An Archaeometric Study of Early Bronze Age Pottery Production and Exchange in Argolis and Korinthia (Corinthia), Greece

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The manufacture and movement of Early Helladic (EH) pottery within Argolis and Korinthia (Corinthia) have been investigated by archaeometric means. The objective was to determine the nature and extent of ceramic exchanges of various wares within this culturally homogeneous area. Neutron activation analysis was performed on samples from 417 objects of the EH II and III periods found at Keramidháki, Korakoú, Phlious, Zygouriés, Tiryns, Asine, Lerna, and Lake Vouliagméni. Multivariate statistical treatment of the concentration data for up to 19 chemical elements yielded 11 compositional reference groups. Many of these reference groups could be attributed to centers of production on distributional or other grounds, thereby allowing the sources of more than half the samples to be determined.

The following conclusions were reached: 1) All eight sites, except possibly Phlious, were sources of common EH II tableware (slipped sauceboats and small bowls). 2) The distributions of these tablewares were limited almost exclusively to the assigned sources and neighboring sites. 3) Many unusual EH II fine wares had other sources and broader distributions. 4) The attribution of coarse wares was complicated by the presence of tempering materials. 5) Some changes in distribution patterns were noted at Zygouriés between early and late phases within EH II. 6) The changes in pottery acquisition patterns which accompanied the beginning of EH III appear to have been more extensive at Tiryns than at Lena or Korakoú.

Introduction

The nature and extent of intercultural contacts in the Early Bronze Age Aegean have recently been the subjects of some discussion.[1] This has focused largely on elucidating the relationships, chronological and otherwise, between Crete, the Cycladic islands, and the Greek mainland during the third millennium B.C. The examination of ceramic artifacts plays a large role in this research. The value of technical examination in providing independent criteria for determining the provenance of ceramics is by now well known,[2] but as yet no studies of this type have been made of Greek Early Bronze Age pottery on any but the smallest scale.[3] The major impediment to such research is the number of reference analyses which must be accumulated before reasonably definite assignments can be made on technical grounds. One step

1. Colin Renfrew, *The Emergence of Civilisation* (Methuen: London 1972) 440–475; P. M. Warren, "Problems of Chronology in Crete and the Aegean in the Third and Earlier Second Millennium B.C.," *AJA* 84 (1980) 487–499; J. B. Rutter and C. W. Zerner, "Early Hellado-Minoan Contacts," in R. Hägg and N. Marinatos, eds., *The Minoan Thalassocracy: Myth and Reality* (Aström: Stockholm 1984) 75–82; Curtis N. Runnels, "Trade and the Demand for Millstones in Southern Greece in the Neolithic and the Early Bronze Age," in A. Bernard Knapp and Tamara Stech, eds., *Prehistoric Production and Exchange: The Aegean and Eastern Mediterranean* (Institute of Archaeology, University of California: Los Angeles 1985) 30–43.

2. A. L. Wilson, "Elemental Analysis of Pottery in the Study of its Provenance: A Review," *JAS* 5 (1978) 219–236; J. S. Olin and A. D. Franklin, eds., *Archaeological Ceramics* (Smithsonian Institution: Washington, D.C. 1982).

3. M. Attas, L. Yaffe, and J. M. Fossey, "Neutron Activation Analysis of Early Bronze Age Pottery from Lake Vouliagméni, Perakhóra, Central Greece," *Archaeometry* 19 (1977) 33–43.

toward amassing this body of reference data has been taken with a recent study of ceramic production and exchange in the NE Peloponnese (Argolis and Korinthia).[4] The main aim of the study was to determine the degree of centralization of pottery manufacture in Early Helladic (EH) times. The present article summarizes the methodology and discusses the main results of that research, emphasizing aspects relevant to discussions of chronology and contact in the Aegean during the Early Bronze Age.

Aims

In his discussion of trade, communication, and innovation in the Early Bronze Age Aegean, Renfrew distinguished four scales of material exchange: within a settlement, between settlements of a single culture, between cultures of the Aegean, and between the Aegean and other areas. He elaborated on the second of these as follows:[5]

> . . . exchange between settlement units of the same culture is the most difficult to detect archaeologically. Within a single early bronze age settlement, large central buildings and the use of seals and sealings can document redistribution for us. Between cultures the presence of artefacts typical of one yet found in another documents the transfer of goods. Yet inside this single cultural region the direct evidence for exchange or movement is much more limited. The uniformity in artefact types in the different parts of the culture territory makes the detection of their exchange more difficult than in the case of exchange between cultures, where the imported pieces in the artefact assemblage stand out much more clearly.

It is on this scale that technical examination of artifacts holds the greatest promise. Pottery of the best known and most widely documented phase of the Early Helladic period, hereafter called EH II, is sufficiently uniform within the NE Peloponnese, and even beyond, that attributions cannot be made on the basis of style alone. Examination of the paste by visual, petrographic, and chemical methods could well provide enough information to attribute pots to their places of manufacture, although use of some of these techniques may encounter difficulties because of the overall uniformity of the underlying geology. Our first objective was to determine if chemical differences could be observed between the most characteristic EH II pottery types found at a number of sites in Argolis and Korinthia. The technique of neutron activation analysis[6] was chosen because of its sensitivity, precision, simplicity, and multi-element capability. The success of a preliminary analytical program[7] aimed at distinguishing small groups of samples from each of six sites gave us confidence in tackling a project of medium size (300 analyses). The aims of this project were to answer the following questions. Was pottery produced at many EH II settlements? Was pottery regularly transported from one settlement to another? How did patterns of production and exchange vary with settlement size, settlement proximity, pottery types, and time?

Within the limits of this study it proved possible to answer the first two of these questions. Some information about the patterns referred to in the third question also emerged, but to obtain a detailed picture requires a far more ambitious program of research.

Methodology

Site Selection

The NE Peloponnese was chosen for this study because its prehistory has been intensely studied for over a century, and because the EH II period is particularly well documented in that area. In an effort to analyze material from only the best known archaeological contexts, it was decided to restrict the selection of sherds to those coming from excavated sites. Permission was obtained[8] to sample material for analysis from eight sites in Argolis and

4. M. Attas, "Regional Ceramic Trade in Early Bronze Age Greece: Evidence from Neutron Activation Analysis of Early Helladic Pottery from Argolis and Korinthia," unpublished Ph.D. dissertation, McGill University (Montreal 1982).

5. Renfrew, op. cit. (in note 1).

6. M. S. Tite, *Methods of Physical Examination in Archaeology* (Seminar Press: London 1972) 273–278; G. Harbottle, "Activation Analysis in Archaeology," in G. W. A. Newton, ed., *Radiochemistry: A Specialist Periodical Report* 3 (The Chemical Society: London 1976) 33–72; R. G. V. Hancock, "Low Flux Multielement Instrumental Neutron Activation Analysis in Archaeology," *Analytical Chemistry* 48 (1976) 1443–1445; F. Widemann, "Neutron Activation Analysis for Provenance Studies of Archaeological Artifacts," *Journal of Radioanalytical Chemistry* 55 (1980) 271–281; S. Amiel, ed., *Nondestructive Neutron Activation Analysis* (Elsevier Scientific Publishing Co.: Amsterdam 1981).

7. M. Attas, "Analyse par activation neutronique de la céramique de Lerne (Grèce) à l'Age du Bronze Ancien: productions locales et échanges commerciaux," unpublished 3rd cycle doctoral thesis, Université de Paris-Sud (Paris XI) (Centre d'Orsay, Paris 1980).

8. The following archaeologists gave permission to study material under their control, and in some cases assisted in the selection of samples: R. Hägg, I. Hägg, J. M. Fossey (Asine); K. Kilian, H.-J. Weisshaar (Tiryns); J. L. Caskey, E.T. Blackburn, M. H. Wiencke, C. Zerner (Lerna); W. R. Biers (Phlious); C. K. Williams II, N. Bookidis, J. Lavezzi (Korakoú, Zygouriés, and Korinthos); J. Wiseman, J. Cherry (Keramidháki); J. M. Fossey (Lake Vouliagméni). Permission to extract and export the pottery samples was obtained from the Greek Archaeological Service by the Canadian Archaeological Institute at Athens. We are indebted to all the colleagues who made possible this project as well as to others who volunteered material from different sites and areas which could not be incorporated into our geographical restrictions.

Korinthia, namely Asine, Tiryns, Lerna, Phlious, Zygouriés, Keramidháki (a district of ancient Korinthos), Korakoú, and Lake Vouliagméni (FIG. 1).

Sherd Selection

Ideally, analytical studies of provenance proceed by first determining the compositions of objects with known provenance, and then comparing these with the compositions of objects with unknown provenance.[9] The selection of objects of the first kind, those which will form the analytical reference groups, must be made with great care. In ideal circumstances the most straightforward approach is to characterize every known workshop which produced the pottery of interest, by analyzing abundant vase types from the site of the workshop itself.[10] Often the excavation of a workshop will reveal masses of spoiled pottery, clay storage areas, or vases in direct association with kilns. These are most likely to have the composition(s) characteristic of that particular workshop's production, and so would constitute the best reference group(s).

Unfortunately, no excavated pottery workshops are known from Early Helladic Greece, although a few overfired "wasters" have been found at Lake Vouliagméni, testifying to pottery production there.[11] In situations such as this, less secure indicators of local composition must be analyzed: objects present in great abundance, objects of extremely simple manufacture, and objects whose size or fragility prohibits their transport. It is also possible to form groups of samples of similar composition whose common origin is not precisely known. These groups can subsequently be linked to specific places by comparison with other analytical data, most commonly with analyses of clays or ceramics of different periods (including modern) whose origin is known. This method is less direct but can be just as reliable (comparison with Attic or Korinthian painted pottery, for example). An early test of clay analysis gave confidence in its general use for pottery provenance.[12]

In accordance with these principles, sherds with the most common EH II forms, surfaces, and pastes were chosen for analysis to establish reference groups. Every effort was made to enlist the assistance of someone intimately familiar with the material from each site for expert advice on the frequencies of the various categories and for input on provenance problems of local importance.[13] The open form known as the sauceboat is the

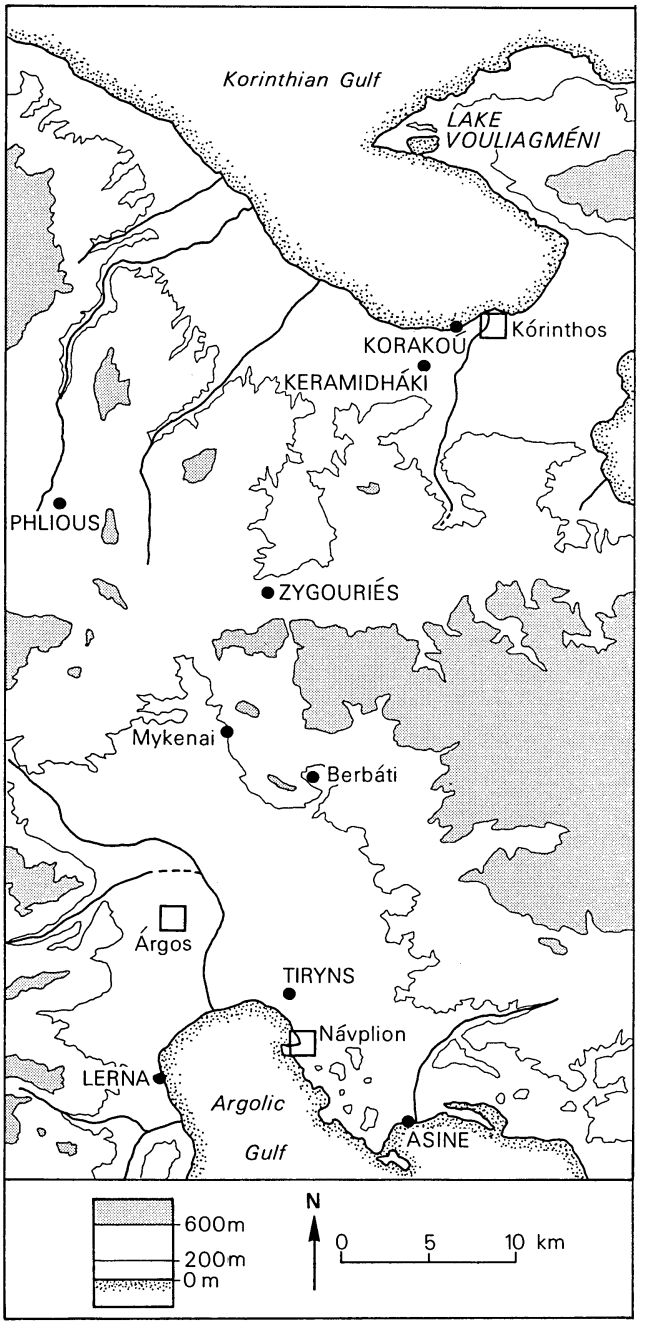

Figure 1. The central portions of Argolis and Korinthia, showing the sites from which pottery was sampled.

9. G. Schneider, B. Hoffmann, and E. Wirz, "Significance and Dependability of Reference Groups for Chemical Determinations of Provenance of Ceramic Artifacts," *Archaeo-Physika* 10 (1979) 269–283.

10. F. Widemann, "L'analyse par activation neutronique de céramiques antiques: groupement et différenciation," *Latomus* 160 (1979) 47–71.

11. J. M. Fossey, "Perakhóra 1972: 1. Excavation at the Early Helladic Settlement by Lake Vouliagméni," *ArchDelt* 28 (1973[1977]) *Khron* 149–152.

12. A. Millett and H. W. Catling, "Composition Patterns of Minoan and Mycenaean Pottery: Survey and Prospects," *Archaeometry* 10 (1967) 70–77.

13. See note 8.

Table 1. Summary of the data set.

Time Period of Analysis	*Institution*	*Sites Represented*	*Number of Samples*	*Elements Determined*
1974–75	CRNL/McGill*	Lake Vouliagméni	111	Sc, Cr, Fe, Cs, La, Eu, Yb, Hf + Ca, Rb, Ce, Th
1977–78	Saclay†	Lerna	51	Sc, Cr, Fe, Cs, La, Eu, Yb, Hf
		Asine	10	+ Na, K, Mn, Co, and in some cases Ca
		Phlious	10	
		Zygouriés	9	
1979–82	EPM/McGill‡	Lerna	4	Sc, Cr, Fe, Cs, La, Eu, Yb, Hf
		Asine	21	+ Ca, Rb, Ce, Th
		Keramidháki	72	+ Na, K, Mn, Co
		Korakoú	44	+ Al, Ti, V
		Phlious	6	
		Tiryns	59	
		Zygouriés	20	
		Total	417	

*Irradiation performed at Chalk River Nuclear Laboratories, Atomic Energy of Canada Limited; measurements were performed at McGill University.

†Irradiations and measurements performed at Laboratoire Pierre Süe, Centre d'Etudes Nucléaires, Saclay, France.

‡Irradiations and some measurements performed at Installation SLOWPOKE, Ecole Polytechnique, Montréal; other measurements performed at McGill University.

Table 2. Assignments and associations of samples to groups.

Group	*Site: KER*	*KRK*	*ZYG*	*PHL*	*TIR*	*ASI*	*LER*	*VOU*	*Total*
M	7 (2)	5	1	(1)	-	(1)	-	-	13 (4)
N	13 (3)	11	8 (1)	2	1	-	1	-	36 (4)
O	7 (4)	(1)	2	-	-	-	1	-	10 (5)
P	3	2	8	4	1	1	4	-	23 (0)
Q	-	2	1 (1)	-	34 (1)	6	-	(1)	43 (3)
R	-	-	-	-	1 (1)	6	4	1	12 (1)
S	-	-	-	-	-	8	(3)	-	8 (3)
T	-	2	-	-	-	-	4 (1)	-	6 (1)
U	1 (1)	1	-	-	10 (2)	-	-	-	12 (3)
V	-	-	-	-	-	-	1	41 (3)	42 (3)
W	-	-	-	-	-	-	-	6 (1)	6 (1)
Regional	(9)	(11)	(3)	(5)	(5)	(3)	(6)	(2)	(44)
Unassigned	(22)	(9)	(4)	(4)	(3)	(6)	(20)	(10)	(78)
Totals	72	44	29	16	59	31	45	65	361

Sites are listed in order: Keramidháki, Korakoú, Zygouriés, Phlious, Tiryns, Asine, Lerna, Vouliagméni. "Regional" and "Unassigned" refer to samples of "regional" composition and "unassigned" samples, respectively. These samples, as well as "associated" ones, are entered in the table in parentheses. Samples from periods other than Early Helladic II and III have been omitted.

most characteristic vessel of the EH II period;[14] together with the shallow bowl with inturned rim,[15] it formed the foundation of the sampling. Both these forms are fine-walled. They were most often fashioned from "semifine" clay; that is, clay containing few or small inclusions. Since the presence of large quantities of natural inclusions or added tempering material can alter the overall chemical composition of the paste, sometimes unpredictably, sampling coarse pottery was avoided unless the object was of particular interest. Among surface treatments, the glossy slip known as "Urfirnis" is the most characteristic, particularly on sauceboats and bowls.[16] Material from some sites showed that it was commonly used to coat ceramic ladles as well. These were, therefore, also sampled when available. Other EH II forms sampled in smaller numbers include jars, *askoi* (one-handled asymmetric flasks), "frying pans," animal figurines, construction material, and domestic objects. The last two categories include such objects as mud bricks, roof tiles, clay bedding and facing, loom weights, baking pans, hearths, and "fire-dogs." The simplicity of manufacture and large quantities required of these objects make local manufacture more likely for them than for small ceramic vessels. Their paste is often quite coarse, however, so that the usefulness of their analysis may be diminished. In addition, sherds from the early part of the Early Helladic period (the EH I phase) were sampled from Lake Vouliagméni, but unfortunately stratified comparanda were not available from other sites in our area. A small selection of later (EH III) material from three sites (Tiryns, Lerna, and Korakoú) was also sampled. It should be pointed out that most of the Lake Vouliagméni and Lerna samples have been analyzed as part of studies characterizing the EH pottery production at single sites.[17] The earlier analyses are here integrated with the rest of the data.

Sampling

Powdered samples were taken by drilling objects, using a fine tungsten-carbide bit mounted in an ordinary hand drill. In this way the appearance of the objects was affected as little as possible. The merits and faults of this method are the subject of a recent technical note.[18] About 0.5 g of powder was extracted, from which 250 to 300 mg was used for analysis.

Neutron Activation Analysis

The principal operations involved in performing neutron activation analysis of ceramic materials are by now fairly well standardized and so will not be described here.[19] Because of the long duration of this work, irradiations were conducted at three research reactors, and measurements performed at two institutions (TABLE 1). The type of encapsulation and the exact irradiation and measurement parameters depend on reactor and instrumental characteristics; these are given in full detail elsewhere.[20] As a control, some samples were analyzed at more than one facility. Overall agreement of the results was very good. For a few elements, however, slight inconsistencies were found in the replicate analyses, arising from differences in the methods used to process the gamma-ray spectra. These inconsistencies complicate the intercomparison of data to some extent (see below), but are not of serious consequence to the interpretation of the results. In all cases a standard pottery that has been prepared and analyzed by Perlman and Asaro[21] was used as the analytical reference.

The results of the analyses were tables of elemental concentrations, up to 19 for each sample, expressed as percentages or parts per million by weight. Because of their size, the tables are not reproduced here. They constitute Appendix A of Attas' doctoral dissertation and will be included in the SARCAR data bank;[22] until then they are available on request from Attas.

Formation of Reference Groups

Two mathematical procedures were used to identify

14. J. L. Caskey, "Greece, Crete, and the Aegean Islands in the Early Bronze Age," in I. E. S. Edwards, C. J. Gadd, and N. G. L. Hammond, eds., *CAH* I (1971) 771–807; see *idem*, "The Early Helladic Period in the Argolid," *Hesperia* 29 (1960) 285–303.

15. J. M. Fossey and M. K. Mogelonsky, "The Typology of Early Helladic Pottery: A Comparison of the Vouliagméni (Perakhóra)—Asine System with the Proposed Tiryns System," *PZ* 58 (1983) 106–113, rim types III.

16. Caskey, op. cit. (in note 14) 778.

17. Attas, Yaffe, and Fossey, loc. cit. (in note 3); Attas, op. cit. (in note 7).

18. M. Attas, J. M. Fossey, and L. Yaffe, "Corrections for Drill-Bit Contamination in Sampling Ancient Pottery for Neutron Activation Analysis," *Archaeometry* 26 (1984) 104–107.

19. Tite, loc. cit. (in note 6).

20. Attas, Yaffe, and Fossey, loc. cit. (in note 3); Attas, op. cit. (in note 4); Attas, op. cit. (in note 7).

21. I. Perlman and F. Asaro, "Pottery Analysis by Neutron Activation," *Archaeometry* 11 (1969) 21–52; I. Perlman and F. Asaro, "Pottery Analysis by Neutron Activation," in R. H. Brill, ed., *Science and Archaeology* (M.I.T. Press: Cambridge, MA 1971) 182–195. (These two are identical texts but the more recent publication contains a more detailed analysis of the standard pottery.)

22. SARCAR is the Smithsonian Archaeometric Research Collections and Records Facility, recently established within the Smithsonian Institution's Conservation Analytical Laboratory. Ronald L. Bishop is the SARCAR Coordinator (personal communication, May, 1984). See also Curt W. Beck, "Smithsonian Archaeometric Research Collections and Records (SARCAR)," *JFA* 11 (1984) 341–343.

patterns in the analytical data. Cluster analysis served to delineate preliminary groups of samples with similar chemical compositions. Discriminant analysis then served to refine these groups and to add other samples to them. Attributions of groups to sites of production could subsequently be made using distributional and other strictly archaeological evidence.

Both these techniques have often been used in archaeological research, particularly but not exclusively for the analysis of archaeometric data.[23] In the present study the computer programs BMDP2D and BMDP7M of the BMDP Statistical Software package[24] were used without modification to perform cluster and discriminant analyses, respectively. The following is a summary of the data processing, which has been discussed in more detail in a separate publication.[25]

Samples with very unusual compositions were set aside initially so as not to distort the standardization procedure. The remaining data were standardized by the program BMDP2D before being clustered, but not otherwise transformed. A complication in treating the data was that at each of the three reactor installations slightly different combinations of elements had been determined. This led us to submit the data to the programs in several steps. First *all* the samples were included, using the concentration values for the eight elements common to all the results (scandium, chromium, iron, cesium, lanthanum, europium, ytterbium, and hafnium). In other steps fewer samples were included, but more elements for each sample: first 12, then 13, and finally the 19 elements measured at Ecole Polytechnique and McGill University (those listed above plus calcium, rubidium, cerium, thorium, sodium, potassium, manganese, cobalt, aluminum, titanium, and vanadium). In all the trials, samples from several sites were intermingled to form a small number of clusters. Strong correspondences existed between certain clusters from one analysis to another, even though the sets of elements and samples under consideration differed. Six clusters appeared in all four analyses, with slight differences in the number of members according to which samples had been included in the clustering. A further five clusters were made up largely of samples with incomplete data.

Discriminant analysis was then used to examine the position among the clusters of all the samples, including those which did not appear in any of the eleven clusters. The discriminant-analysis program BMDP7M calculates and prints a mathematical "distance" (termed the Mahalanobis distance) from each sample to the centroid of every cluster; with this distance is associated a relative probability of membership in that cluster. These distances and probabilities were examined in the hope of improving the confidence of the attributions.

A deliberately conservative choice was made of criteria for definitive attributions. In other words, a sample was merged with a reference cluster only if it was well within (i.e., close to the centroid of) that cluster, and relatively far from others. A sample that had already belonged to a reference cluster had to be much closer to a second cluster before it was reassigned. One result of this approach was a collection of some samples whose attribution was left vague. When a previously-unassigned sample was found to be closer to the centroid of one cluster than to the other centroids, but nevertheless farther from that centroid than the farthest samples already assigned to that cluster, the sample was said to be "associated" with the cluster rather than being a proper member of it. If a sample were found to be associated with two or more clusters characteristic of separate parts of the region under study, the most that could be said about its origin was that it lay somewhere in Argolis or Korinthia. Its composition type was therefore termed "regional."

Results

Procedure

All the attributions and associations were set out as lists of samples in two formats, namely by group and by site. A condensed format showing how many samples from each site belonged to each group is given in Table 2. The constitution of each group was examined for information concerning the place of origin of the objects. When samples from a single site constituted a large proportion of a group, that site became the most likely candidate. The nature of certain samples was also brought to bear on this question. The origins of the groups are discussed in the following sections.

Group M

Keramidháki and Korakoú account for all but one of the 13 samples attributed to group M. This is strong evidence for an origin on the Korinthian plain. The distribution of samples from this group other than those from the plain is limited to a single attribution at Zygouriés and one association each at Phlious and Asine.

23. J. E. Doran and F. R. Hodson, *Mathematics and Computers in Archaeology* (Harvard University Press: Cambridge, MA 1975); Clive Orton, *Mathematics in Archaeology* (Cambridge University Press: Cambridge 1980).

24. W. J. Dixon, ed., *BMDP Statistical Software 1981* (University of California Press: Berkeley 1981).

25. M. Attas, J. M. Fossey, and L. Yaffe, "Provenance-Group Formation Using a General-Purpose Statistical Analysis Package," *Advances in Computer Archaeology* 2 (1985) 1–30.

Group N

Once again, Keramidháki and Korakoú are the findspots of the largest (two-thirds) share of this group's samples. Another 25% was found at Zygouriés, with two samples at Phlious and one each at Tiryns, Lerna, and Vouliagméni. Although possible, an origin at Zygouriés is less likely than one on the Korinthian plain because of the close resemblance between groups M and N for all elements except sodium, potassium, and rubidium and because of the inclusion of VOU 503, a Korinthian-style miniature bowl of the Archaic period found at Lake Vouliagméni.

Group O

Most of the samples in group O were found at Keramidháki, making that site the most likely place of origin. There are also two samples from the latest EH II phase at Zygouriés and one from an early EH III phase at Lerna.

Group P

Samples belonging to this group have broad distribution, with several being found at Keramidháki, Korakoú, Zygouriés, Phlious, and Lerna. (Four Vouliagméni samples, two from Late Helladic vessels and two EH I sherds, are associated with this group and group R.) The Zygouriés samples are the most numerous, making that site (or one in its vicinity) a slightly more likely place of origin than any of the others for the group as a whole. Further arguments on the origin of group P are presented below in the discussion of ladles.

Group Q

Tiryns samples comprise 80% of the 43 samples in this group. Since almost all EH II and Transitional sherds sampled from Tiryns belong to this group, it may be called the Tiryns group *par excellence*. The six Asine samples also included in the group would then be imports. It is curious that no Lerna samples belong to this group, even though two group Q samples have been found as far away as Korakoú. Possible explanations for this are discussed below.

Group R

Although both Asine and Lerna are represented among the samples of group R, the former site is the more likely source for two reasons. First, the six Asine samples in this group represent a larger proportion of the total number analyzed from Asine than the four Lerna ones do of the Lerna total. Second, and more important, among the Asine samples is the mud brick fragment ASI 5. The possibility still exists, however, that some clay beds near Asine and Lerna are so similar that samples in fact from these two sites have been merged into group R.

Group S

Five mud bricks, a modern clay, and two sherds, all from Asine, constitute the eight samples attributed to this group. A further three Lerna samples are associated with it, but they need not share its definitely Asiniote origin.

Group T

Lerna samples predominate in this small group. They are sherds of several different periods, from early EH II to early Middle Helladic (not included in Table 2), and an origin at least close to Lerna is likely. It is disappointing, however, that so few Lerna samples are actually attributed to this group. The only group T objects not from the Lerna excavations are a pair of slipped-and-polished sherds found at Korakoú.

Group U

Early Helladic III pottery from Tiryns accounts for almost all the samples in group U, leaving little doubt as to its origin. A couple of sherds from the Korinthian plain sites of Keramidháki and Korakoú are also included.

Group V

Group V contains nearly all the samples considered in an earlier study[26] to be local products of Lake Vouliagméni. These include the clay samples, the mud bricks, and the rest of what had then been called group L. A single sherd from Lerna is the only object in this group not found at Lake Vouliagméni (LER 28, a saucer from the "House of the Tiles").

Group W

This collection is also equivalent to one from the earlier study, namely VOU-R. Its membership is limited exclusively to Vouliagméni samples mostly of coarse paste, from EH I and II deposits. The group does not include any specific objects pinning its origin to that site, but there is no evidence for associating it with any of the other sites included in this study either.

26. Attas, Yaffe, and Fossey, op. cit. (in note 3) 40–41.

Table 3. Attributions and associations of Early Helladic II reference material: sauceboats and small bowls.

Group	*Site: KER*	*KRK*	*ZYG*	*PHL*	*TIR*	*ASI*	*LER*	*VOU*	*Total*
M	4	4	1	-	-	-	-	-	9
N	4 (2)	8	8 (1)	2	-	-	-	-	22 (3)
O	1 (1)	(1)	2	-	-	-	-	-	3 (2)
P	2	-	3	-	1	-	3	-	9
Q	-	1	1	-	16 (1)	4	-	-	22 (1)
R	-	-	-	-	-	4	2	-	6
S	-	-	-	-	-	1	-	-	1
T	-	-	-	-	-	-	3 (1)	-	3 (1)
U	-	-	-	-	-	-	-	-	-
V	-	-	-	-	-	-	1	5 (1)	6 (1)
W	-	-	-	-	-	-	-	-	-
Regional	(1)	(3)	(3)	(4)	(2)	(1)	(3)	-	(17)
Unassigned	(2)	(1)	(2)	(2)	-	(3)	(6)	(1)	(17)
Totals	17	18	21	8	20	13	19	7	123

Associated, regional, and unassigned samples are listed in parentheses.

Discussion of Pottery Production and Exchange

Introduction

Given the constitutions, origins, and distributions of the compositional groups as set forth above, what can be said about Early Helladic trade?

Although quantitative results are not possible with archaeological material of this nature, useful qualitative deductions may still be made from the analytical data. The results for the EH II reference objects—sauceboats and small bowls—are presented first, since those objects form the core of the study. These results also serve as a point of departure for examining the production and exchange of other ceramic material. The provenances of certain special wares are of particular interest because their modes of distribution may have differed from those of the common tableware. The final section examines the bearing of the analytical results on the study of the transition to EH III at three sites in Argolis and Korinthia.

Sauceboats and Bowls

The first step in studying the provenance of these objects was the modification of Table 2 to include only EH II reference material; i.e., the samples of sauceboats and small bowls in the finer paste categories (TABLE 3). Figure 2 reproduces these data in graphic form. The incidence of high numbers of samples along and near the main diagonal of the table and the figure is striking. It implies first of all that the reference samples from a given site belong to a small number of groups and, conversely, that each group is made up of samples found at a small number of sites. The order of the sites is roughly geographical, from north to south. The groups have been labeled to follow this order. The fact that almost every entry is close to the diagonal therefore means that almost every object has been found close to its supposed place of manufacture. Exchanges have taken place over short distances only. The only two exceptions among the reference sherds are LER 28, which falls into V, the composition group characteristic of Lake Vouliagméni, and KRK 8, a member of Q, the characteristic Tiryns group.

That certain composition groups are characteristic of certain sites implies that these sites at least were centers of production (or that the centers lay in their immediate geographic vicinity). In fact, all sites in this study with the exception of Phlious and possibly Zygouriés appear to have produced sauceboats and bowls,[27] although differentiation between Keramidháki and Korakoú productions is not possible. No composition type has been found to be characteristic of Phlious, and Zygouriés reference material includes sherds belonging to five groups, more than any other site (but see below).

27. Because two ceramic forms were used to constitute the archaeological reference groups, it was important to check that both give similar results. It is possible, in theory, that one production center might specialize in the manufacture of bowls and another in the manufacture of sauceboats. Examination of the constitution of the reference groups revealed that both the sauceboats and the bowls at every site are divided among the one or several analytical groups represented at that site. The treatment of these two forms in combination was therefore justified.

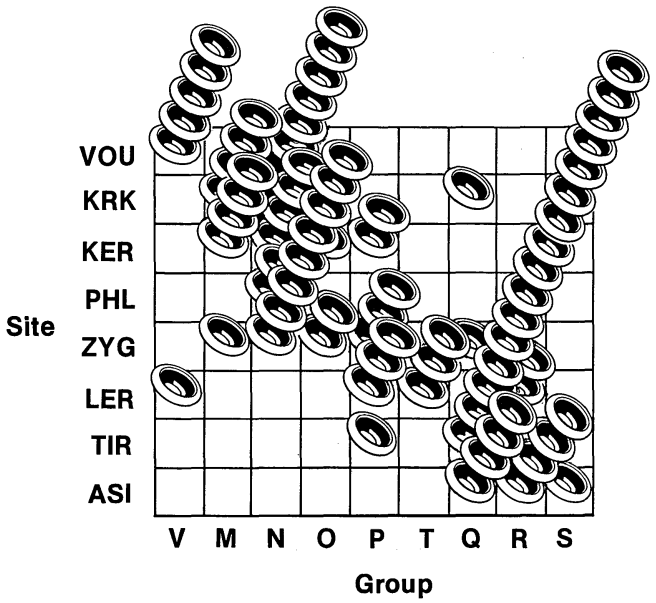

Figure 2. Attributions of Early Helladic II reference samples: sauceboats and bowls.

Lake Vouliagméni and Tiryns were the most self-sufficient centers, each producing almost the entirety of its own archaeological reference group. At Tiryns, in fact, no pottery from any of the other Argolis groups (R, S, or T) was among the EH II sherds sampled. In contrast, several group Q (i.e., Tiryns) reference sherds were found at Asine, where material from groups R and S is considered to be local. A couple of the Lerna reference sherds also belong to group R. It seems that Lerna received pottery from a variety of sources (P, R, and V) in addition to probably producing its own (group T). Pottery of group Q, however, is absent from Lerna.

The proportion of samples in the "regional" and "unassigned" categories varies from site to site and serves as a reminder that ceramic material from only a small fraction of the known Early Helladic II settlements has been sampled. Many other settlements must have produced pottery, some of which would have ended up at our sites. For instance, since six of the eight Phlious reference objects could not be attributed to a group, it is likely that they were made at production centers elsewhere than at one of these sites. They do not form a coherent group, indicating that several sources may be involved, perhaps including one or more at Phlious itself. A high proportion of unassigned samples is found among the Lerna reference material as well. Three of these samples (LER 22, 25, and 26) form a small cluster, whose origin is not evident. Since Lerna and Phlious are on the edge of the region being considered, it is quite possible that objects such as these were brought from production centers outside the region. Border sites would of course be more susceptible to this occurrence than centrally-located ones. Group W at Lake Vouliagméni may also fall into this category.

Ladles

Because the semi-fine paste and Urfirnis slip of many ladle fragments resemble those of the sauceboats and bowls, several samples of ladles had been taken to serve as supplementary reference material. This was the case particularly for Phlious, from which the number of sherds available for sampling was limited. It was expected that the pattern of ladle production would resemble that of the sauceboats and bowls. A glance at Table 4, however, shows that eight of the 12 ladles sampled belong to a single group, namely P. Three of the unattributed ladles are the ones from Keramidháki and Korakoú; the fourth is the only coarse-paste specimen sampled from Phlious. The origins of these four samples are unknown. In contrast, group-P ladles are found at Zygouriés, Phlious, and Asine. At the last two sites, group P is represented *only* by the ladles, whereas reference sherds and other objects belonging to that composition group are also present at Zygouriés. Even though only a small number of samples is involved, the analyses point to Zygouriés as the origin of the group-P ladles, and by extension, of the rest of group P as well. This agrees with, and therefore supports, the indications of the section above on group P which had been formulated without considering the archaeological nature of the samples.

This distribution pattern, namely a single production

Table 4. Attributions and associations of ladle samples.

Sample	*Group*	*Paste*
KER 22	regional	coarse
KRK 29	unattributed	coarse
30	unattributed	fine
ZYG 28	P	fine
29	P	semi-fine
30	P	semi-fine
PHL 2	P	fine
3	P	semi-fine
4	(M)	coarse
5	P	semi-fine
18	P	medium
ASI 18	P	fine

center supplying three widely-separated sites, is unexpected for an object apparently so simple to manufacture. Since there is evidence that ladles were not used throughout the whole of the EH II phase, but only in its earlier stages,[28] perhaps the distribution reflects a trade pattern not maintained until the end of EH II. The long duration of the phase means that changes in the pattern of pottery production within EH II would not be surprising.

Changes within EH II

Further evidence of such changes comes from stratigraphic distinctions within the Zygouriés samples (TABLE 5). Ten of them (ZYG 21 through 30) come from one of the earliest deposits there, a pit called VIII Bothros, while ZYG 7 through 20 are objects from a house of the latest EH II occupation (House of the Snails). The most frequent attribution of the early objects is P, even if the three ladle samples are excluded. Among the late sherds, however, group P is not even represented. Instead, N is the predominant group. A significant change in the utilization of clay resources has clearly taken place. The nature, causes, and implications of this change are unfortunately not so clear. If groups P and N are correctly assigned origins at Zygouriés and on the Korinthian plain, respectively, then it appears that sauceboats and bowls were no longer being manufactured at Zygouriés at the end of the EH II phase. Instead, they were being imported from some distance to the north. The extent and apparent importance of the EH II settlement at Zygouriés, however, encourage one to think that pottery-making might be a likely activity throughout that phase. Could the clay source used for pottery of group N have been located at some point part way between the Gulf of Korinthos (Corinth) and Zygouriés, and exploited by both groups of potters? Or was the change rather one of commercial patterns and activity? It is difficult to tell.

The analysis of a similar suite of samples from Lerna is less informative. Only nine of the 19 reference samples are assigned to groups, and several groups are represented among the objects of both the early and late deposits. No useful deductions can be made from these results. At Tiryns, on the other hand, the results are straightforward: there was no change in clay exploitation between EH II and the Transitional phase. Both sets of samples, TIR 1 through 20 and TIR 31 through 45, belong almost exclusively to the compositional group Q, local to Tiryns.

28. C. W. Blegen, *Zygouriés, a Prehistoric Settlement in the Valley of Cleonae* (Harvard University Press: Cambridge, MA 1928) 96–97; O. Frodin and A. Persson, *Asine, Results of the Swedish Excavations 1922–1930* (Generalstabens Litografiska Anstalts Forlag: Stockholm 1938) 224.

Table 5. Attributions and associations of Zygouriés reference material.

ZYG 7 through 20: sauceboats and bowls from the House of Snails (late EH II).

Sample	*Group*	*Sample*	*Group*
ZYG 7	O	ZYG 14	unassigned
8	N	15	regional
9	N	16	N
10	N	17	regional
11	N	18	(N)
12	N	19	O
13	unassigned	20	M

ZYG 21 through 30: sauceboats, bowls, and ladles from VIII Bothros (earlier EH II).

Sample	*Group*	*Sample*	*Group*
ZYG 21	regional	ZYG 26	P
22	P	27	(Q)
23	N	28	P
24	N	29	P
25	P	30	P

Other EH II Material

Analyses were performed also on samples from other types of objects. These included fine slipped-and-polished ware, animal vases and figurines, sauceboats with unusual decorations, decorated *pithoi* (large storage jars), "frying pans," coarse domestic objects, and construction material. The compositions of the objects varied widely, and most could not be assigned to groups.[29] For the finer wares, this circumstance implies that different sources of clay were used to make the objects. Importation seems likely for many of these, although the possibility cannot be ruled out that certain local clays with unusual properties (and compositions) had been used exclusively for certain specific thin-walled vessels.

A technical explanation is proposed to account for the varied compositions of the coarse wares. Samples of coarse-paste vases were taken because it was hoped that they would provide additional data to establish reference compositions for each site. It was expected that the larger domestic pots (except for transport containers) had been made not far from their place of use and, ultimately, their findspot. It now appears, however, that the distorting effect of temper is sufficient to obscure the connection between the coarse and the fine wares produced at a single site. This, at least, is a more acceptable hypothesis than the one that all the coarse wares and all

29. Detailed attributions have been presented by Attas, op. cit. (in note 4) 352–359.

Table 6. Attributions and associations of Early Helladic III and EH II/III transitional samples from Tiryns, Lerna, and Korakoú.

Pattern-painted Ware			Polished Bowls	
Sample	*Group*	*Ware*	*Sample*	*Group*
LER 42	N	dark-on-light	LER 41	T
43	O	dark-on-light	47	R
44	regional	dark-on-light	48	(S)
45	(S)	dark-on-light		
46	unattributed	light-on-dark		
KRK 42	N	dark-on-light	TIR 79	regional
43	P	dark-on-light	80	(R)
44	N	dark-on-light	81	regional
45	U	dark-on-light	82	R
46	P	light-on-dark	83	unattributed
47	Q	light-on-dark	84	regional

Tiryns Transitional EH II/III Samples			Other Tiryns EH III Samples		
Sample	*Group*	*Shape*	*Sample*	*Group*	*Shape*
TIR 31	Q	bowl	TIR 56	U	jar
32	Q	bowl	57	U	jar
33	Q	bowl	58	(U)	jar
34	Q	bowl	59	U	jar
35	Q	bowl	60	(U)	jar
36	Q	bowl	61	U	jar
37	Q	bowl	62	U	jar
38	Q	bowl	86	U	jar
39	Q	bowl	75	Q	? sauceboat
40	Q	bowl	76	unattributed	? sauceboat
41	Q	sauceboat	77	U	sauceboat
42	Q	sauceboat	85	Q	plain bowl
43	Q	sauceboat	87	U	painted bowl
44	Q	sauceboat	88	U	painted bowl
45	Q	sauceboat			
70	unattributed	pyxis			
73	Q	ouzo cup			
74	Q	ouzo cup			

the fine wares were made at completely different sets of production centers in Argolis and Korinthia or elsewhere. In any case, for sites from which both fine and coarse wares were sampled in quantity (Keramidháki, Korakoú, and Lerna), the majority of the coarse-ware samples did not have compositions that fit the analytical reference composition(s) for that site. Lake Vouliagméni is the exception. The proportion of unattributed and regionally-attributed VOU samples is low compared to those at other sites (TABLE 2), even though many of the objects sampled had coarse or medium pastes. Perhaps this occurs because at that site the paste appears, on the average, to be coarser than at other sites, even for archaeological reference material. Another possible explanation is that in Lake Vouliagméni pottery the inclusions or temper have a composition more similar to the clay matrix than is the case at other sites. Analysis of the separated inclusions would provide useful information in that regard.

The Transition to Early Helladic III

Early Helladic III sherds were sampled from three sites: Korakoú, Lerna, and Tiryns. Two patterns seem apparent from a rapid inspection of the attributions. At Korakoú and Lerna the EH III sherds fell into a number of different groups, many of them made up primarily of EH II material (TABLE 6). At Tiryns a separate cluster, U, of primarily EH III objects has been formed. Closer examination reveals, however, that the situation is more complex, as the sampling criteria were not comparable in the two cases.

Two styles of pattern-painted ware were produced in the Early Helladic III period: dark-on-light and light-on-dark. The first appears to be more common in the Peloponnese, the second in central Greece.[30] LER 46, the only sampled Lerna sherd painted in the light-on-dark style, is also the only pattern-painted sherd left unassigned. Among the other pattern-painted sherds sampled from Lerna and Korakoú, groups N, O, P, Q, U, and (S) (the parentheses indicate that the sample[s] "are associated with" Group S) are represented.

Surprisingly, it is the two Korakoú sherds KRK 45 (dark-on-light) and KRK 47 (light-on-dark) that belong to Tiryns groups (U and Q, respectively), while LER 42 and 43 belong to the Korinthia groups N and O, respectively. Both KRK 46 (the other light-on-dark sherd sampled from Korakoú) and KRK 43 belong to group P. In short, there is evidence for a number of production centers in both the Argolid and Korinthia, decorating EH III vases in both pattern-painted styles. The unusual composition of LER 46 indicates that importing of light-on-dark-painted pots may also have taken place, although from where is not made clear by the analysis.

Polished grey bowls are another ceramic type characteristic of EH III at Lerna and other sites.[31] Three of these were sampled from Lerna: LER 41, 47, and 48. They were assigned on the basis of their composition to groups T, R, and (S), respectively. The Tiryns samples TIR 79 through 84 are also sherds of this ware. Except for TIR 83, which remains unassigned, they were all of regional composition, including one attribution to and one association with group R. Almost all the examples found at these sites, then, need not have come from outside Argolis.

Examples of several other EH III wares were sampled at Tiryns.[32] Jars covered with a thin brown or black slip are the most numerous of these samples. TIR 56 through 62 and 86 are all attributed to, or associated with, group U. In fact they constitute just over half of the group's

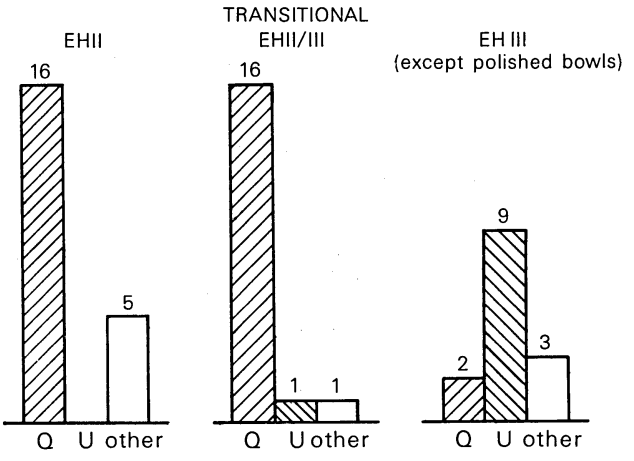

Figure 3. Attributions of Tiryns EH II, Transitional, and EH III samples.

members. The link between U and Tiryns is thus well-established (see section above on group U). Several more Tiryns samples, all from EH III or Transitional deposits, belong to group U as well. TIR 87 and 88, two bowl rims with painted decoration on their broad lips, are among these. Also included are the Transitional (but EH II-style) bowl rim TIR 38 and the sauceboat rim TIR 77, from an "EH III" level. In contrast, two other sherds from EH III deposits (TIR 75 and 76), probably sauceboat bases, are respectively attributed to Q (the main EH II Tiryns group) and unattributed. TIR 85 is the rim of an EH III plain bowl also attributed to group Q. It is notable that almost all of the Transitional sherds belong to that group (FIG. 3). Most of these are EH II-style sauceboats and bowls (TIR 31 through 45), but the two EH III-style "ouzo cups" (TIR 73 and 74) are also members. The only Transitional sherds not members of Q are TIR 38, mentioned above, and TIR 70, a *pyxis* (small bowl) fragment suspected of being a Cycladic import.[33] The composition of the pyxis is unlike any others encountered in this study.

We may summarize the results concerning the EH III samples. Pattern-painted sherds sampled at Korakoú and Lerna have mixed, but almost entirely regional, origins. At Tiryns, sampled sherds from the EH II/III Transitional phase (sauceboats, bowls, and "ouzo cups") mostly belong to the same group as the majority of the EH II sherds, namely Q. From the EH III phase, the brown-slipped jars and both pattern-painted sherds sampled belong to group U, apparently characteristic of that phase at Tiryns. Polished grey bowls of the EH III phase, however, do not belong to group U, having a variety of regional compositions instead. This evidence, admittedly

30. H. Goldman, *Excavations at Eutresis in Boeotia* (Harvard University Press: Cambridge, MA 1931) 116; W. P. Donovan, "A Study of Early Helladic Pottery with Painted Decoration," unpublished Ph.D. dissertation, University of Cincinnati (Cincinnati 1961); D. H. French, *Prehistoric Pottery Groups from Central Greece* (private distribution: Athens 1972) 20–22.

31. J. L. Caskey, "The Early Helladic Period in the Argolid," *Hesperia* 29 (1960) 285–303, especially 296–297; J. B. Rutter, "Fine Gray-Burnished Pottery of the Early Helladic Period: The Ancestry of Gray Minyan," *Hesperia* 52 (1983) 327–355.

32. For discussion of the Tiryns transitional EH II/III and EH III ceramic assemblages, see H.-J. Weisshaar, "Ausgrabungen in Tiryns 1978, 1979. Bericht zur frühhelladischen Keramik," *AA* 96 (1981) 220–256, especially 237–251; idem, "Bericht zur frühhelladischen Keramik," *AA* 97 (1982) 440–466; idem, "Bericht zur frühhelladischen Keramik, Ausgrabungen in Tiryns 1981," *AA* 98 (1983) 329–358, especially 342–353.

33. H.-J. Weisshaar, personal communication, October, 1980.

based on a small number of samples, suggests that at Tiryns the changes in pottery production/acquisition patterns that accompanied the beginning of the third Early Helladic phase were more extensive than those at Lerna or Korakoú.

Conclusions

Summary

The conclusions of this archaeometric study may be summarized in the following 11 points.

1. Ordinary EH II sauceboats and small bowls were produced at all the sites in this study except perhaps Phlious.
2. Distributions of these vases among the sites studied extended in most cases from each production center only to the neighboring sites.
3. Some variations in the distribution patterns within the EH II phase are evident at Zygouriés.
4. Ceramic ladles, characteristic of the earlier part of that phase, seem to have had fewer centers of production, among which one at or near Zygouriés figured prominently.
5. Samples of various special wares from EH II levels, including slipped-and-polished sherds, "plastic" animal representations, and pattern-painted and other unusual sauceboats, often had compositions different from those of the table wares. They were, therefore, made of different clays, probably at different production centers within or outside the region studied.
6. Coarse wares in general (except those at Lake Vouliagméni) could not be attributed to production centers, but in their case it is likely that the added temper has distorted the overall compositions too greatly to allow reliable attributions to be made.
7. EH III pattern-painted sherds sampled at Korakoú and Lerna have mixed, but almost entirely regional origins. Both dark-on-light and light-on-dark EH III wares were manufactured in the NE Peloponnese and this must moderate, to some extent, the previously-deduced geographic division, though regional preferences may, nevertheless, have existed.
8. At Tiryns, sampled sherds from the EH II/III Transitional phase belong to the same group as the majority of the EH II sherds.
9. Brown-slipped jars at Tiryns belong to a separate group, apparently characteristic of the EH III phase there.
10. Polished grey bowls of that phase at Tiryns and Lerna, on the other hand, do not belong to that group but have a variety of regional compositions.
11. The evidence of points 7 through 10, admittedly incomplete, suggests that at Tiryns the changes in pottery production/acquisition patterns that accompanied the beginning of the EH III phase were more extensive than those at Lerna or at Korakoú.

Suggestions for Future Research

This project could be extended in several directions. The geographical coverage could be broadened to include EH II sites to the north, in Boiotia and Phokis; to the east, in Aigina and Attike (Attica); to the SW, in Arkadia, Lakonia, and the rest of the Peloponnese; and to the SE, in the Cycladic islands. This would reduce the proportion of "border" sites in the main area (see the section "Sauceboats and Bowls," above) which might be more likely than "central" sites to receive imports from sources outside the region under consideration. Even within Argolis and Korinthia it should eventually be possible to obtain permission to sample material from more sites, thereby potentially improving the short-range aspect of this trade study. A study on that scale would require certain improvements in methodology. Specifically, larger numbers of reference samples would be needed (resembling the selection from Tiryns, sampled in 1980, when the methodology was more developed than it had been in 1977, the year in which most of the samples were taken). In fact, more samples of every kind would lead to more secure statistical arguments and more reliable conclusions.[34] One aspect deserving particular consideration is the linking of chemical reference groups to specific locations. The analysis of actual clay samples has occasionally been useful in this respect (e.g., at Asine and Lake Vouliagméni) and should be continued where possible. One approach that has not yet been tried is the analysis of kiln debris. Although no Early Helladic kilns are known, material from later periods may be available and would provide firm links between composition types and specific production centers, perhaps applicable backwards to the EH II phase as well.

The extension of the study of regional exchange to earlier and later periods is also feasible. The commercial history of a few sites where habitation continued over a long time span could be examined through analysis of pottery from successive strata. The degree of similarity between the patterns of trade during the three phases of

34. Analysis of more Lerna samples is in progress as part of the Lerna Publications Project. In particular, 150 EH III and Middle Helladic sherds are being analyzed using neutron activation by a collaboration consisting of C. Zerner, J. Rutter, P. Betancourt, M. Attas, and R. G. V. Hancock. M. Attas wishes to thank Jerry Rutter for enthusiastic encouragement to continue this archaeometric research. We all wish to thank Professors Rutter and Curt Beck for useful comments on a draft of this paper.

the Early Helladic period is of particular interest. A problem that has only been touched on in the present work is the nature of the transition between EH II and EH III. Tracing the origins of the new pottery types that appear abruptly in the archaeological record at sites along the east coast of Greece and in the Cycladic islands is a task to which provenance determination by chemical analysis is well-suited. The forms, surface treatments, and pastes are at present undergoing careful study,[35] so that typological evidence can be used to full advantage in selecting the samples and interpreting the results. Key sites include Lerna, Ayía Marína in Phokis, Eutresis and Thebes in Boiotia, Lefkandí and Mánika in Euboia, Ayía Iríni on Kéa, and other Cycladic settlements. At each one the local reference composition(s) would need to be determined and compared to the compositions of the various Early Helladic and Early Cycladic II wares.

Clearly a project of this magnitude must be a collaborative effort if it is to succeed. The cooperation of many archaeologists would be essential to obtain and document the large number of samples required. An automated facility for neutron-activation analysis is equally essential in order to cope with their analysis. Benefits to archaeological research would be many. Along the way to a general investigation of Early Helladic pottery production and exchange, data would be generated that would shed light on problems germane to individual sites or areas.

35. J. B. Rutter, *Ceramic Change in the Aegean Early Bronze Age. UCLA Institute of Archaeology Occasional Paper* 5 (Los Angeles: 1979); J. A. MacGillivray, "Mount Kynthos in Delos: The Early Cycladic Settlement," *BCH* 104 (1980) 3–45; H.-J. Weisshaar, 1981 loc. cit. (in note 32); J. B. Rutter, "Some Observations on the Cyclades in the Later Third and Early Second Millennia," *AJA* 87 (1983) 69–76; J. A. MacGillivray, "On the Relative Chronologies of Early Cycladic IIIA and Early Helladic III," *AJA* 87 (1983) 81–83; J. B. Rutter, loc. cit. (in note 31); the reader is also directed to the several papers in J. A. MacGillivray and R. L. N. Barber, eds., *The Prehistoric Cyclades: Contributions to a Workshop on Cycladic Chronology* (Department of Classical Archaeology, Edinburgh University: Edinburgh 1984); J. L. Caskey, "Did the Early Bronze Age End?," in G. Cadogan, ed., *The End of the Early Bronze Age in the Aegean. Cincinnati Classical Studies* 6 (Brill: Leiden 1986) 9–13.

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