Floating wicks without metal

Abstract: Ancient lighting methods would have included natural materials which were easily available in rural, non-industrial areas. This paper examines one material, the *loumini* wick, and related methods which require no specialized vessels and no specialized "manufacturing" techniques and which can provide reliable and sustainable light at a reasonable price. Special attention is paid to how a *loumini* wick might be employed as a floating wick.

Keywords: ancient lighting, *Ballota acetabulosa*, *loumini* wick, floating wick

Lighting devices in prehistoric, historic and even current pastoral economies often needed to be simple and affordable, and not reliant on manufacturing processes that could not be done in the domestic setting. This paper will look at one such lighting "device," the *loumini* wick, and consider some of the ways in which it may have been used to provide light for daily and special uses.

COMMON LIGHT SOURCES

From ancient texts as well as vase paintings and sculptural remains, it is obvious that torchlight was in common use, especially for outdoor processions (Moullou

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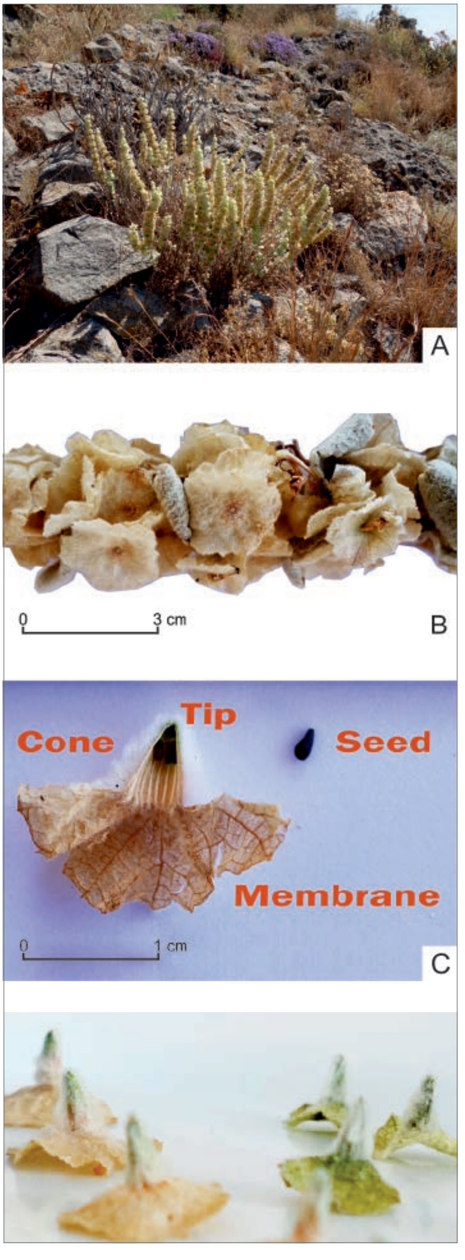

Fig. 1. *Ballota acetabulosa*: A – growing in June at Palaiochora, the medieval capital of Aegina; B – the stem with leaves and calyces; C – split open, so interior of cone is visible (this example had two seeds); D – *loumini* wicks before saturation with oil (mature on left and green on right) (Photos D. Moullou and K. Garnett)

2011: 48–52; Moullou and Topalis 2017). For indoor use lamps were the predominant lighting device. Domestic scenes with lamps are less frequently depicted on ancient artifacts than are ceremonial events with torches, and floating wick lamp depictions are even rarer (Moullou 2010: Appendices 1 and 3). It is almost impossible to determine from these depictions the wick type, whether *loumini*, cord or fabric.

The ancient texts mention *loumini* (φλομίς) wicks among the wicks used. Authors such as Theophrastus (*Hist. pl.*, 7.11.2.1–5), Nicander (*Ther.*, 899), Dioscorides (*De mat. med.*, 4.103.2.7–10) and Pliny (*HN*, 25.121. 1–3) all discuss it.

THE *LOUMINI* WICK

On many Greek islands as well as in mainland Greece and western Turkey, *loumini*, the plant commonly known in English as Greek Horehound (*Ballota acetabulosa*) thrives on rocky slopes in dry and arid conditions [*Fig. 1:A*]. Even today in Greece, the calyces of this plant are harvested and used as wicks in votive household lamps (καντήλια). For instance, on the island of Therassia that was connected to the electric grid only in 1981, the *loumini* wick until that date "was continuously used as a complementary lighting resource in most households" (Douskos and Moullou 2015: 154). Moullou's survey of 2002 reinforces the view that the plant was known and used throughout Greece. With 80 interviewed respondents from all over Greece, this survey compiled information about the use and methods of lighting the *loumini* wick (Moullou

Table 1. Calyx size variations

No.	Source	Color	Maximum membrane diameter	Maximum cone height
1.	Aegina	Green	11	7
2.	Aegina	Green	14	8
3.	Aegina	Green	13	7
4.	Aegina	Green	14	8
5.	Aegina	Yellow	16	8
6.	Aegina	Yellow	16	8
7.	Aegina	Yellow	19	8
8.	Aegina	Yellow	17	7.5
9.	Corinth	Yellow	11	6
10.	Corinth	Yellow	14	6
11.	Corinth	Yellow	16	6
12.	Corinth	Yellow	11	7
13.	Crete	Yellow	11	7

2002: 57ff.). Nowadays the plant can be seen growing at many archaeological sites, for example, in Attica, the Corinthia, Kea, Santorini, Therassia, Crete, Mytilene and Aegina. Once one becomes familiar with the appearance of the plant it is easy to recognize in the landscape [see *Fig. 1:C*; it also gives the terms used in this paper to reference the individual components of the *loumini* wick calyx].

Personal observation suggests that the diameter of the calyx "membrane" varies from location to location and may be related to the available precipitation in a given year. For example, examples from Crete tend to be small. However, it seems the height of the funnel-like "cone" portion of the calyx tends to be relatively constant at 6–8 mm [*Table 1*]. The calyx membranes have irregular and undulating edges [see *Fig. 1*]. When dry, the cone rarely sits vertically, but once oil has saturated the wick, the membrane tends to flatten out and the cone sits closer to vertical and subsequently the flame is vertical unless disturbed by air currents.

LOUMINI WICK QUESTIONS

Moullou has already extensively studied and published results of research and investigations into the use of the *loumini* wick in ancient and modern times in Greece (Moullou 2002; 2010; Douskos and Moullou 2015). From previous experiments (Moullou 2002: 34, 64) and from the comments made by some of the Moullou interviewees the authors knew that the *loumini* wick could float by itself.

To further expand the understanding of *loumini* wick operation it was decided to run some tests and make observations using some *loumini* wicks freshly collected from Aegina and Corinth. The results proved very informative. We focused on tests which would tell us more about how a *loumini* wick behaves as a floating wick, more specifically:

- Do *loumini* wicks behave differently with and without seeds and depending on whether the calyx is green or a mature yellowish color.
- Whether or not flame height increases, if *loumini* wicks are stacked one on top of the other.
- What materials would provide decent substitutes for the metal and cork disks commonly used in today's floating wick lamps, floats which would not have been available in very early times. Materials would have to be inexpensive and readily available to not

to prehistoric and archaic households.
- only recent rural households, but also to prehistoric and archaic households.
- Does a support that works for a floating *loumini* wick also work for a corded linen wick.

To investigate these scenarios, a series of tests were performed. The test designs took a sequential nature, as each result suggested something to test in the next round.

WICK PREPARATION AND INITIAL TESTS

For the initial tests we used both green and mature (herein also referred to as yellow) calyces. However, for the double wick and floating wick tests, we used only the mature calyces, and typically chose ones with larger diameter membranes over smaller ones. Moullou's survey (2002: 57ff.) indicated that the traditional method required the removal of the seed for best operation. However, in practice there is only about a 1 mm difference in flame height and even after running for four hours we did not see any seed explosion or other indication that the seed definitely had to be removed. Additionally, when removing seeds, we found that some calyces had two seeds. Moullou's survey also indicated that the traditional time to pick the calyces was August when the plant was mature. Our sample calyces, both green and yellow, came from the same plant, picked in early June, two weeks before the test period. Additional yellow calyces were collected in Corinth in late July. The *loumini* wicks that were already yellow were mature and behaved as expected.

For this initial test a shallow salad plate was used in order to provide good visibility to all the wicks. In normal practice such a plate or saucer could be used, but because of its limited fuel capacity it would have to be checked frequently and the oil topped up to prevent the *loumini* from extinguishing. Before lighting, each wick was doused with oil to assist in capillary take-up. Additionally, we would wait a minute or two before applying flame to help insure a speedier time to steady light. We observed but did not actually measure that the *loumini* wick would produce a steady flame in less time than the twisted linen wicks would in our other experiments.

Only one green immature *loumini* wick would not light. Also we could use the tip of the flat side of a metal knife to gently extinguish the flame, if we needed to pause the tests. After two hours all wicks were successfully relit without issue.

DOUBLE *LOUMINI* WICK TEST

Some of the Moullou survey respondents mentioned stacking one *loumini* calyx atop another because they thought it would create more light.

For this test, two calyces were deseeded and one stacked atop the other, then lightly coated with oil and placed on a saucer with olive oil sufficient to cover the membrane of the lower calyx. After allowing a few minutes for the wick to provide a capillary feed of the oil up through the wick, the peak of the upper *loumini* wick's calyx was lit using a beeswax taper. The flame appeared to be the same height as it would be on a single wick, and flame and wick behaviors were no different than with a single *loumini* wick. Only the additional physical height provided by the lower wick elevated the flame.

Why might one want to have a stacked *loumini* wick? The reasons that quickly come to mind are:

– elevating the light might provide better illumination, if the oil container had a higher side wall.

– more oil could be added to the reservoir and therefore tending the light by refreshing the oil would not need to be done as often. Note that Moullou (2002: 67) has previously determined that as long as the fuel supply is not extinguished, a *loumini* wick can burn at least up to 48 hours, and perhaps much longer.

FLOATING DOUBLE AND SINGLE *LOUMINI* WICK TEST

We learned of another use for a double wick from Anastassios Antonaras who described (personal communication) how his mother-in-law, Sofia Efstathiou, from the village of Solomos in the Corinthia, told him in the 1990s about the use of the *loumini* wick as a common night light in the days before electrification. She said that it was common to double the wicks and that the lower calyx must be larger and wider than the one over it. At that time, she demonstrated how to gently stack the wicks with the cones at an angle to each other, so that they would form a wider platform (reminiscent of a ballerina's tutu). When placed delicately on a reservoir of olive oil, they would float.

For our test, two calyces were joined. Using a small vessel in the shape of an incense burner with less than two fingers height of oil, water was added to raise the surface level. The double calyx stack was gently placed on the oil and quickly lit. After a few unskilled attempts at this operation, a stack was finally and successfully lit. It continued to burn until the fuel ran out, approximately four hours later. While the double *loumini* was burning, a single *loumini* was added to the vessel [*Fig. 2*]. Once its flame steadied, it became obvious that in this scenario, the flame produced by the double *loumini* was indeed higher than that produced by the single *loumini*.

Once the fuel ran out and the flames died, the two calyces used in the double test were separated and photographed [see *Fig. 2*]. Note that the lower calyx (on the bottom left) shows much less evidence of burning!

Fig. 2. *Loumini* wicks: top, single calyx, and upper left, double stacked calyces; bottom, post-use calyces used as a double *loumini* wick (lower calyx on left, upper calyx on right) (Photos D. Moullou and K. Garnett)

Fig. 3. Floating *loumini* wick tests: A – with cork and leather (single *loumini* wick sitting on a rectangle of leather which sits on a small disk of wine cork); B – variations with cork and leather (on left, two *loumini* wicks resting, one on each end of a narrow strip of leather which rests on a circular slice of wine cork, neither wine cork nor leather pierced; on right, one *loumini* wick resting on a square piece of leather on top of a slice of wine cork (both wine cork and leather have a hole pierced in them); C – with giant fennel (single *loumini* wick sits on a narrow strip of leather which sits perpendicular to and on top of a strip of dried stem from giant fennel); D – with giant fennel and olive leaf (single *loumini* wick sits on an olive leaf which sits on and perpendicular to a strip of the dried stem from giant fennel); E – wick sitting on a leather sling; F – wick sitting on leather on giant fennel (Photos D. Moullou and K. Garnett)

FLOATING *LOUMINI* WICK TESTS WITH CORK

During the previous double *loumini* test, the *loumini* could be observed migrating towards the walls of the vessel. If the vessel were made of glass instead of clay, then the flame might overheat the glass and cause breakage. The following tests examine methods that might be used to keep the position of a *loumini* wick closer to the center of the surface of the fuel reservoir.

TEST 1

No attempt was made to structure a test which involved a modern cork and metal disk float of the type readily available in grocery stores in Greece. Since this was not a set of materials we expected in ancient times in Greece, whether it worked or not was irrelevant to our goals.

Moullou (2002: 64) in her survey of *loumini* wick users conducted in 1999–2000 found that some users remembered that their parents would place their *loumini* wick on a piece of leather, for example from a weathered shoe sole, which rested on a piece of cork or wood. Since old leather would have been a readily available material, even in less affluent households, this seemed like the ideal material to use to create an easily reproducible ancient floating wick without metal. According to Moullou's research, typically a hole was pierced in the leather.

A small simple container was filled with sufficient oil so that the cork, leather and *loumini* would float [***Fig. 3:A***].

Why leather? Rawhide, green hides and leather are all resistant to burning. Since we know that leather was tanned and used extensively in ancient Greece (Forbes 1966; White 1984: Table 12; Flohr 2013), it is likely that people would have had small scraps of rawhide or leather available, even in the poorest of households. Greek historian, Aeneas Tacticus, wrote in the 4th century BC of the fire--resistant properties of rawhide (*Polior.* 33.3 and Rihll 2017: 267–268). We also know that the Romans used leather for their firefighting hoses (Cote and Bugbee 1988: 2; Purpura 2013: 10) and that Roman blacksmiths used leather aprons to protect themselves from the sparks (Grömer, Russ-Popa, and Saliari 2017: 81).

Why *loumini* wicks? The *loumini* wicks could be gathered in the fields for free.

Why cork? Cork (*Quercus suber*) is used along with metal in the modern float, called μολυβήθρα or καντηλήθρα, available in Greek grocery stores. Cork's properties and use were known in ancient times. Theophrastus (*Hist. pl.* 1.2.7, 1.5.2) and other sources mention the cork oak and Pausanias (8.12) mentions that it was used as a floater in fisherman's nets (see also Cooke 1951: 169; Liddell, Scott, and Jones 1996: s.v. φελλός). However, cork presumably would have been more expensive than the convenient scrap of wood, so likely it was not used as often as small fragments of wood or reeds or other flora that would also float.

So our first test in this series involved making a "*loumini* sandwich" by taking a thin slice (approximately 6–7 mm) of wine cork with a hole pierced in its center. On top of the cork a piece of leather (1 mm thick, approximately 30 mm by 30 mm), sourced from an old belt, was placed. The belt was cut so that a hole on the original belt was centered in the scrap and a new hole did not need to be made. The *loumini* wick was then placed on top of the leather with the center cone of the wick aligned with the holes in the cork and the leather [*Fig. 3:B*]. This arrangement worked fine and a steady and reliable flame was produced.

TESTS 2, 3 AND 4

With the success of the previous test, we wondered if the holes in the leather and the cork were actually needed, so tests were done: one without a hole in the cork, another without a hole in the leather, and then one without a hole in both. The absence of the holes seemed to make no difference with the *loumini* wick. We hypothesize that the requirement for a hole is more related to the use of corded wicks rather than actually any requirement for *loumini* wicks.

TEST 5

Next we decided to see if we could use a smaller strip of leather, as some of the Moullou (2002) interviewees described the leather to be in the shape of a strip. Since the larger area of a larger piece of leather would require a larger piece of cork or wood, then it would make sense to use a smaller amount of leather, in order to reduce the amount of wood or cork support. We reduced the size of the leather to a thin strip (same thickness as before) of approximately 30 mm by 5 mm. Feeling confident, we placed not one but two *loumini* wicks on the leather, one on each end. The results can be seen as the two flames on the left [see *Fig. 3:B*].

FLOATING *LOUMINI* WICK TESTS WITH GIANT FENNEL

Now that we had successful tests run with cork, it was time to experiment with a substitute for the cork. We used dried giant fennel (*Ferula communis*), another plant commonly available in antiquity (Liddell, Scott, and Jones 1996: s.v. νάρθηξ), clearly associated with fire and keeping a flame alive since, according to Hesiod (*Theog.*, 567; *Op.*, 52), Prometheus after stealing the fire from Zeus brought it to mankind in a hollow fennel stalk. We took a piece of dried stem and shaved the sides to make a fairly flat float on which to rest the leather, using a strip of leather of the same dimensions that had been

Fig. 4. Floating wick components: left from top, bay and olive leaves; top right, slice of giant fennel stem; center right, strip of leather; bottom right, *loumini* wicks) (Photos D. Moullou and K. Garnett)

used successfully in the previous experiments.

By placing the leather perpendicular across the fennel stalk, and then positioning the *loumini* wick across the top of the intersection of the fennel and leather, we created a floating wick design which seemed to be both practical and economical. By using a cross shape with arms extending beyond the reach of the flame, this improvised floating wick would rest well away from the walls of a vessel, either terracotta or glass or other, where the walls might overheat [*Fig. 3:C*].

This arrangement seems well within the scope of possibilities for an ancient lighting technique which would leave no trace in the archaeological record, but which would be both practical and economical, especially for household use and keep the *loumini* away from the side walls of the vessel for better light dispersion.

FLOATING LINEN WICK TESTS

Once we determined that strips of leather and giant fennel worked well as a support for a floating *loumini* wick, we began to wonder if these materials would also provide an efficient support for floating corded wicks. Different wickholders designed for use with glass lamps are preserved from Byzantine times (Bouras and Parani 2008: 4, Nos 15, 34; Motsianos 2011: 108–110; 2019: 197–201). However, all of these preserved wickholders are of more permanent materials than those we have proposed.

Using a 4 mm twisted linen cord with a slice of wine cork and leather square, with holes in the center of both the leather and the cork, we found that the wick burnt down to the leather singing it. The test was repeated with a 3 mm wick with the same results. Both tests were discontinued because of the unpleasant smell. Clearly use of leather as a barrier is not compatible with a corded wick.

ADDITIONAL TESTS

For the following tests giant fennel and leather strips were cut and green bay and olive leaves collected [*Fig. 4*].

TEST WITH GREEN LEAVES

Since leather provided a sufficient barrier between the wood float and the burning *loumini* wick, we decided to see if green leaves could provide the same function. We chose leaves from bay and olive trees, since they were well known and common in Ancient Greece. As soon as the bay leaf was put into the vessel with the olive oil it sank, whereas the olive leaf did not. We continued the experiment then only with the olive leaf. Note that as an evergreen, a green olive leaf would be available year round. For the three hours of the burn test of the *loumini* wick resting on the green olive leaf and fennel float, its behavior mimicked what we observed with the leather and fennel float [*Fig. 3:D*].

TEST WITH LEATHER SLING TEST

For this test a strip of leather 38 mm by 5 mm was slung across a narrow-walled vessel [*Fig. 3:E*]. No wood or fennel was put under the leather, and the *loumini* wick was placed in the center of the leather sling. Since the leather does not automatically lower itself as the fuel source diminishes, the *loumini* wick will turn dark and expire as it runs out of fuel. At one point when adding oil to the vessel, the *loumini* became elevated above the leather and floated away!

TEST WITH NARROW VESSEL

This test was performed in the same narrowed-wall vessel used in the initial leather sling test, but instead of a leather sling arrangement, the *loumini* wick was placed on a leather strip which rested aligned with, not perpendicular to, a sliver of giant fennel. Both the leather and the fennel were sized so that they were slightly smaller than the interior diameter of the vessel fuel reservoir [*Fig. 3:F*]. Such an arrangement would ensure that the wick remained stationary in the middle of the vessel and would never get near the side walls. This worked well, and suggests that such a method could be used in any-sized vessel which had vertical walls. If walls were not vertical, then the length of the wood or fennel could help ensure clearance for the flame.

CONCLUSIONS

Further tests could include using glass containers, making supports of leather and wood in different sizes or configurations, or using deeper containers with water under the oil. But we hypothesized that these would make no difference to the basic principle identified: lamps with floating *loumini* wicks are easily made from readily available natural materials needing no further processing.

Indeed, floating wicks do not require metal components nor do they leave burn marks. Those used in the past would leave no archaeological trace and thus cause modern researchers to wonder which vessels would have been used as lighting devices.

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Abbreviations

Aen. Tact., *Polior.*	Aeneas Tacticus, *Poliorcetica*. In *Aeneas Tacticus, Asclepiodotus, Onasander* (Illinois Greek Club, trans.) (=*Loeb Classical Library* 156). Cambridge, MA: Harvard University Press, 1928
Diosc., *De mat. med.*	*Pedanii Dioscuridis Anazarbei De materia medica libri quinque* I–III (M. Wellmann, ed.). Berlin: Weidmann, 1907–1914
Hes., *Op.*	Hesiod, *Opera et Dies*. In Hesiod, *The Homeric hymns and Homerica* (H.G. Evelyn-White, trans.) (=*Loeb Classical Library* 57). Cambridge, MA–London: Harvard University Press; W. Heinemann, 1914
Hes., *Theog.*	Hesiod, *Theogony*. In Hesiod, *The Homeric hymns and Homerica* (H.G. Evelyn-White, trans.) (=*Loeb Classical Library* 57). Cambridge, MA–London: Harvard University Press; W. Heinemann, 1914
Nic., *Ther.*	Nicander, *Theriaca*. In Nicander, *The poems and poetical fragments* (A.S.F. Gow and A.F. Scholfield, eds and trans.). Cambridge: Cambridge University Press, 1953
Paus.	*Pausaniae Graeciae descriptio* I–III. Leipzig: Teubner, 1903
Plin., *HN*	Pliny the Elder, *Naturalis historiae* (K.T. Mayhoff, ed.). Leipzig: Teubner, 1906
Theophr., *Hist. pl.*	Theophrastus, *Historia plantarum*. In Theophrastus, *Enquiry into plants and minor works on odours and weather signs* (A. Hort, trans.) (=*Loeb Classical Library* 70). Cambridge, MA–London: Harvard University Press; W. Heinemann, 1916

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