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Reviewed Article:

Sherd Shatter Patterns Experiment

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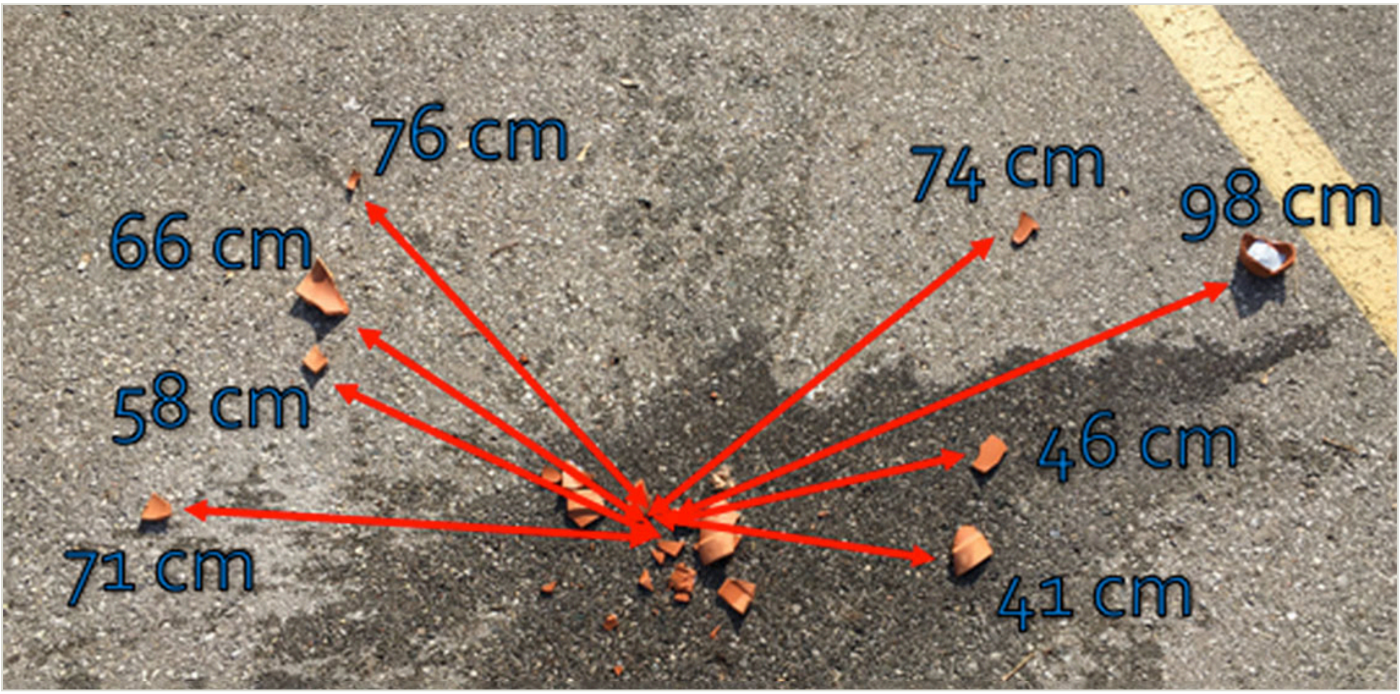

In field archaeology, the importance of non-diagnostic sherds is often overlooked. This archaeological experiment suggests that archaeologists should take into greater consideration, contexts where sherds are found grouped together in close proximity. The authors tested a series of experimental drops of modern pots which were treated as substitutions for ancient examples. Dispersion patterns of the pot sherds were analyzed to determine if it was possible to understand how vessels were used, and thus broken and discarded by people in ancient times. Amongst the variables tested were various vessel sizes filled with different contents which were dropped from varying heights. The results produced

interesting findings that could indeed prove useful to archaeologists if they were applied in the field and laboratory. Due to budget constraints and the narrow scope of the project, only preliminary findings were addressed. In future, the authors would encourage other scholars to build upon their promising research which could be beneficial to archaeologists around the world.

> “ The distribution of sherds from the point of impact followed a specific pattern. Typically, it was found that smaller sherds (small and medium) were concentrated at the point of impact whereas larger sherds (large and extra-large) fell at a greater radius from the centre point.

Introduction

During archaeological excavations, one of the most common cultural materials found is ceramic. Throughout the history of archaeology many spectacular examples of intact diagnostic vessels have been found from cultures in global contexts. These diagnostic vessels and associated sherds are recorded in great detail. With increased digitalization in archaeology, GIS has allowed archaeologists to input exact geographic coordinates of intact vessels and associated sherds where they were originally found within the site. This essentially can result in a recreation of *in situ* conditions of excavations prior to their completion, which is a fantastic tool. On the other hand, non-diagnostic sherds are often overlooked. In Classical archaeology, they are often simply grouped together in likeness (size, thickness, fabric, etc.) and weighed. These less interesting sherds make up the majority of ceramic artifacts found; yet, very little information is recorded about their context.

Basis for Experiment

In 2014, Blanco-González et al. proved that it is possible to locate sherds which came from the same vessel within the same site. There are however, limitations to this study: very specific contextual circumstances must be met and highly specific thin-section analyses with appropriate expensive equipment must first be conducted to achieve meaningful conclusions about sherd dispersion. In the correct context, however, applying this type of study can produce results that are very useful for matching sherds together within a site assemblage (Blanco-González, et al., 2014, pp. 147-148).

An archaeological experiment recently conducted by a group of students for a Medieval Studies course at Wilfrid Laurier University examined sherd shatter patterns to determine if it was possible to see patterns within the archaeological record of ceramic vessel usage and breakage by past peoples. This study produced promising preliminary results which have broader implications for direct application to on-site excavation work and post-excavation analyses. This work calls for scholars to take into greater consideration certain contexts where sherds are found grouped together. Recording more detailed *in situ* contextual information of sherd groupings may in the future produce results which suggest how vessels were used, and broken, by past peoples.

The premise for the initial trial of the experiment was an attempt at recreating scenarios which were most reminiscent of how fine to medium-coarse serving and storage vessels were likely to have been broken during use by past peoples. These wares were chosen for experimentation, rather than finer dining wares, because the cheaper utilitarian wares are often more abundant in the archaeological record than the finer more expensive table wares.

Two sizes of pots were tested in this experiment: a "small" and a "large" size. Alexander's Hill on the site of Sagalassos in southwestern Turkey, has a Middle-Late Byzantine Period ceramic assemblage. The biconical cup is most similar to the "small" pot type: with an average size of 10 cm x 10 cm (height x width) (Vionis, et al., 2010, pp. 436) (See Fig. 1). The jug is most similar to the "large" pot type: average measurements of 12-17 cm circumference and 19-22 cm height (Vionis, et al., 2010, pp. 437) (See Fig. 2). The "large" pot type was among the most common during the Middle-Late Byzantine Period on this particular site. Figure 3 shows that the most common type and weight of sherd found were of this "large" pot type (Vionis, et al., 2010, pp. 432). The jug vessel type's similarity in size, desired usage (storage) and frequency (common) to the "large" pots tested made it a perfect experimental comparison of a modern vessel type to an ancient vessel type.

For the purposes of the original experiment, the types of pots tested in this experiment were compared to an assemblage from a Medieval Period site; however, the experiment has far greater contextual applications in field of archaeology, specifically in Classics.

Research Questions

The focus of this experiment was to examine shatter patterns of pottery sherds from ceramic vessels and attempt to determine, if it is possible to see a reflection in the archaeological record of how ceramic vessels would have been broken by past peoples. Instead of testing dispersion of ceramic sherds over a long period of time (for example, post depositional analyses), it was desired to test them directly after impact in order to determine a shatter pattern. Moreover, determining what types of sherds were produced once a vessel is dropped from a set height was of inherent importance to this study because we intended to apply results of the experimentation in the field during archaeological studies. Therefore, the research questions of this project were as follows: (1) do the contents of a vessel affect how it shatters when dropped (i.e. size, type and dispersion of sherds); (2) how does the height from which the vessel is dropped affect how it shatters (i.e. size, type and dispersion of sherds)?; and (3) depending on the results from research questions (1) and (2), is it possible to understand how archaeological ceramic vessels were broken? Furthermore, could this explain how the vessel was used at the time it was broken?

Materials

For this experiment, eight clay pots were purchased and treated as replicas of ancient vessels for the purposes of the investigation. Four of the pots were of the "small" type with the dimensions of 10.16 cm x 11.43 cm and were a lighter clay colour than the larger pots (See Fig. 4). The remaining four pots were larger with dimensions 13.34 cm x 15.24 cm and were darker in colour (See Fig. 5). These ceramic pots are typically used for potting plants and flowers; therefore, they contained holes in the base. The holes in the base of the pots were covered with duct tape to prevent the contents (oats or water) from leaking out. A measuring tape was used to record the diameters and heights of the pots and also the height at which the vessels were dropped. The vessels were dropped onto a concrete pavement.

Results

Drop	Height of Drop (feet)	Vessel Size (inches)	Contents	Volume of contents (cups)	Sherd type(s)	Size of sherds (S, M, L, XL)
1	6	4 x 4.5"	Oats	½ cup	Sharp	S- 7
						M- 3
						L- 1
						XL- 0
						11
2	6	4 x 4.5"	Water	1 ½ cups	Mostly sharp, some crumble	S- 18
						M- 9
						L- 3
						XL- 0
						30
3	6	5 ¼ x 6"	Oats	3 cups	Sharp	S- 5
						M- 0
						L- 3
						XL- 2
						10
4	6	5 ¼ x 6"	Water	3 cups	Sharp	S- 6
						M- 18
						L- 0
						XL- 3
						27
5	3	4 x 4.5"	Oats	½ cup	Sharp	S- 4

						M- 0
						L- 2
						XL- 2
						8
6	3	4 x 4.5”	Water	1 ½ cups	Sharp	S- 3
						M- 5
						L- 1
						XL- 1
						10
7	3	5 ¼ x 6”	Oats	3 cups	Sharp	S- 1
						M- 1
						L- 1
						XL- 4
						7
8	3	5 ¼ x 6”	Water	3 cups	Sharp	S- 7
						M- 9
						L- 1
						XL- 4
						21

TABLE1. THE RESULTS OF THE EXPERIMENT.

For each trial drop, the drop height, vessel size, vessel contents, content volumes, sherd type, and size and number of sherds produced were recorded. Two possible types of sherds were produced: ‘sharp’ (sherds with serrated edges) or ‘crumble’ (sherds that had chipped surfaces). Drop 2 was the only trial that produced crumbled sherd fragments while all the other trial drops produced sharp sherds. The sizes of sherds were determined by sherd length: small sherds were counted as those less than 2.54 cm in length; medium sherds were between 2.54 cm and 7.36 cm; large sherds were between 7.62 cm and 9.9 cm; and extra-large sherds were 10 cm or greater in length. Figures 6 to 13 show the results of the trial Drops 1 to 8 including the physical distance of sherds from points of impact.

Drop heights at 180 cm and 90 cm were chosen to simulate approximate heights of pots which had been utilized, and then broken, by past peoples in different circumstances. For example, the higher 180 cm drop can be associated with pots being knocked off storage shelves, while the lower 90 cm drop can be associated with pots being knocked off counters or tables while presumably in use.

Experimental Vessel Drops

In summary, the vessels dropped with oats produced an average of 9 sherds, while drops with water produced over two times as many sherds with an average of 22. Surprisingly, the vessel from Drop 6 broke into only 10 total sherds (strikingly different from the expected average of 22). Based on the previous results of vessels dropped with water in them, it was expected that the sherd count from this drop would be larger and more similar to Drops 2, 4 and 8; therefore, this drop created an outlier in the data.

The distribution of sherds from the point of impact followed a specific pattern. Typically, it was found that smaller sherds (small and medium) were concentrated at the point of impact whereas larger sherds (large and extra-large) fell at a greater radius from the centre point. The former point proved true in all trial drops except Drop 8 where smaller sherds dispersed farther from the point of impact than the larger sherds. Drops with water usually had a more uniform distribution of sherds, while drops with oats appeared to be fairly sporadic. It has been suggested that the density of the water prevented sherds from being dispersed at irregular distances from the point of impact due to the weight of the water which may have focused the energy during the breaking of the pots closer to the point of impact. Therefore, more uniform distances were measured and recorded for all water drops (but to a lesser extent in Drop 4).

Furthermore, the drops at 90 cm produced larger and greater numbers of rim sherds. While drops at 180 cm still produced some large rim sherds, all drops at 90 cm produced at least 1 extra-large rim sherd. Plus, three out of four drops produced 2 to 4 extra-large sherds. In fact, the rim of the Drop 5 vessel basically split into 2 halves; both of which ended up going in opposing directions from the point of impact. Also, from Drop 6, almost the entire rim remained intact (an extra-large sherd) apart from one large sherd which broke away.

Variables

In hindsight, numerous variables needed to be / should have been considered in this experiment:

(a) The most important aspect was the vessel types used – these were not identical in typology, height, weight, circumference, volume, fabric (clay) or wall thickness to those found in the Byzantine Period, the time period to which they were being compared, or any other period in antiquity. Although the flower pots may be considered similar to some of the ancient vessels (in terms of size, typology, etc.), they are not truly accurate replacements. Ideally, recreations of pots of common typologies and standardized sizes using identical clay should have been used to get results which would be more comparable to archaeological findings.

(b) The impacts of different types of inclusions were not examined; certain inclusions could have made ancient vessels sturdier (i.e. less likely to break when dropped). However, only fine ceramic vessels (flower pots) were used as equivalents.

(c) No glazed or slipped wares were tested.

(d) Decoration could have also played a factor in the breakage of vessels, but it was an untested variable at this point. Some ancient vessels might have been incised and it is unknown if this might have created weaknesses along which vessels could have broken too.

(e) The methods used by potters to produce the pots were not highlighted either. Vessels could have been hand-made, wheel made, constructed of coils, et cetera. Each of these methods creates different points of weaknesses on vessels. This fact is especially true in coil-made vessels where there would be a risk of breakage between any one of the coils. Moreover, ceramics were often hand-made in antiquity; therefore, imperfections in wall thickness and other factors could create points along which wayward breaks could occur.

(f) The 'replica' pottery vessels used, were gardening pots which had holes in the bases. Since duct tape was used to seal the holes, the bases of the vessels mostly stayed together and were not able to break apart. This variable undoubtedly impacted the results of spread because it was noticed that the bases were shattering. However, the individual broken pieces stayed stuck together due to the duct tape.

(g) Only a single type of impact surface was tested - concrete pavement. This surface type is most comparable to a past rock surface; however, beaten earth surfaces were more likely to have been found in past living conditions and testing these softer surfaces may have yielded different results. Rock-paved, cobbled or mosaic surfaces can be found in antiquity and these irregular surfaces could have influenced the way pots were broken if dropped. Plus, the angle at which ceramics impacted the ground and subsequently broke would have certainty been effected, another factor which must be taken into consideration.

(h) The angles at which the vessels were dropped, for example straight down or on an angle, were not tested.

(i) The firing process is fundamentally responsible for determining the hardness of a pot; this depends on how long the vessel is fired in the kiln for and at what temperature (related to the manufacturing process or (e)). The hardness of a pot's fabric directly correlates with how it would break if dropped. Regrettably, the firing process is a variable that was unable to be controlled in this initial experiment trial.

Factors such as: context, preservation, disturbed or undisturbed contexts, and weathering of sherds which normally occur within the archaeological record could affect how the results of this experiment could be applied to scholarly study of excavated materials. This experiment assumes that vessels in the archaeological record were broken only by dropping; however, they could have been crushed (pre or post-deposition), thrown or hit. Such variables would require a complete change to the methodology used in this experiment and would have yielded different results. Additional experimentation is required.

If one considers the immeasurable variability of these post-depositional processes, the extreme skeptic may find issues with applying the results of such an experiment with complete certainty to archaeological research only after its initial trial. However, a compelling use of the following experimental findings could be used in the specific context of a natural disaster. One example of such a site in which the findings of this experiment could be used exists on Cyprus at Kourion. In this village, a Roman house, the so-called “Earthquake House”, was preserved in an undisturbed state after an earthquake in c. 3rd-4th c. AD forced all the inhabitants from the town. Since that time, the house had remained buried and untouched with three of its inhabitants still remaining inside (Soren, 1985, pp. 52-54). Archaeologically, this presents a unique contextual opportunity to examine many things in a domestic sphere. The study of the ceramic material culture from an *in situ* environment such as this is exactly the type of site where a study on sherd shatter patterns could be valuable.

Moreover, there was a limited amount of pots acquired for this experiment thereby limiting the testing of certain patterns of empty vessels, different sizes, different typologies and more. Additionally, the initial drop may have not been filled with enough contents to have affected results in a useful manner; it was only filled with a ½ cup of oats and this had to be replicated in Drop 5. Therefore, the contents might have been too light to have any impact on scatter and could have resulted in the equivalent of two droppings of empty vessels during experimentation instead of the intended replication of drops of filled vessels.

In a perfect experiment, there would be countless vessels with different characteristics to be broken. However, this would require many more resources than our project budget permitted. Overall, this experiment is more applicable to smaller fine to medium-coarse serving and storage wares used in ancient times rather than larger storage containers (such as: large amphorae) based on the choice of the modern pots used as equivalents to the ancient vessels.

The authors of this paper would encourage others to expand on their preliminary research as it has the potential for very meaningful findings which could, in the future, change how scholars view the importance of discoveries of sherd groupings during excavation.

Overall Findings

Overall findings of the experiment showed that the vessels with highly dense contents (such as: water) produced a greater number of total sherds. In general, these sherds were smaller in size than the sherds produced from vessels with lighter density contents (such as: oats). Drops 2, 4, 6, and 8 produced an average of 22 sherds. Drop 6 produced less than half of the sherds produced than the other trials with high density contents; the presence of this outlier suggests that more expansive testing needs to be completed. The vessels with less dense contents (such as oats) produced fewer numbers of total sherds and these were also generally larger in size. Drops 1, 3, 5, and 7 produced an average of 9 sherds (refer to Table 1).

As expected, it was found that as height increased, dispersion of the sherd fragments increased. When the pots were dropped from a height of 180 cm, there was a larger dispersion of sherds compared to the same vessel being dropped from a height of 90 cm with the same contents. This is particularly evident when comparing Drop 1 (small, ½ cup of oats, 180 cm) and Drop 5 (small, ½ cup of oats, 90 cm). Drop 1 dispersed up to three times the distance from the point of impact relative to Drop 5 (See Figures 6 and 10). This is also evident between Drop 4 (large, 3 cups of water, 180 cm) which dispersed almost twice the distance from the point of impact compared to the dispersion of Drop 8 (large, 3 cups of water, 90 cm) (See Figures 9 and 13).

The dispersion measurements of the sherds did appear to be have been affected by the contents of the vessels. When comparing Drops 3 and 4, which were tested with identical height and vessel types but differing contents, Drop 4 had sherds which ended up twice the distance from the point of impact relative to sherds in Drop 3 (See Figures 8 and 9). In this case, the vessel with the higher density water contents dispersed farther from the point of impact. However, when the same trials were repeated at a lower drop height with Drops 7 and 8, these produced almost replicated dispersion results (See Figures 12 and 13). Therefore, the contents would seem to have had some influence on the overall dispersion of sherds; ultimately, the sherds from the vessels holding the higher density liquid dispersed further from their points of impact once dropped and broken. Additional expansive testing is required to determine if the density of the contents of the vessels affects dispersion in specific patterns.

Research Questions Answered

It can be conclusively stated that the higher density of the contents generally affects the shatter patterns producing results of greater numbers of smaller fragments concentrated at the point of impact and larger sherds which dispersed farther distances from the points of impact. By analyzing the results, it can also be stated that height was a factor that affected sherd shatter with the trend that vessels dropped from greater heights broke into a greater number of fragments and these dispersed farther from the point of impact. Therefore, it can be suggested that perhaps if a pot is found and has been broken into a lot of tiny pieces, that it might have contained a liquid (denser material) and/or been dropped from a greater height. On the other hand, if the pot was only broken into a few pieces, then perhaps it was only dropped from a shorter height and/or contained a lighter material. Analyses of the sherds could be tested to determine whether height or contents, or both, are the main factor(s) when the sherds occur more numerously and in smaller pieces.

Potential Changes to Future Experiment Trials

For scholars wishing to further our study, first, they must decide upon a generalized region and time period for which to experiment on. Choosing typologies of pots for which similar vessels could be gathered for the purposes of breaking them during experimentation would be an essential second step. Controlling different characteristic variables (i.e. measurements, wall thickness, fabric, et cetera) when choosing which vessels to incorporate into the study is of utmost importance because controlling these factors will contribute to the degree to which the results of the experimental drops can be applied to research. If too many variables are left in question, then the study can only be applied in a narrow scope; conversely, if only few variables exist then the study can be applied to achieve a wider scope of research goals. In order to collect more useful results from further experimentation on this topic of study, it would be important for scholars to control the large list of variables outlined in the original experiment. Moreover, increasing the amount of tested variables would be paramount to the relevancy of the gathered results.

In the future, we recommend that this experiment be repeated recording more data and results by dropping more pots of different sizes, typologies, perhaps by dropping them on different angles and on different surfaces (like a softer earth) with different contents (including empty). A better understanding of how certain factors influence others may be achieved. Instead of using personal subjective observations of how large or small the spread patterns of the scatters were, a statistical method could be utilized to make better use of the recorded measurements. Therefore, enabling a better understanding of how certain factors, such as contents or height, affected the dispersion.

Conclusion

While this experiment did provide good baseline data for future experiments concerning sherd shatter patterns, it is only currently possible to apply the results of this study to archaeological contexts in a narrow scope. These parameters were outlined extensively in the findings of this experiment; however, the results as of now might be more applicable to the size of the sherds. Essentially, it can be said that groupings of many very small sherds from the same vessel might be as a result of the vessel containing a liquid and/or being dropped from a great height when it was last used, and thus broken. Conversely, groupings of few very large sherds (relative to potential original vessel size), might be due to a vessel previously containing a lighter material (such as: grains) and/or being dropped from a low height. As of now, stating such results to be accurate and true should be met with warranted skepticism until further experiments are conducted and data is analyzed. If the suggested adjustments were applied to future experiment trials, it would potentially produce results that would be more applicable in the field. More steps would also need to be taken to control the high number of variables encountered during the experiment. Above all, pending results from future experiments, it may be possible to determine how vessels were used, and thus broken and discarded, by past peoples in ancient times, chiefly including contexts from the Greco-Roman or Byzantine periods.

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Keywords ceramics
experiment

Country Canada

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Gallery Image

FIG 1. A BICONICAL CUP WHICH HAS BEEN EQUATED WITH THE SMALL POTS OF THIS EXPERIMENT; FROM VIONIS ET AL. 2010, 436.

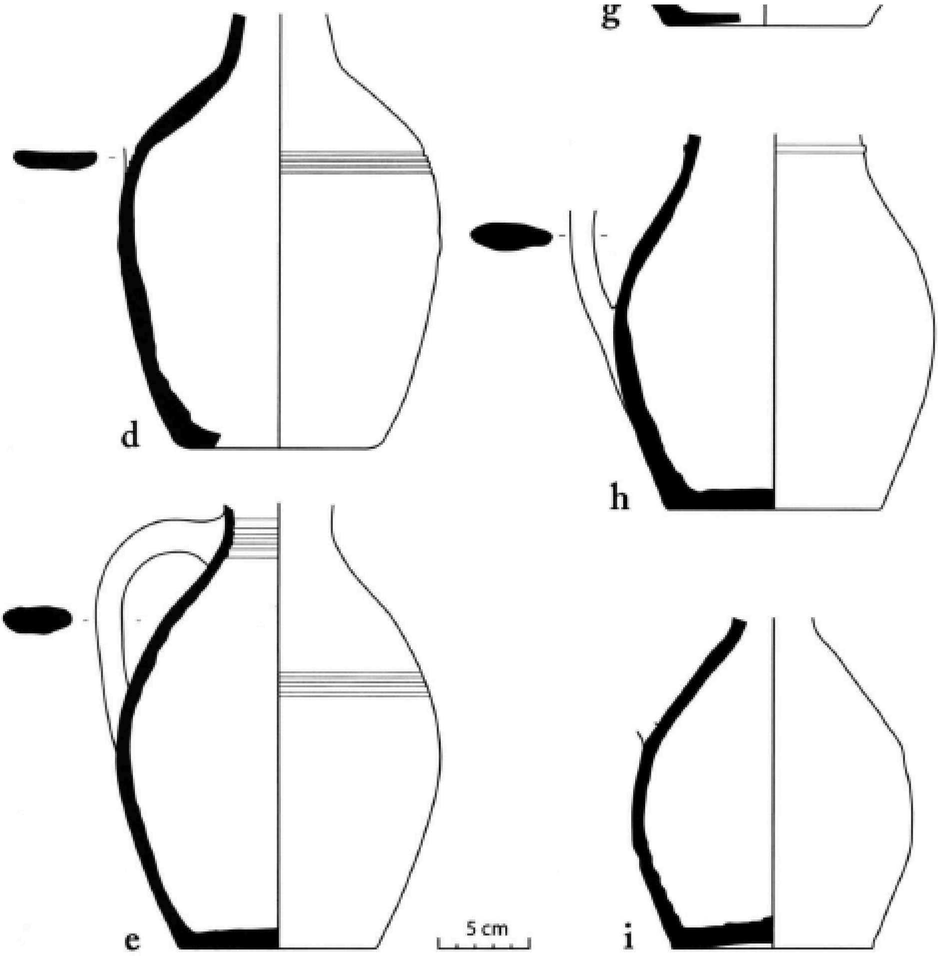

FIG 2. CROSS SECTIONED SKETCHES OF DIFFERENT JUG TYPES; FROM VIONIS ET AL. 2010, 438.

TABLE 1. QUANTIFICATION OF CERAMICS AND TILES FROM ALEXANDER'S HILL

Shape	*Weight (g)*	*Sherds*	*ENV*
Hemispherical bowl	508	6	1
Biconical cup	1,751	21	3
Carinated dish	1,475	20	2.5
Jug	22,344	805	22
Costrel	23,338	470	12
Mixing vessel	3,114	24	2
Cooking pot	19,731	615	13
Storage jar	4,321	38	14
Pithos	70,682	68	12
Glazed dish	3,405	122	6
Tile	3,500	96	12.5
Total	154,169	2,285	100.0

ENV = equivalent number of vessels

FIG 3. QUANTIFICATION OF CERAMICS FOUND AT THE SITE OF SAGALASSOS ON ALEXANDER'S HILL, SPECIFICALLY THE LARGE NUMBER OF JUG REMAINS FOUND IN WEIGHT (G), SHERDS, AND EQUIVALENT NUMBER OF VESSELS (OR ENV); FROM VIONIS ET AL. 2010, 432.

FIG 4. FOUR SMALL POTS USED IN THE EXPERIMENT; PHOTO BY AUTHORS.

FIG 5. FOUR LARGE POTS USED IN THE EXPERIMENT; PHOTO BY AUTHORS.

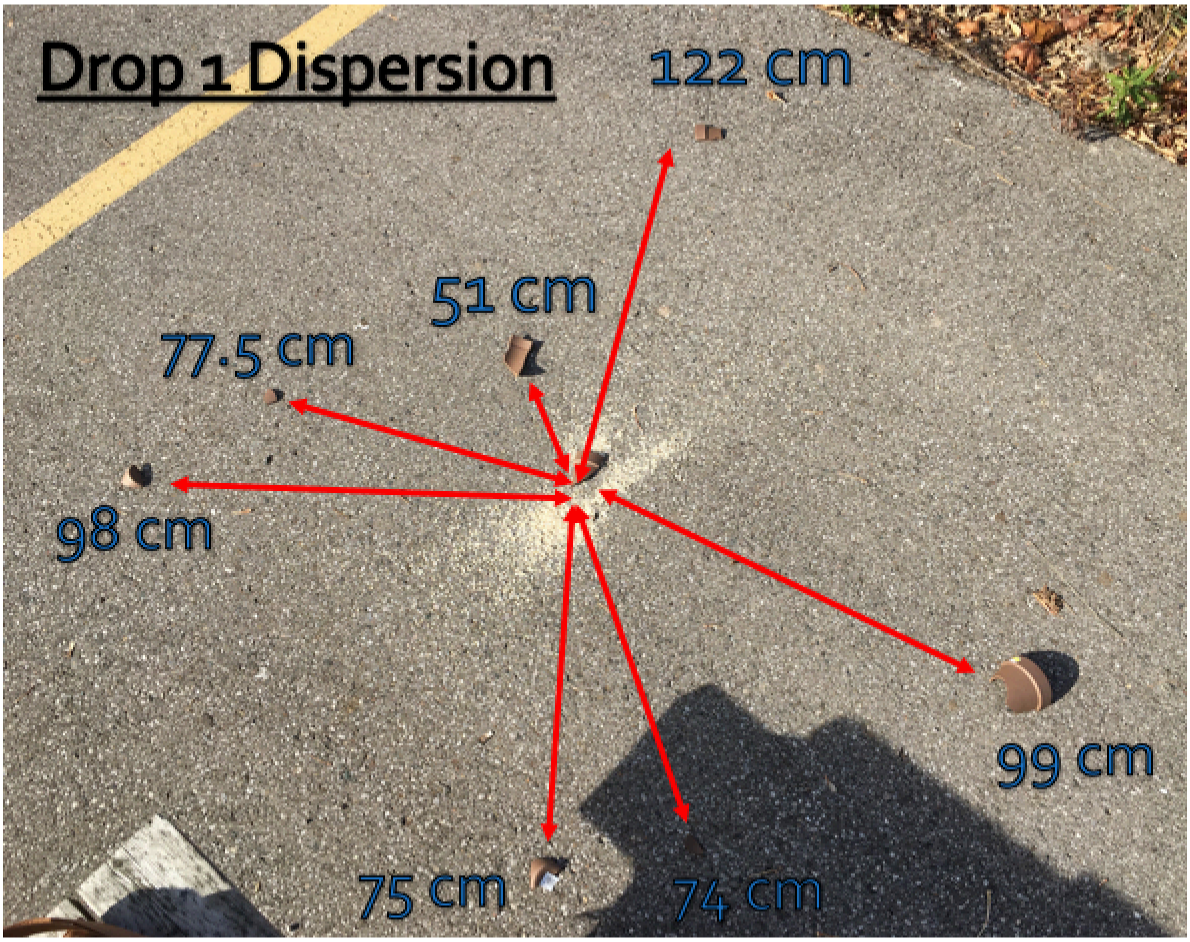

FIG 6. THE DISPERSION OF DROP 1; PHOTO BY AUTHORS.

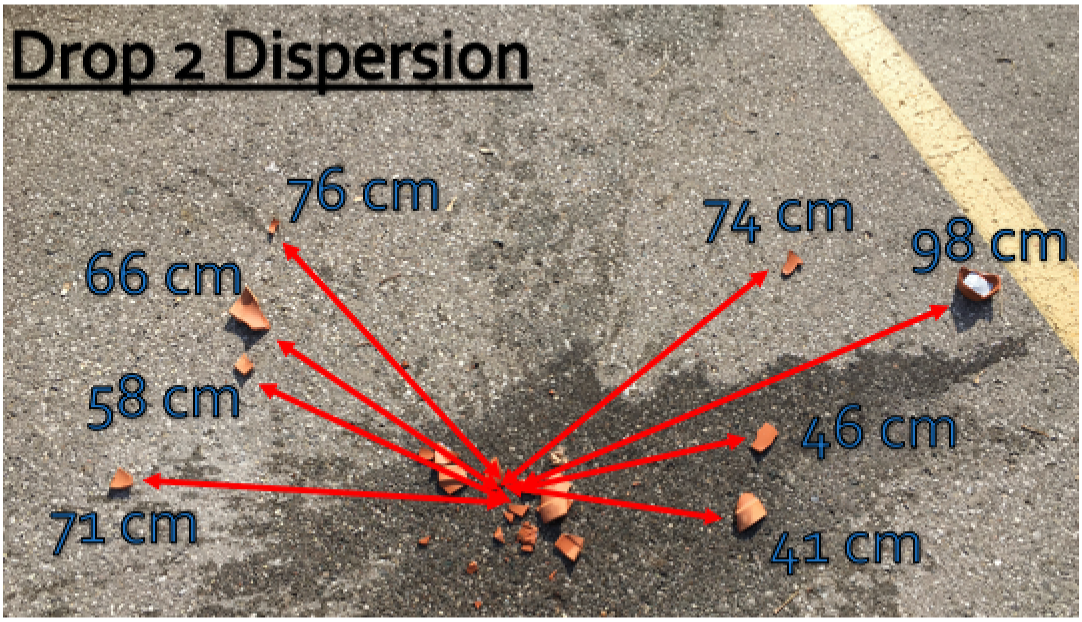

FIG 7. THE DISPERSION OF DROP 2; PHOTO BY AUTHORS.

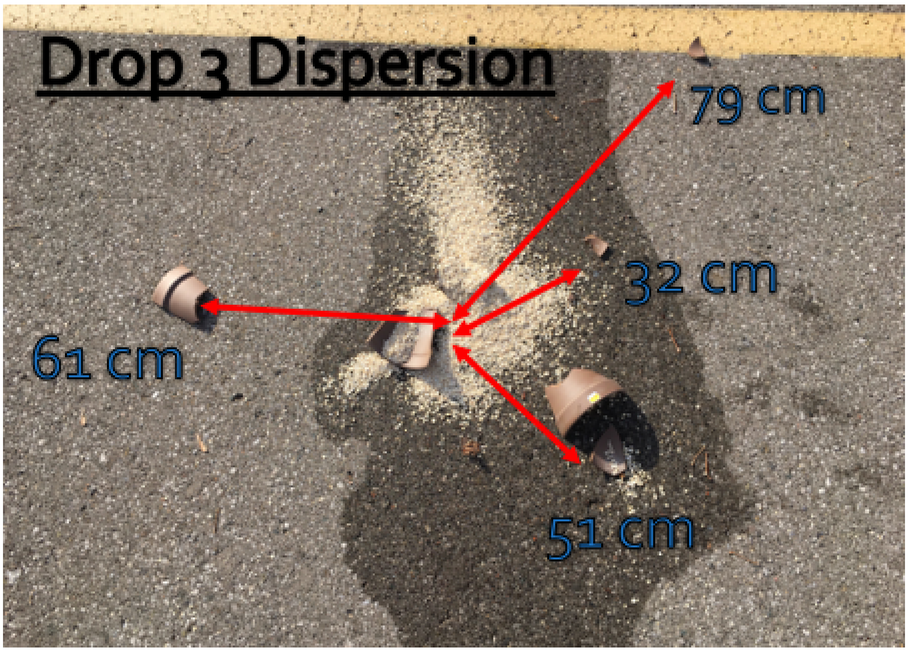

FIG 8. THE DISPERSION OF DROP 3; PHOTO BY AUTHORS.

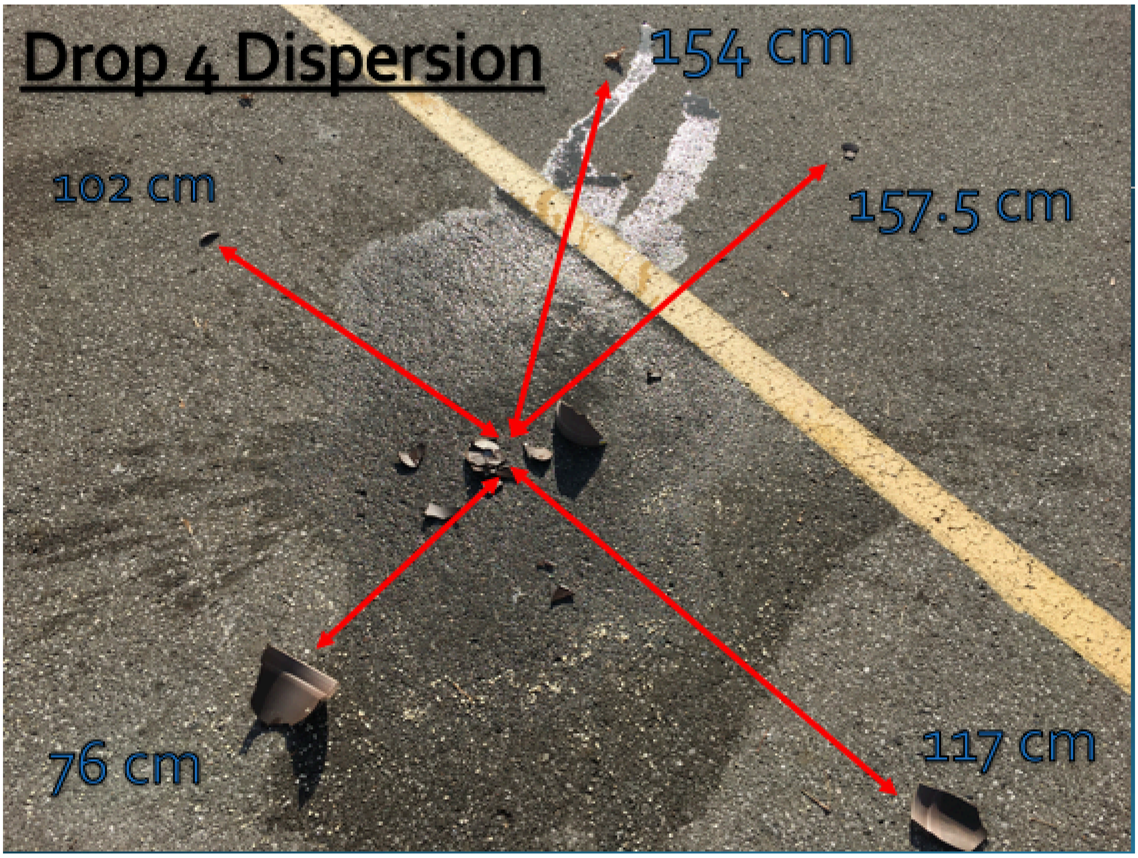

FIG 9. THE DISPERSION OF DROP 4; PHOTO BY AUTHORS.

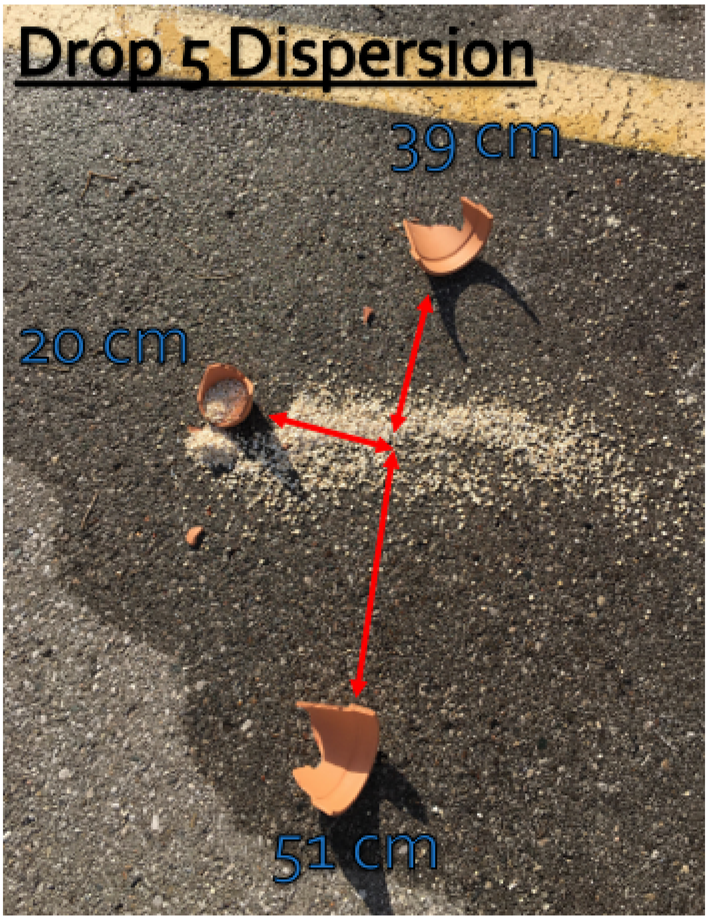

FIG 10. THE DISPERSION OF DROP 5; PHOTO BY AUTHORS.

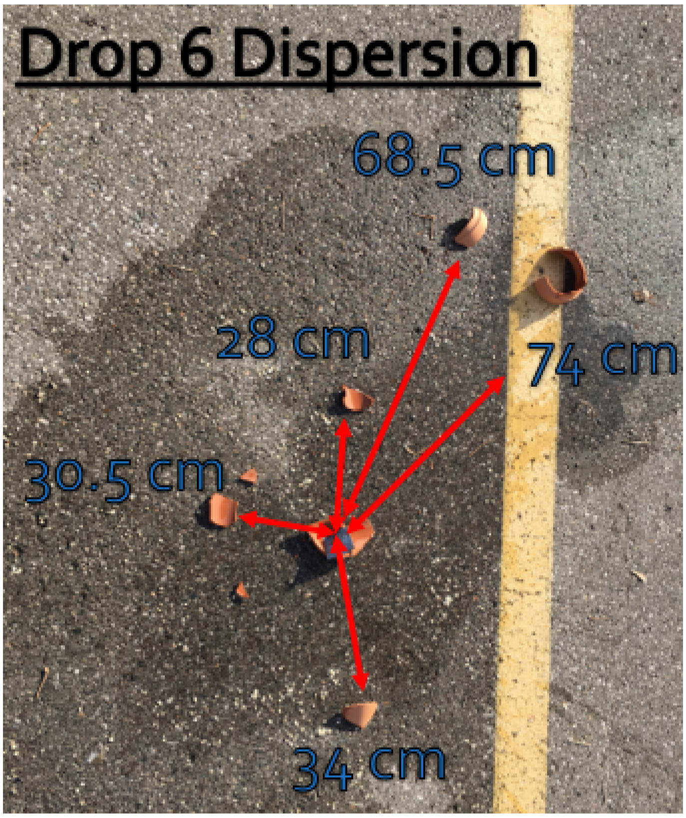

FIG 11. THE DISPERSION OF DROP 6; PHOTO BY AUTHORS.

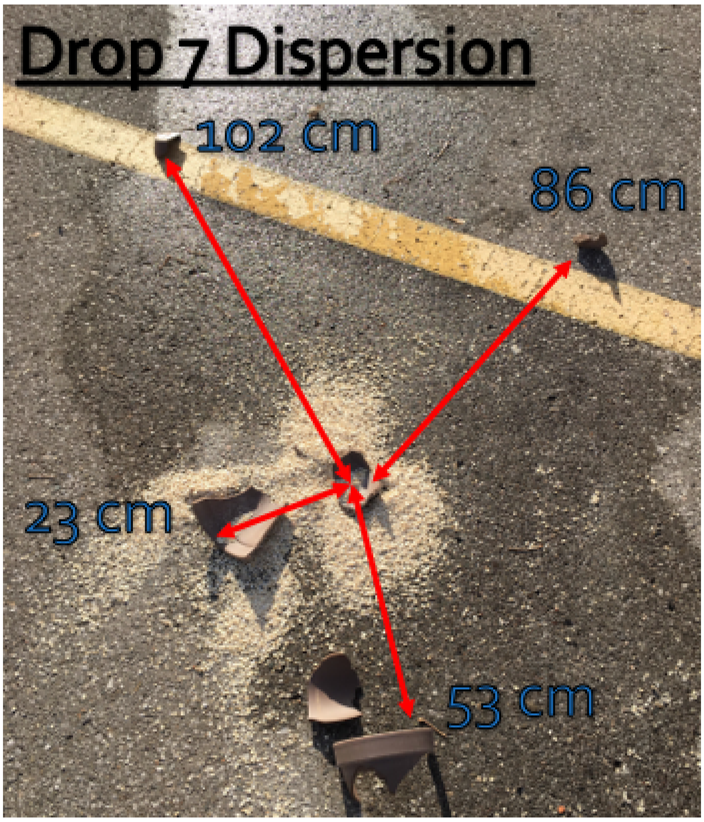

FIG 12. THE DISPERSION OF DROP 7; PHOTO BY AUTHORS.

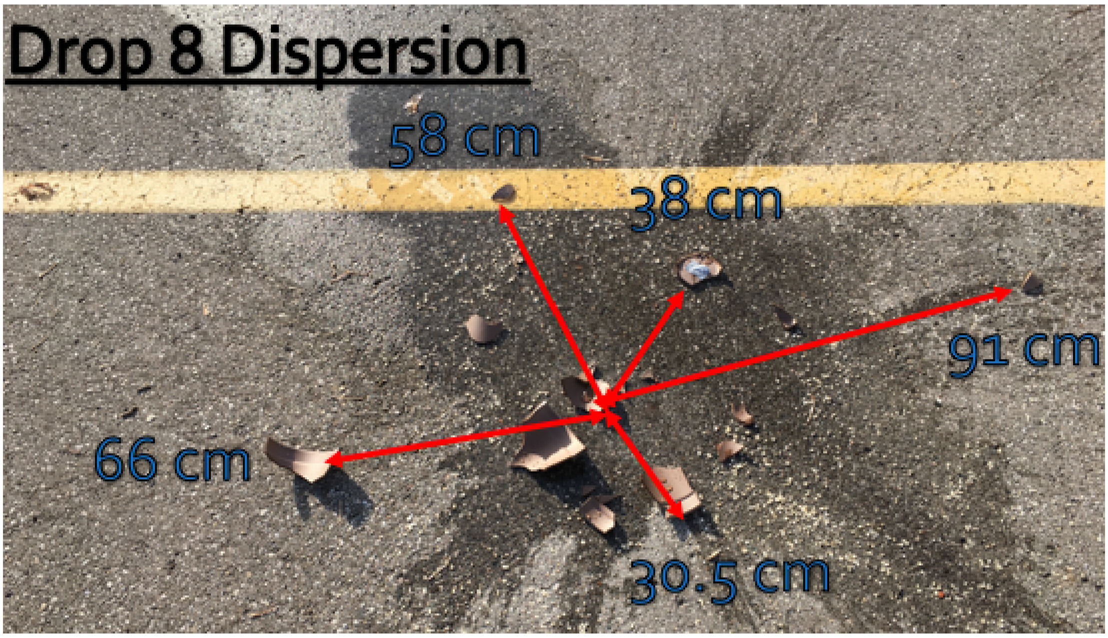

FIG 13. THE DISPERSION OF DROP 8; PHOTO BY AUTHORS.