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SECRETARY'S & EDITOR'S ADDRESS
Department of Archaeology and Classical Studies
Stockholm University
106 91 Stockholm, Sweden
secretary@ecsi.se | editor@ecsi.se

DISTRIBUTOR
Eddy.se AB
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DOMINIC INGEMARK

A Roman bath with broken windows in Asine, Argolis

The result of repeated earthquakes?

Abstract

A substantial assemblage of Roman window glass—consisting primarily of "cast", matt/glossy examples, but also including cylinder-blown, double-glossy window glass—was discovered during the 1926 excavations of a Late Roman bath in Asine, Argolis, the Peloponnese, Greece. It is clear that this material emanates from damage done to the building, and the question of whether this had human or natural causes is discussed in this paper: was it the "barbarian" invasion of the Visigoth king Alaric in the late 4th century AD that led to the windows being broken? Or, was the damage caused by the earthquakes known to have hit the Eastern Mediterranean area in Late Antiquity? Traces of destruction typical of earthquakes were found in the bath building, and the destruction occurred in a period known for its high seismic activity: the so-called Early Byzantine Tectonic Paroxysm, which led to the conclusion that the bath was hit by at least one, possibly several, earthquakes, causing the windows to shatter and fall out of their frames. Some of the glass sherds were in all probability hidden under dust and debris and were never recovered despite the fact that glass was extensively recycled at the time.*

Keywords: Asine, Early Byzantine Tectonic Paroxysm, earthquakes, Late Roman destruction, Roman baths, Roman window glass

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Introduction

The present paper focuses on a hitherto unpublished material from the Swedish excavations of 1926 in Asine, Argolis, the Peloponnese, Greece: the window glass from a bath of Late Roman date (*Figs 1*, *2*). From this relatively small site there is a sizeable assemblage of window glass, consisting of panes manufactured by two different methods: "cast", matt/glossy window glass, and cylinder-blown, double-glossy window glass. The colour and quality of this material suggests it was contemporary with the building.

While excavations of Roman sites frequently yield finds of window glass, typically in small numbers, an assemblage of this size is remarkable. In addition, it appears that the fragments of windows were left more or less in the place where they had fallen out of their frames. This raises a number of questions, and this paper addresses two key ones:

– What caused the windowpanes to shatter and fall out of their frames?

– In an era when cities and towns were kept clean, and when broken glass was extensively recycled, why was so much material left to lie where it had fallen?

* The following work would not have been possible without the kind support of a number of colleagues at Uppsala University, Sweden. I would like to thank Prof. Gunnel Ekroth for inviting me to study the Roman glass from Asine and for her much-appreciated help in finding funding. In this context, I would like to extend my thanks to Stiftelsen Enboms donationsfond for their financial support of this work. I have had the great fortune to be able to discuss my research with two leading experts on Asine: Prof. Emerita Gullög Nordquist and Prof. Emerita Kerstin Höghammar. Both have generously shared their insights, and also helped me access various types of material relevant to the present study. I am also grateful to Prof. Michael Lindblom who kindly assisted me in getting early photographs from the site, and Dr Brita Alroth who meticulously checked the references, John Worley and Ludmila Werkström (Museum Gustavianum, Uppsala) who helped me with photographs of the finds, Dr Frederick Whitling (independent scholar) who helped me with some uncertainties concerning the excavations at Asine, Prof. Henrik Gerding (Lund University, Sweden) who provided me with invaluable insights into how Roman baths work, and Dr Almudena Velo Gala (Universidad de Murcia, Spain) who generously let me reproduce an illustration of a detail from the dome mosaic in the Roman villa in Centcelles. I also extend my thanks to the two anonymous reviewers who kindly provided me with constructive and informative feedback.

Fig. 1. Asine after the excavations in 1926; note the ruins of the Lower Town. No. c 7727, Archive of the Swedish Institute at Athens.

Damage to buildings can be the result of human agency and related to a range of different causes ranging from simple vandalism to conflict and war.[1] Indeed, many have linked destruction that occurred in nearby cities in the Peloponnese in the Late Roman period to the "barbaric invasions" of the former Roman ally, the Gothic king Alaric, in AD 396–397. Damage can also be the result of neglect and abandonment, a slow process which can be regarded as a combination of human decisions and natural forces.

However, due to the nature of the damage to the Roman bath, there are compelling arguments to suggest that the bath was hit by one, possibly more, earthquakes in the Late Roman period. This line of reasoning is strengthened by the fact that we know that Asine lies in an area where there is high seismic activity and it has a long history of earthquakes.[2] Moreover, the windows broke in a period of unusually intense tectonic activity known as the Early Byzantine Tectonic Paroxysm, which occurred in the mid-4th to the mid-6th centuries AD. In short, the window glass—a seemingly insignificant material—has an interesting story to tell.

Any attempt to provide a definitive answer to the above questions is, however, hampered by two facts. Firstly, that at the time of writing this paper almost a century had passed since the original excavations took place. Secondly, the fact that the site suffered significant damage during the Second World War as a result of Axis troops being stationed in Asine, damage which has largely prohibited renewed or further studies of the bath.

This paper is organized in the following manner: first comes a brief background of the excavations of the bath, and the sorry fate the site suffered during the Second World War. This is followed by an in-depth discussion of Roman window glass: the methods of manufacture, its function and uses, and the question of recycling of glass in the Roman era. Then comes the analysis section. This begins with bringing together the results of the study of the window glass, followed by a discussion of the possible causes to why the windows broke: earthquakes and military conflicts. After the conclusions and summary, follows the catalogue of the material.

Background: the excavations of the bath and its later fate

In 1920 the Swedish crown prince Gustaf Adolf—later King Gustaf VI Adolf (1882–1973)—had met the Greek archaeologist, keeper of the Numismatic Museum of Athens, Ioannis Svoronos (1863–1922), to discuss possible Swedish excavations in Greece. Soon this idea would come to fruition through the aid of the Swedish Classical archaeologist Axel W. Persson (1888–1951) whose contacts with Charles Picard

[1] Ambraseys 2006, 1009–1010; Galadini *et al*. 2006, 396.
[2] Zangger 1996.

Fig. 2. Excavating the bath in 1926. No. c 7882, Archive of the Swedish Institute at Athens.

(1883–1965) at the École française d'Athènes gave the opportunity to take over a "French" site: Asine, Argolis, in the Peloponnese.[3] Over the years a number of excavations have been conducted by the Swedes—the first ones took place in 1922, 1924, 1926, and 1930, with the bath being unearthed in 1926 (*Fig. 2*).[4]

The bath is located in the area known as the Lower Town. Despite being of relatively moderate size, the bath featured all the rooms and functions typical for this type of edifice, a *balneum*. It had rooms interpreted as *apodyterium* (changing room), *caldarium* (hot room), *tepidarium* (medium-hot room), and *frigidarium* (cold room) (*Fig. 3*).[5] It was heated with a *praefurnium* (furnace) through a hypocaust system built of brick pillars. In her 1984 study Kerstin Höghammar put forward the hypothesis, inspired by a 1955 study by René Ginouvès, that it may have undergone a transformation sometime in the 4th century AD, from a bath with communal pools to one with individual tubs.[6]

At the time of the excavations, in 1926, the hypocaust below the floor was damaged and in a generally poor state. Indeed, in the field diary we find the following words:

> *Rummet kunde icke fullständigt utrensas, då arbetarna fruktade, att taket skulle falla in.*[7]
>
> The room could not be cleared out completely as the workers feared that the ceiling would cave in.[8]

Only the lower parts of the walls were preserved—from floor level they reached a height of 70 to 90 cm—thus we do not have any information on the window openings.

With the approval of the Greek archaeological authorities the material from the 1926 excavation was transported to Uppsala for further studies, but awaiting later negotiations it was subsequently sent back to Greece. However, an agreement with the Greek authorities in 1931 resulted in the material being returned to Uppsala where it has remained since, and now forms part of the Museum Gustavianum's collections. This must be seen as a stroke of good fortune as it has helped to preserve this specific material intact. In stark contrast, the material from the other years' excavations remained in storage in the nearby city of Nafplio, where it fared less well during the Second World War.[9] The German forces' need for wooden

[3] Whitling 2019, 83.
[4] Höghammar 1984, 79; Nordquist & Lindblom 2020, 288.
[5] Arbman 1938, 111.
[6] Höghammar 1984, 82–84; Ginouvès 1955.
[7] All translations in this paper, from Swedish, Latin, and Greek, are the author's own.
[8] *Diary* 4, 138 [Neander-Nilsson]. The Swedish word "taket", "the ceiling", probably refers to the hanging floor of the hypocaust.
[9] Nordquist & Lindblom 2020, 288–289.

crates meant that much of the material in storage was dumped out of these, and as a consequence it is now mixed up.[10]

Despite being dug in an era with other scholarly interests and standards, it is worthy of note that the preserved material from the 1926 excavation includes "everything", even more modest materials such as mudbricks and plain types of window glass. In addition to the archaeological material the original field diaries—written in Swedish—have also been preserved.[11] In the case of the bath it is the diaries written by Sanfrid Neander-Nilsson (1898–1950) (i.e., diary nos 4 & 5) and Natan Svensson (later, Natan Valmin 1898–1967) (diary nos 8 & 11).[12] We have the original plans and photographs from the excavations, and in addition, single aerial photographs taken by the German Ministry of Aviation in the early part of the Second World War showing the undisturbed site (*Fig. 4*).

But while the 1926 material was saved by being transported to Sweden, the site of Asine suffered a great deal of damage during the war. In the military struggle between the Allied and Axis powers, Argolis was occupied by German and Italian troops. Asine, which had a strategic setting on the coast, was hastily and brutally rebuilt into an Italian military post in 1941. In doing so they used building material from the excavations and repurposed the ancient ruins. The bath was turned into a shelter and storeroom for the troops stationed there. While this meant that the bath survived better than other buildings, it was nonetheless in part rebuilt and altered.[13] So while there are still visible remains of the bath building today, re-examination and renewed studies of the site are likely to be difficult.

Besides being briefly mentioned by Persson in 1931,[14] the bath was published in 1938 by the Swedish archaeologist Holger Arbman (1904–1968). This publication neither included the material found in and around it, nor did it present a more precise date than that it belonged to the Roman era.[15] The site was later revisited and most of the material examined in the mid-1970s and early 1980s by Höghammar. In her 1984 publication Höghammar convincingly argues for a *terminus post quem* of the early 4th century AD based on a detailed study of the bricks and layers of mortar, supplemented by pottery finds and a limited body of numismatic evidence.[16] The finds of Roman window glass corroborate Höghammar's conclusions concerning the date of the bath, as will be discussed in greater detail below.

[10] Exactly what happened with the storage of archaeological finds in Nafplio during the Second World War is unfortunately not documented. Frederick Whitling pers. comm.

[11] Nordquist & Lindblom 2020, 290.

[12] Billig *et al*. 2015.

[13] Yioutsos 2017, 166–168.

[14] Persson 1931, 69.

[15] Arbman 1938.

[16] Höghammar 1984.

Roman window glass

METHODS OF MANUFACTURE—MEANS OF IDENTIFICATION

As mentioned above, the 1926 excavations of the bath yielded two types of window glass: "cast", matt/glossy and cylinder-blown, double-glossy (see *Figs 5, 6*). These were made utilizing two different methods of manufacture, "casting" and blowing respectively. Both manufacturing methods yielded flat panes of square or rectangular shape. Neither type can provide more precise dating in themselves, which is perhaps unsurprising given the utilitarian use of this material. Nevertheless, as will be discussed later in this paper, the colours and the quality of the glass likely suggest a Late Roman date.

In addition to the two types discovered on the site, there existed two other types of window glass in the Roman era. One was known as crown glass in English and *Butzenscheiben* or *Tellerglas* in German. This is essentially formed like a round plate, as is indeed suggested by the German noun *Tellerglas*. Single finds have been unearthed from 4th-century AD Roman sites in Italy and Britain, but this category of window glass is more frequently found in contexts belonging to the Late Antique and the medieval periods respectively.[17] The other type of window glass is matt/glossy window glass of a hemispherical shape.[18]

The "cast" matt/glossy window glass was produced for more than two centuries, *c.* AD 40/50 to AD 300, possibly longer.[19] Blown double-glossy window glass—made with the Lorraine or the cylinder method—is a technique that largely came to replace the "cast" matt/glossy window glass around AD 300. The production of this type of window glass started earlier, however: in the 3rd or possibly even the late 2nd century AD.[20] It was only in the 1950s that the cylinder method was replaced by the Pilkington Process (also known as float glass).[21]

[17] Komp 2009, 34–35 with references.

[18] Foy & Fontaine 2008, 417–426, fig. 8.

[19] Harden 1947, 306; Komp 2009, 23–29. In a paper on the window glass from *Hispania Baetica*—i.e., present-day south Spain—A. Velo Gala, M. García-Heras and M. Orfila discuss finds of window glass made in mid-4th or 5th-century AD contexts in Acinipo (present-day Ronda). Tentatively they suggest two possible ways of interpreting them: either as the recycling of earlier material or the possible continuation of the "cast" matt/glossy method of production (Velo Gala *et al.* 2019, 527).

[20] Allen 2002, 102; Komp 2009, 32. In a study of window glass from Buthrotum, Epirus—i.e., present-day Butrint, Albania—Jennings has argued that double-glossy (i.e., cylinder-blown) window glass dates from the late 2nd to 3rd centuries AD (Jennings 2015, 162).

[21] Pilkington 1969.

Fig. 3. The remains of the bath in 1926. No. c 7872, Archive of the Swedish Institute at Athens.

Fig. 4. Aerial photograph of Asine in the early part of the Second World War (1941) from the Reichsluftfahrtministerium. German Ministry of Aviation, no. 12383, copyright DAI-ATH-RLM, ASINE. Photo taken from the South. The bath is situated to the left of the standing buildings visible on the photo.

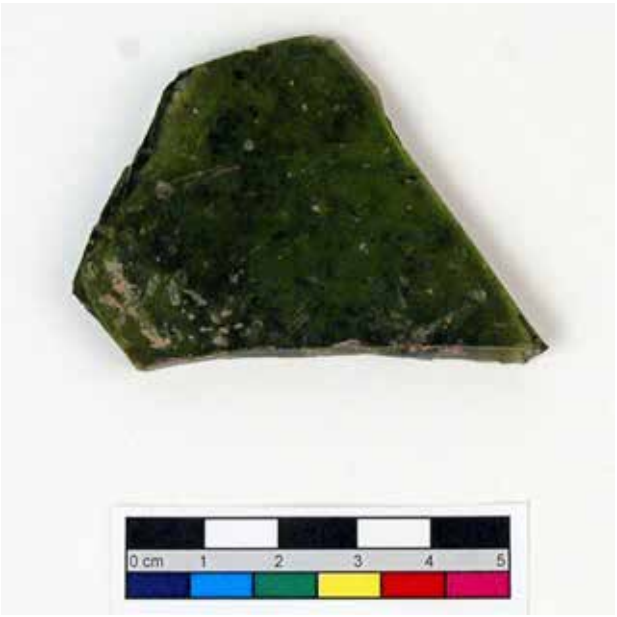

Fig. 5. A fragment of "cast" matt/glossy window glass, seen from the underside. Note the pitted surface. AS 4841, Museum Gustavianum, Uppsala.

Fig. 6. A fragment of cylinder-blown double-glossy window glass. Note the aligned, elongated bubbles. AS 4322, Museum Gustavianum, Uppsala.

The "cast" matt/glossy window glass constitutes an older method of manufacture. Both archaeological and literary evidence suggest that windows made of glass were introduced in the mid-1st century AD. In the North-Western provinces where this category of artefact has attracted considerably more scholarly interest than in the Mediterranean, we have finds from, for example, Colchester, Essex, England that date to the Claudian–

Fig. 7. An almost intact "cast" matt/glossy windowpane in blue-green glass from Herculaneum. BM 1772,0317.21. © The Trustees of the British Museum.

Neronian period (i.e., the mid-1st century AD).[22] Similarly, the use of window glass is attested in the Mediterranean area in the 1st century AD: a number of buildings in both Pompeii and Herculaneum were glazed (see *Fig. 7*).[23] Here, window glass was used in edifices that were restored or rebuilt after the earthquake of AD 62, that is, in the years prior to the devastating volcanic eruption of Mount Vesuvius in AD 79.[24]

Turning to the written sources, they confirm the archaeological evidence as regards when glass was first used for glazing. The Roman moral philosopher and author Seneca the Younger (4 BC–AD 65) writes of glass windows letting through light in buildings as a relatively novel invention: something which happened within living memory.[25] A somewhat later source, the author Pliny the Elder (AD 23/24–79), appears to take the use of window glass for granted.[26] And, while these sources provide us with no information whatsoever on the methods of manufacture, it seems safe to assume that this was of the same type as found in the archaeological record of that date: "cast" matt/glossy window glass.

Glass of this type is very characteristic. The underside of the glass is pitted and matt (see *Fig. 5*), and occasionally this surface has been ground (see *Fig. 8*). In contrast the upper surface is glossy, hence the name: matt/glossy. It commonly occurs with visible toolmarks, traces of instruments to pull and stretch the glass. In the Asine assemblage there is one fragment that has a mark of oval shape—reminiscent of a pontil scar—and it may originate from a pontil (i.e., a long metal rod used when pro-

[22] Harden 1947, 306.
[23] Harden 1974, 281; Dell'Acqua 2004, 109–110.
[24] Arletti *et al.* 2010, 252.
[25] Sen. *Ep.* 90.25.
[26] Plin. *HN* 15.18.59.

Fig. 8. A fragment of "cast" matt/glossy window glass, seen from the underside. Note the ground surface. AS 1574, Museum Gustavianum, Uppsala.

Fig. 9. A fragment of "cast" matt/glossy window glass. Note the circular and somewhat elongated bubbles. AS 3030, Museum Gustavianum, Uppsala.

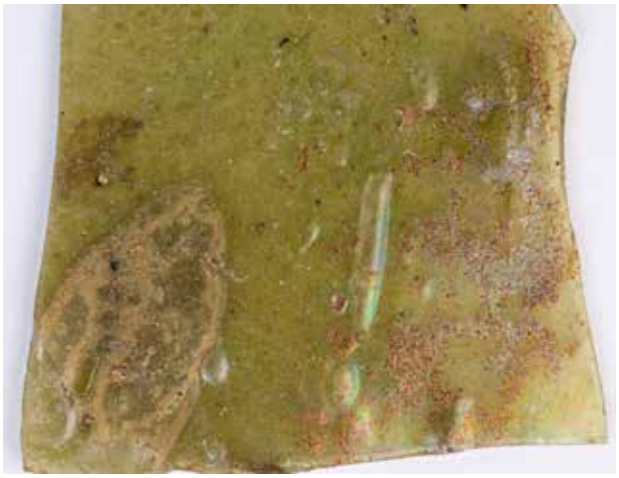

Fig. 10. A fragment of cylinder-blown double-glossy window glass. Note the elongated bubbles. AS 2539, Museum Gustavianum, Uppsala.

ducing glass vessels and objects).[27] The panes are thick, typically 2–5 mm, but sometimes more, and have rounded edges.[28]

In 1966 George Boon put forward a compelling hypothesis for how this glass was manufactured, namely by pouring molten, highly viscous glass onto a tray of stone, clay, mortar, or wood. He argued the tool-marks that often occur on the finds were the result of pushing molten glass into the corners of the tray.[29] This view was widely held within scholarly research until some two decades ago;[30] however, experimental archaeology has demonstrated that it is no longer possible to uphold Boon's hypothesis.

In an attempt to follow Boon's ideas concerning the manufacture of windowpanes, Mark Taylor and David Hill were able to prove that it was impossible to manufacture window glass in the manner previously suggested.[31] Instead, another method of manufacture was tried, a method that produced windowpanes with similar surfaces, edges, and tool-marks as found on Roman matt/glossy window glass. Taylor and Hill were able to show that molten glass was probably picked up with a pontil from the glory-hole and let flow onto a flat surface of a terracotta tile or damp sandstone—not wood, as this would have charred—and flattened by a large cylindrical block of damp wood to form a round disc. This glass was reheated from one side, and pincers and hooks were used to pull the glass into the required shape. The pane was turned 180° and the same procedure was repeated.[32]

Pre-modern glass is to a greater or lesser degree bubbly, and the shape of these bubbles reflect the methods of production. The "cast" matt/glossy window glass from Asine has two types of bubbles: small, circular bubbles and elongated bubbles. The parts of the pane which were pulled out with pincers or hooks would get elongated bubbles (see *Fig. 9*). Elongated bubbles are, however—as we shall discuss below—also typical of cylinder-blown double-glossy glass (see *Fig. 10*).

In identifying window glass of the matt/glossy variant, the characteristics quoted below have to be considered:

[27] Inv. no. AS 4069.
[28] Harden 1974, 280.
[29] Boon 1966.
[30] See, for instance, Price 1996, 396.
[31] Taylor 2001.
[32] Taylor 2001; Allen 2002; Weisenberg 2016.

– The pitted or ground underside and the glossy upper side.
– The "soft" and rounded shape of the edges.
– The typical toolmarks from pincers and hooks.
– The thickness of the glass, "cast" matt/glossy window glass typically being thicker than cylinder-blown double-glossy window glass, often 2 to 5 mm (or more).

In contrast to "cast" matt/glossy window glass, glass panes produced with the cylinder-blown method in the Late Roman period have received considerably less scholarly attention.[33] This method of manufacture was first described in a source of medieval date, *On various arts* by Theophilus Presbyter (*fl.* AD 1070–1125).[34] First a large cylinder-shaped bubble is blown, then the upper and lower ends are cut off, whereafter a cut is made longitudinally. This cut-up cylinder is then folded out, sometimes after first being reheated in an oven.[35] In identifying window glass of the double-glossy variant, the following characteristics have to be regarded:
– The glass being glossy on both sides.
– The thickness of the glass: this is typically, but not always, thin, 1–2 mm (occasional finds are up to 3 mm thick).
The advantage with the latter type of window glass is that less material—raw glass, recycled glass, or both—was needed to produce the panes needed for an edifice. Nevertheless, both types of window glass filled the same function, which will be discussed below. While bubbles cannot be used to identify the method of manufacture, the presence of elongated bubbles, typically aligned, are characteristic for this type of window glass (see *Fig. 10*).

KEEPING OUT THE COLD: THE USES OF WINDOW GLASS

When it comes to the questions of which types of edifices had glazed windows, the reasons why window glass was used, how glass was perceived, and the pricing of glass panes, we are blessed with a wide range of sources. Besides an ample archaeological record, we have historical, epigraphical, papyrological, and iconographic evidence to answer those queries.

Beginning with the archaeological evidence, finds of window glass have been made all over the area that once constituted the Roman Empire.[36] Depending on the date of the buildings, the finds are either of "cast" matt/glossy or cylinder-blown double-glossy variants, or, in the case of long-lived buildings that have undergone repair, both. Typically the assemblages of window glass are relatively limited in size—this due to a high degree of recycling of any damaged material (see discussion on recycled and reused glass below)—and larger assemblages are indicative of either abandonment or catastrophic events.[37]

Baths were by far the most common type of building which had glazed windows.[38] Not only did the glazed windows make the baths a much more pleasant place to be by letting in light, but as argued by James Ring, they significantly lowered the costs of heating.[39] While the window glass would let in light, neither type of window glass would have let you see the bathers in the nude, but merely blurred images. In other words, the windowpanes would have created visual privacy.[40]

Turning to the literary sources, it is clear that the introduction of window glass in the mid-1st century AD made the bathing experience completely different. The satirical poet Martialis (AD *c.* 38–*c.* 102) describes the baths of Lupus and Gryllus in Rome—presumably an older bath—as being dark and gloomy.[41] Clearly, he preferred the light and airy buildings built in his own time. In contrast the moral philosopher Seneca the Younger (4 BC–AD 65) praised the dark baths built in the Republican past. If heroes of the Republican era such as Scipio Africanus (*c.* 235–183 BC) settled for these simple baths, Seneca reasoned, so should those living in his own time.[42] It is very evident that Seneca abhorred the bath culture of his own time, describing the baths he happened to live next to in a both biting and bitter tone.[43]

In this context it is important stress that before AD 100 not only glass, but also other types of materials, such as crystalline gypsum and muscovite mica, were used for windows.[44] For instance, Pliny the Elder discusses a type of stone that lets through light—*lapis specularis*—which could be cut into thin panes.[45] And in her classic study of glass in antiquity, Mary

[33] For a discussion of this type of window glass, see Harden 1959; 1961.
[34] Theophilus Presbyter, *De diversis artibus* 2.6.
[35] Harden 1974, 281.
[36] Ingemark 2014, 149–154.
[37] Milavec 2015, 80.
[38] Stern 1999, 464; see also Herbig 1929; Haevernick 1981, 24–25; Baatz 1991, 7; Sanders 1999, *passim*; Allen 2002, 106–108; Dell'Acqua 2004.
[39] Ring 1996; see also Yegül 1992, 383; Oetelaar *et al*. 2013; Lancaster & Ulrich 2014, 175.
[40] In the baths nudity was the norm (Fagan 1999, 24–26, see also Fagan 2011, 361–362) as attested in the literary sources from the early Empire (Mart. 11.75) to the Late Roman period (Symphosius, *Aenigmata* 89). Related to this is the question of mixed bathing. It has been convincingly argued that men and women bathed together from the Early Imperial period onwards (Ward 1992), but the degree to which this was prevalent has been a matter of debate (Fagan 1999, 26). Evidence suggests that the socially accepted nudity was restricted to this specific context, and it is unlikely that one wanted people outside the baths to be able to see the undressed bathers.
[41] Mart. 1.61, 2.14.
[42] Sen. *Ep.* 86.4, 86.6–13.
[43] Sen. *Ep.* 56.1–2.
[44] Dell'Acqua 2004, 113; Stern 2007, 385.
[45] Plin. *HN* 36.45.160–162.

Luella Trowbridge notes that some early mentions of windows in the literary accounts and in inscriptions may in fact refer to materials other than glass.[46] Nevertheless, glass being a both practical and inexpensive product meant that it soon became the dominant type of material used for windows, and archaeological finds of other types of windows are infrequent.[47]

Not only archaeological and literary evidence support the widespread use of glass windows in baths. A papyrus letter dated to AD 326 from Oxyrhynchus, a town in Roman Egypt, tells us that the city needed glazing for one of its hot baths (θερμῶν λουτρῶν). This letter specifies the quantities of glass needed, and these appear to have been significant.[48]

We also know that windows were used in villas of the well-to-do. In a description of his country villa in Laurentinum, situated some 17 Roman miles outside the city of Rome, the Roman author Pliny the Younger (AD 61–*c.* 114) writes how glazed windows protects the villa's dwellers against foul weather. He also praises the villa's sun-parlour with its folding glass doors, which provided a pleasant climate as well as spectacular views of the sea.[49] The Roman jurist Ulpianus (*c.* AD 170–*c.* 223), quoted in the legal codex *Digesta* (compiled in AD 530–533), clearly viewed the use of window glass in private houses as a way of protecting its dwellers against the cold.[50]

In both country villas and town-houses there were also other uses of window glass. Pliny the Elder describes how storage-rooms for fruit were glazed to keep out the cold winds, which otherwise spoiled the fruit by shrivelling them.[51] Glazed hotbeds were used for growing flowers and grapes, thereby extending the seasons.[52] As we have seen there is a common theme in all the texts discussed above: keeping out the cold, yet letting in the light. This is perhaps best portrayed in one of the riddles ascribed to the Late Roman author Symphosius (late 4th to 5th centuries AD).[53]

> Look deep within: I neither hinder the eye's vision,
> I let through the wandering gaze beyond my parts,
> nor does the cold pass through me, but the sun glistens
> within me.[54]

Fig. 11. A detail from the dome mosaic at the Roman villa in Centcelles, Catalonia, Spain, depicting an edifice with windows (4th century AD). Illustration by Almudena Velo Gala, Universidad de Murcia.

Iconographic evidence—with a wide range that included mosaics, wall-paintings, and tombstones—shows that larger windows typically were made up of a number of smaller panes fitted into frames. A tombstone from the city of Rome dated to the 4th century AD and erected in memory of a glazier, Sabinius, depicts a window divided into nine frames.[55] There are numerous mosaics depicting windows—in all probability glazed windows—on different types of domestic buildings, such as, for example, country villas.[56] One example comes from the dome mosaic dated to the 4th-century AD Roman villa in Centcelles, Catalonia, Spain (see *Fig. 11*).

Another example of this is the mosaic of Dominus Iulius, discovered in Roman Carthage and dated to between AD 380 and 400.[57] The window above the central door of the building on the mosaic appears to be glazed (see *Fig. 12*).[58] While archaeological finds of more-or-less intact windowpanes are rare, discoveries made confirm that windows consisted of several smaller panes that were set into wooden or metal frames, or that were adhered with mortar to the window opening.[59] Finds of such windowpanes in glass have, for example, been made in Herculaneum, in the Bay of Naples, Italy (see *Fig. 7*) and Garden Hill, East Sussex, England (see *Fig. 13*). Windowpanes were also knapped to different shapes, such as lozenges and triangles.[60]

To get an idea of the cost of window glass we can turn to the epigraphical evidence. In Diocletian's *Edict on Maximum*

[46] Trowbridge 1928, 187.
[47] Foy 2016, 103.
[48] *P Oxy*. 3265. For a discussion of this text, see Stern 1999, 458.
[49] Plin. *Ep.* 22.17.
[50] Ulp. *Dig.* 33.7.12.16.
[51] Plin. *HN* 15.18.59.
[52] Mart. 8.14, 8.68.
[53] Leary 2011.
[54] Symphosius, *Aenigmata* 68: *Perspicior penitus nec luminis arco visus, Transmittens oculos ultra mea membra meantes; Nec me transit hiems, sed sol tamen emicat in me*.
[55] *CIL* VI. 33911.
[56] Velo Gala & Garriguet Mata 2017, 162.
[57] Dunbabin 1978, 62, fig. 109.
[58] Velo Gala & Garriguet Mata 2017, 162–163.
[59] See e.g., Price & Cottam 1998b, 24; Stern 1999, 464; Allen 2002, 109.
[60] Ingemark 2014, 150 with references.

Fig. 12. A detail from the mosaic of Dominus Iulius, Carthage, showing a glazed window above a door (mosaic dated between AD 380 and 400). Photograph: O. Mustafin. Creative Commons CC0 1.0 Universal Public Domain Dedication. Via Wikimedia Commons.

Prices—an attempt to hamper the hyperinflation that had plagued Rome by regulating prices for goods and services, issued in AD 301—we also find raw glass and window glass under the heading *De vitro*—i.e., *On glass*.[61] The prices are as follows: Window glass, best [quality] one pound 8 [denarii] [Window glass], second [quality] one pound 6 [denarii][62] While not stated what type of window glass this specifies, it was written at a time when cylinder-blown double-glossy glass had begun to phase out "cast" matt/glossy window glass. The low price of the window glass in comparison to other types of glass led Francesca Dell'Acqua to suggest that what was meant was not actual glass windows, but rather windows made of mica.[63] While she is certainly correct about mica being used as an alternative to glass in windows, Marianne Stern has put forward convincing arguments for this not being the case. As mentioned above, these two entries are placed under the section on glass. Secondly, she stresses the fact that window glass often is of comparatively poor quality, which would ex-

[61] For a discussion on the prices of glass in the *Edict on Maximum Prices*, see Erim & Reynolds 1973; Whitehouse 2004; Barag 2005.

[62] *Edictum de Pretiis Rerum Venalium* 16.5–6, (col. III, 40–41): *Speclaris optimi libra una–octo; Secondi libra una–sex*.

[63] Dell'Acqua 2004, 113.

plain the low price.[64] While window glass may not have been expensive, it carried a certain value and we know that it was normally recycled. Possibly there was reuse of old windows.

THE RECYCLING AND REUSE OF GLASS IN THE ROMAN ERA

Before we turn to the question of recycling, let us look briefly at the possible reuse of window glass in Roman antiquity. The Roman jurist Ulpianus—cited in the legal codex *Digesta*—mentions that windows could be temporarily removed and later restored to their original position.[65] This could possibly suggest that glass windows could be replaced or reused without too much effort.

The fact that the window glass in Asine was left on the ground—it seems more or less *in situ* where it had fallen out of its frames—is striking and calls for an explanation. Why was all of this sharp, hence potentially hazardous, broken glass not swept up? While Asine may have been a society of relatively moderate size, there is no reason to believe that the Roman custom of keeping their towns and cities clean would not apply there. Indeed, it was a legal requirement that private property owners—in the city of Rome itself under the supervision of the *aedile*—kept public streets and areas clean and free of any type of debris.[66]

More importantly, however, broken glass was typically collected to be recycled at the time. There is ample evidence that points towards an extensive use of recycled glass as a source of raw material for new vessels and other objects in the Roman era.[67] There is an, admittedly small, body of textual sources of late 1st to early 2nd centuries AD date that speak of pedlars of low social standing—*ambulatores*—gathering and trading in broken glass.[68] It appears that the glass was exchanged for goods of low value, such as so-called "sulphur matches" (i.e., splinters of wood covered with sulphur used as a means to rekindle a fire).[69] Indeed, the words *vitrea fracta*, i.e., "broken glass",[70] became proverbial for something cheap and tawdry.[71] While there is no mention in these passages of what this glass was used for, it is commonly assumed that it was sold to glass manufacturers to be recycled.

Fig. 13. Windowpane in "cast" matt/glossy glass from Garden Hill, East Sussex, England. BM 1974,0501.1. © The Trustees of the British Museum.

A 6th-century AD text, Gregory of Tours' (*c.* AD 538–594) *Book of the glories of the martyrs*, tells how a church window was stolen by a thief, who melted it down to be sold. Later this man contracted leprosy, as a divine punishment for his sins.[72] This passage demonstrates that window glass was recycled in a later period, and can probably be taken as a confirmation of recycling of this type of glass taking place in Roman times too.

The argument that glass was systematically collected, as suggested by the textual sources—and the assumption that it was thereafter melted to manufacture new objects—is corroborated by two other categories of evidence. Firstly, there

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[64] Stern 2007, 385.

[65] Ulp. *Dig*. 33.7.12.25.

[66] Wallace-Hadrill 2016, 1–2. The regulations in the bronze tables of Heracleia: *Tabula Heracleensis* [= *Lex Iulia Municipalis*] 7–13 (late 1st century BC); Robinson 1992, 59–60. The Justinian Law: *Digesta*, 43.10.1, 3–5 (compiled in AD 529–534, however, reflecting the conditions in the earlier, Imperial Rome).

[67] Stern 1999, 450; Keller 2004; Degryse 2020. Glass was only one of many types of materials recycled: in Roman society everything from human waste to pottery to metal appears to have been collected to be recycled or otherwise reused. As convincingly argued by J.T. Peña, Roman society produced vast quantities of refuse, but a significant part of this was recycled/reused. Also, it is clear that in the late Empire—after around the mid-3rd century AD—when the extraction of virgin raw materials decreased, recycling increased to meet supply demands. (Peña 2020; for a discussion of refuse collection, see Liebeschuetz 2000).

[68] Stat. *Silv.* 1.4.74; Mart. 1.41.1–9, 10.3.3–4; Juv. 5.48. See the discussions in: Leon 1941; Harrison 1987; Whitehouse 1999, 78–79; Stern 1999, 450–451; Peña 2020, 34–35.

[69] *Dig.* 32.1.55.8, 50.16.167; see also: Ov. *Ars am.* 2.439–443; Apul. *Met.* 9.36; Valerius Flaccus, *Argonautica* 2.447–450; Leon 1941, 233; Harrison 1987, 205.

[70] Petron. *Sat.* 10.1; see also the discussion in Leon 1941, 234–235.

[71] Cass. Dio 60.17.6; Keller 2004, 68.

[72] Gregory of Tours, *Glor. mart.* 59.

are a number of finds of collections of glass cullet—that is broken glass vessels, windows, and objects—made in villas, towns, cities, and military camps from all over the area that once constituted the Roman Empire.[73] These finds reflect the fact that broken glass was systematically collected; moreover, finds from sunken ships in the Mediterranean strongly suggest that there was a commercial trade in glass cullet. Indeed, as pointed out by Ian Freestone, thick, heavy windowpanes from old buildings were an excellent source of cullet.[74]

An example of the systematic collection of broken glass was a basket filled with fragments of glass discovered in a basement storage room at a Roman country villa in Pisanella, in the vicinity of Boscoreale, north of Pompeii. This site was preserved in the volcanic eruption of AD 79.[75] An example of the commercial trade in glass cullet is the wreck of the ship now known as *Iulia Felix*, which sunk in the northernmost part of the Adriatic Sea, at Grado, near Aquileia, in the beginning of the 3rd century AD. On this ship a collection of around 11,000 fragments, weighing 140 kg, was transported in a large wooden barrel.[76] Cullet of this kind was then used on glass-working sites. In a Roman house in Aquileia, Domus delle Bestie Ferite—turned into a workshop in the 4th or 5th century AD—a cache of glass cullet was unearthed. This included fragmented windowpanes, mosaic tesserae of glass, and a couple of pieces of broken vessels.[77]

Secondly, chemical analysis of glass objects clearly demonstrates the recycling of glass. Broken glass—glass cullet—was a primary source of material alongside so-called raw glass. In the Roman era raw glass was made in a restricted number of sites, so-called primary production sites, and on the basis of both archaeological finds and chemical analysis we know that these were situated in the Eastern Mediterranean: on the Levantine Coast and in Egypt.[78] This raw glass was then shipped across the entire Empire to secondary production sites, where a range of different types of craftsmen made a variety of glass objects, such as glass vessels and window glass. In this secondary production both raw glass and recycled glass were equally used.

While the raw glass was produced on a few sites and has chemical compositions and trace elements that are relatively homogenous, glass vessels and objects have been demonstrated to have been made from glass batches of mixed origin, reflecting the recycling of materials.[79] Moreover, colourants used in glass are highly diagnostic and can be detected through chemical analysis. For example, a few fragments of strongly coloured glass might end up in a basket of colourless glass by mistake, and when this was melted to make new objects, trace elements of this material is then found in the entire batch.[80] Studies such as those mentioned above paint a picture of extensive recycling of glass in the Imperial era and enforce the arguments based on textual evidence (also discussed above).[81]

The reason for recycling was not only the value of the material itself, a material that could be transported to all production sites, but also that the use of cullet alongside raw glass lowered the melting temperature and hence reduced the fuel costs.[82] In the Roman World there was a constant and large-scale demand for fuel, as this was used for everything from cooking and heating individual households, heating public baths with literally thousands of daily visitors, and all types of industrial activities.[83] Any type of saving of fuels would have been welcomed. In sum, recycling was a common practice in the Roman era, perhaps even more so in the Late Roman period.

Analysis

ANALYSIS OF THE WINDOW-GLASS ASSEMBLAGE

The 1926 excavations of the Roman bath at Asine yielded a substantial assemblage of window glass given the size of the excavation site: in total 123 fragments. Two types of window glass were discovered:

– An assemblage consisting of 85 fragments of "cast", matt/glossy window glass. Of this assemblage 67 fragments were in natural-coloured green (61) or yellow-green (6). In addition to this there were 18 fragments in clear, colourless glass or colourless glass with a slight green tinge.

– An assemblage of 38 fragments of cylinder-blown, double-glossy window glass; however, it must be noted that this includes 19 very small splinters clearly emanating from a single pane. This was in natural-coloured dark green or yellow-green glass of noticeably poor quality.

The diagnostic features of the Roman window glass from Asine were sufficient to identify the type, but much of the material was so homogeneous that an estimated number of panes could not be provided. Indeed, this type of material is very rarely quantified, due to the fact that suggested methods

[73] Paynter & Jackson 2016, 4 with references.
[74] Freestone 2015, 34.
[75] Pasqui 1897, 518.
[76] Silvestri *et al.* 2008, 331.
[77] Boschetti *et al.* 2016, 72–78.
[78] Degryse 2020, 287.
[79] See the discussion in Degryse 2020.
[80] Freestone 2015, 29–30.
[81] Freestone 2015; Paynter & Jackson 2016; Degryse 2020.
[82] Keller 2005, 65.
[83] Domestic use, see Boman 2005; baths, see Nielsen 1990, 17–20; industrial activity, see Veal 2013, 44–45.

establishing minimum numbers are complicated and exceedingly time-consuming.[84]

Turning to the dating of these two groups of glass, beginning with the "cast", matt/glossy window glass, we know that this type of glass was manufactured between around AD 40/50 and AD 300, too wide a timespan to be meaningful. A detailed study of the colour and quality of the glass, however, provides a tentative indication of when the window-panes were produced. The natural-coloured green or yellow-green glass is in all probability late, possibly around AD 300. The smaller assemblage of colourless matt/glossy window glass is probably contemporary. This colour was common in the 2nd and 3rd centuries AD and was to some extent still in use in the 4th century AD.

Also, it is worthy of note that not a single fragment of the matt/glossy window glass is in the colour typical of both glass windows and vessels of the 1st to the 3rd centuries AD: blue-green.[85] The overall picture of this category of window glass thus suggests a Late Roman date, i.e., contemporary with the suggested date of construction of the bath.[86]

If we turn to the date of the cylinder-blown, double-glossy window glass, it is of noticeably poor quality, with impurities and many bubbles, and the colour, natural-coloured green or yellow-green, suggests a mid-4th to early 5th century AD date. There is also a single fragment of a double-glossy pane in colourless glass, which may or may not be contemporary.

There is much to suggest that a single, violent, event in the Late Roman period caused the "cast", matt/glossy glass windows of the bath to shatter and fall out of their frames, and it is suggested that an earthquake could have caused this damage. These fragments had fallen in several directions, with a noticeable concentration of fragments which had fallen in a southerly direction. They had fallen out of the building, but in one case possibly into it, being discovered in the hypocaust. A not insignificant number of sherds from these windows were simply left more or less where they had fallen. There are, however, a limited number examples found further away in the Lower Town. One, single, example was found up on the Acropolis of Asine.[87] The most probable explanation for this find is that it emanated not from the bath in the Lower Town, but rather from Asine's second bath which was situated near the entrance of the Acropolis.[88]

The taphonomic process that this fragmented material went through—as far as it is possible to discern—*does not* suggest a continued breakage or wear of the material over time. There is one single sherd, however, that shows significant wear. In other words, the majority of these sherds were not trampled on by the inhabitants of Asine or their animals, but were somehow protected from further breakage and wear.

The second, smaller assemblage of cylinder-blown, double-glossy window glass, suggests that the bath was renovated and the broken windows were replaced in the later 4th century or possibly early 5th century AD. One sherd was distorted by heat, but on the basis of this single find it is difficult to ascertain whether the building at some point caught fire or if this had some other cause. None of the fragments show any signs of wear, but there seems to be some degree of further fragmentation after the panes fell out of their frames. What caused these windows to break is unclear; it could have natural or human causes.

AN ERA OF HIGH SEISMIC ACTIVITY: THE EARLY BYZANTINE TECTONIC PAROXYSM

As will be discussed in greater detail below, historians, archaeologists, and seismologists have all pointed to earthquakes as one likely explanation for different types of destruction found on ancient sites. Hence, one possible—and, as will be argued, even probable—cause of the windows of the Roman bath shattering and the pillars of the hypocaust to break and slip was one or several earthquakes.

The sort of damage caused by seismic waves is often very specific and can be identified as such, due to the fact that massive forces move in two directions, horizontally and vertically. These forces cause the highest part of a building to move horizontally, while at the same time the foundations move vertically. The results of this are visible in the archaeological record. Pavements and mosaic floors can be folded or fractured,[89] and previously rectangular shapes, such as windows and door openings, are sometimes deformed.[90] Cracks commonly develop from the corners of windows or doors.[91] Other types of traces typical of seismic activity are that walls can be contorted or topple, and bricks and building blocks in walls and other structures can move horizontally and also rotate.[92]

In the original diaries written by the excavators of Asine we find the following note—in Swedish—from 13 April 1926:

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[84] See the discussion in Baxter & Cool 1991.

[85] For a discussion of colours and dating, see Price & Cottam 1998a, 14–16.

[86] Höghammar 1984, 82.

[87] Inv. no. AS 5332.

[88] The second bath, see Frödin 1938, 29. I would like to thank Professor Emerita Gullög Nordquist for pointing this out to me.

[89] Rodríguez-Pascua *et al.* 2011, 22.

[90] Stiros 1996, 132–135.

[91] Galadini *et al*. 2006, 400.

[92] Stiros 2001, 134; Galadini *et al*. 2006, 395, 400; Caputo *et al.* 2011, 347–348.

> *I rummet under den nedre absiden stå tegelpelarna mycket osäkert. En del av dem ha gått isär i mitten och glidit undan i nedre änden.*
>
> In the room below the apse the brick hypocaust pillars are very unstable. Some of them have broken in the middle and the lower end has slid away.[93]

These hypocaust pillars were built utilizing square, flat bricks.[94] This type of damage seems to fit well with an earthquake event, but it cannot be established when this event took place, that is, if it happened at the same time as the windowpanes shattered and fell out of their frames, or at some later time.

The tectonic activity in Greece and the Eastern Mediterranean has had a profound effect on human society there throughout the ages.[95] The time when the "cast", matt/glossy windows of the Roman bath in Asine were broken—sometime in the 4th century AD—was in the beginning of a period of markedly high seismic activity and consequent damage to human habitations. This period, which occurred between the middle of the 4th century and the middle of the 6th century AD, is known as the Early Byzantine Tectonic Paroxysm (EBTP).[96]

The destruction caused by earthquakes in the EBTP is attested by a range of different sources studied within different disciplines. Geological and seismological studies have been corroborated by historical and literary accounts as well as by epigraphical evidence; in addition to which there are numerous archaeological studies which have suggested earthquakes as a cause of various building structures being partly or wholly damaged.[97]

The EBTP covers an extended period of time—two centuries—but on the basis of historical sources it is possible to point to a number of specific earthquake events in the mid- to late 4th century AD which could have caused the windows in the bath to break. The best known—and by far the most studied—earthquake occurred on 21 July AD 365.[98] The Roman historian Ammianus Marcellinus (*c.* AD 330–400) presents us with a vivid account in his work *History*,[99] and on the basis of this it is clear that the earthquake was accompanied by a destructive tsunami.[100] He paints a picture of how the sea first dramatically disappeared, only to return with devastating force, leaving boats far inland on top of roofs. He recounts having seen the remnants of a Laconian ship that was swept approximately 3 km inland at Mothone—probably Methone in the south-west Peloponnese—long after the event.[101]

The Late Roman historian Zosimos (*fl. c.* AD 500) writes of an earthquake in his *New History* that supposedly occurred after the demise of Valentinian I in AD 375. In this he states that Crete and the Peloponnese were shaken—indeed all of Greece, with the exception of Athens—and that many places suffered severe destruction.[102] While it is not uncommon for earthquakes to occur in clusters, it has been argued that Zosimos—or rather his source Eunapios (a Greek sophist and historian, *fl.* 4th–5th centuries AD)—changed the date from AD 365 to AD 375.

Similarly, the Greek rhetor Libanios (AD 314–393) writes of a massive earthquake in his *Orations*, one that took place after Emperor Julian had died in AD 363.[103] It ruined a great many cities, in Libya, on Sicily, in Palestine, and all cities in Greece with the exception of Nicaea. Again, it is possible that the author changed the date from AD 365 to 363 to fit his narrative.[104] A later source, Marcellinus Comes, a Latin chronicler of the Eastern Roman Empire (d. AD 534), writes of an earthquake that took place in the years AD 396 or 397 in his *Chronicles*. According to Marcellinus it lasted for days and made the sky glow;[105] the latter being an example of so-called earthquake light.[106]

The EBTP obviously affected a vast geographical area, but narrowing it down to the vicinity of Asine, there is much to suggest that the two neighbouring cities of Nafplio and Corinth were hit by earthquakes in the latter part of the 4th century AD. In Nafplio, some 10 km north-west of Asine, there is an inscription relating to repairs made to a Christian basilica in the age of Valentinianus I (AD 364–375). This inscription was built into the gates of the city. It was set up by an unnamed *scholastikos* and his students, and specifies that the building should be protected "against earthquakes and the

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[93] Diary 4, 137–138 [Neander-Nilsson]. Arbman writes that: *Some dislocations ... have taken place* (1938, 109). In her 1984 study Höghammar notes that the hypocaust is in very poor condition (1984, 81). Unfortunately, there are no photographs of the damaged hypocaust from the time of the excavation.

[94] Höghammar 1984, fig. 12a.

[95] Stiros 1988, 1633.

[96] Pirazzoli *et al*. 1996, 6083–6084.

[97] Stiros 1988; 1996; 2001. For more general discussion on the relation between seismology, archaeology, and history see Noller 2001; Ambraseys 2006; Galadini *et al*. 2006; Guidoboni & Ebel 2009, ch. 1.

[98] See, for instance, Di Vita 1995; Stiros 2001; Stiros & Papageorgiou 2001.

[99] Amm. Marc. 26.10.15–19.

[100] Kelly 2004; see also Dominey-Howes 2002, 208–209; Shaw *et al.* 2008; Pararas-Carayannis 2011; Papadopoulos *et al.* 2014.

[101] Stiros 2001, 557.

[102] Zos. 4.18.

[103] Lib. 18.292–293.

[104] Rothaus 1996, 106.

[105] *Chron. Marcell.* 10.

[106] For a discussion of this phenomenon and its possible causes, see Whitehead & Ulusoy 2015.

sea": κατὰ σισμοὺς καὶ τοὺς θαλαττίο[υς].[107] What is meant by the latter is not entirely clear: it could mean coastal erosion caused by storms, or it may refer to a tsunami.[108]

Corinth is situated around 60 km north-east of Asine. The notion that seismic activity could have been the cause of damage to buildings in Corinth is by no means new: this was suggested as early as the 1930s by the Swedish-American archaeologist Oscar Broneer.[109] Richard Rothaus has convincingly argued that a number of building structures in Corinth were badly damaged by earthquakes, such as, for instance, the Great Baths on Lechaion Road. In the case of three pagan temples which were damaged, these were left in a state of disrepair, either due to a lack of resources or a lack of interest in the Christian era to rebuild them.[110]

PILLAGE AND PLUNDER IN THE PELOPONNESE? THE GOTHIC INVASION OF AD 395–397

The late 4th century AD was a period that witnessed a great amount of destruction—edifices were damaged in a number of different cities around the Peloponnese—but what caused this devastation has long been a matter of scholarly debate. Did it have natural causes in the form of earthquakes, as discussed above, or was it brought about by human agency, the "barbarian" invasion of the troops of King Alaric in the years AD 395 to 397? Let us therefore, briefly, discuss the "barbarian" invasion led by the Gothic Alaric of the late 4th century AD.

While it matters little in the question of whether the damage had human causes, it is worth noting that the label "barbarian" is far from unproblematic. While Alaric was the king of the Visigoths (AD 395–410), he had no power base outside the Roman Empire, as stressed by Robert Kulikowski.[111] He was a Roman general who had fought on the side of Emperor Theodosius in the Battle of the Frigidus River against the Franks in AD 393. But despite immense sacrifices on the battlefield, Alaric was not rewarded and therefore rebelled against the Romans. This happened in the troubled times following the death of Theodosius, the consequent division of the Roman Empire, and the disintegration of the Roman armies in AD 395.[112] As pointed out by Amelia R. Brown, Alaric's troops were Romanized, being former Roman federates; moreover, they were followers of the Christian faith.[113]

The notion that the late 4th-century AD damage was caused by war—the sacking of cities in Greece, troops plundering and pilfering—derives from the descriptions of Alaric's invasion of Greece in a number of Late Roman texts. These texts are far from unproblematic to use as they suffer from significant political and religious biases:[114] for example, Claudianus (*c.* AD 370–*c.* 404)—a Latin poet and panegyrist of Greek origin, hailing from Alexandria—presents us with a vivid picture of rivers running red with blood, of Argos being plundered of holy vessels, and the city of Corinth brutally set ablaze.[115] Claudianus is the only source that speaks of Corinth being burnt by the barbarians, and it has been argued that this was in fact inspired by Virgil's account of the destruction of Troy.[116] A number of later sources present us with similarly vague descriptions of wide-spread destruction. In his work *Lives of the Sophists* Eunapios laments how sacred temples were razed to the ground.[117] St Jerome (AD 331/348–419) in turn bemoans all the Roman blood spilled and speaks of a rife ravaging of cities.[118]

In contrast, while the later source Zosimos (*fl. c.* AD 500)—a Greek historian living in Constantinople—speaks of a wholesale sacking of cities around the Roman East, he also stresses that the cities of the Peloponnese were essentially defenceless and thus taken without a fight.[119] Brown convincingly argues that what we see in these sources is a West–East divide. The Western portrayal of these events depicts Alaric as the leader of a barbarian horde causing endless harm and destruction; Eastern sources instead speak of Alaric as a Roman official in charge of a confederate army.[120] This leaves the question of what degree of destruction was linked to Alaric's warfare largely unresolved.

Conclusions and summary

Architectural evidence analysed by Höghammar suggests that the bath was erected in the early 4th century AD, and the colour and quality of the "cast" matt/glossy window glass corroborates a date of construction of around AD 300. Like the small bath in Asine, most baths around the Roman Empire had glass windows, and this was to let in the light while keeping out the cold. This aspect is of particular importance in the winter season, the Greek winter climate being cold and

[107] *IG* 4.674.
[108] Stiros 2001, 550, 559.
[109] Broneer 1935, 58, an idea which has been influential among the excavators of Corinth (Rothaus 1996, 106). A few years prior, however, this was also suggested by the classicist John H. Finley Jr (1932, 477).
[110] Rothaus 1996, 105.
[111] Kulikowski 2006, 157.
[112] Kulikowski 2006, 164–165.
[113] Brown 2008, 83–84.
[114] Brown 2008, 83.
[115] Claud. *De Bello Gothico* 610–615; Claud. *In Rufinum* 2.1–12, 2.186–196.
[116] Brown 2008, 86; Claud. *In Rufinum* 2.190; Verg. *Aen*. 2.56.
[117] Eunap. *VS* 476, 482.
[118] Jer. *Ep.* 60.16.
[119] Zos. 5.4–6.
[120] Brown 2008, 91.

wet.[121] Modern weather data from the closest weather station to Asine—Tripolis in Argolis, some 36 km inland from Asine, at about 650 m above sea-level—give average temperatures of 6° C in December and 5° C in January and February. In these winter months the temperature occasionally drops to freezing-point.[122] At this time of the year it must have been particularly pleasant to go the bath, to enjoy the warm water and the good company.

At some point in the 4th century AD this was abruptly disrupted, when the windows of the bath broke and fell to the ground. The size of the assemblage is fairly substantial—85 fragments—which suggests severe damage to the building. And while it could neither be established how many windows the bath had or the size of these, nor how many panes this assemblage equals, the evidence indicates that only part of the "cast" matt/glossy window glass was left on the ground. It can be surmised that this material was largely protected from being trampled upon, as very little further breakage or wear is visible. But while this was left to lie—probably undiscovered, possibly covered by dust and debris—it is likely that other sherds were swept up and recycled. This catastrophic event brings one of Publilius Syrus' (1st century BC) aphorisms to mind:

> Luck is like glass—it glitters before it breaks.[123]

This brings us to the questions: what form of ill fortune struck the inhabitants of Asine? What caused the glass windows of the bath to shatter and fall out of their frames? And when did this violent event take place? What we do know is that after the "cast" matt/glossy windows were broken, these were replaced by cylinder-blown, double-glossy windowpanes. These are of a colour and quality suggesting a mid-4th to early 5th century AD date. In other words, we cannot establish if the earlier windows were broken before Alaric's invasion in AD 396–397 or not.

The degree to which Alaric's troops caused damage in the Peloponnese is debatable on the basis of the conflicting views presented by the historical sources. Additionally, it may well be that the destruction that hit the bath predates these historical events. On the whole, however, it seems less likely that human agency could explain the damage done to the bath, as demonstrated by the material in itself and the architectural remains. Window openings are typically distorted by earthquakes, and glass, being a brittle material, breaks. This could explain the unusually large size of the assemblage. More conclusively, the hypocaust displays damage of a sort typically associated with violent seismic movements: the pillars being broken and the bricks having moved sideways. Whether or not the damage done to the hypocaust was contemporaneous with the windows breaking cannot be established; however, hypothetically it could have occurred at a later stage in time.

The historical sources speak of major earthquakes occurring in the mid- to late 4th century AD—the beginning of the period known as the Early Byzantine Tectonic Paroxysm by archaeoseismological scholars—and as suggested by these, many local or minor events may not have been recorded in the sources. In other words, the windows breaking could be linked to the dramatic events of AD 365 or 396, or it may have been another seismic event all together.

What made the later, cylinder-blown, double-glossy windowpanes break cannot be established. The assemblage is on the whole comparatively small; not counting the minuscule splinters, it consists of 19 catalogued fragments.[124] One fragment was distorted by heat, but on the basis of this single piece of evidence, this does not suggest a more widespread fire. It could be that the damage to the cylinder-blown, double-glossy windows was connected to the earthquakes, which was likely the case with the earlier, "cast", matt/glossy windows. Or, it may be linked to the period of unrest: the "barbaric" invasion of Alaric, or it is simply a case of abandonment where some of the windows were not removed to be reused or recycled.

In sum: it is clear that the bath in Asine was struck by at least one, possibly more, earthquakes which caused the original windows to break and damaged the hypocaust.

Catalogue of the window glass

Abbreviations: Dims = dimensions. WT = wall thickness. All measurements given in mm.

"CAST", MATT/GLOSSY WINDOW GLASS OF ROMAN DATE

AS: without inventory number.

– *Fragment 1*: "cast" matt/glossy window glass in natural-coloured green with larger and smaller elongated bubbles. Pitted on underside, some traces of iridescence on surface. Edge slightly bent up, cracked-off or knapped to a straight edge. Originally of a rectangular shape. Dims 70 × 78; WT 4.2.

[121] *OCD* s.v. Climate.

[122] From the Norwegian Meteorological Institute: www.yr.no, retrieved 11 October 2016.

[123] Publilius Syrus, Sentientae, 219: *Fortuna vitrea est: tum cum splendet frangitur*.

[124] In total there were 38 fragments, of which 19 were very small splinters which were not catalogued.

– *Fragment 2*: "cast" matt/glossy window glass in natural-coloured green, with many slightly elongated bubbles. Edge slightly bent up, forming a slight bulge and then cracked-off. Pitted on underside, some traces of iridescence on surface. Dims 50 × 58; WT 3.5.
– *Fragment 3*: "cast" matt/glossy window glass in natural-coloured yellow-green, with occasional elongated bubbles. Pitted on underside, some traces of iridescence on surface. Dims 23 × 21; WT 1.7.

AS 728

– *Fragment* of "cast" matt/glossy window glass. Natural-coloured green. Occasional small circular bubbles. Dims 63 × 15; WT 1.9.

AS 945

– *Fragment 1*: "cast" matt/glossy window glass. Pale yellowish-green colour and many circular bubbles. Corroded surface. Dims 80 × 67; WT 4.6–1.5 (the edge).
– *Fragment 2*: "cast" matt/glossy window glass in natural-coloured green glass, with occasional small circular and somewhat elongated bubbles. Pitted on the lower surface. The pane is thinner and rounded at the edge. An indent of roughly round shape, *c.* 20 in diameter: traces of tooling? Probably same windowpane as *AS 945, Fragment 1*. Dims 37 × 33; WT 4.9, 1.6 (edge).
–*Fragment 3:* "cast" matt/glossy window glass in natural-coloured green glass, with small circular bubbles. Pitted on the lower surface. The pane is thinner and rounded at the edge, the surface at the edge 7–8 mm bears traces of being fitted into a frame. Dims 63 × 32; WT 3.5, 2.0 (edge).

AS 1305

– *Fragment* of "cast" matt/glossy window glass. Pale natural-coloured green, on underside black surface with a white layer underneath. Pitted on underside. The pane is thinner and rounded at the edge. Dims 20 × 30; WT 3.3, 2.0 (edge).

AS 1574

– *Fragment* of "cast" matt/glossy window glass. Natural-coloured green with many elongated bubbles. Pitted on underside, possibly ground. Dims 35 × 36; WT 3.1. *Fig. 8*.

AS 2736

– *Fragment* of "cast" matt/glossy window glass. Natural-coloured green, with both small and large elongated bubbles. Dims 77 × 55; WT 3.1.

AS 3030

– *Fragment* of "cast" matt/glossy window glass. Pale natural-coloured green with small circular bubbles. Some impurities in the glass, a small cluster of three "stones". Slightly pitted lower surface. Dims 87 × 63; WT 4.2–3.8.

AS 3061

– *Fragment* of "cast" matt/glossy window glass. Green natural-coloured glass, with small and large circular bubbles. Surface showing a great deal of wear after breakage. Dims 35 × 24; WT 3.5.

AS 3170

– *Fragment 1*: "cast" matt/glossy window glass, in colourless glass with few bubbles. Thinner at the edge, rounded. Lower surface slightly pitted. Slightly iridescent. Dims 47 × 40; WT 2.0; 1.7 (edge).
– *Fragment 2*: "cast" matt/glossy window glass, in colourless glass with few bubbles. Same pane as *AS 3170, Fragment 1*. Dims 35 × 20; WT 2.0.
– *Fragment 3*: "cast" matt/glossy window glass, in colourless glass. Same pane as *AS 3170, Fragment 1*. Dims 41 × 28; WT 1.0.
– *Fragment 4*: "cast" matt/glossy window glass, in natural-coloured green glass, with one large elongated bubble. Dims 79 × 35; WT 3.5.
– *Fragment 5*: "cast" matt/glossy window glass, in natural-coloured green glass, with small slightly elongated bubbles. Dims 55 × 32; WT 3.0.
– *Fragment 6*: "cast" matt/glossy window glass, in natural-coloured green glass. Dims 22 × 24; WT 3.0.
– *Fragment 7*: "cast" matt/glossy window glass, in natural-coloured green glass. Dims 45 × 16; WT 2.5.
– *Fragment 8*. "cast" matt/glossy window glass, in natural-coloured green glass. Dims 34 × 13; WT 2.9.
– *Fragment 9*: "cast" matt/glossy window glass, in natural-coloured green glass, with iridescent surface. Dims 30 × 19; WT 2.9.

AS 3263

– *Fragment 1*: "cast" matt/glossy window glass, in natural-coloured green with small spherical bubbles. Lower surface is slightly pitted. The edge of a window. This is considerably thinner along the rounded edge that would along the frame (1.0 mm), whereas the rest of the pane is considerably thicker (3.9–3.0 mm).
– *Fragment 2*: "cast" matt/glossy window glass, in natural-coloured green with small spherical bubbles. Lower surface is slightly pitted. Dims 33 × 37; WT 2.5–2.1.

– *Fragment 3*: "cast" matt/glossy window glass, in natural-coloured green with small spherical bubbles. Lower surface is slightly pitted. Dims 58 × 33; WT 2.1.
– *Fragment 4*: "cast" matt/glossy window glass, in natural-coloured green with small spherical bubbles. Lower surface is slightly pitted. Dims 17 × 7; WT 2.3.
– *Fragment 5*: "cast" matt/glossy window glass, in natural-coloured green with small spherical bubbles. Lower surface is slightly pitted. Dims 9 × 3; WT 2.1.

AS 3344

– *Fragment* of "cast" matt/glossy window glass. Natural-coloured green. The pane is somewhat thinner and rounded at the edge. A large bubble is trapped in the glass. Dims 21 × 15; WT 2.5 (edge), 4.2 (other part of the pane).

AS 3364

– *Fragment* of "cast" matt/glossy, window glass, ground on one side. Natural-coloured green with elongated bubbles. Dims 15 × 36; WT 2.5.

AS 3502

– *Fragment* of "cast" matt/glossy window glass, in very pale natural-coloured green glass with occasional bubbles. Dims 17 × 8; WT 4.0.

AS 3506

– *Fragment 1*: "cast" matt/glossy window glass in natural-coloured green glass with small circular and oval bubbles. Slightly pitted on lower side. Traces of chipping along a straight edge, possibly from shaping the glass into a rectangle. Dims 75 × 38; WT 4.0.
– *Fragment 2*: "cast" matt/glossy window glass in natural-coloured green glass with elongated bubbles. Somewhat pitted on lower side. Dims 79 × 31; WT 6.0.
– *Fragment 3*: "cast" matt/glossy window glass in natural-coloured green glass with elongated bubbles. Dims 65 × 30; WT 4.0.

AS 3537

– *Fragment* of "cast" matt/glossy window glass, in natural-coloured green glass. Dims 26 × 19; WT 5.1.

AS 3780

– *Fragment* of window glass, possibly matt/glossy. Clear, colourless glass with circular bubbles. Surface with iridescence and corroded, making certain identification impossible. Dims 28 × 27; WT 1.5.

AS 4069

– *Fragment* of "cast" matt/glossy window glass. Clear, colourless glass with many small circular bubbles. One small oval mark—not dissimilar to a pontil scar—on upper side, a slight raised area on the underside: from a tool of some sort? Pitted on underside. Edge cut of along a straight line. Dims 44 × 38; WT 2.6.

AS 4254

– *Fragment* of "cast" matt/glossy window glass in natural-coloured green glass, with small circular bubbles. Pitted on the lower surface. Dims 29 × 27; WT 5.0–4.0.

AS 4292

– *Fragment* of "cast" matt/glossy window glass. Colourless with a green tinge; iridescent surface. Dims 41 × 18; WT 2.9.

AS 4351

– *Fragment 1*: "cast" matt/glossy window glass in natural-coloured green. Pitted on underside. Small circular bubbles and one large bubble near surface. Dims 59 × 52; WT 3.1.
– *Fragment 2*: "cast" matt/glossy window glass in natural-coloured green. Pitted on underside. A few elongated bubbles. Dims 30 × 13; WT 4.1.

AS 4370

– *Fragment* of "cast" matt/glossy window glass in natural-coloured green glass. Very bubbly glass with both circular and elongated bubbles. Pitted on the lower surface. An almost rectangular shape with a part chipped off. Dims 32 × 55; WT 5.1–2.4.

AS 4841

– *Fragment* of "cast" matt/glossy window glass, in natural-coloured green with elongated bubbles. Pitted on underside. Dims 58 × 46; WT 5.0–4.0. *Fig. 5.*

AS 5332

– *Fragment* of "cast" matt/glossy natural-coloured green window glass, representing a minimum of one pane. Green, very bubbly glass with many elongated bubbles, including one very large bubble. Dims 93 × 67; WT 3.2.

AS 5484

– *Fragment 1*: "cast" matt/glossy window glass, in pale yellow-green natural-coloured glass with many elongated bubbles. Pitted on underside. Very corroded surface. Dims 59 × 35; WT 5.0–3.9.
– *Fragment 2*: "cast" matt/glossy window glass, in pale yellow-green natural-coloured glass with many elongated bubbles. Pitted on underside. Very corroded surface. Dims 27 × 13; WT 4.9.
– *Fragment 3*: "cast" matt/glossy window glass, in pale yellow-green natural-coloured glass with many elongated bubbles. Pitted on underside. Very corroded surface. Dims 43 × 37; WT 2.1.

AS 5485

– *Fragment* of "cast" matt/glossy window glass, in natural-coloured yellow-green with elongated bubbles. Pitted on underside. Dims 23 × 16; WT 1.8.

AS 5486

– *Fragment* of "cast" matt/glossy window glass, representing one pane. Colourless glass with a green tinge. Lower surface pitted. The fragment is very corroded. Dims 26 × 49; WT 3.5.

AS 5607

– *Fragment* of "cast" matt/glossy window glass. Clear, colourless glass with many very small bubbles. Slightly pitted on lower side. Dims 46 × 40; WT 2.5.

AS 5609

– *Fragment 1*: "cast" matt/glossy window glass in natural-coloured green glass with many elongated bubbles. Slightly pitted on lower side. Dims 58 × 56; WT 3.1.
– *Fragment 2*: "cast" matt/glossy window glass in natural-coloured green glass. Edge of window, thinner at the rounded edge. Dims 28 × 33; WT 4.5; WT (edge) 1.0.
– *Fragment 3*: "cast" matt/glossy window glass in natural-coloured green glass with a few elongated bubbles. Slightly pitted on lower side. Dims 46 × 18; WT 2.3.
– *Fragment 4*: "cast" matt/glossy window glass in natural-coloured green glass with a few elongated bubbles. Slightly pitted on lower side. Dims 37 × 18; WT 3.0.
– *Fragment 5*: "cast" matt/glossy window glass in natural-coloured green glass with a few bubbles. Dims 50 × 18; WT 2.5.
– *Fragment 6*: "cast" matt/glossy window glass in natural-coloured green glass with a few small bubbles. Dims 34 × 16; WT 2.8.
– *Fragment 7*: "cast" matt/glossy window glass in natural-coloured green glass. Slightly pitted on lower side. Dims 20 × 11; WT 2.1.
– *Fragment 8*: "cast" matt/glossy window glass in natural-coloured green glass. Dims 22 × 10; WT 2.1.
– *Fragment 9*: "cast" matt/glossy window glass, colourless, iridescent. Slightly pitted on lower side. Dims 40 × 10; WT 3.0.
– *Fragment 10*: "cast" matt/glossy window glass, colourless, iridescent. Slightly pitted on lower side. Dims 31 × 16; WT 3.0.
– *Fragment 11*: "cast" matt/glossy window glass, colourless, iridescent. Slightly pitted on lower side. Dims 47 × 7; WT 3.0.
– *Fragment 12*: "cast" matt/glossy window glass, colourless, iridescent. Slightly pitted on lower side. Dims 19 × 16; WT 2.9.
– *Fragment 13*: "cast" matt/glossy window glass, colourless, iridescent. Slightly pitted on lower side. Dims 25 × 20; WT 1.9.
– *Fragment 14*: "cast" matt/glossy window glass, colourless, iridescent. Slightly pitted on lower side. Dims 28 × 12; WT 1.8.
– *Fragment 15*: "cast" matt/glossy window glass, colourless, iridescent. Slightly pitted on lower side. Dims 23 × 8; WT 1.5.
– *Fragment 16*. "cast" matt/glossy window glass, colourless glass, iridescent. Dims 17 × 7; WT 2.0.
– *Fragment 17*: "cast" matt/glossy window glass? Slightly bent shape. Colourless glass, iridescent. Dims 50 × 19; WT 2.5.
– *Fragment 18*: "cast" matt/glossy window glass? Colourless glass, iridescent. Dims 40 × 30; WT 1.1.

AS 5627

– *Fragment 1*: "cast" matt/glossy window glass in natural-coloured green glass, with small circular bubbles. Pitted on the lower surface. Dims 45 × 39 mm; WT 4.0.
– *Fragment 2*: "cast" matt/glossy window glass in natural-coloured green glass, with small circular bubbles. Pitted on the lower surface. Dims 56 × 26; WT 4.0. Joins *AS 5627 Fragment 1*, i.e., is the same pane.
– *Fragment 3*: "cast" matt/glossy window glass in natural-coloured green glass, small elongated bubbles. Pitted on the lower surface. Dims 39 × 13; WT 4.0. Possibly same pane as *AS 5627 Fragments 1* & *2*.
– *Fragment 4*: "cast" matt/glossy window glass in natural-coloured green glass, many small and one larger elongated bubbles. Pitted on the lower surface. Dims 42 × 20; WT 2.9.
– *Fragment 5*: "cast" matt/glossy window glass in natural-coloured green glass, many small elongated bubbles. Pitted on the lower surface. Dims 39 × 12; WT 3.0. Probably same pane as *AS 5627 Fragment 4*.
– *Fragment 6*: "cast" matt/glossy window glass in natural-coloured green glass, small elongated bubbles. Pitted on the lower surface. Dims 31 × 6; WT 3.0. Probably same pane as *AS 5627 Fragment 4*.
– *Fragment 7*: "cast" matt/glossy window glass in natural-coloured green glass, small elongated bubbles. Pitted on the

lower surface. Dims 24 × 5; WT 3.0. Probably same pane as *AS 5627 Fragment 4*.
– *Fragments 8* & *9* (two joining fragments glued together): "cast" matt/glossy window glass in natural-coloured green glass, with small circular bubbles. Pitted on the lower surface. One straight edge, possible where it fitted into a frame. Dims 34 × 31; WT 4.9. Probably a different pane than *AS 5627 Fragments 1–4*.
– *Fragments 10–17*: eight splinters of "cast" matt/glossy window glass in natural-coloured green glass. WT *c*. 3.0.

AS 5770

– *Fragment* of "cast" matt/glossy window glass, in natural-coloured green with occasional bubbles. Dims 72 × 22; WT 3.5.

AS 5771

– *Fragment* of "cast" matt/glossy window glass in natural-coloured green glass, with a few slightly elongated bubbles. Dims 79 × 37; WT 3.1.

AS 7166

– *Fragment* of "cast" matt/glossy window glass in natural-coloured green glass, many small and two large circular bubbles. Pitted on the lower surface. Very worn after breakage. Dims 35 × 30; WT 4.1.

CYLINDER-BLOWN, DOUBLE-GLOSSY WINDOW GLASS OF LATE ROMAN DATE

AS 945

– *Unidentified fragment* of almost flat shape, a double-glossy windowpane? The fragment was exposed to heat. Very bubbly glass in poor quality natural-coloured green glass. Dims 45 × 35; WT 3.0.

AS 1305

– *Fragment* of double-glossy window glass. Natural-coloured yellow-green, with many elongated bubbles. Traces of iridescence. Dims 57 × 15; WT 1.2.

AS 2539

– *Two fragments* from one pane of a double-glossy windowpane. Very poor quality, bubbly glass, in natural-coloured green with single black specks. Large and small elongated bubbles, making the surface bubbly. *Fragment 1*: Dims 43 × 52; WT 1.9. *Fragment 2*: Dims 26 × 25; WT 2.8. *Fig. 10.*

AS 2957a

– *Fragment* of a double-glossy window glass. Natural-coloured yellow-green, poor quality, glass. Large elongated bubbles. Dims 40 × 22; WT 1.0.

AS 3010

– *Fragment 1*: double-glossy windowpane in colourless glass. Surface corroded and iridescent. Dims 30 × 38; WT 2.3.
– *Fragment 2*: double-glossy windowpane in natural-coloured green glass. Dims 27 × 17; WT 1.9.
– *Fragment 3*: double-glossy windowpane in natural-coloured green glass. Dims 25 × 15; WT 2.0.

AS 3030

– *Two fragments* of window glass, possibly double-glossy. Pale natural-coloured green. *Fragment 1*: Dims 92 × 43; WT 2.2. *Fragment 2*: Dims 40 × 14; WT 2.7. *Fig. 9*.

AS 3051

– *Fragment* of double-glossy window glass. Natural-coloured green, very bubbly glass with many elongated bubbles. Edge of the windowpane slightly bent up. Dims 54 × 48; WT 2.8.

AS 3177

– *Two fragments* of double-glossy window glass, representing a minimum of one pane in natural-coloured green glass, with elongated bubbles. *Fragment 1*: Dims 44 × 15; WT 2.8. *Fragment 2*: Dims 43 × 24; WT 2.5.

AS 3391

Fragment of a double-glossy windowpane, in natural-coloured green. Poor quality, with large elongated bubbles. Dims 45 × 25; WT 2.0.

AS 4322

– *Fragment* of double-glossy window glass. Natural-coloured green glass with many small circular to elongated bubbles. Dims 32 × 47; WT 2.0. *Fig. 6.*

AS 5496

– *Fragment* of double-glossy window glass? Very poor quality, natural-coloured yellowish-green glass with many bubbles. Dims 33 × 19; WT 1.6.

AS 5607

– *Fragment* of double-glossy window glass, in natural-coloured green with many elongated bubbles. Dims 26 × 11; WT 2.0.

AS 5772

– *Fragment 1*: double-glossy window glass. Very poor quality glass: yellowish-green with many elongated bubbles. Iridescent surface. Dims 59 × 37; WT 1.9.
– *Fragments 2–20*: 19 splinters of thin, double-glossy window glass in natural-coloured green. Dims: most less than 10 × 10; WT0.9–1.1.

DOMINIC INGEMARK
Department of Archaeology and Ancient History
Uppsala University
Box 626
751 26 Uppsala, Sweden
dominic.ingemark@antiken.uu.se

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