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METAL*Consn*-info

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Bulletin of the Research On MEtal Conservation

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BROMEC22

Editorial

This new issue of BROMEC comes at a time where most of you have contributed greatly to our forthcoming METAL07 conference (www.metal07.org) that will be held next September in Amsterdam. The organising committee has received more than 120 abstracts (!) which show how active research in metal conservation is today. From these only half had to be selected for papers. You will soon receive the preliminary programme. Other abstracts will be presented as posters but some of you preferred to resend your abstract for the next ICOM-CC triennial conference that will be held in New Dehli in 2008.

Still we received a few abstracts on on-going research projects. We are first very happy that Clemson University is now in charge of the future development of the Hunley project and the Graduate Program in Historic Preservation. No doubt that more and more people will be trained there by the very good team in place. In previous BROMEC issues we were promoting the research carried out currently at Gent University on the stabilisation and protection of corroded lead artefacts exposed to aggressive organic vapours. A second pole of research on this topic is now established in Berlin at MCB. Cleaning of metal threads in textile fabric is still a major issue that needs further work and the National Museum of Denmark is currently carrying out essential work on this topic.

Conservation students provide us more and more abstracts related to their diploma work. In this issue we present two projects from HEAA-ARC (La Chaux-de-Fonds – CH) students. One is about a survey of past conservation treatments on archaeological iron artefacts in CH. The second is on laser cleaning of outdoor bronze monuments. Tunisia has submitted an abstract on the characterization of the corrosion products formed on ethnographic metal artefacts. Another abstract comes from the very active team coordinated by P. Dillmann and is about the use of iron in gothic architecture.

A call for collaboration is sent finally by James Crawford (assistant editor of BROMEC) who is currently following a Masters in Applied Conservation Studies at The Institute of Conservation and Management of Cultural Heritage, Heritage Malta. His research project is about defining a methodology to clean historic armours based on the use of analogues.

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

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Clemson University takes over Hunley Project (***CCC***)

In January 2007 the Clemson Conservation Center in the School of Materials Science and Engineering of Clemson University was officially approved to take over the management of the Warren Lasch Laboratory and the *Hunley* Project (Charleston, SC, USA). The mission of the Clemson Conservation Center is to develop an internationally recognized center for research focused around the *Hunley* Project and the Graduate Program in Historic Preservation. The areas of research to be emphasized will be related to the stabilization and preservation of objects of historical and cultural significance recovered from marine and terrestrial sites as well as general conservation/corrosion studies including stabilization methods. Other areas of interest will include the development of non-destructive evaluation methods and corrosion prevention. Some current research studies at the Center are summarized below.

Since early 2003, Clemson University and Hunley scientists have been working on an experimental treatment for the removal of chloride from archaeological cast and wrought iron samples (See BROMEC 4 & 17). The promising initial results have turned the research toward studying the effectiveness of subcritical treatment on the transformation of Cl^- containing corrosion products into more stable compounds. Dried iron samples obtained from the *H.L. Hunley* submarine (1864) were subjected to subcritical treatment in order to characterize the transformation of corrosion products such as akaganeite that occurred during the process. In this study, the Cl^- release is monitored during treatment by sampling the solutions and using ion chromatography (IC) to quantify the chloride extraction. Mössbauer spectroscopy and X-ray diffraction are being utilized to characterize the corrosion products before and after treatment. Once treatment is completed, samples are digested with nitric acid and the residual Cl^- content determined. To date, the analytical studies show that akaganeite is completely transformed after subcritical treatment. Some of these results will be presented by de Vivies et al. at the upcoming METAL07 Conference in Amsterdam. This initial study is currently being expanded and repeated on larger and more representative archaeological artefacts in collaboration with Jean Bernard Memet (A-Corros, France, jbmemet@yahoo.fr). This research is also looking at the effect of various stabilization techniques (e.g. electrolytic reduction, soaking in alkaline sulphite, soaking in caustic and subcritical treatment) on terrestrial and air-dried maritime artefacts.

In a related study, we are comparing the effects of subcritical treatment on the corrosion products of cast iron from freshly excavated specimens from a maritime site with similar specimens treated using soaking in alkaline solution with or without cathodic polarization. The cast iron specimens utilized for this study were obtained from an American Civil War era artillery shell, recovered from brackish water near Charleston, SC, USA. One sample was kept untreated and used as a reference in the identification of the corrosion products present before treatment. One was subjected to cathodic polarization in sodium hydroxide (NaOH). One was soaked in a 1%w/w water solution of NaOH, and the last sample was treated under subcritical conditions at 180°C and 52 bar using a 0.5%w/w water solution of NaOH. The Cl^- content before and after treatment was determined by digestion and the chloride release during treatment by IC. The corrosion products are being characterized by Dr. Desmond Cook (DCook@physics.odu.edu) at the Condensed Matter and Materials Physics Research Group at Old Dominion University using Mössbauer Spectroscopy and X-ray diffraction. A preliminary analysis of the corrosion product characterization data suggests that all of the treatment methods resulted in significant changes in their composition. This work will be presented by Gonzalez et al. at the METAL07 Conference.

Future work is planned on expanding the scope of the subcritical treatment method to include other metals and a broader range of larger specimens using a new and significantly larger treatment chamber.

The Center would like to acknowledge the past and continued support of the State of South Carolina, the School of Materials Science and Engineering at Clemson University, the Condensed Matter and Materials Physics Research Group at Old Dominion University and the Friends of the Hunley Inc. and Hunley Commission for supporting this research.

Contacts: Mike Drews and Paul Mardikian (CCC)
Funding: Clemson University

Ongoing research projects

 Historic printing block collection threatened by active lead corrosion (*FHWT/**MCB***)

The approx. 10,000 artefacts of the collection of historic printing blocks for stamps of the German Museumsstiftung Post und Telekommunikation are documents of the enormous changes that have taken place in German society over the last 150 years, as well as representing the progress of printing technology during this period. The earliest of these printing blocks was made around 1850 and was manufactured out of different alloys. While the lead alloys on the printing forms were later replaced by copper, which was galvanised with steel to harden the surface, lead continued to be used to form the printing base, in order to achieve the proper height in the letter printing techniques. Alongside artefacts of letter printing technology, the collection also includes examples of other types of printing forms, like intaglio printing and several other processes.

The analyses carried out on behalf of the Berlin Museum for Communication by the author, revealed that most of the collection is in a fairly stable state today, but there is a serious conservation problem in preserving a lot of the lead-alloy objects. The severest degradation processes are occurring on the objects of the mid-1800s. For more than a hundred years, these printings blocks were stored in oak cupboards. Due to the humidity, the acids of the oak came in contact with the lead alloys, resulting in active lead corrosion. Most of the surfaces of the printing forms are now covered in white lead-acetate, under which there are partly fairly stable surfaces or, in other cases, very fragile and heavily corroded areas of hydrocerussite. The latter is turning the finely structured ornaments into loosely fixed powder. Generally, the higher alloyed printing forms are in better shape than the bases of the printing blocks on which the hydrocerussite is dominating under large expansion of volume - the corroded layer is up to 5 mm thick. As long as no material analysis is done, the composition of the lead alloys can only be estimated: usually, printing forms for letterpress printing are manufactured out of a rather stable and hard alloy consisting of about 70 % lead, 23% antimony, 7 % of tin and probably a small amount of copper. The base is generally made of a different lead alloy with less antimony and tin. In summary, the process of degradation seems to be about the same as described by C. Degrigny und R. Le Gall.

The most promising way to conserve these objects is electrolytic consolidation. While some experience exists in the treatment of relatively pure lead, there is less experience in the treatment of lead alloys (BROMEC 9, CZ abstract). Research is therefore required to find out the correct parameters. There is also a need for research to find a proper and affordable way of storing these objects until an effective conservation coating is found (Mark Dowsett and al.'s paper at the forthcoming METAL07 conference). Together with the Museum for Communication, we have decided to take part in this research with the aim of contributing some knowledge on this serious conservation problem that affects a number of collections constituted of lead based artefacts.

Reference:
C. Degrigny und R. Le Gall, Studies in Conservation 44 (1999), 157-169

Contacts: Thomas Dempwolf (FHWT) and Dr Veit Didczuneit (MCB)
Funding: no external funding

Ongoing research projects

 Cleaning of sulphide on silver and gilt silver threads in silk textiles using laser in the UV- and visible range (***NMD***)

Cleaning silver and gilt silver threads that decorate brocade, embroidery and passementeries in museum collections represents a complicated conservation problem. It would be needed though for textile fabrics made of very tarnished silver and gilt silver threads that show a poor recollection of the brilliance and luxury they had when they were produced. The ornamented fabrics are nearly always of silk. Many methods have been used to clean this type of textiles - but without great success. The preservation of the fragile silk is the main concern in choosing a cleaning method since the silk fibres form the base of the textile construction.

This project aims to determine the feasibility of laser cleaning of textile fabrics containing silver and gilt silver threads. The laser method is chosen because it can be performed with a minimum of mechanical stress to the textile and without adding any chemicals, which are difficult or impossible to clean off after the treatment. In a previous project that was carried out in 1997-2000 we investigated the electrolytic cleaning using a potentiostatic cathodic/anodic technique, reversing the current to avoid the re-deposition of silver on the top of the gilding. The method gave very good results but had the disadvantage that the textile was submerged into an electrolytic bath. Cleaning by laser has the advantage that it can be carried out without wetting or dismantling the object.

The objective of the project is to improve the cleaning technique on the silver and gilt silver by using laser with wavelengths in the UV- range. The short powerful wavelengths can be performed in short pulses to avoid unnecessary heating of the silver and to minimise the total treatment time. However the UV light is known to damage silk fibres. Therefore cleaning experiments with visible light were chosen as well, where silk absorb only very weakly. To avoid re-deposition of silver compounds from the corrosion products on the cleaned surface the target material will be purged with helium.

Knowing the working temperature is important for the silk, this parameter will be measured under the silver while cleaning it with laser. Since 300°C is the minimum temperature required to dissociate silver sulphide, it is expected that silk fabric can be seriously damaged during the treatment.

The next step in this project will be to investigate the way the silk core in the silver thread is affected by this treatment. The analytical techniques considered in this project are colorimetry, polarised ATR-FTIR, tensile strength and SEM.

Contact: Bodil Taarnskov (NMD)
Funding: no external funding

New research project

 A survey of past conservation methods on archaeological iron artefacts in Switzerland. The case study of iron objects recovered from La Tène site (NE) (***HEAA-Arc***)

Storage areas of museums are full of archaeological iron artefacts that have in most cases been conserved. The treatments are rarely documented when they were carried out a long time ago. In case a new intervention is required the conservator is faced to an important question: what is the most appropriate treatment in the absence of any knowledge of the previous one?

Our project aims to perform a survey on past conservation methods on archaeological iron artefacts in Switzerland. It is conducted within the frame of a final diploma work of the Haute Ecole d'Arts Appliqués (HEAA) at La Chaux-de-Fonds, option conservation of archaeological and ethnographic artefacts.

Our study concentrates on the collection of objects recovered from La Tène site. Our choice was based on two specificities: on one hand the majority of artefacts from this site were excavated at the end of the 19th and beginning of the 20th centuries ; on the other hand, the reputation of the site and the development of the antiquities market have lead to a dissemination of artefacts within the country and abroad as well.

Because of their geographical dispersion and the early excavation at La Tène site the artefacts have been exposed to different conservation interventions. Their nature depended on the approach of the leading restoration schools of the time and the development of knowledge as well as new conservation protocols.

To discover which methods have in fact been applied, written records found in archives from museums and laboratories were consulted and oral discussions with the conservators that treated the artefacts were considered. The information compiled has been checked with microchemical tests and more sophisticated analyses such as FTIR spectroscopy and GPC.

Although this project is applied only to artefacts of the Tène site and only Swiss conservation methods are considered, this survey is seen as very beneficial to all archaeological iron artefacts. Indeed it should help us recognise past interventions, detect any side effects due to them and find a solution to them based on new knowledge in the field.

Contact: Caroline Böhm (HEAA-Arc)
Funding: no external funding

New research project

 /  Characterization of the interaction of laser radiation with copper alloys used in outdoor sculpture in the United Kingdom (***HEAA-Arc / CT-NCC-NML***)

Laser cleaning has been successfully used on a wide range of materials for over 30 years. Laser cleaning of metals, however, has received relatively little attention within the conservation field during that time. Copper alloy outdoor monuments strongly suffer from the effects of the polluted environment to which they are exposed in all urban and industrial areas in the world and there is a strong need for preserving those monuments and using the most sensitive conservation techniques available.

During the past 5 years, conservators at the National Conservation Centre (National Museums Liverpool) have laser cleaned several copper alloy outdoor sculptures, including the Monument to Lord Nelson in Liverpool, designed by Matthew Cotes Wyatt and sculpted by Sir Richard Westmacott (1813) as well as the Monument to Queen Victoria in Southport, sculpted by George Frampton (1912). Laser cleaning was chosen as the principle cleaning method in each case as it was believed to be the most effective and controllable method available at the time. These treatments were successful in removing active corrosion products, pollution deposits and paint layers and thereby greatly improving the long-term stability and aesthetic appearance of the sculptures. However, laser cleaning of copper alloys is not self-limiting and some discoloration in the surface of the cuprite layer (Cu_2O) was observed, as the original red-brown colour turned into a grey-violet tinge. This phenomenon seemed to reverse with time and the discoloration was not visible anymore after the statues had been waxed.

Thus, a research was carried out to characterize this side-effect of laser cleaning. The behaviour of different corrosion layers on different types of copper alloys and the degree of reversibility of the discoloration were studied. For this purpose, laser-cleaning tests have been carried out using a Q-switched Nd:YAG laser (wavelength 1064 nm, pulse duration 10 ns) at various fluence levels (0.61, 0.85, 1.12 J/cm^2), on three different industrial alloys: copper, brass and bronze, which have been commonly used for monumental sculpture in the United Kingdom. An artificial cuprite layer was formed on the samples and non-corroded samples were used as well. Treated surfaces were studied by optical microscopy (OM), optical metallography, X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), X-Ray Energy Dispersive spectroscopy (EDX) and visible spectrophotometry. Eventually X-Ray Photoelectron Spectroscopy (XPS) or Auger Electron Spectroscopy (AES) will be used to complete the results. This will improve the understanding of the laser cleaning of outdoor copper alloy monuments, thus allowing conservators to improve the quality of cleaning undertaken and minimise the risk of damaging the surface.

Contacts: Maya Froidevaux (HEAA-Arc) and Martin Cooper (CT-NCC-NML)
Funding: no external funding

New research project

 Characterization of the alteration of copper based ethnographic artefacts (***DC-FSB***)

The alteration of two copper based ethnographic objects used to cook couscous has been studied. Both belong to the collection of the association of Medina protection and El Alia heritage protection (Bizerte region, 60km North of Tunis – Tunisia).

Different analytical techniques were used such as X-radiography, metallographic observation, SEM coupled to EDX spectrometry and AFM. Furthermore electrochemical characterization techniques were employed: E_{corr} vs time monitoring, EIS and voltametry.

Superficial characterizations have revealed that the condition state of the cooking pot is good in comparison to the colander that presents a more corroded state.

Furthermore we noticed that for the colander the interface in contact with the broth is more corroded than the interface with the couscous' semolina. In addition it was shown that the copper is not attacked compared to tin that is consumed

Electrochemical measurements showed that a protective layer has developed at the surface of the material that prevents the action of any aggressive ion such as chlorides (Cl^-).

Contact: Nébil Souissi (DC-FSB)
Funding: no external funding

New research project

 The use of iron in gothic architecture: the case of Troyes and Rouen churches (***LPS-CEA***)

Iron occupies an important part in the construction of Rouen and Troyes churches. From the 13th century onwards, it is employed by ten or so of tons for the reinforcement of stained glass windows. Structural rods and chains of iron are also used in masonry and carpentry work as well as smaller pieces, cramps and pins, in order to attach sculpted ornaments. The questions of the functions, quantities, origins and cost of this iron are treated within an interdisciplinary study using surveys in monuments, research in medieval written records and metallographic analyses of 74 pieces of iron sampled directly from the buildings. This study also allows to show the nature and the quality of the iron used in construction, its forging treatments and eventually to understand the influence of the great transformations of medieval ironworking (hydraulic hammer, blast furnace) on the use of iron in gothic architecture.

Contact: Maxime Lheritier (LPS-CEA)
Funding: Région Ile de France (post-doc grant)

Call for collaboration

Artefact analogues for investigating original surface limits and corrosion product removal techniques for the ferrous armour of the Knights of St John, Palace Armoury, Malta (***HM/UoM***)

Ferrous artefacts from a burial environment, or indeed in an indoor museum, can be often partly or totally masked with corrosion product (CP) layers; reducing surface legibility and corrosion resistance, and possibly containing altered traces of original surfaces. This experimental research aims to diagnostically determine the presence or absence of original surface limits in atmospherically corroded wrought ferrous artefacts so as to indicate an appropriate level of CP removal during conservation treatment. Specific application is made to the partly corroded 16-17th century North Italian style munitions armour of the Knights of St John, Palace Armoury (PA), Malta. Artefact analogues (coupons) are used to develop accurate preliminary conservation methodologies and to thereby lessen inaccurate direct treatment interventions and treatment testing on artefacts. The work also reviews treatment techniques used to remove corrosion products from areas adjacent to reflective metal.

Descriptions of CP stratigraphies and practical determination of the original surface limits (*limitos*) via internal and external surface markers on archaeological metal artefacts has been thoroughly reviewed and developed by Dr R. Bertholon. Significant temporal, environmental and accessibility differences between metal artefacts housed indoors and artefacts formerly in archaeological environments favour less formation and less preservation of CP layers on the former. Nonetheless, relatively thick CP layers (250-350µm) have been documented covering areas of sheet metal armour (800-1200µm) at the PA. Corroded matt surfaces adjacent to uncorroded metallic surfaces pose curatorial interpretation & aesthetic issues. Recent less interventive methodologies avoid emptying corrosion pits of all CPs, but approaches remain empirical.

To permit destructive and reproducible stratigraphic probing, followed by experimental investigation of CP forms, stratigraphies and cleaning techniques, a series of artefact analogues (coupons of low alloy steel) are corroding by accelerated laboratory humidity cycling. Prior to corrosion exposure "diagnostic markers" were applied over the metal surface. The markers are visually detectable (macroscopically and microscopically) due to their colour contrast and high atomic number (Z) that enable them to be relatively radio-opaque; making them suitable for SEM backscatter examination of embedded cross-sections.

Series of cleaning techniques currently used by the PA and international armour conservation laboratories will be applied to coupons and examined by surface and cross-section perspectives. The results from the coupons are to be discussed with the PA curators. Finally, it is proposed to apply an optimised methodology further developed from the coupons onto one PA armour artefact. The resulting surface will be characterised physically and also assessed in terms of aesthetics in collaboration with PA curators.

Call for collaboration:
The series of corrosion product removal techniques investigated in this research comes from a variety of sources. These include published conservation/restoration literature, interviews and a laboratory questionnaire specifically formulated for the research. So as to represent unpublished practices, the research author invites conservators, restorers, armourers, curators etc who have direct experience with the treatment of partially corroded ferrous surfaces to complete the questionnaire (English version only). The questionnaire is available from the author.

Reference:
Bertholon, R. La limite de la surface d'origine des objets métalliques archéologiques. (2000). Université Paris Sorbonne – Paris I. PhD thesis

Contact: James Crawford (HM/UoM)
Funding: no external funding

General information

Websites

- ARTECH network: http://server.icvbc.cnr.it/progetti_futuri/progetto_artech.htm. Network facilitating the access of conservation professionals to different investigation techniques of Cultural Heritage artefacts

- **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

- **ENVIART** (Chemical Interactions between Cultural Artefacts and Indoor Environment): www.enviart.org. You have to register (free access) to get access to all information.

- **e-Preservation Science**: http://www.e-preservationscience.org. Online publication of papers in conservation science.

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

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

- 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."

- **METAL*Consn*-info** homepage: http://rsc.anu.edu.au/~hallam/METALConsn-info.html

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

- **New York Conservation Foundation** website: http://www.nycf.org/

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

- **RESTAURACION METAL SUR AMERICA**: www.restauraciondemetales.cl

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

- 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)

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

Future seminars and conference

- **Conservation Science 2007** (10-11 May 2007, Milano, I) organised by Universita degli studi di Milano, ICON and the Institute of Conservation Science. For more information please contact Joyce Townsend (joyce.townsend@tate.org.uk)
- **Meeting of the "Arts et Techniques métallurgiques pré-industriels. Etude et Conservation" Group** (24 May 2007, Brussels, Belgium) held at the Musées Royaux d'Art et d'Histoire, Brussels. For more information please contact Monique de Ruette (m.deruette@mrah.be)
- **COST Strategic workshop "Past, Present, Prediction"** (31 May – 2 June 2007, Ohrid, FYROM) about simulation techniques, dosimeters, sensors in conservation research and application, organised by COST. For more information visit the following website: http://www.cost.esf.org/heritage-ppp or contact Hannelore Roemich: hannelore.roemich@nyu.edu
- **Workshop on science for conservation and preservation of cultural heritage** (4-5 June 2007, Wroclaw, Poland) organised by the Faculty of Chemistry and the Unesco Chair of Interdisciplinary Studies, University of Wroclaw. For more information visit the following website: http://www.ift.uni.wroc.pl/~kweron/konfchem/index.html
- **2nd conference Archaeometallurgy in Europe** (17-21 June 2007, Grado and Aquileia, I) organized by the Associazione Italiana di Metallurgia. For more information visit the following website: www.aimnet.it/archaeometallurgy2.htm
- **COST Interdisciplinary Training School On Cultural Heritage** (10-15 September 2007, Genova, I). For more information visit the following website: www.cost.esf.org/2007-ts-genova
- **METAL07**, triennial meeting of the ICOM-CC Metal WG (17-21 September 2007, Amsterdam, NL). For the whole programme, list of papers and posters and abstracts visit the following website: www.metal07.org
- **Conference on Surface Modification Technologies (SMT 21), Session on "Arts and Surfaces"** (24-26 September 2007, Paris, F). The session on "Arts and Surfaces" will be

coordinated by Dr Alessandra Giumlia-Mair. For more information please contact Alessandra Giumlia-Mair (giumlia@yahoo.it)

- **Symposium 2007** – Preserving Aboriginal Heritage: Technical and traditional approaches (24-28 September 2007, Ottawa, Canada) organised by the Canadian Conservation Institute. For more information visit the following website: http://www.cci-icc.gc.ca/symposium/index_e.aspx

- **Training Seminars on Research Planning, Characterisation, Conservation and Management in Archaeological Sites – ARCHAIA** (28-30 January 2008, Copenhagen, DK and 15-17 May 2008, Bologna, I) addressed to 90 post-graduate students, scholars and professionals of different backgrounds. The results of some funded EU research projects and COST actions will be presented. For more information visit the following website: www.archaia.eu

- **Holding it all together; ancient and modern approaches to joining, repair and consolidation** (21-22 February 2008, London, UK) organised by the British Museum. For more information contact Janet Ambers: science@thebritishmuseum.ac.uk

- **Art2008**, 9th International Conference (25-30 May 2008, Jerusalem, Israel) on the non-destructive testing, microanalysis and preservation in the conservation of cultural and environmental heritage, organised by the Israel National Society for NFT. For more information visit the following website: www.isas.co.il/art2008

- **Ancient mining in Turkey and the Eastern Mediterranean** - AMITEM (15-21 June 2008, Ankara, Turkey) organised by the Institute of Archaeometallurgical Studies, Bogazici University, Istanbul (Turkey), the Deutsches Bergbau – Museum Bochum (D), the Institute of Archaeology, London (UK) and the Atilim University, Ankara (Turkey). For more information visit the following website: http://amitem.atilim.edu.tr

Abbreviations and acronyms

AES: Auger Electron Spectroscopy
AFM: Atomic Force Microscopy
CCC: Clemson Conservation Center
CT-NCC-NML : Conservation Technologies, National Conservation Centre, National Museums Liverpool
DC-FSB: Département de Chimie, Faculté des Sciences de Bizerte, Tunisie
DED-SS: Division Expérience DIFFABS – Synchrotron SOLEIL
EDX: Energy dispersive X spectroscopy
EIS: Electrochemical Impedance Spectroscopy
FHWT: Berlin University for Applied Science
FTIR: Fourier Transform InfraRed
GPC: Gas Phase Chromatography
HM: Heritage Malta
IC: Ion Chromatography
LPS - CEA: Laboratoire Pierre Süe – Centre d'Etudes Atomiques
MCB: Museum for Commuication Berlin
NMD: National Museum of Denmark
SEM: Scanning Electron Microscopy
UoM: University of Malta
XPS: X-Ray Photoelectron Spectroscopy
XRD: X-Ray Diffractometry

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Bulgaria: Petia Penkova, conservator, National Academy of Arts, Department of conservation-restoration, Sofia
Canada: Judy Logan, conservator (retired), Ottawa
Chile: Johanna Theile, conservator and lecturer, Facultad de Arte - Universidad de Chile Las Encinas, Santiago de Chile
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United Kingdom: Catia Viegas Wesolowska, conservator, Victoria & Albert Museum, Londres & Mark Dowsett, physicist, Warwick University, Coventry
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