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Reviewed Article:

Ancient Distillation and Experimental Archaeology about the Prehistoric Apparatuses of Tepe Gawra

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The Perfume Theme Park Museum of Cyprus' research protocol of Experimental Archaeology (https://www.perfumecypark.org), aims at verifying hypotheses of ancient perfume manufacturing processes, to formulate a possible comparison with modern realities derived from the island's ancient cultural heritage. What has recently emerged from international investigations is that distillation is a very ancient art, which existed for many centuries before

its parameters and functions were formalised. It may have been born before use of ceramics, suggesting that the need to distil created clay apparatus/alembic, not the contrary (Belgiorno 2017, pp. 51-59).

> This experimental archaeology investigation had the aim of verifying the reliability of Levey's hypothesis about the possible function of some vases found in the Tepe Gawra. What we can now state is that we have proved that two distinct apparatuses, assembled with replicas of the vessels published in the excavation reports, can be used for distilling. In our case we have used botanical parts and obtained perfumed water and a small quantity of essential oil...

Introduction

The extraordinary documentation of distilling practices of people living in the forest and nomads, it takes to ancient traditions and knowledge too long ignored (Bourke 1893, pp. 65-70; Valenzuela-Zapata et al., 2013, pp. 157-191). While the domed glass alembic distilling method began to circulate around the Mediterranean in the 7th century AD, totally different methods had already been in use since the 1st century BC in China, Mongolia, India, and South America (Belgiorno 2017, pp. 45-71). Therefore, we cannot and must not seek a precise differentiation between equipment used to produce alcoholic beverages or fragrances, as it seems clear that there has never been any. Our investigation concerns archaeological contexts in which objects, possibly associated with distillation have been found, and thus focuses on pots found in Mesopotamia, Slovakia, Sardinia, and Cyprus (Belgiorno 2018, pp. 79-101). The chronology spans 3000 years, from the end of the fifth millennium BC to the second millennium BC.

One of the first scholars to move back knowledge on distillation in prehistoric Mesopotamia was M. Levey, who, in 1950, recognized a Late Chalcolithic jar from Tepe Gawra as the lower part of a distilling apparatus. He did this by connecting its functionality with some Akkadian cuneiform texts and late Arabic manuscripts describing how to make perfumes in the 9th century AD.

There have been many discussions on Levey's assumptions and suggestions on how the upper part of the Tepe Gawra jar was. Discussions arose again after the discovery of similar pots at Bronze Age sites in Turkey, Cyprus, Sardinia, and Slovakia (Belgiorno 2018, pp. 79-101). This paper aims to experimentally verify Levey's hypothesis on the functionality of the apparatus. It is based on four steps:

1. The review of the excavation reports of Tepe Gawra and its ceramic corpus;
2. The reproduction of pots possibly related to distillation;
3. The test of the functioning of the apparatuses reproduced;

4. The comparison with an Iranian tradition that still uses similar apparatuses in order to answer Levey's assumption that these devices were intended for perfumes and not for alcoholic beverages.

Materials

Geographical areas

Despite many attempts to usurp its primacy, Mesopotamia is still considered as the cradle of many important past civilizations. Its evolution - as in the case of Egypt with the Nile - has been linked to the presence of the great rivers Tigris and Euphrates (See Figure 1).

From the beginning of the Neolithic period or even earlier, the region and the rivers played a key role in connecting the East to the West because they hosted different commercial routes along which goods from India, the Arabian Peninsula, Europe, and the Mediterranean transited. It is therefore not surprising that the cultural overlap facilitated the production of knowledge and the improvement of advanced technologies in safe and resourcefully plentiful areas. The North-Eastern Mesopotamian region, which today corresponds to the border areas between Syria, Turkey, and Iraq, is hilly and rich in water sources. It is suitable for pastoral settlements, and from the sixth millennium BC to the second half of the fifth millennium was occupied by the Halaf culture and then by the Ubaid culture which overtook a large part of Mesopotamia. Studies on the biodiversity and environment of Mesopotamia suggest that the climate of the fifth and fourth millennium BC was rainier and cooler than today, and that spontaneous vegetation extended from the highlands down to the Tigris river valleys. This favoured urban culture, sheep-farming, and agriculture.

Botanical resources

Botanical resources played an important role in the creation of urban centres favouring sheep farming and the cultivation of vegetables. However, few studies have been conducted on clarifying the ancient biodiversity of the region, especially in terms of wild forest plants and endemic species. For this reason, our study and experimentation involve endemic plants, but only those which still exist in the highlands of Northern Mesopotamia and which are known to be useful for making fragrances (Moorey and Postgate 1992, pp. 197-199; Farhad Hasan 2017: 40-68). These are: Juniper (*Juniperus oxycedrus*), Pistachio (*Pistacia mutica*), Syrian pear (*Pyrus syriaca*), Azarole (*Cratoegus azarolus*) and Hawthorn (*Cratoegus P. monogyna*), Montpellier maple (*Acer monspessulanum*), Bay leaf (*Laurus nobilis*), Turkish pine (*Pinus brutia*, occurring in the district of Mosul Liwa), and Italian Cypress (*Cupressus sempervirens*).

These species were possibly involved in the production of perfumed waters and essential oils.

We started our experimental research with *Pinus*. It is one of few available species in Cypriot summer, which is when we ran the first experiment. Our intent was to demonstrate the functionality of the apparatus and not to reproduce the Mesopotamian fragrances of the fifth millennium BC, even though some pots from Tepe Gawra (See Figure 2) decorated with pine tree branches suggest that this plant had some importance for the people who lived in the village in the fourth millennium BC. Another important component in the evolution of Mesopotamian technology was the availability of reeds. Reeds are one of the most significant resources growing around the plentiful in marshes of the Tigris valley, and are still employed in building, in the making boats, in transportation, for animal feed, and in moving liquids.

The most widely used common reed species are the *Phragmites australis* and *Arundo donax* (giant reed: Bor and Guest 1968, Flora of Iraq, IX, P.376). They can reach a height of 4.50 m and a diameter of 6 cm. The rod, when cleaned outside and inside, can be used for any kind of distillation.

The 660 clay tablets recovered from the palace in Nineveh (669–626 BC) form a major source of information on drugs used in Mesopotamia. They refer to texts written around 1700 BC, which were preserved when invaders set the Nineveh palace on fire. The tablets were deciphered by R. Campbell Thompson, who established that many were copies of much older texts, repeating the names of third millennium BC Sumerian drugs. Middeke-Conlin (2014) offers a complete picture of the production, use, and social importance of these fragrances, referring to the earlier research of Zimmern (1925) and Campbell Thompson (1925) who published the *Dictionary of Assyrian botany* in 1949. During the same years, Ebeling started a discussion on possible Mesopotamian technical knowledge on perfume production (1948, 1949, 1950a and 1950b), subsequently focusing the attention of scholars in an unexpectedly vast field of research.

In response to drawings produced by E. A. Speiser (1935) and A. J. Tobler (1950), Levey (1955) published photos of pottery from Tepe Gawra (held in the University of Pennsylvania Museum of Art and Anthropology) which were possibly involved in distillation processes.

In 1959, Levey provoked a deep discussion on aromatic preparation technologies which involved chemical apparatuses, furnaces, chemical extraction techniques, waters, oils, fats, resins, and waxes. Levey was a real precursor to the discussion of Mesopotamian perfumery chemistry. He compared the latter to the Medieval Arabic technology and practically excluded the late Arab world from the invention of distillation. In the following years, the extensive material discovered during early twentieth century excavations in Mesopotamia formed the subject of C. F. Myers' PhD thesis (1975). Myers focused on identifying the aromatics mentioned in the ancient texts, while J. Needham - in his encyclopaedic *Science and civilization in China* (1980, p. 82, fig. 1455) - included the Tepe Gawra devices in the list of the most ancient apparatuses for distillation, and discussed the procedure suggested by Levey.

Moreover, when Speiser (1935) and Tobler (1950) published the excavation of Tepe Gawra, they were primarily interested in the cultural history of a characteristic Chalcolithic village in the North East of Mesopotamia, not strictly connected with the evolution of the technology and its relationship with the environment and biodiversity.

Their interest focused on the possible existence of a Chalcolithic state society with rulers, bureaucrats, and which maintained administrative control of economies and specialized production, whatever this could be. The evaluation of the natural environment and the biodiversity of available resources were considered of secondary importance - they followed a protocol which is almost the opposite of ours today.

In turn the equation, which for years has been supported by the archaeometry investigations by Alessandro Lentini and me (Belgiorno and Lentini 2012; Lentini 2015), is based on the importance of biodiversity as an evolutionary element for the technology, which formed the culture, not the reverse. According to this equation, we find, around Tepe Gawra, different ecosystems.

The forest on one side and marshes and desert on the other side provide material for any kind of healing products such as perfumes, pharmaceutical compounds, and cosmetics. It is the perfect combination of biodiversity for a distillation technique to evolve into a sophisticated system.

Moreover, distillation in this region seems to begin at the end of the fifth millennium, but its use of such advanced technology suggests that it had a background going back centuries.

The main site

Tepe Gawra is a small site of about one hectare. It hosted a small community of 150-200 people between the 7th to the 2nd millennium BC. It is situated along the Tigris valley, in Iraq, near the present-day village of Fadiliyah (24 km NE of Mosul).

The name Tepe Gawra comes from Kurdish and means “great mound”. It was investigated during the British occupation of the region in 1927 by E. A. Speiser (1935).

The site’s small size is housed in a temple which underwent different episodes of reconstruction while maintaining a central position in the small village of c. 150 inhabitants, and the fact that the channel pots were found inside and outside the houses, allow the scenario of domestic laboratories surrounding a temple to match with Levey’s theory about fragrance production.

The lavishness of the funerary garments found in the Tepe Gawra tombs does not balance with the site’s scarce natural resources. The only possible explanation is that a form of possible specialized production for ceremonies dedicated to the deity in the temple took

place. This theory is indirectly confirmed by M. Rothman (2000) who, in republishing the Tepe Gawra material, underlined the extraordinary number of luxuries collected from the site (incised seals and sealings, and gold and silver jewels) and suggests that in order to have become so rich the small community must have produced something special or precious. He points to the textiles, to the number of spindle whorls and to the presence of silver and gold items in the graves. However, the insignificant number of loom weights found in different levels (12 small fragments in total) excludes the manufacture of precious clothes.

In reality, more pots found at Tepe Gawra do not match with clay objects from other Chalcolithic or Early Bronze age sites. This suggests the occurrence at this site of an exclusive specialized activity which involved the creation of scented waters, oils, ointments and miraculous drugs for pilgrims venerating the goddess in the tripartite temple located in the middle of the village.

Moreover, the wealth of the people, visible also in the high-quality ceramics, engraved gems, and rich funeral goods, suggests the existence of an advanced form of social organization, which involved trade with surrounding populations and possibly also with caravans crossing the slopes of the Zagros.

The site fascinated students for decades, for the extraordinary quality of its artefacts, jewels and seals representing animals, marriages, and religious ceremonies, which are testimonies of an unexpected social level of a small Chalcolithic village.

Where the ceramics are concerned, the collection includes unusual shapes: funnels and strainers, jars with eccentric spouts, pots with two or three necks, pots with two perpendicular mouths, and bell-shaped vases with one hole in the bottom and a second under the rim (Speiser 1935: Pl. LXIII 29, 38, 39; LXIV 49; LXX 140; Tobler 1950: Pl. CXXXI, 221; CXXXII, 227, 230, 231; CXXXVII 282; CXXXVIII 296, 298; CXL 319, 320, 325; CXLII 343, 346; CXLIII 356, 360, 363,365, 366; CXLVI 405, 406, 407, 410; CXLVII 411; CXLVIII 434, 436, 438). These ceramics form a repertoire that we can hardly compare with that of other coeval sites. The pots' functions were enigmatic even for the archaeologists who excavated them. Unfortunately, these archaeologists decided to conserve and record only a few complete examples. This material includes the pot that attracted Levey's attention in the 1950s. It is a large jar with an oval body, and a large mouth with a double rim forming a channel with holes in the bottom. It is an unusual shape for the fifth millennium BC that a few years later, was found in other nearby sites. In his research, Levey focuses on the carrying over of Mesopotamian perfume production into the Arab world and returns to the issue in several papers (Levey 1955a, 1955b, 1959, 1960, 1973).

The most ancient device of Tepe Gawra

In our review of the published material, we also found a second device composed of three pieces (from levels XII-XIA) which present matching dimensions and diameters. These pieces correspond to the Middle Chalcolithic period, i.e. the oldest phase of the site. The device consists of a deep bowl (n°413 h. 25.2 cm, dm. 30.8 cm; Tobler 1950: p. 240, Pl. CXLVII, rough brown ware: G5: level XI, 7M) which has the correct dimensions to contain strainer basin n°319 (h. 7,5 cm, dm 24,2 cm; Tobler 1950: p. 238) and the bell-shaped pot n. 325 (h. 22 cm, dm 22.8 cm; Tobler 1950: p. 238) with two holes of which one is situated in the bottom and the other on the side under the rim (See Figure 3).

The functionality is deducible from replicas perfect assemblage (See Figure 4). We can note the correspondence of the central hole of the filter with that at the top of the "bell-shaped vase" (n°325) which acts as an expansion vessel for the distillation apparatus (See Figure 5). The set arranged by us bears intriguing parallels with the aludel published and commented on by Needham in 1980 (p. 22 fig. 1390) about a sealed reaction vessel for sublimation (i.e. *Yao-fu* from the *Thai-Chhing Shih Pi Chi*).

M. Levy's channel rim jar

At Tepe Gawra, 12 examples of this jar were found at different levels. Four are complete and eight are fragmentary. M. Levey, who in 1950 studied the material in the University of Pennsylvania Museum of Art and Anthropology, connected these jars to some unusual strainers and funnels found together, and which were probably related to the rituals performed in the tripartite temple in the small village. This vessel type has a conical shape with a rounded base, it measures approximately 45-50 cm in height, and has a variable diameter of 39 and 50 cm. The channel around the mouth forms a ring of 8cm thick and of 10/12 cm depth, thus corresponding to a capacity of 2 litres while the pot itself can hold approximately 37/40 litres. It has a row of holes in the bottom, communicating with the inside of the vase (See Figure 6).

During the last fifty years, other sites around Tepe Gawra in the Tigris valley have been investigated and more examples and fragments of the same jar type have been found at Tell Qalinj Agha (Erbil), Tell Brak (B. Abu al Soof 1969; J. Oates 1987), Leilan Tepe (T.J. Wilkinson and D.J. Tucker 1995; K. Abu Jayyab 2012), Tell Khirbat al-Fakhar Hamoukar (K. Abu Jayyab 2012) and Arslan Tepe (Malatya) in Turkey. All seem to belong to a period spanning from 4200 to 3500 BC, corresponding to the IX-XII levels of Tepe Gawra, the CH XIII of Tell Brak, and the LC1-2 (Late Ubaid 1-2) of Khirbat al-Fakhar Hamoukar, testifying that the pot is far from being an isolated phenomenon (S. Al Quntar, L. Khalidi and J. Ur, 2011: 157, 159, fig. 7: 1, 2, 3) as it is generally reported in papers on the history of perfumes.

Since, for almost a century, the top piece of the vessel (lid or cover acting as the expansion vessel) was considered lost by the directors of Tepe Gawra excavations (Speiser (1935) and Tobler (1950), different hypotheses were made about its shape. J. Ryšánek and V. Václavů

(1989, p. 199, fig.3) offer an illustrated reconstruction (Belgiorno 2018, 59 fig. 29), while the Chemicals Museum of the University "La Sapienza" of Rome presents clay models (Belgiorno 2018, p. 45, fig. 16).

The cover/expansion vessel of the channel rim jar

Following a complete review of the material published by Speiser and Tobler and of the location of the jars in different levels, we found two possible antagonists for the channel rim jar. They match in the dimension of the lower part.

The first is pot n° 2233 corresponding to the n° 411 of Tobler 1950 Pl. CXLVII (held in the University of Pennsylvania Museum of Art and Anthropology) which has a flaring rim. The spout is inserted in the lower part of the body near the base. This piece was included by Levey in his 1955 paper (p. 180, fig. 9). If we turn the pot upside-down, it works perfectly as an antagonist for channel jar n°406 (Tobler 1950 Pl. CXLVI), thus creating a perfect device with a domed expansion vase (h. 30,2 cm, dm 38 cm) with a side spout in the correct position for holding a reed to collect condensation (See Figure 7).

The second is pot n° 2838 (Speiser 1935, n° 49, h. 37 cm. d. 46,5 cm; Rothman 2000, p. 60, p. 263, p. 398 inv. n°2838, held in the Bagdad Museum) which was found in level VIIIA and thus corresponds to a date between 3800-3600 BC. It is similar in shape and dimensions to n° 2233 (Tobler n°411 Pl. CXLVII) but has a hole instead of a spout near the base. It works perfectly as an antagonist for another channel jar (See Figure 8): piece n° 2227 (University of Pennsylvania Museum of Art and Anthropology n° 33-3-036, h. 47 cm, dm. 54,1 cm Tobler, 1950). The latter was found in the same level and square (IX-VIIIA, Sq. J K 5) and corresponds to the Late Chalcolithic period, to between 3700-3500 BC (Rothman 2000, pp. 3-137).

Furthermore, the size, the shape, and the spout's position for both pieces (Penn Museum n°2233 and Bagdad Museum n°2838) allow them to work as a traditional alembic dome comparable to the modern copper versions (See Figure 9; https://www.noblegrape.ca/products/alchemist-series-alembic-pot-still).

After 6000 years, the shape remains similar, but the spout has moved from the middle of the body to the centre of the top, as is the case for the bell-shaped apparatus of Tepe Gawra (See Figures 3, 4 and 5) which must be the most ancient one found.

The strainer flask

Alongside the unusual vase from Tepe Gawra, strainer flask n° 360 (Tobler 1950 Pl. CXLIII, conserved at Bagdad Museum) from level XI A (Levey 1955, p. 180, fig. 13) – which presents fully drilled walls – has the correct shape and size (h. 33,6 cm, dm. 22,2 cm) to be positioned inside the channel jars designed for holding plants for steam distillation (See Figure 10).

The strainer is a very important element in the distillation procedure. Needham (1980: fig. 1473 C) considers the jar with the perforated base as the main element of traditional Chinese steam-cooking, and from which China's distillation apparatus was invented: “Conjectural design of the most ancient Mongolian Chinese still type. A bowl of cooling water caps the upper vessel (*tsʻlng*) and a collecting-bowl stands upon its perforated bottom (or, of course, on the grating of a Hsien when the two vessels were combined into one). The *li* below provides the vapours, and the distillate collects in the bowl, equipped subsequently with a side-tube”.

A second strainer flask was found in level X but was not illustrated because it was too fragmentary (Tobler 1950, p. 159). For the above reason, the experimental assemblage (See Figure 10) was done with the replica of channel jar n° 405 (Tobler 1950: Pl. CXLVI; found in level XI, Sq. G6, h. 36.5 cm, dm. 53.5 cm.)

Methods

The experiments

To make replicas we used the local Cypriot clay and the expert knowledge of the Kornos ceramists. The latter still make vases without using the lathe: they polish the ceramic surfaces with a piece of reed and leather. All the replicas were of the similar size as the originals.

The tests made with the three apparatuses were arranged in the middle of a pit surrounded by basalt pebbles.

To test the functionality of the first apparatus we used the replicas of n° 319, n° 325, and n° 413 found in level XIA/XII, square G5-6 of Tepe Gawra, belonging to the Middle Chalcolithic, 4200 BC (See Figures 3, 4 and 5). Considering the location, their assembly appears to be the oldest and most complete apparatus found at Tepe Gawra, never considered as a possible device to make distillation. n° 413 is a deep bowl h. 25.2cm, d. 30.8cm (Tobler 1950, p. 240, Pl. CXLVII), which has the correct dimensions to contain the strainer basin n°319 (Tobler 1950, p. 238, Pl. CXL, h. 7,5cm, d. 24,2cm) and may hold the bell-shaped pot n. 325 (Tobler 1950, p. 239, Pl. CXL, h. 22cm, d. 22,8cm). The lower pot was filled with 6 litres of water, leaves and fresh resin of pine trees collected around and covered by the filter basin (n°319) positioned upside down. The whole was covered with the bell- shaped pot, closing temporary the hole at the top with a cork, whereas this is the safety valve to prevent the dome from cracking. A long reed of Arundo Donax was inserted in the side hole. The fire was arranged gently around the deep bowl in the middle of a pit surrounded by basalt pebbles and the device started to still after one hour, continuing for more than three hours (See Figure 11). After use, remains of rosin (colophony) were clearly visible on the inside surface of the pots (See Figure 12). The liquid was collected into a jug positioned outside the circle of stones.

For the first experiment to test the functionality of the second apparatus, we used the replica of the strainer jar n°360 h. 33.6cm, d. 22.2cm, as container to arrange a steam vapor distillation introducing inside pine tree leaves. As a replica of Tepe Gawra channel pots, we have chosen n°406 h. 48cm, d. 53cm (See Figure 13), as the size contains perfectly the strainer jar (See Figure 10). For the cover we made replica of n° 2233 corresponding to the n° 411 of Tobler 1950 Pl. CXLVII (held in the University of Pennsylvania Museum of Art and Anthropology), considering mainly the dimensions of the height and the diameter (h. 30,3 cm d. 38 cm), enlarging the mouth as in the original. A one-meter reed was inserted into the spout to carry out the distillation liquid into a jug positioned outside the circle of stones, and a fire placed around, not under the vase (See Figure 13). After more than an hour the first drop of liquid appeared at the extremity of the barre. Distillation continued slowly for five hours. It was possible to observe that the distilled liquid contained, in addition to aromatic water, some floating essential oil, which was recovered with a dropper (See Figure 14).

The second experiment was made assembling replicas of vessels n° 406 (Tobler 1950, p. 240, Pl. CXLVI, level IX, corresponding to n° 2227 Penn Museum n° 33-3-036) and n° 49 (Speiser 1935, p. 44, PL LXIV, corresponding to n° 2838 of Bagdad Museum. Rothman 2000, p. 60, p. 263, p. 398) found in the interconnected levels IX and VIIIA. No filter was inserted inside, as none were found in the level where the two vessels were discovered at a short distance from each other. The cover has the same shape and approximately the same dimensions (h. 37cm. d. 46,5 cm) of the spouted pot n°411, with a hole positioned near the base (See Figure 7). A one-meter reed was inserted into the spout to carry the distillation liquid into a jug positioned outside the circle of stones, and wet rags of cold water were rolled around the barrel during distillation to facilitate condensation (See Figure 15). In this case we could observe that the functionality of the apparatus has improved in terms of speed and yield of the product, which this time was collected in a glass jug. Like the first time, distillation continued for hours.

After receiving photos of the Roses festival from Kashan in Iran (See Figures 17 to 20), a last experiment was arranged in which the reeds were placed in the same position as the traditional Iranian alembics (See Figure 16). The experiment demonstrated that the upward-turned reed, connected to another one which was downward-turned, increased the distillation yield.

Videos of the experiments are available on https://www.perfumecypark.org

Conclusions

This experimental archaeology investigation had the aim of verifying the reliability of Levey's hypothesis about the possible function of some vases found in the Tepe Gawra. What we can now state is that we have proved that two distinct apparatuses, assembled with replicas of the vessels published in the excavation reports, can be used for distilling. In our case we have used botanical parts and obtained perfumed water and a small quantity of essential oil, but

we cannot exclude that the same apparatuses were used to still alcoholic drinks from fermented compounds.

The experimental process began with the reproduction of the pottery and this operation allowed us to observe the details and the difficulties faced to make them without the use of the lathe with adequate characteristics to withstand a temperature suitable for boiling liquids. The next phase concerned the assembly of the vessels that could form an apparatus by moving the hypothesis from theory to reality within the limits of the compatible dimensions of the individual objects. This operation allowed us to understand how important some additional elements were, such as the internal filters, which are accessories present in modern distillers, and the quantity of vegetables and liquid they could contain.

We also realized how important the domed shape of the upper part of the apparatus was, that is the antagonist essential for the distillation process, as it acts as an expansion vessel to collect the steam.

At the same time we were able to verify that a common *Arundo donax* rod can be used as a condenser to collect the liquid at a certain distance from the fire, and how it can be cooled by wrapping it in wet cloths to accelerate the condensation of the liquid. Direct experience has shown how important the distribution of fire around, and not under, the apparatus was - gradually increasing the heat without the risk of fractures of the ceramics, respecting the recommendations of the experts that neither alcoholic drinks nor essential oil exceed 100 degrees of temperature. The alcohol in fact vaporizes at 70 degrees and the essential oil is dispersed in the vapor after 100 degrees.

The presence of the liquid recovery holes in the vessels with the channel rim also suggests a more advanced knowledge in terms of distillation, since it would be a widely known system for recovering part of the condensate and improving both the alcohol content of the distillates and the yield of essential oils. Their presence is therefore not an indication of the preferred destination of the devices, but only of a more advanced technological knowledge.

Only the comparison with the Iranian tradition that still uses similar appliances to produce rose water and essential oil responds to Levey's assumption (1973 "Early Arabic Pharmacology") that these devices were intended for the production of aromatic essences.

As was mentioned in the introduction, later evidence can be found in the Mediterranean (Belgiorno 2018, pp. 79-101) and this suggests that this technology survived and spread. It is however a real surprise to find its survival in modern Iran, where very similar apparatuses of clay and copper are still used to produce perfumed waters.

Keywords ceramics
alcohol
container / vessel

Country Iraq
Syria

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FIG 1. MESOPOTAMIAN SITES WHERE CHANNEL POTS HAVE BEEN FOUND. DRAWN BY AUTHOR, BASED ON GOOGLE MAPS.

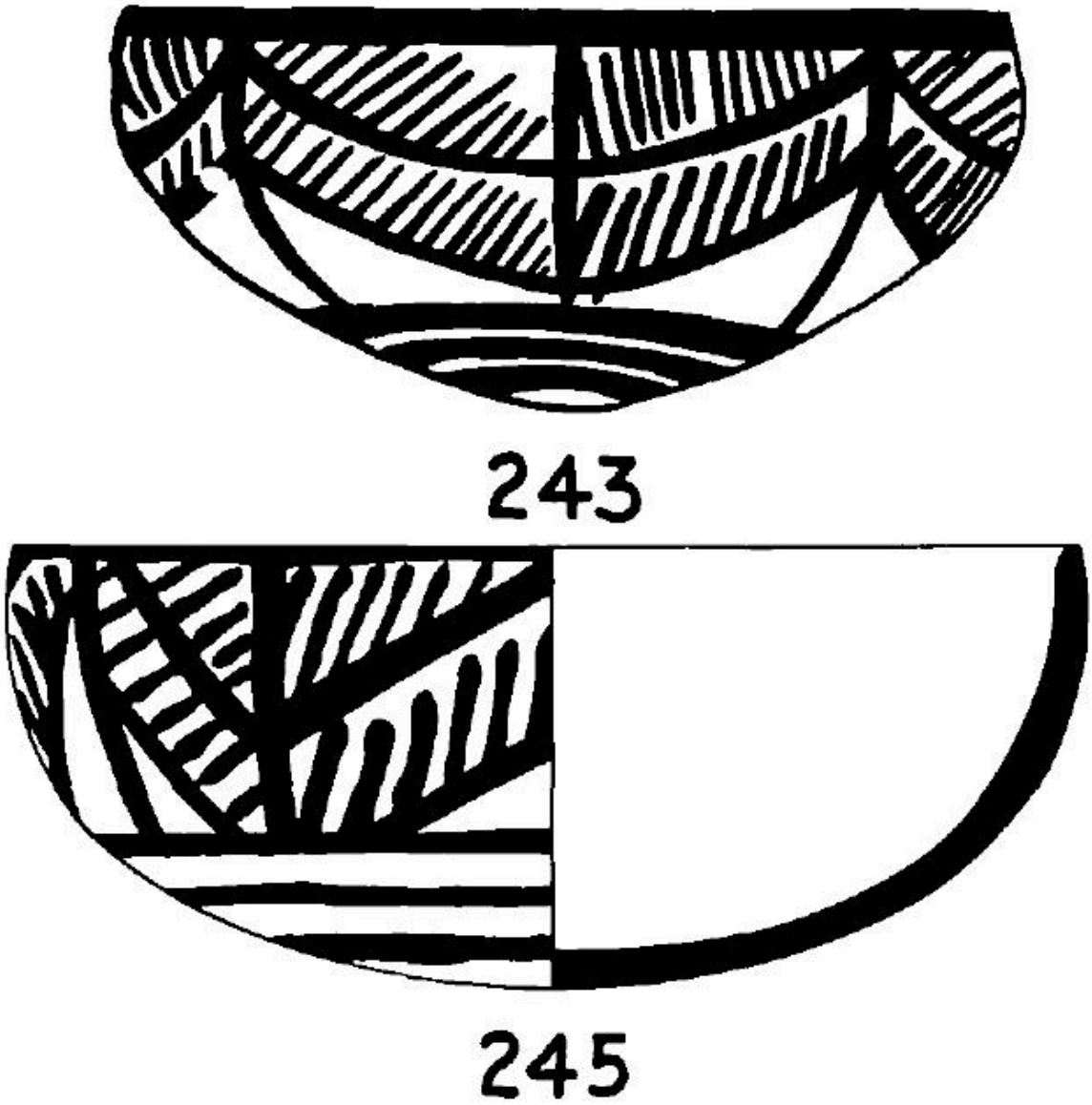

FIG 2. REPRESENTATION OF PINUS BRANCHES WITH NEEDLES ON TWO BOWLS FROM TEPE GAWRA LEVEL XII. DRAWN BY AUTHOR, BASED ON TOBLER 1950.

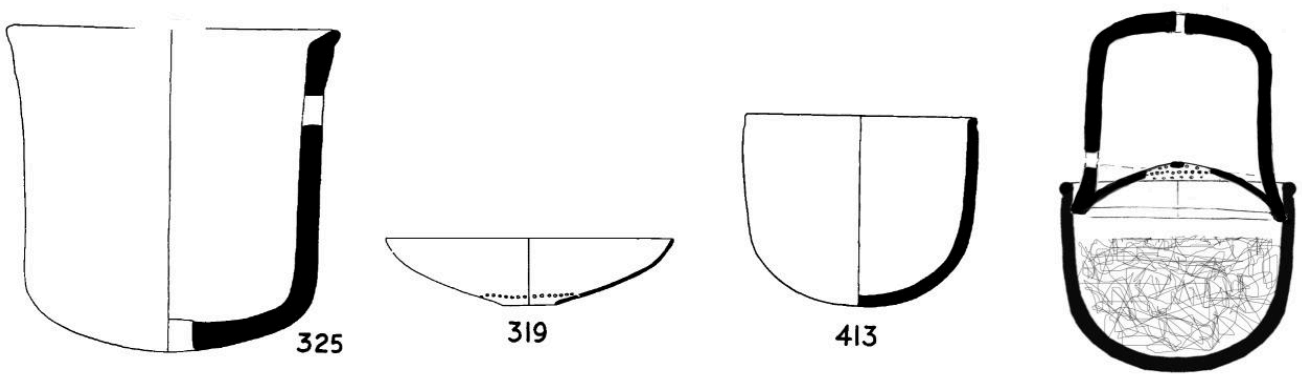

FIG 3. DRAWINGS N° 325, N°319 AND N° 413 FROM TOBLER 1950.

FIG 4. REPLICAS OF N° 325, N° 319, N° 413; AND ASSEMBLING OF N° 319 ON N° 413.

FIG 5. FINAL ASSEMBLING OF N° 325, N° 319 AND N° 413.

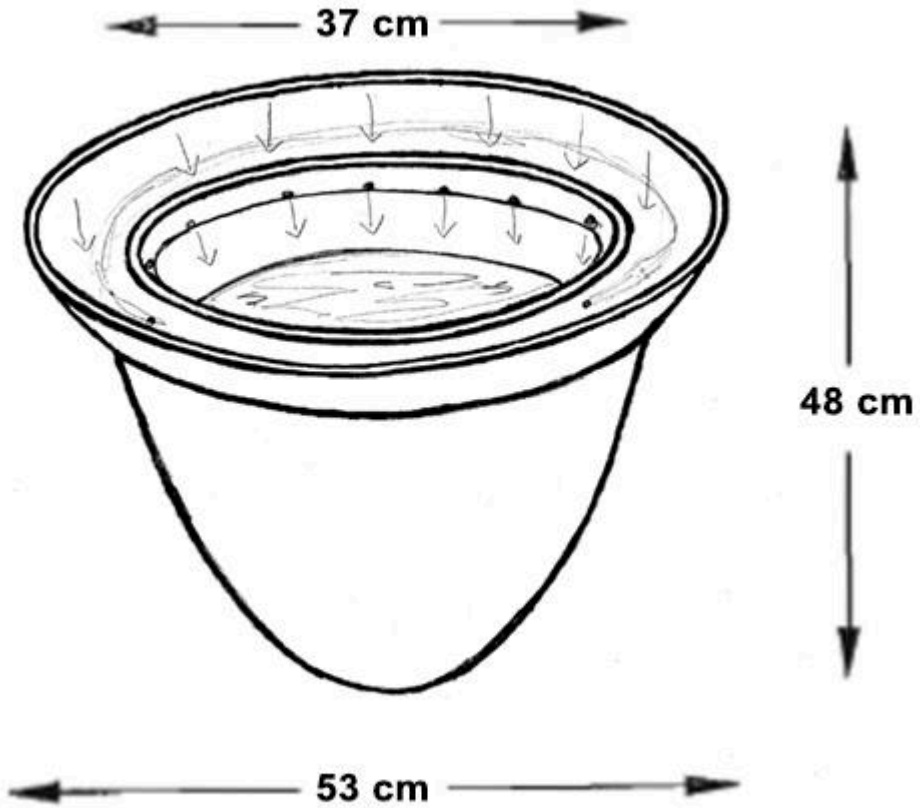

FIG 6. STANDARD DIMENSIONS AND TYPOLOGY OF TEPE GAWRA CHANNEL RIM JAR.

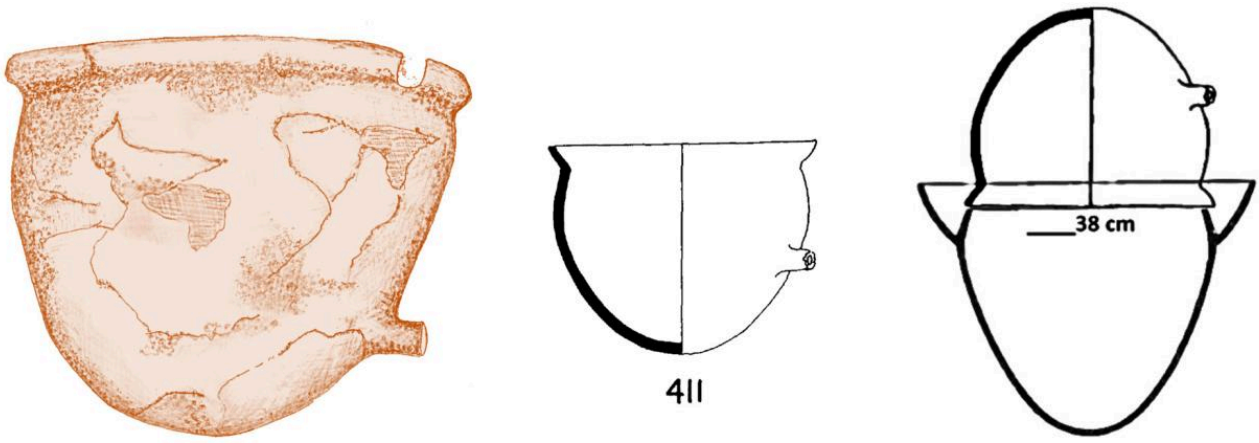

FIG 7. DRAWING OF THE N°411 FROM LEVEY 1955A, FIG. 9, AND GRAPHIC ASSEMBLAGE ON N°406 TOBLER 1950 PL. CXLVI.

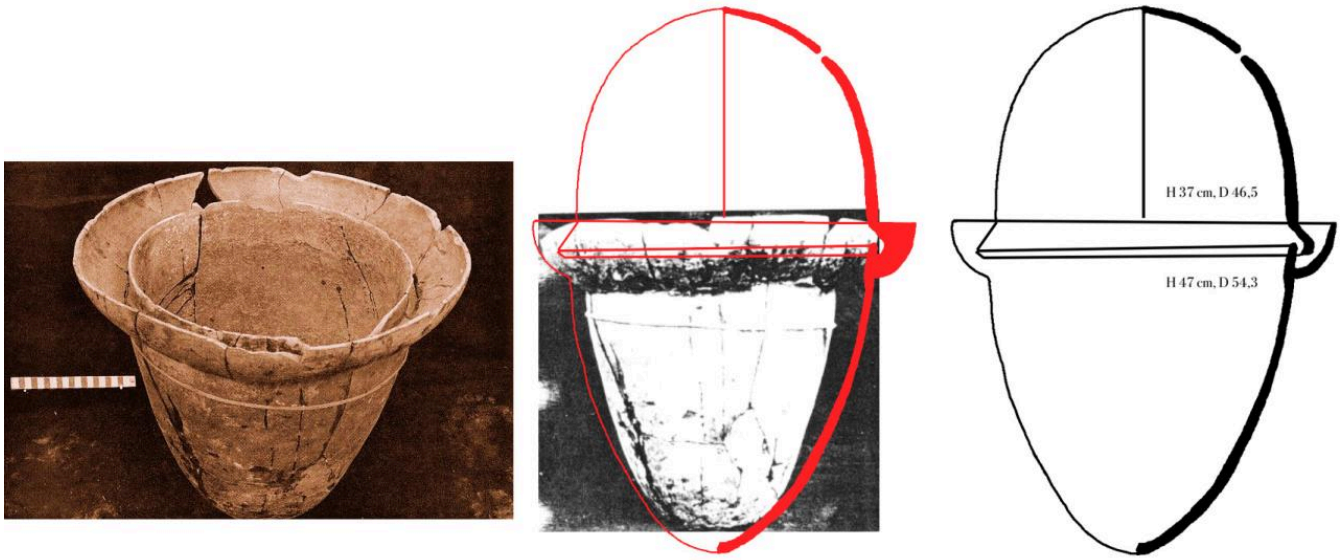

FIG 8. CHANNEL COLLAR JAR N° 406 (TOBLER 1950 PL. CXLVI) (AT PENNSYLVANIA UNIVERSITY MUSEUM OF ART AND ANTHROPOLOGY) AND ITS ASSEMBLAGE WITH COVER N° 49 (SPEISER, 1935), (AT BAGDAD MUSEUM).

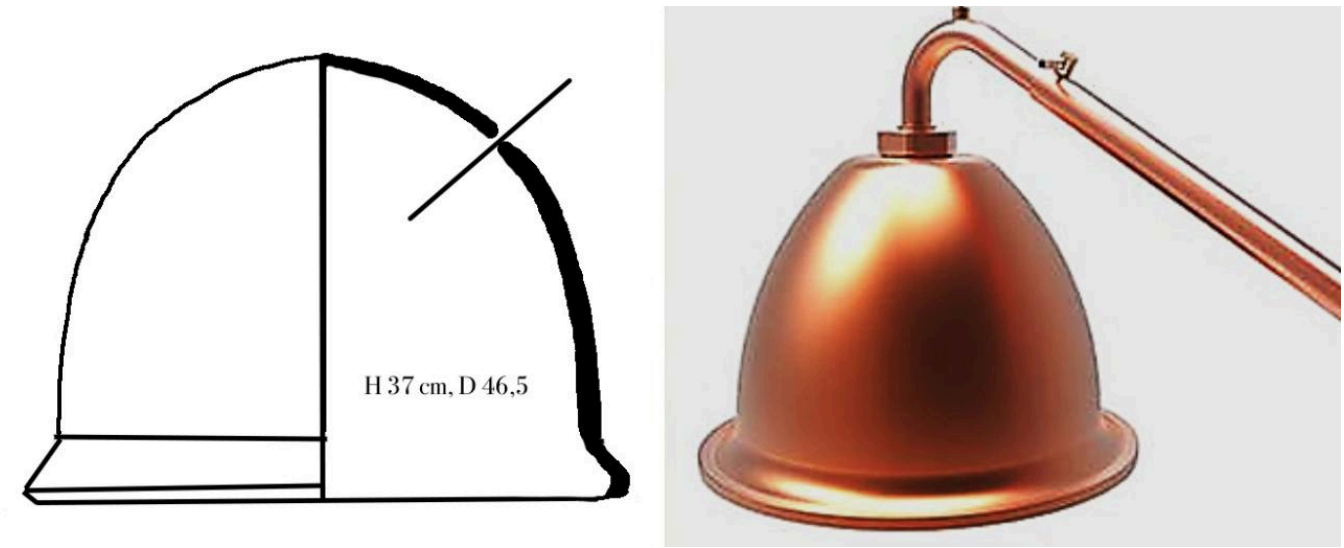

FIG 9. COMPARISON BETWEEN TEPE GAWRA N°49 WITH COPPER DOME-TOP FOR DISTILLATION OF “NOBLE GRAPE” COMPANY: OXFORD (902 423-2739).

FIG 10. REPLICA OF TEPE GAWRA STRAINER FLASK N° 360 INSIDE THE REPLICA OF CHANNEL JAR N°406.

FIG 11. FIRST EXPERIMENT WITH REPLICA OF TEPE GAWRA CALCOLITHIC APPARATUS WITH ARUNDO DONAX

FIG 12. REMAINS OF ROSIN (COLOPHONY) INSIDE THE LOWER POT AFTER THE EXPERIMENT.

FIG 13. FIRST EXPERIMENT WITH THE SECOND TEPE GAWRA APPARATUS INCLUDING N° 360, N° 406 AND N° 411.

FIG 14. ESSENTIAL OIL RECOVERED WITH A DROPPER.

FIG 15. SECOND EXPERIMENT WITH THE SECOND TEPE GAWRA APPARATUS, INCLUDING REPLICAS OF N°406 AND N° 49.

FIG 16. FINAL EXPERIMENT OF TEPE GAWRA SECOND APPARATUS WITH REEDS POSITIONED AS IN KASHAN, IRAN.

FIG 17. TRADITIONAL CLAY TOP OF APPARATUS TO STILL ROSEWATER, KASHAN IRAN.

FIG 18. GHAMSAR- KASHAN, IRAN. GOLABGIRI (“MAKING ROSEWATER”). COURTESY OF AROMEDE SMELL TOURS, IRAN.

FIG 19. GHAMSAR- KASHAN, IRAN. GOLABGIRI (“MAKING ROSEWATER”). COURTESY OF AROMEDE SMELL TOURS, IRAN.

FIG 20. GHAMSAR- KASHAN, IRAN. GOLABGIRI (“MAKING ROSEWATER”). COURTESY OF AROMEDE SMELL TOURS, IRAN.