

Retrospective: An Interdisciplinary and Integrative Analytical Study of Aegean Transport Stirrup Jars

Abstract: Transport stirrup jars, used for the movement of liquid commodities in bulk, lend themselves to interdisciplinary analytical approaches. An appreciation of early work, bleeding edge at the time, reminds us of how quickly and radically methodologies change. Early work on transport stirrup jars concentrated on chemical approaches, which often yielded ambivalent results. More recent, full integration of typological, chemical, petrographic, and epigraphic analyses enables a far more secure understanding of production technologies and movements, although already these results are undergoing reassessment. Crete was extremely active in the transport stirrup jar industry in the Aegean Late Bronze III period, exporting jars primarily to Greek mainland sites but also to various sites stretching from Sardinia to the Levant.

1. Introduction

In 2011, Richard Jones, Peter Day, John Killen, and the author published a comprehensive analytical study of transport stirrup jars (TSJs) (Haskell et al., 2011). This publication presents results of a holistic, interdisciplinary study embracing a variety of methodological angles - typological, chemical, petrographic, and epigraphic. Haskell's work involved typological classification and grouping. Richard Jones did the chemical work, Peter Day the petrographic studies, and John Killen the epigraphic. The book represents a recent stage of a decades-long trajectory of analytical work on TSJs.

First, some quick definitions. Under consideration here the large, utilitarian, transport type, in contrast to the ubiquitous fine ware stirrup jar. TSJs were used for the storage and transport of liquid commodities in bulk. Generally 0.40-0.45 m in height, most held some 12-14 L (as estimated by the author by truncated cones; cf. Ventris and Chadwick, 1973, 58-60, 393-394). They most likely contained olive oil, although other commodities such as wine are likely (see Haskell, 2011a, 5). Olive oil was of considerable importance in the Bronze Age, judging from evidence provided in Linear B tablets on the mainland and Crete. Oil could be used for cooking, lighting, textiles, cleaning, and as a base for aromatics – perfumed oil. TSJs were carefully stoppered, the clay caps over the stoppers sealed to guarantee the integrity of the contents.

TSJs moved in relatively large numbers primarily within the Aegean through the Late Bronze IIIB period. Outside of the Aegean, while a very few were exported to the central Mediterranean, rather more TSJs were exported to Cyprus and the Levant. In eastern Mediterranean contexts, the most recognizable TSJs are those decorated with the octopus motif; many such pieces bear Cypro-Minoan signs on the handles incised after firing.

Within the Aegean, of greatest intrinsic interest has been a small and rather anomalous subset of the TSJ corpus, those pieces inscribed with Linear B (ISJs), as they bear on the hypothetical political and economic map of Late Minoan IIIB Crete and beyond. Many ISJs have been found on Crete and on the Greek mainland. The largest surviving deposit is at Thebes, with other pieces at Mycenae, Tiryns, Knossos, Chania, and elsewhere. The longer inscriptions consist of three words, two of which are personal names and one of which is a place name. Sometimes *wa-na-ka-te-ro* (the adjective of *wanax*, king, i.e. "royal") is substituted for one personal name. The place names presumably refer to the places of manufacture of the jars and/or of the contents.

Certain place names on ISJs can be matched up with west Cretan place names known on the Knossos Linear B tablets. Some archaeologists and philologists connected the ISJ industry

directly with Linear B Knossos, a few going so far as to suggest that ISJs provided confirmatory evidence for downdating the Knossian archives to the 13th century. This became a great archaeological and philological controversy (summarized by Haskell, 1997), and was the major impetus that drove early ISJ and TSJ analytical studies. The 2011 study broadened the scope, as it goes well beyond the anomalous ISJ corpus.

2. TSJ Analytical Studies

The 2011 study is most fully appreciated with an understanding of its place within the historical context of TSJ analytical studies. The historical context provides a cautionary tale regarding evolving methodologies that might now be considered at the bleeding edge. While remarks here can reasonably be interpreted as a self-review of the 2011 study by one of the authors of the 2011 study, the main point is that caution and care are required on the part both of researchers and readers not to become overconfident in terms of methodology and interpretations of results. Today's cutting edge is tomorrow's dull blade. Already the 2011 study is somewhat out of date.

2.1 Earlier Studies

The 2011 publication represents a recent chapter of analytical studies of TSJs that had been ongoing for five decades. Analytical work on TSJs began with chemical work performed by the Oxford Laboratory for Archaeology and the History of Art and their project to develop a chemical "pottery map" of the Bronze Age Aegean world (Catling et al., 1961; 1963). The Oxford lab attempted to establish by chemical analysis, specifically optical emission spectroscopy, characteristic signatures for the pottery supposed to have been made at major Aegean centers.

As a test case, the resulting, initial pottery map was applied to the controversial ISJ issue. Some 25 TSJs (mostly ISJs) were selected at Thebes and analyzed, the study published by Hector Catling and Ann Millett (1965). The results of the analyses of the Thebes pieces were both intriguing and immediately controversial, and unfortunately taken entirely out of the context of this initial test case. 18 of the 25 jars were assigned to Crete, specifically east Crete (2 shops), 5 were assigned "local" Theban manufacture, and 2 to Peloponnesian. Furthermore, the five jars of supposed Theban origins were problematic.

Criticism was pointed. Philologists noted that Linear B place names on ISJs likely referred to locales in west Crete rather than east Crete (Palmer, 1972), although they took comfort that Crete was the source of the relevant ISJs. Methodologically, critics noted issues with respect to visual assessment of the data and the lack of sufficient discrimination between chemical profiles of various sites (see McArthur and McArthur, 1974; Wilson, 1976; also J.T. McArthur, 1978). In particular, on the basis of the elements chosen for analysis, the investigators could not distinguish chemically between what they considered to be local Theban and local Knossian. This became known as the "Thebes/Knossos effect." Nevertheless, given the predilection then to adopt the simplest solution in an ambivalent situation, it seemed easiest to accept the jars as "local," that is, Theban.

Too late for the Oxford investigators, but at about the same time that the Catling and Millett study appeared in print, excavators at Chania in west Crete began uncovering ISJs. Up to this point little had been excavated in west Crete, meaning that the Oxford lab's pottery map was in fact inadequate in its coverage of west Crete. In 1974, the locus of analysis changed from Oxford to the newly established Fitch Laboratory at the British School at Athens, moving us into the next phase of early ISJ studies. In light of the continuing Chania finds, the Fitch Lab, now

under the direction of Richard Jones, established a control group for Chania, analyzed certain Chania found inscribed jars, and reassessed the 18 jars at Thebes thought originally to be east Cretan. Almost predictably, the 18 “east” Cretan jars at Thebes were found to have a somewhat better match with west Crete, and so they were simply reassigned (Catling and Jones, 1977). By visual assessment, west Crete seemed to be an appropriate correction for the formerly “east” Cretan jars.

There remained, however, fundamental methodological objections regarding interpretation of the data. Furthermore, the obvious shortcomings of control groups became quite visible. Problematic was the ease with which east Cretan jars were reassigned to west Crete, showing how dependent projects like this are upon identifying and properly characterizing local control groups. Not only was there the “Thebes-Knossos” effect, but now the chemical overlap between east and west Crete manifested itself.

In fairness to the original investigators, it is well to remember that the original 1965-1977 Thebes project was conducted explicitly as a pilot study, to assess the viability of the technique. This is an important point, often forgotten. The investigators were experimenting with a new and unproven chemical analysis technique. Scholarly criticism was to be expected. Over-interpretation of the results was an unfortunate consequence. An archaeological agenda was driving the analytical program. ISJs were selected for this test case because of their potential relevance to the nagging chronological problem of the date(s) of the Linear B archives at Knossos, but some archaeologists and philologists assumed more certainty from chemistry than chemistry could provide (see Haskell, 2008).

Taking into account the masses of responses to the Thebes studies, the time was ripe for a broader study. The Fitch Lab now expanded the project and sampled *all* extant ISJs from throughout the Aegean; a few uninscribed TSJs at Mycenae and Tiryns were thrown in for good measure. This takes us into the final phase of early ISJ analytical work (Catling et al., 1980). In terms of research design, this project marked a significant advancement. The authors of the 1980 study (Hector Catling, Richard Jones, John Cherry, and John Killen) for the first time consciously brought together three lines of inquiry: analytical, archaeological, and philological. That is, the investigators advanced the line of approach to attempt to integrate various avenues of inquiry. Also, a key ingredient of the 1980 study was the tentative application of statistical assessment to the data derived from chemistry, although still tempered to a degree by visual assessment.

The investigators also had access to some preliminary typological work that Haskell had done with uninscribed TSJs at Mycenae from the House of the Wine Merchant and the House of the Oil Merchant (Haskell, 1981), plus results of petrographic work on these same jars done by John Riley (1981) of Southampton University. Although the typological and petrographic assessments were not a formal part of the 1980 ISJ analysis project, the researchers could take comfort that these assessments for the most part corroborated theirs.

Some results of the 1980 study confirmed what had already been suspected from earlier, more narrowly focused studies. Most ISJs were assigned by the investigators to west Crete, as were most of the few sampled TSJs at Mycenae and Tiryns. On the other hand, provenance assignments of certain TSJs and ISJs were highly controversial. For example, at Thebes, ISJs TH Z 866-860 were classified as of probable local, i.e. Theban, manufacture. Yet these ISJs fell within the “Thebes-Knossos” effect overlap. There remained an archaeological predilection to assume most the economical interpretation, that is local, for TSJs that fell squarely within local chemical parameters. Chemistry still was not able to distinguish definitively between chemical

profiles of various sites. In addition to the Thebes-Knossos and east Crete–west Crete overlaps already identified, Knossos-Argolid and west Crete–Argolid overlaps appeared.

2.2 2011 Study

In the 2011 phase of this continuing analytical trajectory (Haskell et al., 2011), the investigators at long last expanded the corpus of samples to include a substantial number of representative uninscribed TSJs, far more common than the anomalous ISJs. Furthermore, they were able to integrate petrographic work, by Peter Day, on a significant number of samples. John Killen filled in with fresh observations on the inscriptions.

The results: virtually all TSJs that travelled significant distances from their places of manufacture were made on Crete. Some 2/3 are associated with west Crete and 1/3 with central Crete broadly, both north and south central Crete. Mainland shops did indeed produce transport-size stirrup jars, but these appear to have been intended for local use or short-distance travel at most.

Overall there is a *regional* nature of production technology on Crete, that is, a decentralized pattern. Vigorous workshops existed in disparate areas of Crete, producing distinctive pottery. Regionalism was the case also in the production of fine ware pottery (Kanta, 1980). In the case of TSJs, this distinctiveness is reflected typologically, chemically, petrographically, and epigraphically. Although typological, chemical, petrographic, and epigraphic groups initially were established independently, there was a remarkable degree of correspondence among the groups (Haskell, Jones, & Day, 2011).

Typologically, there is considerable uniformity in the west Cretan group in body proportions, as well as in decoration. TSJs associated with west Cretan production technology are relatively slender, with the maximum diameter somewhat above the median (see Haskell, 2011b). Most west Cretan jars are decorated with simple bands, and can be dark on light or light on dark. Sign forms on west Cretan pieces occur either on the shoulder or body, are of fairly large size, and are close in form to signs seen on Linear B tablets.

In contrast, jars associated with central Cretan technology often have a comparatively heavy shape. Central Cretan jars can be nearly as broad as tall, with the maximum diameter nearer the median, but there are considerable variations in body proportion and shape within the central Cretan group. Decoration can be octopus or octopus derivative (deep wavy line), or bands. Linear B signs tend either to be very neatly rendered in small characters, as is the case with the Unexplored Mansion jar (KN Z 1716: Sacconi, 1978, pl. LX: bottom), or extremely poorly, even incompetently, rendered, as with three pieces at Thebes (TH Z 866-868: Sacconi, 1978, 144-145, plates XLIII:bottom, XLIV:top, XLIV:bottom).

Looking more generally at the corpus of Linear B ISJs, the *vast* majority of our sample group was manufactured in west Crete, a very few in central Crete, and probably none the mainland. At Thebes, with by far the largest and most representative deposit of ISJs, the ratio in favor of west Crete is very high, with some 94% of the ISJs associated with west Crete and only 6% with central Crete. The 6% are represented by just three nearly identical jars (TH Z 866-868), assigned in the 1980 study as most likely local – back when “local” was the default mode. One should note here that these pieces at Thebes, as well as various other pieces found in Aegean and eastern Mediterranean contexts, were manufactured in *south* central Crete, some distance from Knossos.

Of particular interest are the results for TSJs found on Cyprus and in the Levant. Almost without exception, all TSJs here come from *central* Crete. Many bear octopus decoration, a characteristic motif of central Cretan TSJs intended for export. To this extent, therefore, the

regionalism that we see in production applies also to export patterns. TSJ fabrics associated with central Crete cornered the eastern Mediterranean market, with only a very few west Cretan TSJs here. This stands in contrast to fine ware pottery – west Crete is nicely represented on Cyprus by Kydonian Workshop fine ware vases (Hallager 2011, 375-376).

One should note here that V. Karageorghis (2008) reports that a curious jar found at Sidon may bear Linear B signs, not visible in the published images but restored in the drawing. While the authors of the 2011 study have not analyzed this piece, the decoration and surface treatment visible in the images seem consistent with both central and west Cretan TSJ production technologies. The signs as restored seem more central Cretan than west Cretan. In any case this is an anomalous, stray piece and not in and of itself evidence for the use of Linear B in the eastern Mediterranean.

3. Conclusions

I conclude here by briefly considering the nature of the 2011 study and its publication.

3.1 Provenance-Directed Analyses

There has been a general trend away from provenance-directed analyses of individual classes of pottery and toward developing a broader understanding of technologies of production at a site or over a region. It has been noted quite correctly that there is not a simplistic relationship between compositional space and geographical space (Jones and Day, 2011, 26-27). Nevertheless, provenance and movement are of considerable archaeological and historical significance, and determinations of origins and movements represent an appropriate aspiration.

Furthermore, over the long course of chemical analysis projects, considerable criticism has been directed at the methods of interpretation of data derived from chemical analyses, some of which I have already alluded to. Methodologically, archaeological chemist Richard Jones now has assessed the data in a variety of ways, by univariate assessment of what he demonstrated are the most diagnostic elements (calcium, magnesium, chromium, and nickel), and multivariate analysis, both cluster analysis and principle component analysis. Basically, Jones combined "objective" statistical work with subjective but reasoned evaluation of what the data are telling us – that is, he blended the **art** of data assessment with objective statistical assessment. Through focusing on the essentials, Jones has developed meaning and has been able with a certain level of confidence to associate specific jars with specific production traditions, most of which can be associated with geographical areas. Day's petrographic work has provided a tremendous boost to the chemical work, and in our project to a large extent has confirmed and of course considerably refined much of what chemistry has done.

3.2 Publication Format

As the 2011 book is a print publication, it was not possible to include all of the data – not only chemical, but also typological and petrographic. The sheer bulk of information would have made the book impossibly long and expensive. This opens the question regarding the most suitable format for publication of such an analysis study. Unrestricted access to all data offers the obvious advantage of enabling researchers to attempt to replicate or validate the work, yet some data without context may invite potential misunderstanding and misinterpretation. There are, however, certain data that are not easily liable to misinterpretation and electronic publication would have been ideal for such data, especially for those consulting this study in the field. For example, color digital images of the TSJs themselves would enhance the articulation of the typological work. Furthermore, high resolution photomicrographs of petrographic thin sections,

of which the authors were able to include only a few, would supplement strongly verbal fabric descriptions.

Raw data derived from chemical analyses present more of a predicament. Just as many excavators have been reticent to share unfiltered field records, some archaeological chemists may be wary of sharing data without context. Perhaps moderated dissemination is an option, which certainly happens informally already on an ad hoc basis.

In terms delivery and storage of electronic data, that is local media vs. online, each offers advantages and of course they are not mutually exclusive. On a local storage medium such as a flash drive, data and preset queries can be included, yet they remain static. Nevertheless, for researchers in the field where internet access may be sketchy at best, a local medium makes most sense. Online storage and presentation, on the other hand, enable the authors to update data, manage and refine preset queries, and add additional data as they become available.

4. Conclusion

The TSJ analytical project project has been an opportunity for the integration of the hard and soft sciences. While it represents a recent phase of a very long-term project over some 50 years, more remains to be done to better integrate typological, chemical, petrographic, and epigraphic work, as well as conduct organic residue analyses. New work in Attica is already forcing a reevaluation of conclusions reached in the 2011 study.

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