AIHV 18
Thessaloniki, Greece, 2009

The 18th Congress of AIHV on the
HISTORY OF GLASS

Programme and Abstracts
18th Congress of the International Association for the History of Glass
21-15 September 2009

Organizers:
AIHV, Hellenic Committee
Archaeological Museum of Thessaloniki, Hellenic Ministry of Culture

Programme and Abstracts Book
Editorial and layout: Anastassios Antonaras, Despina Ignatiadou
Revision of texts: Nadia Coutsinas, Despoina Tsiafaki
Design and production: Ziti Publications - www.ziti.gr
The Organizing Committee of the 18th Congress of the International Association for the History of Glass welcomes you to Thessaloniki.

This congress is the outcome of a great effort to organize our triennial meeting for the first time in Greece, and the Balkans.

Our 18th meeting has attracted an impressive number of international speakers from 30 countries and all 5 continents. Ahead we have a full program of 150 communications in two parallel sessions of lectures and two poster sessions. We hope that this meeting will offer us more than an overview of new finds; that it will be the forum of the exchange of views and the sharing of knowledge over the advances of our research.

The 18th Congress coincides with the exhibition *Glass Cosmos*, currently on display at the Archaeological Museum of Thessaloniki. Glass products were present in the everyday and the religious life of the northern Greeks and were consequently buried with their owners. Eleven northern Greek museums, ephorates of antiquities, and university excavations offered finds to be exhibited on loan, on the occasion of the congress.

Finally, the organizing committee would like to express its thanks to the institutions and bodies of the city that supported the effort.

The Organizing Committee
# Committees

## Honorary Committee

<table>
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<tr>
<th>Name</th>
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<tr>
<td>Clasina Isings</td>
<td>Independent scholar</td>
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<tr>
<td>Polyxeni Adam Veleni</td>
<td>Archaeological Museum of Thessaloniki</td>
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<tr>
<td>Stella Drougou</td>
<td>Aristotle University of Thessaloniki</td>
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<tr>
<td>Ioannis Stratis</td>
<td>Aristotle University of Thessaloniki</td>
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## Congress Organization Committee

<table>
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<tr>
<th>Name</th>
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<tr>
<td>Despina Ignatiadou</td>
<td>Archaeological Museum of Thessaloniki</td>
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<tr>
<td>Anastassios Antonaras</td>
<td>Museum of Byzantine Culture</td>
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<tr>
<td>Nadia Coutsinas</td>
<td>Independent scholar</td>
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<tr>
<td>Christos Gatzolis</td>
<td>Archaeological Museum of Thessaloniki</td>
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<tr>
<td>Despoina Tsiafaki</td>
<td>Cultural and Educational Technology Institute, Xanthi</td>
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## Academic Committee

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<tr>
<td>Anastassios Antonaras</td>
<td>Museum of Byzantine Culture</td>
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<tr>
<td>Stefano Carboni</td>
<td>Art Gallery of Western Australia</td>
</tr>
<tr>
<td>Emel Erten</td>
<td>Gazi University, Ankara</td>
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<tr>
<td>Danielle Foy</td>
<td>Maison Méditerranéenne des Sciences de l’Homme, CNRS</td>
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<tr>
<td>Ian Freestone</td>
<td>Cardiff University</td>
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<tr>
<td>Yael Gorin-Rosen</td>
<td>Israel Antiquites Authority</td>
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<tr>
<td>Julian Henderson</td>
<td>Nottingham University</td>
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<tr>
<td>Despina Ignatiadou</td>
<td>Archaeological Museum of Thessaloniki</td>
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<tr>
<td>Janet Duncan Jones</td>
<td>Bucknell University, Lewisburg</td>
</tr>
<tr>
<td>Ingeborg Krueger</td>
<td>Independent scholar</td>
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</table>
Irena Lazar  
*University of Primorska, Piran*  

Yiannis Maniatis  
*Demokritos*  
*National Center for Scientific Research*  

Georgianna Moraitou  
*2nd Ephorate of Prehistoric and Classical Antiquities*  

Marie-Dominique Nenna  
*Maison de L’Orient et de la Mediterranee, CNRS*  

Lisa Pilosi  
*The Metropolitan Museum of Art*  

Jennifer Price  
*Independent scholar*  

Thilo Rehren  
*Institute of Archeological Materials and Technology UCL*  

Birgit Schlick-Nolte  
*Independent curatorial associate*  

Yoko Shindo  
*Research Institute for Islamic Archaeology & Culture, Tokyo*  

Jane Shadel Spillman  
*The Corning Museum of Glass*  

Eva Marianne Stern  
*Independent scholar*  

Michael Tite  
*Independent scholar*  

Pavlos Triantafylidis  
*22nd Ephorate of Prehistoric and Classical Antiquities*  

David B. Whitehouse  
*The Corning Museum of Glass*  

Nikos Zaharias  
*University of Peloponnese, Kalamata*  

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**Sponsors**

![Logo 1](image1.png)  
*Museum of Byzantine Culture*  

![Logo 2](image2.png)  
*Prefecture of Thessaloniki, Prefect P. Psomiadis*  

![Logo 3](image3.png)  
*Municipality of Thessaloniki, Mayor V. Papageorgopoulos*  

![Logo 4](image4.png)  
*Society of Friends of the Archaeological Museum of Thessaloniki*
Conference Venues

Museum of Byzantine Culture
2 Stratou Avenue
P.O. Box 50047
GR – 54013 Thessaloniki
T: 2310 868570
www.mbp.gr
**Oral presentations:** Museum of Byzantine Culture, Auditorium 1 and Auditorium 2

**Poster Sessions:** Museum of Byzantine Culture, Lobby

**Conference Secretariat:**
1. Sunday September 20th, 16:00 to 20:00, Archaeological Museum of Thessaloniki, Lower Atrium
2. Monday 21st to Friday 25th, 08:30 to 19:00, Museum of Byzantine Culture, Lobby of Auditorium 2

**Opening reception:** Archaeological Museum of Thessaloniki, Lower Atrium

**Welcome City Tour:** Start in front of the Archaeological Museum of Thessaloniki

**Thematic City Walks:** Start in front of the Museum of Byzantine Culture, main entrance

**Farewell Party:** Thessaloniki Prefecture, the gardens

**Coffee breaks:** Museum of Byzantine Culture, Lobby of Auditorium 2
BUS TRANSPORTATION to CONFERENCE VENUES

For your transportation from the hotels to the Conference Venue:

A: From ABC Hotel: Line 11, bus stop Kamara (Egnatia str.) to bus stop Stratigio, or walk 5-10 minutes

B: From City Hotel, Luxembourg & Tourist Hotel: Line 39 & 12, from bus stop Plateia Aristotelous (Mitropoleos str.) to bus stop Stratigio, or walk 15-20 minutes

C: From El Greco Hotel, Park Hotel & Pella Hotel: Lines 10, 11 & 31, from bus stop Kolomvou (Egnatia str.) to bus stop Stratigio

D: From Mediterranean Palace Hotel: Line 12, from bus stop Agios Minas (I. Dragoumi str.) or Line 12 & 39 from bus stop Venizelou (Mitropoleos str.) to bus stop Stratigio
## Oral Presentations

**Monday, 21/09/2009**

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<th>SESSION B Byzantine</th>
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<tr>
<td>09:00</td>
<td>Opening</td>
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<tr>
<td>10:00</td>
<td>Coffee break</td>
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<tr>
<td>10:30</td>
<td>Stern M.</td>
<td>Antonaras A.</td>
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<tr>
<td></td>
<td>Glass production in Greek texts. From the Mycenaean to the Byzantine period</td>
<td>Gold-glass tiles from St. Demetrios’ wall decoration</td>
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<tr>
<td>11:00</td>
<td>Nightingale G.</td>
<td>Ozgumus U.</td>
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<tr>
<td></td>
<td>Glass and faience and Mycenaean Society</td>
<td>Recent glass finds in Istanbul</td>
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<tr>
<td>11:30</td>
<td>Smirniou M., Rehren T., Adrymi-Sismani V., Asderaki E.</td>
<td>James L.</td>
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<tr>
<td></td>
<td>Mycenaean glass. A matter of local production or of a trade network?</td>
<td>Glass and the manufacture of Byzantine mosaics</td>
</tr>
<tr>
<td>12:00</td>
<td>Arhontidou A., Vavliakis G.</td>
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<td></td>
<td>Glass finds from the excavations at the region Archontiki of Psara</td>
<td>Three gold-glass pieces from Byzantium</td>
</tr>
<tr>
<td>12:30</td>
<td>Lunch break</td>
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<tr>
<td>14:00</td>
<td>Reade W., Freestone I.C., Bourke S.</td>
<td>Verità M., Zecchin S.</td>
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<tr>
<td></td>
<td>High and low-CaO groups of glass in the late bronze age Levant and Mesopotamia</td>
<td>Scientific investigation of Byzantine glass tesserae from the mosaics on the south chapel of Torcello’s Basilica, Venice</td>
</tr>
<tr>
<td>14:30</td>
<td>Biron I., Henderson J., Matoian V., Evans J.</td>
<td>Drauschke J., Greiff S., Stamenković S.</td>
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<tr>
<td></td>
<td>Scientific analysis of glass beads from Ras Shamra - Ugarit (Syria)</td>
<td>Early Byzantine glass from Caricin Grad / Iustiniana Priema (Serbia) — First results of chemical and archaeological investigations</td>
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<tr>
<td>15:00</td>
<td>Kirk S.F., Shortland A. J., Eremin K.</td>
<td>Keller D.</td>
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<tr>
<td></td>
<td>The distribution of glass and other vitreous materials at the Hurrian city of Nuzi. The significance of glass in the late Bronze Age Near East</td>
<td>Glass table ware from an Early Byzantine monastery in southern Jordan</td>
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<td>15:30</td>
<td>Erten E.</td>
<td>Aïbabin A., Khaïredinova E.</td>
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<td></td>
<td>Early ancient glass from Saraga Hoyuk, Gaziantep, Turkey</td>
<td>Le verre provenant des fouilles du Bosphore protobyzantin</td>
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<tr>
<td>16:00</td>
<td>Coffee break</td>
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<td></td>
<td>X-ray analysis of head of Pharaoh, a glass sculpture from 18th Dynasty Egypt</td>
<td>Glass finds from Gnezdovo as a result of Russian-Byzantine trade in Xth century</td>
</tr>
<tr>
<td>17:00</td>
<td>Nicholson P.T., Jackson C.M., Freestone I.</td>
<td>Mercangoz Z., Cakmakci Z.</td>
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<td></td>
<td>The Harrow Chalice. Early glass or early fake?</td>
<td>Glass objects from the excavation in Ku adasi Kadikalesi / Anaia Excavation</td>
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<td>17:30</td>
<td>Liardet F.</td>
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<td>Taking the heat. An archaeological and ethnographic study of the making of core-formed alabastra of Mediterranean Group I</td>
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<tr>
<td>Time</td>
<td>SESSION A</td>
<td>SESSION B</td>
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<td>09:00</td>
<td><strong>Nenna M.-D.</strong></td>
<td><strong>Newby M.</strong></td>
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<td></td>
<td>Les contenant à huile parfumée façonnés sur noyau dans les dépots votifs des sanctuaires grecs. L'exemple de l'Artémision de Thasos</td>
<td>Terracota, stone, metal or wood. Evidence for the materials used in the production of early Byzantine glass moulds</td>
</tr>
<tr>
<td>09:30</td>
<td><strong>Arletti R., Ferrari D., Acquaro E., Vezzalini G.</strong></td>
<td><strong>Winter T.</strong></td>
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<td></td>
<td>The Pre-Roman glass from Mozia (Italy). First archaeological data</td>
<td>Glass vessels from excavations at the church of the Holy Sepulchre in Jerusalem</td>
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<tr>
<td>10:00</td>
<td><strong>Jones J.D., Reade W.</strong></td>
<td><strong>Mossakowska-Gaubert M.</strong></td>
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<td></td>
<td>The composition of colourless and light blue glasses from Iron Age to Hellenistic Gordion, Central Turkey</td>
<td>Verres de l’époque byzantine - début de l’époque arabe en Égypte. Objets provenant de sites monastiques</td>
</tr>
<tr>
<td>10:30</td>
<td><strong>Ignatiadou D.</strong></td>
<td><strong>Whitehouse D.</strong></td>
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<td>A haemation vessel from Pydna</td>
<td>Towards a classification of early Islamic relief-cut glass</td>
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<tr>
<td>11:00</td>
<td>Coffee Break</td>
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<tr>
<td>11:30</td>
<td><strong>Patera I., Nikolaidou – Patera M.</strong></td>
<td><strong>Kato N., Shindo Y., Izumi, N.</strong></td>
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<td>Hellenistic tomb at the ancient city of Philippi</td>
<td>Comparative study of Islamic glass weights and vessel stamps with the daily used vessels from Egypt</td>
</tr>
<tr>
<td>12:00</td>
<td><strong>Oikonomou A., Beltsios K., Zacharias N.</strong></td>
<td><strong>Henderson J., Evans J., Barkoudah Y., Bertier S.</strong></td>
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<tr>
<td></td>
<td>Analytical and technological study of an ancient glass collection from Thebes, Greece. An overall assessment</td>
<td>The roots of provenance. Radiogenic isotopes and glass production in the Islamic Middle East</td>
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<tr>
<td>12:30</td>
<td><strong>Loukopoulou P., Karatasios I., Triantafyllidis P.</strong></td>
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<td>Corrosion morphology of Hellenistic glass beads in relation to their manufacture technique</td>
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<tr>
<td>13:00</td>
<td>Lunch break</td>
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<tr>
<td>14:30</td>
<td>Poster Session</td>
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<tr>
<td>16:00</td>
<td><strong>Connolly P., Rehren T.</strong></td>
<td><strong>Moraitou G., Loukopoulou P., Tiligada D.</strong></td>
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<td></td>
<td>The Hellenistic glass-making industry</td>
<td>A triple ark for the Kenchreai opus sectile glass panels. Preventive conservation and access at Isthmia Archaeological Museum</td>
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<tr>
<td>16:30</td>
<td><strong>Lankton J.</strong></td>
<td><strong>Pilos L., Stamm K., Wypyski M. T</strong></td>
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<tr>
<td></td>
<td>Gold-glass beads in Hellenistic Rhodes and contemporary Java: Technological challenges and choices</td>
<td>Three-layered Islamic cameo glass. A new example in the Metropolitan Museum of Art</td>
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<tr>
<td>17:00</td>
<td>Coffee break</td>
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<td>17:30</td>
<td><strong>Auth S.</strong></td>
<td><strong>Valentini F., Diamanti A., Salerno C.S., Palleschi G.</strong></td>
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<td></td>
<td>The Denderah cache of glass inlays. A possible votive pectoral</td>
<td>Analytical strategies for the conservation of degraded glass based on the new materials. A comparative study with the conventional products</td>
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<td>18:00</td>
<td><strong>Gradel C.</strong></td>
<td><strong>De Vis K., Cagno S., Janssens K., Caen J.</strong></td>
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<td></td>
<td>Hellenistic and Roman glass in Meroitic kingdom</td>
<td>The browning of excavated stained glass</td>
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**Wednesday, 23/09/2009**

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<th>SESSION B Post-Roman West, Venetian / Façon de Venise</th>
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<td>09:00</td>
<td>Robin L. L’artisanat du verre à Lugdunum – Lyon au Haut Empire</td>
<td>Frey A., Greiff S. Early Medieval glass beads with metal tubes</td>
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<td>09:30</td>
<td>Louis A. La place du mobilier en verre dans les sépultures gallo-romaines de Champagne-Ardenne</td>
<td>Wouters H.J.M. Local Merovingian glass workshops in Huy, Belgium? An analytical approach</td>
</tr>
<tr>
<td>10:00</td>
<td>Saguì L., Santopadre P., Verità M. Glass technology, colours, forms and shaping in the 2nd century opus sectile glass materials from the villa of Lucius Verus in Rome</td>
<td>Broadley R., Bayley J. The Church Lane assemblage. Early medieval glass-working in the shadow of Canterbury Cathedral</td>
</tr>
<tr>
<td>11:00</td>
<td>Coffee break</td>
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<td>11:30</td>
<td>Szilamér Pániczel P. Roman glassworking in Dacia</td>
<td>Ihr A. Potash glass in Medieval Sweden</td>
</tr>
<tr>
<td>12:00</td>
<td>Cosyns P., Cagno S., Nys K., Janssens K. Regional production and trade of black glass vessels in the North-western provinces of the Roman empire, during the late second and early third century AD</td>
<td>Shortland A.J., Scott R., Power M. The interpretation of compositional groupings in 17th century window glass from Christ Church Cathedral, Oxford</td>
</tr>
<tr>
<td>13:00</td>
<td>Lunch break</td>
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<tr>
<td>14:30</td>
<td>Demierre Prikhodkine B. Le verre du Quartier de la Maison aux mosaïques à Érétrie (Eubée, Grèce)</td>
<td>Kunicki-Goldfinger J.J. Inter-relationship of technology and style in late Medieval to early Modern vessel glass of central Europe</td>
</tr>
<tr>
<td>15:00</td>
<td>McCall B. Use or re-use. An examination of Roman glass finds from the Paphos theatre site, Nea Paphos, Cyprus</td>
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<tr>
<td>15:30</td>
<td>Coffee break</td>
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<tr>
<td>16:00</td>
<td>City walks</td>
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<tr>
<td>Time</td>
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<td>Session B</td>
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<td>09:00</td>
<td>Fadić I., Štefanac B.</td>
<td>Mănucu-Adameșteanu G., Poll I.</td>
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<tr>
<td></td>
<td>Workshops' stamps on square-sectioned jugs from Zadar region</td>
<td>Bracelets en verre découverts dans les necropoles de Isaccea-Vicina, Département de Tulcea (Xe-XIIe siècle)</td>
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<tr>
<td>09:30</td>
<td>Lazar I.</td>
<td>Radičević D.</td>
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<td>The origin of Roman glass from Bakar necropolis (Adriatic, Croatia)</td>
<td>Medieval glass bracelets from Banat territory</td>
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<tr>
<td>10:00</td>
<td>Buljević Z.</td>
<td>Gorin-Rosen Y.</td>
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<td>Glass from Roman necropolis in Lora and Poljud Split, Croatia</td>
<td>An outstanding fourteenth-century glass assemblage from a Mamluk quarter at Zefat in the Northern Galilee, Israel</td>
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<tr>
<td>10:30</td>
<td>Mandruzzato L., Vidulli Torlo M.</td>
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<td>Eighteenth century oriental glass private collections in the Civici Musei di Storia ed Arte di Trieste</td>
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<td>11:00</td>
<td>Coffee break</td>
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<tr>
<td>11:30</td>
<td>Chiriac C., Sever-Petru B.</td>
<td>Paynter S.</td>
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<td></td>
<td>Some aspects concerning the Roman glass in Moesia Inferior. The case of Ibida (Slava Rusă-jud.Tulcea)</td>
<td>The importance of pots. The role of refractories in the development of the English glass industry during the 16th / 17th centuries</td>
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<tr>
<td>12:00</td>
<td>Price J.</td>
<td>Medici T.</td>
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<td>Glass from the late Roman courtyard house at South Shields, a northern frontier fort in Britain</td>
<td>Revisiting the ‘Moura glass treasure’. New data about 17th century glass in Portugal</td>
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<td>Analysis of a late Roman assemblage from South Shields</td>
<td>The isotopic analysis of North-Western European forest Glass. Working towards an independent means of provenancing</td>
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<tr>
<td>13:00</td>
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<tr>
<td>14:30</td>
<td>Poster Session</td>
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<tr>
<td>16:00</td>
<td>O’Hea M.</td>
<td>Wouters H., De Clercq W., Meulebroeck W., Baert K., Thienpoint H., Terryn H., Nys K.</td>
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<tr>
<td>16:30</td>
<td>Brems D., Ganio M., Walton M., Degryse P.</td>
<td>Caen J.</td>
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<tr>
<td></td>
<td>Mediterranean sand deposits as a raw material for glass production in antiquity</td>
<td>Stained glass materials and techniques in the Low Countries during the Renaissance and Baroque era</td>
</tr>
<tr>
<td>17:00</td>
<td>Coffee break</td>
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<tr>
<td>17:30</td>
<td>Fujii Y.</td>
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<td>A study on a late Roman blue glass bowl with relieves of sea creatures motif</td>
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<tr>
<td>Time</td>
<td>SESSION A Roman to Late Antiquity</td>
<td>SESSION B 18th and 19th centuries, Asia, Africa</td>
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<tr>
<td>09:00</td>
<td><strong>Greiff S.</strong>&lt;br&gt;Relationship between enamelling on glass and other opaque glass technologies</td>
<td><strong>Dungworth D.</strong>&lt;br&gt;Historical, archaeological and scientific investigation of the Thames Plate Glass Company</td>
</tr>
<tr>
<td>09:30</td>
<td><strong>Coutsinas N.</strong>&lt;br&gt;Le matériel en verre de la cité d’Itanos (Crète orientale)</td>
<td><strong>Lauriks L., De Bouw M., Wouters I.</strong>&lt;br&gt;Glass in roofs. Study of the 19th century literature on building technology</td>
</tr>
<tr>
<td>10:00</td>
<td><strong>Zacharias N., Papageorgiou M., Beltsios K.</strong>&lt;br&gt;Technological and typological investigation of late Roman glass mosaic tesserae from ancient Messene, Greece</td>
<td><strong>Zelasko S.</strong>&lt;br&gt;Designers at Count Schaffgotsch’s Josephine Glassworks in Szklarska Poręba (Schreiberhau), Silesia 1842-1950</td>
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<tr>
<td>11:00</td>
<td><strong>Coffee break</strong></td>
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SYNCHROTRON RADIATION X-RAY ANALYSIS OF ANCIENT COLORED GLASS FROM EGYPT

ABE, Y.1, KIKUGAWA, T.2, TANTRAKARN K.1, NAKAI I.1

1. Department of Applied Chemistry, Tokyo University of Science, Tokyo, Japan
2. The Ancient Egyptian Museum, Shibuya, Tokyo, Japan

We have applied two X-ray techniques utilizing synchrotron radiation, i.e. XAFS and XRF to the study of colored glass from Egypt, the New Kingdom to Roman period. XAFS is suitable for the analysis of local structure and chemical state of the component element of sample responsible for the color. Especially, XAFS is useful for analysis of glass or material with unknown structure. SR-XRF analyses are suitable for nondestructive characterization of trace elements. We have used high energy XRF analysis utilizing 42 keV X-rays, which is suitable for characterization of heavy trace elements in the samples using K-line X-rays.

SR experiments were carried out at Institute of High Energy Accelerator Research Organization utilizing synchrotron radiation. X-ray analyses utilizing high energy X-ray up to 42keV were carried out at BL-NW10A, Photon Factory Advanced Ring (PF-AR), which is a 6.5-GeV storage ring and those utilizing moderate energy were carried out at bending magnet beam line of BL-4A, 9A and 12C, Photon Factory from the 2.5GeV ring. Conventional XRF and X-ray diffraction techniques were also used to characterize the specimens. Samples used were museum collections of cored glasses, mosaic glass inlays, faïences, and pigments of painted pottery from Egypt of the New Kingdom to Roman period.

Co K-edge XANES spectra of blue cobalt glass showed that there is not much difference in the chemical state of Co in between the glasses from the New Kingdom and those of Roman period. Co K-edge spectrum of the blue pigment of painted pottery was close to that of CoAl2O4 spinel but was distinct from that of Co3O4 spinel. Pb2Sb2O7 was identified from yellow glass with core form and Ca2Sb2O7 and CaSb2O6 were responsible for the white color of opaque amulet glass based on the analytical data obtained with a combined used of XAFS and conventional XRD technique. We will also report the results of the Cu K-edge and Sb-K edge XAFS analysis on these glass and chemical classification of cored glass based on the trace heavy elements determined by XRF analyses.
Nous nous proposons dans le cadre de cette étude de présenter les objets en verre provenant des fouilles des années 2007-2008 du faubourg du Bosphore, situé au pied sud-est de la montagne du Mithridat et daté des Ve et Vi siècles. La représentation sur les formes entières comporte les récipients en verre provenant des fouilles des années 1904-1906 de la nécropole située dans la rue Gospitalnaya. Les fragments de vitres sont les trouvailles les plus nombreuses. Dans les couches de la première moitié du Ve s. on a trouvé des fragments de gobelets de différentes formes décorés de gouttes de verre bleu, les couches de la fin du Ve et du Vi siècle ont livré des fragments de verres à tige creuse sur support circulaire. Comme exemplaire unique, notons le récipient cruciforme trouvé dans la fosse de ménage du Vi s. Les découvertes de scories, de déchets de verre témoignent de la possibilité de l’existence d’une officine de verriers dans ce faubourg du Bosphore.
GOLD-GLASS TILES
FROM ST. DEMETRIOS’ WALL DECORATION

Antonaras A.C.

Museum of Byzantine Culture, Thessaloniki, Hellenic Ministry of Culture

A group of triangular and curvilinear gold-glass tiles were unearthed in the debris of the Basilica of St. Demetrios at Thessaloniki. The present communication aims to locate their original place on the now destroyed wall decoration of the basilica, to reconstruct their decorative theme and to date them according to the date of the renovations the monument underwent.

Also, the use of gold-glass tiles in the Byzantine world will be examined as a whole, in the light of several newly found or published examples. The different shapes of the tiles and the distinctive types of their decoration, as well as their different dating will be examined in order to conclude whether they all represent Justinian works or if they have really been “rediscovered” during the renovation of arts and crafts that occurred during the reign of the Macedonian dynasty (9th–11th c.).
Psara is a small island, some 10 nautical miles west of Chios, with an area of 42 square kilometers with rocky character.

In Odyssey of Homer the island is called Psyrie (Ψυρίη). By the geographer Strabo we are informed about a settlement and from Eustathios about a harbour. Demosthenes mentions the island because of its harbour and its strong winds.

The earliest indication for human presence on the island goes back to the Neolithic times. The recent excavations on the west coast of Psara at the region Archontikii brought to light an organized settlement preserving parts of houses, storage areas, and a cemetery dated in the Mycenean period. Among the many and rich finds of the cemetery are included many objects of glass and other vitreous materials, as faience. They are mainly glass beads and ornaments of different kinds and glass seals with different devices.

The quantity and the quality of these finds indicates the existence of a rich and prosperous settlement in the area of the northeast Aegean, in relation to the spread across of the Mycenaean civilization to the Mediterranean, during the 14th and 13th century B.C.
This study presents the results of an archaeometrical investigation performed on a series of opaque pre-roman glass objects (vessels and ornaments) dated from the 6th to 4th century BC coming from Sicilian sites. Most of these samples were previously archeologically studied by Basile and co-workers (2004) and de Simone et al. (2008), while some others represent unpublished materials stored at the Whitaker museum of Mozia, of which a first typological-structural characterization will be given in the frame of this study.

More than forty core-formed vessels and beads recovered in the Phoenician-Punic Mozia and Birgi’s sites were analyzed thought a micro destructive approach. The complete chemical analyses were obtained by Electron Microprobe on small fragments of glass - of less than 1 mm³; the same fragments were used for X-Ray Powder Diffraction experiments.

The aims of this work are: 1) to obtain a chemical characterization of these samples in order to understand the raw materials employed for their production; 2) to obtain information regarding the opacifying phases dispersed in the glass; 3) to make a comparison with the results recently obtained on coeval and similar finds recovered in other cultural context, in particular in Northern Italian Etruscan contexts (Arletti et al. 2008) in order to understand whether they could belong to the same Greek-Eastern production.

The chemical data of these samples confirm they are silica soda lime glass produced with natron. The opaque decoration of the samples was realized by using Sb based opacifiers. The major and minor analyses seem to suggest a common origin with the coeval material found in Northern Italian context.

Bibliography

THREE GOLD-GLASS PIECES FROM BYZANTIUM

Atik Şeniz

Istanbul Archaeological Museums

The subject of this research is the three pieces of gold glass found in Istanbul in 1963 which haven’t been published.

The role of Istanbul, the capital of Byzantine Empire (in other words Constantinople or Byzantium) in the history of medieval glassmaking is still poorly documented and much disputed. The publication of the glass finds in Istanbul will contribute to the glass history.

The three pieces of glass which were produced with gold-glass technique and were found in the excavation in the second court of Topkapı Palace will be presented for the first time.

A large quantity of the Byzantium ceramics found in the same excavation will be also taken under consideration, especially their contribution to the dating. The other finds of the excavation made with gold-glass technique will also be considered in the presentation. Information for the production place of these glasses will be reviewed as well.
THE DENDERAH CACHE OF GLASS INLAYS: A POSSIBLE VOTIVE PECTORAL

Auth Susan H.

Independent scholar, ancient glass, Monroe, New Jersey, U.S.A.

Flinder Petrie’s 1898 excavations at Denderah uncovered a cache of glass inlays deposited in earlier animal burial catacombs. Although stripped from their original metal backing, they were carefully preserved as sacred objects in a jar of the 4th c. A.D. They presumably came from the storage crypts of Hathor’s temple at Denderah. The inlays, comprising hundreds of pieces, are now divided between museums in Cairo, London, Philadelphia, Boston and Chicago.

A few of the glass inlays, such as wings, hawks’ heads and ankh and was scepter borders were made using refined fused mosaic techniques. However, the majority of the inlays were not. These consist of rosettes set in squares or octagons; lotus buds and flowers on white backgrounds; udjat eyes on squares and colored bands and triangles. The designs were made by mounting individual elements, such as the petals of rosettes, in cloisonné fashion with strips of metal. The design was set into holes cut out of the glass background while a black pitch-like substance held the elements in place. Inlay elements thinner than the surrounds were smeared on the back with black pitch to hold them in place. Harsh colors such as turquoise and orange were combined in clashing combinations. Some of the orange glass is streaky, while the white is flecked with black specks.
MIHO MUSEUM is located in Shiga prefecture in the central part of Japan. It was founded in 1997. The number of glass collection exceed 200, which include glass objects from the classical period to the middle ages from Egypt, Northern Mesopotamia, Aegean area, Iran, Eastern Mediterranean regions, Italy, China and Japan.

We have analyzed over 60 glass collections representing each region and era using portable X-ray fluorescence spectrometer at the Museum nondestructively to deepen the understanding of the collection. Some of the results are given as follows. Head of Pharaoh, possible Amenhotep III (Museum sample #16), Egypt (1400-1350 BC) is an unusual glass sculpture with cobalt blue color. The composition was similar to those of the cobalt glass produced by core technique in 18th dynasty, Egypt. Fluted Cup Terminating in a Lion’s Head (#59) and colorless Plate (#62), attributed to Iran, Achaemenid period, contained significant amount of Sb, which may be used for decolorizer. The high content of Na₂O (19.9 wt%) with relatively low level of MgO (0.8 wt%) for the latter glass suggests that the glass is natron type. Cup with green color (#73) was due to the coexistence of Cu and Pb, cup with blue color (#68) due to Cu, and Bowl (#70) and shallow Basin (#71) with blue color due to Co and Cu, Bowl (#72) with purple color due to Mn are from Eastern Mediterranean or Italy in 1st century BC to 1st century AD. Sword Pommel (#198) from China in the Han dynasty is a white opaque glass resembling to jade and was a lead barium glass. Bottle with Wide Mouth and Cord Decoration (#159) and Double Cosmetic Tube with Suspended Handle (#160) belonged to the soda lime glass, which is typical for glass from Syro-Palestinian coast produced using quartz sand from the coast and natron from Egypt in 4 to 6th century AD. Cut-glass Bowl (#176) from Iran showed characteristic composition of plant ash glass of the Sasanian period (4 - 6th century AD). In this way, selected important glass collections of the MIHO Museum will be introduced with descriptions, color photographs and information of their chemical compositions.
CHARACTERISATION OF GLASS FROM LISAKOVSK, KAZAKHSTAN

Beesley Elizabeth¹, Smirniou Melina¹, Usmanova Emma², Peters Renata¹

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2. State University Karaganda, Karaganda, Kazakhstan

It is widely known and accepted that glass was mass produced and exchanged in the late second millennium BC in the Eastern Mediterranean. Also, archaeological finds show glass becoming common in Central and South Asia in the mid-first millennium BC. However, glass dated to the second millennium B.C from the area of Caucasus is very rare.

The present study investigates a unique polychrome glass bead found in Lisakovsk in Kazakhstan during the 2003 excavation season. The site is classified as of the Fyodorovo-Alakul culture dated in the Late Bronze Age period between 1600 BC and 1400 BC. The glass bead and other vitreous materials from the same site were analytically examined, using Electron Probe Microanalysis, to determine and compare their chemical compositions.

The study gives an insight of LBA glass use and exchange in the region of Caucasus, and identifies the raw material used for the production of the Kazakhstan vitreous materials.
GLASS PRODUCTION
IN THE ROMAN AND EARLY BYZANTINE CITY
OF NOVAE/ MOESIA SECUNDA

Biernacki Andrzej B.

The Roman legionary camp and subsequent early-Byzantine city of Novae on the lower Danube (Moesia Secunda) has been investigated by Polish and Bulgarian scholars for almost fifty years now. The international interdisciplinary Archaeological Expedition of the Adam Mickiewicz University of Poznań has been exploring the city since 1970. Besides vestiges of buildings and other structures, extensive archeological studies have also yielded movable sources of various categories.

The most numerous group of these, after ceramic vessels, are glass vessels, amounting to a dozen thousand. Of particular interest are oil lamps, goblets and unguentaria; reliable documentation is available for dividing these items into types and periods of manufacture. The most numerous class of oil lamps is the so-called Type II (consisting of two elements): such lamps were either hung individually or, more often, placed in metal lighting fixtures, encountered abundantly in the early-Christian basilicas of Novae.

Goblets were among the most common drinking containers in Novae, especially between the turn of the 5th and the late 6th c. Interestingly, they were rather poorly made—of non-transparent glass and undecorated, which may be explained by the fact that most users did not expect a high quality of these products, constituting an easily breakable item of ordinary tableware. The goblets were manufactured in local workshops in Novae.

Obviously a highly numerous category of finds are windowpanes, mainly coming from public and sacred buildings of Novae and dated to between the late 4th and the 6th c. Equally conspicuously, most of these were made of fairly unclear glass with many gas bubbles, which lowered their transparency. The glassmakers of Novae usually made windowpanes by first blowing a cylinder and then stretching and straightening it to obtain a thin, even and smooth plate of glass.

Furthermore, a corpus of vessels has been collected, predominantly tableware and containers of various artistic values and technical characteristics. There is also the category of glass jewelry, consisting of bracelets, beads and an extremely numerous and representative collection of intaglios and cameos. The occurrence of unfinished products, particularly intaglios, may suggest that these were locally made.
Among the glass items found in Novae, of exceptional value are two types of relics:

- remnants of manufacturing equipment (furnaces) and waste material from at least four glassmaking workshops discovered *in situ* and dated to between late 3rd and early 5th c.;

- waste glass material from various stages of the manufacturing processes, lumps of congealed glass and cinders, as well as elements of destroyed furnaces identified on secondary deposits.

Laboratory tests have established that in the glassmaking region of Novae and its immediate environs, the sodium technique of glassmaking prevailed, in two forms: sodium, calcium, aluminum and silicon (77% of the tested samples), and sodium, calcium and silicon.

So far, our research has ascertained that from the late 4th to the 6th c. Novae was a major center of glassmaking in Moesia Secunda.
Excavations of the sites of Ras Shamra - Ugarit and Minet el-Beida - Mahadu, in Syria, have produced one of the largest concentrations of glass objects in the Late Bronze Age Middle East. Glasses are weathered in general. But recent excavations in a district of the city have produced an exceptional group of glass beads (more than 200) very well preserved and of a variety of hues: translucent colourless, purple, green, blue, turquoise, amber and opaque yellow, white (with red, yellow and white opaque decorations for some beads).

48 pieces (complete beads or samples) were exported for scientific investigations in the framework of a collaborative project between the Syro-French mission of Ras Shamra, the General Direction of Antiquities and Museums of Syria, the CNRS, the University of Lyon 2, the Centre de Recherche et de Restauration des Musées de France, the University of Nottingham and the British Geological Survey.

In order to study this production (chemical composition, colorants, opacifiers) and to try to provide a provenance for the glass we have chemically analysed the samples using electron probe microanalysis, proton-induced X-ray emission and thermal ion mass spectrometry (the latter has provided the strontium and neodymium isotope signatures). All of the soda-lime glasses were made from a plant ash source of alkali. By determining a combination of $^{87}\text{Sr}/^{86}\text{Sr}$ and $^{143}\text{Nd}/^{144}\text{Nd}$ isotope ratios in selected glasses we hope to provide unambiguous evidence for the provenance of these glasses (i.e. where they were made). Sr and Nd isotope signatures have been determined for samples of plant ash and silica from the region and a direct comparison will be made with the results for Ugarit glass samples.
The paper presents a group of glass vessels, which were mainly found in Guangxi province, in tombs dating from the Western and Eastern Han period (206 BCE – 220 CE). The group, comprising about twenty items, consists mainly of small deep cups and shallow bowls, which are mould-made. Their characteristic features suggest a local manufacture somewhere in the area. Apparently they were produced there for only a limited period. Chemical analyses are available for nine of the vessels revealing a potash glass. Such a glass composition was not used in the Mediterranean area or Western Asia at the time, but it is known from India and Southeast Asia. The particular potash glass of the Guangxi vessels is further characterised by its low lime content. According to analyses of other glass objects found in the region, this glass composition seems to have a characteristic distribution in northern Vietnam and southern China. This points not only to extensive regional glassworking but also to primary glassmaking in the region, which is also reflected in a Chinese text.

The sudden appearance of a local production of glass vessels in this region is a remarkable fact, and demands an explanation. As we know that glass vessels from the Mediterranean arrived in the same period in southern India and China, the question arises whether an incentive from abroad triggered the manufacture of such glass vessels, and whether this possibly also involved a technology transfer. The Chinese written sources describe for the Han period the maritime long-distance connections and trade as far as the south-eastern coast of India via the ‘Thai-Malay Peninsula, now increasingly documented in the archaeological evidence. The ports Hepu and Xuwen in the Gulf of Tonking are to be regarded as the Eastern starting points of the ‘Maritime Silk Road’ in that period.
THE EARLIEST WALL MOSAICS AND THE ORIGIN OF GLASS. 
AN ARCHAEOLOGICAL AND ARCHAEOOMETRIC STUDY ON 
ROMAN AGE GLASS FROM ITALY

Boschetti C.¹, Leonelli C.², Corradi A.²

¹ 1. Dept. of Chemical Sciences, Padova University, Padova, Italy
² 2. Dept. of Materials and Environmental Engineering, Modena and Reggio Emilia University, Modena, Italy

This research displays the relationship between the earliest Roman wall mosaic technique in Italy and the origin of Italian glass. Recent literature investigation demonstrated the suitability of making glass using the Naples Gulf sands and so hypothesized the existence, during the Roman age, of a local glassmaking industry, as attested by Pliny the Elder. Besides, waste products deriving from the manufacture of Egyptian blue aggregates and powders were found in different sites of the Naples coastal area. For the moment, because of the lack of archaeological data, it is very difficult to propose a chronology of the activity of local workshops dedicated to the production of vitreous materials. A chronology is here proposed observing the developments of the use of glass in the Italian wall mosaics.

By the analysis of the earliest wall mosaics (end of the 2nd - end of the 1st century BC), it was possible to document the use of a multi-material technique with a mix of shells, stone and Egyptian blue tesserae, tuff blocks and coloured glass shards. Focusing the attention on the practice of recycling glass shards it is possible to notice that it was gradually abandoned and totally disappeared during the second quarter of the 1st century AD. In fact, in this period shards are fully replaced by the frequent use of glass tesserae in a wide range of colours. The systematic presence of shards of luxury glass vessels, like millefiori or opaque red, testify that the mosaic makers operated a careful selection, probably based on the existence of a trade of high quality broken glasses. From the beginning of the second half of the 1st century AD also the use of Egyptian blue declines and coloured glass tesserae become the exclusive material of wall mosaic. These observations permitted to argue that a local glass industry gradually developed starting from the beginning of the 1st century AD and reached the full achievement at the half of the century.

These topics will be illustrated presenting a complex of archaeological and archaeometric data considering wall mosaics from the Naples region, but also from the North of the Country.
Vitreous mosaic tesserae are firstly used in Eastern and Southern Mediterranean starting from the half of the 3rd century AD. This first use of glass is restricted to luxury artifacts but, starting from the end of the 1st century AD the number of evidences gradually increases. Just at the end of the century glass tesserae are widely used and become the material of election in wall and vault mosaics. The success of glass continues in the centuries till the flourishing of Byzantine mosaic art.

Considering the spatial and temporal distribution of the evidences, glass tesserae are a meaningful material to carry out research focused on the mosaic history, but also transversal researches focused on the investigation of the evolution of glass technology in the centuries.

These two aims strictly connected each other, are object of two projects involving the Department of Archaeology of the University of Nottingham and the Department of Materials and Environmental Engineering of the University of Modena and Reggio Emilia.

The first project, *Mosaic glassy tesserae from Italian sites: the study of provenance and technology*, started in January 2008, is founded by the British-Italian partnership program for young researchers (British Council-CRUI) and it is aimed at investigating the technological changes in glass mosaic tesserae from the Hellenistic mosaics to the Middle Ages. The two research groups involved have a deep experience into the study of vitreous materials and are sharing the knowledge acquired in their previous researches to draw up a general view of the material.

The second project, *The interdisciplinary provenance of Italian mosaic glass tesserae* (ProMoTe) will start in September 2009, thanks to the financial support of the EU Marie Curie Action FP7-PEOPLE-IEF-2008. It will be focused on the first use of glass in Roman mosaics of Italy, with a particular attention to the topic of the provenance.

Both the projects are based on an interdisciplinary work methodology, integrating the archaeological approach with the scientific investigation and involving scientists coming from different academic background (archaeologists, physics, chemists, engineers) to draw up an effective reconstruction of the past.
LA VAISSELLE DÉCORÉE DU SITE D’AL-SHIHR AU YÉMEN (IX-XVIIème SIÈCLE).
IMPORTATIONS ET PRODUCTIONS LOCALES

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Al-Shihr, la « Grandissime cité » selon M. Polo, était un port de commerce réputé de l’Hadramaout, dont l’activité avec les régions du pays, ainsi qu’avec l’Orient islamique, l’Asie (Inde et Chine) est bien attestée par les textes, et les découvertes de céramiques. Une grande quantité de verre a été inventoriée d’octobre à décembre 2007 au terme de l’ensemble des campagnes de fouilles de la mission française dirigée par C. Hardy-Guilbert (CNRS UMR 8084). Le corpus inédit est constitué de 509 fragments généralement datés d’entre le xiiie et le xviiie siècle, dont 321 tessons de vaisselles et 188 bijoux de verre dont 185 bracelets. Parmi ce lot, 23 exemples de vaisselle présentent la particularité d’être finement ornés : la décoration qui peut-être marbrée, cannelée, de filets, de traits, de disques se déroule sur des panses, des cols. Ce type de motifs qui est bien attesté au Yémen même, comme à Kawd am-Saila, ainsi qu’au Proche-Orient, en Iran et Irak, parfois jusqu’en Asie pour des périodisations souvent similaires, suggère l’hypothèse d’une part d’importations. Pourtant, la qualité de la pâte de verre de certains de ces modèles est proche de la majorité des exemples non décorés du corpus, pâte qui correspondrait également à celle de quelques scories de verre trouvés sur le site. La présence de nombreux creusets avait déjà conduit à conclure en 1999 à la présence d’un atelier de verrier attribué au xvie siècle.

Repères bibliographiques

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MEDITERRANEAN SAND DEPOSITS AS A RAW MATERIAL FOR GLASS PRODUCTION IN ANTIQUITY

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In past decade, several attempts have been made to determine the provenance of ancient glass based on major, minor and trace elemental compositions, rare earth element patterns and isotopic signatures of O, Pb, Sr and Nd. In particular, trace elements and Nd isotopic signatures have shown to be promising indicators of different geological provinces across the Mediterranean.

It is believed that Nd together with trace elements in Hellenistic and Roman period glass (i.e., natron based glass) originate from the non-quartz fraction in the silica raw material which is most probably sand. It is well known that the Nd isotopic composition of deep-sea sediments in the eastern Mediterranean varies significantly due to the varying sediment influx from the Nile (fluvial), the Sahara (eolian) and the European continent (fluvial) and shows a pronounced E-W gradient from -3.3 ° Nd at the mouth of the river Nile to -10.1 ° Nd at Gibraltar. Although it is not possible to directly compare the Nd signature of glass to sea-floor sediment, such significant differences between the eastern and western Mediterranean offer a great potential in tracing the origins of sand used in primary glass production. As for trace elements, very little information is available for how they partition into a sand material.

This study therefore investigates whether variations in Nd isotopic signatures and trace element contents can distinguish sand deposits around the Mediterranean, all suitable raw material candidates for glass production. It is also looked into how the elements investigated could enter a glass batch, by studying the different mineral fractions of the silica raw material. The range of sand trace elemental and isotopic characteristics is then compared to that of imperial Roman natron glass from around the Mediterranean, indicating primary production in both the east and west of the Empire.
THE CHURCH LANE ASSEMBLAGE:
EARLY MEDIEVAL GLASS-WORKING
IN THE SHADOW OF CANTERBURY CATHEDRAL

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In 1983 rare evidence of early Medieval glass-working in England was excavated from Church Lane, Canterbury by Canterbury Archaeological Trust, but was never published. The material was recently rediscovered and is currently being investigated. The assemblage consists of fragments of at least two different crucibles, both with glass adhering to the inside and outside of the sherds, and also cullet in various forms. Preliminary qualitative XRF analysis has shown that it is all alkali glass. We hope to be able to refine the dating of the assemblage, but current indications are that the earliest possible date would be c. 9th century AD when Church Lane was first established as an intramural thoroughfare, and the latest would be the late 12th century (associated pottery has been provisionally dated to c. 1150 AD).

The location of the site on Church Lane is potentially very significant – the site was just inside the city wall and next door to the church of St Mary Northgate, a church of Saxo-Norman foundation that was certainly in existence by the mid-12th century. It is also very close to Mint Yard Gate, to the precincts of Canterbury Cathedral and to the Cathedral itself, and was near the Archbishop of Canterbury’s large stable complex. This paper aims to address questions about the date of the assemblage, the type of glass that was being produced (window, vessel, other?), the type of glass-working operation it represents, and whether the production was connected either to St Mary Northgate or to the Cathedral, or both. Quantitative XRF and SEM analyses will provide additional information and will contribute to the understanding and interpretation of these finds.
GLASS FROM ROMAN NECROPOLIS IN LORA AND POLJUD, SPLIT, CROATIA

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In Split, Croatia, in the northwestern part of the city, at the districts of Lora and Poljud the largest Roman city necropolis is established. Investigators mentioned about forty graves there. Cambj, who investigated it in the year of 1965, dates the necropolis in Lora from the 2nd half of the 1st to the early 3rd c. AD. Cambj pointed out some characteristics of the necropolis in Lora with mainly incinerated graves in urns, two stone walled graves for inhumation, all buried without system for there were no grave lots, grave architecture, tombstones or inscriptions. Only one inscription dedicated to C. Orhivio Amempto with the mention of taberna, immured in the stone wall of the monastery in Poljud near Lora, is the possible indicator of the sepulchral architecture in the grave parcel in Lora. Still, that necropolis has not been technically evaluated on the basis of all collected and preserved inventory. So, at this moment, the only clue for determination lies in the fact that finds come mainly from incineration graves. In 1953. Nikolanci described finding of urns and grave finds of demolished ossuary at Poljud and dated it to the end of the 1st and the beginning of the 2nd c. AD. Graves from Lora and Poljud belong to the same necropolis. Back then Split was part of salonitan ager. Salona was Roman Dalmatian metropolis. Those archaeological, grave finds, even with quality, evidence an organized roman life at Split peninsula from the 1st to the 3rd c. AD. Let us mention here few rare finds of glass such as lamp from Poljud or grape Bunch-shaped Bottle. Here glass inventory from the necropolis will be evaluated considering all preserved grave finds.
After several years of intense study an overview of the materials and techniques applied for the production of stained glass windows in the Low Countries during the Renaissance and Baroque era has been realised.

During that period the Low Countries were one of the most important centres in Europe for the production of stained glass and several important material-technical innovations took place during that time in the Netherlands. Apart from the numerous art historical studies about the studied stained glass, a thorough investigation on their materials and techniques was missing. This gap in our knowledge has been filled now by confronting relevant historical documents with visual examination of still existing original stained glass windows and roundels, and chemical analysis of glass and glass paints samples.

The results of the combined study of archival documents, the remaining stained glass panels and windows, and the samples in and from The Netherlands, Belgium and England, Spain and Portugal show surprising differences with the ‘traditional’ opinions handed down up to now. They also prove that an inter-disciplinary approach is revealing better and more accurate information than separate studies.

The new insights are not only of the highest importance for a renewed and improved approach of present conservation-restoration of stained glass windows of that period, but they also provide us a tool to change our perceptions on the preservation and presentation of cultural heritage.
In the framework of the study of the glassmaking ‘à la façon-de-Venise’ in Northern Europe, a number of glass samples dated to the first half of the 17th century, excavated in the city of London, were analyzed via SEM-EDS (major and minor elements) and LA-ICP-MS (trace elements). The samples originate from two locations (Aldgate and Old Broad Street) where glass workshops were active at the time.

While few samples are made of the common and cheaply produced potash and high lime low alkali (HLLA) glass, the majority of the samples are made of soda glass. In particular two distinct groups are observed, whose composition appears to be related to the site of provenance. The samples originating from the Old Broad Street excavation are similar in composition to the Façon de Venise glass commonly produced in continental Europe to imitate the Venetian objects. The samples from Aldgate, instead, are characterized by a higher potassium concentration, together with higher amounts of elements related to sand impurities (Zr, Ti). This suggests that the Aldgate workshop produced a glass of a lower quality than that made in the Old Broad Street one.

A comparison with Façon de Venise and Venetian glass compositions show that there is no resemblance with the actual Venetian production, yet the recipe seems to be the same which was in use in Antwerp at the end of the 16th century, probably attesting a shift of glassworkers from the Low Countries to England.

Finally, the similarity of the alkali composition of Spanish and Italian Barilla-fluxed glass to that of a part of the Old Broad Street samples, suggests that Barilla was used as a flux by the English glassmakers.
TO THE QUESTION OF THE ORIGIN OF ENAMEL-PAINTED GLASS FROM 12th-14th CENTURIES IN BOHEMIA

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Our paper concerns the glass vessels painted by gold and enamels from medieval Bohemia. Only 13 more or less fragmentary preserved vessels are known at present. Most of them come from the centre of the city of Prague. Recent processing of the finds focusing on the typology and chronology of glass vessels has proved that they are very variable (Černa-Podliska). Vessels of three basic types are concerned: goblets, beakers and bottles. The goblets prevail while the two remaining shapes are represented by one specimen each. Most vessels are painted by gold and enamels, rarely by enamels only. Vessels decorated only by gold have not been recorded. The decoration can be observed on a limited number of finds but its diversity is evident. Four basic motifs occur: 1. zoomorphic, 2. architectural, 3. figural and 4. heraldic.

All painted glasses found in Bohemia are imports. Visual evaluation of the quality of glass matrix and iconography of the decoration were decisive for solving the question of their origin. According to the presented criteria roughly one half of the finds are products from the glassworkshops in the Near East (Aleppo), while the others are considered to be of European origin, most probably from Murano but in one case also from Constantinople or an unknown workshop under Byzantine influence.

New investigation of these glasses was accomplished to specify their origin by means of X-ray microanalysis with the aim of finding some indicators in their composition. 13 samples were analyzed and measured and their composition is presented.

The finds of painted glass in Bohemia present an expressive evidence of the cultural and trading contacts of Central Europe with south and SE-Europe and with more remote territories in the Near East, already at the end of the Early Middle Ages and the beginnings of the High Middle Ages.
This paper aims to discuss a few aspects concerning the discoveries of glass vessels from Ibida (Slava Rusă – jud.Tulcea). Strategically located at a crossroads in the northern part of central Dobroudja, the city flourished especially beginning with the 4th century A.D. when it was rebuilt by Emperor Constantine and his descendants.

The types of glass vessels discovered here cover the whole Roman and Early Byzantine periods (1st to 4th century A.D). Although the majority of forms encountered here are not rarities, nevertheless they throw a new light on the local production (a furnace for glass making was even discovered there in 2004) in the province of Moesia Inferior and on the circulation of glass throughout the Roman Empire.

Our study comes thus to enrich the knowledge about the typological variety of glass vessels which are to be found in the northern part of Moesia Inferior in its relation to other provinces of the Roman Empire, especially the eastern Mediterranean and the northern Italy.
THE HELLENISTIC GLASS-MAKING INDUSTRY

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The value of compositional analysis in archaeological glass is derived from the unique composition an artefact inherits from the composition of raw materials, and the tools and applied processes utilized in its production.

The variation found in the raw materials and tools (such as crucibles and furnaces) is a consequence of geologically unique (and therefore, geographically distinct) rock and sediment forming processes, particularly at the concentration levels of minor and trace element components. Tools can add to the compositional make-up of the raw materials used; other processes, such as melting, can both add through incidental contamination with furnace/fuel products, and remove through element fractionation between the desired product (in this case, glass) and any leftover ‘scum’, and through the loss of volatile components.

Much work [Freestone, 2006] has gone into the study of the major and minor components of glass of late Roman to Early Islamic date in the Eastern Mediterranean. This has led to the conclusion that the Levantine coastal region was the centre for much of the glass circulating from the Middle East to Europe in this period.

Similar work has not been done for the Hellenistic glass industry, and I believe that by concentrating on the trace element composition of glass, it is possible to produce a more detailed knowledge of the structure of a glass industry. This has to some degree been borne out by work carried out in the Institute of Archaeology (IoA) laboratories, of chromium in 2nd-3rd century BC glass samples from Rhodes, and the evidence of chromium as a characteristic localizing marker for Rhodian ceramic amphorae [Whitbread, 1995].

Glass samples were acquired from Rhodes and Volos, Greece, and subjected to analysis by Electron Probe Micro-Analysis, ICP-MS and XRF. The data were then treated with statistical and other mathematical techniques to identify glass-groups and the distinguishing element differences.

Bibliography


REGIONAL PRODUCTION AND TRADE
OF BLACK GLASS VESSELS IN THE NORTH-WESTERN
PROVINCES OF THE ROMAN EMPIRE,
DURING THE LATE SECOND AND EARLY THIRD CENTURY AD

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Prior research demonstrated that the late second to middle third century AD blown vessels in black glass are barely present outside the provinces Gallia Belgica and Germania Inferior (Cosyns, Hanut 2005). Since no specific distribution patterns can be attributed to the different vessel shapes and because glass workshops having produced black glass vessels are lacking, it remained unclear how many workshops produced this type of material.

By means of chemical analysis using SEM-EDS and LA-ICP-MS (Van der Linden et al. in press) the chemical composition of a large set of samples dating from the late 2nd and early 3rd century AD resulted in unexpected information leading to a better understanding of the Roman glass production and trade in the North-western provinces. Within the High-Iron group two contemporaneous groups have been clearly discerned showing the use of distinct production recipes. Furthermore these two distinct productions are geographically related.

References
LE MATÉRIEL EN VERRE DE LA CITÉ D’ITANOS
(CRÈTE ORIENTALE)

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La cité d’Itanos en Crète orientale fait l’objet depuis 1994 d’un programme d’exploration de la ville et de ses environs, à travers la fouille du centre urbain et la prospection de son territoire. La recherche y est le fruit d’une collaboration internationale impliquant plusieurs institutions belge, françaises, grecques et italienne.

La ville d’Itanos a été occupée au moins du ixᵉ siècle av. J.-C. au viᵉ siècle ap. J.-C. La fouille de la nécropole hellénistique, des quartiers d’habitation (phases romaine et protobyzantine) et de la basilique protobyzantine A a permis de mettre au jour du matériel en verre qui va être présenté ici pour la première fois. En Crète, seuls les verres de Cnossos et de Gortyne ont été publiés de façon détaillée. L’étude des verres d’Itanos permettra d’apporter un nouvel éclairage, à partir de l’exemple d’une cité résolument tournée, de part sa position géographique, vers les échanges internationaux.
LE VERRE DU QUARTIER DE LA MAISON AUX MOSAÏQUES À ÉRÉTRIE (EUBÉE, GRÈCE)

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Plus connu pour la découverte de mosaïques à galets polychromes datées du IVᵉ siècle avant J.-C., le Quartier de la Maison aux mosaïques à Érétrie révèle des structures et du mobilier d’époque classico-hellénistique, mais également plusieurs vestiges d’époque romaine. C’est vers ceux-ci que se focalise notre enquête, puisque, outre quelques murs et structures dont la fonction est difficile à établir, plus de mille fragments de verre soufflé y ont été mis au jour.

Constituée de formes variées et de plusieurs ornements de parure (perles, bague, pendentifs), la verrerie de ce quartier est particulièrement riche. A l’échelle d’Érétrie, il s’agit de la fouille la plus importante en matière de quantité d’objets en verre après les découvertes faites dans le Quartier du Sébasteion, situé à l’Ouest de la Maison aux mosaïques.

Environ trente ans après les fouilles, nous entreprenons l’étude de ce verre, dont l’analyse exhaustive n’avait pas été faite, afin de compléter nos connaissances du verre d’époque romaine à Érétrie. Cette recherche s’inscrit dans la lignée des analyses précédentes faites pour le verre de deux quartiers jouxtant la Maison aux mosaïques ; elle nous permet d’apporter nos conclusions sur le mobilier en verre utilisé dans les premiers siècles de notre ère à Érétrie.
Ancient glass objects, such as stained glass windows in situ or archaeological finds, show different patterns of alteration, depending on their composition, their conservation history and the environment of which they have been surrounded. In the present case we focus on the dark appearance of glass caused by the presence of Mn-inclusions in the superficial layer.

Manganese in glass is normally present as the colorless Mn(II), it can also exist as the strongly purple coloring Mn(III). Higher oxidation states are not present in glass since they are unstable at the temperature at which glass is produced [1]. The manganese rich inclusions in the glass, brownish to black, are in the +3 and +4 oxidation state [2]. Several explanations have been proposed for this phenomenon: the manganese could originate from the external environment, carried in aqueous solution [3], or the manganese present in the inclusion could as well be that contained in the original glass [4]. Also a microbiological origin of this kind of alteration has been suggested [5]. Dark surface layers can be converted into colorless ones by a treatment with an aqueous solution of reducing agents [6].

Less extensive studies have been performed on this type of glass alteration and on the reversing yet.Untreated samples coming from Belgian and English archaeological sites, but on different kinds of environment (wet and dry) were examined by EPMA analysis. These analyse show extensive alteration due to Mn-inclusions. In order to understand the modalities of growth of these Mn-inclusions, analysis with high resolution tomography (at ESRF and with a commercial instrument) were executed. The samples were treated with products, as healthy as possible for as well the conservator as the glass artifact, to reduce Mn to a colorless state. The effectiveness of such methods were checked by EPMA and tomography.

References
In the collection of the Pogliaghi’s museum in Varese are preserved two vases in green glass with bronze mounts. They originally came from the Borghese’s altar in Rome. These kind of vases are generally attributed by scholars to the Medici’s glass-furnaces in Florence and in Pisa. They were produced at the beginning of the 17th century.

One of the two pieces was broken and so it was possible to make a quantitative chemical analysis. The results have reserved an interesting surprise. The glass has 69% percentage of lead and a 28% percentage of silica. It’s a kind of glass that find a correspondence with the supposed composition of the so-called “vetro di piombo”, lead glass, already mentioned in Venetians recipes books from the 14th century. It’s interesting to notice a precise correspondence with an Antonio Neri’s recipe named “Lead glass with emerald colour” collected in his book L’Arte Vetraria distinta in libri sette, published in Florence (1611 - 1612). A book based on Venetian glass recipes and on Neri’s experience in Medici’s glassfurnaces. The computation of the composition of the recipe (cap. 65) is very similar, almost identical, with the one resulting form the chemical analysis of the Pogliaghi’s glass vase, taking in consideration the approximation of the computation. This kind of lead glass was used not only to imitate hard stones (fake gems so called “verisei”) but also blown glasses as mentioned in the chapters n.63 and 64 of Neri’s recipe book where he gives precise information on the way to prepare this kind of glass to be used for blown objects.
À partir de l’analyse des collections de verre dans la Région Lombarde, à l’occasion de la réalisation des premiers volumes du « Corpus des collections du verre en Lombardie » (Projet Européen Glassway- Le verre de l’antiquité au contemporain), on a visité différents musées et réserves pour vérifier la présence de pièces datées de l’antiquité à nos jours. Dans la Villa-Musée de Lodovico Pogliaghi, artiste éclectique et sculpteur (réalisateur du portal du Dôme de Milan –dont en 2008 on a célébré le centenaire), qui se trouve tout près de la ville de Varese, au Sacro Monte, on a découvert une véritable collection de verres, datés à partir de l’antiquité jusqu’au xixe siècle. Parmi les verres anciens, une partie significative est représentée par des fragments de verres fondus et formés dans un moule (verres monochromes, mosaïqués, aussi comme marbrés) datés de la fin du 1er siècle av. J.-C. - 1er siècle apr. J.-C., qui proviennent – semble-t-il – de Rome ou bien du Sud de l’Italie. En effet Lodovico Pogliaghi fut plusieurs fois à Rome et eût plusieurs contacts avec des antiquaires de la Capitale. Il aimait beaucoup les différents matériaux, les différentes couleurs, et il aimait utiliser, dans la construction aussi comme dans l’enjolivure de sa Villa, des différentes matières. On illustre ici une première analyse de ce groupe de verres, en considérant les principales typologies ici représentées: on trouve des fragments des récipients aussi comme des verres plats colorés, utilisés vraisemblablement comme décor architectural.

On peut affirmer l’exceptionnalité de ce groupe de verres, surtout en considérant la rareté de ce genre d’attestations en Lombardie, malgré tout on doit regretter l’absence de toute notice en ce qui concerne le contexte d’origine de ces verres.
GLASS FINDS FROM GNEZDOVO AS A RESULT OF RUSSIAN-BYZANTINE TRADE IN THE 10th CENTURY

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The Byzantine Empire was a major centre of attraction for the 10th – 11th centuries Barbarian world. It was the most civilized state of both Europe and the Near East and the magnificence of Constantinople fascinated every foreigner. Great Byzantine riches, luxurious clothes and exquisite food were lusted for in the northern Barbarian periphery linked to Byzantium by the Volkhov-Dnieper waterway called «the route from the Varangians to the Greeks…».

The analysis of written sources is indicative of strong trade links between the Rus and Constantinople.

Strange as it may seem, given such active links, well-recorded in written sources, the archaeological record documenting the Rus-Byzantine relations is rather scarce. We are going to analyze glass finds of Byzantine origin from the excavations of well-stratified occupation deposit in the flood-plain part of the Gnezdovo site (the key-point on the route from the Varangians to the Greeks), which are few in number yet quite significant.

The set of glass finds consists of fragments of vessels, gaming piece, ornaments (bracelet and finger-rings). The main aim of our research was to identify the provenance of glass objects. We studied the technology, morphology, ornamental pattern and chemical composition. As a result the byzantine origin of glass pieces was substantiated. The analysis of dynamic of the inflow of byzantine import indicate the expansion of trading contacts with Empire in the second half of the 10th century.
ROMAN GLASS FROM TOMIS IN FUNERARY CONTEXT:
CHRONOLOGICAL AND TYPOLOGICAL ASPECTS

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Tomis, one of the most important urban settlement on the western coast of the Black Sea and capital of the roman province Moesia Inferior, distinguish itself through the richest ancient glass production, especially during the imperial era. The archaeological excavations conducted throughtout the city in the last 40 years have enriched considerably the documentation concerning the ancient glass from Tomis. The aim of our presentation consists in pointing out the chronology of the main types of glass vessels which can be identified in the funerary inventories belonging to Roman necropolises of Tomis datable between the 1st and the 3rd centuries AD. From the abundant material existing in the collection of the National Museum of History and Archaeology Constantza, we have chosen a series of representatives funerary complexes, in order to provide doubtless/precise informations about the chronological frame in which the glass vessels fits in, together with other objects from the inventories such as pottery, lamps, coins. The material can be divided into four categories:

1. **Tableware**: jugs, jars, convex jars beakers, cups, deep cups with stepped rim and one handle (*modiolus*), bowls, *guttus* and *trulla* recipients, decanter type vessels, pear-shape vessels (a local form of the decanter type vessels).

2. **Storage and transport recipients**: amphorae, prismatic and cylindric bottles. These are vessels with large dimensions, free blown-, and in some cases mould-blown.

3. **Cosmetic pots**: the most frequent category is known as *Unguentaria*, evidence showing a lot of different forms (globular, conical, tubular). In the same category we have also included a type of vessels known as *aryballos*.

4. **Luxury vessels**, illustrated by a number of particular beakers, all of them blown in figurative moulds (*lotus* beakers, mythological beakers, human-shape beakers). Also here we analyze a special category of bowls, the ones bearing on their bodies a dedication for the users.
The site of Caričin Grad in southern Serbia is situated on a spur orientated to the North with steep slopes on three sides and a plane hillside in the South. Archaeological excavations have brought to light impressive remains of an early Byzantine city that was divided into three parts – the “lower town”, the “upper town” and the “acropolis”, each protected by strong city walls. Especially the so called acropolis with its Episcopal church, baptistery and several buildings of administration demonstrates the importance of the place, but also the other districts provide representative architecture and churches as well as areas of craft production. Generally the site is identified with “Iustiniana Prima”, a city founded by emperor Justinian I as it is recorded by Procopius. Due to historical and archaeological data Caričin Grad / Iustiniana Prima was erected from the 530ies onwards and abandoned in the early 7th century.

As a result the archaeological material can be dated very precisely to the 6th and early 7th century. A research project run by the RGZM and the Archaeological Institute in Belgrade is dedicated to the glass finds of Caričin Grad. Among them one can find typical forms of stemmed goblets, small beakers and bowls, glass lamps (for polycandela, but also single lamps), flasks as well as fragments of window panes and tesserae. Especially raw glass fragments and remains of glass working activity are of special interest. Ca. 350 samples of all kinds of these glass forms will be analysed by Micro-RFA and ICP-MS at the RGZM in Mainz. The aim is to explore the possible existence of a local glass workshop, to find the origin of the probably imported raw glass and connect it to the already defined glass groups known from the eastern Mediterranean and at least to find out more about the structure of early Byzantine glass production and distribution. First results show typical soda-lime-components with strong connections to Roman glass compositions. Some samples, however, are characterised by higher potassium and magnesium fractions possibly due to additions of plant-ash components. These unexpected results can only be completely evaluated when all samples have been analysed.
HISTORICAL, ARCHAEOLOGICAL AND SCIENTIFIC INVESTIGATION OF THE THAMES PLATE GLASS COMPANY

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The Thames Plate Glass Company thrived during the middle part of the 19th century as it supplied plate glass of the highest quality to England’s capital city. There are numerous historical references to the company, and its premises in the East End of London. These include a particularly colourful but informative account by Henry Wills who collaborated with Charles Dickens on journals such as Household Words. Sir Michael Faraday undertook a study of plate glass for use in lighthouses and reported that the Thames Plate Glass Company’s was the clearest, strongest and most durable. The quality of the glass was also prized by Dr Pepper who used the company’s glass for the theatrical projection of images (‘Dr Pepper’s Ghost’).

Excavations in 2008 by Wessex Archaeology uncovered remains of the site, although it had been severely damaged by 20th-century activity. The collection of samples of plate glass manufacturing materials and waste from these excavations has provided possibly the first opportunity to study the archaeological remains of plate glass manufacture. Samples of possible raw materials include sand, although this may have been an abrasive rather than a raw material. Waste products include numerous fragments of glass waste and plaster of Paris. The semi-finished glass recovered is of particular interest for the insight it gives into the grinding, smoothing and polishing processes employed. Samples have been investigated using a variety of scientific techniques, including SEM-EDS and EDXRF to characterise the chemical composition of raw materials and waste products. In addition, innovative techniques, such as confocal laser scanning microscopy and laser interferometry, are being applied to characterise the surface of semi-finished glass.
Excavations undertaken in the Salvage Project of the Archaeological Heritage of the Ilisu and Kargamis Dam Reservoirs in the regions of Gaziantep and Sanliurfa (Turkey) have produced important results for the settlement history of South-Eastern Anatolia. Saraga Hoyuk on the west bank of Euphrates was one of the mounds excavated under this project. The excavation in the Late Bronze Age, i.e. Mitannian levels produced a number of glass beads. They were found in an architectural complex and it was reported that the building was a structure with some religious and industrial function. Some furnaces, an oval ditch, traces of metal and slag revealed that there was some sort of production in the workshop within the architectural complex. Although the glass was not found in great quantities in Saraga Hoyuk, the present state of information and related archaeological data may suggest some type of a simple glass working at the site. However, the archaeological information provided from the excavations is sufficient enough to add its name to the glass yielding centers of the Mitannian world.
WORKSHOPS’ STAMPS ON SQUARE-SECTIONED JUGS
FROM ZADAR REGION

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Antique glass finds are especially numerous in the region of Croatian northern Dalmatia (southern Liburnia). More than 5000 morphologically different glass vessels were discovered in the wider area of Zadar (comprising Zadar (Iader), Nin (Aenona), Podgrade (Asseria) and Starigrad-Paklenica (Argyruntum). Certain vessels can be related to local workshops, no matter whether their origin can be located in the eastern Mediterranean. «Pseudo-Mercury» small bottles belong to this group of finds, as well as bell-shaped bottles and small bottles, small urns, small bottles with square-sectioned bodies and concave vertical sides, and jugs with square-sectioned bodies as the most numerous ones. More than 400 whole glass square-sectioned jugs are kept in Zadar, and almost half of them (172 vessels) bear a relief stamp at the bottom. These relief stamps can represent a reflection of a glassmaker’s or workshop’s activity, but they can also stand as symbols or names of perfume or medicine makers. It is also possible that some geometric or floral sign could stand for certain kind of product contained in the glass vessel. Different geometric and heart-shaped ornaments, zoomorphic presentations, Christograms and crosses can be found on square-sectioned jugs from the Zadar region. Some of these ornaments are specific for the central Dalmatian region, or central area of the Croatian coastal region, i.e. eastern Adriatic coast.

Besides the relief symbols at the bottom of the jugs with square-sectioned bodies, mentioned area also revealed some examples with texts in relief, mainly makers’ names, such as Lucius Aemilius Blasius, Caius Salvius Gratus and Gneius Pompeius Cassianus, or initial letters CSOR with two heart-shaped relief ornaments.
MULTI-DISCIPLINARY INVESTIGATION
OF MEDIEVAL WINDOW GLASS, FOCUSSING ON THE EAST WINDOW OF YORK MINSTER

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The Great East Window of York Minster (1405-1408) comprises 287 individual panels and a range of these is being sampled for analysis while the window is dismantled for conservation. For the first time we will have a comprehensive understanding of the compositional variation within a major work by a known medieval glazier. Currently we have analysed 136 glass samples from 6 panels by SEM-EDXA as well as 32 from another window by the same glazier, John Thornton of Coventry. This exceptionally well-contextualised and focused sample allows us to explore a wide range of issues, from procurement of the materials to corrosion. Analysis reveals fundamental differences between the base compositions of white and coloured glasses, allows us to identify production batches (Freestone et al., AIHV Annales 17, in press), material cut from single sheets of glass and to recognize glass pieces from other medieval panels that have been inserted during later repairs. As original glass pieces in a single window are likely to have essentially identical histories, the comparisons are informing our understanding of the influences of composition and environment on corrosion. Currently we are extending our sample to other windows made by Thornton, to contemporary windows by other glaziers, and to well-understood panels from other periods, as well as extending the East Window sample. Using laser ablation ICP-MS for trace elements, we are obtaining trace concentrations, and hope to further understand the origins of the various glass colours.
EARLY MEDIEVAL GLASS BEADS WITH METAL TUBES

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Early Medieval glass beads with metal tubes inserted as string hole appear in female tombs of the Later Merovingian Period. Most beads are produced from a transparent glass mass, only a few are made from opaque glass.

The main distribution seems to focus in Southern Germany, the south-eastern parts of the Frankish sphere. Similar constructed beads are found in more Eastern regions like in Awar cemeteries.

The aim of this study is to find out whether the different examples are technologically and chemically comparable which might hint to a possible common place of production. One further question to be addressed is the function of this inserted metal tube. Was it on esthetical reasons or an important technological advantage? How do the chemical compositions compare to similar beads without this feature?
A STUDY ON A LATE ROMAN BLUE GLASS BOWL
WITH RELIEVES OF SEA CREATURES MOTIF

Fujii Yasuko

I focus on glass fragments of a dark blue large shallow bowl with reliefs of sea creatures’ motif which is owned by the Middle Eastern Centre of Japan. Regarding this type of glass products, no prior study has been conducted except a brief reference made by the original collector, who purchased the fragmental glasses in Beirut with respect to estimation of its original whole size and producing time (“Late Roman Period”).

Recently I could make deep observation and study of them, together with Ms. Tami Ishida, a cut glass artist, taking into account results of the chemical analysis. The main points of the observation are the following:

1) Shape and Size: Sixteen pieces remain, all of which are fragmental and small. The total space of the fragments is smaller than one fourth of the whole part. Its diameter is estimated about 36 cm and its height about 5 cm (it has around 7cm diameter flat bottom and slightly outward rim).

2) Colour: A dark blue transparent glass.

3) Inside Surface: most of the preserved pieces have traces of wheel abrasion inside; through the study of these traces I could identify the method of production as well as the original position of each remaining piece.

4) Outside Surface: reliefs on the surface, the thickness of which is around 1-2 mm (thickness of the base body is about 3-4 mm). It looks different from vasi diatreti rather it looks more like the Lycurgus cup of Late Roman period.

5) Motif: among sea creatures motif, shells, a shrimp, several fish and half animal fish can be identified. The motif is common in Late Roman period.

6) Chemical analysis: Natron glass (Roman glass composition).
GLASS WORKSHOPS IN ANCIENT ZADAR

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During the last decade of the 20th century and the first few years of the 21st century in Zadar it has been dug over 1900 graves, and if we count those dug before that, the number rises at 2100 graves approximately. Their specificity is a large number of glass goods.

Bell-shape bottles belong to Dalmatian glass workshops, along with other bottle shapes found which also have their roots from Dalmatia (especially Jader), too. Their classification in literature has never been properly processed so in the past the rare pieces were generally classified as type 82A1 C. Isings. Lately De Tommaso classified them in borders of his typology as type 53.

The amount of material and its distribution on the coastal area showed that the findings of these bottles are narrowly concentrated. Having said that, Zadar rose as a place with undoubtedly the most pieces found, and graves gave us the opportunity to lower the bottles in the middle of 2nd century AD at tops. No matter what, along with their recognizable shape, there are bigger or minor differences in all basic elements, but also partly in the chemical substances of the glass.

Because of that the spectroanalysis of all the available pieces had been made. Analysis showed the possibility of using magnesium oxide with antimon oxides as decolorizer.

It can be concluded that the bell-like bottles were manufactured separately from rest of the glass dish. However, it must be emphasized that there is a possibility of the existence of more than one workshop of glass bottles in this area which used various decolorizators.
AN OUTSTANDING FOURTEENTH-CENTURY GLASS ASSEMBLAGE FROM A MAMLUK QUARTER AT ZEFAT IN THE NORTHERN GALILEE, ISRAEL

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A large varied assemblage of glass vessels was unearthed during excavations conducted in 2004 among the ruins of al-Watta (‘the lower’) Mamluk-dated quarter at the town of Zefat, about 800 meters to the southwest of the medieval/Ottoman fortress. The excavations yielded a plethora of archaeological finds, including pottery, coins, glass and imported items, indicating a wealthy community. These finds were dated from the fourteenth and fifteenth centuries, but some may be dated more accurately, from the fourteenth century and no later.

The glass assemblage includes various plain vessels of low quality, alongside enameled glass vessels and high-quality vessels of purple, brown, blue and emerald-green glass, decorated with applied marvered trails in various patterns. This group of vessels is of special significance as it comes from well-dated complexes of a limited chronological range. Furthermore, most of these vessels imply a local production during the Mamluk period, and enrich our knowledge of vessel forms and decorations.
HELLENISTIC AND ROMAN GLASS IN MEROITIC KINGDOM

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Hellenistic and Roman Glass Vessels are scarce in the Kingdom of Meroe. It is difficult to estimate the reality of importations due to the lacks of publication and the hazards of excavations. Yet, this material remains interesting to study since it underlines the exchanges with Egypt and the Mediterranean World. The study of these objects, namely: their typology, their origin, their geographical distribution, their penetration into the méroitic territory and their context of discoveries reveals important disparities. Furthermore, it offers important information upon the nature of the exchanges, the value of these objects for Meroitics people, the commercial roads, and the chronology. This paper will present the various types of object found in méroitic context and propose some interpretations based on the re-examination of already published materials and remarks on the existence or not of local production and on the relations between the Meroitic Kingdom, Egypt and the Mediterranean World.
RELATIONSHIP BETWEEN ENAMELLING ON GLASS AND OTHER OPAQUE GLASS TECHNOLOGIES

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Opaque glasses were widely used for decorative purposes in antiquity. Glass vessels, tesserae, beads and enamels applied to different carrier materials were decorated with or entirely made from opacified glasses. While other materials have been investigated in some depth, enamel decoration on glass vessels has attracted much less attention. At the archaeometry lab in Mainz a research-programme was set up to study the manufacturing technique of Roman enamelled glassware. Starting from a technological case study of fragments of Roman enamelled beakers from Lübsow (Lubieszewo, Poland) the question was raised whether enamels made for decorating thin glass vessels had to meet other demands than those vitreous masses used on metals or as independent materials.

The compilation of data comprised analysis of main and trace elemental composition of vessel glasses and of the vitreous paint layers by Micro-XRF. Raman-microspectrometry was used for identifying opacifiers and pigments. A detailed microscopical study yielded insights into the details of the manufacture process. The results demonstrated that for the enamelled decoration no glass masses with low melting-points had been used and that some pigments were quite unusual compared to other opaque glassware of the same period.

With the results of the Polish enamelled glasses and similar Roman objects from Germany and Denmark in mind a review of other opaque glass materials from the same and later periods was carried out. It was found that especially the red colours used on glass differed from the typical copper-reds used for producing tesserae, enamelled jewels, beads etc. However, similar materials and technologies used for enamelling Roman glass objects can be found among Islamic masterpieces nearly 1000 years later.

The paper will discuss the reasons why different opaque glass craft traditions had to be used for different types of vitreous opaque materials.
THE INFLUENCE OF GRADIENT TEMPERATURE CHANGES ON A GLASS REACTION INTENSITY WITH VOC IN MUSEUM CABINETS

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The problem of the local circumstances in a museum, sometimes called micro-climate has been studied for many years.
Because the problem consists of many aspects, it was treated in a multidirectional way.

Research in this area has been undertaken by the Faculty of Materials Science and Ceramics of the Technical University of Science and Technology in co-operation with The National Museum in Cracow. We have been working on VOC inside showcases and examining their influence on the surface of the glass exhibits.
The arrangement of lighting in museums and the characteristics of the light that enters the building must be known.
The character of the reaction between media as formaldehyde, acetic and formic acids with mainly the 18th c. glass was analyzed. The induced corrosion processes on the prepared for these purpose glass sensors, pointed reaction dependence on glass stage, relative humidity and temperature inside the showcases.
The results presented in this paper are limited to gradient temperature changes inside of cabinet, and were determined by long term measurement of temperature in the museum. We have found that these temperature changes originated from different sources.
Measurements were done using the following testing methods – a thermo-vision camera, data-logger, Scanning Electron Microscopy – SEM, Energy Dispersive Spectroscopy – EDS, Secondary Ion Mass Spectroscopy – SIMS.
EARLY BYZANTINE GLASS FINDS FROM ELAIUSSA SEBASTE (AYASH/MERSIN – TURKEY)

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The Italian Archeological Mission from the University of Roma “Sapienza” has been coordinating the excavation activities in Elaiussa Sebaste which was used to be one of the main harbors of Cilicia Tracheia. During the excavations within a very ideal context, the remains related to buildings like the basilica, the palace, various houses and ceramic workshops had been exposed. During the study, many glass findings gathered were dated with respect to stratigraphy and the typological work carried out revealed many critical knowledge about the glass forms used in the region.

The glass finds of the Early Byzantine Period in Elaiussa Sebaste are mostly covering pieces of opaque blue glass threads vessels of different forms, bottles, window glasses and lamps. Six different forms were detected among the lamps which constitute the highest percentage of the finds. Besides the bronze and the lead wick holders found near the lamps, many terra cotta materials utilized for the same purpose are standing as nice examples supplying data for the determination of lamp illumination.

As a result of the studies carried out until the present time; the occurrence of a local glass production in Elaiussa Sebaste has been questioned based on the knowledge about the glasses and glass production of Cilicia Region. The high quantities of some forms among the glass finds can be seen as clues to reveal a possible local production.

Although a glass furnace has not been exposed during the excavations yet; the achievement of the exposed examples like production debris and raw glass pieces from the related layers can be seen as factors strengthening the thesis of the occurrence of a glass production in Early Byzantine Period. These finds had revealed the requirement of a more detailed study on glass findings and the further archeometric analyses carried on the examples taken from conjectural regional forms and raw glass pieces has put forward very interesting outcomes about the glass production in the city.
Ever since Lamm wrote his comprehensive survey of Islamic glass vessels there has been an unresolved question about where in the Middle East the main production centres for various vessel forms with characteristic decoration were. There is archaeological evidence for the primary manufacture of glass at sites such as at 9th-12th century al-Raqqa in Syria and 10th-12th century Tyre in the Lebanon, but up to now there has not been an easy way of stating, with confidence, where specific Islamic glass vessel types were made. From the 9th century onwards Islamic glass was manufactured from plant ashes and silica. Chemical analysis using electron microprobe analysis of 250 samples of raw furnace glass and vessel glass from al-Raqqa has shown what compositional types were fused from primary raw materials and worked there: there is archaeological evidence at the site for both primary and secondary glass production. However, whilst an important first step in characterising the glass, it does not constitute an independent means of providing a provenance for glasses made at al-Raqqa.

A new way of providing a provenance for Islamic glasses is the determination of radiogenic isotopes in them, set in an environmental context. We have determined chemical and isotopic characteristics ($^{87}\text{Sr}/^{86}\text{Sr}$ and $^{143}\text{Nd}/^{144}\text{Nd}$) of 40 glass samples from al-Raqqa and Damascus (Syria), and from Beirut (the Lebanon). We have also determined the isotopic signatures for 45 samples of plants and sand (the basic raw materials used to make Islamic glass) from multiple locations in Syria and the Lebanon. For the first time this has provided a geological provenance for Islamic glasses in the Middle East and provided the basis for being able to state with confidence which types of glass vessels were made in different urban centres in the Islamic world and when glass was traded between them.
EARLY ISLAMIC GLASS FROM QASR AL-HAYR ES-SHARQI, SYRIA: EVIDENCE FOR A NEW TECHNOLOGY

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Recent scientific excavations of the peripheral settlements around the 8th-10th century AD “palace” at Qasr al-Hayr es-Sharqi in the Syrian steppes under the direction of Denis Genequand (Université de Lausanne) has produced well-stratified sequences of Early Islamic glass vessels. In particular, House A has yielded a range of highly-decorated glassware from ca 729- ca 830, such as scratch-decorated bowls, marvered, lustre-painted and pincer-decorated vessels. All of these may be found both at other élite sites in Syria (such as the “palaces” at Raqqa) but also from more modest urban sites further south in Bilad es-Sham, such as at Pella in Jordan (University of Sydney excavations) and Aqaba (North Carolina excavations).

Chemical analyses of glass vessels using electron microprobe has shown that, under the Umayyad caliphate, the majority of soda-lime glasses were made from the anticipated natron source of alkali. However, a small number of samples were made from glass which evidently involved either the use of a different alkali source or a different source of lime. Given the rather conservative technology involved in the production of natron glass, largely on the coast of the Levant, this new technology suggests that experimentation occurred as early as the later 8th century with new raw materials. This could be because the natron source of alkali was becoming less usable and anticipated the introduction of the “new” plant ash alkali source in the early 9th century in the Middle East. In this paper we will discuss how these new discoveries fit the regional context of glass production both in archaeological and scientific terms. We will also suggest where some categories of glassware found at Qasr el-Hayr es-Sharqi may have been manufactured using scientific and archaeological comparisons.
The Garamanets have long been recognized as one of the crucial elements of the trade in the Eastern Sahara. Following a survey of the glass material in Germa and during the Work of the Fezzan Project it was possible to reassess the glass material found in the Fezzan proper. The material dates from the late Hellenistic to the Early Islamic period and shows marked changes in the type of material chosen for trade to the area that appears to be the preferred trading partner. While the exchanges in the early Roman period have to be characterised as medium status, but carefully controlled items with a strong preference to the Western Mediterranean, it seems that from the third century onwards a much wider assemblage of material was brought to the oasis, probably predominately from Egypt, and including very high quality items as well as everyday articles.

The paper will survey the material found and draw on parallels from other sites in the region.
NOVELTY GLASSES FROM THE DUTCH GOLDEN AGE.
EXTRAORDINARY GLASSES FROM THE 17th CENTURY
EXCAVATED IN THE CITY OF AMSTERDAM

HULST Michel

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The poster will present the first archaeological evidence of 17th century novelty glass used in the city of Amsterdam.

During the 17th century Amsterdam was at the height of its power, and huge fortunes were accumulated by only a small merchant elite. These new rich rapidly developed a taste for luxury and the exotic. This is not only reflected in the large quantity of glass which sometimes is found in cesspits from this time but also in the quality of some extraordinary glasses. Most of these glasses are for table use, such as welcome beakers, trick glasses and table centrepieces. Some of these glasses could also be meant for collecting and displaying in a showcase or even a specialised ‘kunstkamer’ or cabinet of curiosities. This could be the case for some of the glasses excavated in the cesspit of the neighbour of Rembrandt dating in the late 16th till early 17th century. Although most of the glasses from this cesspit are the waldglas roemers, it also contained façon de Venise beakers with stamped gilded lionheads and some goblets. However, the most unusual vessels present include a winged goblet with scroll work, a flute on a composite stem, fragments of a lobbed tazza, an unusual high stem of a goblet and a green glass bowl with a handle. These vessels as well as the beakers and goblets could be part of an art collection.

The Amsterdam glass furnaces where famous for their high quality glass production, and some of the extraordinary glasses must have been made there. Furthermore, there is additional archaeological evidence that points to the production of high quality glass vessels. Glass waste from the glasshouse Soop (operating between 1601-1625) revealed a trim-off of chalcedony glass as well as a ribbed bowl made of marbled glass. Glass waste from Soop as well as the glasshouse ‘De Twee Rozen’ (the Two roses) at the Rozengracht (circa 1657-1679) showed the production of millefiore glass vessels. Both chalcedony and millefiore are so rare in archaeological context that we can only assume these must have been made in small quantities for the art collections of the very rich.
ANCIENT GLASSMAKING IN ILE-IFE, SOUTHERN NIGERIA

Ige Akin

Glass of different colors is found on crucible lining, together with long drawn beads in the famous Olokun grove in the ancient town of Ile-Ife, southwestern Nigeria. Ethnographic and historical data show that the glass was regularly being produced in southwestern Nigeria by around 1200 AD. Dark blue, white, brown and green glass beads recovered from these sites and other groves and shrines were scientifically characterized by electron probe microanalysis (EPMA). Two chemical types were distinguished: a low calcium, high alumina type and a high calcium, high alumina type. Ethnographic data suggest the high calcium content results from the addition of snail shells in the production process which was also a Yoruba symbol of priestly benediction.

Glass have been produced with similar compositions as excavated glass from powered samples of a combination of oligoclase calcium feldspars, quartz and micas. Experimentally produced glass displays different hues, from colourless to dark olive-green and pink, according to the chemical composition of the raw materials. Electronprobe analysis of the glasses shows that the glasses are higher in alumina and lower in CaO than the glass found in excavation sites.

KEY WORDS: Glass, drawn beads, X-ray Fluorescence, Electron probe, Ile-Ife, in excavation sites.
A HAEMATINON VESSEL FROM PYDNA

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Glass grave-goods in the cemeteries of ancient Pydna, in Macedonia, northern Greece, are numerous. The simple pit grave of a rich lady, buried there in the last quarter of the 4th c. BC, contained diverse glass objects. Among them is an outstanding red glass handleless skyphos decorated with relief long petals. The vessel is damaged and its surface appears green today but it retains its shape and its once bright opaque red glass is still visible in patches.

The typology and composition of this unique find are discussed. Red glass finds are extremely rare in Greece, but in the ancient sources they appear with a Greek name: Pliny the Elder calls red glass “haematinon” (bloody). Shape, decoration, and manufacture technique, place the vessel within the small, distinct group of similar, but made of colorless glass, skyphoi of the same period; six of those have been unearthed in Macedonia and two in Rhodes. The use of red glass in the production of this vessel probably proves that it was worked in the workshop/s that specialized in the production of colorless glass vessels.
In this paper, potash glass production in the 14th century in western Sweden will be discussed. The specific place has been excavated by myself and is one part in my Ph.D. This production site will be compared to others in the dissertation.

Generally, it is said that the smelting technique came to the eastern part of Sweden in the 16th century. As the local museum holds over 25kg of glass mass, analysed to be potash, the chronology of primary glass production in Sweden has to be altered.

During the late Iron Age (in Sweden end of ‘Viking age’ 10th -11th century), manufacturing was conducted by ambulant workers often of foreign origin. In this time, glass production was done with imported raw glass, remelted and reshaped. The production was mainly for jewellery. Thus, the Iron Age production was a custom orientated, non-stationary manufacturing. By the 14th century this chain of operation had changed dramatically. With the opening of monasteries and the know-how within the brotherhoods, the glass production came to be a rigid and stationary manufacturing in a monastery environment.
There are more than 1000 fragments of core-formed glass vessels stored in the Ashmolean Museum, Oxford. These fragments have a museum tag; No. E.4486, and derived from Sinai, Egypt (?), Petrie, 1904-5. In other words it was clear only that these were acquired from Sinai Peninsula, but study of Philip Simpson clarified that these were acquired at Serabit al Khadim, nearby modern town of Tor.

Serabit al Khadim was a mining site of turquoise, in which there was a temple which was built by Egyptian Pharaohs from Middle Kingdom to New Kingdom. During the New Kingdom, Queen Hatshepsut, Tuthmosis III and Amenhotep III enlarged upon and extended the Middle Kingdom temple. These Pharaohs reigns are particularly important for studies of core-formed glass vessels.

The temple was mainly dedicated to the goddess Hathor who not only personified the principles of love, motherhood, and joy but also was the patron goddess copper and turquoise. It seems that these glass fragments were dedicated for Hathor. Because light blue glass were written as molten turquoise in ancient Egypt, it is likely that there was a connection in Hathor and glass. Indeed, there was a temple of Hathor at Timna, the New Kingdom mining site of copper and also core-formed glass vessels were revealed at this site.

It was considered that Egyptians and Levantines engaged in mining together at Serabit al Khadim, because relics of Egyptian and Levantine were revealed from this site. So, I will introduce the core-formed glass vessels from Sinai, outside of Egypt, and study the relation of exportation from the view point of shapes, patterns or colours.
This paper will attempt to show the variations in subject and the critical change in role and meaning of the modern ‘art sacré’ vitrauxs in the Chapel of the Rosary in Vence, compared to the medieval stained glass windows of the 12th and 13th centuries.

In Middle Ages glass becomes a medium of mysteries. In dim and doubtful light men would be gathered together in Cathedrals and churches and would be more earnestly fixed upon religion and devotion. The stained glass windows, the colourful ‘bible of the illiterate poor’, with their vigorous, simplified images and vivid colours had a mystical dimension as they managed to drew the onlooker from the material to the immaterial, bringing -in combination with the impact of architecture and sculpture- the divine into human life.

In 1948 Henri Matisse, with his unique work in the Chapel of the Rosary in Vence, would try to create for the first time an atmosphere that would respond to the very spirit of the religious order for which it was destined. Following a different route and reason, his stained glass windows are characterised by weightlessness and luminosity. Moreover, by eliminating medieval shadows -the material representation of suffering- he succeeded to build a temple for a religion, which refused the idea of evil. Positioned between the bright colours of his vitraux, one feels as if one is part of the painting, inside a ‘corner of Heaven’ according to the master’s goal: “We will have a chapel where everyone will feel hope, however burdened with sins, released by the surrounding joy and light”.

FROM DIDACTIC STAINED GLASS WINDOWS OF MEDIEVAL CATHEDRALS TO THE REDEMPTIVE DIVINE LIGHT IN MATISSE’S VENCE CHAPEL

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Glass played an important role in Caričin Grad, judging by the numerous finds of fragments of window panes, vessels, lamps and tesserae. Windows were used in the city’s architecture, in the churches and public buildings, as well as in the houses discovered in the settlement in the Lower Town. The vessels we most frequently came across were cups with a stem resting on a foot, glasses and lamps with handles, as well as those with cylindrical bases, whereas flasks with a spherical receptacle, a cylindrical neck and a curved rim, were encountered more rarely. The finds in Caričin Grad are evidence of the significant commercialisation of glass goods, thanks to the mastery of this production process and, its expansion, primarily with the development of trade and frequent military troop movements.

A number of finds are proof of glass manufacturing in Caričin Grad. Suffice it to mention the finds of glass chunks: the large piece of blue glass discovered in 1953, in the cluster of buildings north-west of the public square with its circular ground plan, and the pile of chunks made of yellow-green glass, discovered in the Lower Town settlement inside a building erected in front of the tower on the western defence wall. The find of fragments of window panes buried in a pit in the south part of the Upper City, also, indirectly testifies to the manufacture of glass. This glass was evidently collected to melt it down. In 2008 in front of the south-eastern corner tower of the Lower town were found the remains of a workshop for producing glass or vitreous materials dating from the reign of Justininan I.
This paper will examine chemically the glass assemblage found at the Commandant’s House of the Fort at South Shields, Tyne and Wear, UK, dated to around AD 280-320, and presented in an earlier paper by Professor Jennifer Price.

This late Roman assemblage consists mainly of table wares in colours typical of the late third and early fourth century, such as blue and yellow-green, including some colourless decorated (cut) fragments. The phasing of the site gives a clear sequence of dates which can be used to date the glass through this late Roman period. The dating of the glass suggests that the earlier, late third century glasses typically consist of colourless and blue green tablewares, but surprisingly the yellow-green glass (HIMT) typical within many British late Roman assemblages, is not found in significant numbers until the very latest phases. The very close dating of the site allows a sequence of compositional patterns within the glass assemblage to be established through this very short time period, and helps us to understand the sequence of the introduction of different styles and glass compositions at this northern outpost.
GLASS AND THE MANUFACTURE OF BYZANTINE MOSAICS

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Byzantine glass manufacture (by which Constantinopolitan glass manufacture is often meant) has been variously described as ‘one of the great historical enigmas’, a ‘medieval mystery’ and as ‘neglected’. It has also been said of Byzantine glass that ‘almost nothing survives’. This baffling apparent shortage of material has even led to suggestions that the Byzantines did not make glass, or, at least, not very much of it. In fact, several million tons of Byzantine glass survive, often in their original location, in the form of Byzantine mosaics.

This communication examines what is known about the glass making up Byzantine mosaics. No written sources survive from Byzantium about the methods used for making a mosaic or creating its tesserae, and nothing is known of the ways in which manufacturing patterns developed and changed over time, or, indeed, of where and exactly how tesserae were created. Instead, research must focus on the mosaics themselves and above all on their glass. This communication will bring together what is known about the composition of Byzantine glass mosaic tesserae and will outline some of the questions posed by this data: did the differently coloured glass tesserae on one site all come from the same batch of raw glass? Where did that raw glass come from? Do we have any sense of how the sourcing of raw materials for glass-making changed over time? By collating evidence about the make-up of glass tesserae, it may become possible to add to what is known about patterns of glass manufacture in the Mediterranean throughout the Middle Ages.

The communication presents the work of the Leverhulme Trust International Network for the Composition of Byzantine Glass Mosaic Tesserae.
Mosaic glass/Millefiori glass has inspired since antiquity competent glass artists to create exceptional pieces. Some of those makers –especially Italian and French makers of the 19th and 20th centuries– have become very famous and their work is abundantly documented. Yet some others of equally high craftsmanship have never become really known.

Other pieces are constantly not correctly attributed, because we neglect some necessary background facts. Important technical details in the making of mosaic glass are not duly considered by glass historians. These aspects will be described and analysed in this lecture.
During the construction of Iron Gate I water plant in the region of the Middle Danube in today’s Serbia, there were four campaigns of protective archeological excavation on the site at Saldum (Roman Gratiana or Kantabaza). The excavations revealed items of stone architectural remnants and numerous portable findings, which were subsequently dated to the period between 1st and 6th century AD.

Among other items, artefacts included a number of glass containers, mostly different variations of cups, bowls and bottles. The morphological and typological analysis of the artefacts will help us answer some of the following questions:

1. What conclusions can be drawn about social circumstances in Saldum between 1st and 6th century AD, based on available portable findings, with special emphasis on glass artefacts?
2. What was the character of Saldum settlement in the time of the early Empire - civilian or military?
3. What relation, in terms of commercial flow, development of economy and local manufacture, can be made between the glass artefacts from Saldum and other relevant Roman and late Roman findings excavated in the Iron Gate Region?
4. What indications of population changes can be identified through available portable artefacts?

Even though almost four decades have passed since the initial discoveries of numerous fortification facilities in the Iron Gate region, only one of them has been thoroughly documented in the form of a monography. The material found in Saldum stands at the core of the second highly important project, currently undergoing the process of preparation, which would hopefully shed some new light on the life of one of the many military forts guarding the Danube Limes in the times of the Roman and Late Roman Empire. A detailed analysis of the glass containers, along with the comparative study of other portable findings from this site, will hopefully help present the main developmental stages of the settlement. They will also help show details regarding the flow of commerce, economic background, population figures and all other relevant information which can be gathered and reconstructed on the basis of the available glass materials.
THE COMPOSITION OF COLOURLESS AND LIGHT BLUE GLASSES FROM IRON AGE TO HELLENISTIC GORDION, CENTRAL TURKEY

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Samples of Iron Age to Hellenistic glass from Gordion, the capital of ancient Phrygia in central Anatolia (modern Turkey) have been analysed by EPMA and solution ICP-MS. The ancient Phrygians were innovative builders, producers of furniture and mosaics, and metallurgists. The presence of glass at Gordion indicates that ancient Phrygia was the first civilisation in Anatolia known to have used glass from as early as the late 8th century B.C.E. and into the Hellenistic period.

Our program of analysis focuses on two groups of vessels that are either unparalleled or unusually concentrated at Gordion: 1) moulded colourless and light blue vessels from the 8th century levels of the site, and 2) moulded colourless vessels in the Achaemenid style from the second half of the 4th century into the 2nd century B.C.E.

Anatolian / Near Eastern glass-making traditions of the first half of the first millennium B.C.E. have been little investigated and are not well understood. Our analysis addresses key questions about these earliest vessels from Anatolia. How are the 8th century bowls from Gordion related in composition to each other and to colourless and light blue vessels from the east, such as the great Assyrian capital Nimrud (Iraq).

In the 4th century B.C.E. production of moulded glass vessels re-emerged after a long hiatus following the fall of Assyria in the late 7th century B.C.E. Some have seen this new industry as a conscious revival of earlier forms and techniques. Chemical compositional data will provide evidence to show whether 4th century B.C.E. glass making re-institutes the technological traditions of the 8th century B.C.E., or whether innovative practices were employed or borrowed from elsewhere. How are the 4th to 3rd century vessels related chemically to those produced on Rhodes and in Macedonia at this time?
I had the opportunity to examine the weathering of the glass finds which came to light during the subway excavation at Sirkeci in Istanbul.

In this paper, the weatherings of the glass finds which belong to different periods will be evaluated based on their chemical analysis according to weathering types. On the few Islamic glasses more irisation and milky weathering were detected. However on the Roman glass there are more rainbow effects and pitting while Byzantine glasses have enamel-like weathering, irisation with rainbow effect, pitting, dulling and milky weathering. Among the Venitian glasses enamel-like weathering and irisation with rainbow effect are the most common type of weathering. On the other hand Ottoman glasses are relatively in good condition of preservation except some with enamel-like weathering. Among the glass sherds found in the excavations, there are plenty of wasters which have weathering will be examined along with the weathering of the window glasses.
COMPARATIVE STUDY OF ISLAMIC GLASS WEIGHTS AND VESSEL STAMPS WITH THE DAILY USED VESSELS FROM EGYPT

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Glass weights and vessel stamps were officially produced in Egypt to certify the accurate ‘weight’ and ‘quantity’, respectively. They are historically important objects with an inscription of era name on their surface. Sayer and Smith (1974) and Gratuze and Barrandon (1990) have showed the chronological changes of Islamic glass based on chemical analyses of 17 and 70 samples, respectively.

In this study, more than 350 pieces of glass weight and vessel stamp (private collection) were non-destructively analyzed by two kinds of X-ray Fluorescence spectrometers; one was developed for the light element analysis (OURSTEX 100FAII-L) and the other was for the heavy element analysis utilizing high energy X-ray source (Epsilon5). This study was especially based on the readings of the inscription by Dr. Kawatoko (Director of Research Institute for Islamic Archaeology and Culture). To investigate fully the wider significance of the results reported here, same analytical investigation for the vessels or raw chunks from Fustat (owned by Waseda Univ.) was carried out.

The natron-based glass weights and vessel stamps mainly produced in the eighth century exhibited characteristically low lime content. The compositional differences between glass weight and vessel stamp were observed in their trace elements such as barium and lanthanum. In addition, apparent compositional changes of the vessel stamps were found in 720 and 750 A.D. based on the level of elements such as Al, Ti, Fe, Cr and Ni, which are probably derived from their silica source. On the other hand, the low-lime natron-based vessels from Fustat showed a trace element pattern similar to that of glass weight. This study suggests that these vessels seem to have been produced from the same silica source with the glass weights. Useful compositional data to investigate the transition of Islamic plant-ash vessels was also obtained from the glass weights dated after 10th century.
It was well known that a clear change in alkali source from natron to plant-ash had occurred in Egypt and the Eastern Mediterranean area between the eighth and the tenth centuries. To characterize various types of Islamic glass, the on-site analyses of glass objects mainly excavated in the Raya site (Archaeological director: Dr. M. Kawatoko), one of the important port cities for the Red Sea trade, have been conducted using a portable X-ray Fluorescence spectrometer. The chemical analyses of natron-based objects from Raya have provided evidence that they were produced from Syria-Palestine area or Egypt in the eighth to the ninth centuries.

In this report, more than 250 plant-ash vessels mainly from the Fort of Raya (9-12th century), which have been analyzed in Egypt between 2007 and 2008, were studied. We especially shed light on the relationships between the chemical composition and the typological features to characterize plant-ash glass that forms a much wider compositional range than natron glass.

The chemical analyses suggest that three types of plant-ash glass coexisted with natron glass in the ninth century stratum at the Raya site. It should be noted that the colorless plant-ash glass with high ratio of magnesium to calcium and with low impurity levels, which is compositionally consistent with the colorless glass from Nishapur (studied by Brill), was detected. The typological similarity for the glass objects from both sites was also observed. Additionally, another type of plant-ash based glass (around 11-12th centuries) with a higher level of aluminum, titanium and lead than the other types of plant-ash glass was detected in the archaeological area, located close to the Raya. The present analytical and typological characterization of the plant-ash based glass from the Raya/Tur area has allowed comprehensive understanding of the production technology and glass trade through the period.
THE GLASS WORKSHOPS ON MOUNT CARMEL
FROM CREATIVE ARTISANS TO COLLECTORS WORLDWIDE

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Hundreds of glass vessels were discovered in salvage excavations of cemeteries comprising rich burial caves in the western foothills of Mount Carmel. The largest glass assemblages were recovered in the vicinity of the city of Haifa, particularly at Horbat Qastra, Tirat Ha-Carmel and Shiqmona, and farther south at the Ha-Bonim site. Most of the vessels in these corpora date from the fourth and fifth centuries CE.

The extraordinary large quantity of vessels, as well as their varieties in comparison to other groups from the region, all point to an intensive local production. The characteristic features and artistic style of the vessels reflect the particular fingerprint of the local artisans.

Many vessels resembling those from the Mount Carmel area are kept in collections all over the world. Some of them are closely associated with Azeez Khayat, a well-known antiquities dealer who was active in the region in the early twentieth century. These vessels were randomly dug and found their way to various collections. The data accumulated from recent archaeological excavations enable us today to accurately identify the provenance of many of these vessels.
GLASS TABLE WARE FROM AN EARLY BYZANTINE MONASTERY IN SOUTHERN JORDAN

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Between 1997 and 2007, the Finnish Jabal Harûn Project (FJHP), supported by the University of Helsinki and the Academy of Finland, excavated the Early Byzantine monastery of St. Aaron on Jabal Jarûn near Petra in Southern Jordan, dated between the 5th and the 9th centuries AD. The glass finds from this excavation provide a case study to present the use of glass as tableware in an Early Byzantine monastery. A contextual analysis and functional comparison with the pottery will provide evidence for the daily use of glass vessels in the monastery. Glass beakers and cups were used in Petra since the 4th century AD as the main drinking vessel, as pottery drinking vessels are almost entirely absent from the archaeological record. In the Early Byzantine period, glass goblets fulfilled this function followed by larger glass cups in the Early Islamic period. The relevant finds from the monastery on Jabal Harûn demonstrate how and when this change occurred. Furthermore, at the same time a considerable change in the role of glass tableware is attested: from the 5th to the 7th century AD, glass tableware consisted of goblets accompanied by some bowls and flasks, but during the 8th and 9th centuries AD glass plates and dishes were also present and the number of bowls increased. Therefore, glass tableware completely replaced the pottery tableware in the latest phase of the monastery dated to the Early Islamic period. This raises questions of trade connections, as after the end of the production and import of African Red Slip Ware hardly any imported pottery such as glazed wares reached the monastery and glass tableware was imported instead.
THE DISTRIBUTION OF GLASS AND OTHER VITREOUS MATERIALS AT THE HURRIAN CITY OF NUZI: THE SIGNIFICANCE OF GLASS IN THE LATE BRONZE AGE NEAR EAST

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The 2nd millennium BC site of Nuzi, in modern Iraq, was excavated from 1927 to 1931 by an American team from Harvard University. The final Mitanni level, Stratum II, was interpreted as a destruction layer and there was only limited occupation of the site beyond this level. The majority of the vitreous material, and all of the Bronze Age glass vessels, found at Nuzi comes from this level. As part of a major international research project the glass assemblage from Nuzi has been reassessed, including the vitreous material held in the Semitic Museum at Harvard University and the excavation finds books also held there. As part of this project the distribution of glass and vitreous (faience and frit) objects and glazed ceramics across the site has been examined in some detail.

Glass is generally thought of as being a high status material during the Late Bronze Age – probably restricted to the wealthy elite. However, the distribution of glass vessels and glazed ceramics at Nuzi has indicated that these classes of objects had distinct religious significance as well. Almost all of the glazed ceramics found are in locations which are either part of the temple complex or in private ‘chapels’ in the palace and residential settings, consistent with Starr’s (1939) interpretations in the original excavation report. While some glass vessels are associated with elite contexts, such as the vessel fragments noted from M79 – (a high status bedroom) and from the House of Shilwi-Teshub, the majority of the glass (vessels and beads) and glazed ceramic objects found at Nuzi are from ritual contexts, possibly those specific to the worship of Ishtar. This is in contrast to contemporary sites at Alalakh, Tell al Rimah and Tell Brak where glass objects were found more evenly across the palaces and temples, as well as from grave contexts.
The remnants of the city of Chersonesos have been explored more than 180 years now. Archeologists and historians have shown particular interest in the topography of this Byzantine city, whose buildings have been fairly well preserved. Publications devoted to glass wares are not numerous. The most important are recent publications of the assemblages from the well-dated layers where glass artifacts are presented. However, the problem of typology and chronology in papers is often open.

In 2001, research of block 55 in the western part of Chersonesos that includes sacral and residential buildings started within the long-term Ukraine-Poland scientific-research project “Topography of Roman and Early-Byzantine Chersonesos Taurica” which is being realized together with National Preserve “Chersonesos Taurica” (Sevastopol, Ukraine) and Adam Mickiewicz University in Poznań (Poland). The supervisors of this project are Dr A.B. Biernacki (Poland) and Dr E. Klenina (Ukraine). By the present day a five-apse church with baptistery of the 11th-13th c. and ancient dwelling house are uncovered in the block 55.

I would like to present glass wares founded during excavation seasons of 2001-2003 in block 55. They were classified according to functional features into three groups: vessels, lamps, adornments. The most numerous group comprises fragments of Roman and early-Byzantine vessels (beakers, jugs and bottles, goblets). The lamps are presented by fragments of three-handled and conical wares of the early-Byzantine period. The adornments are presented by numerous fragments of the glass bracelets of the Byzantine period and a bead with flute of the 1st c. AD.
BYZANTINE PERIOD GLASS OBJECT FROM MERSIN, YUMUKTEPE MOUND

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Yumuktepe Mound is a Mediterranean settlement situated at the city-center of Mersin in southern Turkey. Its history goes back to the 7000 BCs. At the top of the mound lies a settlement from the Middle Ages (11th-13th centuries). This was actually a fortress-settlement established after Cilicia was regained from the Muslim Arabs towards the end of the 10th century. After the second half of the 11th century it was used only as a farm. The core of the settlement is formed by a church and a grave chapel. Houses, barns and streets surround the church. Although architecturally the remains are quite poor, small finds from the Middle Ages, on the contrary, are rather satisfactory in number. Ceramic, metal, bone, ivory, stone and glass finds comprise of examples imported from the Christian and Muslim communities in Constantinople, the Aegean Islands, mainland Greece, Cyprus, Syria, Iraq and Egypt.

Among glasses for everyday use there are lamps, goblets, flasks, jugs, beads, pendants and bracelets. They all are produced and decorated by using different techniques. Among them there is a unique, Syrian import oil lamp with enamel decoration whose nozzle is bordered with sphinxes in pseudo-script form. On its globular body there are depictions assumed to be pavilions in heaven, which remind us of Chinese pagodas. It must have been a hanging-lamp and was probably bought as a pilgrimage souvenir from one of the Syrian cities renowned for its enameled glass production and brought here.

Within the frame of this paper we will try to present the various kinds of glass vessels that have been unearthed at the 11th to 13th c. strata of the Yumuktepe Mound.
A round the year of 1600 a great change happened in the glass production. The aesthetics issues mostly concerning ornamentation schemes turned towards precious stones and rock crystal. Instead of elaborate fire-worked shapes that Muranese glaziers developed into perfection, the engraved ornaments became the most desirable. This new technique prevailed and caused the chemical changes in bulk mass and new glassmaking technologies. Venetian glassmaking lost its primate and declined. The most important glass centers became Bohemia and Silesia with the satellites all around Middle Europe.

The comparisons between late 16th and early 17th centuries Façon de Venise glasses, and 17th Century Middle-European glass show us the intermingling of both techniques, mutual influences, territorial increase and decrease of both, and other issues, important for glass history. Because of change of some ingredients in the glass mass, we can easily use the results for datation of glass objects. The time line before- and after the year of 1600 is clearly visible.

The chemical structure of glasses was investigated by combined PIXE and PIGE methods, developed for the successfully concluded investigation of mediaeval Glass. Several groups were discerned that can be attributed to certain places of production.
The paper discusses the evolution in form of glass vessels and glass chemical composition showing their parallelism, independence or mutual interaction in late medieval to early modern time. It shows how the demand for new and improved products interacted with changes in glass technology.

Chemical analysis of over 1000 vessels from historical collections and from archaeological contexts is discussed based on the results obtained by the use of several instrumental methods, among others: EPMA, SEM-EDS, EDXRF, LA-ICP-MS, NAA, PGAA.

Among the discussed vessel types, nuppenbechers, vessels made in Venetian style and Baroque style goblets from central Europe serve as the main examples. The forms of nuppenbechers and of vessels made in Venetian style were evolving for almost the whole period representing different technological and aesthetic backgrounds. On the other hand, the evolution of Baroque style objects was a direct response to the new possibilities given by technological advances in seventeenth and eighteenth centuries.

It is shown how these two processes, technological change and evolution in style, interacted over a significant chronological period.
A single object, excavated in one of the medieval cesspits in Elbląg, Poland, is made of strongly green glass and has an unusual form resembling the claw beakers that were so common in early medieval north-western Europe. The vessel was analysed using electron probe microanalysis (EPMA). The discussion is based upon the type and decoration of the vessel and the chemical composition of the glass. This allows us to put forward a proposal for the origin of the glass.
THE COMPOSITION OF WINDOW GLASS
FROM THE CESSPITS IN THE OLD TOWN
IN ELBLĄG, POLAND

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Window glass fragments recovered from cesspits, if not bearing any signs of decoration, constitute a serious problem for archaeologists, as there are almost no grounds to date them or to ascertain their origin. Chemical analysis may constitute an important tool in such research.

This paper reports the results of chemical analysis of window glass pieces found in cesspits in the Old Town of Elbląg, Poland, one of the most important Hanseatic ports, beside Gdańsk, on the Southern Baltic Coast. To characterise the window glass, two instrumental methods were used. General composition, in terms of the major glass components, was analysed by the use of scanning electron microscopy – energy dispersive spectrometry (SEM-EDS). Some minor and trace constituents were analysed using total reflection X-ray fluorescence spectrometry (TXRF). Over 100 post-medieval fragments were included to the project. The results allow us to group the glass finds by their chemical composition and to characterise the evolution of post-medieval window glass in the region.
GOLD-GLASS BEADS IN HELLENISTIC RHODES
AND CONTEMPORARY JAVA: TECHNOLOGICAL
CHALLENGES AND CHOICES

LANKTON, James W.

Gold-glass beads, made by enclosing a thin layer of metal foil between two layers of glass, are one of the most distinctive and widely-traded ornaments from antiquity. While gold-glass beads are often considered an Egyptian invention, among the earliest examples are those from the late third to early second century BCE glass workshop remains found on the Kakoula site in the city of Rhodes. Although the bead workshop itself has not been excavated, the debris, used as fill in rebuilding a nearby Hellenistic house, included approximately 200 gold-glass beads, varying in shape and size, along with glass tube fragments possibly used in their manufacture. With insight from recent field research in eastern Java, where contemporary bead-makers are producing excellent replicas of ancient gold-glass beads, we will explore some of the unusual technological challenges Hellenistic beadmakers faced in making these complex and beautiful objects. Among these challenges were forming the colourless glass tubes, covering these tubes with metal foil, enclosing the inner tubes within an outer layer of glass, and separating the double tubes into individual beads. There is no reason to assume that working processes are similar for two production sites separated by over 2000 years, but the technical requirements for producing gold-glass beads have not changed, and the novel and unexpected methods of the Javanese workers may help us understand both how the early beads might have been made, and the types of tools and refuse that would be associated with the beadmakers’ technological choices.
GLASS IN ROOFS: STUDY OF 19th CENTURY LITERATURE ON BUILDING TECHNOLOGY

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Due to improvements in material properties and in calculation methods, metal and glass constructions were used for the new types of buildings in the nineteenth century: market halls, railway stations, fabrication halls, exhibition halls and greenhouses. Art Nouveau often used metal and glass to achieve bright covered internal spaces. Architects and engineers aimed for the most slender metal construction so more light could enter through the roof glazing.

Many of these nineteenth century glass roofs must undergo a major renovation. During rehabilitation, the construction needs to be adjusted to meet present standards of comfort and safety. The first step in this rehabilitation is to make a historic study of the construction of the glass roof, including how the building was constructed: the building technology.

This paper will focus on the building technology of the nineteenth century glass roofs in Belgium. The geometry of the connection of the glass panels to the metal supporting structure and the bonding techniques used to make this connection will be examined in the context of the geometric typology of the glass roof (for example double or single curved roofs). The research will be based on the available course books from the nineteenth century (e.g. CLOQUET, L., Traités d’architecture. Tome 2: Portes, fenêtres, cheminées, charpente, menuiserie, planchers, combles, couvertures, Ed. Baudry & Cie, Paris et Liège, 1898, 548 p.), books from prominent Belgian architects and engineers (e.g. VIERENDEEL, A., Chapitre 5 : Le verre et les vitrages, pp. 325-378 in La construction architecturale en fonte, fer et acier, Uystpruyst, Louvain, 1902) and the leading Belgian magazines (e.g. Annales des travaux publics de Belgique, 1843-1948).

By means of literature study the paper illustrates the evolution in the construction details of glass coverings in the 19th century.
THE ORIGIN OF ROMAN GLASS FROM BAKAR NECROPOLIS (ADRIATIC, CROATIA)

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The chronological span of the material extends from the beginning of the 1st century to the end of the 3rd century, with an emphasis on the period between the second half of the 1st and the 2nd centuries. The earlier material arrived in the Adriatic during the 1st century primarily through Aquileia. The material also includes individual cosmetic vessels produced in Mediterranean workshops. The products from Italic workshops were joined in the 2nd century by vessels from the Mediterranean, particularly from the Cyprian production centres. Individual forms indicate that the Adriatic trade also had contacts with towns in Asia Minor. Wealthy individuals could have ordered exceptional products from individual workshops that were not a part of the mass production. One example is a bowl from an Egyptian workshop with figural decoration of the ‘contour groove group’. In the 3rd century, the diversity of forms and their variants slowly declines, and various bottles and bowls and balsamaria predominate. Some forms of balsamaria in particular and also the so-called pseudo-Mercury flasks are forms that can be defined as products of local glass workshops. Their distribution throughout the broader area of Dalmatia suggests their origin and marketing in one of the coastal cities of the eastern Adriatic. The analyzed glass material reflected the flourishing economic situation on the coast of the Adriatic from the imperial period and onwards. The region was the meeting point of western and eastern influences. The numerous harbours served as trade bases for the eastern Mediterranean area, and the lively economy, trade, and general prosperity is indirectly shown through the glass material from Bakar - ancient Volcera.
GLASS FINDS FROM ARCHAEOLOGICAL EXCAVATION
AT SANTA MARIA DI BANO CISTERCIAN NUNNERY,
NORTH-WESTERN ITALY (13th – 16th century)

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In 2002, 2004 and 2005 archaeological excavations were undertaken by ISCUM at Cistercian nunnery of Santa Maria di Bano located in south Piedmont in North-western Italy revealing part of cloister, refectory and a complex system of pipe and drain.

The monastery was occupied by Cistercian nuns from the beginning of 13th century and was abandoned at the end of 15th-beginning of 16th century.

A lot of fragmentary glass objects was collected from levels dated from 13th to 16th century: beakers and cups also with applied pinched threads and blue trails or enamelled or with mould blown decoration and spiralling blue trail. This poster presents a selection of the objects found in archaeological layers referred to the 13th – 16th century.

The glass vessels shows links not only with Ligurian but also with Provencal and Venetian glass production and reveal another aspect of the important role assumed by the genoese monastery in low Piedmont and Liguria.
Core-formed vessels of Mediterranean Group I, dating from the late 6th century BCE until the end of the 5th century BCE and probably made on the island of Rhodes (Grose 1989), are subdivided into Classes on the basis of body shape and decorative motif. Interestingly, some Classes display a high level of consistency in execution while others contain vessels whose features are markedly inconsistent. Drawing on developments in physiology, practice theory, sociological studies of embodiment, and general ethnographic studies of craft activity, I decided to find out what, in terms of craft practice and skill level, lay behind these seemingly very differently made vessels. I therefore undertook an apprenticeship with the professional glass workers and archaeological researchers Mark Taylor and David Hill. Using glass of authentic composition, I started to reproduce certain Classes of Group I alabastra. As my level of skill increased, I learned which tools and craft gestures produced which features of the ancient vessels. As well as hand skill, the properties of the glass and the working temperature of the furnace influenced certain vessel features in unexpected ways. In addition, we observed how each craft worker or small working team could develop ‘signature traits’, that is to say a personal or team style in the execution of the vessel. I was then able to thoroughly re-appraise the ancient vessels as the products of a dynamic working tradition where hand skills were continually being taught and learned; to provide an explanation for the inconsistency of some Classes; and to distinguish working team traditions within several Classes of the Group. This paper summarises the main events in this extremely fruitful project, which was kindly funded by the Rakow Foundation at the Corning Museum of Glass, New York.

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PORTUGUESE GLASS COLLECTIONS AND PRODUCTION SITES

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The project “Provenance Studies of Portuguese glasses”, started in 2004, aims at the comparative study of glass objects existing in national territory in Portuguese and European context.

The main goal of this work is to determine the production centres of decorative and utility glass from Portuguese collections (museums and archaeological sites) currently unknown and probably from local production. The existing glass collections attributed to Portuguese manufactures active between the eighteenth to nineteenth centuries will be characterized. The detailed analysis of the glasses was used to test a possible correlation between the compositions obtained for these glasses and the ones from the two main production centres, Coina and Marinha Grande. The chemical composition and production period was related with formal and stylistic characteristics of the objects.

The results of the chemical analysis performed with X-ray fluorescence spectrometry on glass objects from Museu do Vidro in Marinha Grande, Museu Nacional de Arte Antiga (Lisbon), Museu Nacional de Soares dos Reis (Oporto) and Museu Nacional de Machado Castro (Coimbra) will be presented and discussed.
LA PLACE DU MOBILIER EN VERRE DANS LES SÉPULTURES GALLO-ROMAINES DE CHAMPAGNE-ARDENNE

Louis Aurore

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Cette communication se propose de présenter les résultats d’une étude concernant la place du mobilier en verre dans les sépultures gallo-romaines de Champagne-Ardenne. Ce travail se place dans un projet scientifique plus large, impulsé par l’Inrap et mené par des anthropologues, chargés d’opération et spécialistes des mobiliers, intitulé « Pratiques funéraires et sociétés à l’époque romaine en Champagne-Ardenne ».

Les mobiliers d’accompagnement sont traités conjointement par les spécialistes de la céramique, du métal et du verre. Dans un premier temps, la recherche s’est axée sur les sites dont les sépultures contenaient ces trois mobiliers et définis comme sites de référence. Ces observations ont mis en évidence des « codes » funéraires récurrents. Ensuite, pour chaque mobilier sont introduites de nouvelles valeurs venant confirmer les observations précédentes.

Cette étude a permis de travailler sur les objets en verre issus de contextes de découvertes bien datés par la céramique et le métal et de faire avancer non seulement les connaissances intrinsèques sur ce mobilier mais aussi sa place dans la culture matérielle de cette région par le biais de son implication dans les pratiques funéraires. Les résultats reposent sur un corpus de 15 sites ayant livré 57 sépultures pour 117 individus.

Les objectifs de cette recherche se traduisent par l’établissement d’une chrono-typologie des récipients présents dans les tombes, permettant de montrer les particularités dans les formes fréquentes dans cette région mais aussi de resserrer leur datation par le biais des mobiliers associés (céramique et métal). La question du réemploi d’objets domestiques en contexte funéraire est également soulevée au travers de plusieurs exemples. Ce travail sur les formes ouvre ainsi le volet de la place du mobilier en verre dans la culture matérielle gallo-romaine régionale au travers des découvertes funéraires.

Dans un second temps, cette étude a permis d’avancer sur la relation qu’entretient l’individu avec le mobilier en verre, ou sur le rôle de ce mobilier dans les pratiques funéraires. Elle révèle effectivement une interaction entre nature de l’objet et sexe du défunt, entre fonction et positionnement par rapport au corps, entre évolution chronologique des formes et mode de traitement du corps (incinération et inhumation).
BYZANTINE GOLD-LEAF GLASS TESSERAE: A CLOSER LOOK AT MANUFACTURE TECHNIQUE AND DECAY

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Gold-leaf glass tesserae were used in abundance for the decoration of Byzantine monuments. Gold-leaf tessera is a unique type of glass tessera due to its sophisticated manufacture technique- a metal leaf is enclosed between two layers of glass. Manufacture technique of gold-leaf glass tessera necessitates high expertise of the craftsman and the exact method employed during the Byzantine period has not been investigated. In addition, manufacture technique inevitably influences decay as durability of glass is affected by internal and external factors.

Gold-leaf glass tessera is considered to be more fragile and less durable compare to other glass tesserae categories. However, till now its nature and decay has not been the subject of a systematic research. The aim of current study is to investigate gold-leaf glass tesserae condition and alteration for conservation purposes. The study comprises of in situ examination of gold-leaf glass tesserae and sampling of representative tesserae for further investigation.

A closer look at gold-leaf glass tesserae was carried out in situ, on mosaic fragments and detached tesserae mainly at the Byzantine Monastery of Dafni (11th century). Macroscopic examination of tesserae aimed to study technological features and decay prior to further investigation of alteration phenomena on selected samples.

During in situ examination and sorting of detached tesserae a large number of tesserae deriving from the edge of glass slab was revealed. Examination of this type of tessera facilitated investigation of manufacture technique.

Preliminary results regarding manufacture technique and decay of gold-leaf glass tessera would be presented.
CORROSION MORPHOLOGY OF HELLENISTIC GLASS BEADS IN RELATION TO THEIR MANUFACTURE TECHNIQUE

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This work presents the results from the study of a large group of Hellenistic glass beads, derived from the Kakoula excavation, in the city of Rhodes. Glass beads were studied in order to survey their condition and examine their decay patterns. The beads were fashioned in a variety of types, namely drawn, pressed, folded, wound, cut or by a combination of methods. In general, beads are regarded as one of the most defective product of glass industry mainly due to the fact that they are small size objects of massive production. Massive production provokes poor mixing of glass; low working temperatures, inadequate surface finishing etc.

The study of the specific group provide a unique opportunity to correlate the manufacture process of different shaped and collared glass beads to the glass condition of the finds, which was buried for the same time period under the same environmental conditions. Examination of the glass beads under stereomicroscope was used for the initial evaluation of their preservation. Moreover, cross sections of representative samples were examined under optical and scanning electron microscope (SEM/EDX) in order to study the microstructure and the compositional changes of the corroded glass areas, as well as specific corrosion phenomena.

The microscopic examination of the beads and the study of their corrosion morphology provided data for the manufacture techniques and the production technology used, resulting to a better interpretation of the archaeological finds. The results indicated that the preservation of glass beads was affected by both, internal and external factors.

Different preservation condition and corrosion phenomena of glass were recorded on finds of the same colour. The variations identified in their preservation condition were depended on whether the glass was used for the main body or for the decoration of the beads. Considering that the glass finds were exposed to the same environment, these variations are more likely to be related to the different ways of fashioning and finishing of the glass beads.
A NEW ROMAN EMAIL PAINTED GLASS BEAKER
(1st-2nd CENTURY AD) EXCAVATED IN BARBARICUM
(ZABORÓW IN POLAND)
CONTEXT AND PARALLELS

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Roman painted glasses are very uncommon. In 1986 a new glass of type Eggers
186 was excavated in Zaborów, Poland. The decoration illustrates scenery of four
gladiators of which one is a Hoplomachus (a gladiator of the heavy class), another is
a Retiarius – a net fighter.

Closest parallel are two painted glasses from Lubieszewo (Lübsow), Pomerania,
which got lost during World War II. From Barbaricum a number of related glasses
are known: Polowite (Pollwitte) and Rostolty in Poland.

An email painted glass of the same shape was excavated 1984 at Bassenheim, Ger-
many – then Roman Empire. The dating makes it obvious that they belong to the
same group of enamel-painted Early Roman glasses.

Important for the discussion of origin and dating of enamel-painted Roman glass
is the painted glasses from Begram – also parallels to the above mentioned glasses.

Painted glass is among the most exceptional specimens of ancient glass, and fur-
thermore they are found in the most unexpected parts of the old world. The Early
Roman enamel-painted glasses from Barbaricum are all – except the new glass from
Zaborów – from richly equipped grave finds in a limited part of Barbaricum. The
grave field Zaborów is part of an important iron extraction area, which played an
important role during Roman times because of export of iron for the Roman terri-
tory. The painted glass from Richard-Wagner-Strasse, Germany, demonstrates that
the production of enamel-painted glasses in the Rhine area later continued with the
Circus-beakers. Import of painted glasses must be the result of diplomatic gifts, ex-
change and trade and maybe also of Roman military activities.

The publication of Zaborów is in cooperation with Dorota Słowińska and Kata-
rzyna Dejtrowska, Muzeum Starożytnego Hutnictwa Mazowieckiego, Pruszków, Po-
land.
GLASS WORKING IN AMPHIPOLIS
DURING THE ROMAN PERIOD

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Amphipolis was an Athenian colony (438/7 BC) and one of the most important settlements of Macedonia. According to the archaeological evidences and the historic testimonies Amphipolis has proved a continuous development either as Ennea Odoi or as Amphipolis, from the Archaic up to the early Christian times. The rich cemeteries of Amphipolis and its surrounding area provide us important information about the history and the society of the city and its countryside. The rescue excavations of the last decade at the northeastern and mainly the eastern areas of the ancient city (Eastern cemetery), revealed many graves with important finds, among them a number of glass vessels. During the construction of the modern road system of Egnatia Odos, two more cemeteries have been discovered at the area of the modern village Nea Kerdyllia, which was under the cultural influence of Amphipolis. The finds from this cemeteries can be dates to the hellenistic and the roman period.

The glass vessels comprise a great group of the finds at the cemeteries of Amphipolis and the area of Nea Kerdyllia and affirm the existence of a local macedonian workshop. Besides that, they reveal the extended commercial contacts between Amphipolis other workshops of the eastern and western parts of the Roman Empire. Most of those glass vessels have common features with other that have been found in roman and early Christian period graves at Thessaloniki and from different other areas of Macedonia. All those glass vessels display a vast majority of types, colours and decorative techniques.

This paper will focus on the selective presentation of roman and early Christian period glass vessels from closed groups and an attempt will be done of a typological analysis and comparative chronology according to the finds that have been unearthed with the glass vessels, and especially the coins.
This paper presents the preliminary results of the glass study in Madinat Ilbira (Atarfe, Spain) in the Islamic period (eighth to eleventh century A.D.). The first excavation took place in 2001 in Cerro del Sombrerete, where the fragments presented here were recovered (trench 1000). One of them especially remarkable, produced with the so-called sandwich technique and a decoration in gold leaf representing a bird.

Formal and functional study is attempted in this work, together with chemical analysis of one fragment in which lead was used as flux. This use will not be widespread until several centuries later.

The importance of Madinat Ilbira glass is the clear chronology established. The Islamic city was founded in the 9th century and abandoned in the 11th century. Similar examples were found in the area of the former Persian Empire, dated between the 9th and 10th centuries A.D. in the context of a wealthy man’s residence, permitting certain analogies with the city of Madinat Ilbira.

New information is presented here with the aim of contributing to the archaeological debate in Spain and the Mediterranean.
The Collections of the Civici Musei di Storia ed Arte of Trieste were established in 1873 in order to complete the lapidarian collection that had grown around the J.J. Winckelmann cenotaph. Through the years they were enriched thanks to the acquirement of small groups of archaeological findings coming from various countries gravitating on the Mediterranean Sea basin. The sea trade activities played an important role to the town once and the merchants have proved to be rather sensitive to antiquity and its material expressions.

Among the other numerous objects flown together in the public collections, some groups of glass vessels are particularly interesting for their chronological and typological variety.

They are typical productions of eastern Mediterranean regions, and they cannot be compared with any of the glass objects imported in northern Adriatic from those areas.

Their acquisition by the Museum of Trieste gave the opportunity to the visitors to get a wider overview of the ancient glass productions, following one of the main purposes of the institution, which is “to give study material not only to the specialist, but also to the artist and the artisan and to educate the students”.

Particularly interesting among them is a group of vessels of Cypriot production, which includes pyxides and cups of mould formed glass of Hellenistic tradition as well as bag-shaped cups of blown glass, but more objects have been acquired in Crete, in Tunisia, in Egypt and in the syro-palestinian region.
Les recherches archéologiques démarrées en 1954 à Isaccea, cité située au bord du Danube, près de la ville de Tulcea, ont dévoilé plusieurs systèmes de fortification et des monuments appartenant à la cité romaine Noviodunum-Vicina byzantine. Les découvertes ont mis en évidence un consistant dépôt des xie-xive siècles, avec des dizaines de milliers de monnaies, des trésors ou bien des découvertes isolées et plusieurs découvertes céramiques, objets de parure ou de culte, quelques-uns au caractère d’unicité pour le territoire de Dobroudja. Le développement extraordinaire de cette cité fortifiée au caractère urbain nous est suggéré aussi par le grand nombre de nécropoles planes et tumulaires qui totalisent plus de 500 tombes d’inhumation.

L’inventaire funéraire – qui comptait des pièces de parure, de rite et des monnaies – est très varié et représentatif pour cette période. Parmi les nombreux objets découverts, nous présentons les bracelets en verre – une catégorie très bien représentée.

Les bracelets sont portés aux poignets, d’habitude en seul exemplaire (sur chaque main), mais il y a des situations où on rencontre deux ou trois pièces au poignet. Du point de vue chronologique, les plus variés par la forme, la couleur et le décor sont les bracelets des xie-xie siècles. Aux xie-xiiie siècles nous avons constaté une certaine standardisation de la couleur du verre et de la décoration.

Les bracelets des xie-xie siècles proviennent des ateliers de Constantinople mais il y a aussi des produits appartenant aux ateliers balkaniques. On remarque l’existence d’une certaine catégorie – des pièces travaillées négligemment, sans éléments de décor – fait qui suggère qu’elles ont été produites pour être déposées rituellement dans les tombes.

Les exemplaires des xie-xiiie siècles se distinguent par le décor – des motifs incisés ou en relief- et proviennent des ateliers provinciaux.

This paper is concerned with analysing glass fragments from archaeological sites in Petra, Jordan. It focuses on samples from Petra Church Project, North Ridge Project and Petra Great Temple. The aim is to understand the archaeological and technological significance of the glass production in Petra through the transition period from the Late Roman to the Early Islamic period (4th to early 7th centuries AD). The chemical analyses were applied mainly to three glass categories including transparent glass, mosaic tesserae and glass cakes. Optical microscopy, backscatter electron microscopy with energy dispersive spectrometry examination and electron microprobe analyses (EPMA) were applied to examine these samples. The results help to understand the relationship between these different categories in the production of these glasses. The chemical compositions of these samples display their relationship to other defined Levantine compositional groups.

Roman colourless glass was used in Petra during the Nabataean and Roman periods (1st century BC – 4th century AD), which was found in the Great Temple and with some fragments in the Petra Church. In Byzantine Petra (5th – 6th centuries AD), a glass of a more stable composition was used and found in most of the fragments in the Petra Church; and in the Ridge Church glass. This composition is similar to Levantine I and could have been made from the same sand. However, it has the ‘Petra’ characteristic, which includes the calcium phosphate and manganese oxide particles that were found in the glass tesserae and cakes. In addition, the transparent glasses have relatively higher phosphate content. In the early 7th century AD, churches in the Levant were abandoned, partly or completely. Petra Churches were also stripped selectively of their finds, including the glasses that were collected outside the church where they were excavated.
FUNCTIONS AND USERS OF GLASS VESSELS
FROM THE 1st CENTURY B.C. WITH THE INVENTION OF
THE FREE-BLOWING TECHNIQUE TILL THE MEDIEVAL AGES

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The banner aims to present the structure, the goals and the conclusions of the author’s doctoral thesis approved by the Department of History and Archaeology of the Aristotle University of Thessaloniki in 2009.

Structure – Main sections:
◆ “Glassworkers, glass vessels and their users”: through the analysis of manifold factors focuses in the construction of the picture of the evolution noted in the glass industry with the changes brought by the free-blowing technique invented during the 1st century B.C.
◆ “Depictions of glass vessels on archaeological monuments”: a combined study of the archaeological monuments and findings, of the written sources, of the chemical analyses etc as well as stylistic comparisons with published findings recording the level of actual reflection and reproduction of the environment and of real glassware of the period in question.
◆ “Typology – Uses of glass vessels”: examines the evolution of glass-form for the better understanding of form, of use and of the relation between form and function. Development of a broad and balanced typology using multiple criteria and including glass forms from the Forum of Thessaloniki.
◆ “Glass and Science”: concentrates upon the scientific dimension of glassware and of its functions making discernible the revolution marked by the free-blowing technique in a multitude of levels.

The aim of the research was through a comprehensive multifaceted methodology to develop a coherent depiction of the impact and of the functions of glassware regarding the practical needs and the social life of the Roman Empire during a certain period of time, from the 1st century B.C. till the medieval ages.
USE OR RE-USE: AN EXAMINATION OF ROMAN GLASS FINDS FROM THE PAPHOS THEATRE SITE, NEA PAPHOS, CYPRUS

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Excavated glass finds from the Theatre site in Nea Paphos, Cyprus cover the Hellenistic to Ottoman periods and indicate a long period of activity in the Theatre precinct. The majority of our vessel glass dates from the Roman period and is associated with various phases of the Roman Theatre. Following the major earthquake of A.D. 365, the theatre was no longer used as a performance space and quite soon came to be used as a quarry for other building projects, initially the Christian basilica some 200m away. A large quantity of the glass found on site, however, dates from the Late Roman period, 5th – 7th centuries A.D. In this paper I will present an analysis of Roman glass finds from stratified contexts dated before and after the earthquake event as a means of discovering how the glass was being used on site. In addition to vessel fragments there are sporadic finds suggesting secondary glass manufacture was carried out within the Theatre precinct. My aim is to discern from the nature and frequency of finds how the site was being used during the Late Roman period. Does the pattern of glass finds indicate that glass vessels were being used and discarded on site for purposes of consumption, or do the finds represent an accumulation of raw materials associated with secondary glass vessel production? By addressing these questions we will be able to gain a clearer picture of how the site functioned in the Late Roman period: either the finds are indicative of continued site usage in a social context during the post-earthquake phase, or alternatively, the glass artefacts could indicate a new industrial phase at the site, in conjunction with quarrying activity and the dismantling of the Roman Theatre.
REVISITING THE ‘MOURA GLASS TREASURE’:
NEW DATA ABOUT 17th CENTURY GLASS IN PORTUGAL

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Around 1988 a remarkable group of glass objects was occasionally recovered at Moura, a town located in the interior of the Alentejo Region, in the South of Portugal.

The assemblage was composed mainly by fragmentary flasks and bottles, decorated with mould blown pattern of ribs, or by applied slices of multicoloured (millefiori) canes. Opaque red glass was also present.

Lacking a reliable archaeological context, the glass complex was interpreted as Islamic, and dated to the 12th - 13th century. The peculiar shape of the bottles recorded, most of them with bulged or globular necks, as well as the preferred use of strong coloured green, red and blue glass, supported this interpretation.

Twenty years after the discovery, new data provided by recently excavated Portuguese archaeological sites enable us to revise this attribution, and to date the assemblage to the 17th century.

The re-examination of the complex gives also the opportunity to focus on the millefiori glass found in Portugal.

Bibliography:
THE ISOTOPIC ANALYSIS
OF NORTH WESTERN EUROPEAN FOREST GLASS:
WORKING TOWARDS AN INDEPENDENT MEANS
OF PROVENANCING

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Glass is one of several early modern industries where the development from small-scale workshop to large-scale industry offers a valuable insight into wider socio-economic trends. Previously, medieval and early modern forest (wood ash) glass has been studied using a range of analytical techniques. However, characterisations of production centres and exchange systems for forest glasses are difficult to verify, in part because very few examples of raw glass from furnace sites have been investigated. The necessity for an independent means of provenancing glass used in the study of exchange systems is clear.

Compositional analysis can provide evidence for the raw materials used and can sometimes provide compositional groupings specific to sites. However, strontium, neodymium and oxygen isotope determinations can actually provenance the glass by linking the geological ages, or sources, of raw materials to production sites. The potential of using Sr and O isotopes in the study of plant ash glasses has recently been established (Henderson et al., J. Archaeol. Sci., 32, 2005).

Using EPMA-WDS we have analysed over 220 raw glass samples from sixteen European production sites in operation between the fourteenth and seventeenth centuries. These analyses have shown surprisingly distinct compositional groupings which are relatable to the region or, in some cases, the period of production. We have analysed over 70 glass and raw material samples from these sites using TIMS to determine strontium and neodymium isotope ratios. The isotopic analyses have also been very effective in showing differences between sites, even those within the same region. Moreover, we have been able to define specific raw material types and shown that mixing of seaweed-ash and wood-ash raw glasses has occurred. This paper will argue that the combination of these techniques offers a promising new way of provenancing archaeological glass.
GLASS OBJECTS FROM THE EXCAVATION IN KUŞADASI, KADIKALESI/ANAIA (TURKEY)

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Anaia, which dominated the Samian Sound from the Prehistoric period to the Middle Ages, was a diocese during the Byzantine period. It assumed the role of a commercial centre (Kommerkion) and was one of the customs (Emporion) by reason of its strategical position. Because of these reasons Byzantine castle now called as Kadıkalesi might have been built in late the 12th century and early 13th century on a mound.

Numerous glazed and unglazed pottery, glass, bone and metal objects have been unearthed through ongoing excavations at Kadıkalesi/Anaia carried out since 2001. From the finds, we can deduce that the fortress not only had been a defence of the Anaian harbour used for international trade, but also protected a monastery with its ceramic, glass, metal and jewellery production within the walls.

Among the finds, glass objects of Anaia take an important place. It is possible to classify the glasses of Kadıkalesi excavation into three groups: the first group is composed of objects for daily usage such as unguanteriums and beakers, the second group is composed of lighting devices like glass lamps and windowpanes, and the third group is composed of jewellery objects, especially bracelets. All of the Anaian glass objects, with some different and new shapes of them, usually were made by free blowing and trailing technique used commonly in ornaments.

This paper aims to present a selected group of glass finds from Kuşadası, Kadıkalesi excavation, as an indicator of a provincial life in the Byzantine Empire in the 12th and 13th century.
PAST CONSERVATION AND RESTORATION INTERVENTIONS ON THE KENCHREAI OPUS SECTILE PANELS: THE GREEK APPROACH

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Conservation and restoration interventions constitute a critical parameter for the preservation of artworks and may adversely influence their interpretation and appreciation. The Kenchreai Opus Sectile glass panels have received various conservation and restoration treatments first on site and consequently in different museum premises in Greece and in the USA. This paper explores the materials and methods used in Greece by conservator Charalambos Deilakis of the Hellenic Archaeological Service. Information was drawn from unpublished excavation reports, an oral interview with the conservator and examination of the panels at Isthmia archaeological museum. The methods used are discussed in the context of the conservation know-how of the period and recent knowledge in glass corrosion and conservation. All intervention procedures used on the panels are comparatively assessed making use of aesthetic, effectiveness, adequacy and reversibility criteria.
A TRIPLE ARK FOR THE KENCHREAI OPUS SECTILE GLASS PANELS: PREVENTIVE CONSERVATION AND ACCESS AT ISTHMIA ARCHAEOLOGICAL MUSEUM

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The Kenchreai Opus Sectile Glass Panels have been exposed for the last 30 years to the uncontrolled environment of Isthmia archaeological museum with deleterious consequences. The present communication reports on the preventive conservation action taken by the Hellenic Ministry of Culture for this important group of glass finds. The project was implemented in 2005-2006 in the framework of the EU co-funded Peripheral Operational Program of the Peloponnese.

A walk-in chamber was installed in the storage area of the museum aiming at providing safe environmental conditions for the panels while serving as a working space. The chamber is dynamically air conditioned with a continuous flow of filtered air, conditioned at preselected values of temperature and relative humidity. In the interior of the chamber, the panels are stored in tailor made chests of drawers made of inert materials. The old backing and packing materials were replaced by new supports made of inert and rigid materials according to size and fragility.

The chamber design and specifications, the materials and the mounting methods were chosen in order to simultaneously facilitate visual inspection and study of the panels with limited handling while providing physical, chemical and biological protection to the panels.

Provided that the air-conditioning unit is regularly inspected and maintained, the unique Kenchreai opus sectile glass panels will now be safe and accessible for further study and research.
VERRE BYZANTIN ET ISLAMIQUE :
BASE DE DONNÉES BIBLIOGRAPHIQUES
http://www.ifao.egnet.net/bases/verre/

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La base de données bibliographiques sur le verre byzantin et islamique fait partie du programme « Objet d’Égypte » dirigé par Sylvie DENOIX et réalisé à l’Institut français d’archéologie orientale au Caire (cf. /axes/culture-materielle/objets-egypte/).


Les rubriques et les enregistrements sont bilingues : français et anglais ; elles peuvent être interrogées dans les deux langues. Une exception concerne la rubrique contenant un choix d’informations issues de telle ou telle publication, présentées sous forme de points. Elle est rédigée en français pour les textes français, italiens et allemands, et en anglais pour les textes anglais.


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Je souhaite présenter dans ma communication les objets en verre datés du ve au viie siècle, trouvés lors de travaux archéologiques sur des sites monastiques en Égypte. L’époque byzantine jusqu’au début de l’époque arabe est la période du plein développement du mouvement monastique en Égypte. Les objets en verre seront présentés dans leur contexte archéologique et social.

J’ai choisi comme exemples les sites de Bawit (Moyenne Égypte), Esna (Haute Égypte), Kellia (Basse Égypte) et de Naqlun (l’Oasis du Fayoum).

Caractéristiques des sites :

Bawit : Une communauté monastique a été fondée à Bawit, d’après les témoignages littéraires, par l’abbé Apollô vers la fin du ive siècle et les différentes parties du complexe monastique (églises, ermitages, d’autres bâtiments) ont été occupées vraisemblablement jusqu’au xiie siècle. Des travaux archéologiques sont en cours, menés depuis 2003 par l’Institut français d’archéologie orientale (Ifao) en collaboration avec le Louvre.


Naqlun : Le site de Naqlun comprend un complexe d’environ 90 ermitages construits et utilisés à des périodes différentes, entre le ve et le xiiie siècle. On retrouve aussi des traces de l’ancien couvent et de deux cimetières. L’ancien monastère a fonctionné du ve au xive siècle, le cimetière bas fut utilisé probablement déjà au vié siècle et ultérieurement, et le cimetière haut vraisemblablement de la fin du xve-xive siècle jusqu’au xixe siècle. Les fouilles sont menées depuis 1986 par le Centre polonais d’archéologie – Université de Varsovie.
X-RAY ANALYSIS OF HEAD OF PHARAOH, A GLASS SCULPTURE FROM 18th DYNASTY

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As one of the unique collections of MIHO MUSEUM, Shiga, Japan, there is a well known glass sculpture named “Head of Pharaoh, possibly Amenhotep III”. The glass is opaque blue. It is said that the sculpture was produced in the 18th Dynasty, 1400-1350 B.C. The first analysis was made by Dr. R.H. Brill (1999) at the Corning Museum of Glass. S.M. Goldstein (2001) proposed that the artifact was produced by the technique of lost wax casting. The existence of large glass sculpture is of incredible importance for the history of glass. So, we have reanalyzed the object and compared with other glass artifacts in the New Kingdom.

The analysis was made at the MIHO MUSEUM by portable instruments of XRF spectrometer and X-ray diffractometer developed by us. The XAFS analysis of blue glass was carried out at Photon Factory, Japan utilizing synchrotron light source. The weight of the object is 4308g and the height of the largest fragment is about 17cm and the volume is roughly 1500cm³ with an estimated density of 2.9g/cm³. The concentration of MgO was high at 7wt%. The blue glass was chemically characterized by the coexistence of Mg, Al, Fe, Co, Ni and Zn. It is known that cobaltiferous alums from the Western Oases of Egypt contain significant amount of Mg, Mn, Fe, Ni, and Zn and were used in the second millennium BC as a colorant to produce dark blue glasses (Shortland et al. 2006). The present analytical data supports that the dark blue color was produced using the cobalt colorants made from cobaltiferous alums.

The white pigment used for the white of the eye was analyzed by the portable powder diffractometer. The diffraction data revealed that the material is magnesite MgCO₃. We have also focused on the crystal chemistry of cobalt in the glass. We have examined local structure of Co in the cobalt glass produced by core technique in the 18th dynasty of the New Kingdom, Egypt by XAFS analysis and revealed the chemical state.

It is during the Egyptian 18th Dynasty that first large-scale production of glass occurred. This unique glass sculpture may be a fruitful gift of the technological innovation in Egypt.
LES CONTENANTS À HUILE PARFUMÉE FAÇONNÉS SUR NOYAU DANS LES DÉPÔTS VOTIFS DES SANCTUAIRES GRECS : L’EXEMPLE DE L’ARTÉMISION DE THASOS

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L’offrande aux divinités de contenants à huile parfumée façonnés sur noyau est attestée par les inventaires des temples, notamment d’Athènes et de Délos. Les informations qu’ils nous offrent doivent être complétées par le mobilier mis au jour dans des dépôts votifs. On proposera ici un recensement des sanctuaires qui ont livré de tels objets (Héraion de Délos, sanctuaire d’Athéna à Lindos, Antre corycien, sanctuaire de Démeter à Cnossos, sanctuaires de Déméter et de Koré à Corinthe et à Cyrène....) et l’on présentera le mobilier inédit provenant de la fouille de l’Artémision de Thasos. Plus de trois cents fragments de verres façonnés sur noyau y ont été mis au jour. Ils appartiennent principalement aux alabastres, amphoriques, oenochoés et aryballes de la première phase de production datée de la fin du VIᵉ et du Vᵉ s. av. J.-C.
VENETIAN RENAISSANCE GLASS FROM THE CAUCASUS

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At the previous meeting of the AIHV in 2006, Dedo von Kerssenbrock-Krosigk gave a paper on the problems in distinguishing between original pieces of Venetian gilt and enameled Renaissance glass and later copies. This poster will focus on examples of securely-dated Venetian Renaissance glass excavated in the northern Caucasus in the late 19th century and now preserved in the State Hermitage, St Petersburg, and in the Historical Museum, Moscow. It will then compare these pieces against a group of similarly decorated vessels, some of which have had their authenticity disputed, to see if it is possible to recognize features that may help to discriminate between originals and later imitations.
This paper will examine the evidence for the different materials used to form the moulds utilized in the production of Byzantine glass vessels from the Eastern Mediterranean, dating from the 5th to 7th century AD. Surviving glass moulds from antiquity are exceedingly rare, so this paper will concentrate on the evidence that may be deduced from detailed examination of the glass vessels themselves. For the most part, moulds were only used to form and decorate the body and sometimes the base, while the neck and mouth were free-blown and shaped after extraction from the mould. Where the resulting body decoration is in low relief, it is possible to suggest that these vessels were created mostly in terracotta moulds. Where the body is polygonal, the terracotta panels were probably held vertically in some sort of container mould and set onto a terracotta or stone base plate or directly onto the floor. Alternatively, where the decoration is depressed or in sunken relief, metal moulds tended to have been used. For these vessels, the moulds could have been made from long decorated strips bent and secured to form open-ended polygonal cylinders. On others, decorated base plates formed an integral part of the mould, as for the bronze hexagonal mould with geometric decoration found at Sebaste-Samaria, Israel. Other vessels show evidence for two decorated metal pieces being bent to form two half-hexagons that were subsequently fixed or held together, often resulting in vessels with a squashed hexagonal section.
THE HARROW CHALICE: EARLY GLASS OR EARLY FAKE?

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In 2006 Nicholson published a preliminary investigation of an Egyptian glass chalice from the collection of Harrow School, Middlesex, U.K. The piece was collected by the distinguished Egyptologist Sir John Gardner Wilkinson (1797-1875) and described by him in his catalogue of the collection at Harrow School in 1864 accompanied by a water colour illustration.

Examination of the piece suggested that it might belong to a small group of early 18th Dynasty glasses which include the well known Munich chalice bearing the name of Thutmose III and a plainer vessel from Gurob now in the Ashmolean Museum, Oxford. If the piece does indeed belong to this group it would be an important and early example of its type with relevance for the origins of glass working, and perhaps glassmaking, in Egypt. However, with such an unusual piece considerable caution must be exercised in case the piece is an unusual, early, fake.

Following the initial investigation permission has now been granted by the Keepers and Governors of Harrow School and by the Curator of the Museum for it to be investigated scientifically. This paper presents the results from a major elements analysis undertaken using the Scanning Electron Microscope (SEM) at Cardiff University and Trace Element Analysis using Laser Ablation-Inductively Coupled Plasma Mass Spectrometry (LA-ICPMS) at Imperial College London with a view to determining the likely status of this unusual piece.
GLASS AND FAIENCE AND MYCENAEN SOCIETY

**NIGHTINGALE Georg**

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Glass and faience were an integral element of Aegean material culture; with faience being the older material with a long history especially on Minoan Crete and glass appearing at a later stage and being commonly used in the later stages of the Late Bronze Age. Then the Mycenaen culture marked the final floruit of Late Bronze Age culture in Greece. Glass and faience was used mainly in the form of beads and inlays; but other uses like as architectural element, for vessels or luxurious goods like sword hilts etc. are known as well. The heavy emphasis on beads and the dominance of the colour blue are a peculiar feature of the Aegean vitreous industries.

It is very interesting to see that especially the use of the beads seems to be very egalitarian; quite in contrast to the hierarchical nature of the society, as it is known from the texts and from archaeology. Is this picture deceiving? Do glass and faience beads or other glass and faience objects act as markers of status or of function in society? For some burials it is possible to single them out as belonging to the upper classes of Mycenaen society. Weapons, bronze vessels and gold jewellery are commonly recognized as markers of status. An analysis of the patterns of distribution of glass and faience beads and of other glass and faience objects in such burials allows interesting conclusions to be reached. A further light on the use of glass and faience in the Aegean is shed by the Mycenaen beads exported to the Eastern Mediterranean and to the West.
The glass assemblage excavated by Brown University at the Great Temple in Petra (Jordan) from 1998-2007 provides significant new material for our understanding of the interaction of Nabataean trade and culture within and beyond its region in the first two centuries CE. Glass from the Augustan-Trajanic periods at the Great Temple falls into two groups: those that follow the generic Levantine traditions of glass workshops, and those which were clearly imported from either the western Mediterranean, Roman Egypt, or from specialised workshops in Phoenicia and/or Judaea. Imported, non-Levantine glass comprises nearly two-thirds of the MNE of 77 vessels; this is a significantly different pattern from that as yet found in non-garrisoned cities or coloniae elsewhere in the Levant.

“Imported” Flavian glass also falls into two groups. The largest has a range of forms, but shared an intentionally decolourised fabric and were all decorated by either intaglio cutting and/or cold-painting. Some close parallels come from the corpus found - well beyond Rome’s borders - at Begram (Afghanistan). The second, more utilitarian category of Flavian glass indicates a direct connection with the western Mediterranean, if not Roman Italy.

This paper will highlight the contribution these élite vessels can make to our understanding of “romanisation” or “globalisation” for a kingdom which had pre-Roman commercial and cultural ties to Alexandria, and a nominal economic independence from Rome prior to its annexation in AD 106. It will also highlight the peculiarity of the material culture of Nabataea and its successor, provincia Arabia, in relation to other regions of Syro-Palestine.
ANALYTICAL AND TECHNOLOGICAL STUDY
OF AN ANCIENT GLASS COLLECTION FROM THEBES,
GREECE: AN OVERALL ASSESSMENT

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While significant knowledge about antiquity glassmaking has been accumulated through archaeometric studies, glass production issues like provenance and transfer of technology during the Greek antiquity of the historical period remain ill-understood.

An archaeological glass collection originated from mainland Greece, Thebes, is introduced and examined in this study. The collection consists of glass beads and fragments from core-formed glass vessels. The beads were excavated from a cemetery in the vicinity of Thebes spanning from Archaic to Hellenistic times (7th-2nd B.C.), while the fragments were excavated from an archaeological site in the city of Thebes and are dated at Classical times.

This work aims at presenting analytical data from the Mainland site of Thebes, Greece towards the characterisation of ancient glass collection through the use of a scanning electron microscope equipped with energy dispersive X-ray microanalysis (SEM-EDX) and also by used non-destructive x-rays fluorescence (XRF). The non-destructive analysis of the major, minor and trace elements in the glass artifacts was performed using a bench-top XRF spectrometer, whereas SEM/EDX microanalysis has complemented and cross-checked the glass matrix composition. An attempt will be presented as regards the potential origin (local or imported) of the glasses recovered by using compositional and technological markers.

The results to be presented constitute the first overall assessment of technological issues relevant to glass production during historical times in Thebes, and will contribute to the development of a compositional databank for glasses from ancient Greece.
RECENT GLASS FINDS IN ISTANBUL

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During the excavations of Marmaray-Metro Subway Project at Sirkeci hundreds of glass shards came to light. The earliest glass finds belong to the Roman period. The colours of these finds are bluish, greenish, yellowish, olive, turquoise, purple and amber. These Roman examples are usually cut, trailed, free-blown, mould-blown glasses and twisted bracelets.

Early Byzantine examples (5th-8th C.) are more in number. Conical lamps, stemmed lamps, goblets, thumblers, bracelets, window glasses are the examples for the daily use. Conical lamps in particular, are made of high quality glass. Some are horizontally whereas some others are dotted with cobalt blue glass drops. Window glasses are crown, cylinder-blown and cast. Especially cast window glasses are bubbly and colourless. Some of them have wheel-polished edges. They may have been coming from an important building located in modern Sirkeci. One of the surprising find in the area is a mosaic-glass wall-plaque.

There are many Ottoman glass shards in Sirkeci. Early Ottoman glasses (15th c.) are olive, brown, yellow and turquoise spirally ribbed lentoid bottles. In the later centuries (16th-17th c.) bottles became taller, as well as their colour turned into turquoise. A lot of glass shards which belong to piriform vases or bottles were unearthed. 18th-19th glasses are more decolorised and present more refine workmanship.

Some Venetian glasses were unearthed. These are goblets, vases and lamps from the 16th c. Filigree glasses in particular constitute a big number. These glasses most probably were the daily goods of Italian families once they lived at Sirkeci and Tahtakale.

Besides all these Byzantine and Ottoman examples some glass waste, deformed or devitrified objects come to light.
I will analyse the available information related to ancient glassworking in the late Iron Age Dacian Kingdom and the 2nd and 3rd century Roman province of Dacia. I will try to shed light on some of the aspects of craftsmanship from this region based on published or unpublished archaeological data which could attest the presence of a glass workshop. The 1st century BC - 1st century AD Dacian Kingdom, which has been conquered by the emperor Traian through the two Dacian wars, has been transformed shortly after 106 AD (the end of the second Dacian war) into a Roman province. Being officially abandoned by the emperor Aurelianus in 271 AD, this province (with his about 150 years of being) was one of the most short-lived provinces of the Empire, and offers important dating evidence for the archaeological material from this chronological sequence. Some of the settlements of pre-roman (Sarmizegetusa Regia) and roman Dacia (Porolissum, Apulum, Sarmizegetusa, Tibiscum, Dierna) are relatively rich in finds related to glassworking, but from this region there is no clear evidence for glass production.
An assemblage of twenty-nine mosaic tesserae excavated at Ancient Messene, Western Peloponnese, Greece was studied for chemical characterization, technological and archaeological interpretations. The coloured translucent and opaque glass specimens that preserve evidence of their supporting surface derived from an annex of the Isis sanctuary and are securely dated in the Late Roman period (4th c. B.C.). Investigation proceeded using a Scanning Electron Microscope equipped with Energy Dispersive X-rays microanalysis (EDX-SEM). It was found that the matrix for all samples was a soda-silica-lime glass that was heterogeneous with many dispersed inclusions. It is suggested that chemical analysis can contribute significantly in our understanding of mosaic tesserae fabrication that is bounded in general terms to social and economic issues. The results are also compared to those of similar nature reported in literature, in an attempt to locate both general and local manufacturing traditions within the High Empire. Finally, a comparison with standard glass material from the same excavation is pursued, in order to assess possible connections.
ANALYTICAL AND TECHNOLOGICAL STUDY OF ROMAN – EARLY CHRISTIAN GLASS OBJECTS FROM ANCIENT MESSENE, GREECE

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Systematic excavations at the very important archaeological site of Ancient Messene in Western Peloponnese have revealed several thousand glass sherds spanning a broad chronological period from Hellenistic to Early Christian Times (4th B.C. – 6th A.D.).

Within the aims of the present study, a total of 60 samples derived from objects dated to the Roman and Early Christian periods were studied with a Scanning Electron Microscope equipped with Energy Dispersive X-rays microanalysis (EDX-SEM). Sample selection was made on the grounds of type and colour of glass while the assemblage includes also vitreous debris, a painted window fragment and two well-preserved fragments of glass cakes. SEM-EDX quantitative analyses was employed with the aim to identify the chemical composition of the glass; this information which is directly associated to the raw materials used for its manufacture, coloration, translucency and opacity can also provide information about the technological state and properties of the material. Further, it is possible to draw conclusions regarding local secondary fabrication workshops that remelted and shaped lumps of raw glass. Finally, we obtain analytical evidence for recipe changes during the transitional period from the Roman to Early Christian time. The implications of the above are discussed in the light of the archaeological evidence.
In June 2006 the IH’ Ephorate of Prehistoric and Classical Antiquities conducted a rescue excavation in a private owned property at the centre of the modern village of Krinides, where the extended east cemetery of the ancient city of Philippi is located. Among the fifty tombs of various form and chronology, which were found during the research, one tomb, number 21, is distinctive. It is a large marble built cist grave, which contained a female burial, accompanied with all of her jewels and toiletry. Among the rich buried items which included, golden jewels, clay vessels and figurines, iron items, silver and bone decorative items, a copper bowl and a copper mirror, a marble grater and some other artifacts, 2 rare and small glass alabastra vessels are outstanding.

The comparative study of the artifacts leads to date tomb 21 to the first half of the 2nd century B.C., offering in this way a total, chronologically tight, for the two alabastra vessels that concern us.
THE IMPORTANCE OF POTS: THE ROLE OF REFRACTORIES IN THE DEVELOPMENT OF THE ENGLISH GLASS INDUSTRY DURING THE 16th / 17th CENTURIES

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Prior to the 16th century, most of the green glass for windows and vessels used in Britain was produced in France and Germany, but some glass was made in England, and a number of medieval furnaces have been excavated (Crossley 1990). The glass made at English medieval glasshouses, referred to here as potash-glass, was rich in potash and lime and susceptible to weathering. In the late 16th century, glass workers from Lorraine and Normandy came to England. The glass made by these French glassworkers was brighter and more durable than the earlier English glass. Analyses have shown that the later glass generally contains more lime and less potash, so it is referred to as “High-Lime, Low-Alkali” or HLLA glass (Mortimer 1997).

Previously, there have been many valuable studies of potash- and HLLA glass, focusing on the raw materials used in their production and in particular on the plant ashes that were the dominant source of flux (for example Turner 1956, Sanderson and Hunter 1981, Jackson et al. 2005). However this paper will consider another aspect of the transition from potash- to HLLA glass, which has received less attention but was also crucial to successful production, specifically the choice of clay used to make the pots that held the glass. Potash- and HLLA glass types have been experimentally recreated in order to compare the conditions required for the production of each type. Compositional and mineralogical information on the ceramics recovered from furnace sites producing each glass type are also contrasted, to investigate the compatibility of these ceramics with the challenging furnace conditions.

References
THREE-LAYERED ISLAMIC CAMEO GLASS: A NEW EXAMPLE IN THE METROPOLITAN MUSEUM OF ART

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A carved glass fragment with a depiction of a fantastic animal excavated at Nishapur (Iran) and now in The Metropolitan Museum of Art was recently examined as part of the reinstallation of the Museum’s Islamic galleries. The fragment was described by Jens Kröger in his catalogue of the glass from Nishapur as being carved of dark blue glass and he compared it with other carved Islamic glass objects whose colors imitate semi-precious stones, in this case, lapis lazuli. However, the recent examination revealed that the fragment is actually composed of three layers of differently colored glass, with layers of opaque white blue overlaying the dark blue base. The fragment is carved in such a way that each succeeding layer is stepped back slight from the one beneath so that a white outline is created around the figure of the animal. This fragment now joins one at the Corning Museum of Glass as only the second recognized example of a three-layered Islamic cameo glass.

This paper will present a stylistic and technical description of the fragment in the Metropolitan Museum, in comparison with the Corning Museum fragment, and will attempt to place both in the context of Islamic carved glassware and related antecedents in the Roman world.
GLASS FROM PALMYRA – FINDS FROM THE EXCAVATIONS IN THE SO-CALLED ‘HELLENISTIC’ TOWN

PLOYER R.

In the area of the so-called ‘Hellenistic’ town of Palmyra a cross-road with following building complexes and a caravan building located in the north were excavated within the years 1999 to 2007. From these two areas more than 1300 glass fragments could be recovered. Through the documentation of these glass finds it has been possible to record the form spectrum of the Palmyrenean glass from a settlement context from the 1st century BC up to the 4th century AD for the first time. Several fragments of ribbed bowls belong to the oldest finds and date from the early 1st century BC to the end of the 1st century AD as well as mold-cast plates and bowls. Early mold blown vessels like hexagonal bottles with high relief and date-shaped bottles were also in use at this time.

The bigger part of the glass vessels dates into the 2nd and 3rd century. Glass of the middle imperial period find their parallels primarily in the finds of Dura Europos where the beginning of a glass manufacture between 70 and 100 AD has been proven and which probably produced up to the destruction of Dura in 256. To the rich form spectrum of the Palmyrenean glass of this time different cups, bowls, bottles, cans and pots have to be mentioned.

Beside ceramic finds from upper layers also glass fragments from the late 4th century suggest that the area of the ‘Hellenistic’ town was still settled at least at times and partially in the late antiquity.

The origin of the glass vessels proves to be problematic. It can be supposed that utility ware was made locally in the region, even if any evidence of glass working is still lacking from Palmyra. The question of the provenance of the luxury vessels remains open. It is reasonable to assume that some of them were from the Levant or imported from Cyprus or Egypt. Vessels with engraved decoration may come from Dura Europos.
According to the glass finds from early and middle Roman times from the area beyond the limes north of the Lower Danube we established that all these glass items are only of provincial Roman production. At the moment, it is impossible to establish either the exact location or the general area of production.

Concerning the chronology of the glass vessel from the discussed region, we can observe that there was not a continuous spreading of glass import in the Barbaricum, as is traditionally stated in the literature. Our research points to the glass finds belonging to two main chronological groups:

a. the first, end of the 1st - beginning of the 2nd c.;

b. the second, first half of the 3rd c.

A separate category comprises artifacts which can’t be dated.

Analyzing the function of the glass finds, we observe the clear dominance of drinking vessels and containers for toiletries. Jars and bottles, as well as dishes, are very rare. Prevalence of the toiletry vessel during the first period is an important point for discussing the kind of relationship between Romans and Barbarians.

During the 3rd c. the situation changes and drinking vessels outnumber other types. They are found grouped in the lower stretches of the Dniestr and Danube rivers, as well as close to the Eastern Carpathians, where there are many known archaeological sites of the so-called “Free Dacians”. The distribution of the glass vessels is along the old trade ways, as in the previous period. This was probably a result of the situation of local markets.

The glass vases discovered in the settlements are fewer in number than the artifacts from burial contexts from 3rd c. But the forms are the same as glass vessels from graves. Differences between “life” and “death” cultures are not attested.

Toiletry vessels, such as bottles for body oils, are common in the graves from the first chronological group (end of 1st - beginning of 2nd c.). However, cups prevail during all the 3rd c. Beakers are found in the sub-Carpathian region, but the cups are spread only in the lower stretches of the Dniestr and Danube rivers. These differences are seen in many examples of Roman goods attested in the eastern Carpathian regions.
GLASS FROM THE LATE ROMAN COURTYARD HOUSE AT SOUTH SHIELDS, A NORTHERN FRONTIER FORT IN BRITAIN

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The fort at South Shields is sited on the south bank of the mouth of the River Tyne, in north east England. It formed part of the military frontier system in northern Britain. The first fort was established in the late first century and military units occupied the site at many periods from then until the end of the fourth century.

In the late third century, a large house with a courtyard, probably the commanding officer’s residence, was constructed in the south east area of the fort, and excavation has identified several periods of occupation between that time and the end of the 4th century. The house, barrack and adjacent areas have produced a substantial quantity of glass vessel fragments from secure contexts (colourless, bluish green, greenish and yellowish green tablewares and some containers), as well as window fragments and objects, and these make an interesting case-study in the changing patterns of use and the range of vessel glass in use in a high status official building in northern Britain in the fourth century.
MEDIEVAL GLASS BRACELETS FROM BANAT TERRITORY

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Glass bracelets represent a typical 11th-12th c. jewellery in Central and eastern Serbia, similarly to other parts of Balkan Peninsula which have been under Byzantine domination. During the same period this kind of jewellery does not appear often in the territory northern of Sava and Danube which was part of the Hungarian state. The only exception is presented by the south-eastern part of Banat, where glass bracelets have been found in several sites and this phenomenon will be the theme of the present communication. That territory, as it is today understood, spreads from Danube till upstream of Tamis on the north, while on the West it is constrained by the Karas valley, and the East by the Cerna valley. That territory is highlands, unlike the rest of the plain Banat’s territory. The majority of the so far known glass bracelets are found in necropoleis (Caransebes, Cuptoare, Moldova Veche, Sopotu Vechi, Dupljaja), while only some are founded in settlements (Gornea, Dupljaja). Necropoleis are dated from the end of 11th to the beginning of 13th century, while glass bracelets mostly appear in the 12th century. Common find in the same necropoleis represent other jewellery -mainly different forms of earrings- which are not known in other parts of southern Panony, but have direct analogies with finds from southern of Danube. The presence of these finds has been interpreted as strong Byzantine influence which is generally obvious in the material culture of this specific territory, while in the rest of the Banat territory and other parts of medieval Hungary typical burial finds belong only to the Bijelo Brdo type.
STUDY AND ANALYSIS OF SEVENTEENTH CENTURY FILIGRANA GLASS FRAGMENTS FROM THE MONASTERY OF STA. CLARA-A-VELHA, PORTUGAL

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Micro-EDXRF and PIXE analytical techniques were used to determine the chemical composition of twenty-three filigrana glass fragments and seven filigrana canes from an archaeological excavation carried out in the Monastery of Sta. Clara-a-Velha in Coimbra, Portugal. These fragments were made by several filigrana techniques using opaque white glass threads and in a few cases opaque red, green, blue, yellow and purple glasses were also applied in the filigrana decoration.

The analysis of the different glasses in the filigrana fragments and canes – the colourless glass used to make the vessels and the colourless, opaque white and/or coloured glasses used in the threads – was in most cases performed directly on the surface without any previous preparation.

Preliminary results show that the colourless glasses of the fragments and canes are all of the soda lime silicate type being the tin oxide the opacifier used in the white glasses.

The results obtained are also compared with compositions of façon de Venise filigrana glasses from Belgium, German and France and of Venetian filigrana archaeological findings in an attempt to determine the production centre of the filigrana glass objects from this archaeological site. The results obtained are discussed.
High and Low-CaO Groups of Glass in the Late Bronze Age Levant and Mesopotamia

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Some 43 Late Bronze Age glasses from Pella in Jordan and 16 glasses from Nuzi in Iraq have been analysed by SEM-EDXA, EPMA and solution ICP-MS. These glasses date from the sixteenth to the fourteenth centuries B.C.E. and are predominantly opaque turquoise blue and transparent blue beads, pendants, ingots and vessels. All base glass compositions are of the silica-lime-soda type, with elevated MgO, K₂O and P₂O₅, suggesting that the glass-making technology at this time employed consistent recipes and similar raw material sources, with its products being dispersed across a broad geographic region.

Surprisingly, these typical Late Bronze Age Mesopotamian glasses clearly divide into two groups based on CaO content. This phenomenon is observed at both sites throughout a period spanning approximately 200 years. Comparisons are made with published data including those of Late Bronze Age Egyptian and Mesopotamian glasses to explore the extent and significance of the observed dichotomy. This discovery raises interesting questions such as whether the existence of a high and a low CaO group could be related to object form or colour and the translucency or opacity of the glasses. Does the observed difference in lime content reflect glass production by more than one workshop which each access slightly different raw materials, such as plant ashes, that are combined in similar recipes to produce glasses of otherwise closely similar composition? These issues will be considered in the light of both the current knowledge of LBA glass-making traditions and the recent research on the nature and complexities of plant ashes used in ancient glass-making.
L'artisanat du verre durant l'Antiquité est depuis longtemps connu à Lyon. En effet, le quartier qui s'étend le long de la rive gauche de la Saône, sur le quai Saint-Vincent, s'intègre dans la vie artisanale de Lugdunum pendant le Haut-Empire, plus particulièrement au Ier siècle ap. J.-C. Plusieurs investigations archéologiques, durant les années 1960, ont mis au jour des structures et/ou des déchets attestant de l'artisanat du verre. Il existe l'atelier de la Muette, place de la Butte et les vestiges de la cour de la Manutention militaire. La découverte de deux fours de verriers sur le site des Subsistances en 2000 a confirmé l'activité artisanale de ce quartier ; s'en suivra celle de l'atelier de la Montée de la Butte en 2000-2001 comptant au moins seize fours et trois fosses dépotoirs. Ce centre artisanal semble s'arrêter au début du IIe siècle. Des vestiges d'activité verrière de l'époque sévérienne sont connus sur un autre site lyonnais, l'atelier de la Vieille Monnaie, qui constitue un point de comparaison essentielle.

Nous souhaitons donc faire un point sur les vestiges d'ateliers de verriers découverts jusqu'à présent à Lyon. Il semble important de mettre en avant les différences et les corrélations qu'il peut exister entre les structures et le mobilier des différents sites mis au jour.

Nous sommes en droit de nous poser plusieurs questions : les vestiges appartiennent-ils à un même atelier ou s'agit-il de plusieurs zones de travail ? Existaient-ils une spécialisation et une complémentarité de production ? Enfin, s'agit-il d'activités contemporaines ?

À partir de cette documentation, nous essayerons d'établir un bilan de l'artisanat du verre à Lyon.
THE BRITISH MUSEUM’S AMARNA GLASS FISH
SCIENTIFICALLY INVESTIGATED

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The famous Egyptian glass fish figure in the British Museum (EA 55193) has been exhibited around the world but never been the subject of scientific study. Found in the ancient city of Akhetaten at Amarna, the fish has generally been assumed to be a local product, as during the city’s brief existence (c. 1350–1330 BC) it was a glass manufacturing centre. A full scientific examination has now clarified its composition and added nuance to the question of provenance.

The fish was studied by optical microscopy and X-ray fluorescence (XRF) analysis. Because of the value and fragility of the fish, we decided against micro-sampling and electron microscopy at variable pressure in favour of XRF under ambient pressure, also because of the XRF’s higher sensitivity for transition metal elements like manganese, iron, nickel, cobalt, copper and zinc. The XRF results were calculated using the PyMCA code developed at the European Synchrotron Radiation Facility (ESRF).

The blue, light blue, yellow and white glasses have typical Late Bronze Age (LBA) compositions. Moreover, the blue glass was deliberately coloured with cobalt and copper. This type of colouration is rare in LBA glass, but examples have been found both at Amarna and Malkata. This means that the fish originates from an Amarna or Malkata workshop, which are as yet undistinguishable through scientific analysis.
LES PERLES EN VERRE DU CAUCASE DU NORD DES IIe-IIIe SIÈCLES : LA TECHNOLOGIE DE FABRICATION ET LA COMPOSITION CHIMIQUE

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La plupart des perles sont monochromes, fabriquées de tubes étirés et de tiges étirées, ce qui est typique pour cette époque. Les perles avec une feuille métallique à l'intérieur et celles polychromes, notamment « millefiori », ont également été examinées.

Les perles de Brut 2 se distinguent par leur composition chimique variée. Leur verre a été produit à base de cendre végétale ainsi qu'à base de natron. La grande partie des perles est fabriquée en verre dont la composition ne permet pas d'identifier les matières premières. Une série d'échantillons se distingue par la concentration basse du calcium (à partir de 2,4 %)/ Certains verres se caractérisent par la haute concentration du plomb (17-36%). Ces dernières sont opaques, rouges et oranges, colorées par le cuivre avec de l'étain. Le verre translucide incolore des perles à une feuille métallique est fabriqué à base de natron et décoloré par l'antimoine. Le verre bleu foncé est coloré par des minerais de cobalt d'origine différente.

La composition chimique du verre des perles indique leur différence d'origine, en confirmant la diversité des relations culturelles de la population du Caucase du Nord dans les premiers siècles de notre ère.
GLASS BEADS FROM BANAT AND BACHKA, LATE ANTIQUITY TO GREAT MIGRATION PERIOD (PRELIMINARY RESEARCH DATA)

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The research is focused on glass beads from the necropoleis of Banat and Bachka in northern Serbia (the region of southeastern Pannonia). Most of the beads are dated to Late Antiquity, preliminary data shows that the number of beads dating to the Great Migration period is less. At present, no specialized studies of the local beads from Late Antiquity have been published. In most of the burial complexes, bead assemblages consist of both glass beads and beads made from other material. The ornaments in question were made into necklaces; in Late Antiquity they must have been sewn onto dress as well. Morphological and technological analysis of the beads has been carried out, the manufacturing technology has been researched in accordance with the system developed by Z.A. L’vova. The glass beads are represented by monochrome and polychrome items varying in shape and size. The beads from burial complexes have been dated on the basis of the metal finds, primarily coins and fibulae. The chemical composition of the glass has been determined through emission-spectral analysis. Comparative study of the beads from Banat and Bachka together with material from synchronous sites in other regions, primarily from Eastern Europe (North Pontic region, Northern Caucasus, Dnieper region and Central Russia) as well as from Central and Western Europe allows to identify the features which characterize assemblages from the sites in question and to compare the dates. The color of the beads, their technological and morphological characteristics as well as the chemical composition of the glass can yield important information about the clothing, cultural relations and aesthetic preferences of the people to whom the sites used to belong.
Micro X-Ray Fluorescence Spectroscopy (m-XRF) is used in order to determine the elemental concentration of glass sherds found in glass workshops’ context from the area of Thessaloniki. Two sherds are derived from the Acheiropoietos excavation site. One of them is a glassy end of glass blower’s pipe (Gb) and the other is a base of a glass vase (Gv). The third sherd is a glass chunk found in the ancient forum of Thessaloniki (D). Major elements such as Si, Na, Ca, Mg, S and Al, as well as trace elements such as Fe, As and Ti are determined and quantified using suitable standard reference materials. Conclusions concerning the origin and the manufacture techniques of the studied material are drawn. Finally, multivariate statistical protocols are applied in order to compare the studied material with glass samples from other places such as east Mediterranean coast and Peloponnesus.
GLASS TECHNOLOGY, COLOURS, FORMS AND SHAPING IN THE 2nd CENTURY OPUS SECTILE GLASS MATERIALS FROM THE VILLA OF LUCIUS VERUS IN ROME

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Recent studies allowed attribution of a huge amount of more than twenty thousand glass pieces (monochrome glass as well as polychrome glass imitating marbles, precious stones and millefiori glass) formerly pertaining to the Gorga collection, to the decoration of a villa of the second century A.D. in Rome. The villa was built by emperor Lucius Verus on the Via Cassia, at the gates of Rome. Excavations occurred in the second half of the 19th century, and most the uncovered objects were put on the antique market. Further researches and the analysis of the finds exhibited or preserved in the depositories of several Italian and foreign museums, have demonstrated new attributions of glass pieces and geometric and figural panels to the decorative covering of the villa. Instead, a study on the technical aspects of such a complex decorative work has not yet been undertaken.

The reasons that motivated the use of glass, were investigated in a recent study of the 4th century opus sectile panels from Porta Marina (Ostia, Rome). Promising results were obtained through a careful examination of the glassy materials associated to analytical investigation, thus improving the knowledge of their use in this kind of works and the understanding of the technology of production of these extraordinary materials. In this paper some preliminary results are reported of a collaborative study started recently by the researcher who discovered, studied, classified and illustrated in several publications the opus sectile glassy materials of the Gorga collection (Lucia Saguì), together with the Istituto Centrale del Restauro of Rome and the Stazione Sperimentale del Vetro of Venice. The aim was to define the functional features of the vitreous materials used and to understand which melting, coloration and opacifying techniques were used to obtain them. Forming, cutting and shaping techniques used for these materials were investigated as well. An attempt is made in the present investigation at assessing which was the supply source for glass, in which form it reached the markets and whether a local production took place, given the importance of the yard.

References
BYZANTINE GLASS IN UHERSKÉ HRADIŠTĚ-SADY,
A CHRISTIAN CENTRE OF GREAT MORAVIAN EMPIRE
(MORAVIA, CZECH REPUBLIC)

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Uherské Hradiště-Sady was a major Christian centre of the Great Moravian Empire in the second half of the 9th century. It is believed that this religious area, consisting of churches, a settlement, a burial ground and a wooden palace, was the seat of Archbishop Methodius (880-885). Some of the finds, especially jewellery, a cross with a Greek inscription and writing instruments (styluses), appear to be evidence of the presence of the Byzantines. The glass finds have yet to be assessed. Thirty fragments of glass vessels (among which lamps and small bottles may be identified), window glass and a mosaic cube have been excavated in graves, a church, a chapel and semi-dugout houses. The glass is either colourless with a greenish tinge or blue and red. The decoration consists of applied red trails, gold leaf and an architectural motif of white opaque glass. Cultural categorisation of the artefacts will be supported by analyses by Professor K. H. Wedepohl. The finds provide a new perspective on contacts between Moravia and the advanced Byzantine culture, and are the first step towards the assessment of a large series of glass from the Staré Město-Uherské Hradiště Greater Moravian agglomeration.
THE INTERPRETATION OF COMPOSITIONAL GROUPINGS IN SEVENTEENTH CENTURY WINDOW GLASS FROM CHRIST CHURCH CATHEDRAL, OXFORD

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A long term study is being carried out into all aspects of the window glass of Christ Church, the Cathedral church of the Diocese of Oxford in the UK. As discussed at AIHV-17 (Powers and Shortland 2008), Christ Church had a major scheme of windows put into place in the mid-seventeenth century, perhaps the most largest and most important scheme to be put into any English church between the medieval period and the mid-nineteenth century. This scheme was almost completely destroyed, but is now being reconstructed from thousands of fragments found on the site and rare documentary records. Part of this reconstruction is a major analysis project both of the glass itself and the pigments used on it. This paper presents the results of SEM-WDS and LA-ICPMS analysis of the seventeenth century glass and how that analysis can help in picking out individual windows and groups of windows from variation in their compositions. It shows variations in the high lime low alkali glass types and suggests possible provenance for the manufacture of the glass.
GLASS FINDS FROM ANTINOOPOLIS, EGYPT

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This paper will focus on glass finds discovered in the North Necropolis of Antinoopolis, in Middle Egypt, during the recent and previous excavations carried out by the Mission of the Istituto Papirologico “Girolamo Vitelli”, now directed by Rosario Pintaudi. In addition to a large number of lamps and other utilitarian vessels, the necropolis has also produced a significant number of fragmentary monochrome and mosaic revetments plaques and a very interesting fragment of opus sectile panel. The glass elements are particularly well conserved, and also show the presence of the original adhesive used to fix them to a support. This feature provided a unique opportunity to chemically study the composition of the organic materials used as glue for fixing the glass elements to wood supports, and to reconstruct the technologies used to produce such as adhesives.

The glass finds, dating from 4th to 6th centuries, include also fragments of painted glass and a very impressive example of reverse-painted glass, a bowl with cold-painted decoration on the outside to be viewed from the inside, through the glass.
MYCENAEAN GLASS: A MATTER OF LOCAL PRODUCTION OR OF A TRADE NETWORK?

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Finished glass objects are found in large quantities scattered throughout Egypt, Mesopotamia, the Levant, and the Aegean during the late second millennium BC. We propose that glass was primary produced in a few centres, then transferred and exchanged to the more widely available secondary glass making workshops throughout the Eastern Mediterranean.

Glass was used and consumed in the Mycenaean world, however there have not been many studies discussing its provenance. The present paper examines glass beads found in a tholos tomb at Kasanaki, which is located in the inlet of the Pagasetic Gulf where actually functioned the big palatial center of Iolkos, with whom the tomb is certainly connected.

We attempt to investigate the production, exchange and consumption of glass in Late Bronze Age (LBA) Mycenaean Greece. The samples were analysed using Electron Probe Microanalysis and Scanning Electron Microscopy to determine their chemical composition and identify their raw materials.

The present study characterises the glass from Eastern Thessaly -in fact from a site located in the biggest port of Central Greece from where all the commercial exchanges of Thessaly with the Aegean World were taking place- and positions it within a broader compositional group. Performing multivariate analysis of the major elements and comparing our samples with LBA glass from the literature, it is examined whether the glass was made locally or internationally exchanged. The paper adds to our current knowledge of glass manufacturing in the LBA mainland Greece.
NEW RESEARCH
CONCERNING THE ORIGIN OF GLASS
OF THE PbO-SiO\textsubscript{2} SYSTEM

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Chemical analyses of glass beads from graves of the early-medieval burial sites in Slovakia and Moravia showed the content of PbO higher than the 50-weight percentage. These glasses are included into the PbO-SiO\textsubscript{2} system. As their coloring substances, CuO, Fe\textsubscript{2}O\textsubscript{3} as well as their own honey-like color, were used. The interdisciplinary analysis of the archaeological findings of approximately 35 000 glass beads from graves of the 7\textsuperscript{th} - 11\textsuperscript{th} centuries in the region around the bed of middle Danube and its river inflows enabled to clarify the occurrence of this type of glass in time and place. Linking these results into the context of published interdisciplinary research in Europe has complemented the knowledge about this glass regarding unknown concentration findings from the 9\textsuperscript{th} and 10\textsuperscript{th} centuries. New direct verification of glass manufacturing of the PbO-SiO\textsubscript{2} system is reliably documented in Slovakia and in Moravia in archaeological findings from the 12\textsuperscript{th} century. The analysis of findings in context from the 9\textsuperscript{th} and 10\textsuperscript{th} centuries enables to formulate the hypothesis about the origin and production of these glasses in the central Danube area and in south Moravia already from the 9\textsuperscript{th} century.
This paper investigates the philological evidence for ancient glass production, manufacturing techniques, and the organization of the craft. The focus is on the Greek-speaking world.

I will discuss selected Greek words denoting artisans, tools, equipment, workshops, and manufacturing processes in texts of the Mycenaean, classical Greek, Roman imperial, and Byzantine periods. After having established when the words are encountered for the first time, I will identify their original meaning and investigate whether they changed their meaning over time, and if so, how and why they changed.

No technical treatises on ancient glass production have been preserved. Nevertheless the philological evidence from literary texts and epigraphy is relevant for several areas of research: it sheds light on ancient manufacturing techniques and how they developed over time as well as on the types of workshops and where they were located. The evidence also tells us how much (and how little) the artisans’ contemporaries understood about the processes related to primary and secondary glass production and the relationship of these crafts to each other.
NEW FINDS OF CORE-FORMED GLASS
FROM APOLLONIA IN ALBANIA

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Recent excavations by an American and Albanian team at the site of a previously unknown Greek temple in the urban area of Apollonia in Albania recovered several fragments of core-formed glass vessels. The small body fragments come largely from securely dated contexts as early as the Archaic and Early Classical periods. As such they offer new information about the distribution and dating of Archaic, Classical, and Hellenistic core-formed glass bottles. Among the fragments are a few pieces that seem to be entirely unique in the corpus of Greek core-formed glass vessels: these include one fragment of a purple-on-white alabastron with a rare herringbone design, and one fragment of an alabastron or oinochoe that has additional unmarvered thread trails applied to the body over marvered zig-zag trailed decoration.

The presence of core-formed glass vessels at this previously unknown sanctuary site underscores its importance as a major cult center, where the glass vessels probably served as one type of votive gift to the deity. At the same time, the careful stratigraphic excavation of the temple compound offers rare glimpses of unusual core-formed vessels found in a securely dated non-funerary context in the Greek world.
The Belbek IV necropolis is situated in the south-western Crimea in the Belbek river valley. The site dates back to the second quarter of the first century A.D. or the first half of the third century A.D.

Among the most common artifacts in Belbek IV burials are beads made of glass, faience, stone, amber, agate, and other materials. Initially, we studied the morphology and techniques. This paper is concerned with the study of the chemical composition of glass and faience beads. The composition of 28 beads was identified by Yegorkov with emission spectrum analysis. The results of the analysis were interpreted according to the method by Ščapova.

With this methodology, all analyzed beads save one faience bead were found to be made of glass. The analysis of the chemical composition of glass and faience revealed the sources of alkali and alkali-earth materials and helped to calculate norms of recipe. Beads were divided into chemical classes according to the classification of the ancient glass composition. The origin of the beads was determined by correlating the norms to the types of alkali and alkali-earth materials. The beads were classified by glassmaking schools, with the most part (13 specimens) being associated with the Near Eastern school, with workshops spread throughout the inner regions of Near East/Southwest Asia, possibly in Syria. Eight beads were linked to the Mesopotamian school, with workshops in the inner regions of Near East/Southwest Asia, namely Mesopotamia. Five beads were linked to the provincial Roman school with workshops throughout Egypt, the eastern Mediterranean and the territory of the European provinces of Rome. One bead was classified as pertaining to the metropolitan Roman school with workshops in Rome. The faience bead, in our opinion, was produced in the traditional glassmaking regions (Egypt or Near East/Southwest Asia), rather than in mountain regions.
SPATIAL AND TEMPORAL CONSIDERATIONS OF TECHNOLOGICAL CHANGE: EXAMINING EARLY ISLAMIC GLASS FROM AYLA, JORDAN

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Scholars have studied the chemistry of glass artifacts for decades in order to understand production technology. Chemical groupings based on trace element compositions (especially MgO and K₂O) have allowed us to see that the basic technology of ancient Near Eastern glassmaking changed twice over the course of early history due to the source of alkali used as a flux: from plant-ash to natron, and back again to plant-ash. In 2004 the author undertook chemical analysis of glass artifacts from two sites in southern Jordan: Byzantine Petra (ca. 5th–6th c. CE) and Early Islamic Ayla (ca. 8th–9th c. CE); it was assumed that the findings would fit into the general dichotomy of natron-based Roman/Byzantine glass and plant-ash-based Islamic glass. However, the findings were unexpected: both assemblages were made with natron. The Ayla glasses are not earlier Roman/Byzantine products found in later archaeological contexts, because their cobalt blue color and incised decoration clearly mark them as Umayyad or ‘Abbasid period products. This suggests that there was some degree of industrial continuity during a time of significant political and cultural change.

This paper takes into consideration the 2004 study and current scholarship about reasons for the changing glass technology in the 8th–10th centuries CE. The author seeks to clarify ancient glass production and consumption by looking at the spatial and chronological patterns. Technological analysis has traditionally focused on the properties of materials rather than on the people and choices involved; historical and anthropological analysis can provide a fuller explanation for the reasons behind the episodes of stability and change observed in the production activities during this critical period in glassmaking history. It is not enough for scholars to simply show that change occurred, we must think about why it occurred and the processes by which technologies are shaped and stabilized.
ON-SITE X-RAY FLUORESCENCE ANALYSIS OF MARITIME GLASS FRAGMENTS FROM SOUTHERN THAILAND

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A great number of glass vessel fragments and glass beads has been found from many locations in Southern region of Thailand, along with other important archaeological finds such as Chinese ceramic ware and Iranian pottery. However, beside the limited research related scientific analysis of archaeological glass in Thailand, there are only few papers about this artifact. In this article, we will provide a series of chemical compositional analysis over hundred glass fragments found from three archaeological sites along Andaman Sea and Gulf of Thailand. First group of the glass sample is a series of glass vessel fragment in various color found from Thung Tuk site of Ko Kao Island located in the Andaman Sea. The site dates from 9th to 10th centuries AD. The second group of the glass sample falls to be a group of glass vessel fragments found from Laem Pho site, located opposite to Thung Tuk on the coast of the Gulf of Thailand dating to the same period. The last group is glass vessel fragments and associated lumps of raw glass unearthed from Khuan Luk Pat site located further southern in the land. The majority of the glass finds consist of fragment of bluish and pale green mould-blown glass bottles, beakers and bowls which are clearly non-local product.

The nondestructive analysis of the archaeological glass has been conducted in Thailand by a portable type X-ray fluorescence spectrometer developed by our research group. The analysis results show that the glass fragment samples are attributed to several kinds of glass, such as Roman and early Islamic Natron type soda-lime-silicate and Islamic plant ash soda-lime-silicate glass coexisting in all sites. In addition, the role of Southern Thailand as an international port of East-West trading route during 9th to 10th centuries AD will be discussed, according to the glass decoration and its chemical compositions.
A few years ago during the excavation for the construction of a high building, came to light some new findings of glassware in the C section of the Roman necropolis of the city. Tombs of different types (sarcophagus, urns, covered with tiles etc.) discovered in this sector, had in their inventory vases of glass. Nevertheless, this new glass collection being presented here belongs to the inventory of the dead. These are types known from before (olae cinerarae etc.) and also new forms as: laboratory vases, small bottles with one or two handles.

Coming from a closed inventory, all vases mentioned belong to Italian productions of the 1st-2nd century of our era.
The glass fragments to be presented in this paper were recovered from excavations in a medieval bathhouse – the Isa bey hamam in Selçuk, a town on the western coast of Turkey very close to the ancient city of Ephesos. This town is dominated by a hill called Ayasoluk, a name deriving from the original Ayios Theologos (Greek: Άγιος Θεολόγος). Several buildings on its slope include a fortress and the famous Mosque of Isa Bey. A project to survey the buildings of the medieval period starting at the time of the Aydinogullari Emirate up to the consolidation of the Ottoman Empire was conducted by the Austrian Academy of Science in collaboration with the Austrian Archaeological Institute under the direction of Şule Pfeiffer-Taş. A major part within this project was the excavation in a bathhouse next to the mosque, the Isa Bey Hamami.

The glass fragments recovered there include glass which can be dated approximately to the 10th – 13th c. AD, probably from the strata earlier than the building itself. Work on the stratigraphy of the site and a final publication is still in progress. Another group of glass fragments datable to the 14th – 15th c. AD seems to be related to the period when the Hamam was in use. For the first group parallels could be found in the byzantine and islamic cultures, while for the second and later group – consisting mainly of drinking vessels – comparable forms lead to Italy, thus reflecting cultural and economic relations with the city-states of Genova and Venice. There is also a type of drinking vessel which is unparalleled in the West.

The round crown-glass windows were originally inserted in the holes of the covering domes, of which fragments displaying an interesting diversity of colours must have created special light effects in the interior.
2006 GLASS FINDS IN THE ROMAN THEATRE AT IZNIK

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Roman theatre excavations in Nicaea constitute the most important finding center of Anatolian glassmaking. With its enduring economical and political structure, Nicaea could have lodged many workshops and artisans. Dated to the 2nd Century Traianus era, the glass finds from the theater excavation carried on since 1980, are rated as continuum of earlier years. During 2006 campaign, mostly findings dated to Byzantine era have been identified. These are summed up to 1502 glass pieces entered in glass inventory most of which are consisted of candle and goblet pieces. All these findings and glass wasters, in other words excess materials, are the most important indicators of the production density attributed to the region. During the Nicaea excavation, that is expected to be carried on for a long period of time, the new findings will contribute to the classification of the existing brief descriptions and resolve the importance of Nicaea in the history of mankind as one of the habitats weighed upon history of mankind.

Glass Figurine: 1
Millefiori Sherd: 1
Spout: 2
Gobleds Sherds: 107
Candle Sherds: 42
Broad Glasses: 26
Bottle Sherds: 39
Cup Sherds: 6
Glass Sherds: 1278
Total Findings: 1502
The traditional consolidating and protective products, widely used in the conservation of the objects of artistic interest, are not able to assure a complete stabilization of ancient glass affected by chemical-physical deterioration. This last is responsible for the micro-cavities production, the increased porosity and the decohesion of glass that loses its intrinsic mechanical properties.

Considering this, during the restoration stage it is necessary to improve the cohesion of the degraded material in order to restore the original mechanical properties and, at the same time, to fill the micro-cavities to protect the glass objects from further action of atmospheric agents. Actually, the most common consolidating products employed in the field of the objects of historical-artistic interest can be either inorganic or organic. These two kinds of materials present merits and disadvantages. The main advantages of the inorganic consolidating products are principally two: easy penetration inside the glass and the similar properties (physical and mechanical) to the glass material; on the other hand these products do not have a protective action and it is necessary to apply a protective agent in a following stage. The polymeric consolidating are able to carry out contemporaneously a consolidating and protective function but they have a penetration difficulties into the glass micro-cavities.

For this purpose, a new strategy has been suggested here based on the in situ polymerisation of the monomer combined with the use of the TiO$_2$ nanoparticles. In this way, the in situ polymerisation could increase the penetration of small monomer molecules, increasing the penetration depth. On the other hand, the presence of the TiO$_2$ nanoparticles, used whether a homogeneous dispersion or in the polymer/TiO$_2$ nanocomposite, could enhance the protective function considering the heterogeneous photocatalytic behaviour of TiO$_2$ nanoparticles, due to their large surface area and selective reduction/oxidation of different atmospheric agents.
ANALYSIS OF CHAMPLEVÉ ENAMELLED OBJECTS IN BELGIAN MUSEUM COLLECTIONS; COMPARISON OF TECHNIQUES

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⁴. Collectiebeleid / Behoud en Beheer, Hessenhuis, Falconrui 53, 2000 Antwerpen, Belgium
⁵. Koninklijke musea voor Kunst en Geschiedenis (KMKG/MRAH), Jubelpark 10, 1000 Brussel, Belgium

Documenting the evolution of the chemical composition of the glass and colouring agents used to produce 12th-13th century Champlevé enamelled objects is relevant to gain a better insight in the history of the manufacture of these type of artefacts. 15 Champlevé objects present in collections of Belgian museums were semi-qualitatively analyzed by means of portable microscopic X-ray fluorescence spectroscopy (μ-XRF). Quantitative information was obtained by analyzing several small glass fragments of these objects using Electron Probe Micro Analysis (EPMA). Most analyzed objects were produced in Limoges, France and are dated between the 12th and 14th century. The results of the analyzed enamelled objects were compared with a glass and pigment composition database. By documenting this technological history it becomes possible to establish a set of chemical parameters that can be used to discriminate between authentic artefacts and 19th century reproductions. This will help to identify exceptional cases of Champlevé enamel such as incorrectly dated objects and later restorations.

The results obtained by means of EPMA and portable μ-XRF analysis proved to be very useful in the discrimination of early (12th-13th century) from late (19th century) Champlevé objects. From a total of 15 objects examined, five featured a chemical signature that deviated from the published literature composition database and pigment use consistent with its presumed period of manufacture. Moreover, the in situ qualitative data obtained by portable μ-XRF analysis proved to be sufficiently reliable to make this discrimination.
The Harvard Glass Flowers were made by Leopold Blaschka and his son Rudolf between 1887 and 1936. They are extremely realistic botanical glass models and were originally intended as teaching specimens. Today, however, they are one of the key visitor attractions at the Harvard Museum of Natural History. The earlier models are primarily made with painted clear glass, while the later models incorporate more colored glass and ultimately very little or no paint was used. The Blaschka collection at Harvard is unique not only because the Glass Flowers were made exclusively for Harvard, but also because it includes workshop materials, some of the Blaschkas' earlier glass works, and extensive archives that provide information on the production process.

Analysis was undertaken to determine and compare the composition of the clear and colored glasses used in the Blaschkas' early works, including glass eyes, jewelry, early plant materials, sea creatures, and the botanical models produced between about 1887 and 1895. The delamination and corrosion problems exhibited by some of the flowers, primarily the early models, are of particular interest and influence preservation and conservation strategies. The use of colored glasses in the early work is also of great interest: the glass eyes include both clear and colored glass and the jewelry and early plants are mostly colored glass, contrasting with the sea creatures and early glass flowers which are mainly painted clear glass with very little colored. Why the Blaschkas didn't use more colored glass for the flowers initially is not clear, but may relate to the working properties of the glass and therefore to the composition. The results of recent analyses and comparison to previous unpublished analysis will be presented.
Les productions verrières au Haut Moyen Âge dans le nord de l’Europe sont méconnues. Les ateliers mis au jour restent rares et les objets conservés sont peu nombreux. Dans cette phase importante précédant le passage du verre sodique au verre potassique, il est encore difficile de définir les matériaux et techniques utilisés ainsi que les objets qui ont été produits.

Pour l’époque mérovingienne, des récipients complets trouvés dans des nécropoles belges présentent un aspect très semblable. Notamment grâce aux décors, il est possible de repérer lesquels ont été fabriqués dans le même atelier. Il est dès lors envisageable d’étudier une production, ou du moins une partie, d’en évaluer l’homogénéité et, éventuellement, de la caractériser.

Dans le cadre d’une thèse de doctorat, une centaine de vases provenant de nombreux musées ont été analysés par PIXE-PIGE (particule induced X-ray emission et particule induced γ-ray emission). Méthode non destructive, elle donne accès à une composition élémentaire quantitative et dose avec précision la plus grande partie des éléments du tableau périodique (Z>11). D’après ces analyses, tous les verres mérovingiens possèdent une composition sodique caractéristique des verres au natron. Au début de la période, les verres mis au jour sur les mêmes sites et dans des contextes de même époque présentent des compositions chimiques semblables malgré des formes différentes alors que des verres identiques découverts dans des sites éloignés sont chimiquement différents. Environ 200 ans plus tard, les objets se raréfient et plus aucune homogénéité ne peut être distinguée. Ces résultats tendent donc à prouver que si les premiers verriers mérovingiens travaillent encore comme leurs prédécesseurs romains, leur artisanat évolue au cours de la période, sans doute en fonction des matériaux disponibles, et annonce l’avènement du verre potassique.
The great program of the mosaic decoration of Torcello’s Basilica of the eleventh-twelfth centuries includes the right minor apse (chapel of the SS. Sacramento or south chapel). During restoration in late twentieth century, glass tesserae (colored glass pastes and gold foil tesserae) were sampled from the mosaics of the south chapel and analyzed by scanning electron microscopy and quantitative X-ray microanalysis to identify the glass composition and the nature of colorants and opacifiers.

The results of the analyses reported in this paper, allow identification of two groups of tesserae, produced with different raw materials and techniques, used at the same time in the original Torcello mosaics. Both a local production (Venice was at this time a flourishing glassmaking centre) or the import of the glassy materials from other Byzantine areas can be suggested. Anyway, no archaeological or documentary evidence exist on the origin of these vitreous materials.

The comparison of the analytical data with the present knowledge on medieval glassmaking technology and with the results of similar investigations on Byzantine mosaic tesserae (west wall of Torcello, St Mark’s cathedral in Venice, Hosios Loukas in central Greece and Monreale in Sicily) and on twelfth century mosaics in Rome, allow formulation of some hypotheses on the origin and provenance of the two groups of glassy materials.
TOWARDS A CLASSIFICATION
OF EARLY ISLAMIC RELIEF-CUT GLASS

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Between the ninth and the 11th centuries CE, glass workers in the Islamic world produced relief-cut objects of exceptional quality (see, for example, *Glass of the Sultans*, 2001, nos. 78-100). The Corning Museum of Glass has several outstanding examples of Islamic relief-cut glass, together with more than 200 fragments. This material will be described in the forthcoming catalogue of the Museum’s Islamic scratch-engraved and wheel-cut glass. Meanwhile, this paper addresses the question: can the monochrome (usually colourless) relief-cut glass of the ninth to the 11th centuries be divided on the basis of style into categories that reflect geographical or chronological distinctions?
The Church of the Holy Sepulchre in Jerusalem, one of the most important religious centers of Christianity, is an elaborate architectural and historical monument. Many studies have been devoted to the development of its buildings since the construction of the first Byzantine church in the fourth century CE, but only rarely were these studies relied on results of archaeological excavations.

An excavation conducted in 1997 in the underground halls of the Coptic Patriarchate compound north of the Church, exposed several construction phases. The glass finds from this excavation, some of which originated in clear stratigraphic contexts, provide evidence for various periods of use in the Church and its surroundings: the early Byzantine period (the fourth–fifth centuries CE), the early Islamic period (the eighth–tenth centuries CE), and the Mamluk and Ottoman periods (the fourteenth–nineteenth centuries CE).

Among the most significant finds is an early Islamic cameo glass, one of the few recovered from a well-documented archaeological excavation. The diverse Mamluk assemblage of glass vessels from the thirteenth–fourteenth centuries CE includes plain bottles, jugs, bowls, beakers, jars and oil lamps, as well as several marvered pieces and an inscribed gold-painted and enameled vessel. The large-scale Christian pilgrimage to the Church of the Holy Sepulchre during the late Ottoman period is manifested in 'Holy Water' bottles that were inscribed in Russian and adorned with the image of Christ on the Cross.
During extensive excavation campaigns at the end of the 20th- beginning of the 21st century along the Meuse river in Huy, Belgium, three merovingian occupation sites were found with a tremendous amount of glass remains. Two of them contain significant remains of glass activity as glass drops, wires, cast glass masses, fillets of glass, glass beads and a lot of crucibles with glass remains. Apart from the archaeological study, also an analytical investigation was executed. This communication will present the SEM-EDX analysis results of around 800 samples. An attempt will be made to a statistical evaluation of the results in order to answer questions as whether or not correlation existed between the three sites of Huy itself and with other Merovingian glass finds in the Meuse valley.
The town of Middelburg-in-Flanders and its castle were founded during the mid-15th century as an expression of the elite status of the owner, Pieter Bladelin, treasurer and councillor of the Dukes of Burgundy Philip the Good and his son Charles the Bold. By founding his new town near the important centres of Bruges, Damme, Sluis and Aardenburg, Bladelin expressed his economic and political power and desire for noble status. The town continued to prosper in the 16th century under the rule of the d’Oignies family. By 1578 town and castle had lost their high status. Middelburg and other towns along the coast and in the Scheldt estuary like Ostend, Aardenburg, Sluis, Hulst and Antwerp, became an important arena in the Eighty Years War in which Dutch Protestant and Spanish Catholic armies fought in what was to become the border between the present-day countries of Belgium and the Netherlands.

The castle of Middelburg-in-Flanders must have had an enormous monumental impact on its environment due to its visual presence and symbolic and social function. A detailed registration of all window glass fragments combined with the lead canes provides a significant amount of information about the different types of fenestration used in the castle. The results of the case study of the castle of Middelburg-in-Flanders (about 1300 fragments of flat glass) were impressive. After detailed registration we could recognise 20 different shapes of lozenge windows and plain glazing in the Flemish Renaissance Style, one fragment of a stained glass window found near the chapel and engraved mirror glass.

Thanks to careful excavation methods, extensive art historical, historical and archaeometrical research combined with an in-depth study of the archaeological material, it is now possible to visualise the fenestration of the castle between 1448 and the end of the 17th century.
Among the many glass finds from the late Roman site of Ain et-Turba in the Kharga Oasis, excavated between 1907 and 1909 by members of the Metropolitan Museum, were fragments of enameled glass. Scientific analyses of the glass and enamel decoration were recently conducted using energy dispersive and wavelength dispersive X-ray spectrometry in the scanning electron microscope (SEM-EDS/WDS). The glasses were found to have soda-lime-silica compositions with relatively low levels of magnesia and potash, compatible with ‘Roman-type’ glass produced using natron as the alkali source. Blue, red and black enamels have overall compositions similar to the glass substrates, aside from the addition of the colorants. Red is formed by the addition of particles of iron oxide, while the blue is colored with cobalt and opacified with calcium antimonate, but also appears to contain particles of the blue mineral lazurite, the principle component of lapis lazuli. The yellow enamel consists of a high-lead glass containing particles of the yellow opacifier lead antimonate. Green enamel, while also containing lead antimonate, is unlike the yellow in having a soda-glass composition with a relatively small amount of lead. Black enamel also contains lead antimonate, along with some copper and large amounts of iron. Comparisons are drawn between the compositions of these very early examples of enameled glass and other contemporary late Roman glasses as well as recent technical studies of medieval Islamic enameled glass from Syria and Egypt.
GLASS FINDS FROM NOVO BRDO AND THEIR SIGNIFICANCE IN LATE MEDIEVAL GLASS PRODUCTION

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Novo Brdo, which is one of the biggest medieval Serbian cities and the most important mining site, trade and artisan center (14th-15th c.), is systematically excavated over a long period of time. Numerous glass finds are included among the movable finds of the excavations.

All glass objects are found in two churches (the only two completely excavated buildings of the city), and around them, where two necropolises were created. The older church, known as Saška, or as Santa Maria in Nouamonte di Dogni targ, served Catholics, mainly from Dubrovnik and Kotor. The other one is the main and monumental church of the city, known as the Cathedral.

The biggest part of the city remains unexplored and therefore it is very difficult to estimate the diversity and the quantity of glass originally circulating in the city. As no glass workshops have been unearthed it is also impossible to determine the existence of local products and their typology.

Glass finds from Novo Brdo are quite numerous and several different types of objects can be identified among them. Regardless to its fragmentary condition, it represents one of the richest and most important glass groups from a medieval Serbian site. It can also be very helpful in dating finds from other Balkan sites as well, because several objects can be firmly dated, as some of them are found in intact graves dated with 15th c. coins., and others come from sealed, mid 15th c. destruction layers.

Apart from round window panes and two types of lamps, which represent a usual find in churches, several types of beakers and bottles used in burials have been identified. Glass jewels (beads, bracelets and gems), which are not very characteristic for this period, are also present in burials of the Cathedral’s cemetery.
DESIGNERS AT COUNT SCHAFFGOTSCHE'S JOSEPHINE  
GLASSWORKS IN SZKLARSKA PORĘBA (SCHREIBERHAU),  
SILESIA, 1842-1950  

ŻELASKO Stefania

Josephine Glassworks, which used to be amongst the most prominent European glassworks, had good fortune to have the very best European designers form its very beginning. In Biedermeier and Historicism periods, the leading role both in the technology and creating new designs was played by Franz Pohl senior and junior as well as by Arthur Gerlach – an academic painter. Josephine manufactured original master designs in new glass and manufacturing technologies; was involved in numerous experiments and patented net filigree, pink gold ruby, alabaster and red copper ruby glass. Since having achieved great success at Great London Exhibition in 1851, the glassworks kept manufacturing in all decorative techniques. There used to be glass painted with enamel and gold, engraved, multi-coated and tinted en masse. The London Great Exhibition brings international fame for their glass works, which was primarily represented by pieces of extraordinary splendour. The prise medal was rewarded to Josephine Glassworks for coloured glass and hundreds of millefiori-paperweights. In 1873, the Josephine's products were awarded the gold medal in Vienna. At the end of the 19th century, professor Max Rade from Dresden and professor Camillo de Maes from Berlin were amongst Josephine's designers, whose collections were given the gold medal at World Exhibition in Paris in 1900. In the 20th century, its most prominent designer was Alexander Pfohl – extremely diligent and original. Professor Siegfried Haertel was the glasswork's other outstanding designer. Besides them, there were Bernardine Bayerl and Dr Gretsch. Their designs earned the Grand Prix in Paris in 1937 for the company. Josephine Glassworks was leading in the world markets with elegant, good proportions, excellent taste, expensive and sought after worldwide products. These Manufacture was primarily occupied with the production of glass for the royal courts of Europe.
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