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Editor’s note

It isn’t often that we get contributions on a Dark Age topic but in this issue, perhaps predictably, two have come along together. A new ALG member, Tereza Štolcová, has sent us a report on post-excavation analysis of finds from the Chamber Grave at Poprad in her native Slovakia. Her description of the grave is fascinating in its own right but even more so are her illustrations of the leatherwork which, at least to my eyes, gives more than a nod towards Roman traditions.

Chris Lynn’s speculative article on Pictish symbols and their connection to leatherworking is guaranteed to provide either a revelatory moment, or a reason to jump up and down while shouting “Impossible!” Whatever the reaction, he would be delighted to hear your thoughts on the matter. 21st century technology is in here too, as Susanna Harris and Kathryn Piquette report on the potential of ‘Reflectance Transformation Imaging’ to assist the process of species identification when dealing with archaeological leather.

Finally, some better news at last on future prospects for the Museum of Leathercraft collection in Northampton. You can read about the latest developments on pages 9-10. Our thanks to all who have provided content for this edition of the Newsletter, making it one of the most varied in a long time. Contributions to the next edition will be most welcome, and can be sent to me any time before 14th March next year.

Sue Winterbottom

The 2015 Spring Meeting and AGM

A very successful Spring Meeting was held this year in Portsmouth, where we were guests of the Mary Rose Museum. Eleanor Schofield, Head of Conservation and conservators Sue Bickerton and Johanna Sandstroem made us welcome with coffee and biscuits and showed us round their stores. We were able to handle and discuss various leather items from the ship, including shoes and parts of jerkins, and in passing to see and appreciate the great quantity of other classes of finds.

This was followed by lunch in the large, airy café ‘Boathouse No. 7’ near the entrance to the Historic Dockyard, after which we held our AGM. We were then given free admission to the Mary Rose Museum itself and were able to explore the galleries corresponding to the different levels of the ship and view their finds at our leisure.

at the AGM:

Diana Friendship-Taylor came to the end of her second term as Meetings Co-ordinator and was thanked for her splendid work. Angela Middleton was elected as the new Meetings Co-ordinator: proposed by Mike Redwood and seconded by Di Friendship-Taylor. Tim Martin and Di Friendship-Taylor were elected Ordinary Members: proposed by Susanna Harris and seconded by Jackie Keily. The Treasurer, Roy Thomson, and Newsletter Editor, Sue Winterbottom, were reappointed for a further year.

The full minutes of the meeting can be read on the ALG website at, http://www.archleathgrp.org.uk/members/minutes.htm

Forthcoming Meetings

2015 Autumn Meeting
(now postponed until January)

The Autumn Meeting this year is being postponed until early 2016 so that we can visit two shoe exhibitions in London, one at the British
The perfect day for a group photograph in front of Nelson’s Victory in Portsmouth’s Historic Dockyard.

An obliging passer-by took this photo of the assembled company as we launched into the AGM Spring Meeting 2015
Museum and one at the Victoria and Albert Museum, in a single day. By postponing, we are also able to have a gallery talk in the BM about the exhibition - this cannot be scheduled before January 2016. These are the details of the planned visit:

**Date: Friday, 22nd January 2016**

At the BM we can indulge in *Footwear from the Islamic World* (provisional title). Conservator and ALG member Barbara Wills will also be giving a gallery talk, telling us about examining and conserving some of the shoes in preparation for this exhibition.

We then move on to the V&A to see *Shoes: Pleasure and Pain*. This exhibition displays around 200 pairs of shoes, ranging from a sandal decorated in pure gold leaf originating from ancient Egypt to the most elaborate designs by contemporary makers. See this web page for details:

http://www.vam.ac.uk/content/exhibitions/shoes-pleasure-and-pain/

Please note: there will be a charge for the V&A exhibition. If we get 10 or more people for this visit, the ticket price will be reduced to £10.80 p.p. (normally £12). The V&A opens late on Fridays: last entry to the exhibition is 20:30, with the museum closing at 22:00.

**Proposed timetable:**

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<tr>
<th>Time</th>
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<tr>
<td>12.00</td>
<td>Meet at the BM for lunch (optional)</td>
</tr>
<tr>
<td>13.15</td>
<td>Gallery talk by Barbara Wills; John Addis Gallery, Room 34</td>
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<tr>
<td></td>
<td>Then look around the exhibition</td>
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<tr>
<td>15.00</td>
<td>Tea/ coffee/ cake break</td>
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<tr>
<td></td>
<td>Travel across to the V&amp;A</td>
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<tr>
<td>17.00</td>
<td>Meet at the V&amp;A, tour exhibition</td>
</tr>
<tr>
<td>18.30</td>
<td>Depart (or stay on for dinner)</td>
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</tbody>
</table>

To take part, or for more information, please contact Angela Middleton, the Meetings Coordinator:

Angela.Middleton@HistoricEngland.org.uk

**2016 Spring Meeting**

(no date set yet)

A west country meeting, based around Plymouth Museum has been suggested. We would be able to view leather finds from the Cattewater wreck (probably 16th century) and organic material, including leather, from the Whitehorse Hill cist burial (Bronze Age). Both are on display there. At Mount Edgcumbe House, on the outskirts of Plymouth, there is also a permanent exhibition on the wreck of the *Metta Catharina*, which sank in Plymouth Sound in 1786. The displays include some of its large cargo of aromatic Russian hides (see the article by Angela Middleton in *Newsletter* 39, pp. 8-9) Diana Friendship-Taylor has offered to organise the meeting and is continuing to investigate local places of interest.

**More details of both forthcoming meetings** will be available on the ALG website nearer the time or, if you are interested in attending, please contact Angela, Diana, or one of the other committee members for an update (contact details on the final pages).

**Recent items**

**Recent finds from Oxford**

A ‘complete leather shoulder bag’ and around 50 medieval shoes have turned up recently at the start of major excavations at the Westgate Shopping Centre in Oxford. The excavation area, just outside the medieval city walls, contains the site of the medieval Greyfriars. Waterlogging has created excellent survival conditions and more such finds can be anticipated as the excavations will continue until December:

www.bbc.co.uk/news/uk-england-oxfordshire-33539442

**Still busy making Lederhosen...**

Angela Middleton has found an great video online that shows work in progress at the old Kolesch Tannery in Biberach, southwest Bavaria. Traditional leather clothing for sports wear, brass bands and folklore groups is produced from deerskins by a fish oil tanning method which dates back to the foundation of the business in 1723. The film demonstrates how some processes, earlier done by hand, are now done by machine.

It is fascinating viewing and for those of us who find the commentary in German difficult to follow, Angela Middleton has provided a step-by-step summary in English, which makes everything so much clearer!
Due to unfavourable soil conditions, organic finds in general are rarely found in the territory of Slovakia. However, an exception to the rule is represented by a unique complex of wooden, leather and textile finds discovered ten years ago at the south-eastern foot of the High Tatra Mountain range. In late 2005 a remarkable double-chambered grave (Fig. 1) dated to the early Migration Period (late 4th / early 5th century AD) was discovered in Matejovce near Poprad in northern Slovakia (PIETA 2009; LAU & PIETA 2014). The find was excavated for four months in 2006 by collaboration between the Institute of Archaeology of the Slovak Academy of Sciences in Nitra, The Sub-Tatran Museum in Poprad and the State Archaeological Museum, Schloss Gottorf, Schleswig, Northern Germany.

After excavation, all wooden, textile and leather objects, including soil blocks retrieved in situ were transported for conservation and restoration to the specialised laboratories of the State Archaeological Museum at Schloss Gottorf. A young man, most probably a chieftain of still unknown origin, around 20-25 years old and about 170 cm high, was buried here. Due to waterlogging, the grave yielded abundant evidence of organic material, most notably the perfectly preserved parts of an inner (2.90 x 1.70m) and an outer (3.95 x 2.70m), wooden chamber. Also present were the wooden parts of a death bed and a table, all lathe-turned, as well as many leather remains, textiles, fragments of gold threads, bast and basketry. Both chambers were made of European larch (Larix decidua).

The outer log-built chamber was found at about 5m below the present surface on a platform of twelve timbers set on two round beams and was covered by a set of another twelve solid beams. Inside it, a sarcophagus-like chamber built in a ‘plank and muntin’ construction, was covered by a gabled roof. The grave was accessed by robbers in antiquity as testified by torches, an iron axe, hoe and wooden shovels left at the entrance but above all by dislocated grave goods.
and especially by the absence of luxury metal objects. The remaining finds include: a golden pendant made from a *solidus* of the Emperor Valens (AD375), wheel-turned and hand-made pottery, a glazed *mortarium*, a bronze Hemmoor bucket, a gaming board with several glass gaming pieces, an amber bead, a bronze arrowhead, an iron knife, a silver clasp, a silver awl with wooden handle, around 50 hazelnuts, parts of a human skeleton and some animal bones, as well as a basket containing pins and shears. The destruction caused by robbing had one advantage: muddy sediment, rain and underground water flooded the grave and thus preserved it in an almost anaerobic state for some 1600 years. For this reason the wooden, leather and textile objects had still survived. For the first time in Slovakia, it was possible to study such a unique and well preserved collection of organic finds from an archaeological context.

The laboratory examination of *in situ* blocks has been done in several stages between 2008 and 2015. (ŠTOLCOVÁ, ZINK & PIETA 2009; ŠTOLCOVÁ & LAU 2013; ŠTOLCOVÁ & ZINK 2013; ŠTOLCOVÁ, SCHAARSCHMIDT & MITSCHKE 2014). Most recently, a three year research project was started in 2013, funded by the German Research Foundation (DFG) and entitled ‘Das Frühvölkerwanderungszeitliche Kammergrab von Poprad, Slowakei – Eininterdisziplinäres Forschungsprojekt zur Auswertung eines außergewöhnlichen Fundes’ (‘The Migration period chamber grave at Poprad, Slovakia – an interdisciplinary research project for evaluation of an extraordinary find’) and is being co-ordinated by the archaeologist Nina Lau at ZBSA. It is carried out in co-operation between the ZBSA, the *Niedersächsisches Landesamt für Denkmalpflege* in Hannover, the Koninklijk Instituut voor het Kunstpatrimonium in Brussels as well as the Curt-Engelhorn-Zentrum für Archäometrie in Mannheim. The author of this article was awarded a post-doctoral position from October 2014 until December 2015, during which the conserved and restored leather and textile finds from Poprad have been documented and analysed.

From 2013-2015, the laboratory excavation of *in situ* blocks has been carried out at the *Niedersächsisches Landesamt für Denkmalpflege* in Hannover by the conservator Dorte Schaarschmidt. She also undertook the leather conservation and restoration at the State Museum, Schloss Got-torf, under the guidance of textile and leather conservator Gabriele Zink, who also took part in the excavation of the grave in 2006. Leather finds were impregnated with polyethylene glycol (30% PEG 600 in demineralised water) followed by vacuum freeze drying. Most of the objects were so well preserved, that they did not require further restoration. Broken parts were joined with an acrylic polymer solution (Plexisol® P 550-40) and if necessary, supported by backings of coloured Japanese paper. Identification of the leather types is carried out in co-operation with Jutta Göpfrich, conservator at the *Deutsches Ledermuseum*, Offenbach.

The aim of the laboratory examination has been to document carefully and retrieve fragile organic objects from the blocks of soil and to conserve them. Among them, layers of decayed woollen textiles were found, within which microscopic fragments of golden threads could be recognised. Textiles also include a fragment of sprang, tablet-woven pieces, tabbies and twills, but also fragments of a unique multi-coloured slit-tapestry (ŠTOLCOVÁ, SCHAARSCHMIDT & MITSCHKE 2014, 52-56).

The large collection of 85 recovered pieces of leather objects was very well preserved due to the slightly acidic pH-value of the soil and thanks to the waterlogged conditions. All pieces of leather bear traces of stitching via thread impressions, or the remains of threads between
stitch holes, and therefore show evidence of having been connected to some other, now decayed, material. They can be divided into several categories according to their shape: 1. Single-layered strips with a whip and saddle stitch. 2. Lengthways-folded strips with a double row of saddle stitch, some of them with a slit or slits on the folded edge. 3. Loops and 4. Trefoils (both originally attached to the lengthways-folded strips through a slit: see Fig. 2). 5. Single-layered triangular, almond-shaped or rectangular pieces with different stitches. 6. Single-layered triangular openwork ornaments with a saddle stitch (Fig. 3).

The complete inventory of the grave has been digitalised in a Geographical Information System at the ZBSA. The structural elements of wooden chambers as well as all parts of wooden furniture were 3D-scanned and put into the GIS. Completely dispersed finds have caused difficulties in reconstructing the general picture of the grave before the act of robbing and therefore also of the reconstruction of the deceased’s assumed clothing. Textiles might equally well be part of the wall hangings or even furniture upholstery but it is difficult to be certain, due to their bad state of preservation. The evaluation of the leather finds suggests they are evidence for the reinforcement and decorative closure of parts of a garment. There is no evidence of leather shoes yet.

The uniqueness of this collection provides great potential for various detailed analyses. A future project will look at the technological aspects, including weaving technology, tanning process and stitching technique. Furthermore, the material has been also submitted to colour and dye analyses, radiocarbon and strontium isotope analyses.

tereza.stolcova@gmail.com

Acknowledgement

This paper was written as part of the DFG project “The migration period chamber grave at Poprad, Slovakia – an interdisciplinary research project for evaluation of an extraordinary find” and the APVV-14-0842 project “Central Europe between the Celtic Oppida and the Ancient Slavic Centres of Power.”

Fig. 2 Documentation of leather objects: a) loop; b) trefoil and c) lengthways-folded strip with a double row of saddle stitch and with two slits. It was found with a trefoil attached in the middle slit. Photo and drawing by Tereza Štolcová.
Some recent publications...

Footwear in Ancient Egypt: The Medelhavsmuseets collection

André Veldmeijer has recently published a catalogue of the Egyptian footwear collection in the Stockholm Medelhavsmuseet (Museum of Mediterranean and Near Eastern Antiquities). The catalogue is illustrated with full-colour photographs and diagrams and is preceded by a wide-ranging survey of footwear in ancient Egypt. As well as looking at chronological developments this considers regional differences in style and technique and also the role of footwear in conveying status and individuality. The catalogue is
available to read or download from this website:
http://www.varldskulturmuseerna.se/en/
medelhavsmuseet/collections-and-research/
research/research-on-the-egyptian-collection/

The Museum of Leathercraft, Northampton - latest developments

One of the Trustees of the Museum of Leathercraft, Michael Pearson, has contacted us about current plans for developing and re-housing the museum. At present it is housed at Abington Park Museum, Northampton, where members of the ALG had an introduction to it, some for the first time, in April 2012.

To reflect the international importance of the collection and the global interest it is now generating, the museum is rebranding itself as the International Museum of Leather Craft. Plans are afoot to move the collection to a larger facility within the next few months, where the public will have better access to it and there is a longer term (4-5 year) plan to combine all leather interests on the new University of Northampton Campus in the centre of the town. This should include the Museum of Leathercraft, The Leather Conservation Centre and the existing Leather Technology teaching facilities (ICLT).

Ensuring the future of the museum will require considerable financial support and the involve-

Medieval tanneries at Bourges (Cher, France)

David Germinet, a French zooarchaeologist, has been in touch: both to congratulate the ALG on the work it does and also to inform us about the publication of large excavations in the city of Bourges (Roman Avaricum) in 2009-2010 which included an area occupied by tanneries and leatherworkers from the 12th until the 18th century:


The tanneries made use of the Yévrette, a canalized river on the northern fringes of the city. Tannery structures identified were liming pits, dyeing pits, tanning pits and a watermill, probably a bark mill. Further evidence for the activity was in the form of animal and human urine, bark tan or grape seeds, leather craft tools, leather waste (from cattle, sheep and goat skins) and a variety of other organic remains (manure, decomposition juices, viscera and organs). This waste accumulated in an uncontrolled manner until the early 14th century, when the public authorities appear to have stepped in to control the polluting activities. The intervention led to substantial re-planning of this part of the urban area.

The publisher’s website:
http://racf.revues.org/1858

lists the contents of both volumes. Medieval tannery structures are covered in Vol. 1 : Stratification et structures, Chapters 5-7 while Vol. 2 : Catalogue des mobiliers, Chapter 10 includes a section on bone working, leatherworking and shoemaking.

A tiny fraction of the stores of magnificent leather items being rediscovered
ment of significant numbers of volunteers. The Trustees are currently considering the best ways to encourage potential supporters to become "friends". In the meantime, Mike Redwood, another Trustee and an ALG member, has written about the museum in an online blog, reproduced below with permission. Hopefully it will whet your appetite to know more about how the project is progressing. Anyone interested in getting involved at this stage is invited to get in touch with the Curator, Philip Warner. Michael Pearson has promised to keep the Leather Group up to date with the development of plans for wider public involvement. By the time you read this a new website, http://www.imolc.com/ will have been launched - so visit it as soon as you can and sign up to the mailing list!

‘History Counts’

(from The Redwood Blog at www.internationalleathermaker.com)

For the last quarter of a century, 4000 years of leather history have sat hidden in boxes in the ancient English leather and shoe making city of Northampton. The reality of this unbelievable truth is coming to light, day after day, as the recently appointed curator and his volunteers open the boxes and cross check with the original catalogue to uncover the details of the biggest collection of its kind in the world. The collection was started by designer John Waterer and leather chemist Claude Spiers in 1946. Some readers of this blog from around the world will have studied under Spiers - do let us know if you were one. After many years on display in London, a curious set of events led to its removal to Northampton where funding changes soon caused it to be deposited in store for such a long time that, apart from a few dedicated trustees, it was set to be forever forgotten until just a year ago.

What is clear is that Waterer and Spiers were well connected in the industry. They were quickly able to build a quite fabulous collection which was steadily added to by industry enthusiasts. So, being uncovered are items from Tutankhamen's tomb and fragments of the Dead Sea Scrolls (the items examined in the 1960s by Dr Ron Reed when he was my lecturer at Leeds University - just one more reason I should have taken more interest in my studies).

I have spent the day watching England's Antiques and Fine Art Valuer and TV personality Adam Schoon look through just a tiny fraction of the items with a skilled eye. Without question the mix of a leather technologist (with an interest in historic leather making) and a true expert in antiques can bring objects to life. Adam's skill at uncovering almost invisible markings and deducing from them details of age and function,

TV presenter Adam Schoon with a large Medieval Blackjack

sometimes right down to the name of the owner and the individual craftsman is quite astonishing.

Consequently, while it is apparent that there are a significant number of individual items of huge historical importance and unmeasurable value, every item appears to tell a fascinating story of social and technical history.

Now the battle is on for more resources to open every box and fully update the records and, then, find a way to make them accessible to scholars, designers and the public as a whole. This is the job of the Curator Philip Warner. If you are interested to support this in any way, contact Philip via museumofleathercraft.org or via Twitter @PJW_MoL

If we are to continue the movement of attracting youth back to leather as a great material and tanning as a wonderful career and to inspire more generations of great designers, we need this collection out front and prominent.

Mike Redwood
mike@internationalleathermaker.com
Twitter: @michaelredwood
Some Pictish symbols: leatherworking diagrams and razor holders?

by Chris Lynn
Northern Ireland Environment Agency (retired)

A recent article on Pictish symbol stones, available to read in draft form at:
http://www.archleathgrp.org.uk/archive/CL.pdf
suggests that many of the symbols are diagrams outlining stages in the manufacture of decorated leather cases for mirrors, combs and crescentic head-knives. Over 240 stones are known from NE Scotland: from Fife, through Aberdeen, Moray and Inverness to Orkney. There are some 30 different symbols but some occur more commonly. The symbols are found on unaltered slabs (Class I) and on cross-carved, dressed stones (Class II) which are probably in general later than the Class I stones, the overall date range suggested as being from the fifth to the eighth century.

Each stone carries two different symbols, seemingly paired randomly though some apparent preferences and avoidances can be detected. The stones are interpreted most commonly as grave markers and the symbols are thought in some way to identify or to commemorate the person buried. In about one third of cases an extra symbol, a Mirror or a Mirror-and-Comb, accompanies the pair. This is usually interpreted as a sign that the person commemorated was a woman. Only in two cases does the Mirror appear as one of the main pair.

Although the symbol types have descriptive names such as Mirror Case, Double Disc and Z-Rod, Rectangle, Divided Rectangle, Tuning Fork and Crescent and V-Rod, it is unclear which, if any, object the symbol was derived from (apart from the Mirror Case which does resemble one). The article suggests that a significant proportion of the symbols are leatherworkers’ diagrams, showing stages in the manufacture of leathercases.

The illustrations show some of the relevant symbols with their usual names and, below, a leatherworking interpretation. Drawings from Mack 1997.
simple decorated leather cases, arguably in some examples made of snakeskin. Thus the Crescent was a case for a head-knife, the Double Disc and Z-Rod was a mirror case cut from one piece of material and awaiting stitching, the Tuning Fork was a snakeskin with a median strip removed, the Rectangle was an embossed wallet for a comb. Other object symbols such as the Triple Disc, Flower and possibly the Pictish Beast or Elephant are images of, or derive from, Late Roman razor holders. The main set of symbols, therefore, seems to have been derived from decorated cases for objects used for personal grooming - viewing (mirror), combing and shaving.

Why did the Picts at some time in, or shortly after, the Late Roman period create or adopt a regularised system of symbols based to a large extent on images of decorated leather cases? Did they relate to names or qualities? Could the symbols have been derived from some codified source such as a system of trade marks or a pattern book? Do the identifications suggested in the published article make sense from a leather technology perspective? Are there other aspects of the Pictish symbols that might be better understood if interpreted in the light of leather technology?

I am hoping that a group interested in archaeological leather technology might appreciate critically, amplify or improve the suggestions made in the article. If they are accepted as having substance, they should raise the profile of leatherworking in Pictish studies. I first got to thinking that the symbols might have to do with leather, for example shoe parts, from remembering 7th century shoes we found in a waterlogged site in County Antrim.

chrislynn67@outlook.com

References

Note: the full draft text of Chris’s article will be available on the ALG website only for a limited period. Emania is the journal of the Navan Research Group, whose website is at http://www.navan-research-group.org/emania.html

ALG website - password reminder for members

As well as extensive bibliographies of leather-related books and articles, the website contains full contact details for committee members and an archive of copies of the Newsletter from No.15 (March, 2002) onwards.

These are in the Members’ Area of the site and to access it you will need the password, which is scabbard. If you want to add something to the bibliography, or if you have any problems using the website, please email the Newsletter editor, Sue Winterbottom.
Reflectance Transformation Imaging (RTI) for visualising leather grain surface morphology as an aid to species identification: a pilot study.

by Susanna Harris and Kathryn E. Piquette

The identification of the animal species is an essential aspect of archaeological leather analysis. There are several routes now available for species identification. One is to submit small samples for either ZooMS, a form of protein finger-printing using mass spectroscopy (Collins et al. 2010), or DNA analysis (Schlumbaum et al. 2010). When these are not feasible, the more traditional route is through a microscopic examination of the cellular structure of hair or skin. The analysis of hair is common to textile and fur research. The analysis of skin is particular to leather research and is based on a deep understanding of the fibrous structure of collagen viewed in cross section and the grain surface pattern of different species (e.g. Haines 2006; Leather Conservation Centre 1981; Michel 2014). This form of identification is based on the comparison of diagnostic features in leather of known species with features seen in archaeological leather artefacts of unknown species. It is based on the premise of moving from the known to the unknown.

One of the problems with visual analysis is that many leather specialists do not have access to the extensive reference collections or equipment needed to become familiar with the diagnostic features of leather from different animal species. The purpose of this pilot study was to test the value of Reflectance Transformation Imaging (RTI) as a digital imaging method for visualising leather grain surfaces and to assess its potential as an online tool for aiding species analysis of archaeological leather. Preliminary observations are reported here. The pilot was carried out by the authors using an RTI illumination dome at the University of Oxford.¹

Reflectance Transformation Imaging (RTI)

Reflectance Transformation Imaging (RTI) is an advanced digital imaging technique that entails taking multiple captures of an object. With a high-resolution camera and macro lens an excellent level of surface detail can be recorded. Using either a lighting dome or arm, or the high-light technique (Mudge et al. 2006), the object is illuminated in a hemispherical configuration. These images are then compiled into a single file called a .ptm file (Malzbender et al. 2001) that can be viewed using open access software such as RTIViewer 1.1.0.² The viewer can virtually relight the object’s surface from any direction, much like tilting it back and forth to catch the light and shadow that best reveal features of interest. RTI is especially effective for detecting faint traces or documenting complex surface shape where self-shadowing otherwise leads to information loss, e.g. cuneiform tablets, rock art, textiles, lithics, coins etc. (Earl et al. 2010; Frank 2015; Piquette 2011) and, of interest to us here, leather.

Method: Image capture of the leather grain surface

Leather has two distinct surfaces. The surface once covered in hair and subsequently exposed after dehairing by the tanner is called the grain layer. The surface originally connected to the underlying muscle is called the flesh layer. The grain and flesh layers are connected by a fibrous network called the corium (Haines 2006, 12, fig. 3.2; Michel 2014, 25-6). This study focuses on the leather grain surface. RTI data was captured for the leather grain surface of 22 samples from reference collections held by Dean Sully of the UCL Institute of Archaeology, Roy Thomson, Leather and Conservation Scientist and Laura Youngson-Coll, Contemporary Maker in Leather and Vellum (Fig. 1). To achieve a suitable level of magnification we used a Nikon digital SLR

Fig. 1 Leather samples from the reference collections of Dean Sully, Roy Thomson and Laura Youngson Coll (Photo Susanna Harris).
camera, fitted with an AF-S NIKKOR 200mm lens. Leather samples were placed one at a time, grain side up, in the Oxford RTI illumination dome (Fig. 2). Equipped with an array of 76 LED computer-controlled light sources, the camera then captured 76 images in the RAW file format, each illuminated by a different LED (Fig. 3). This capture process was repeated for all leather samples. The resultant image data were subsequently processed into .ptm user files. Fig. 4 shows the RTIViewer interface. As can be seen from these images, the view can be magnified (Fig. 5) and the light position altered to bring out different features of the grain surface pattern (Fig. 6a-b). The ability to view images at varied magnifications will assist those who have access to different magnification equipment with which to compare their archaeological material (e.g. hand lens, microscope). In addition, viewer tools enable mathematical enhancement of grain surface features (Figs. 5c-d, 6c-d). The default and enhancement views bring out different features of the grain surface. For example, by adjusting the light source the alignment of raised features changes (Fig. 6a-b). In other views, the hair follicles are more evident (Fig. 4, Fig. 6c). Some enhancements may be more useful than others. It is worth noting that the original captured images are retained in the archival .dng format. This provides an image that can be used for further digital processing and analysis.

Potential of RTI for species identification

The pilot study provided sufficient results to evaluate RTI as a tool for imaging leather grain surfaces from reference collections. The resulting image files were discussed with committee members of the Archaeological Leather Group and Prof. Matthew Collins of York University. Some of the advantages and drawbacks of this technique are listed in the table on p. 16. The main advantage of this technique is the production of multiple high quality digital images which can be viewed in two dimensions or using an RTI viewer for augmented visualisation. The RTI data, with its ability to provide the appearance of 3D surface information, offers a more natural...
Fig. 5  The grain surface of chrome tanned elephant skin:  
A  Default view at 20 % of source image,  
B at 50%.  C Static Multi Light view at 100%,  
D Luminance Unsharp Masking view at 100%  
(RTI snapshots Susanna Harris).

Fig. 6.  The grain surface of vegetable tanned cattle skin. All show the same area of the leather sample 
at 100 % of source image:  
A & B Default view from contrasting light angles,  
C Luminance Unsharp Masking,  
D Specular enhancement (RTI snapshots Susanna Harris).
visual experience of the leather grain surface. This enables the user to see morphological details of the fine, interwoven collagen fibres just below the epidermis as well as the position, shape, size, density and distribution of the hair follicles: all potential diagnostic features of animal species (Leather Conservation Centre 1981, 9-11; Reed 1972, 25). This represents a major advance in leather grain surface pattern visualisation which has otherwise been illustrated by single fixed light photographs published in books and atlases (Haines 2006, 17-19; Michel 2014, 32-38; Reed 1972, 26-7, figs. 7-10).

One of the main drawbacks of RTI imaging for species identification is that the grain surface pattern should be observed in combination with other diagnostic features viewed in transverse cross section of the leather such as corium thickness and hair-shaft penetration (Michel 2014; Reed 1972, 25-35). Another important consideration is that in the face of advances in

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<td>Can be used on skins with epidermis and hair removed through processing into leather.</td>
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<tr>
<td>Potential for creating large reference image library for samples covering multiple species, tanning processes and areas of the hide.</td>
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<tr>
<td>Provides detailed two and three dimensional views of leather grain surface pattern morphology.</td>
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<tr>
<td>Digital image files can be viewed and interrogated as individual image files or using the RTIViewer.</td>
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<tr>
<td>Enables digital collation of leather reference collections held at different institutions and in private or public collections.</td>
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<tr>
<td>Potential for online reference collection of leather grain surface pattern, which can be viewed at different magnifications on a personal computer or handheld device.</td>
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<tr>
<td>RTI files can be viewed online either as individual images or using an online RTI viewer.</td>
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<tr>
<td>RTI files can be made accessible to a wide range of leather specialists to use as a reference collection, without the need to produce their own RTI files.</td>
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<tr>
<td>Potential to use digital RTI image files to develop an alternative to species identification by ZooMS and DNA analysis.</td>
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<tr>
<th>DRAWBACKS</th>
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<td>Methodological problem that grain surface patterns of archaeological leather may be lost through tanning process, wear or decay.</td>
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<tr>
<td>Due to the RTIViewer design, the scale is not always visible when viewing the images. As a photographic rather than microscopic technique, images are viewed at uncertain degree of magnification; there is no method of calibrated measurement yet.</td>
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<tr>
<td>General requirement for well documented reference collections of samples with known species, tanning process and area of hide.</td>
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<tr>
<td>Depending on camera lens used, may not provide sufficient magnification of grain surface to view certain features. Microscopic RTI may provide a better solution.</td>
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<tr>
<td>Grain pattern is only one aspect of microscopic species identification and should be used in combination with other diagnostic features such as corium thickness, hair-shaft penetration and hair cuticle pattern.</td>
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<tr>
<td>Initial image capture requires good quality digital camera, training and specialist equipment. This expense and expertise may not be practical for all specialists.</td>
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<tr>
<td>Although collection managers may be concerned about the light exposure of archaeological leather objects during RTI capture, the use of safe LEDs and filters on other light sources alleviates this concern.</td>
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</table>

Table: Summary of the main advantages and drawbacks of using RTI in order to build an online reference collection to aid species identification of archaeological leather.
ZooMS and DNA identification of plant and animal species, identification by visual observation of magnified morphological features is currently under scrutiny (e.g. Ørsted Brandt et al. 2014). In future projects, a combined approach verifying identifications across techniques would be desirable.

**Future directions**

This pilot project was carried out to test the feasibility of RTI as a digital imaging technique to aid in the microscopic analysis of leather to determine species. It has provided promising results which we hope to develop into a larger project. We would like to hear from those who are interested in collaborating with this project and those with leather reference collections to which they would be willing to allow access for imaging. Please contact Susanna Harris: susannaharris@hotmail.com or tcrnsm4@ucl.ac.uk.

**Notes**

1. Built with AHRC DEDFI funding by the University of Southampton (Earl et al. 2011)
2. RTIViewer: http://culturalheritageimaging.org/What_We_Offer/Downloads/View/

**Acknowledgments**

This pilot was carried out as part of Susanna Harris' British Academy Postdoctoral Fellowship held at UCL Institute of Archaeology. Thanks are due to Dean Sully, Roy Thomson and Laura Youngson Coll for the loan of their leather collections, to Dominica D’Arcangelo for the original inspiration to improve digital imaging of leather grain surfaces and to Matthew Collins and committee members of the Archaeological Leather Group for their enthusiastic response to this pilot project. We express our thanks to Charles Crowther and Maggy Sasanow at the Centre for the Study of Ancient Documents, University of Oxford, for permitting use of the RTI dome. We acknowledge the Archaeological Computing Research Group and School of Electronics and Computer Science at the University of Southampton, who built the RTI dome as part of a collaboration with the Centre for the Study of Ancient Documents and the Faculty of Oriental Studies at the University of Oxford. They were supported by the Arts and Humanities Research Council’s Digital Equipment and Database Enhancement for Impact (DEDEFI) scheme in 2010-2011.

**References**


Welcome to a new ALG member!

Please do look at the ALG facebook page:
www.facebook.com/ArchaeologicalLeatherGroup

if you haven’t already done so. It is visited by many researchers interested in historical leatherworking, even if they have not so far joined our group – or even (shock, horror!) heard of it before finding their way to the page. Angela Middleton and Jackie Keily contribute items regularly on behalf of the Leather Group and recently ran a competition, offering free ALG membership for a year to the 700th person to ‘Like’ the page.

The winner was Blair Crewther who is a medieval re-enactor living in Queensland, Australia. He began making wooden items such as training pells for swordsmanship and archery target frames but gradually became interested in leatherworking and acquired a collection of tools. His projects have included a 14th century arrow bag and a large drawstring pouch. He regularly attends events such as the Abbey Museum Medieval Festival (Brisbane) – an annual fair that boasts a medieval banquet, jousting tournaments, music, puppet shows, falconry and the guaranteed participation of hundreds of medieval costume and weaponry enthusiasts:

http://abbeymedievalfestival.com/

At re-enactments Blair adopts the persona of a Welsh archer named Alwyn ap Porffor. While his day job is in the IT industry, he writes:

I am very much into the history of things and where the idea for something came from. I have quite a number of woodworking and leatherworking facebook groups in my favourites and your site was shared by one of the members of a group that I belong to, The Capricornia Medieval Guild. I am happy to join your group and hope to spend quite some time looking through what is on show and sharing what I may be able to contribute myself.

We hope Blair continues to follow the Leather Group’s page and that facebook will be a source of many new members in years to come.

Archaeological Leather Group Committee 2015-16

Chair Jackie Keily, Department of Archaeological Collections and Archive, Museum of London, London Wall, London, EC2Y 5HN
Tel 020 7814 5734
email: jkeily@museumoflondon.org.uk

Secretary Quita Mould, 51 Whin Common Road, Denver, Downham Market, PE38 0DX
Tel. 01366 384289
email: quita@onetel.com

Treasurer Roy Thomson, 29 Herne Road, Oundle, Peterborough, PE8 4BS
Tel 01832 272048
email: roythomson@greenbee.net

Newsletter Editor Sue Winterbottom, 48 Lyndhurst Street, Stoke-on-Trent, ST6 4BP
Tel 01782 833213,
email: sue@suewinterbottom.freeserve.co.uk

Meetings Co-ordinator Angela Middleton, Archaeological Conservator, English Heritage, Fort Cumberland, Fort Cumberland Road, Portsmouth, PO4 9LD
Tel 023 9285 6787
email: Angela.Middleton@HistoricEngland.org.uk

Ordinary Member Dominique Mathieu, Association La Couenne, Presbytère 31800 ASPRET-SARRAT, FRANCE
Tel (outside France) (00-33) 9 53 98 28 28
(within France) 09 53 98 28 28
email: lacouenne@free.fr

Ordinary Member Lucy-Anne Skinner, Little Jessups, Station Road, Mayfield, East Sussex
Tel 07971 682829
email: lucy.skinner@gmail.com
Ordinary Member  Vivi Lena Andersen,
Museum of Copenhagen, Vesterbrogade 59,
1620 Copenhagen V
Tel +45 4095 0773
email: vivila@gmail.com

Ordinary Member  Diana Friendship-Taylor,
‘Toad-Hall’, 86 Main Road, Hackleton,
Northants, NN7 2AD
Tel 01604 870312,
email: liz@friendship-taylor.freeserve.co.uk

Ordinary Member  Tim Martin, Tower
House, The Square, Talgarth,
Brecon, Powys LD3 0BW
Tel 01874 711829
email: tim@context-eng.demon.co.uk

Co-opted Member  Yvette Fletcher, The
Leather Conservation Centre, University Cam-
pus, Boughton Green Road, Northampton,
NN2 7AN
Tel 01604 719766
email: lcc@northampton.ac.uk