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What Purposes Did This Serve? An Unusual Glass Vessel from The Archaeological Museum of Kastamonu

Hangi Amaçla Kullanıldı? Kastamonu Arkeoloji Müzesinden Alışılmadık Bir Cam Kap

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Abstract

Glass has been utilized throughout history across a diverse range of fields, including the medical and beauty industries, burial rituals, lighting instruments, architecture, and tableware. Its applications encompass various purposes, forms, types, and decorative styles. Glass artifacts, produced using various techniques since their inception, have gained widespread prominence, particularly following the discovery of the free-blowing method. This technique has established glass as a dominant material across all previously mentioned sectors. In certain instances, the identification of the functional areas of these objects is relatively straightforward. This can be attributed to the fact that familiar forms adhere to established traditions and have been designed and manufactured consistently over an extended period, thereby fulfilling the same functional role. However, certain examples identified during archaeological excavations or recorded in collections present atypical forms. It is challenging to ascertain the function and period of certain artifacts that cannot be contextualized, particularly as they are not derived from archaeological excavations and thus remain subject to interpretation. The case of the Kastamonu Museum, as discussed in this study, is a notable example that deserves interpretation alongside other similar, though rare, instances. In addition to presenting a rare artifact to the archaeological community, the application of 'experimental archaeology' to support our interpretations of the artifact underscores the significance of this study.

Keywords: Glass, Roman Period, Kastamonu Museum, Anatolia, Paphlagonia.

Öz

Camın tarih boyunca medikalden güzellik sektörüne, ölü gömme ritüellerinden aydınlatma araçlarına, mimariden masa kaplarına kadar pek çok farklı alanda, pek çok farklı amaçla, farklı form, farklı tip ve farklı dekorasyonla kullanıldığı bilinmektedir. Kimi durumlarda bu objelerin kullanım alanlarını saptamak oldukça kolaydır. Çünkü alışıldık formlar bir geleneği takip ederek çok uzun seneler aynı şekilde tasarlanır ve aynı şekilde üretilirler; aynı fonksiyona hizmet ederler. Fakat arkeolojik kazılar sırasında saptanan ya da koleksiyonlarda belgelenen kimi örnekler formları ile sıra dışı bir şekilde karşımıza çıkar. Özellikle arkeolojik kazı buluntusu olmadığından kontekst içerisinde tespit edilemeyen kimi buluntuların işlevini belirlemek ve kullanım dönemini tespit etmek oldukça zordur ve yorumlamaya açıktır. Bu çalışmada sunulmakta olan Kastamonu müzesi örneği de aynı şekilde, çok nadir olan benzer örneklerden yola çıkılarak yorumlanmaya ihtiyaç duyan sıra dışı bir örnektir. Bu kadar nadir bir eseri arkeoloji dünyasına tanıtmanın yanı sıra, eserle ilgili yorumlamalarımızı "deneysel arkeoloji" metotlarından faydalanarak desteklemek ise bu çalışmanın önemini perçinlemektedir.

Anahtar Kelimeler: Cam, Roma Dönemi, Kastamonu Müzesi, Anadolu, Paphlagonia.

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Introduction

Many ancient glass artifacts do not meet the necessary criteria for accurate dating and functional determination. This limitation stems from the recyclable nature of glass, which was frequently repurposed for secondary production in antiquity. Furthermore, the inherent fragility of glass results in artifacts suitable for typological studies being rarely identified during archaeological excavations. One of the most significant factors that exacerbates this adverse situation in Ancient Anatolia is the quantitative deficiency in glass studies. In conclusion, in contexts where excavation findings are inadequate and literature reviews are incomplete, museum collections hold significant importance, regardless of whether they have been acquired through confiscation or donation.

The example of the Kastamonu Museum (Figure 1) holds considerably valuable in this context[1]. The artefact, which was incorporated into the museum collection through confiscation in 2011, is attributable to the ancient region of Paphlagonia, where the museum is situated; however, the precise location of its excavation and the specific stratum to which it belongs could not be ascertained[2].

The significance of the artefact is primarily attributable to its rarity. Our research has unveiled that a mere 13 instances have been documented to date, among them two originating from Anatolia, one of which pertains to the artifact housed at the Kastamonu Museum, the subject of our present analysis.

All specimens were produced using the free-blowing technique. Each specimen features a -shaped mouth, a narrow, elongated cylindrical neck, a spherical body, and a flat, slightly concave base. Their most prominent characteristic is their exceptionally narrow spout. All specimens fall within the pale blue to pale green color spectrum. The rim may be either rounded or unworked; however, the specimens typically display minor variations in size and detail[3].

Figure 1. Drawing and photograph of the Kastamonu Vase.

Parallel Findings and Challenges in Origin and Dating Research

Unfortunately, very few artifacts can be traced back to their origins, and even fewer have been uncovered through scientific archaeological excavations. Among the identified artifacts, only those from Lete (Greece) (Antonaras, 2017, p.103-104), Arles (France) (Quicherat, 1874, p.74), and Albenga (Italy) (Antonaras, 2017, p.104) are classified as excavation finds. It has been reported that the vase housed in the Damascus National Museum is an artifact originating from Raqqa (https://glass.museumwnf.org/database-item/mwnf3/objects/ISL/sy/Mus01/15/en), while the vase housed in the Louvre Museum is attributed to Tibériade (probable Syro-Palestinianproduction) (https://collections.louvre.fr/en/ark:/53355/cl010281453). Additionally, the artifact located in the Gaziantep Medusa Glass Museum is sourced from the Yozgat-Çorum-Çankırı regions (Çakmaklı&Höpken, 2015, p.79-80). The artifact housed in the Kastamonu Museum originates from the region in which the museum is situated; however, its precise provenance remains unclear. The origins of the artifacts housed in the collections of the Cologne Museum (La Baume & Salomonson 1976, 44, no.104), Amphipolis Museum, Israel Museum, Efthrafsti Polyteleia exhibition and Allaire Collection are also currently unknown. Therefore, the issue of provenance is relevant to the majority of the identified artifacts. However, the available data suggests that similar types of artifacts were distributed across various provinces of the Roman Empire. In instances where the provenances are uncertain and similar types of artifacts are dispersed across extensive regions, it is prudent to refrain from making assertions regarding the production sites of such artifacts.

One of the adverse consequences associated with the predominance of artifacts that are not derived from excavated contexts is the challenge of accurately dating these objects. At this juncture, we will employ contextualized examples to perform a stylistic analysis grounded in these instances.

The Lete artifact (Figure 2) is derived from the region known as Villa Rustika. T. Antonaras, who conducted a comprehensive analysis of the artifact, posits that the stratigraphic layer corresponding to its introduction is dated to the 2nd-3rd centuries AD, aligning with the destruction layer of the structure. However, he also acknowledges that the majority of other glass artifacts recovered from the surrounding area are predominantly dated to the 1st and 2nd centuries AD. (Antonaras, 2017, p.104)[4].

Figure 2. Vase found in Lete (Antonaras, 2017, p.103).

Figure 3. Vase found in Arles (Quicherat, 1874, p.74).

[1] The research documented herein was conducted in accordance with the "Scientific Research Protocol" dated July 1, 2024, and assigned the identification number E-74130190-152.99-5457098, in collaboration with the Kastamonu Provincial Directorate of Culture and Tourism. The copyright for the photographs and drawings utilized in this publication is held by the Ministry of Culture and Tourism, General Directorate of Culture and Museums, Kastamonu Museum.

[2] Due to the circumstances surrounding the artifact's arrival at the museum, it is impossible to ascertain the precise location of its discovery with certainty. However, based on information obtained from museum experts, it is indicated that the individual who identified the artifact recovered it from the surrounding region.

[3] See footnote 8 for a discussion of these variations.

[4] T. Antonaras notes that the artifacts from this specific region, when evaluated within the context of the site's characteristics, may have been utilized over an extended period by members of the same family, functioning as a form of "family heirloom" for approximately one century (mid-1st century AD to mid-3rd century AD) (Antonaras 2017, p.104).

Figure 4. Vase found in Albingaunum Necropolis (https://www.fotos-reiseberichte.de/italienische-riviera/albenga/roemisches-glas.htm)

All information regarding the Arles find (Figure 3) is derived from the collection of M. Augier, a noted collector. M. Augier acquired several artifacts unearthed during the road excavations conducted for the development of the route connecting Arles to Montpellier. The historian Jules Quicherat interviewed with M. Augier and subsequently disseminated the information concerning these artifacts to the academic community (Quicherat, 1874, p.73-82). Based on this information, we conclude that the artifact within the scope of our study originates from the Roman necropolis known as Aliscamps in Arles. It was discovered at the same stratigraphic level as the other artifact depicted in the figure[5], suggesting that both may represent grave finds (Quicherat, 1874, p.80-81).

Conversely, the study does not offer information regarding the dating of the artifact; however, T. Antonaras, in his analysis of these artifacts with a focus on the Lete find, ascribed a date to the 1st and 2nd centuries AD. He also noted that the archaeological contexts provide support for this chronological assessment (Antonaras, 2017, p.104).

The final artifact (Figure 4) associated with this group, which may be classified as a result of archaeological excavation, originates from the necropolis excavation in Albenga. The excavation results indicate that the group of artifacts associated with the context in which the artifact was discovered dates to the 1st and 2nd centuries (Massabò, 2001, 122-123, no. 71). The consistency of this dating with previous examples is significant in the context of addressing dating discrepancies.

Figure 5. Vase from the National Museum in Damascus (https://glass.museumwnf.org/database-item/mwnf3/objects/ISL/sy/Mus01/15/en).

Figure 6. Vase from the Israel Museum (Brosch, 2003, 347 no: 458).

Figure 7. Vase from the Medusa Glass Museum in Gaziantep (Höpken & Çakmaklı, 2015, p. 79, cat.no.140).

As previously discussed, the provenance and dating of museum and collectible vessels pose significant challenges due to the uncertainty surrounding their precise origins. However, there are instances within this category where a general location can be established based on the information provided to collectors, among other sources. The first specimen whose provenance has been discussed is preserved in the National Museum in Damascus[6] (Figure 5), and it has been proposed that it originated in Raqqa, Syria (https://glass.museumwnf.org/database-item/mwnf3/objects/ISL/sy/Mus01/15/en). It can be confidently asserted that the city played a pivotal role not only as a center for archaeological discoveries related to glass but also as a critical production hub in the history of glass. Archaeological evidence indicates that Raqqa served as a production center during the Abbasid period, renowned for the manufacture of a substantial quantity of glass vessels (Handerson and others, 2005) . Additionally, three distinct archaeological sites associated with primary glass production have been identified in this region, dating from the 8th to the 9th, 11th, and 12th centuries (Handerson and others, 2004). The dating assigned to the vase housed in the Damascus Museum indicates that it belongs to the Islamic period (9th to 10th centuries AD.), likely corresponding to an era in which the city demonstrated significant prominence in the production of glass and glass vessels. (https://glass.museumwnf.org/databaseitem/mwnf3/objects/ISL/sy/Mus01/15/en) Another comparable artifact from the Islamic period (Figure 6), of unknown provenance, is located in the Israel Museum (Brosh, 2003, p. 347, no.458). T. Antonaras noted that the vases housed in the Damascus and Israel Museums were inaccurately attributed to the Islamic period; he subsequently dated these vases to

[5] The artifact in question was characterized as a "thermometer" by the sellers during the acquisition phase of the collection (Quicherat, 1987, p. 81).

[6] Information regarding the vase housed in the Damascus Museum is accessible through the online catalog of the "Museum with No Frontiers.". In the museum catalogue, it is acknowledged that the artifact in question is of Islamic origin, specifically dating to the Abbasid period, with a suggestion that Raqqa may have served as the production center, given its significance as a prominent center for glass production during this era. (https://glass.museumwnf.org/database-item/mwnf3/objects/ISL/sy/Mus01/15/en) Conversely, both stylistic analysis and comparisons with analogous examples indicate that it may be more appropriate to date the artifact to the Roman period.

the Early Roman Imperial Period (Antonaras, 2017, p. 104, footnote.1153-1154).

The vase (Figure 11), acquired by the Louvre Museum through acquisition, is believed to have originated from the Syria-Palestine region and was likely discovered in Tiberias. It is dated to the last quarter of the 1st century AD and the 2nd century AD (75-200 AD) (https://collections.louvre.fr/en/ark:/53355/cl010281453).

The Medusa Glass Museum in Gaziantep houses glass artifacts from a collection acquired at various dates. Similar to much of the museum's collection, the artifact under examination in this study (Figure 7) was recovered from the Yozgat-Çorum-Çankırı region. Based on comparative analysis with analogous examples, this artifact is dated to the period between the 1st and 3rd centuries (Höpken&Çakmaklı, 2015, 79). Another artifact, potentially discovered in Crete and dated to the late 1st to early 2nd century AD, is displayed in the temporary exhibition titled Efthrafsti Polyteleia (Antonaras, 2017, p. 104, footnote.1158).

Analogous finds from Cologne (Figure 8), Amphipolis (Figure 9) and Allaire Collection (Figure 10) also present issues related to provenance. While the vases from the museums of Cologne and Amphipolis have been dated to the 1st and 2nd centuries AD based on analogous finds (La Baume & Salamonson, 1976, p. 44; Antonaras 2017, p. 104)[7], the vase from the Allaire collection has not been assigned a specific date. Although it was noted that experts ascribed the same chronological framework to the other artifacts, it was emphasized that this particular artifact exhibits a distinct base type that sets it apart from the others[8] (https://ancientglass.wordpress.com/2019/08/15/roman-glass-guttus-2/). It is noteworthy that there are two examples from the Amphipolis Museum that have yet to be published[9] (Antonaras, 2017, p. 104, footnote.1159).

Figure 8. Vase from The Cologne Museum (La Baume & Salomonson, 1976, 44, no.104).

Figure 9. Vases from the Museum of Amphipolis (https://maps.app.goo.gl/84Cq1B6xwByBJzcdA)

Figure 10. Vase from The Allaire Collection (https://ancientglass.wordpress.com/2019/08/15/roman-glass-guttus-2/).

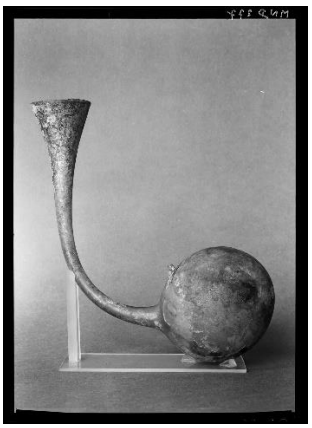

Figure 11. Vases from the Museum of Louvre (https://collections.louvre.fr/en/ark:/53355/cl010281453).

To summarize the distribution of vessels with known or probable provenance centers, it can be stated that four vessels are located in Greece, two vessels are situated in Anatolia (including one find from the Kastamonu Museum), two vessels originate from Palestinian Syria (one of which is housed in the Louvre Museum in France), and one vessel each is located in Italy, and France.The provenance centers or even the regions of the remaining finds have not been determined. It has been observed that all of the aforementioned findings—bearing in mind that there are very few examples in the literature—exhibit minimal variation in basic characteristics such as form, size, and color. This finding reinforces the hypothesis that some of the vessels may have originated from the same workshop. Conversely, determining the specific region in which this workshop was situated is challenging due to the extensive geographical distribution of the artifacts.

Perspectives on the Utilization of the Vessels

Firstly, it has been noted that certain vessels have not yet been incorporated into the existing literature. For the group beyond these examples, there exists a range of expert opinions regarding the areas of application. Conversely, despite the considerable similarity of the vessels in terms of their technical characteristics, the divergent perspectives among experts concerning the uses of these artifacts have delineated the primary focus of this study.

Although the artifact is presented as a "milk pump" in the museum's

[7] SearchCulture.gr, a national portal that disseminates information regarding the Amphipolis Vase, attributes a chronological range to the artifact, specifically from 100 BC to 200 AD. (https://www.searchculture.gr/aggregator/edm/mnam/000150-789145?language=en).

[8] The parallel examples all exhibit a concave base, rendering them incapable of standing independently. Conversely, the example from the Allaire collection features a base ring, which enables it to maintain a stable standing position. Another distinctive feature of the work is its three cut-line decorations(https://ancientglass.wordpress.com/2019/08/15/roman-glass-guttus-2/). With the exception of the examples from the Kastamonu Museum and the Allaire Collection, all of the vases are undecorated. The decorated examples in question feature common and relatively straightforward decorative techniques, such as simple cut-line decoration or irregular counted ribs, which do not obstruct the visibility of the contents.

[9] The photograph utilized in this study was sourced from Google visitor photos of the Amphipolis Museum (https://maps.app.goo.gl/84Cq1B6xwByBJzcdA).

exhibition area, research suggests that such bottles may have fulfilled medical or chemical functions. In addition to serving as milk pumps in nursing, they may have been utilized as urine bottles or distillation vessels until the Medieval period (Höpken & Çakmaklı, 2005, s. 79).

Similar to the artifact exhibited at the Medusa Museum, the rationale for the use of the Arles artifact pertains to its relation to chemistry. Researcher J. Quicherat posits that the pitcher component, which is no larger than a pinhole, likely served a function analogous to the safety tubes incorporated into chemical apparatuses (Quicherat, 1874, p. 80-81). At this juncture, it is important to note that the artifact under consideration is classified as a grave find and was discovered in conjunction with the other object illustrated in Figure 3. Although the individuals who sold the second item to the collector described it as a "thermometer" (Quicherat, 1874, p. 81). its precise function remains uncertain. Nevertheless, if it can be established that the objects were employed in the fields of chemistry or medicine, the identity of the grave owner may be inferred.

The hypothesis that the vase housed in the Damascus Museum may have served as a vessel utilized in the field of chemistry is bolstered by the observation that its decorative elements were removed to facilitate the examination of the chemical reactions occurring within it (https://glass.museumwnf.org/database-item/mwnf3/objects/ISL/sy/Mus01/15/en). Similarly, the vase housed in the museum in Cologne is characterized as a "distillation flask" (La Baume & Salamonson, 1976, 44). The vase displayed in the Louvre Museum is similarly referred to as a "retort," suggesting its utilization in the process of distillation (https://collections.louvre.fr/en/ark:/53355/cl010281453).

In contrast to the aforementioned interpretations, which align more closely with medical or chemical functions, the most distinct proposal was posited for the Lete artifact. A comprehensive commentary on the subject was presented by T. Antonaras, who conducted an analysis of the Lete example. He posited that the most significant insight into the utilization of the vase lies in the presence of the lugs on the vessel. His explanation is as fallows:

The moment that the body walls are heated enough at the desired spot, they are pierced with an abrupt, violent movement of the rod, which is equally swiftly removed transforming the blob into the conical spout. These lugs were probably used to control the flow of the contents, which due to the obliqueness of the neck could not flow if extra air was prevented from entering the vessel body from another point. Thus, the user could stop or allow the flow of the vessel's contents by sealing or opening the hole of the lug/spout with his/her finger. This flow-control system must have been particularly useful at events such as banquets and for libation offerings (Antonaras, 2017, p. 103-104)[10].

The Vase from the Kastamonu Archaeological Museum and an Interpretation of the Functional Contexts of Comparable Artifacts

The vase from the Kastamonu Museum (Figure 12-13), identified as originating from one of the centers within the region and consequently classified within the Paplagonia glass typology, exhibits similarities to other analogous artifacts in nearly all of its physical characteristics. It has a height of 16,5 cm, a maximum length of 18 cm, a rim diameter of 5,1 cm, and a spout diameter of 1 mm. The production technique employed is characterized by free blowing. The rim remains unworked and exhibits a funnel shape, complemented by a narrow, elongated neck and a spherical body. The slightly concave base precludes the vessel from standing flat. The aforementioned features regarding the measurements[11] and characteristics of the form are, on average, comparable to other analogous finds. In contrast to the other artifacts, which are predominantly undecorated and plain, the Kastamonu example incorporates ornamental elements, featuring irregular ribs on the body. Although these ribs, created with the assistance of glassmaking tools, are primarily confined to the body, it has been observed that they irregularly extend onto the curved neck.

Figure 12. General view of the vase in the Kastamonu Museum.

Figure 13. Detail view of the vase in the Kastamonu Museum.

The technical characteristics enumerated above serve as the sole initial criterion for ascertaining the function of the artifact, as it is not an artefact of archaeological excavation, and the contextual information pertaining to the find remains unknown. In our literature review for parallel examples, we identified that experts have documented the utilization of these artifacts in various contexts. These include their application in distillation processes, in medical or chemical fields for the measurement and dosing of liquids, in nursing functions such as breast pumps or baby bottles, and as daily vessels for banquets and beverages, where the spout serves a flow control function[12].

Reflections on Glass in Experimental Archaeology

At this stage of our study, considering the diversity of opinions regarding the parallel examples, we have employed the method of "experimental archaeology" to ascertain the function, as there is no consensus even among the excavated examples. To achieve this objective, subsequent to the study conducted at the Kastamonu Museum, we facilitated the production of an accurate replica of the vase (Figure 14-15) by undertaking comprehensive technical

[10] Another expert who opposes the potential function of distillation and advocates for the use of libations is B. Massabò. Professor B. Massabò noted that he had observed a similar vase from the Albingaunum necropolis in the Museum of Hanià (Crete) and that it was a grave find. He posits that these specific vases are linked to the concept of the funerary banquet (On January 20, 2025, we engaged in written communication with Professor B. Massabò. We would like to express our sincere gratitude for his valuable insights.)

[11] Among the specimens for which measurements can be accurately determined, the only specimen exceeding a maximum length of 20 cm is located in the Damascus Museum (https://glass.museumwnf.org/database-item/mwnf3/objects/ISL/sy/Mus01/15/en).

[12] See page 17-18 of the appendix table for a compilation of perspectives regarding the utilization of the findings.

measurements of the original artifact[13].

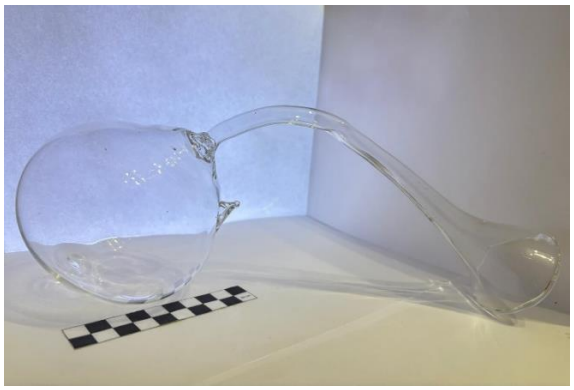

Figure 14 -15. Replica of the Vase from the Kastamonu Museum.

Liquid filling and draining tests were conducted on the replica (Figure 16-21). It was observed that in instances where the slanted and narrow neck hinders the efficient entry and exit of the liquid, the presence of the spout facilitates the escape of air, thereby enhancing the ease of filling or draining the liquid. However, this function is hindered by the positioning of the spout. However, this function is handicapped by the positioning of the spout.

Figure 16-17. Fluid Filling with the Spout in Both Closed and Open Positions.

To provide a more detailed and descriptive explanation: The drainage of liquid from the artifact can only be achieved by inverting it, such that the mouth of the vase is oriented upwards. In this inverted position, the spout remains elevated, facilitating the entry of air and thereby restoring the liquid flow from the funnel mouth to its normal state. Furthermore, manipulating the spout with a finger in this orientation proves effective in regulating the volume of liquid discharged. However, it is our contention that if the primary function of the artifact was to enable control over the inlet and outlet of the liquid, the spout should have been oriented in the opposite direction.

Figure 18-19. Drainage of liquid from the vase in two distinct holding positions with the spout in an open position.

[13] We extend our gratitude to glass artist Mustafa Cem Kılıç of the Eskişehir Camgöbeği Glass Workshop for his contributions to the production of this work.

Figure 20-21. Drainage of liquid from the vase in two distinct holding positions with the spout in an closed position.

Another intended use recommended by experts is the nursing function, wherein it is utilized as a milk pump or baby bottle. At this juncture, it is important to recall that in the original vase, the spout features an opening that is as narrow as the tip of a pin. This feature was retained in the replica, and the hole of the spout was created using the same methodology. Our experiments with the breast pump indicated that it is not feasible to pump by inhaling through the mouth with the assistance of a wooden or glass rod affixed to the spout[14].

Although the alignment of the funnel mouth and the spout in the same direction, prior to the invention of plastic tubing, suggests that the spout could be used with a glass or wooden tube—similar to a pipette—it is essential for the spout hole to be wider to enable effective pumping functionality as a breast pump. Moreover, positioning the spout in parallel alignment with the onset of the neck is likely to enhance the pumping efficiency. Additionally, it is evident that the glass or wooden tube connected to the spout should be designed with a sloped orientation. Although it is posited that such an arrangement could have been produced by a manufacturer aiming to create a breast pump, the improper positioning of the spout on the artifact raises questions regarding this possibility. Furthermore, the presence of an unworked rim on the artifact significantly diminishes the likelihood of skin contact, even when accounting for the effects of polishing[15].

The final hypothesis posits that this collection of vessels was utilized in laboratory settings for distillation or analogous processes. The conclusion drawn from our experimental study suggests that this hypothesis may be valid. In addition, the non-porous structure of glass, along with the ease of visual observation of contents within glass containers, renders glass an unequivocal preferred choice for laboratory applications. Consequently, it is evident that throughout history, significant efforts have been made to utilize glass in various laboratory processes. It is highly probable that this purpose was specifically oriented towards the "distillation"[16] function.

The distillation method prioritized in our experimental study is the "Bain-maria method" (Figure 22-23), which is periodically compatible with the dating of the group of artifacts that constitute the focus of our research[17]. The method is named after an ancient alchemist from the 1st to 3rd centuries AD, referred to as “Maria the Jewess” or “Maria the Alchemist.” (Patai, 1994, p. 79). Our understanding of her contributions is primarily derived from the writings of Zosimos, who is recognized as the first biographically documented alchemist in history (Escolano & Poveda, 2022, p. 77). Another reason for choosing the Bain-maria method in the experiment is the susceptibility of the glass group in question, which may have been produced in the early and/or middle phases of the Roman period, to thermal stress, which causes the glass to crack due to temperature differences when in contact with heat. The bain-marie method mitigates the risk of glass cracking by positioning the glass vessel directly over a heat source. This risk reduction is attributed to the relatively constant boiling points of water and alcohol, which ensures that when the distillation flask is submerged in water, the temperature remains below 100 degrees Celsius, thereby significantly decreasing the likelihood of cracking. However, it is important to note that this method is exclusively applicable for the distillation of water, which has a boiling point of 100 degrees Celsius, as well as for liquids that require heat below this threshold (e.g., ethyl alcohol, which has a boiling point of 78.4 degrees Celsius). In contrast, the distillation of metals, such as gold, necessitates higher temperatures that cannot be achieved using the bain-marie technique. In summary, this represents a technique for mitigating thermal stress in the processes of water and alcohol distillation.

Our experiments demonstrated that simple mixtures, such as water and alcohol, can be effectively separated in a glass vessel utilizing the bain-marie method (Figure 24). From the mixture within the apparatus, the boiling alcohol initially evaporated through the elongated neck of the artifact. Upon reaching the funnel's aperture, the vapor cooled and subsequently condensed, accumulating in droplets within the collection container. However, for this process to operate efficiently, it is essential to simultaneously cool the neck of the artifact to ensure that a majority of the vapor is captured in liquid form. This cooling can be accomplished by applying cold water to the neck. In the absence of cooling water, there is an elevated likelihood that some of the evaporated alcohol will be lost. Nevertheless, a successful distillation process was observed even in the absence of cooling. These findings suggest that the artifact may represent a primitive form of a modern retort utilized for distillation in the field of chemistry.

[14] M. Obladen notes that the design of breast pumps has evolved in accordance with the materials available throughout history. In antiquity, the ancient Greeks utilized ceramic guttus types to both empty the breast and nourish the infant. Subsequently, the Romans developed glass milk pumps. Additionally, mothers themselves employed these pumps to facilitate the elevation of retracted nipples (Obladen 2012, p. 669-670)

[15] Within the vase group, the Kastamonu Vase, which is the focus of this study, along with the examples from the Gaziantep Medusa Museum and the Albingaunum necropolis, were produced with unworked rims. In contrast, the rim is absent in the Lete Vase. Additionally, no documentary evidence was found for the artifact from the Efthrafsti Polyteleia Exhibition.

[16] Distillation is an ancient separation technology employed for the separation of liquid mixtures, with origins that can be traced back to the chemists in Alexandria during the first century A.D. (Halvorsen, 2001, p. 28). In contemporary times, distillation has emerged as the predominant industrial separation technology The traditional distillation technique comprises three principal components: a still (cucurbit), a delivery tube (solen) in conjunction with a distillation head (ambix), and a receiving vessel (bikos). The term "ambix" was subsequently adapted into "alembic" through its Arabic origin (al-), and during the Middle Ages, the term "alembic" frequently referred to the entire distillation process (Rasmussen, 2008, p. 31).

[17] The vases preserved in Kastamonu, Cologne, the Gaziantep Medusa, Amphipolis and the Efthrafsti Polyteleia Exhibition Museum, as well as those documented as excavation finds from the Albingaunum necropolis, Arles, and Lete, are dated to the early phases of the Roman Empire. (For comprehensive information, please refer to the appendix section)

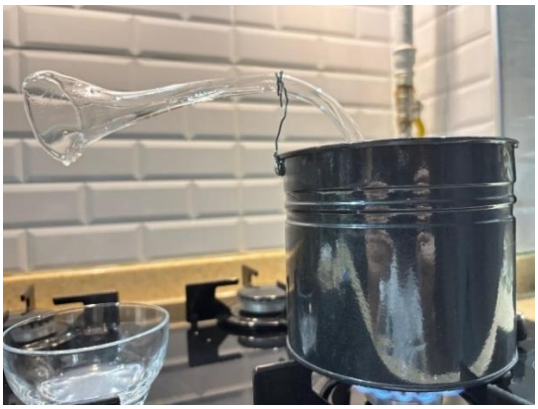

Figure 22, 23. Distillation analysis of a simple alcohol denatured-water mixture using the bain-marie method.

Contemporary retorts lack the funnel-shaped mouth found in earlier designs. Instead, they have a distinct spout at the top of the body for introducing liquids. This spout is sealed with a stopper during the distillation process. In contrast, earlier vessels do not require a stopper; their mouth and neck design allows for both the capture of evaporated liquids and the easy addition of new liquids. On the other hand, the spout is essential for facilitating air evacuation during the ingress and egress of liquid through the narrow and curved neck. It is critical that the aperture of the spout does not exceed the diameter of a pinhead, as this restriction prevents the loss of vapor from the liquid intended for separation during distillation. Consequently, the design of the spout and the constriction of its bore are well-suited for the artifact's application in distillation processes.

In addition, direct distillation is not necessary in this context. Historically, various types of bain-marie vessels equipped with double boilers have existed. One such example can be observed in the illustration by Philippo Vlstadio Patricio in his 1528 study, COELVMPHILO SOPHORVM SEV DE SECRETIS (Figure 25). This illustration prominently features a vessel with a funnel mouth, which bears a striking resemblance to the apparatus that is the focus of this article (Vlstadio Patricio, 1528, p. xiv). This vessel is designed to condense and collect the evaporated liquids within the depicted system.

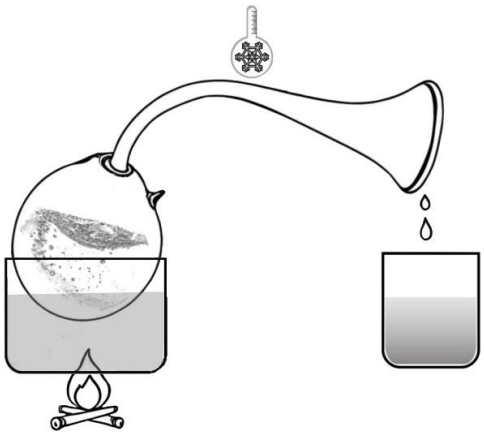

Figure 24. Illustrating a simple distillation apparatus.

In summary, based on the aforementioned experimental results supported by archaeological data, we conclude that, although the specific organization of use during the functional processes of the vase group under study could not be precisely determined—particularly regarding the temperature requirements and the potential for a cooling process during distillation—it is our assessment that the artifacts functioned as laboratory vessels and were most likely utilized for distillation purposes.

Figure 25. Illustration of distillation apparatus by Vlstadius Patricius (Vlstadio Patricio, 1528, p. xiv).

Concluding Remarks

The fields of chemistry and medicine, while distinct disciplines, can be regarded as interconnected domains within the context of our subject, due to their fundamentally organic relationship. Both possess ancient historical roots. Both individuals have systematically refined their techniques over time and have progressively broadened the range of tools and materials employed in their work. Both demonstrate an indispensable reliance on glass due to its transparent properties, particularly in conjunction with the glassblowing techniques developed during Roman times.

The earliest known evidence suggests that the Epipaleolithic period, spanning approximately 20,000/18,000 BC to 10,000/9,000 BC, is associated with the initial discoveries in the field of medicine[18].

Although its emergence, unlike that of other branches of science, was rooted in superstition, magic, or astrology, it was soon recognized that chemistry is also an indispensable discipline. The chemical production of copper can be traced back to approximately 4500 BC, subsequently leading to the production of bronze (3700 BC), tin (2500 BC), lead (1700 BC), and iron (1500 BC) (Szydło, 2022, p. 2). The Sumerians are credited with the discovery of various chemical techniques, including distillation, extraction, and sublimation, around 3500 BC. (Levey, 1955, p. 24-27).

It is evident that both fields possess ancient historical roots, and their organic relationship is apparent in terms of their objectives and methodologies. Chemistry is as indispensable as health sciences in areas such as disease prevention, diagnosis, and treatment. For instance, organic chemistry serves as the foundation of pharmaceutical chemistry and plays a critical role in the discovery and development of chemical compounds that enhance human health (Çelik, 2024, p. 45). In conclusion, if the vase group examined in our study is indeed a distillation vessel, as we propose, it can be classified as a component of a laboratory setting applicable to either the field of chemistry or health-related disciplines. Another piece of evidence that supports our hypothesis concerning the function of the vase group is the finds from Arles. Numerous archaeological studies have demonstrated that medical artifacts have been discovered in the

[18] The trepanation hole of a 50-year-old man discovered in the Vasilyevka II cemetery near Kiev, Ukraine, represents the earliest documented medical intervention of the Epipaleolithic period (Taştemür, 2015, p. 32).

graves of physicians[19]. The same is likely true for the alchemists of antiquity. Regrettably, it is not possible to verify this for the group of vases that is the focus of our study, as the provenance of most of the artifacts remains uncertain[20].

Nonetheless, the Arles finds have been classified as funerary artifacts, despite the absence of concrete evidence from a scientifically conducted excavation in their records. It is also significant to note that both contexts of Arles finds are associated with medical or chemistry-related themes (see.fig.3).

There exist varying opinions regarding the period during which this group of vases was produced. While the prevailing consensus indicates the 1st and 2nd centuries, some scholars propose a range of dates extending back to the Islamic period. At this juncture, the excavated specimens possess significant importance, as they denote the early phases of the Roman Empire, thereby providing a foundational basis for our chronological assessment. Moreover, the construction techniques utilized in the vessels, along with the decorative elements.

As indicated in the text, the introduction of the vase group that constitutes the focus of our study—specifically, the analysis of the vase from the Kastamonu Museum—holds significant importance due to the rarity of such artifacts in the archaeological literature. This significance is further amplified by our methodological approach, which is notable for the limited number of instances in which experimental methods have been applied to archaeological glassware. In this context, the Kastamonu Museum vase significantly enhances the archaeological glass history of Anatolia and Paphlagonia, as well as contributing to the history of medicine and chemistry in its capacity as a laboratory vessel.

[19] For examples of doctors' graves where archaeological medical finds have been identified, refer to the following sources: Lazar (2019, p. 80-94), Garland (2018, p. 85-102), Hensen et al. (2004, p. 81-100).

[20] The Lete vase is an artifact acquired through excavation; however, the excavation archive is deficient in comprehensive data regarding the vase. Nevertheless, T. Antonoras, taking into account the preservation condition of the artifact, posits that it may potentially be a funerary find. (Antonoras 2017, p. 207, cat.no 313)

Appendix

Abbreviations: H.: Height; RDm.: Rim Diameter; mxDm.: Maximum Diameter; SDm: Spout Diameter, BDm: Body Diameter

Fig.	Loc.	Find Spot	Description	Date	Ref.	Function
1	Kastamonu (Türkiye)	Paphlagonia Region (Anatolia)	H: 16 cm RDm.5.1 cm SDm. 0.1 cm. Complete Blue Green Squat globular body. Horizontal shoulder with pinched vent-spout. Long vertical tubular neck, curving at right angle towards a funnel mouth with unworked rim. The body is decorated with 5 ribs.	1st-2nd cen.AD.		Laboratory equipment (Distillation Flask)
2	Unspecified	Lete– Villa Rustica (Thessaloniki Prefecture)	Fragment. Translucent greenish.	1st end – early 2nd cen.	Antonaras, 2017, p. 103,104, no.54., cat.no.313	Libation Offering Object
3	Borély Museum (Marseille, France)	Alyscamps necropolis (Arles)	H.6 cm. RDm.: 5.5 cm. BDm 9 cm. Complete Squat globular body. Horizontal shoulder with pinched vent-spout. Long vertical tubular neck, curving at right angle towards a funnel mouth with rounded rim.	1st century for stylistic reasons (Antonaras, 2017, s: 104)	Quicherat, 1874, p. 74; Morin 1913, 182, fig. 460	Chemistry?
4	Aquileia, Museo Civico del Patriarcato (Italy)	Albingaunum necropolis	H. 18.7 cm. BDm. 8.4 cm. Complete. White-Translucent. An oval-shaped body. Horizontal shoulder with pinched vent-spout. Long vertical tubular neck, curving at right angle towards a slightly funnel mouth with unworked rim.	Late 1st century AD to early 2nd century AD	Antonaras, 2017, p.104; Massabò 2001, p.122-123, no. 71; https://www.fotosreiseberichte.de/italienischeriviera/albenga/romisches-glas.htm	Medical Implement
5	National Museum in Damascus (Syria)	Raqqa? (Syria)	H.: 22.2 cm mxDm.9.6 cm Complete White-Translucent An oval-shaped body. Horizontal shoulder with pinched vent-spout. Long vertical tubular neck, curving at right angle towards a slightly funnel mouth with rounded rim. .	9th -10th cen. AD. (Abbasid)	https://glass.museumwnf.org/database item/mwnf3/objects/ISL/sy/Mus01/15/en	Chemistry?
6	Israel Museum (Israel)	Unknown	H.23.2 Complete Colorless Globular body, Horizontal shoulder with pinched vent-spout. Long vertical tubular neck, curving at right angle towards a slightly funnel mouth with rounded rim. .	Islamic period	Brosch 2003, p. 347 no:458	Medical Implement
7	Medusa Museum of Archaeological Glass	Yozgat–Çorum–Çankırı Region	H.18.2 cmç	1st - 3rd century AD.	Höpken & Çakmaklı,	Milk Pump / Distilleries' utensil

	Artifacts (Gaziantep/Türkiye)		RDm. 3.2 cm mxDm. 8 cm Almost Complete Blue Green Globular body, horizontal shoulder, cracked off rim, curved neck, little nozzle (spout) with fire rounded rim.		2015, p. 79, cat.no.140.	
8	Cologne Museum (Germany)	Unknown	H.16 cm. Complete Blue Green An oval-shaped body. Horizontal shoulder with pinched vent-spout. Curved Neck, Funnel shaped mouth	1st-2nd cen.AD. ?	La Baume & Salomonson 1976, p. 44, no.104.;	Distillation flask
9	Museum of Amphipolis (Greece)	Unknown	Two artifacts are available. Both vases exhibit identical forms. H.17 cm. D. 9.5 cm. – H.13 D.7 Translucent An oval-shaped body. Horizontal shoulder with pinched vent-spout.	100 BC – 200 AD.	Antonaras, 2017, p. 104, footnote.1159 https://maps.app.goo.gl/84Cq1B6xwByBJzcdA ; https://www.searchculture.gr/aggregator/edm/mnam/000150-789145?language=en	Unspecified
10	Ancient Glass Blog of The Allaire Collection (Nico F. Bijnsdorp Collection)	Eastern Mediterranea, probably Syria	H.18.8 cm RDm 3.9 cm Base Diameter: 4.8 cm Weight: 76 gr. Complete Transparent Squat globular body with pushed in base ring. Horizontal shoulder with pinched vent-spout. Long vertical tubular neck, curving at right angle towards a funnel mouth with rounded and thickened rim. The body decorated with three horizontal encircling lines	Unspecified	https://ancientglass.wordpress.com/2019/08/15/roman-glass-guttus-2/	Unknown
11	Efthrafsti Polyteleia Exhibiton	Unspecified	Unspecified	1st-2nd cen.AD.	Antonaras, 2017, p. 104, footnote.1158	Unknown
12	Louvre Museum	Tiberias	H. 23.2 cm, RDm. 8.5 cm, BDm. 15.5 cm, Complete, Transparent. Oval-shaped body with horizontal shoulder, pinched vent-spout. Long vertical tubular neck, curving at right angle to funnel mouth with rounded rim.	1st-2nd cen.AD.	https://collections.louvre.fr/en/ark:/53355/cl010281453	Distillation flask

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