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Article

Clarifying Key Concerns about the Dating of Holy Relics: The Holy Chalice of the Last Supper at the Cathedral of Valencia

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Abstract: The Cathedral of Valencia, Spain, has preserved the so-called Holy Chalice of the Last Supper since 1437. It consists of a foot, a gold stem, and an upper cup carved in agate stone. Based on a pious tradition, this cup is supposed to be the one used by Jesus of Nazareth to institute the Eucharist. According to an archeological study published in 1960, this agate bowl was crafted around the 2nd–1st centuries BC, but people visiting this famous relic often wonder about its authenticity and about the evidence supporting it as a Hellenistic–Roman cup. Attempting to clarify this concern, a photographic characterization of the agate cup is presented and discussed. The main conclusions are the following: (i) The typology of the bowl is common to classical tableware, but the wall thickness, shape of the rim, and foot are typical of gemstone cups from the Hellenistic–Roman period. (ii) This cup would have been extremely valuable, which agrees with the location of the Cenacle in the aristocratic neighborhood of Jerusalem. This case study highlights the importance of further investigating the dating of historical objects as a key issue to support their authenticity.

Keywords: Eucharist; relic; Cenacle; Passover meal; cup of blessing; gemstone cup



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1. Introduction

The city of Valencia yields a varied cultural heritage, but one artwork of particular relevance is the Holy Chalice of the Last Supper, which has been kept in the metropolitan Cathedral since 1437. According to a pious medieval tradition, the upper agate cup of this Chalice is supposed to be the one used by Jesus of Nazareth during the Last Supper to institute the Eucharist (Mt 26:27, Lk 14:23), which stands as one of the most important relics of Christianity. However, people visiting the Cathedral of Valencia often doubt the relic's authenticity, which habitually occurs with old-century historic objects.

1.1. Authenticity of Christian Relics

In the Catholic Church, relics have always received particular veneration and attention. The term relic is usually applied to the body, a part of the body, or some personal memorial of a saint, which is preserved as worthy of veneration [1]. In 2017, the Holy See approved a canonical procedure in order to verify the authenticity of the relics and mortal remains of the Blessed and of the Saints [2] because such relics may not be displayed for the veneration of the faithful without a certificate of ecclesiastical authority guaranteeing their authenticity.

A different case corresponds to the holy relics attributed to Jesus of Nazareth, like the Holy Shroud or the Holy Chalice, because it is not possible to certify their historical traceability given their age. The Catholic Church does not officially pronounce their authenticity because this issue corresponds to science and it is not a matter of faith. Nonetheless, the Church encourages the development of scientific and historical studies on these holy relics, as well as on the historicity of Jesus.

The authenticity of the Holy Shroud preserved in the Cathedral of Turin, Italy, has been discussed in multiple studies [3,4]. Interestingly, some coincidence has been found between particular bloodstains in the Shroud and in the Sudarium of Oviedo [5]. The latter,

venerated in the Cathedral of Oviedo, Spain, is supposed to be the cloth that was wrapped around the head of Jesus after his death (Jn 20:7). Relics of the True Cross (i.e., small fragments of the wooden cross where Jesus was crucified on) are widespread throughout Europe, but the study of their traceability becomes complex, particularly for the smallest relics [6].

Another relic associated with Jesus is the Titulus Crucis, which is claimed to be the title board of the cross on which Jesus was crucified. This piece of wood is kept in Rome at the Church of Santa Croce in Gerusalemme. A radiocarbon study has suggested that the wood dates between 980 and 1146 AD [7], which leads to doubts about its authenticity. Likewise, according to radiocarbon tests, the Holy Shroud has been dated between AD 1260 and 1390 [8], which has raised many concerns regarding its genuineness.

1.2. The Holy Chalice of the Last Supper

The Holy Chalice consists of three parts, a base, a gold stem with two handles, and an agate cup, the latter of which is the relic strictly speaking. In the present study, “Holy Chalice” will refer to its current configuration as displayed in the Cathedral of Valencia. However, as Jesus presumably used just the upper agate cup, it seems convenient to apply another denomination to avoid confusion. Hence, the expression “Holy Grail” will be used hereafter to refer to the gemstone cup, not taking into consideration some mythical connotations often associated with this name.

The pious tradition explaining how this valued relic ended up in Valencia is the following. The family of Saint Mark the evangelist was supposedly the owner of the upper room (Cenacle) where the Last Supper took place (Mk 14:15, Act 12:12) [9]. This family would have lent Jesus this precious cup of blessing for the Passover ritual dinner. Years later, Saint Mark acted as an interpreter and assistant of Saint Peter for a long time [9]. Such a close relationship would explain why the Holy Grail was presumably taken to Rome, where the first pope was martyred. The expression in the Roman Canon “*accipiens et hunc praeclarum calicem*”, mentioned during the consecration of the wine, which can be translated as “took this same illustrious chalice”, alludes to a particular chalice, probably the one used in Rome by the first popes (i.e., the Holy Grail) [10].

In 258 AD, Pope Sixtus II was requested by Emperor Valerian to hand over the wealth of the Roman Church. The pope commissioned his archdeacon Lawrence to accomplish this mission, which is a historical fact documented by several authors like Saint Ambrose of Milan (ca. 339–ca. 397), Saint Peter Chrysologus (ca. 400–ca. 450), and the poet Prudentius (348–ca. 413) [11]. According to an ancient oral tradition kept in northern Spain, a few days before being martyred, Saint Lawrence tried to save the most important relics and sent the Holy Grail to Osca (present-day Huesca, Spain), as it was the place of residence of his family [12].

In 713 AD, because of the Muslim invasion of the Iberian Peninsula, the Chalice was hidden in different places in the Pyrenees. As the reconquest progressed, and the territories of the incipient Kingdom of Aragon became safe, the Chalice was kept in several monasteries and churches. Around 1082 AD, it entered the Monastery of San Juan de la Peña (Huesca), a place hidden by mountains with difficult access, where the Chalice was guarded for about 300 years, leading to the development of legends about the Holy Grail [13] (pp. 176–187, 197–201) [14,15]. In 1399 AD, the prior of this monastery delivered the Chalice to the King of Aragon, Martín I, as testified by a notarial deed that is the first documentary evidence mentioning the Holy Chalice currently in Valencia [16] (pp. 161–165). A few decades later, the court of Aragon was moved to Valencia, and the whole collection of royal relics was transported to this city in 1432. Five years later, the Cathedral of Valencia received these valued relics as a guarantee for a loan requested by the king and became the definite place where the Holy Chalice was guarded.

1.3. Authenticity and Interpretation in Cultural Heritage

In the field of heritage, authenticity can be interpreted in two different ways: (i) the authenticity of emotional experiences undergone by visitors and (ii) authenticity referring to the genuineness of objects displayed in the exhibitions according to documented information [17]. The relationship between authenticity and integrity has also been discussed in the field of heritage conservation [18].

The interpretation and authenticity of experiences are important to practitioners involved in the management of interpretive sites because interpreters may seek to provide authentic experiences at their sites [19]. The impact of tour guides' interpretation on people's experiences is well understood. Such interpretation produces a positive outcome in the comprehension of heritage sites, emotions, and satisfaction [20]. Experimental studies have shown that a high-quality personal experience enhances the authenticity and satisfaction of visitors [21]. On the other hand, museum curators basically focus their interest on the authenticity of the objects in view at exhibitions [22]. This consideration is pertinent for people visiting the Holy Chalice at the Cathedral of Valencia because they often wonder about the relic's authenticity.

1.4. Concerns about the Authenticity of the Holy Grail and Objectives of this Research

In the late 1950s, the Archbishop of Valencia, M. Olaechea, commissioned A. Beltrán, a professor of archeology at the University of Valencia, to perform a detailed study on the Holy Chalice. According to this research, published in 1960, it was concluded that the archeology could not oppose the Christian tradition that this cup was the one used by Jesus at the Last Supper, which is the main research assumption considered in the present work. Beltrán dated the agate cup between the 4th century BC and the 1st century AD, more likely around the 2nd–1st centuries BC [23] (p. 103). This dating has been revised by recent work, suggesting that the cup was crafted from the 1st century BC up to the 3rd century AD [24].

There are several reasons explaining why people often doubt the authenticity of this relic. One explanation is due to poor knowledge about the history of the Holy Chalice given the scarce information available to visitors about the archeological studies of this artwork. Another reason is the existence of other cups that claim to be the true Holy Grail; for example in [9], ref. [13] (pp. 28–36), and ref. [16] (pp. 42–44). Nonetheless, the Holy Chalice in Valencia is backed up by an ancient tradition from medieval times since the first historic document mentioning this Chalice is dated 1399 AD [16] (pp. 161–165).

The main objective of the present work is to further investigate the dating of this agate cup in order to make clear one query that often arises when people visit the Holy Chalice of the Last Supper: What evidence supports the agate cup being supposedly carved in the Hellenistic–Roman period, as proposed by Beltrán [23] (p. 103)? Providing plausible explanations for this concern is crucial for creating a credible story about the Holy Chalice that can captivate the interest of visitors.

The research assumption is that the gemstone cup was crafted before the Last Supper, which took place ca. 33 AD [25]. This hypothesis is consistent with the likely dating proposed by Beltrán [23], but Arasa has suggested that it could have been carved even much later [24]. Thus, further research is necessary to better investigate the dating of this agate cup, which is the main goal of the present work.

Regardless of the discussion about the authenticity of relics attributed to Jesus, the Catholic Church approves and promotes their veneration to provide continuity to such centuries-old traditions. For this reason, in order to highlight the importance of the Holy Chalice of the Last Supper, in 2014, the Holy See granted the Diocese of Valencia the option to periodically declare a Jubilee Year of the Holy Chalice once every five years.

2. Methods

As so much time has passed since the study by Beltrán [23], a multidisciplinary research project was proposed by a group of researchers from different Spanish universities, and permission was granted by the Cathedral Chapter to further investigate the Holy

Chalice. The experimental studies proposed were carried out in two sessions in April 2018. Part of the discoveries were published recently [26]. The preliminary results were presented at a conference held in Valencia from 30 April to 2 May 2021.

The present work provides some aspects of interest and a novel discussion derived from these on-site investigations, but only regarding the upper agate cup, which is the relic itself. The foot and stem of the Holy Chalice are also of great archeological interest, but they are outside the scope of this work.

The methodology applied here basically consisted of a photographic characterization of the agate cup, which brings to light certain aspects not studied in detail by Beltrán in 1960. In fact, the author did not publish good-quality color pictures, which are of relevant interest. This photographic characterization is structured in Section 3 according to different aspects: the Grail's translucent character (Section 3.2), the pattern of the design (Section 3.3), molding at the base (Section 3.4), molding at the rim (Section 3.5), whitish discoloration on the surface (Section 3.6), and irregularities on the Grail's surface (Section 3.7). In each subsection, key photographs are presented, which are discussed in detail according to a literature review on the subject and, in some cases, web searches and particular experiments. The main purpose was to focus on those details supporting the hypothesis that the cup was carved in the Hellenistic–Roman period.

In order to clarify the methodology applied and aimed at reinforcing the scientific rigor of this study, a conceptual map (flow chart) is presented in Figure 1. It shows the operationalization of how this case study was addressed and the main conclusions, linking the on-site photographic characterization of the Grail, according to different aspects with complementary studies: web searches of Roman cups, a literature review, and some experiments with replicas of the Holy Grail.

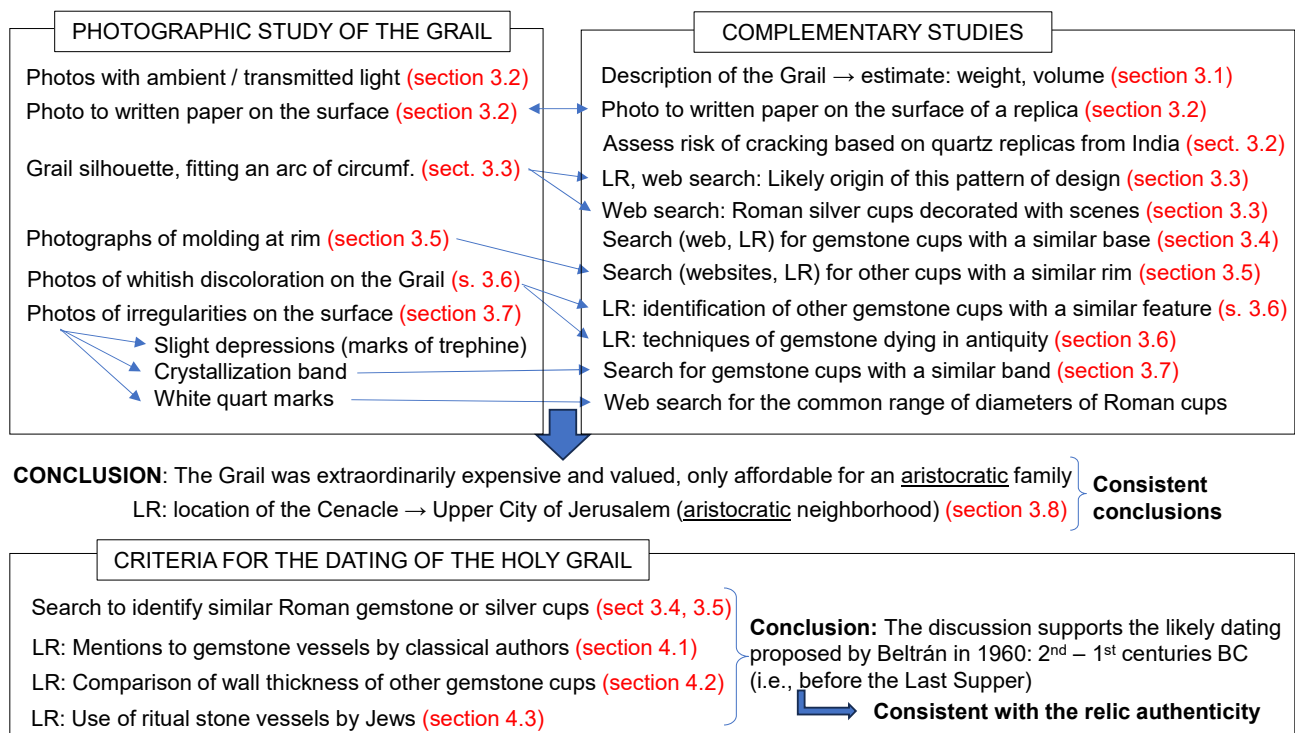


Figure 1. Flow chart of the research and discussion presented in this article, following the order of the different subsections. LR stands for “literature review”.

Section 3 ends with a literature review of the location of the Cenacle, revealing that, quite probably, it stood in the aristocratic neighborhood of Jerusalem. This consideration agrees with the biblical text insinuating that it was the house of a wealthy disciple of Jesus,

as well as with the results exposed in Section 3 leading to the conclusion that this gemstone cup would have been very expensive, only affordable for the aristocratic classes.

Next, Section 4 discusses different criteria that should be taken into consideration for the dating of the Holy Grail: mentions of gemstone vessels by classical authors (Section 4.1), a comparison of the wall thicknesses of other gemstone cups (Section 4.2), and the use of ritual stone vessels by Jews (Section 4.3). The main conclusions are presented in Section 5.

3. Results

3.1. Overall Description of the Holy Grail

The Holy Chalice was kept for several centuries in the reliquary cabinet at the sacristy of Valencia's Cathedral. In order to enable veneration by the faithful, it was moved to the former Chapter Room of the Cathedral in 1916, which was designated as the Chapel of the Holy Chalice (Figure 2). The Chalice is located in a recessed reliquary behind the altar, with a golden background to highlight the artifact. Unfortunately, it has to be viewed at a minimum distance of about 4 m because the altar area (presbytery) is reserved for liturgical use, meaning that it is not possible to get closer to observe the beauty of this famous chalice. The color of the gemstone cup appears to be quite uniform because agate bands or stripes cannot be clearly appreciated at this distance, and the Grail looks rather opaque. In the publication by Beltrán [23], photographs were in black and white, so subtle details could not be appreciated.



Figure 2. Chapel of the Holy Chalice at the Cathedral of Valencia, Spain. Photograph by J. Leyva.

From a typological standpoint, the Holy Grail is an agate bowl with reddish-brown tones, roughly hemispherical in shape with an ovoid tendency [27] (p. 32). The different tones of brown between bands seem to be caused by dissimilar concentrations of the pigments providing the color. The bowl has a differentiated base or pedestal that is hidden by a platen joined to the chalice stem. This base, with a height of less than 1 cm, is not cylindrical but ring-shaped, with concave recessed molding at its junction with the bowl. According to Beltrán [23] (p. 55), the cup measures about 6.5 cm in height (including the pedestal) and 9.5 cm in diameter, with a wall thickness of about 3 mm. The surface is smooth and perfectly polished. The only visible decorative motif is incoming molding at the rim, half-round, shallow, and of unequal width [27] (p. 32).

Taking into account that the density of agate is 2.58–2.64 g/cm³, and based on a mathematical model with the dimensions of the Holy Grail, its weight has been estimated as 205 g (±15 g). In the experiments of April 2018, the total weight of the Holy Chalice was determined to be 677 g (±0.1 g), which implies that the agate cup accounts for about 30% of the total chalice weight.

The Holy Grail has a volume of around 220 mL. Considering that Jesus distributed the cup of wine among the apostles at the Last Supper (Mt 26:27), that cup would not be excessively full to prevent the wine from spilling. As such, it is estimated that the Holy Grail might have contained approximately 150 mL of wine in that ritual celebration, a volume that remains 1 cm below the rim.

3.2. Translucent Character and Wall Thickness

One of the most striking results of the research carried out is that the Grail is much more translucent than expected. When it is illuminated from within, the appearance changes dramatically. Some of the bands seem to be white when observed with reflexed light (Figure 3a), but when applying transmitted light (Figure 3b), it becomes apparent that these bands are translucent. The alternance of colorless vertical stripes with others, yielding reddish-brownish tones, leads to an extraordinarily beautiful image when applying warm lighting (Figure 3b). This appearance is somewhat reminiscent of a burning flame. Based on this similarity, it has been speculated that one verse of the book of Revelation might be an implicit description of the Holy Grail: “a kind of translucent *sea* mingled with fire” (Rev 15:2). The expression “a kind of sea” would indicate a figurative sense, maybe in reference to the Sea of Bronze of the ancient Temple (1 Kings 7:23–25), which had a hemispherical shape [28]. As the Last Supper was celebrated with the light of candles or oil lamps (i.e., warm lighting), the appearance of the Holy Grail in Figure 3b would be more or less the appearance of the agate cup when Jesus instituted the Eucharist.

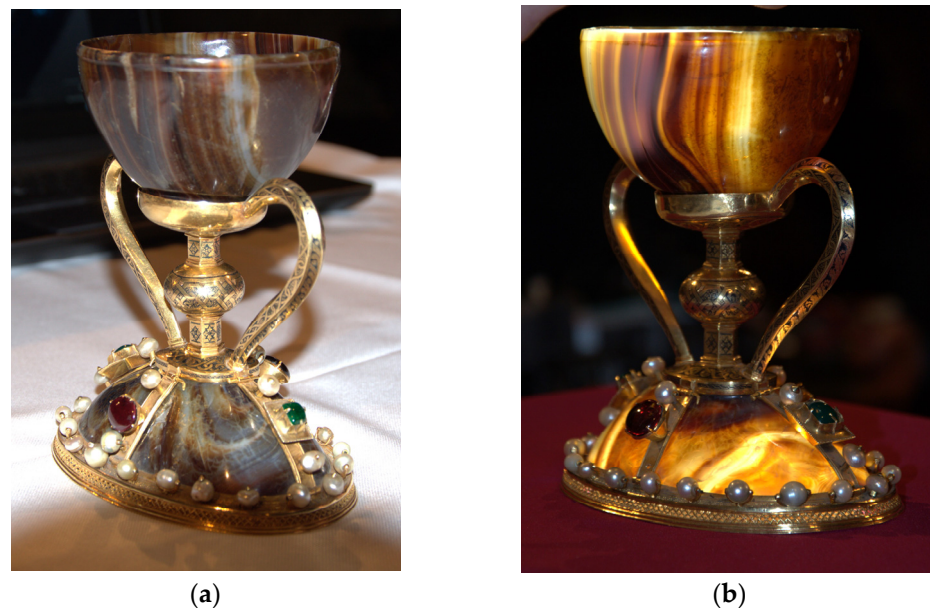


Figure 3. (a) Holy Chalice observed with ambient light; (b) Holy Chalice observed with transmitted light by holding a handheld lamp of warm light above and putting a lamp below the base. Photographs by J. Leyva.

The foot of the Holy Chalice is also made of stone, with perimetric goldsmithing (Figure 3), which is rather uncommon for medieval chalices. This foot was described by Beltrán as being made of chalcedony, “very diaphanous against the light” [23] (p. 57). Expert researchers in gemology have concluded that the upper cup and the gemstone at the foot can be classified as banded agate [26] (p. 94). One discovery was that both gemstones acquire extraordinarily similar tones when the Chalice is illuminated from below and above (Figure 3b). This color similarity was not expected because the foot is dated to the 10th–11th centuries AD [23] (p. 112). This coincidence in the appearance of both gemstones composing the Holy Chalice leads to speculation that the foot was carefully sought to

resemble the Grail as much as possible, which was not an easy task in medieval times given the scarcity of agate bowls in the Iberian Peninsula.

In order to qualitatively establish how translucent the Grail is, we wondered if it would be possible to read a text by looking from inside the cup and placing a written paper outside of it, touching the surface. The experiment was carried out, and indeed, Figure 4a shows an infrared photograph revealing that a text written in Latin can be read [29]. The same text was placed on the surface of an agate bowl (Figure 4b), which is a replica of the Holy Grail purchased from Yasin Agate manufacturer, a local workshop in Khambhat, India. This bowl weights 213.5 g with a diameter at the rim of 9.8 cm, which implies similar dimensions and weight compared with the Grail.

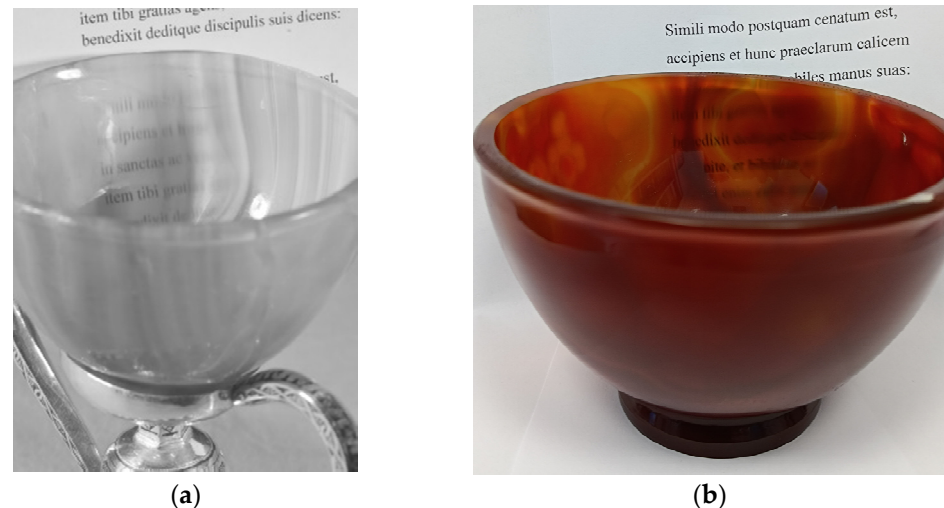


Figure 4. (a) Infrared photograph showing a written Latin text touching the outer surface of the Holy Grail. Photograph by J.C. Valcárcel [29]. (b) Photograph showing the same text on the surface of an agate replica of the Holy Grail. Photograph by the author.

The translucent overall character of both bowls, which is apparent from Figure 4, is partly due to their rather thin walls. In Beltrán's study, the wall thickness of the Holy Grail was described as about 3 mm [23] (p. 54), but the detailed visual inspection of the Chalice the author carried out revealed that this thickness is slightly lower at the rim. Hence, it seems more correct to consider an approximate wall thickness of ≈ 4 mm. One part of the investigation performed was a metrological characterization of the Holy Chalice with a 3D scanner [30]. Ongoing research based on this 3D model will provide an accurate description of the dimensions, which is of relevant interest in elucidating how the Grail was handcrafted and will enable a comparison with analogous gemstone vessels.

The origin of the raw agate rock (geode) from which the Grail was carved is unknown. According to Pliny the Elder (1st century AD), the size of agate "exceeds any other stones of this class". The deposits of this material were located in India and in areas of the eastern Mediterranean such as Sicily, Phrygia, Thebes (Egypt), Cyprus, Trachinia, Mount Parnassus, the Isle of Lesbos, Messene, and Rhodes [31].

In ancient times, many of the raw gemstones used to carve prized vessels, mainly the largest ones, came from India [32] (p. 23), ref. [33] (pp. 398–400). In this country, one of the places that has maintained the tradition of carving vessels from hard stones for centuries is the city of Khambhat [32] (p. 23), ref. [34]. A workshop in this city was requested to manufacture a few replicas of the Holy Grail in clear crystal quartz, with dimensions as similar as possible to the original and with a wall thickness of about 4 mm. Pictures of these cups are available from the author upon request. According to this workshop (Yasin Agate; owner, Yasin Bapu, 45 years in the business), the risk of cracking during the manufacture of bowls like this one increases considerably when the wall thickness is less than 5 mm. In fact, it turned out that five out of eight cups cracked while being crafted despite having an

average thickness of about 6 mm. This wall thickness was estimated mathematically from the weight of the cups, assuming an approximately hemispherical shape and a density of 2.6 g/cm^3 for quartz. This experimental proof illustrates the considerable risk of fracture that would have existed in gemstone vessels in antiquity.

This same workshop was also commissioned to craft twelve replicas of the Grail in tiger-eye agate. The weight of these cups ranged from 209 g to 256 g, with seven of them being heavier than 220 g (i.e., the estimated upper boundary for the Grail's weight). This result reveals a bias toward manufacturing bowls thicker than the Holy Grail, probably because the workshop intended to reduce the risk of cracking. Given the difficulty nowadays of carving gemstone cups with a wall thickness like that of the Holy Grail, despite the availability of modern techniques, this suggests that there would be a non-negligible risk of cracking or fracture during their manufacture in the Hellenistic–Roman period. Such risk is difficult to estimate (5/8 according to the experiment mentioned), but it would undoubtedly result in a higher cost for the final product (i.e., a 50% risk of cracking would double the price of a manufactured gemstone vessel sold in the market).

It is postulated that the wall thickness of the Holy Grail is similar to that of gemstone bowls from the time when it was carved. A thin wall was desirable for the greatest translucency, which was a highly appreciated property. In fact, regarding agate gemstones, Pliny mentions that “some persons set the highest value upon those stones which presented a transparency like that of glass” [31]. A reduced wall thickness would favor the demand for these precious vessels, despite increasing their fragility and the risk of cracking during manufacture, ultimately resulting in a higher price.

3.3. Pattern of Design of the Holy Grail

Regarding the Grail's typology, it is one of the simplest and most common forms of classical tableware. Therefore, the dating criteria that can be applied to this piece, for which the place and archeological context of the discovery are unknown, are based both on the type of material from which it was carved and on the shape or the pattern of the design [24] (p. 167, 177).

According to a metrological characterization of the Holy Chalice carried out in 2018 with a high-resolution 3D scanner [30], the diameter at the rim is about 9.7 cm (Figure 5a), although Beltrán indicated a value of 9.5 cm [23] (p. 55). One novel finding not reported yet is that the pattern of the design, or outline, of the Grail fits with surprising precision with an arc of radius of approximately 7.2 cm, the center of which is located on the upper edge, so the tangent line to this arc, at the rim, becomes vertical (Figure 5a). However, in the side view of the Chalice, this silhouette is not so precise, with a maximum deviation from the target outline of about 2.5 mm near the base (Figure 5b) but not on the opposite side. This outer pattern can be described as an ogival shape truncated at the base. An ogive is defined as a figure formed by two equal arcs of circumference intersecting at one of their ends, forming a tip.

This particular pattern of design, which was achieved with astonishing precision (Figure 5a), undoubtedly indicates that the Grail was carved according to a model existing at the time. The likely origin of this pattern is discussed next. If an ogival profile, typical of a Gothic arch, is rotated around its axis of symmetry, it becomes an ogival surface of revolution, which is characteristic of ancient Persian domes. This fact leads to the hypothesis that the outer pattern of the Grail (i.e., a flat-based ogival shape) can be traced back to Persian culture. In fact, this ogival shape is found in a terracotta bowl (4200–3800 BC) preserved at the Louvre Museum (Paris), discovered in the Persian city of Susa (Figure 6a) [35]. Another similar bowl was found in Tall-i Bakun, near Persepolis (present-day Iran), dating to the beginning of the 4th millennium BC [36].

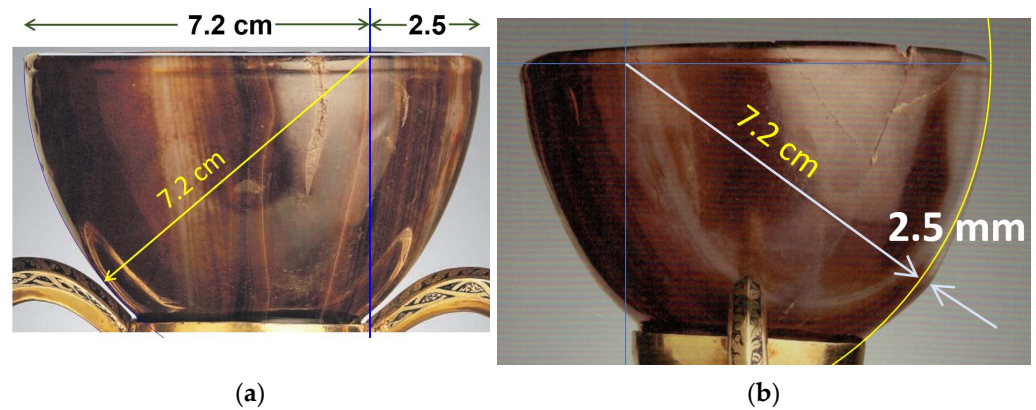


Figure 5. (a) Front view of the Holy Grail showing that an arc of around 7.2 cm fits perfectly with the silhouette. (b) Side view of the Grail showing that the silhouette has a deviation of around 2.5 mm from the same arc. Photographs by I. Higuera.

This typology was maintained during the Achaemenid Persian Empire (550–330 BC). The commercial development of this empire supposedly led to the expansion of this pattern throughout the eastern Mediterranean. Subsequently, this design was assimilated by Classical Greece in fused glass bowls (see [37] as an example) and in ceramic vessels. Some Greek terracotta skyphos also present an ogival shape with a flat base, such as one at the Met Museum in New York, dated around 460 BC (Figure 6b) [38]. The ogival typology mentioned persisted in the Hellenistic world until the 1st–2nd centuries BC with the name “mastós”, a Greek word meaning udder (see Figure 6c [39] as an example of an attic black-figure mastós, 520–500 BC).



Figure 6. (a) Terracotta bowl decorated with wavy lines, Susa I (4200–3800 BC). Louvre Museum, Paris, France (Near Eastern Antiquities, Room 7) [35]. (b) Greek terracotta skyphos, ca. 460 BC, on view at the Met Museum (New York, NY, USA), gallery 171 [38]. (c) Attic black-figure mastos (520–500 BC), on view at Getty Villa (Los Angeles, CA, USA), ref. 90.AE.122 [39].

Gemstone cups from the Hellenistic–Roman period like the Grail are supposed to imitate the goblets decorated with scenes, which were very popular throughout the Mediterranean area among the aristocratic classes to inspire discussion at refined banquets and as a sign of opulence to impress guests [24] (p. 167). Many of these silver cups are preserved in museums and private collections, dating from the 1st century BC to the 1st century AD, most of them with handles and a differentiated foot. Figure 7a shows a Roman silver goblet dated between 25 BC and 100 AD, with an ogival profile [40]. Another similar vessel is the so-called Warren Cup (15 BC–15 AD) found near Jerusalem (Figure 7b) [41].



Figure 7. (a) Two-handled silver cup with relief decoration (25 BC–100 AD), on view at Getty Villa (Los Angeles, CA, USA). Dimensions: 12.5 × 16.3 × 11.4 cm [40]. (b) Warren Cup, on view at the British Museum, London, UK, ref. 1999,0426.1 [41].

3.4. Base of the Holy Grail

The base or pedestal of the Grail is not observed, as it is hidden by a small gold bowl joined to the Chalice stem. According to Beltrán [23] (p. 55), this bowl has a height of 1 cm and a diameter of 5 cm, which implies that the base of the Holy Grail is slightly smaller, about 4.5 cm in diameter [24] (p. 166), or perhaps up to about 4.7 cm. In comparison with the outline of two other similar Roman cups on display at the British Museum [42,43], it has been estimated that the pedestal of the Grail has a height of about 7 mm. This base cannot be cylindrical; otherwise, the firm attachment of the Grail to the Chalice stem would not be possible. On the contrary, this pedestal is assumed to be shaped as a convex molding at the bottom and concave at the joint with the cup. This recessed molding, annular or ring-shaped, allows the gemstone to be fastened to the gold stem by means of a toothed platen that remains hidden in the aforementioned gold bowl.

This pattern of design at the Grail's pedestal is probably intended to somehow imitate the foot of silver Roman cups (Figure 7). The same profile as the Grail's base is found in two sardonyx bowls displayed at the British Museum, already mentioned, both dated around 1–50 AD [42,43], as well as in a skyphos carved in rock crystal at the time of Emperor Augustus (27 BC–14 AD) (Figure 8a), with decorations of leaves, preserved at the National Archeological Museum of Naples, Italy [44]. An agate cup belonging to a private collection, dating from the 1st century BC, has an outline very similar to that of the Holy Grail, including the ring-shaped base and molding at the rim (Figure 8b) [32] (p. 79), ref. [45]. This resemblance reinforces the hypothesis of a similar dating for the Grail.

3.5. Molding at the Rim of the Holy Grail

Luxurious Roman silver cups commonly had a plain rim, clearly differentiated from the main body decorated with varied motifs (see Figure 7 as examples). The rim of the Grail has been described as half-round molding: shallow and unequal in width [27] (p. 32). It is like a groove running along the cup perimeter, below the rim. This molding was rather common in gemstone cups. In fact, the repertory of Del Bufalo [32] comprises at least seven Roman cups with a rim like that of the Holy Grail, with the following references: 21 (p. 50), 49 (p. 56), 78 (p. 63), 124 (p. 79), 270 (p. 131), 302 (p. 144), and 303 (p. 144).



Figure 8. (a) Skyphos carved in rock crystal (27 BC–14 AD), National Archeological Museum of Naples, found in ancient Capua, Italy [44]. (b) Roman agate cup from a private collection [45].

The design of the Grail's rim might be considered merely aesthetic, trying to imitate the luxurious silver cups of that time. However, there might be certain functionality for this molding. When drinking from a conventional glass or cup without any type of molding at the rim, which is the common case nowadays, it is well known that a small amount of liquid slowly drips from the edge downward. This is not a problem if the liquid is transparent, but in the case of wine, in a context in which the cup is held for a long time like at a banquet, these drops can drain and fall to the floor or stain clothes. However, with the molding at the rim of the Holy Grail, being like a shallow incision, the surface tension of the liquid would allow this small amount of wine to be channeled horizontally following the groove of this molding, achieving a reduction in dripping. Hence, the molding at the rim of the Grail suggests that this cup was carved for the purpose of containing wine, since such molding would not be necessary in a water cup given that water drops do not stain. It is appealing that the cup of blessing presumably used by Jesus to institute the Eucharist was carved deliberately with the intention of containing wine.

After searching on the internet for images of Roman silver cups, one was found whose rim looks quite similar to that of the Grail. It is the so-called Cup with Cranes (Figure 9), dated between 25 BC and 50 AD. Its relief decoration with cranes recalls the landscape of the Nile River, which suggests that the cup was crafted in Alexandria, Egypt, according to the museum curators [46]. This bowl has a diameter at the rim of 10.3 cm, which is slightly higher than the Grail, which is 9.7 cm [30].

Although the silhouette of the Cup with Cranes is slightly different from that of the Holy Grail, being rounded at the base and not flat, the rim molding has an irregular appearance, not very marked, just like the Grail. Moreover, the width (relative to the cup height) coincides in both cups, as shown in Figure 9. In contrast, Roman silver cups usually had a wider plain rim (see right section of Figure 9). The resemblance of the rim between the Cup with Cranes and the Grail suggests similar dating and that the latter was probably crafted in Alexandria as well. Beltrán [23] (p. 76) also considers this possibility, although he broadens the likely place of manufacture to the workshops of Egypt, Syria, or Palestine, from Alexandria to Antioch.

The supposed manufacture of the Cup with Cranes in Alexandria is relevant to the present research because most vessels carved in precious stone in the Roman world are assumed to have been produced in this Mediterranean city. In Egypt, there was an ancient tradition of manufacturing containers carved with lathes from hard stones like granite, diorite, syenite, basalt, etc. [47]. This is confirmed by the enormous number of these vessels, more than ten thousand, found at the Saqqara site near Memphis [48]. Some of them, dated to about 3100–2500 BC, are on view at Cairo's Museum.



Figure 9. Cup with Cranes (25 BC–50 AD), on view at Getty Villa Museum (Los Angeles, CA, USA), gallery 211 [46]. On the left, a vertical section of the Holy Grail, revealing the similar width of the molding at the rim (yellow arrows). On the right, the vertical section of the cup in Figure 7a, revealing wider plain molding at the rim.

The Egyptians built the so-called Canal of the Pharaohs, joining the Nile River with the Red Sea. Its construction may have started as early as ca. 1850 BC, but scholars suggest that it was either re-dug or possibly completed by Darius the Great (522–486 BC) [49]. This maritime route enabled navigation from the Nile River to the Indian Ocean, which favored the economic development of Egypt by getting rid of the caravan peoples of Arabia who demanded payment for customs. In 331 BC, Alexander the Great founded the city of Alexandria as the capital of Egypt, which became the main Greco-Roman center of culture and business.

Since the reign of Ptolemy II (285–246 BC) but especially at the end of the 2nd century BC, Egyptians have explored the sea routes of Africa and India. Permanent routes to India were opened, with commercial ships leaving from Alexandria. The Indus River area was rich in deposits of different varieties of quartz, particularly agate, carnelian, rock crystal, onyx, and sardonyx. These raw gems traveled to Egypt, mainly to Alexandria. Faced with a supply of relatively large precious geodes from India, the lapidary craftsmen of Alexandria boosted the manufacture of gemstone vessels, which were shipped throughout the Roman Empire. As a result, this city became the main producing center for precious vessels [32] (p. 23), ref. [33] (pp. 398–400), which formed part of the tableware used by the elites as a symbol of social distinction [24] (p. 177).

3.6. Whitish Discoloration on the Surface of the Gemstone

The Grail has a fracture as a result of an accidental fall suffered in 1744 [23] (p. 56). A silversmith recomposed the larger fragments, with the exception of a small shard, approximately triangular in shape, which is missing at the rim [27] (p. 32), as can be observed in Figure 10a.

One of the most striking aspects that arises when observing the Holy Grail is a whitish discoloration present on one side in its rearview (Figure 10a). The Holy Chalice has always been displayed in the Cathedral chapel in its front view so that this discoloration is not noticeable to visitors, and it remains largely unknown. Surprisingly, there is no written reference to this whitish area in the first documents describing the Chalice, probably because it was considered a natural characteristic of the stone [26] (p. 102).

This faded color is very apparent; it extends up to the rim but, curiously, not inside the cup. In fact, this discoloration is barely noticeable when the Grail is illuminated from within (Figure 3b), which implies that it is very superficial, and hence, it was not present in the original raw gemstone. This discoloration had to occur on the carved vessel, but it is unknown how and when it happened. It can only be stated that it was produced prior to

1663 because the whitened area is represented in an engraving of the Holy Chalice from that date, which is exhibited at the Museum of Valencia's Cathedral.



Figure 10. (a) Picture of the Holy Grail showing an apparent whitish discoloration. Photograph by J. Leyva. (b) Agate bowl (Neo-Assyrian), British Museum, London, UK, ref. 118766. Diameter: 15.5 cm, height: 4.5 cm.

It has been postulated that the faded area could have been produced by the application of some product on the Grail's surface [27] (p. 32), assuming that it was caused accidentally by some substance with which only one area of the cup was in contact. Maybe some type of acid, perhaps soaked on a cloth. Osacar and Naya speculate that it could be sulfuric acid [26] (p. 102), but this hypothesis requires experimental investigation.

Scholars have always assumed that the color of the Holy Grail is natural for the raw agate stone from which the cup was carved. Hence, discoloration would have occurred in this area because of some aggressive agent producing superficial damage, eliminating the natural coloring pigment [26]. By contrast, another possibility would be that the original stone from which the Grail was crafted was whitish in appearance and the cup was dyed once carved, so the whitish discoloration would be a depigmentation or fading of the artificially dye added.

The hypothesis that the Grail was dyed raises some concerns. For example, it becomes uncertain why some translucent bands alternate with others yielding brownish tones. If the Grail was dyed after being carved, it would be expected to find all bands with pigment, to a greater or lesser extent. Experts explain that the amount of dye absorbed depends on the degree of compaction of the quartz microcrystals [50]. Given the crystalline structure of agate, its layers can absorb different amounts of dye, while other layers can absorb none at all [32] (p. 26). Quartz is a crystalline mineral composed of silicon dioxide (SiO_2), so the atoms are linked in a continuous framework of silicon–oxygen tetrahedra that does not allow for the diffusion of organic dyes. Agate and other varieties of chalcedony are also composed of silicon dioxide, but the crystal structure is less compact, allowing for the diffusion of coloring substances. In agate, not all bands have exactly the same degree of compactness in the crystal structure, mainly because of the speed at which that layer is formed (i.e., a slower speed gives rise to more compact crystals). Thus, when agate vessels are dyed, the more compact bands hinder the diffusion of the coloring pigment inward [50].

There is strong evidence supporting that it was common in antiquity to dye gemstone vessels. The British Museum exhibits a fragment of an agate bowl with a flat base from the Neo-Assyrian period (production date, 680–669 BC) found in Nineveh (present-day northern Iraq) [51]. Figure 10b displays a broken section of this bowl. It can be observed that the inner part of the agate is less colored and that the pigment has diffused only through a few millimeters; it has not penetrated the full thickness of the stone [32] (p. 51). Although this bowl is much older than the Holy Grail, it proves that the pigmentation of gemstones was common in ancient times to improve their visual appearance [50]. One of the methods was cooking with honey [32] (p. 24–25), as described by Pliny the Elder: “these

are said to be boiled in honey without interruption for seven days and nights (...) In general, all gems are rendered more colorful by being cooked thoroughly in honey" [52].

This artificial coloring is also apparent in some gemstone vessels that have partially lost their color. For example, one Roman agate cup from a private collection (c. 1st BC–c. 1st AD) has lost some caramel brown coloration on the rim [32] (p. 30, 111). The Kunsthistorisches Museum in Vienna exhibits a large agate dish that appears rather whitened, probably because of the dilution of the caramel treatment over the centuries [32] (p. 31, 46). A similar case is a skyphos at the Louvre Museum in Paris, with a whitened pale appearance, probably because it lost its dye treatment with honey caramel [32] (p. 67). The same applies to a vase held at the Victoria and Albert Museum in London [32] (p. 58).

One of the singularities of the Holy Grail is that the agate bands or stripes are arranged vertically (Figure 11a,b). This feature is quite atypical because agate is formed when a rock cavity is progressively covered on the inside in concentric layers that grow inward. Agates are most commonly found as nodules within the cavities of volcanic rocks, denoted as geodes. Cavities are then filled in with silica-rich fluids. Layers are slowly deposited on the cavity walls, working their way inward. Therefore, if a cup is carved from a conventional agate geode, the bands cannot be parallel but concentric.

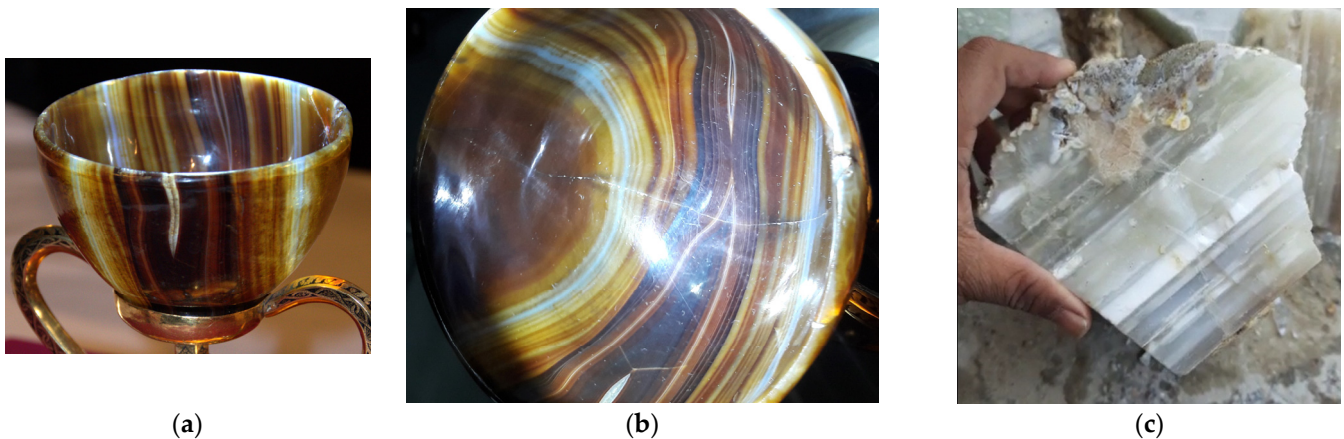


Figure 11. (a) View of the Holy Grail showing the vertical agate bands. (b) Picture taken from above, showing the contrast between bands. Both photographs by J. Leyva. (c) Raw agate stone from Jhagadia, Gujarat, India. Picture by the manufacturer Yasin Agate, Khambhat, India.

The aforementioned workshop in Khambhat was asked about what type of agate or variety of chalcedony could give rise to a bowl with parallel bands like in the Holy Grail. This inquiry led to a type of whitish agate originally from the Jhagadia area in Gujarat (India). A picture of this material (Figure 11c) reveals the presence of parallel bands with a whitish appearance, which can render red-brown tones after being dyed (Figure 4b). Interestingly, the tone of these bands in Figure 11c is quite similar to the appearance observed in the whitish discoloration of the Grail (Figure 10a).

3.7. Irregularities in the Surface of the Gemstone

A visual inspection of the Holy Chalice also revealed other details of interest. Slight depressions can be observed at different points on the outer surface of the Grail [24] (p. 166–167), ref. [27] (p. 32), which supposedly originated during the carving and polishing process. Such irregularities are typical of a piece handcrafted with traditional techniques. Some of these imperfections seem to be marks of a trephine, an instrument used in ancient times to drill holes in rocks, which was the precursor of modern drills. The diameter of the trephine used to carve the Grail might be estimated from some of these marks.

In the front view, a translucent band with a porous appearance is observed both on the outer face (Figure 12a) and inner face (Figure 12b) of the Grail. This band acquires a whitish appearance when illuminated with transmitted light. It is a natural veining that

reaches almost half the cup height, with a porous appearance conferred by the presence of larger quartz crystals [23] (p. 32). A similar crystallization band is observed in a fragment of an onyx bowl with a grooved rim kept at the British Museum [53].

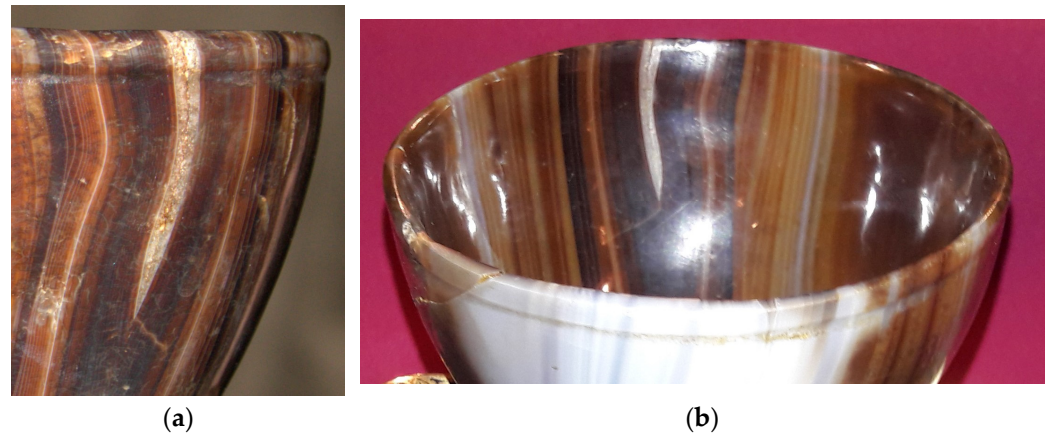


Figure 12. Crystallization band observed on the Holy Grail. (a) Zoom of this band in the front view. (b) Band observed from inside the Grail. Photographs by J. Leyva.

Such distinct quartz crystallization in this part of the Grail is common in agate geodes. In fact, when the cavity of rock where agate is formed becomes practically covered by silica, the deposition of material from the outside is much slower, which favors a more perfect crystallization, giving rise to small visible crystals. This crystallization band in the Grail could be considered a slight aesthetic defect, though the band is translucent and does not clash too much. Nevertheless, if the lapidary craftsman who carved the Grail had intended to avoid this differentiated band, the cup size would have become smaller, reducing its volume and, therefore, its commercial value.

Regarding other details of interest on the surface, white quartz marks or spots can be observed in a lateral view of the Grail, as well as concentric bands around these marks (Figure 13a). Such irregularities unfavorably impact the aesthetic appearance of the gemstone. However, this defect cannot be observed at all on the inside (Figure 13b), which leads one to speculate that the inner volume was carved first. These whitish marks on the outer wall correspond to the limit of the raw agate from which the cup was carved [26] (p. 96). Hence, the marks pertain to the irregularities of the wall of the cavity in the rock where the silica began to be deposited, gradually forming the agate stone.

The presence of these irregularities, together with the crystallization band, suggests that the cup was carved trying to achieve the largest possible size. This conclusion seems reasonable since a greater cup volume would lead to a higher price on the market. An internet search was carried out for Roman silver goblets, which showed an average diameter at the rim of about 11 cm. Only around 10% of them have a diameter lower than the case of the Holy Grail. Although further research is required to better estimate this percentage, this suggests that the Grail's size is in a low percentile compared with the silver cups of the Roman period, which would justify the lapidary's desire to maximize its diameter as much as possible when carving the gemstone.

A recent study speculates that perhaps the Grail's owner had it carved to be used as a Jewish blessing cup for the Passover Dinner since its volume exceeds the minimum requirement for cups reserved for that ritual dinner [13] (p. 238). However, this hypothesis is arguable because it is unknown what the Jewish blessing cups looked like at that time, given that Jewish art is characterized by aniconism. It seems more reasonable to assume that the Grail is a Hellenistic–Roman cup that a wealthy Jewish family purchased to be used as a ritual chalice. Moreover, the minimum volume established for Jewish ritual cups is also a matter of debate. According to rabbinic sources, each cup should contain at least

one revi'ith of wine, but unfortunately, there is no consensus about this biblical measure of capacity, ranging from 73 to 160 mL according to different scholars [54].

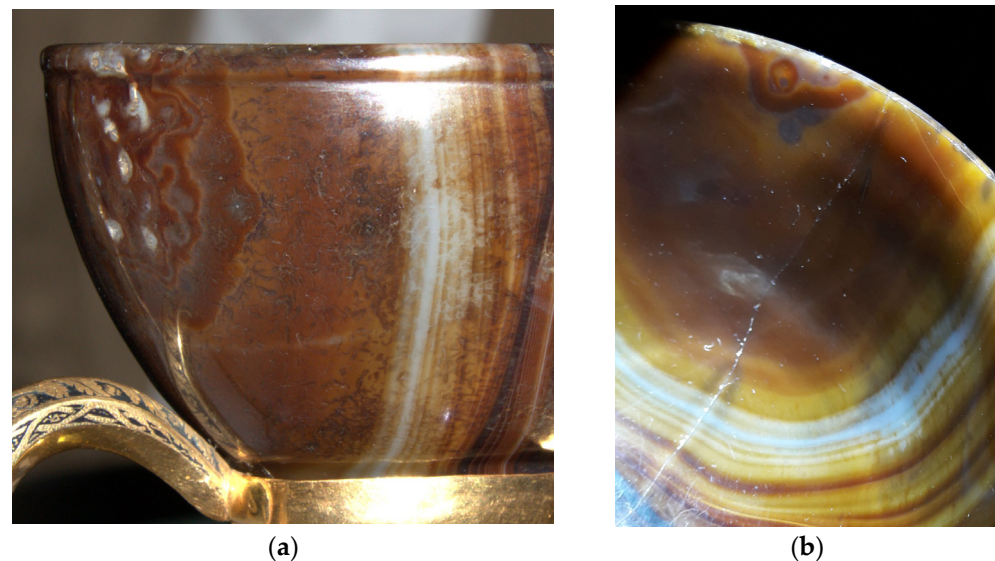


Figure 13. (a) White spots observed on the surface of the Holy Grail. (b) Inside view showing that these spots are not clearly observed. Photographs by J. Leyva.

3.8. Archeological Evidence about the Location of the Cenacle

The Last Supper took place in a large two-story house with servants (Lk 22:10,12) that would have belonged to a wealthy family. Mark's gospel insinuates that it was the house of a discreet disciple of Jesus (Mk 14:12–15). A literature review was carried out regarding archeological studies about the Cenacle in order to elucidate its exact location and to find evidence supporting the house belonging to a rich family. This review is presented next, starting with the oldest texts mentioning the Cenacle.

Epiphanius of Salamis (ca. 392 AD) narrates the journey of Emperor Hadrian to Jerusalem, which occurred in 130 AD:

He went up to Jerusalem, the famous and illustrious city which Titus, the son of Vespasian, overthrew in the second year of his reign. And he found the Temple of God trodden down and the whole city devastated, except for a few houses and the church of God, which was small, where the disciples, when they had returned after the Savior had ascended from the Mount of Olives, went to the upper room. For there it had been built, in that portion of Zion which escaped destruction, together with blocks of houses in the neighborhood of Zion and seven synagogues which alone remained standing [55].

In Epiphanius' time, this upper room to which the apostles returned after Jesus' ascension was associated with the place where they lived in Jerusalem (Acts 1:13) and where the Last Supper took place. It was also considered the place where Jesus appeared to the apostles after his resurrection (Jn 20:19,26) and where the Holy Spirit descended on the day of Pentecost (Acts 2:1–4) [56] (p. 40). Nonetheless, some scholars speculate that it could be the home of James, a relative of Jesus (Gal 1:19; 2:9) whose house was a regular meeting place for Christians in Jerusalem (Acts 12:17; 21:18).

According to Epiphanius, this upper room was located on Mount Zion. This name refers to the ancient Jebusite fortress conquered by King David (2 Sam 5:7), considered equivalent to the "city of David" (1 Kings 8:1; 2 Chron 5:2). This fortress was located at the southern end of the eastern hill of Jerusalem (Ophel) between the Temple and the pool of Siloam [57]. At the time of Jesus, this area of Jerusalem was called the Lower City, which was inhabited by merchants, artisans, and the lower classes. However, Christians began to refer to the western hill of Jerusalem as Zion, where the neighborhood known as the Upper City was located.

Epiphanius indicates that the whole city was destroyed in 70 AD except for the area of Mount Zion, where the Cenacle Church remained, standing “together with blocks of houses in the neighborhood of Zion and seven synagogues”. Those houses were probably built or rebuilt in the decades that followed, as the Jews returned a few years after the destruction of Jerusalem. This is attested to by Eutychius of Alexandria (10th century):

When the Christians, who had previously fled in the face of the Jews, had crossed the Jordan and settled in these areas, learned that Titus had destroyed the Holy City and killed the Jews, they returned to its ruins and settled there. They built a church and chose a second bishop by the name of Simon, son of Cleophas. [...] This occurred in the fourth year of the reign of Vespasian [56] (pp. 19–20).

Apparently, in the fourth year of Vespasian (73/74 AD), a group of Judeo-Christians who fled from Jerusalem returned and erected a small church on the ruins of the southern part of Mount Zion, which Epiphanius calls the “Church of God”. The place chosen was most likely the location of the house where the fundamental events of the Church’s birth took place: the Eucharist and Pentecost.

Hadrian decided to rebuild Jerusalem in 131 AD, but not the Temple, and renamed the city Aelia Capitolina. It was smaller than the original city, and new walls were built. Curiously, the old sanctuary of Mount Zion was left outside the walls, which preserved its location, and it remained accessible to the Christian community [56] (pp. 26, 134, 191). Various authors such as Saint Jerome, Eucherius, Sophronius, and Cyril of Jerusalem mention the “Church of the Apostles where the Holy Spirit descended upon them” [58] (pp. 84, 94, 158, 351–353).

In order to honor the location of this upper chamber, Christians built a large basilica between 379 and 381 AD called *Hagia Sion* (Holy Zion), which was attached to the small Cenacle Church [56] (p. 36). It became an important center of Christianity in Jerusalem, the “mother of all churches,” competing in importance with the Church of the Holy Sepulcher consecrated in 335 AD. Archeological studies suggest that the current Cenacle building was a Christian religious construction from its beginnings, which was a small adjacent structure separate from *Hagia Sion*. This implies that this structure surely already existed when the great basilica was built [56] (pp. 142, 150, 151, 191), probably the one described by Epiphanius. *Hagia Sion* was damaged by the Persians in 614 AD [58] (p. 353), but it was partially rebuilt years later. After its destruction by the Muslim caliph Al-Hakim in 1009, the crusaders erected here a church dedicated to the Virgin.

In short, although there is no certainty about the exact location of the Cenacle, it is very likely that it stood in the Upper City: the aristocratic neighborhood about 400 m away from Herod’s palace [59]. These houses, which were distinguished by their grandeur and decoration, offered a fabulous view of the Temple.

4. General Discussion

4.1. Mentions to Gemstone Vessels by Classic Authors

The fact that bowls carved from gemstones were very valuable in Hellenistic–Roman times becomes apparent in mentions of these vessels cited by several classic authors, as discussed next in chronological order.

Appian narrates that Mithriades VI, King of Pontus (120–63 BC), used the city of Talaurei (present-day Turhal in Turkey) as a warehouse where two thousand onyx cups were found [60]. Some of them came from the Egyptian kingdom of the Ptolemies (323–30 BC), deposited on the island of Cos. This historical note credits the prosperity of the manufacture and trade of gemstone vessels in the eastern Mediterranean in this period.

Cicero (ca. 70 BC) writes, “There was also a vessel for wine, a ladle hollowed out of one single large precious stone” [61]. Years later (29 BC), the poet Virgil mentions, “*ut gemma bibat et Sarrano dormiat ostro*” [62]. This expression of “gems for drinking” (*gemma bibat*) became popular as a sign of ostentation and refinement.

Suetonius comments that Emperor Augustus, after conquering Alexandria in the year 30 BC, kept nothing of all the royal wealth except one “*murrinum calicem*” (i.e., a gemstone

cup) and ordered all the gold vessels to be melted down [63]. A biblical quote insinuates that onyx was highly prized in antiquity, possibly as much as gold (Job 28:16).

In 59 AD, Seneca narrates, “I see murrine cups, because madness would boast little if they did not toast themselves in precious glasses, drinking in them what they soon will vomit” [64]. Years later (63 AD), Seneca makes another quote on precious vessels: “How much more is this man to be envied than he who is served on precious stones?” [65].

Apuleius (123–180 AD) talks about “precious stones made to drink out of; Servitors (...) filled great gems made in form of cups with aged wine” [66]. Saint Cyprian of Carthage, around the year 246 AD, also associates the use of precious cups with banquets: “He sighs at the banquet, although he drinks in gem” [67]. Saint Jerome writes (ca. 384 AD): “Let others have their wealth, drink in their gems” [68]. Around the same years, Paulinus of Nola asks, “Do those men seem to you happier who are bright with purple, who drink from gems?” [69].

These references are evidence that drinking vessels carved in hard stones were luxury objects used by social elites in Roman times as a symbol of distinction. The quotes about such gemstones for drinking made by late Roman authors from the 3rd and 4th centuries AD support the dating of the Holy Grail proposed by Arasa, from the 1st century BC up to the 3rd century AD [24,27]. Indeed, these texts prove the existence of such precious cups but not necessarily that their trade and manufacture were booming.

4.2. Additional Criteria for the Dating of the Holy Grail

Some experts suggest that the production of gemstone vessels was in decline in the mid-1st century BC given the competition with glass vessels whose quality had improved significantly [70] (p. 25). Such rivalry between gemstone and glass cups is a key issue in providing accurate dating for the Holy Grail. For example, two Roman cups on display at the British Museum [42,43] present a very similar outline to the Grail, but according to the website of this museum, their thickness at the rim is 1.5 mm, clearly lower than the Holy Grail. Such reduced wall thickness might be intended to imitate the transparency of blown glass vessels, whose technology was invented at the end of the 1st century BC, which would explain why both cups were dated, in 1923, to the period 1–50 AD. The thicker walls of the Holy Grail would imply an earlier manufacture.

The repertory of Del Bufalo includes a very thin cup fragment of about 6.5 cm in length and 1.5–2 mm in thickness, dated to the 1st century BC, found at an archeological site in Rome [32] (p. 26, 110). Again, this thickness is clearly lower than in the case of the Holy Grail, supporting the idea that the latter might have been crafted earlier.

The Vatican’s Christian Museum, Department of Decorative Arts, keeps a fragment of an agate Roman vase dated to the 1st century BC–1st century AD [32] (p. 108), with a length of about 6.5 and an unknown origin (inventory number MV.60,477.0.0). The thickness at the base is 4.4 mm, 2 mm closer to the rim, and 2.6 mm at an intermediate position [71]. Another agate cup with the same thickness at the rim of 2 mm was discovered in 1992 in Herculaneum, Italy (ref. 78,969). It presents a diameter of 5.3 cm and is dated to the period 1–50 AD according to the museum curators, though Del Bufalo suggests a broader dating (100 BC–50 AD) [32] (p. 107). The wall thickness of the Holy Grail at the rim is slightly higher than 2 mm, which again would suggest a manufacture earlier than these two cups.

An agate bowl discovered in Qift (Egypt) in 1930, dated 300–100 BC, with a diameter of 9.1 cm [72], has a wall thickness at the rim of 3.45 mm, which is very regular, and remains the same about 2 cm below the rim [73]. Interestingly, although the wall thickness of the Holy Grail is irregular from top to bottom, it is comparable to that of this Egyptian bowl.

In summary, these clues derived from other gemstone cups are consistent with the likely dating proposed by Beltrán: around the 2nd–1st centuries BC [23] (p. 103). The metrological research in progress on the Holy Grail [30] will provide a precise characterization, allowing for a detailed comparison with other Hellenistic–Roman gemstone cups in future studies, which is a key issue in more accurate dating.

4.3. Ritual Stone Vessels in Jewish Culture

In the 1970s and 1980s, large quantities of vessels carved from local limestone were discovered in multiple Roman-era archeological excavations in Jerusalem, Sepphoris, and in the rural areas of Judea and Galilee [70] (pp. 3–4). However, gemstones such as rock crystal, agate, onyx, and sardonyx are harder than limestone, requiring a more arduous, slow, and delicate method for the manufacture of containers. Without a doubt, the Grail would have been extraordinarily expensive, only affordable for a wealthy family. This consideration is consistent with the fact that the Last Supper was celebrated in a large two-story house with servants (Lk 22:10.12) located in the aristocratic neighborhood of Jerusalem, as discussed in Section 3.8.

When Herod the Great built his palace (ca. 25 BC), many aristocratic families moved to the Upper City south of Mount Zion, where the Cenacle is located. This is corroborated by archeology; in a 1971–1972 excavation, evidence was found of wealthy residents who had moved to Mount Zion shortly after 31 BC. The area was densely populated for the next century [74]. In another excavation led by Gibson and Tabor to the east of the Cenacle, a luxurious residence from the 1st century AD was discovered [56] (p. 129), [75].

According to Josephus, Judea suffered a strong earthquake in 31 BC [76]. Although Karcz believes that it was probably a modest earthquake [77] (pp. 774–778), the destruction caused by this event could have been an incentive for wealthy families to decide to build new residences in the Upper City.

The time period under Herod's reign after the aforementioned earthquake (31–4 BC) basically overlaps with the government of Emperor Caesar Augustus (27 BC–14 AD), who favored a long period of stability in the Roman Empire called *Pax Romana*, which some scholars date until 180 AD. The maximum development of luxury was reached in parallel with the economic growth and territorial expansion of the Roman Empire, becoming the period of greatest splendor in lapidary art (glyptics).

Taking into account the availability of gemstone vessels in this period and the fact that they were highly appreciated by aristocratic classes, it is perfectly possible that the Cenacle's owner possessed a gemstone cup for ritual purposes. Therefore, it cannot be rejected that Jesus used a precious bowl for the Last Supper. In contrast, it is not likely that Jesus was offered a cup made of glass because glass vessels were relatively cheap at that time.

5. Conclusions

5.1. Main Findings of this Research

This photographic characterization of the Holy Grail has led to the conclusion that this gemstone would have been extraordinarily valuable given its relatively large size and the difficulty of carving hard rocks like agate, which increased the risk of cracking, as well as because of its extraordinary beauty, as a result of its translucent character and atypical vertical banding. Another factor that would increase the price is the fact that the raw agate came from far away, probably from India.

This conclusion is consistent with the premise that the Cenacle belonged to a rich, discreet disciple of Jesus, as insinuated by Mark's gospel (Mk 14:12–15). This disciple would have lent Jesus the Upper Room with everything arranged for the Passover Dinner (Mk 14:15), including the most valuable cup of blessing owned by the family [9].

Several features of the Holy Grail (i.e., its outline, rim, and the design of the foot) are typical of Hellenistic–Roman gemstone cups, which were very valued among the aristocratic classes. The references to such vessels by classic writers support this consideration, as discussed in Section 4.1. A comparison of the overall shape and wall thickness with other cups (Section 4.2) provides valuable clues that support the dating proposed by Beltrán, around the 2nd–1st centuries BC [23] (p. 103).

In summary, different arguments have been exposed supporting that, quite likely, the agate cup of the Holy Chalice was carved before the Last Supper, which is a fundamental issue for its authenticity. These arguments should be accessible to people who visit the

Cathedral of Valencia, mainly through the official website of the Cathedral and in tourist guides. Such information would reinforce visitors' perception of the relic's authenticity, although such perception depends on many other issues not tackled here.

The present research is not expected to have a substantial impact on the perception of the authenticity of the Holy Grail in Valencia, but it will undoubtedly contribute to supporting the tradition that this cup was used by Jesus at the Last Supper. Considering that the periodic celebration of Jubilee Years in Valencia is expected to significantly increase the number of tourists, the publication of new scientific and historical studies on the Holy Chalice will contribute to fostering interest in this artwork in the forthcoming years.

5.2. Limitations of the Research and Future Considerations

The main limitation of the present work is that it basically consisted of a photographic characterization as preliminary research for further studies based on the metrological characterization carried out in 2018 with a high-resolution 3D scanner [30]. These studies, which are currently in progress, will provide precise values for the measurements, which are of great interest, especially the wall thickness at different points, as well as the variability of this thickness. Further research comparing this metrological characterization with that of other Hellenistic–Roman cups will allow for more precise dating for the Holy Grail. Experts in the field and archeologists specialized in the Roman era are welcome to contribute to these future works.

The degree of translucency of the Holy Grail could have been measured instrumentally, as well as the color, which will be an objective for future studies. The origin of the design pattern is discussed in Section 3.3, but this topic can be better investigated with a broader literature review.

Regarding the whitish discoloration on the Grail's surface (Section 3.6), little is known about this feature. A group of researchers from the Universitat Politècnica de València is currently carrying out experiments with samples of agate slices to elucidate what agents could have caused this discoloration. Another goal is to find out if it was due to contact with a very aggressive product for a short time or, on the contrary, with a less aggressive product acting for a long period. It also remains to be clarified whether the Holy Grail yields the natural color of the raw stone or if, on the contrary, the gemstone was artificially dyed.

Another aspect of interest is guessing the price of agate bowls in antiquity, which depends on several factors. One of them is how long it would take to carve such a cup. In a reported study of ancient stone-working technology, it was found that, even with a bronze drill bit, it took up to 5 h to drill a tiny hole 1 cm deep in a hard stone like quartz [78]. Empirical studies are necessary to elucidate how the Grail was carved and to estimate the amount of time required for crafting a gemstone cup like this at the time it is dated. Maybe it was the work of several months. This information will be useful to tentatively elucidate the price of the Holy Grail when it was purchased.

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