Glass News

Published by The Association for the History of Glass Ltd
www.historyofglass.org.uk

July 2016 **Number 40** **ISSN 1362-5195**

Panel 3b of the Great East Window of York Minster, depicting Revelations 18: merchants mourning the destruction of Babylon © The York Glaziers Trust with the kind permission of The Chapter of York

Welcome to Glass News Issue 40!

This issue contains details of forthcoming meetings and exhibitions, new books, and a large number of grant reports and articles. Many thanks to everyone who has sent in contributions!

The autumn 2016 meeting of the AHG - *Glass in Imitation of Other Materials* - will be held at University College London on the 7th of November. Further details can be found on page two.

We are always on the lookout for information on interesting finds, new research, ideas, queries, new books and reviews, and any other glass-related news or meetings. The editors' details are given on the final page. We look forward to receiving your contributions for issue 41.

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REMINDER

MEMBERS AND SUBSCRIBERS ONLY. Would you like to enjoy all the wonderful Glass News pictures in colour? If so, please email one of the editors (see back page) and we will also email future issues of Glass News to you as a full colour PDF!

While every effort is made to check the content of the articles and reviews, Glass News does not accept responsibility for errors.

AHG STUDY DAYS AND AGM

Glass in Imitation of Other Materials

Monday 7th November 2016
Institute of Archaeology, University College London, 31-34 Gordon Square, London WC1H 0PY

The classification of materials is a practice with deep roots in the past, but the multifarious properties of glass lent it an intermediary or ambiguous position in many classification systems: from the Bronze Age description of glasses with reference to precious stones, and the role of glasses in alchemical theories of the Middle Ages, to the difficulties encountered by modern science in attempting to determine its physical state, glass has resisted classification.

This ambiguous position also stems from the chameleonic properties of man-made glasses, which can be worked to shape when either hot or cold, can be produced in almost limitless hues, and can be either transparent or opaque. Glass is particularly suited to mimicking the properties of stones and gemstones, though it also has strong connections with metals and pottery. Much like the plastics of the 20th century, glass may at times in its history have been a by-word for *ersatz*. Yet imitation was often a very complex matter, for the properties of glass also lend it a unique value in many applications. Just as the Roman vessel known as the Portland Vase originally reflected cameo work in natural stones, which would have been impossible to achieve on such a large object, so it too was imitated in ceramic by Josiah Wedgwood in the late 18th century.

The aim of this study day is to explore aspects of the use of glass in imitation of other materials. What purposes were behind this practice, and how was it achieved from a technical perspective? Which materials were mimicked, and how did this affect the value of the glass itself and the material it was imitating? What was the purpose of mimesis and imitation at different times?

The study day covers a range of subjects over three millennia, from Egyptian glass and faience of the Late Bronze Age (Paul Nicholson, Susan Sherratt); to glass imitating Chinese jade (Ian Freestone), or opal and agate (Colin Brain); early English china (Mike Noble); cameo glasses (Paul Roberts); Hellenistic and Roman banded glasses (Jenny Price); glass inlays in Anglo-Saxon metalwork (Jo Ahmet); and glass skeuomorphs in the Near East (St John Simpson).

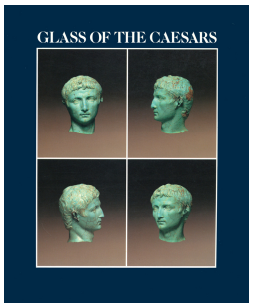
For further details, please do contact Daniela Rosenow (DRosenow@britishmuseum.org) or Chloë Duckworth (cd227@le.ac.uk).

If you would like to attend, please send your full contact details and a cheque for £15 (members of AHG), £25 (non-members) or £8 (students) payable to the Association for the History of Glass Ltd to: Denise Allen, 12 Birchy Barton Hill, Exeter EX1 3ET, UK. Lunch is not provided, but is available locally.

Members wishing to attend the AGM of the Association only, which will be held on the same day, may do so free of charge.

SAVE THE DATE

24-25th November 2017
The British Museum, London, WC1B 3DG



November 2017 will see the 30th anniversary of the *Glass of the Caesars* exhibition in the British Museum.

To mark the occasion, the AHG is in the process of organising a 2-day seminar in conjunction with the Department of Greece and Rome and the Department of Scientific Research to be held in the British Museum. The seminar will examine how our understanding of Roman glass, both art historically and technically, has changed and developed in the intervening period, and where research might lead us in the next three decades.

Still in its early stages, the AHG is hoping to invite speakers to talk on specific topics on the first day (Friday November 24th), which will conclude with a Keynote lecture that evening, followed by an optional dinner. The second day (Saturday 25th) will be open to other talks and posters.

A call for papers, with further details, will go out later this summer. The lecture hall at the British Museum is limited to 130 people, so spaces will be limited.

To make sure that you are kept informed or if you have any suggestions or indeed offers of help, please contact Martine Newby Haspeslagh.

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Address: c/o Didier Ltd, 66b Kensington Church Street, London W8 4BY

OTHER MEETINGS

Glass - Back to the Future!
SGT Centenary Conference

Sheffield, UK
4-8th September 2016

It is hard to imagine modern life without the fascinating material that is glass. We have come a long way in our use and understanding of this material since Professor WES Turner founded the Society of Glass Technology in 1916 to bring the wider glass community together, yet significant challenges and opportunities remain.

The Society of Glass Technology Centenary Conference (SGT100) in Sheffield will be a significant opportunity to review the state of glass in its widest manifestations - from the theoretical challenges of understanding the glassy state and the glass transition to the latest developments in the application of glasses in windows and containers, information technology, medical applications and waste vitrification, as well as the history and artistic applications of glass.

The organisers are proud that the SGT100 meeting is also the 2016 European Society of Glass (ESG 2016) meeting - a meeting that traditionally has a strong industrial focus and thus we therefore look forward to a conference that brings people from all parts of the glass community together.

Plenary and keynote talks, invited talks, contributed papers and poster sessions will cover all aspects of glass science, technology, manufacture, engineering, art, archaeometry and heritage. Topics will be addressed within five key themes:

- *Fundamental Glass Science*
- *Applied Glass Science and Technology*
- *Glass Industry, Manufacture and Applications*
- *History, Heritage and Archaeometry of Glass*
- *Glass Art and Craft*

For further details and registration please visit the conference website:
http://www.centenary.sgt.org/Conference.htm

Glass in Western Europe AD 700-1600
8th International Congress of the Association Française pour l'Archéologie du Verre

Besançon, France
5-7th December 2016

The Middle Ages have been highlighted as an important area of study since the very beginning of the Association, especially through the exhibition catalogue *À travers le verre, du Moyen Âge à la Renaissance* in 1989 and the conference proceedings *Le verre de l'Antiquité tardive et du haut Moyen Âge* in 1995. Since then, no significant state-of-the-art overview has been published. An issue also noticeable at European level since the last relevant document is the exhibition catalogue *Phönix aus Sand und Asche. Glas des Mittelalters* published in 1988.

The increasing number of rescue and systematic excavations on medieval sites, along with the democratisation of new conservation methods has allowed a considerable improvement and renewal of this theme. However, as stated above, the lack of a comprehensive overview is still greatly hindering local studies. Therefore, this congress intends to provide the opportunity to think about the significance of glass products in medieval societies.

If complete thoroughness is out of reach, then this congress intends to achieve an updated state of research. For this purpose, original works and thematic overviews, whether chronological or geographical, are invited on the subject of production, distribution and uses of medieval glass in Western Europe. Overcoming academic and national boundaries is also one of the primary objectives. This exercise will certainly require reasoning, not in quantitative terms, but rather in qualitative ones, especially for the earlier periods which are more dependent on discoveries and their state of conservation.

The 8th International AFAV Congress therefore wishes to highlight progress in glass history, but also to draw attention to the shortcomings of this theme, in order to give guidelines for future research on a material which has already proved its relevance for a better understanding of medieval societies. Submitted papers will be reviewed by a scientific committee. Interdisciplinary approaches based on exploitation of archaeological, historic and archaeometric sources, and collaborations between researchers, will be favoured. Oral and poster presentations can be submitted in English or French.

For further information please visit the conference website: http://www.univ-fcomte.fr/afav2016/index.html

EXHIBITIONS

Margaret Agnes Rope
Celebrating the Life and Times of the Shrewsbury Stained-Glass Artist

Shrewsbury Museum
September 2016 – January 2017

Head of St Winifrede, from a window by Margaret Agnes Rope in Newport RC Church in Shropshire

Readers will be interested to know that the work of Margaret Agnes Rope is at last to get a well-deserved boost. 'Marga' Rope (not to be confused with her cousin) was born in 1882 and is usually classed as a 'Later Arts & Crafts' style stained-glass artist. Her work can be seen in over forty churches across four continents.

This year, her achievements are to be profiled in a major exhibition, the first to be dedicated solely to her life and works. As such, it is expected to attract visitors from far and wide.

Following the example of Christopher Whall, and her own mentor Henry Payne (under whom she studied in Birmingham), Margaret Rope took seriously the Arts & Crafts ideal of being heavily involved with the making of the work. She is known to have kept a workshop at the famous Glass House studios in Fulham, where the co-owner Mary Lowndes encouraged women to strike out as independent makers. Her use of the recently developed 'slab glass' gave her work that distinctive jewelled look sought after by Arts & Crafts practitioners.

Curiously, despite her achievements, she has largely disappeared from art-history. This is not just the fault of the critics. She left very few records (only three photos of her are known to exist, and only one letter); and, at the age of forty, she also entered an enclosed convent – though she continued to work from there for another twenty-five years.

This exhibition, which has been put together largely by enthusiasts of Margaret's work on behalf of Shrewsbury Museum, will be the first real chance to assess her work. (Though, one should say that she did get an honourable mention in Peter Cormack's book for Yale University Press last year).

Undaunted by the apparent paucity of available artefacts, the Museum has in fact sourced many objects, most of which will be being seen in public for the first time.

A specially designed light-show will display projected photos of her church glass.

If readers do decide to visit the exhibition, do make sure to go on a day when the town's Cathedral is open to visitors: the magnificent West Window there is one of Margaret Rope's finest works.

Nowadays, museums have to be 'hands-on'; and the present-day Shrewsbury glass artist Nathalie Liege will also be leading sponsored workshops in making stained-glass at the same time as the exhibition. It's expected that lectures and complementary activities will also run alongside the exhibition.

The Museum has set up a special email address for enquiries – which can help with matters from Shrewsbury tourism information right through to offers of extra information about Margaret Rope: rope2016@gmail.com

AHG GRANTS

Grants are available from the Association for the History of Glass, for educational or research activities consistent with the Association's charitable aims. These could include, for example, attendance at a conference to present a lecture or poster, a study visit, fieldwork, or publication of scholarly works. There are no restrictions on who may apply or on the topics of applications, which will be judged on merit. Multiple applications in different years will be considered with individual awards up to £500. See also the AHG website for details (www.historyofglass.org.uk).

An application form may be downloaded from the website, or can be obtained from the Honorary Secretary, Denise Allen. Email: denise_allen52@hotmail.com

AHG Grant Report
The hand of the painter? Understanding medieval glass-painting workshop organisation through scientific analysis

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Introduction

Medieval documents, such as that of Theophilus Presbyter (De Diversis Artibus), provide information about the tools and technological steps involved in both glass-making and the making of stained glass windows, but our knowledge about the organisation of artistic production within the craft workshops that created the windows is more limited.

Chemical analysis has the potential to provide important insights in this area, but analysis is impeded by the architectural context of the glass, rendering it impossible to remove samples for laboratory analysis. Alternatively, we must rely on in situ surface techniques, such as handheld portable X-ray fluorescence (pXRF), which can be problematic in its use for medieval stained glass. Therefore, another focus of this research is in the development of a methodology using pXRF for the study of medieval stained glass.

The Great East Window of York Minster

This research benefits from the opportunities provided by one of the largest conservation projects of its kind in Europe, York Minster Revealed (https://yorkminster.org/york-minster-revealed.html), which has entailed the dismantling of the Great East Window (GEW). With the permission of the Dean and Chapter of York and the support of the conservators of York Glaziers Trust, it has been possible to take samples for laboratory analysis of the cross-sections and to analyse the glass using handheld pXRF.

Surviving copies of the contract tell us that the GEW was created over a three year period between 1405 and 1408 by the influential glass-painter of the International Gothic Style, John Thornton of Coventry, and his workshop (French 2003); this window is widely considered Thornton's masterpiece (Marks 1993). The subject matter is the 'beginning and end of all things', depicting the Books of Genesis and Revelations (Apocalypse). For the pilot study, one panel (Panel 3b, see page 1) from the Apocalypse cycle was selected.

Development of a methodology using pXRF

Handheld pXRF has many advantages for use in archaeology and cultural heritage: it can be used directly on the surface of an object, allowing the generation of compositional data when it is impossible to take samples; it is far less expensive; and it is much faster, allowing more material to be characterised. Window glass is in many ways ideal for pXRF analysis as the sample material should be flat, level and homogeneous. The importance of pXRF for the study of window glass has already been demonstrated by the work of David Dungworth and colleagues (Dungworth 2012 and other works).

However, medieval glass is the exception. As Theophilus detailed, medieval glass was made using a recipe of sand and wood or fern ash, resulting in a glass low in silica and high in alkali (potash); this composition makes the glass especially prone to deterioration through the leaching of some elements, in particular potassium, from the surface of the glass (De Bardi et al. 2013). This affects surface analyses by pXRF drastically because the results are only characteristic of a small depth in to the sample and are therefore reporting the composition of the corroded layer.

The depth of analysis by pXRF varies depending on the element being analysed, as heavier elements have higher energy characteristic X-rays that are read from deeper within the glass (Kaiser and Shugar 2012). Therefore, while lighter elements calcium and potassium are greatly affected by surface conditions, heavy trace elements strontium and rubidium are far less affected. These particular elements share properties and are naturally associated with calcium and potassium respectively; strontium is introduced into the glass with the calcium-rich raw material, and the same for rubidium with potassium, and can therefore be measured instead as a "proxy" for the major elements.

Therefore, this methodology is centred around the analysis of these trace elements, as they are well-measured by pXRF and reflect differences in raw materials, technology as well as chronological and geological source.

A subset of the glass was also sampled for cross-sectional analysis by electron microprobe, which provided high quality data on the major elements and served to inform

and validate the analyses by pXRF. Analysis of this control group verified that strontium and rubidium define the same compositional groups as calcium and potassium.

Organisation of artistic production

The batch is an important concept in the study of workshop practice and organisation of production. A batch of glass refers to glass made from a single working pot in a furnace, containing glass that is homogeneous; all the glass objects (in this case, sheets of glass) will be of an identical composition and can be identified analytically (Freestone et al. 2009). The batches were identified using trace elements, and verified by the major element compositions of the control group. The spatial distribution of the batches identified by pXRF were then examined and interpreted for organisation of production.

The spatial distribution of the batches indicate that the frame was cut and painted separately from the interior scene. This could reflect the workflow of a single craftsman, or alternatively reflect the work of two or more craftsmen. Other lines of evidence support the latter interpretation and furthermore suggest that this is the work of differently skilled craftsmen, such as an apprentice and a master glass-painter.

Some aspects in windows such as the GEW were 'stock design features' that were not unique to a panel or window, but offered to supplement the individual design requested by the patron (Marks 1993, 31). The frames fall under this category: the frame found in 3b is found in four of the nine panels of this particular row.

Visually, the frame has thicker lines and is less detailed than the interior, which has artistic value (bringing the frame into the foreground and contributing to the three-dimensionality of the image), but also requires less skill. This, along with the repetition, makes the frame ideal work for a lower-skilled craftsman, such as an apprentice.

This is therefore potential evidence of a hierarchal structure within the workshop, based on skill, experience and reputation.

Final remarks

The new "proxy" methodology using heavy trace elements strontium and rubidium has significant potential in the study of medieval stained glass using handheld pXRF. Further development of the methodology is an on-going focus of this research.

The new evidence for the hierarchical organisation of production within the craft workshop that created the GEW is amongst the more exciting results to stem from this research so far, though other findings related to the organisation of production and other aspects of the life history of the window (including glass-making and sourcing the glass, and centuries of conservation post-construction) have been brought to light through this research.

This report is a summary of research presented at the 20th AIHV congress held in Fribourg, Switzerland, September 2015, with Ian Freestone and Nick Teed as co-authors.

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AHG Grant Report
Overview of the current archaeometrical glass research at Vrije Universiteit Brussel

Andrea Ceglia

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I am grateful to the AHG for having financially supported me to attend the AIHV20 glass conference in Fribourg, Switzerland. On this occasion I not only had the chance of presenting a poster on a study of the production technology of red glass tesserae, but foremost the grant gave me the opportunity to listen to many interesting talks who inspired me in my research in the fascinating world of glass. Among others, I attended the keynote of Prof. Ian Freestone in which I proudly took note my work got extensively reported. In this brief contribution I will give you an overview of my past and future work.

In July 2015 I completed my PhD entitled 'Unravelling technology and distribution of ancient glass by X-ray and UV-vis-NIR absorption spectroscopy'. The aim of the research was to carry out a thorough investigation of the benefits and limitations of optical UV-vis-NIR spectroscopy in the field of archaeometry of glass. To perform this work I compared optical spectroscopy with synchrotron X-ray absorption spectroscopy (XAS) in order to quantify Fe^{2+}/Fe^{3+} in glass (Ceglia et al. 2015c). In addition I used chemical data from glass fragments to determine the link between optical parameters and the compositional groups.

The archaeological application of my work focused on early Christian contexts in Cyprus, 4^{th}-7^{th} century AD. I want to thank here Dr. Peter Cosyns who works on the technology and typology of the Cypriot glass findings. We combined our approaches to get the most out of the research on Cyrpiot glass. We worked on this region because the island was a hub of the trade and commercial routes between the East Mediterranean regions, such as the Levant and Egypt and the rest of the Empire.

UV-vis-NIR spectroscopy was successfully applied in-situ in the depots of Larnaca and Paphos, where I studied the material of three sites: Ayioi Pente at Yeroskipou, Maroni-Petrera and Kalavasos-Kopetra (Ceglia et al. 2015b). The optical research proved that it is possible to link specific parameters, such as the UV absorption and the content of Fe^{2+} to glass groups, identified by means of Electron Probe Micro Analyzer (EPMA). The main benefit is that I could study many more fragments than what would have been granted for sampling. Of course the measurements require prior polishing of the material with a hand-held rotatory tool to remove dirt and the superficial weathering layers.

Photo taken in Paphos during the cleaning of a glass fragments with a Dremel rotatory tool © Andrea Ceglia

Another outcome of my research on Cypriot glass derived from the chemical analysis of the major and minor elements by EPMA. I recognized three major groups, Levantine 1, HIMT and HLIMT. The latter is a label that stands for High Lime Iron Manganese Titanium because it refers to a compositional group which has high amount of lime but similar features of HIMT (Ceglia et al. 2015a). It was very exciting when I compared this material with data in the literature finding that it appears commonly in later contexts, mostly related to the 6^{th} century. This information made me come up with the hypothesis of a chronological distribution of the glass compositions.

During my PhD I also worked together with Peter Cosyns on another topic of his archaeological research: Roman black glass. We have investigated the case of the deliberate addition of iron to produce black colour. Because of the high absorbance of these glasses, I employed XAS. The study of black glass jewellery and vessels dated between the 1st and the 5^{th} century AD shows that there is a technological change at the end of the 2^{nd} century. Black glass was initially produced by controlling the redox conditions in the glass melt, likely adding reducing agents such as coal, ashes or minerals like sulphides, while in later times the colour was obtained by large additions of iron minerals with no particular attention to the redox conditions (Ceglia et al. 2014).

Currently I am working in a close collaboration with Peter. I recently carried out an in-situ campaign on the Cypriot early Christian basilica of Katalymata ton Plakoton, focusing this time on the glass window panes (re)used within the ecclesiastical building. Furthermore, I am expanding my chronological expertise, since in the same campaign I had the opportunity to study the Hellenistic and early Roman glass from the house of Orpheus in Paphos. The preliminary results will be presented on the international workshop "Reflections on glass" hold in Nottingham on September 17th 2016. An ultimate line of research I am working on is the characterization of Roman glass from different Belgian sites, which will possibly offer new insight on the consumption in this area of the ancient world.

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AHG Grant Report
British Instruction at Japan's First Western-style Industrial Glassworks, 1874-1883

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If you are interested in glass and visit Japan, it is likely that within a few days you will hear of a certain glassworks that was established under British influence in Shinagawa, Tokyo, in the early Meiji period. This is because Japanese glass historians, manufacturers, artists, collectors and curators honour this factory as the seed of Japan's modern glass industry.

I first heard about the Shinagawa Glass Factory (SGF) because of family history. My great grandfather, James Speed, was one of four British glassmakers who were invited to Japan to help establish the country's first modern Western-style industrial glassworks between 1874 and 1883. Until then, Japanese glassmaking had been a small scale craft industry, very largely unconscious of the great developments in European glassmaking because Japan had been closed to the outside world for more than two centuries. Glass was regarded as a precious material suitable only for religious or high-status objects.

But when Japan was forced open by Western powers in the 1850s European goods were wanted, so the government created various model industrial plants, inviting foreign experts to help modernise industry in addition to every aspect of the country. At SGF, Speed and his colleagues advised, assisted and instructed Japanese glassmakers in every form of Western glassmaking.

The first goal for the factory was window glass for Japan's new Western-style buildings. But this proved very difficult and flat glass was in fact not achieved in Japan until early in the 20th century. There was more success with flint glass, of all types. Western designs, colours and methods were introduced, along with machine cutting and engraving, modern annealing and - perhaps most important of all - the general model of an industrial factory with mass production intended to supply both a domestic and an export market.

As the government had hoped, many of the trainees went on to set up their own modern glassmaking businesses. For example, Magoichi Shimada set up Shimada Glass Company in Osaka, Japan's largest tableware manufacturer in the 20th century. The company stayed in family hands through three generations, eventually becoming part of today's Toyo Glass Co. www.toyo.sasaki.co.jp/e/company/history.html

Figure 1: Glass vase by Chuzaimon Ooshige, SGF trainee. Colour overlay, wheel engraved, 22.3 x 9.5cm © Sally Haden – with thanks to Shinagawa Historical Museum.

Another significant result was the development of Edo Kiriko, a uniquely Japanese form of cut glass. This was first made in Tokyo in the 1830s, in imitation of a handful of imported British or Irish items, sometimes using hand tools. At SGF Japanese craftsmen received instruction from Bohemian-born British engraver, Emanuel Hauptmann, on the use of engraving and cutting machinery.

Thanks to grants from the AHG, the Great Britain Sasakawa Foundation and the Association for Glass Art Studies, Japan, (AGASJ), I was able to visit Tokyo last autumn to give a lecture, meet glass manufacturers and do some research. About 100 people attended the AGASJ conference lecture (double the usual number) and I visited the Shinagawa Historical Museum where I was shown a vase engraved by one of Haupmann's apprentices (Figure 1).

Modern interest in the factory dates to the 1960s, a time of growth and prosperity for Japanese glass manufacturers. Confident of their future and with the leisure to think about heritage, they created a memorial beside the site of what had been SGF (Figure 2).

Figure 2: Visiting the memorial for SGF © Sally Haden

It is remarkable how much respect Japanese glassmakers have for SGF and the British men who taught there. I understood this best when I was introduced to Mr Yasuyuki Shimizu, President of Toyo Glass Co., and Mr Toru Horiguchi of Horiguchi Glass Co., both most enthusiastic about their companies' connection with SGF. Mr Horiguchi's training descends directly from Hauptmann (Figure 3).

Figure 3: Examples of modern Edo Kiriko glass © Sally Haden – with thanks to Tajima Glass Co., Tokyo

They invited me to return to Japan to hear more about their work, so plans are now underway to visit Horiguchi Glass and Toyo Glass this autumn, for discussions, research and the development of further plans. There will be historic meetings with at least three great grandchildren of men whom my great grandfather taught in Shinagawa, who are still connected to the glass industry. Also an introduction to Professor Tanahashi, a science expert on how Edo Kiriko was made before SGF.

Finally I should like to acknowledge the generous support of my project partners, Ms Akiko Inoue Osumi of AGASJ and Mr Ritsuo Yoshioka of Japan Uranium Glass Collectors Club, who have helped at every turn. With them I will continue to make the results of the work known through written publications, my website www.hadenheritage.co.uk, lectures and exhibitions.

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A Setting of Garnet or Glass: An examination of inlaid Garnet and Glass on the 5th-7th century Metalwork of Kent

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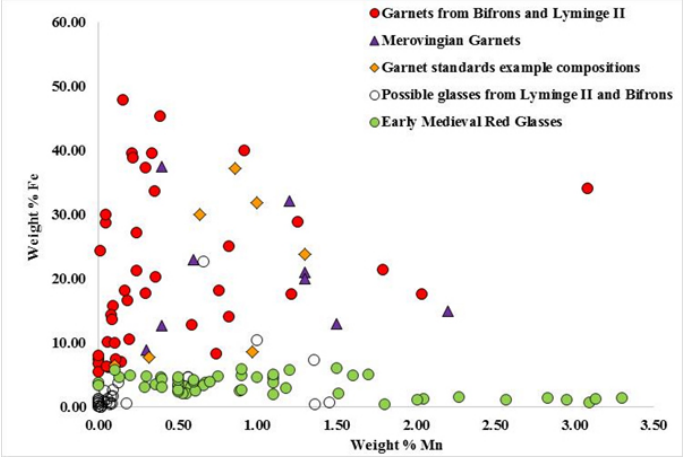

Figure 1: Compositional plot of garnet and possibly glass inlays from the project. The garnets present a similar pattern to known compositions while the glass is comparatively inconsistent and unclear, the two highest iron glass points are from inlays set into an iron frame while the next two highest are both opaque. Data plotted alongside Scandinavian and German garnets standards from Deer et al. (1982, 499-605) and those used by Farges (1998, 327). Also shown is compositional data of Merovingian garnets assessed by Farges (1998, 327) and Perin et al. (2007, 71). Early medieval red glass compositions from the transparent red from the Sutton Hoo millefiori (Bimson and Freestone 2000, 135), red-purple glass from the Staffordshire Hoard (Meek 2016), opaque red glass from Eriswell Hill beads (Peake and Freestone 2012, table 1) and 6th-7th century Byzantine opaque red tesserae from Beit Shean, Israel (Shugar 2000, 379). It should be noted that this data comes from a variety of analytical methods however it still gives a good comparison of general patterns © Walter Ahmet

The garnet-inlaid jewellery and metalwork of Anglo-Saxon England has been described as 'one of the chief glories of Anglo-Saxon craftsmanship' (Leahy 2003, 160). The Sutton Hoo and Staffordshire Hoard assemblages would seem to confirm such an assertion. Key elements of this fabulous metalwork are contrasting coloured glass inlays which, with one notable exception (Bimson and Freestone 2000) have until recently been relatively under-studied. The project described here, explores the relationship of garnet and glass on Anglo-Saxon metalwork of the 5th-7th centuries and was inspired by the discovery of a substantial number of coloured glass inlays on metalwork of the Staffordshire Hoard, including garnet-mimicking red glass inlays (Magnoler 2012, Meek 2016) and the relatively understudied nature of the topic in general. The polychrome garnet-inlaid metalwork of Kent was chosen for study due to its wide chronological spread and its relative frequent occurrence in cemeteries for the Early Anglo-Saxon period (roughly the late 5th- mid 7th centuries AD).

The project aimed to identify possible chronological variation and frequency of garnet-mimicking glass inlays (GMGIs). To accomplish this, as much information as

possible about the inlays, their parent objects and the context of their discovery would be needed. Material was selected from three relatively complete and well-recorded cemetery assemblages: Bifrons (three miles south-east of Canterbury in the parish of Patrixbourne), Lyminge II (just north of the modern village of Lyminge, 5 miles north-west of Folkestone) and The Meads Cemetery (just north-west of modern Sittingbourne). Details of every relevant find were recorded with information about associated grave goods, material composition etc. The inlays were then closely examined to establish their identity. To ensure an accurate identification a comparative examination employing both portable X-ray fluorescence (pXRF) composition data and digital microscopy was used to identify the material. This also provided a good opportunity to assess the relative effectiveness of the two methods in distinguishing between garnet and glass.

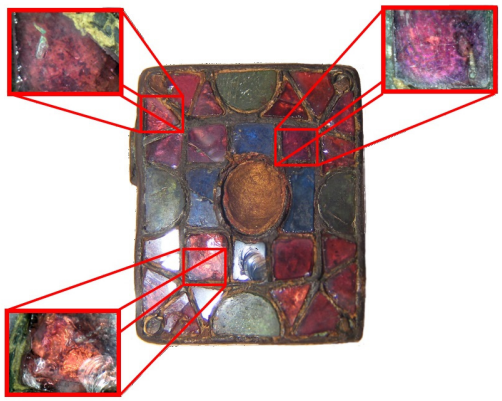

Figure 2: Late 5th – early 6th century Frankish buckleplate from Lyminge II grave 36. Design dominated by red glass of various shades, the majority of which present with large turquoise inclusions and weathering. The top two magnifications show good examples of this. The bottom however shows an incredibly clear and lustrous setting confirmed as a garnet with pXRF © Maidstone Museum and Bentiff Art Gallery

In total 267 extant inlays from 46 objects were examined, of which the majority were available for digital microscopy and 127 for assessment with an Olympus Delta pXRF device. Only eight pXRF readings contradicted the suggestions made with digital microscope observations. Four of these results were established as being misidentified during the digital microscope phase of work. The other four contradictions could not be resolved, however in 35 cases the pXRF results were inconclusive so it may be better to class these four cases with these readings. The inconclusive group can be roughly split into two. The first returned no viable or limited data due to improper placement of the pXRF beam which in turn was due to difficulty manually positioning and supporting the delicate equipment and the objects under examination. This problem could easily be remedied in future work with the application of a column stand to allow subtle adjustments to the instrument height.

The second group to provide inconclusive data were those for which background noise from the object obscured the composition of the inlay – usually because it was too thin or below the 3 mm minimum diameter requirement of the focused pXRF beam. Despite substantial background noise a strong iron/manganese component was detected which, after discounting other contamination, allowed a garnet identification to on occasion be suggested. Inconclusive data was a particularly prevalent problem amongst the glass inlays. Even when glass could be suggested through microscope observation the data was often highly suspect compared to that of the garnets and known early-medieval red glasses (see Fig. 1).

In spite of initial challenges with the methodology 113 garnets, 96 glass, two white paste and one red carnelian inlays were identified while 55 remained unidentified. Of the 96 glass inlays an astonishing 50 were of some kind of GMGI. This is far more than previous work would suggest (Bimson 1978, 430; Bimson and Freestone 2000, 131; and Coatsworth and Pinder 2002, 150) (even if one takes into account that about half of these come from just two Frankish buckleplates from Lyminge II (See Fig. 2)).

The apparent high presence of red glass leads to a number of questions. First, why is it being used? The suggestion for other assemblages, such as the Staffordshire hoard is that GMGIs are repairs for missing or broken garnets (Magnoler 2012). While this may be the case for some of the pieces examined during this project; there are a number where this seems unlikely. The buckleplate shown in Figure 2 for example, is dominated by red glass and has only a small number of garnets. In other cases it appears that the glass was used to create a composite inlay with a reused garnet during the production of a new object. This can be seen on a pair of mid-6th century square headed brooches from Lyminge II grave 44, where an inlaid omega ladder pattern of garnets along the bows (more typical of earlier Frankish design traditions) employed composite glass and garnet in places. Another possibility is that glass and garnet inlays are being mixed together by unscrupulous or indifferent craftsman/suppliers. If this last point is correct it may go some way to answering the second important question: where did this red glass come from? If the garnet and glass are arriving at Anglo-Saxon workshops mixed they may have all originated in the same central cutting/polishing workshop in continental Europe as proposed by Birgid Arrhenius (1985). Alternatively

GMGIs in this material could relate to the proposed insular production recently suggested for GMGIs in the Staffordshire Hoard (Meek 2016). Without more accurate compositional analysis of this corpus it is not sensible to propose which is more likely.

This project perhaps created more questions than it answered, but it can now be stated, with a reasonable degree of certainty that the Kentish corpus, like that of Sutton Hoo and the Staffordshire Hoard contain a number garnet-mimicking glass inlays. It also seems likely that both the garnet and glass were being reused to extend the supplies of both materials. Future work will hopefully begin to answer the questions raised and begin to fit these discoveries into the wider picture of garnet jewellery and material reuse of Early Medieval Europe.

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AHG Grant report: High-Boron Glass Bracelets from a Middle Byzantine settlement in Southern Turkey

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A group of glass bracelets from 10th-12th century AD contexts at a small fortified settlement on the southernmost Byzantine-Islamic frontier (*al-thughūr*) have revealed some surprising chemical characteristics. The bracelets were analysed together with fragments of vessel glass excavated near Kinet Höyük at the Tupraş Field site, which has been identified as the settlement of Ḥiṣn al-Tīnāt described by Early Islamic geographers. The glass from the site was typologically and chemically assessed in 2010-2012 as part of a doctoral dissertation project, and the results of this study showed that many of the glass bracelets were made from an unusual type of glass containing high levels of the trace element boron. Intriguingly, none of the vessels were made of this high-boron glass variety. In order to test these results, additional samples of vessel and bracelet glass were collected in 2013 and analyzed in 2015 with the help of a generous grant from the AHG.

Figure 1: Examples of the 10th-12th c. glass bracelets excavated at Ḥiṣn al-Tīnāt, Turkey © Carolyn Swan

A major aim of the chemical analysis of ancient glass is to reconstruct ancient technologies, production groups, and circulation networks for different fabric types. Laser Ablation - Inductively Coupled Plasma - Mass Spectrometry (LA-ICP-MS) has become a popular method of analysis precisely because it allows the quantification of trace elements necessary for the better discrimination of different glass types. The use of this technique has led to the increased identification of glass with a high boron content. Although Robert Brill first noted the elevated boron levels in some ancient glasses in the late 1960s, his observation went largely unnoticed until the last five years. LA-ICP-MS analyses of glass artefacts from the city of Pergamon have been shown to contain high levels of boron, and might indicate an industry origin in western Anatolia (Schibille 2011; Rehren et al. 2015; Tite et al. 2016); these studies are thus defining a new technological group as well as demonstrating its significance.

The glass bracelets from Ḥiṣn al-Tīnāt offer new evidence for the existence and circulation of high-boron glass types. What makes the Ḥiṣn al-Tīnāt assemblage special is the light it can perhaps also shed on production and distribution patterns of glass within the Byzantine world. Glass bracelets are a form of material culture that is widespread, both spatially and chronologically. Bracelets enjoyed great popularity during the Middle Byzantine era, and the finds at Ḥiṣn al-Tīnāt show that even the inhabitants of a small fortified settlement on the southernmost frontier of the empire were keeping up with the latest fashion trends (Figure 1). The typological similarities of the Ḥiṣn al-Tīnāt bracelets with examples from the Balkans and Anatolia rather than with the Islamic world, combined with the unique high-boron glass fabric, might be suggestive of a product that is truly "Byzantine." This is an exciting possibility, considering the traditional dominance of places like Syria-Palestine and Egypt in glassmaking history.

In summary, two subtypes of high-boron glass have been identified for the glass bracelets of Ḥiṣn al-Tīnāt: one group has high boron, lithium, and alumina while the other group has very high boron, lithium, and strontium (Table 1). A full interpretive report of the analytical results of the glass bracelets and a discussion of the production context is being prepared for publication. I am very grateful to the AHG for its support, making this research possible.

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	SiO_2	Na_2O	K_2O	MgO	Al_2O_3	CaO	FeO	TiO_2	P_2O_5	MnO	B	Li	Sr
Vessels: mineral soda types	71.3	14.05	0.56	0.70	2.96	9.28	0.50	0.05	0.12	0.05	64	4	321
Vessels: plant ash types	67.1	13.25	2.33	3.31	1.84	9.73	0.61	0.05	0.37	0.94	88	12	537
Bracelets: without high boron	68.1	12.35	2.40	2.46	2.05	9.28	0.73	0.06	0.41	1.62	80	7	520
Bracelets: high boron, lithium, alumina	56.4	19.53	4.20	3.59	**9.79**	4.31	1.69	0.06	0.25	0.08	**1661**	**109**	188
Bracelets: higher boron, lithium, and strontium	64.9	14.62	1.60	2.66	2.67	11.09	2.39	0.07	0.11	0.07	**2509**	**466**	**1995**

Table 1: Average group composition for the high-boron glass bracelets from Ḥiṣn al-Tīnāt, Turkey, in comparison with the average composition of 8^{th}-12^{th} century CE vessel glass from the same site (reported as wt% for oxides and ppm for elements)

The Origins of Fibre Optics

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Fibre optic communication was a British invention. Although fibre optics had been used for many years for transmitting light and images for various applications, mostly medical, it was the research lab of Standard Telephones and Cables in Harlow, Essex, which first suggested using glass optical fibres for communication. Kao and Hockham of STC published their paper in *Proc. Inst. Elec. Eng*. in 1966. Forty three years later, Kao was to receive half a Nobel prize for this work. Kao and Hockham collaborated with the Post Office Research Station in Dollis Hill, North London. It was always realised that in order to be sufficiently transparent, the glass would have to be exceptionally free from transition metal impurities, so the glass would have to be made from very pure ingredients. One of the chemists (possibly the only chemist) at Dollis Hill was Dr Mark Faktor, a former student of Don Bradley at Birkbeck College, London. Both Mark and Don were old friends of mine and they knew that my research department at British Titan Products in Stockton-on-Tees was skilled in making super-pure titanium dioxide for research. We were able to do so because we had a solid-source mass-spectrometer which could measure the concentrations of transition metals in titania at less than 1 ppm. So Mark asked me if BTP would make samples of very pure oxides for their use in glass making. We signed a contract with the Post Office to provide kilogram quantities of certain pure oxides. The actual contractor was Titanium Intermediates Ltd (TIL), a subsidiary of BTP, which made and sold metal alkoxides. I do not know which oxides were chosen in addition to silica, because I left BTP in 1968 before the laboratory work was started. The first deliveries of kilogram quantities of pure oxides were made to the new Martlesham Heath laboratories of BT, probably in 1969.

A consortium for developing low-loss optical fibres was formed in 1969; its members were the British Post

Office, STC, the Scottish company Barr and Stroud (which made optical equipment), and British Titan Products (which made titanium dioxide pigments). It is unclear how often the consortium met or when it was disbanded.

Then, in 1970, Corning announced their "soot" process for making silica fibre preforms (US patents 3,711,262; 3,737,292), and the rest is history. The history is recounted in Chapter 11 of Jeff Hecht's excellent book *City of Light* (1999); but he was mistaken in assuming that British Titan Products used neutron activation for analysing a piece of Corning fibre, they were not equipped for this.

Reference

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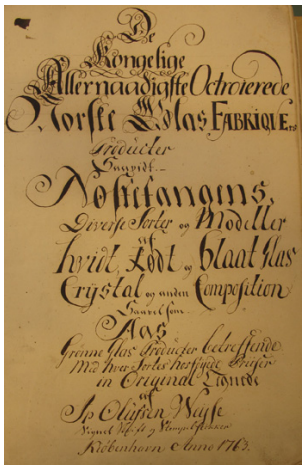
NEW BOOKS



Hand-drawn model book from Nøstetangen Glassworks 1763 – an industrial-historic document in facsimile

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Introduction

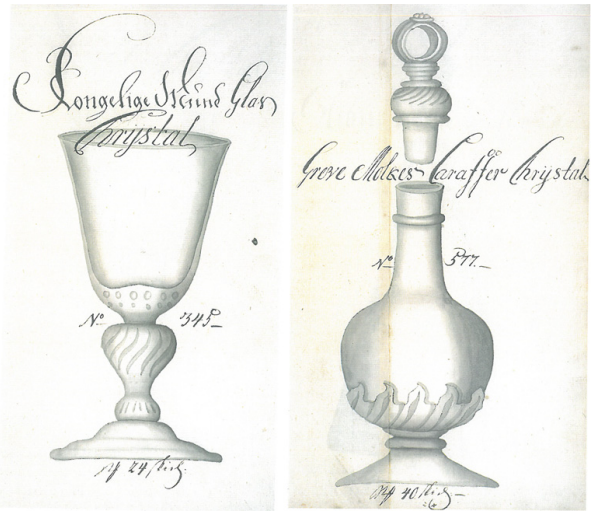
In Denmark, production of glass in the Renaissance ceased in the middle of the 17th century because of the wars with Sweden and the resulting poor economic situation. From then on, people managed with imported goods.

Nøstetangen Glassworks was established on the initiative of the king in 1739, together with several other industries, in an effort to make the twin monarchy of Norway and Denmark more self-sufficient.

To begin with, glassmakers were brought in from the German region, and they introduced the continental European style to Norway. Some years later, they were joined by glassmakers from England, who brought their own English style with them. These two very different traditions melted together into a style that was uniquely Danish and Norwegian. Production was large and varied, as can be seen from a hand-drawn model book, which today would be called a catalogue. Even on a European scale, it is rare to find such good model books from the 18th century.

The model book from 1763

In the mid-1760s production had become so extensive that it was necessary to have an illustrated model book, often with coloured drawings, giving the names and prices. The model book is drawn by hand, and six copies are known, dated 1763, 1764 and 1774. They are all slightly different, but all drawn by Ip Olufsen Weyse, letter and stamp engraver, in Copenhagen. The format is approximately A4, and consists of more than 360 pages, all in stiff half-leather binding. Five copies are in Norway (in Bergen, Hadeland and Oslo), and there is one in the Royal Library in Copenhagen which was never completed, however.



Pages from the catalogues Kgl. Mund Glas Chrystal and Grev Molkes Caraffer Chrystal

The model book includes about 600 different glass items, of which the majority are illustrated in fine coloured drawings. Several of the glasses have been named after the person who originally ordered them. Examples are "Hoffets Dessert" (Court Dessert), "Hoffets Slebne Wand Caraffer" (Court cut water carafes), "Count Molke's no 1" and "Gersdorf's formed Caraffer," just to mention a few.

The reproductions
A facsimile of the model book has now been produced in full size (20x30 cm), and consists of 432 pages. The publication includes a text with comments and analysis in Danish and English by Jan Kock MA, Associate Professor emeritus, Aarhus University. The publication was supported by a number of funds.

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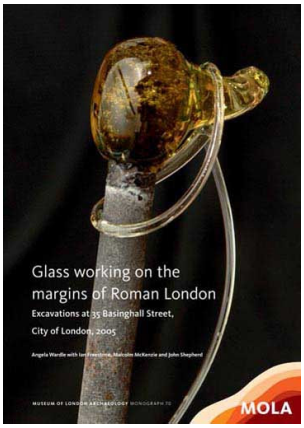

Glass working on the margins of Roman London: excavations at 35 Basinghall Street, City of London, 2005
Angela Wardle
with Ian Freestone, Malcolm McKenzie and John Shepherd
MOLA Monograph Series 70
MOLA, 2015

ISBN 978-1-907586-33-0

£20

Excavations in the upper Walbrook valley, in a marginal area in the north-west of the Roman city, recovered over 70 kg of broken vessel glass and production waste from a nearby workshop, giving new insights into the workings of the glass industry and its craftsmen. The area was developed in the early 2nd century AD, with evidence of domestic buildings and property boundaries. Two later buildings constructed in the mid-2nd century AD may have been associated with the glass-working industry. The disposal of a huge amount of glass-working waste in the later 2nd century signals the demise of the workshop, with the area reverting to open land by the 3rd century AD. The comprehensive nature of the glass-working waste has made it possible to study the various processes from the preparation of the raw materials in the form of cullet, broken vessel and window glass, to the blowing and finishing of the vessel. All the glass originated ultimately in the eastern Mediterranean, some of it arriving as raw glass chunks, which was supplemented by cullet collected locally for recycling. A review of the current evidence for glass working in London also examines the implications for the organisation of the industry.

http://www.mola.org.uk/publications/glass-working-margins-roman-london-excavations-35-basinghall-street-city-london-2005

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