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École française d'Athènes & online

**'NO HALF
MEASURES FOR
UNDERSTANDING
ANCIENT
POTS'**

**Aims and Methods of
Capacity Studies
in the Mediterranean
Bronze Age**

Book of abstracts

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Measuring Marks on Canaanite Amphorae?

Cassandra DONNELLY, Postdoctoral researcher

Artemis GEORGIU, Assistant Professor/PI

Archaeological Research Unit, University of Cyprus, ComPAS ERC Starting Grant

The question of whether the marks on Canaanite amphorae in any way reflect a system of measure has not been sufficiently explored. This paper presents an initial inquiry into the potential connection between marks and a metrological system by taking as its case study slash marks incised after-firing on and below the handles of Canaanite amphorae. These particular marks have been selected for study because their unique placement and configuration indicates they are part of a closed system of meaning separate from the Middle Bronze Age before-firing marks on vessel handles and shoulders and the Late Bronze Age after-firing marks on handles. The slashes appear in various configurations and numbers, indicating a possible connection between the marks and metrology. The goal of this case study is to bring to the fore marks comprising multiple parallel bands on the body and handles of Canaanite Jars from contexts of Late Bronze Age Cyprus and beyond, and to discuss the possible links, if any, with the vessels' capacity. The authors not only entertain metrological interpretations of the marks, but also explore other possible interpretations including the contents, origins, or destination of the marked vessels. It is hoped that the paper will serve as a first step towards understanding Canaanite Jar marks and their possible relationship to metrology.

“Canaanite” amphorae, hieratic jar docketts and measure marks from Deir el-Medina: Reconstructing economic networks between Egypt and the Levant in the Late Bronze Age

Laurent BAVAY, Professor, Université Libre de Bruxelles,
Centre de Recherches en Archéologie et Patrimoine (CReA-Patrimoine)

Beside official inscriptions on royal and religious monuments, pottery provides a major source of information on Egypt's foreign relations during the Late Bronze Age. In particular, the interdisciplinary study of transport amphorae has proven especially successful in reconstructing the economic system behind the import of Levantine products in Egypt. Geochemical analyses of “Canaanite” amphora fabrics from Memphis and Amarna demonstrated the existence and geographical provenance of different groups within this category of imported vessels. These groups can be related to the hieratic inscriptions (so-called “jar docketts”) preserved on many amphorae from the site of Deir el-Medina in the Theban necropolis, mentioning dates of production, the product contained in the jar, the producer (usually an estate) and other details about the vessel contents that provide great detail on these economic networks. We will focus in particular on measures noted in ink on these Levantine amphorae, usually under the handle. How should we interpret them, and what can these capacity measures tell us about the involvement of the Egyptian administration in the Syro-Levantine production region?

Measuring the Trade in the Eastern Mediterranean: Middle and Late Bronze Age Levantine Amphorae Under Study

Cydrisse CATELOY, PhD, UMR 7041 Arscan

Amphorae are a particularly rich source of information. They are efficient chronological indicators, testify to specific regional production centres and represent great evidence of the dynamics of exchanges across the Mediterranean. Closely linked to maritime transportation and to the economy of ancient societies, amphorae have been examined through various approaches, from typological and petrographic angles for determining their place of origin, to organic residue analyses allowing the identification of the products held inside. As one of the first mass-traded Maritime Transport Containers (MTC), the appreciation of their capacity must also be considered, since this aspect is essential for the study of the Bronze Age exchanges in the Mediterranean. By crossing all these data, it is possible to better define the logistics related to maritime trade, and also to reconstruct part of the established exchange networks of the 2nd millennium BCE. In this regard, a corpus of 200 complete and almost complete Levantine amphorae has been investigated. This material dates from the very beginning of the Middle Bronze Age to the end of the Late Bronze Age, with some of the latest amphorae belonging to the Early Iron Age. As a result, the study encompasses almost a millennium of Mediterranean trade. Although limited to complete vessels, this corpus provides a comprehensive overview of the primary types of amphorae exchanged during this period. This case study, focusing on the very first amphorae to have circulated in the Mediterranean, seeks to determine the actual ranges of capacities in use and whether potential volumetric units can be identified. The capacity is also confronted with a diverse set of data, including proportional size, shape, type, period, and region of import, which offers a much more insightful view of the material under study.

Standardization of Canaanite Jars from the Uluburun Shipwreck

Cemal PULAK, Professor

Rachel MATHENY, PhD Candidate

Institute of Nautical Archaeology at Texas A&M University

One-hundred and fifty-three Canaanite jars were recovered from the Late Bronze Age Uluburun shipwreck. This assemblage constitutes the largest corpus of Canaanite jars found from a single, closed context. Consequently, they present a unique and exceptional opportunity to study Canaanite jar production, capacities, shape and size standardizations, transportation, and potential regional and interregional organizations and networks. While these Canaanite jars share certain similar features, they exhibit a broad range of sizes, shapes, and construction features. This variation, however, is not random. A metrological investigation into the artifacts, which included volumetric measurements, 2-D geometric morphometric analysis, and quantal analysis, suggests that the Canaanite jar assemblage from the ship can be categorized into four statistically significant sizes and ten discrete types. The results demonstrate that Late Bronze Age potters controlled the size and shape of their transport jars, and that this level of standardization is visible within the Uluburun assemblage. When considered with their petrographic analysis results and known comparanda, these sizes and types correlate with production regions, contents, and Eastern Mediterranean trade networks. Presented here are the methodologies developed and used to examine the level of standardization within the Canaanite jar assemblage from the Uluburun shipwreck and an overview of the typology and methods of control utilized by Bronze Age potters.

A Standard Pot for Dry Measures? Investigating an Unseen Type of Mycenaean Storage Jar

Russell WEBB, PhD Candidate, University Paris 1 Panthéon-Sorbonne, UMR 7041 Arscan

Ever since the inception of Mycenaean pottery analyses and classifications, little attention has been paid to understanding storage jars as a functional category of vessels. This oversight results in a significant gap in our knowledge, both in terms of ancient techniques and socio-economic factors related to the production and use of these jars. This paper discusses an unseen type of storage jar identified by the author. Until now, it has been amalgamated in research with "belly-handled amphorae" (Furumark Shape 58) and, to a lesser extent, with "pithoi" (Furumark Shape 13). The key parameters for its recognition are capacity and, by extension, dimensional range, which exhorts us to look beyond shape in the definition of meaningful pottery types. The presentation outlines the defining features of the newly identified type of storage jar, drawing upon an exhaustive corpus from Late Helladic mainland sites (primarily settlements), as well as an updated study and documentation of material from Mycenae and Dimini. The morphometric and contextual analysis reveal three particularly interesting elements: firstly, these jars are standardized, with a main group around 45-55 litres; secondly, they seem to be more specifically adapted to the storage and transport of dry foodstuffs; and thirdly, they are exclusively related to the palatial period and therefore do not seem to have been produced in post-palatial times. Reflecting upon these aspects, the paper delves into the possible connection between this type of jar and the Mycenaean dry system of measures, which is documented in the Linear B record. Strong evidence suggests that the jars were used as a standard of measurement, in the same way the "transport stirrup jar" (Furumark Shape 164) was used for liquid measures. As a result, this study provides new perspectives on Mycenaean metrology and the identification of the absolute values of the units of measure.

Interpreting Late Bronze Age Cypriot Pithoi from a Volumetric Perspective: A Reconsideration of their Use and Circulation Pattern

Francesca PORTA, Postdoctoral researcher, CEMA INCAL, UCLouvain

Pithoi are one of the most iconic artefacts of the Late Bronze Age (LBA) Cyprus. They were indeed retrieved in over a hundred sites on the island and their importance in the management and storage of substances is now undisputed. In general terms, pithoi do not fit some of the acknowledged criteria for the definition of transport containers, especially regarding size. However, an increasing number of recent excavations and publications showed how Cypriot pithoi crossed the borders of the island reaching different Mediterranean regions, from the Levant to Andalusia. Moreover, their presence amongst the materials of the shipwrecks of Uluburun, Cape Gelidonya and Point Iria further demonstrate their wide circulation on long-distance maritime routes. Despite their widespread diffusion, large scale volumetric studies are completely missing, preventing the possibility to fully comprehend the pattern of their use and circulation. To fill this research gap, the present contribution analyses Cypriot pithoi combining technological and typological features with volumetric estimation. Thanks to the ongoing excavation at Pyla-Kokkinokremos (south-eastern Cyprus) a significant corpus of measurable pithoi is now available, representing thus an ideal case study to develop research concerning pithoi and storage. Starting from the Pyla materials and including all the measurable specimens published from Cypriot and Mediterranean contexts, I will discuss the possible existence of capacity classes and their links to morphological types. In such a way I will be able to verify if morphological and volumetric categories were eventually devoted to specific use. Technological, typological and volumetric data will be also taken into account in order to verify the reason(s) behind the large-scale diffusion of LBA Cypriot pithoi in the Mediterranean.

From Capacity of Pots to Storage Behaviour: Storage Jars in Context at the Minoan Villa at Gortyna

Santo PRIVITERA, Postdoctoral researcher, University of Bologna

Since its discovery in 1958, the Late Minoan IB Villa of Mitropolis (Gortyna) has been famous for both its imposing architecture and the rich floor assemblages. Amongst the latter, in particular, a group of large storage jars stand out, that were mostly placed along the walls of six rooms on the ground floor. Given its importance, a new assessment of this group of vessels by the author was included in the new program of studies devoted to the final publication of the building, directed by Nicola Cucuzza. The 58 storage jars represent one of the largest such assemblages in Crete (along with Knossos and Hagia Triada) and the Aegean; further vessels of smaller size (amphoras and jars) were also found in the same rooms. It was only possible to fully restore 31 storage jars, that were formally analyzed following Christakis's typology, 13 of which were also drawn. This paper firstly deals with various attempts to calculate the capacity of such vessels, especially those based upon the application of simple geometric rules and usage of devoted softwares. Based upon such results, the capacity of comparable storage jars is also inferred. Eventually, the relationship between size and capacity of the vessels and their precise find-spot is assessed, in order to highlight how the storage and circulation of liquid and dry staples interacted with the layout of the building and the organization of storage areas at the time of final destruction.

Demo of Capacity Measuring Tools and Comparative Study

Animated by **Cydrisse CATELOY**, with interventions from **Laurent BAVAY** and **Ortal HARUSH**

This practical session offers a review of the different measurement methods available in archaeology, in order to make them known and to help choose the one(s) best suited to the corpus to be studied. There are indeed several ways of estimating the volume of a vessel, some of which are more appropriate for a given situation than others. On the one hand, direct measurements may be undertaken when a vessel is accessible and sufficiently preserved. The methods consist of filling the vessel with a liquid or solid material (water, polystyrene beads, rice, lentils, sand, etc.). On the other hand, indirect measurements may be considered if a vessel is either inaccessible, incomplete (albeit retaining its profile) or too fragile to be handled. The methods thus require a scaled drawing from which the volume is estimated, most often by computer software that operate in different ways (ULB Capacity solution, Pot Utility, Amphoralex, AutoCAD, etc.). More recent approaches consist of digitalising a vessel with a laser instrument or with a 3D scanner, necessitating the material to be mostly complete and accessible. Several of these methods will be presented in detail, taking into consideration their modalities, advantages and limitations. Although direct measurements are by definition more reliable, indirect measurements may be in certain situations easier and faster to implement. Therefore, which method should be chosen and how accurate is it? These methodological considerations will be assessed with the presentation of a comparative study of several measurement methods applied to a sample of complete vessels. Direct measurements were taken by filling the vessels with water and polystyrene beads, while indirect measurements were obtained from the drawings using different computer software. The results of this comparative study provide a better insight into the degree of accuracy that can be expected when using each of these methods, and allow for a more informed choice of the appropriate way to conduct a capacity study.

Plain Handless Conical Cups: Practices of Daily Measuring in Malia and Minoan Crete

Maria Emanuela ALBERTI, Associate Professor, University of Florence

Plain handless conical cups are one of the most common and most studied vessel shape of Minoan Crete. They come to light by thousands in almost each excavation and fill boxes and boxes in the Museum storerooms. Their dimensions, profile, fabrics have considerably varied during the centuries and throughout the various regions of Crete, even though the shape becomes more standardised and widespread during the Neopalatial period and especially during LM IA and LM IB, so that the term 'handless conical cups' or 'skoutelia' is often automatically paired with that period (Gillis 1990; Van de Moortel 2001; Wiener 2011). The obvious conclusion is that they should have been a multi-functional shape and should have played an important role within the Minoan daily life, as the variety of their find-spots suggests (from kitchens, pantries and workshops to reception rooms and shrines). Being quite a compact shape, handless conical cups tend to survive the taphonomic process in fairly good conditions, so that complete or full profile examples are very common. This enhances the possibilities to perform metrological analysis on their capacity. Among their various possible functions, they could have been used as a measuring device for daily operations, somehow approximated, but embedded in the traditions and consuetudes of the society, especially concerning food. This has already been suggested for EM III Phaistòs (Todaro 2021). The present paper provides an overview of the plain handless conical cups from the Neopalatial layers of the Complex Pi, Malia (from MM IIIA to LM IA advanced), presenting their metrological characteristic and variations, with comparisons from the other Malia excavations. In addition, their association in the large LM IA mature fillings from rooms 10, 11 and 13 with quantities of cooking pots, cooking trays and large kalathoi seems to indicate a strong connection with food preparation, consumption and (possibly) quantification. Some experimental tests reinforce this research line. Comparisons with materials from other sites of Crete (Knossos, Kommos, Phaistòs, Haghia Triada, Sissi, Mochlos, Palaiastro) and with Linear A documents offers a wider perspective on the Malia evidence.

The Decorated Rounded Cup at Knossos: MM IIIA – LM IIIB

Charles STURGE, PhD Candidate, University of Cincinnati

The Rounded Cup, or Teacup, is one of the best known decorated Minoan fine tableware vessels. This paper uses this shape to offer a methodological case study of how we might integrate capacity data with other metrical data to produce new insights and hypotheses for the function of specific types. Tracking the evidence for the shape at Knossos between MM IIIA and LM IIIB, this paper argues that changes in the size and volume of these vessels reflect both changes in consumer demand and a fluctuating role within the decorated repertoire, despite ostensibly being the same shape. For each period, taking aggregated information collected from published data, the paper uses complementary datasets showing the range and distribution of rim diameters, and the volume of both complete and minimum preserved volume of incomplete vessels to build a picture of continuity and change, alongside data from other selected tableware shapes which are considered to have had a potential influence on the role and function of the Rounded Cup. At the start of the period, in MM IIIA, its larger size and volume compared to the Straight-Sided Cup suggests a diacritical function, before an expansion in size range and popularity in LM I implies a transformation into a multi-functional individual eating and drinking shape. In LM II, in response to the introduction of the Goblet we see a dramatic contraction in its volumetric range, suggesting a new and specific function for the vessel, before its size and volume range expanded again in LM IIIA as it regained its role as a multi-functional pot. Finally, in LM IIIB the Rounded Cup once again diminished in average size and volume, presumably as a response to the introduction and growing popularity of the larger Deep Bowl.

How Many Kylikes in a Krater?

Proportions and provisions in pottery production at Petsas House, Mycenae

Kim SHELTON, Associate Professor, UC Berkeley

Lynne KVAPIL, Associate Professor, Butler University

This paper examines the relationship between the capacities of vessels from the ceramic workshop of Petsas House, in the settlement of Mycenae, and adds critical information to the corpus of data on vessel capacity in the Aegean. Studies of vessel volumetrics, particularly on Crete, seem to indicate that there were forms of standardized volumes for certain vessels, such as the «hemikados», «kados», and «heavy kados» (following the terminology proposed by Alberti 2012; 2017), applicable to cooking ware vessels and pithoi. Such systems also appear to survive into the Mycenaean world at sites like Pylos where standardized volumes appear to echo those of vessels from Malia and Akrotiri, suggesting that there may even have been a longstanding pan-Aegean system. Petsas House was a multi-functional industrial and residential building which housed a ceramic workshop that was active during the 14th c. BCE but was destroyed toward the century's end in an earthquake and conflagration. Study of the vessels produced at the Petsas House suggest that the house supplied the emergent palace on the acropolis as well as the community at large with cups, bowls, and other containers for official business, communal feasts, and daily dining. In all, excavations carried out in the early 1950s and renewed beginning in 2000, thousands of whole and mended pots and vast quantities of sherds have been recovered from the ruins. Preliminary work on the volume of standard mass-produced kylikes and conical cups from the workshop indicate a 250ml capacity, while other kylikes hold many times that. This paper expands on that knowledge by comparing the capacities of drinking and dining vessels that would have served different communities in the settlement, on the acropolis, and beyond, and vessels that were specifically built for storage and trade, especially piriform shapes like stirrup jars and amphorae. We seek to position Petsas House within the world of Aegean measures while simultaneously examining subtle differences between measuring systems employed at the level of large-scale consumers, like the palace, with those that might have been utilized by non-palatial residents of the settlement.

Measuring Capacities of Late Bronze Age Kraters: New Insights into Consumption Practices in Aegean Funerary Contexts?

Laetitia PHIALON, Faculty member, University of Fribourg

The krater was undoubtedly the main vessel of the banquet in ancient societies. In the Late Bronze Age Aegean, it already held a central position in feasting occasions. Conical and amphoroid kraters were the main types used in Late Minoan Crete, whereas stemmed, amphoroid and ring-based kraters were the dominant types in Mycenaean Greece. While the dimensions of Late Bronze Age kraters are often indicated in pottery catalogues and site publications, their capacities remain largely unknown (with the exception of the vessels from the Palace of Nestor at Pylos). Whereas volumetric measurements are central to the study of amphorae, linked to issues on ancient trade, the question arises as to why and how the capacities of open vessels such as kraters may represent a useful parameter in the analysis of tableware sets and in the understanding of consumption practices. This paper aims to explore the informative potential of the capacities of Late Bronze Age kraters discovered in Aegean funerary contexts, on the basis of published material with complete profiles. It will first compare the capacities of Late Helladic kraters from the Greek mainland, followed by those of Late Minoan kraters from Crete. The study will also consider kraters found in tombs on Karpathos and Rhodes, providing insights into Minoan and Mycenaean influences in the Dodecanese. Additionally, a note on the capacities of pictorial kraters from Cyprus will be added to the debate. The methodological reflections regarding volumetric measurements discussed in this paper will be drawn from issues raised in my recent research on the capacities of goblets and kraters from Early Mycenaean settlements (Phialon 2020) and the capacities of Rude Style bell kraters from Cyprus (Phialon forthcoming).

Change and Continuity in Cooking Practices in Minoan Crete. A Diachronic Volumetric Analysis of the Traditional Tripod Cooking Pot

Charlotte LANGOHR, F.R.S.-FNRS Research Associate, Lecturer at UCLouvain, AEGIS Research Group

Evgenia TSAFOU, PhD, UCLouvain, AEGIS Research Group

The tripod cooking pot is the Minoan ceramic cooking pot par excellence, produced and used all over the island from the Prepalatial to the Postpalatial periods (2900-1200 BCE). This shape presents a common morphological development throughout these periods and among the different regions of the island. It is then part of a broader Cretan pottery and cooking tradition, which is not much altered by external influences, except at a very advanced stage of the Postpalatial period (end of 13th c. BCE). Its ubiquitous use in the Minoan domestic sphere makes it particularly prevalent in our archaeological assemblages, while its sturdiness generally ensures a good state of preservation that enables a good understanding of its morpho-stylistic characteristics and developments. On the northeastern coast of Crete, extensive excavations have been carried out at the site of Sissi by the Belgian School at Athens during ten campaigns (2007-2011; 2015-2019). Ceramic materials from all phases of the Bronze Age have been uncovered on this small coastal hill within domestic, communal and funerary structures, including a wide range of cooking pottery. Based on a large and representative corpus of Neopalatial, Final Palatial and Postpalatial tripod cooking pots, we would like to consider elements of change and continuity in the cooking practices of the Sissi inhabitants through a diachronic analysis of the volumetric data related to this essential type of Minoan cooking vessels. Combined with a morphometric, use wear and contextual analysis of this large set of Sissiot tripods cooking pots, this volumetric analysis of a single aspect of material culture will demonstrate how a more nuanced understanding of both the maintenance of social practices and the emergence of new traits in subsistence activities can be gained using a local-based approach.

Capacity and Illumination Duration: New Perspectives on Minoan Lamps and the Rhythm of Activities

Bastien RUEFF, Postdoctoral researcher, École française d'Athènes

In Minoan Crete, among multiple technological innovations, the development of clay and stone lamps accompanies the emergence of the palatial system. Within the growing towns, more densely occupied, this category of specialized artifacts - for which evidence from before the 2nd millennium BC is scarce - testifies to new lighting practices. During experiments conducted by the author to reconstruct the light of their flames, capacity proved to be essential in the determination of the duration of illumination, along with other parameters such as surface treatments and the nature of the fuels. In this paper, we present the results of a volumetric and functional approach of lamps, from Middle and Late Minoan towns in Eastern and Western Crete, which contributed to estimating the duration of illumination provided by their flames. The capacities of about 200 archaeological lamps with a complete profile were measured with the software PotUtility. Despite a wide morphological variety, a certain degree of standardization characterizes the capacity of lamps. This result leads us to consider shared craftsmen' traditions as well as similar ways of managing the organization of space and time, that depend partly on the distribution and properties of artificial light sources. Indeed, some distribution patterns of activities could be identified, based on the illumination duration, whether indoor or outdoor, in administrative or domestic contexts. After the collapse of the Minoan palaces, during the 15th-14th centuries BC, the production of lamps with a specialized shape comes to an end. Their progressive replacement by other objects, more limited in capacity, opens avenues on new lighting techniques and ways of occupying spaces.

Vessel Capacities and Perfume Production at the Palace of Pylos

Isabella VALINOTI, PhD Candidate, University of Pisa

The present study is based on the analysis of the capacities of some particular vessels found inside Room 60 and Court 47 in the Palace of Pylos (LH III B2 Late). In the economy of this palatial center, perfume production had a significant role, as attested by the numerous tablets in Linear B concerning transactions of aromatic oils and raw materials between specialized perfumers working for the palace: the so-called a-re-pa-zo-o (Lis 2016; Lupack 2016; Sarpaki 2001; Shelmerdine 1985). In particular, a special range of vessel shapes from rooms 60 and 47 has been connected to this production and can be considered highly specialized (Lis 2016; Shelmerdine 1985). The parallel with the description of the production process as reported by classical sources (Theophrastus, Dioscorides) provides important insights on the use of the Pylos vessels. More specifically, the compared metrological analysis is the key to reconstruct their function as well as the sequence of use within the production process. From a first phase of "boiling" the ointments, the perfumer moved on to a second phase of maceration, a third of filtering and a fourth of conservation. In accordance with the sources of the classical era, each phase involved the use of specific equipment and the oil in this way was submitted to a pre-treatment process in order to improve its receptivity. Subsequently, the perfumer took care of inserting the "heart" aromatic substances, that is the final fragrance. The oil underwent a substantial volumetric increase as it passed from one phase to the other, so that it is possible to identify the vessel forms used for each stage of oil processing. In conclusion, in this specific case the metrological study had a real crucial significance to fully understand the function and the methodology of such an important production industry within the Palace of Pylos during the LHIII B2 Late.