-de-Fonds. Of the 47 tested materials, CLAMTEC was able to propose nearly exact compositions for 44 of them (for brass, brass with lead) or very similar compositions, where the elements are identified, but their concentration was not similar (for quaternary alloys, bronzes with zinc, and maillechorts). These last alloys increased the size of the database to 120 references of differing composition.

DiscoveryMat is a freeware: http://157.26.64.17:8080/bilat-discoveryMat-user/index.html

1. Translated by M.Voisot, J. Crawford and M. Bouchard. Original version submitted by author in French; refer to BROMEC 34 French version.

2. Degrigny C. et al., 2010. Qualitative analysis of historic copper alloy objects by measuring corrosion potential versus time. In Mardikian, P., et al. ICOM-CC Metal WG interim meeting, METAL 10, Proceedings of the International Conference on Metals Conservation. Clemson University, 11-15 October, Charleston.

The St Maurice project: development of an electrolytic pen for cleaning tarnished gilt silverware with wooden cores [1] (HEACR, ASM)

Ongoing research project

Contact: Christian Degrigny (christian.degrigny@he-arc.ch) (HEACR), Denise Witschard (ASM)

Funding: HES SO

In 2015 the Saint-Maurice Abbey will celebrate its 1500th anniversary. The treasury of the monastery will be redistributed into a new space and the most remarkable silverware (made of gilt or non-gilt silver, which is atmospherically tarnished) will have its original brilliance returned. Restoration of these exceptional heritage objects present conservators with the delicate problem of cleaning composite artefacts without removing the metal sheets which are nailed onto wooden cores. Mechanical or chemical cleaning techniques are too aggressive in these cases and should be avoided; likewise for traditional electrolytic reduction by immersion.

The St Maurice project aims to develop methods for localized cleaning, specifically based on the innovative use of an electrolytic pen. Several undocumented attempts have been made in the past, but they led to undesirable side-effects like staining of the cleaned metal (caused by non-renewal of the contaminated cleaning solution), or by accidental discharge of the solution onto the wooden core.

The tool we would like to develop is inspired by the early work of Arie Pappot (Rijksmuseum, Amsterdam), who developed a pen in which the solution is constantly renewed. For this new pen, we improved the flow of the solution with the addition of two diaphragm pumps: one with a fixed flow for supplying the cleaning solution and the other with a variable flow for its extraction. The positions of the built-in electrodes as well as that of the inflow and outflow tubes may be adjusted. Discharge problems were solved by adding an absorbent pad to the tip of the pen.

The first prototype is being tested, with success, at the St Maurice Abbey. Nonetheless, the treatment parameters had to be redefined. The use of the pen, when compared with the immersion treatment, shifts the reduction and oxidation potentials some several hundred millivolts and constant renewal of the solution causes significant fluctuations in current, making it difficult to locate the reduction and oxidation peaks during linear voltammetry.

During the second year of the project we will refine the treatment parameters. The ergonomics of the pen will be improved in collaboration with the Laboratoire de Recherches en Anthropotechnologie – EDANA from the Haute Ecole Arc Ingénierie. The new optimized version of the pen will be used for cleaning the most prestigious objects of the treasury.

1. Translated by M. Bouchard and J. Crawford. Original version submitted by author in French; refer to BROMEC 34 French version.

Conservation of a fluvial deposit of bronzes from Agde-La-Motte [1] (CREAM, AC)

Finalized research project

Contact*:* Patrick Pliska (ppliska @mairie-vienne.fr) (CREAM), Philippe De Viviès (AC)

Funding: No external funding

In February 2004, a bronze age deposit being threatened by erosion was discovered in the Hérault river (France) during a survey by archaeologists from DRASSM. The deposit was transported within its earthen mass to CREAM in Vienne, where its condition was assessed and it was kept in a humid environment in order to prepare a treatment plan.

In demineralised water signs of active corrosion appeared (cracking, surface lifting and unidentified efflorescence) which led to requests for C2RMF to analyse the corrosion products. Much sulphur and oxygen were detected, but no chlorine, as we were expecting. As the water was contributing to deterioration, drying (atmospheres of RH <45%) was undertaken. In consultation with the curator of the Museum of l'Ephèbe d'Agde a conservation-restoration program was launched. Consolidation of the objects was made since they were extremely fragile. A dry atmosphere was recommended to the museum, but an air conditioning failure caused an unusual reactivation of the corrosion; particularly spectacular on an object which had been consolidated with an acrylic resin.

Considering the unconventional corrosion, a study by A-Corros was requested. Through analyzing the corrosion products it confirmed and complemented the results from the C2RMF. However, the limited time and the restricted budget did not allow to the proposition of a definitive model for the transformation mechanism of these corrosion products. It did however confirm the need to improve the environment of the object, and the establishment of very low and stable relative humidity conditions.

1. Translated by M. Bouchard and J. Crawford. Original version submitted by author in French; refer to BROMEC 34 French version.

Abbreviations and acronyms

AA: ARC'Antique, Nantes, France

AC: A-Corros, Arles, France

ARC-Nucléart: Atelier Régional de Conservation, Grenoble, France

ASM: Abbaye St Maurice

C2RMF: Centre de Recherche et Restauration des Musées de France, France

CEA: Centre d'Etudes Nucléaires, Grenoble, France

CREAM: Centre de Restauration et d'Etudes Archéologiques Municipal de la ville de Vienne en Isère, France

DRASSM: Direction Régionale de l'Archéologie Subaquatique et Sous-Marine, Marseille, France

EDS/EDX: energy dispersive X-ray spectroscopy

Empa: Eidgenössische Materialprüfungs- und Forschungsanstalt, Switzerland

HEACR: La Haute Ecole de Conservation-Restauration Arc, Switzerland

HES SO: Haute Ecole Spécialisée de Suisse Occidentale, Switzerland

IAASCR: Institute of Archaeology of the Academy of Sciences of the Czech Republic (Archeologický ústav AV ČR, Praha, v. v. i., Oddělení záchranných výzkumů - pracoviště Restaurátorské laboratoře), Prague

ICT: Department of Metal and Corrosion Engineering, Institute of Chemical Technology (Vysoká škola chemicko-technologická v Praze, Ústav kovových materiálů a korozního inženýrství), Prague

LAMUN: Laboratory of Microbiology, Institute of Biology, University of Neuchâtel, Neuchâtel, Switzerland

MAC Lab: Maryland Archaeological Conservation Laboratory, USA

MIH: Musée International d'Horlogerie

NTUA: Department of Chemical Engineering, National Technical University of Athens, Greece

RH: relative humidity

SEM: scanning electron microscopy

SNM: Laboratory of conservation research, Sammlungszentrum, Swiss National Museum, Switzerland.

TEIA: Department of Conservation of Antiquities & Works of Art, Technological Educational Institute of Athens, Greece

UP1PS: Université Paris 1 Panthéon-Sorbonne, France

XRD: X-ray diffraction

XRF: X-ray fluorescence

General information

Future seminars and conferences

New **Iron and Steel 2013: Rust, Regeneration and Romance** (10-14 July 2013, Ironbridge, United Kingdom). The Ironbridge Gorge Museum Trust and the University of Birmingham is pleased to announce this multidisciplinary conference and welcomes speakers and delegates from applied and scientific disciplines. For further information: http://ironandsteel2013.wordpress.com/

New **RAA 2013: 7th International Congress on the Application of Raman Spectroscopy in Art and Archaeology** (2-6 September 2013, Ljubljana, Slovenia). The purpose of this biannual event is to gather contributions towards the latest developments on the application of Raman spectroscopy to cultural heritage materials. It aims to promote best practice in its application through various disciplines: e.g. art-history, history, archaeology, palaeontology, conservation and restoration, museology, degradation, archaeometry. For the preliminary programme refer to: http://raa13.zvkds.si/programme/

New **18th International Conference on Ancient Bronzes** (3-7 September 2013, Zürich, Switzerland). The following subjects will be addressed: Greek and Italic bronze artefacts from Iron Age Central Europe; Greek bronze artefacts from the Mediterranean region; large-scale bronzes; Roman statuettes; Roman toreutics; manufacturing techniques & restoration; analytics and written records. Information: www.prehist.uzh.ch/bronzekongress2013

New **BUMA VIII**: **International Conference on the Beginning of the Use of Metals and Alloys** (10-15 September 2013, Nara, Japan). The main theme is “Cultural Interaction and the Use of Metals” and topic categories include: Iron and Steel Technology, Copper and Bronze Technology, Precious Metals and Coinage, Casting Technology of Bronze and Iron, Swords and Iron Artifacts, History of Alloys, Ores and Metal Production, Experimental Metallurgy, Survey Methods and Conservation. Information: http://buma8.wiki.fc2.com/wiki/TOP%20PAGE

New **Metal 2013** (16-20 September, 2013, Edinburgh, Scotland). The International Council of Museums Committee for Conservation Metal Working Group is pleased to announce that online registration and accommodation links are active for the upcoming Interim Meeting. Note that the Early Bird Conference Fee is valid before 1 July 2013. For more information: http://www.metal2013.org/

New **Big Stuff 2013** (25-27 September, Ottawa, Canada). This unique triennial international meeting focusses on the challenges and triumphs of conserving our large technology heritage. The current theme is: "Saving Big Stuff in tight economic times". The conference will feature three days of talks, workshops and discussions about the preservation of sites, oversized objects, machinery, and working technology in the context of their significance and interpretation. For more information including attendance and submission of paper/poster abstracts, visit: http://www.sciencetech.technomuses.ca/english/whatson/big_stuff_conference.cfm

Announcements

New **ICOM-CC Enamel Working Group** The main purpose of this group is to facilitate the contact and the circulation of information between conservators, scientists, historians, curators and enamelers. It can also address issues relating to enamel-metal composites. If you wish to join the group and receive the newsletter by e-mail, please send a message to Agnès Gall Ortlik (gallortlik@yahoo.fr) with your address and contacts. For more information: http://www.icom-cc.org/88/ENAMEL/#.UO6p328z034

New Studying dechlorination mechanisms of ferrous archaeological artefacts corroded in marine environments: a case study with aerated and deaerated alkaline solutions. The PhD thesis of Florian Kergourlay describes the characterization of the corrosion system on seawater-corroded iron ingots by an array of multi-scale analytical techniques before, during and after a dechlorination treatment. The research raises questions on the dechlorination mechanisms and models for chloride ion diffusion proposed in the literature: http://tel.archives-ouvertes.fr/docs/00/72/11/76/PDF/Kergourlay_2012_these.pdf

Websites

New **American Institute for Conservation (AIC) Metals Conservation Wiki** - contributors requested! http://www.conservation-wiki.com/index.php?title=Metals

New **Big Stuff 2007 presentations** are available: http://www.bergbaumuseum.de/web/aktuelles-veranstaltungen-2007-bigstuff

New **British Museum's Library Catalogue** is accessible to external scholars:

http://www.britishmuseum.org/research/libraries_and_archives.aspx

New **Bronze Conservation Colloquium** (State Academy of Art & Design Stuttgart, Germany, 2012). For the abstracts and brochure see: http://www.bronze-colloquium.abk-stuttgart.de/bronze-colloquium-download.html

New **Getty Conservation Institute's electronic publications**: freely available PDF documents covering a range of conservation subjects: http://www.getty.edu/conservation/publications_resources/pdf_publications/

ANDRA: Agence Nationale pour la Gestion des Déchets RadioActifs. The following documents can be ordered for free from this website: *Analogues archéologiques et corrosion* (French) and *Prediction of Long Term Corrosion Behaviour in Nuclear Waste Systems* (English) (http://www.andra.fr/interne.php3?publi=publication&id_rubrique=82&p=produit&id=5).

Archaeological Iron Conservation Colloquium 2010 (24-26 June 2010, State Academy of Art and Design, Stuttgart) extended abstracts (Gerhard Eggert and Britta Schmutzler (Eds.)) are online:

- http://www.iron-colloquium.abk-stuttgart.de/Documents/Tagungsband_session_1.pdf
- http://www.iron-colloquium.abk-stuttgart.de/Documents/Tagungsband_session_2.pdf
- http://www.iron-colloquium.abk-stuttgart.de/Documents/Tagungsband_session_3.pdf
- http://www.iron-colloquium.abk-stuttgart.de/Documents/Tagungsband_session_4.pdf
- http://www.iron-colloquium.abk-stuttgart.de/Documents/Tagungsband_postersession.pdf

ARTECH network: Network facilitating the access of conservation professionals to different investigation techniques for Cultural Heritage artefacts (http://www.eu-artech.org/).

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

BROMEC subscription: For direct email notification of BROMEC publication web links and calls for submission of abstracts and announcements, simply subscribe with your preferred email address: (warwick.ac.uk/bromec-subscription).

CAMEO: 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://cameo.mfa.org/).

Cost Action G7: Artwork conservation by laser: (http://alpha1.infim.ro/cost).

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

Cost Action D42: ENVIART: Chemical Interactions between Cultural Artefacts and Indoor Environment. Register (free) to access all information (http://www.echn.net/enviart/).

Electrochemistry in Historical and Archaeological Conservation (11-15 January 2010, Leiden, the Netherlands). The majority of presentations from this workshop held at the Lorentz Center (http://www.lorentzcenter.nl/), are available for download: http://tinyurl.com/lorentzpresentations

e-Preservation Science: Online publication of papers in conservation science (http://www.morana-rtd.com/e-preservationscience/).

European Cultural Heritage Network: European network of professionals interested in the conservation of Cultural Heritage (http://www.echn.net/).

European Federation of Corrosion's Working Party 21: dedicated to corrosion of archaeological materials http://www.efcweb.org/Working+Parties/WP+21.html

Ge-Conservacion is a periodical published by GEIIC (Grupo Español de Conservación/Spanish Conservation Group of the International Institute for Conservation of Historic and Artistic Works: www.ge-iic.com/) in association with the Duques de Soria Foundation. Its purpose is to contribute to the scientific development, dissemination and exchange of cultural heritage conservation and restoration knowledge: http://ge-iic.com/revista/index.php?lang=en

ICOMAM: International Committee of Museums and Collections of Arms and Military History: (http://www.klm-mra.be/icomam/).

ICOM-CC Metals Working Group: (http://www.icom-cc.org/31/working-groups/metals/). This site is for all official ICOM-CC Metals WG activities, forums, news, file downloads and information. The co-ordinator can email members from this site once members have registered on-line as a member of the Metals WG. Public access to this site is limited.

Incredible Industry: The proceedings from the Nordic Association of Conservators 18th Conference, "Incredible Industry, Preserving the Evidence of Industrial Society" (25-27 May 2009, Copenhagen, Denmark) are now freely available online (www.nkf-dk.dk/Bulletin/NKF-Incredible-industry09.pdf).

Industrial artifacts review: Industrial design and the role of art and photography in promoting cultural heritage (http://industrialartifactsreview.com/).

Infrared and Raman for cultural heritage: (http://www.irug.org/default.asp).

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

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

La limite de la surface d'origine des objets métalliques archéologiques ("The original surface limits of metallic archaeological artefacts"): PhD thesis by Régis Bertholon, establishes a detailed methodology for determining and describing the location of the former original surface, as modified by its corrosion mechanisms. In French, the document provides an invaluable archaeological metals conservation resource through its synthesis of archaeology, mineralogy and corrosion science. Useful for the conservator and researcher alike, numerous detailed photographs and schema complement the comprehensive text: http://tel.archives-ouvertes.fr/docs/00/33/11/90/PDF/Limitos.pdf

Metal 2010 proceedings: The Editors and ICOM-CC Metal Working Group Coordinator announce that the conference proceedings from Metal 2010 are available for sale. Please go to www.lulu.com and search for "METAL 2010" to purchase your full colour or black and white copy. Included in the proceedings are 49 full text papers, 13 poster abstracts, transcripts of the question and answer session for each paper, transcripts of the panel discussion for all 12 sessions, and an author index; totalling 489 pages.

METALCons-info: Metals Conservation Information (http://metalsconservationinfomation.wetpaint.com/) is where the old METALCons-info site is being moved and redeveloped. This is a wiki based site, which means it can be grown by contributions from "writers" - i.e. you. Its power depends on how willing you are to use it. Each week it sends a summary of activity to members – so sign up! It is currently publicly visible, but this may change with any unwanted activity.

M2ADL: Microchemistry and Microscopy Art Diagnostic Laboratory (http://www.tecore.unibo.it/html/Lab_Microscopia/M2ADL/).

New York Conservation Foundation: (http://www.nycf.org/).

PROMET: A 3.5 year European 6th Framework funded project (21 partners from 11 countries around the Mediterranean basin) that developed conservation strategies for outstanding metals collections throughout the Mediterranean (http://www.promet.org.gr).

Restauración Metal Sur América: (http://www.restauraciondemetales.cl/).

TEL: PhDs on line (http://tel.ccsd.cnrs.fr/).

Yahoo Groups Metals Conservation: A discussion group for all who are interested in Metals Conservation. Join in and make this a "Metals Cons-Dist List" (http://groups.yahoo.com/group/Metals-Conservation-Discussion-Group).

National Contacts

Argentina: Blanca Rosales (brosales@fibertel.com.ar), researcher, CIDEPINT, La Plata.

Australia: David Hallam (dhallam@nma.gov.au), senior conservator-restorer of objects, National Museum of Australia, Canberra.

Belgium: François Mathis (francois.mathis@ulg.ac.be), archaeometrist, Centre for Archaeometry, University of Liège (Université de Liège), Liège.

Bulgaria: Petia Penkova (petiapenkova@yahoo.com), conservator-restorer, National Academy of Arts, Department of conservation-restoration, Sofia.

Chile: Johanna Theile (jtheile@udd.cl), conservator-restorer and lecturer, Faculty of Art, University of Chile The Oaks (Facultad de Arte, Universidad de Chile Las Encinas), Santiago de Chile.

Croatia: Zoran Kirchhoffer (zoran.k@tehnicki-muzej.htnet.hr), conservator-restorer, Zagreb Technical Museum (Tehnički muzej Zagreb) and Sanja Martinez (smartin@fkit.hr), electrochemist and lecturer, Faculty of Chemical Engineering and Chemical Technology, University of Zagreb (Sveučilište u Zagrebu), Zagreb.

Denmark: Karen Stemann Petersen (karen.stemann@natmus.dk), conservator-restorer, The National Museum of Denmark (National Museet), Copenhagen.

Egypt: Wafaa Anwar Mohamed (wafaaanw@yahoo.com), conservator-restorer, Giza.

Finland: Pia Klaavu (pia.klaavu@nba.fi), conservator-restorer, National Museum of Finland (Suomen kansallismuseo), Helsinki.

France: Elodie Guilminot (elodie.guilminot@arcantique.org), conservation scientist, Arc'Antique, Nantes.

Germany: Britta Schmutzler (britta.schmutzler@ gmx.de), PhD "object conservation" student, State Academy of Art and Design (Staatliche Akademie der Bildenden Künste), Stuttgart.

Greece: Vasilike Argyropoulos (bessie@ teiath.gr), assistant professor, Department of Conservation of Works of Art, Technological Educational Institution, Athens.

Hungary: Balazs Lencz (lenczb@gmail.com), senior conservator-restorer, Conservation Department, Hungarian National Museum (Magyar Nemzeti Muzeum), Budapest.

India: Achal Pandya (achalpandya@hotmail.com), head of department, Cultural Archives and Conservation, Indira Ghandi National Centre for the Arts, New Delhi, India.

Italy: Paola Letardi (paola.letardi@ismar.cnr.it), scientist, Institute for Marine Corrosion of Metals (Istituto per la Corrosione Marina dei Metalli), Genova.

The Netherlands: Ineke Joosten (ineke.joosten@ icn.nl), conservation scientist, The Netherlands Institute for Cultural Heritage (Instituut Collectie Nederlan), Amsterdam.

Norway: Douwtje Van der Meulen (d.l.v.d.meulen@iakh.uio.no), conservator-restorer, Conservation Department, University of Oslo (Universitetet i Oslo), Oslo.

Portugal: Isabel Tissot (isabel.tissot@ archeofactu.pt), conservator-restorer, Portuguese conservation-restoration Institute (Instituto Português de Conservação e Restauro), Lisbon.

Romania: Dorin Barbu (barbu_dorin_laboratory @yahoo.com), conservator-restorer, National Brukenthal Museum (Muzeul Naţional Brukenthal), Sibiu.

South Africa: Bradley Mottie (bmottie @iziko.org.za), conservator, Iziko Museums of Cape Town, South Africa.

Russian Federation: Andrey Chulin (andrey_chulin@yahoo.com), conservator-restorer, the State Hermitage Museum, St Petersburg.

Spain: Emilio Cano (ecano@ cenim.csic.es), scientist, National Centre for Metallurgical Research (Centro Nacional de Investigaciones Metalúrgicas), Spanish Council for Scientific Research (Consejo Superior de Investigaciones Científicas), Madrid.

Sweden: Helena Strandberg (helena.st@ comhem.se), conservator-restorer and conservation scientist, freelancer, Göteborg.

Switzerland: Valentin Boissonnas (valentin.boissonnas@ he-arc.ch), conservator-restorer and lecturer, Technical University (Haute école de conservation-restauration Arc), La Chaux-de-Fonds.

United Kingdom: Maickel van Bellegem (Mbellegem@ thebritishmuseum.ac.uk), conservator-restorer, British Museum, London.

United States of America: John Scott (NYConsnFdn@ aol.com), New York Conservation Foundation, New York.