

BROMECC 36

Bulletin of Research on Metal Conservation



July 2016

Editorial

BROMECC 36 contains seven abstracts on research covering archaeological, historic and modern metals conservation. They comprise a call for collaboration by a consortium in southern France that is endeavouring to remove copper staining from outdoor stone using non-toxic materials. Also, two projects from Brazil present their material diagnosis approaches to informing conservation strategies. The first focuses on contemporary metals used in the structures and finishes of architecture and sculpture, while the second is for an item of industrial heritage; a steamroller which features in the title image for this issue of BROMECC. Further ways of diagnosing materials and their degradation mechanisms are outlined in a Swiss abstract concerned with cans containing foodstuffs. This work will also be presented at ICOM-CC's upcoming Metal 2016 conference in New Delhi: 26-30 September 2016. Updates on ongoing projects in France and Spain are given too. In France, a new shared laboratory has been established to progress the subcritical stabilisation method for archaeological iron and also for optimising protection by organic coatings of metallic artefacts exposed to air. In Spain, works on *in situ* electrochemical impedance spectroscopy for evaluating protection by coatings and patinas have been extended to acquire larger data sets from heritage and over multiple time intervals. Lastly, insights into comparing the efficacy of spraying and brushing Paraloid B-72 for protecting wrought iron are given in laboratory research from the United Kingdom.

New announcements include details on where to download for free the proceedings from MetalEspaña 2015 and how to register to La Journée ICOM Métal France 2017.

On behalf of my BROMECC colleagues, I thank Julie Masson-MacLean for her contribution as a Francophone translator and wish her the very best!

And here's wishing you enjoyable and informative reading!

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Cover image: Detail of the steamroller identification plate, German trademark L. Schwartzkopff (1927) – B.M.A.G. (Berliner Maschinenbau Actien Gesellschaft). It shows the boiler production number (Kessel No. 9107) and the maximum capacity of the equipment (14 ATM). Refer to abstract by da Silva, “Steamroller: a proposal for the conservation and restoration of the (in)visible industrial heritage”.

BROME C website: warwick.ac.uk/bromec

BROME C subscription: warwick.ac.uk/bromec-subscription

Using natural products for metal oxide stain removal from stone ¹ (AC, ACB, ACSAS, NSAS)

Call of collaboration



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Funding: No external funding

The presence of copper oxide staining on the surface of stone cultural heritage is an important issue for the conservation-restoration of historical monuments, particularly for statuary. Metal components – especially bronzes – in contact with stone of all types in outdoor environments are problematic due to their corrosion by rainwater and the leaching of the stone by runoff containing metallic compounds. Also, corrosion products precipitate on stone surfaces and their accumulation impairs the legibility of works by decreasing chromatic contrast and by causing physico-chemical changes. Urban and marine environments with pollutants containing sulphur and chlorine species accentuate degradation.

In this context, research has been conducted three times (between 2009 and 2012) during complementary and brief studies of stone supports by collaborations between A-Corros Expertise, LERM and conservation-restoration specialists. The variable results highlighted the need for several organisations with complementary skills in the ARCHEOMED® group to develop an effective cleaning product which is non-toxic to humans and the environment. It must also be useful on a large scale for monuments and artworks. A call for cooperation is made to the readership in the context of a European project so a natural and non-toxic product and a method can be found for removing copper metal oxide stains from outdoor stone.

1. Translated by M. Bouchard and J. Crawford. Original version submitted by author in French; refer to BROME C 36 French version.

Conservation-restoration of metallic cultural heritage with electrochemical techniques: research and implementation (CREMEL II)¹ (CENIM-CSIC)

New research project



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Funding: MINECO Programa Estatal de I+D Orientada a Retos de la Sociedad, ref. HAR2014-54893-R

Between 2012-2014, the COPAC group at CENIM-CSIC ran the CREMEL project: conservation-restoration of metallic cultural heritage with electrochemical techniques (see BROME C 35). This involved developing a method adapted to diagnosing and treating metallic heritage: a gel electrochemical cell was used for *in situ* non invasive and non destructive electrochemical impedance spectroscopy (EIS). Its effectiveness was validated on real artworks, e.g. the bronze sphinxes of the National Archaeological Museum (Madrid). Comparisons of patinas in different zones on the sculpture or the effect of old restoration treatments were made: permitting optimization of a new methodology for evaluating the protective capacity of patinas and applied coatings.

Following CREMEL, CREMEL II commenced. It involves research and implementation of electrochemical techniques for conserving-restoring metallic cultural heritage. The main objective of this second phase is to apply improvements in a systematic way and to monitor over time specific collections (indoor and outdoor sculpture, contemporary art, chalcographic plates, etc.). This should gather information about the evolution of patinas and coatings. Further objectives are to:

- achieve a wide series of reference data for different materials, states of conservation, treatments applied, etc;
- determine the evolution over time of heritage patinas and coatings in different environmental conditions;
- establish indicators to help anticipate failure of protection systems (before corrosion is visible and, therefore irreversible) in order to optimize materials for conservation treatments; and
- collaborate with metal conservator-restorers to integrate this methodology into a daily activity; making it possible to respond to problems they encounter daily and to fulfil their actual needs and requests.

The ultimate overall objective is to improve the efficiency of preserving metallic cultural heritage. More information is at www.proyectocremel.es y www.cenim.csic.es/index.php/presentacion-copac.

1. Translated by A. Crespo, D. Lafuente and J. Crawford. Original version submitted by author in Spanish; refer to BROME C 36 Spanish version.

Conservation of contemporary metal heritage¹ (PGD-UFRGS)

New research project



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Funding: FAPERGS

Objects and structures made of modern metals are becoming a significant part of our cultural heritage. Aluminium and titanium alloys, stainless and weathering steels, metals with superficial modifications produced by anodization and eletrodeposition processes have been widely used to conceive sculptures, architectural ornaments and structures as well as many other items present in museums. In order to satisfy the demand for adequate strategies to conserve this contemporary heritage, an 18-month project was launched at the Federal University of Rio Grande do Sul (UFRGS).

The project, “Elements for the conservation of contemporary heritage: metallic materials in design, art and technology”, takes a multidisciplinary approach to the characterization of contemporary metallic artefacts. It is focused on artefacts from three groups:

- outdoor sculpture
- indoor museum collections
- scientific items.

Study of these artefacts focuses on researching their manufacturing processes and a detailed examination addressing their states of conservation and possible ongoing alterations. Composition is determined by X-ray fluorescence (XRF) analyses.

The project relies on the collaboration of engineers, museologists, art historians and artists in order to form a more holistic view on the material-based questions for works of contemporary art and design. It is expected to gather information which is valuable to conservation professionals and complements the description of cultural objects and practical aspects of their creation.

At the end of the project, a study guide based on the collected data will be developed and a workshop will be organized to share results with the professional community.

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

LETRIP: a shared laboratory for the preservation of metallic cultural heritage ¹ (NIMBE-LAPA, AC)

New research project



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Funding: ANR

The LETRIP (Laboratoire d'Etude des Traitements et Revêtements Innovants pour la Patrimoine) project is a laboratory shared between the academic institution NIMBE/LAPA (Nanosciences et Innovation pour les Matériaux la Biomédecine et l'Énergie/Laboratoire Archéomatériaux et Prévision de l'Altération) and the company A-Corros, with its branch specialised in the restoration of cultural heritage. Funded in 2016 for 3 years, it aims to develop research programs devoted to preserving metallic cultural heritage.

LAPA and A-Corros are two key participants in the heritage sciences who have shared their competences over the past ten years. Their partnership is an innovative response to the need to develop high performing tools and protocols with a long-term and research-based perspective.

The objectives of LETRIP are two-fold. The first is to advance the stabilisation treatment of archaeological artefacts in subcritical conditions (refer to BROMECC 4, 17, 22, 29, 35). To ensure reproducibility and reliability, this process requires extensive research on the evolution of the structure and the texture of corrosion products during treatment. The second objective is to optimise organic protection treatments for metallic artefacts exposed to air; all while meeting ethical considerations for cultural heritage. For this work, research and development is crucial for understanding the formation mechanisms of metallo-organic compounds and how they interact with the porous corrosion product layer so neutralisation of reactive regions can be optimised.

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

Conservation of cAns in collectioNS: the CANS project ¹ (HE-Arc, MEN, EPFL, HES-SO VS)

Ongoing research project



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Funding: Swiss National Science Foundation (SNSF) grant no. 152946

As a symbol of consumer society, cans are already considered part of our cultural heritage. However, assuring proper conservation of these composite objects is challenging. Interactions between metal containers and their food contents are still puzzling for conservator-restorers; not to mention the other materials like internal coatings, paper or adhesive.

The CANS project (Conservation of cAns in collectioNS) comprises interdisciplinary research that brings together conservator-restorers and conservation scientists from the Haute Ecole Arc de conservation-restauration, ethnologists from the Ethnographic Museum of Neuchâtel, food technology experts from the Institute of Life Technology and Institute of Systems Engineering at the HES-SO Valais and corrosion scientists from the Ecole Polytechnique Fédérale of Lausanne.

The CANS project focuses on unopened cans that retain their contents. The objectives are to develop conservation methods that respect the material authenticity and cultural values of these composite objects. The project includes:

- investigating the values and functions of cans in society
- identifying the principal conservation problems in different museum collections
- assessing the relationship between observed deterioration, environmental conditions and composition of cans (materials, structures, contents...)
- investigating mechanisms involved in the long-term degradation of containers and their contents
- proposal of preventive conservation strategies and possible interventions

In the first year of the project, a report documenting the condition of 150 cans was made by collaborating with 5 different Swiss institutions. They were the:

- Burghalde Museum in Lenzburg, which has cans made by *Hero*, a Swiss brand
- Alimentarium in Vevey, which is the museum for the Nestlé Foundation
- Ortsmuseum in Küsnacht, a small regional museum
- Bernisches Historisches Museum (Bern Historical Museum)
- Stiftung HAM, which has collections from the Swiss army

Also, researchers from MEN prepared a questionnaire aiming to establish the existence of cans in collections worldwide. It was disseminated to nearly 60 museums.

Regarding deterioration of the cans, the stratigraphy of the tinplate on the cans was studied in depth. Surface analyses (SEM-EDX, AES) and electrochemical measurements (chronoamperometry) revealed an interface between the tin and the steel substrate and showed that the structure of this composite material is more complex than anticipated.

Concerning the food contents of the cans, the most corrosive species were identified.

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

Steamroller: a proposal for the conservation and restoration of the (in)visible industrial heritage¹ (UFMG)

Ongoing research project



Contact: Ronaldo André Rodrigues da Silva (raros@ufmg.br) (UFMG), João Cura D'Ars de Figueiredo Júnior (UFMG), Valquíria de Oliveira Silva (UFMG)

Funding: No external funding

This research proposes an action plan for the preservation and conservation of industrial and cultural heritage. The studied object is a German Schwartzkopff steamroller. This steam engine was built in the 1920s and was working throughout the 1940s and 1950s at the Pampulha campus construction works of the Federal University of Minas Gerais (UFMG), Belo Horizonte, Minas Gerais, Brazil. The research aims to acknowledge industrial machinery not only as an historical asset, but also as a cultural one; and include science and technology as part of the identity and representation of individuals, groups and society in general.

The methodology that has been followed started with a composition and technical description of the structure (mainly composed of iron alloy), study of its characteristics and identification of the main physical-mechanical, chemical and biological agents contributing to its degradation. Analysis and sample collection areas were established, for multiple techniques (X-ray fluorescence spectroscopy, infrared spectroscopy and microbiological ones).

It is expected that the results will diagnose the conservation state of the steamroller and will establish appropriate conservation measures. To conserve and promote industrial heritage, greater awareness of its relevance within the university community and society is needed since it is part of our historical and social memory and, therefore, part of our cultural heritage.

1. Translated by D. Lafuente and J. Crawford. Original version submitted by author in Spanish; refer to BROMECC 36 Spanish version.

Does the application method of Paraloid B72 on wrought iron affect its protection against corrosion? ¹ (TW)

Finalized research project



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Funding: No external funding

The application of a coating on outdoor metal objects is common practice in the heritage sector to temporarily prevent corrosion. Coating systems can fail due to imperfections introduced as a direct result of the application process. This laboratory research was carried out with the aim of assessing two popular application methods for conserving heritage: spraying and brushing.

Paraloid B-72, (or Acryloid B72 in the USA) was chosen for this work since it has been extensively used in conservation since the 1960s and is one of the most common coating systems currently in use. It has long-term reversibility, reliability, and stability: favouring retention of its corrosion protection properties. A series of 38 wrought iron test coupons with natural weathering and corrosion were extracted from a historic gasometer. Six coupons were left uncoated for use as controls. The remainder were divided into two sets of 16 coupons; of which one set was coated by brushing and the other by spraying. Three spray applications and two brush applications were deemed representative of conservation practice and have previously been shown to be protective.^{2,3}

Coating thicknesses were calculated⁴ and were also measured by optical microscopy of sample cross-sections. Thickness variations were 11 to 44 μm for spray applications and 5 to 30 μm for brush applications; with mean thicknesses of 22 μm and 25 μm , respectively.

Quantitative data on protection were obtained by measuring over time the corrosion potential (E_{corr}) of the system with a potentiostat. The samples were immersed in 1.5 M aqueous sodium chloride. The failure rate for each coating method was hypothesised using linear sweep voltammetry and Tafel plots. Qualitative data were obtained through visual assessments made by macro- and micro-photography. Colour changes and evolution of corrosion products indicated coating failure.

Data demonstrated that the sprayed coating inadequately protected coupon edges and corners. It also produced an uneven coating. Brush coated samples showed less signs of failure than sprayed samples and they featured smaller local variations in coating thickness within each sample.

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

2. Lee, E. 2010. A study on the effectiveness of Paraloid B72 as a coating system depending on the different number of applications. MSc Thesis, Cardiff University

3. Degrigny, C. 2008. The search for new and safe materials for protecting metal objects. In: Argyropoulos, V., Hein, A. and Harith, M.A. (ed.) *Metals and Museums in the Mediterranean: protecting, preserving and interpreting*. TEI of Athens, PROMET consortium, Athens. pp 179-235

4. Decker, P., Brüggerhoff, S. and Eggert, G. 2008. To coat or not to coat? The maintenance of Cor-Ten® sculptures. In: *Materials and Corrosion* 59 (3). pp.239-247

Abbreviations and acronyms

AC: A-Corros, Arles, France

ACB: Atelier Caroline Botbol, Arles, France

ACSAS: Aslé Conseil SAS, France

AES: Auger electron spectroscopy

ANR: Agence nationale de la recherche, France

Archeomed®: Pôle économique et technologique dédié aux métiers de la culture et des patrimoines, Arles, France.

CENIM-CSIC: National Centre of Metallurgical Research-Spanish National Research Council. Avda. Gregorio del Amo, 8. 28040, Madrid, Spain

COPAC: Corrosion and Protection of Materials of Cultural Heritage and Construction.

CREMEL I: Conservation-restoration of metallic cultural heritage with electrochemical techniques: development of a specific methodology adapted to diagnosis and treatment

CREMEL II: Conservation-restoration of metallic cultural heritage with electrochemical techniques: study and implementation

EDX: energy dispersive X-ray spectroscopy

EIS: electrochemical impedance spectroscopy

EPFL: Ecole Polytechnique Fédérale of Lausanne, Switzerland

FAPERGS: Rio Grande do Sul Research Support Foundation, Porto Alegre, Brazil

HE-Arc: Haute Ecole Arc Conservation-restauration, Neuchâtel, Switzerland

HES-SO VS: Haute Ecole Spécialisée de Suisse occidentale, Valais, Switzerland

LERM: Laboratoire d'Études et de Recherche sur les Matériaux, Arles, France

MEN: Musée d'Éthnographie de Neuchâtel, Switzerland

MINECO: Ministry of Economy and Competitiveness

NIMBE-LAPA: Nanosciences et Innovation pour les Matériaux la Biomédecine et l'Énergie/Laboratoire Archéomatériaux et Prévision de l'Altération, CEA/CNRS Université Paris Saclay, UMR3685, France

NSAS: Nutréine SAS., France

PGD-UFRGS: Pos-Graduação em Design, Universidade Federal do Rio Grande do Sul Brazil

SEM: scanning electron microscopy

TW: the Whitworth, University of Manchester, Manchester, United Kingdom

UFMG: Universidade Federal de Minas Gerais, Belo Horizonte, Brazil

XRF: X-ray fluorescence

General information

Future seminars and conferences

New

ICOM France Metal Day 2017 (20 January 2017), organized by Elodie Guilminot from Arc'Antique and Anne Le Bail Genachte from the Institut National du Patrimoine (INP). This day aims to help exchanges between restorers, curators and scientists. Two themes will be covered: treatment of composite objects and restoration of decorated metals. It will be held at the INP in Aubervilliers. Registration is free, but required due to limited seating. Registration contact: Elodie.Guilminot@Loire-Atlantique.fr

ICOM-CC Metals Working Group Triennial meeting: The Indira Gandhi National Centre for the Arts (IGNCA) in New Delhi, India will be hosting Metal 2016. <http://www.metals2016.org/>

Announcements

New

The proceedings of MetalEspaña 2015 are available. The 2nd Congress of Conservation and Restoration of Metallic Heritage, which took place on 1-3 October 2015 in the Real Casa de la Moneda of Segovia has published proceedings that can be downloaded for free from:

- <http://www.metalespana2015.es/>
- <http://www.uam.es/ss/Satellite/es/1242657076216/subHomeServicio/SECYR.htm>
- <http://digital.csic.es/handle/10261/132099>

Websites

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

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>).

Big Stuff 2007 presentations available: <http://www.bergbaumuseum.de/web/aktuelles-veranstaltungen-2007-bigstuff>

British Museum's Library Catalogue is accessible to external scholars:
http://www.britishmuseum.org/research/libraries_and_archives.aspx

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

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>

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/>).

Conservation science tutorials created by the Foundation of the American Institute for Conservation of Historic and Artistic Works (FAIC) and the Getty Foundation are available: <http://cool.conservation-us.org/byform/tutorials/consitut/index.html>

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/>).

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

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>

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/

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

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 enamellers. 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>

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.

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 “Archéomatériaux 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.

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

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

Staffordshire Hoard Symposium papers from the March 2010 meeting held at the British Museum are available: <http://finds.org.uk/staffshoardsymposium>

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>).

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