“Hyksos” Trade Connections between Tell el-Dab’â (Avaris) and the Levant: A Neutron Activation Study of the Canaanite Jar

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Introduction

On examination of the enigmatic “Hyksos” (Egyptian ḫk ṭ h wr stw—“rulers of foreign lands”) of Egyptian history and legend, it is clear that Tell el-Dab’â, as ancient Avaris, the capital of the Hyksos in the northeastern Nile Delta (Bietak 1986, 1991a, and this volume), holds and will continue to hold a prime place in ongoing discussions and debates. Tell el-Dab’â is pivotal also because it provides a stratified sequence of occupational and burial remains from the late Twelfth Dynasty of Egypt (late Middle Kingdom) through the Seventeenth Dynasty (the end of the Second Intermediate Period) that can be correlated with contemporaneous developments elsewhere in the Levant and Egypt. Bietak has shown that the major strata and subphases of Tell el-Dab’â fit well with Middle Bronze (MB) sequences at other sites in the Eastern Mediterranean, even though the Dab’â assemblages have a higher percentage of native Egyptian material and a distinctive Syro-Palestinian artifactual repertoire (see also Dever and Kempinski, this volume).

Contemporaneous inscriptions from Tell el-Dab’â are relatively few and shed limited light on historical and cultural developments during the Middle Bronze Age (see Bietak, this volume). Additional information about the role of the Hyksos at Tell el-Dab’â, however, and especially their connections with the Levant, traditionally considered their origin (see Redford, this volume), can be gleaned by other methods.¹ In this chapter, Neutron Activation Analysis (NAA), a very precise physicochemical technique, is used to measure the chemical compositions of the pottery wares for one principal type at Tell el-Dab’â: the so-called Canaanite Jar, or amphora (Fig. 5.1); (Grace 1956; Amiran 1970:102–105, 138–144; Wood 1987; Leonard 1995). Statistical evaluation of the data enables the vessels to be “fingerprinted,” that is, the source(s) of the clay(s) from which they are made and their place of manufacture, are, to a high degree of probability, established. The trade relations between Tell el-Dab’â and other parts of the ancient world, which bear significantly on the economy—even the ethnic origins—of the “Hyksos,” can then be reconstructed and assessed.
The Cultural and Archaeological Setting

The Middle Bronze Age in the Eastern Mediterranean, dating from about 1900/1875 to 1550 B.C., was a period of dramatic development in the urban civilization of the Levant (see Dever, this volume). As will become evident below, special note should be taken of the developments in the "Gaza group of Middle Bronze Age sites" along the southern Palestinian coast (Fig. 5.2, see Oren, this volume). Here, a large number of Middle Bronze city-states were clustered in the vicinity of modern Gaza close to or along the coastal plain. Besides ancient Gaza itself, which is covered by a modern city and has been excavated only to a limited extent, the group includes Tell el-Ajul (very likely Sharuahe, the Hyksos bastion that Ahmose fought and defeated after three years of fighting; see Kempiński 1974), and Redford and Oren, this volume), Tell Jerumim, Tell el-Far'ah South (which has also been identified with Sharuahe), Tell Haror (Tell Abu Hureira), and Ashkelon. Also part of this group, but further to the north and inland, are Tell Bet Marna and Lachish.

Tell el-Dab'a/Araris shared in the MB urban development. This site went from being a relatively small village in the late Middle Kingdom (stratum IIb, beginning ca. 1815 B.C., according to Bietak 1991a) to a huge urban complex of temples, palaces, cemeteries, and residences by the Hyksos period proper (stratum II1/2nd half of b, beginning ca. 1620 B.C.). The expansion of Tell el-Dab'a into one of the largest settlements in the Eastern Mediterranean during the later Middle Bronze Age, encompassing an approximately 2 km² area with a high density of settlement, points to a concomitant growth in population. This demographic increase has been variously explained, as the result of native Egyptians and/or descendants of Semitic clans who worked in Middle Kingdom Egypt (Van Seters 1966) settling at Tell el-Dab'a, or of the infusion of new peoples from Syria-Palestine, in accordance with the Manethonian tradition reported by Josephus. As this NAA study minimally shows, however, intensive trade connections with MB city-states elsewhere in the Eastern Mediterranean were crucial to the economic development of the site.

The Canaanite Jar

The Canaanite Jar (Fig. 5.1) is an apt designation for this pottery type—an ovoid-shaped amphora with two handles, a rounded or slightly flattened base, and a narrow mouth—because it most likely originated in ancient Canaan, a regional name that was closely associated with the Syro-Palestinian coast (Speiser 1956; Landsberger 1967). Indeed, the earliest examples of the type occur there, and their antecedents can be traced back to the handleless jugs of the Early Bronze Age in the same region (Parr 1970). The Canaanite Jar, with a capacity of approximately 30 liters, became the liquid container and the export pottery vessel par excellence for Mediterranean sea trade. With relatively minor modifications of shape, it continued to perform these functions for thousands of years, through Greek and Roman times (Koehler 1995) and up until the Islamic period.

The Tell el-Dab'a Corpus of Canaanite Jars

Based on the 275 Canaanite Jars that were included in the NAA study, the MB amphorae of Tell el-Dab'a are remarkably standardized in their size, overall shape, rim and base profiles, ware, and other features, attesting to a high level of craftsmanship (see "Short Excursus on Canaanite Jar Fabrication and Fabric," below).

The stylistic development of the Canaanite Jar at Tell el-Dab'a is nearly identical to that of other MB sites in Syria and Palestine. For example, the mid-MB IIA through early MB IB rims of the Canaanite Jars, in both the Delta and Palestine, are generally elongated and flaring, sometimes developed on the exterior, and have an exterior ridge (see Fig. 5.1). Lewelflaring rims, which have highly developed interior and exterior profiles, begin to appear in MB IB and are very common by MB BC throughout the Eastern Mediterranean.

What is particularly significant for the pottery sequence at Tell el-Dab'a, however, is that the earliest stage of MB IA in Syria-Palestine appears to be min-
Neutron Activation Analysis and Pottery Provenance in the Old World

The physicochemical method of NAA has been extensively employed in pottery provenience studies, because of its sensitivity and precision in measuring as many as 35 elements, including rare earths that often characterize a clay source, and because it requires very small samples (50-200 mg) that are non-destructively analyzed.

Relating the chemical composition of a particular ancient pottery sample to a given clay source, thereby “fingerprinting” the pottery and its presumed place of manufacture, is based on what has become known as the Provenience Postulate (Weigand, Hachbold, and Sayre 1977:15-341). Briefly, the assumption is made that the chemical variation within a given clay source is less than that between different sources. A native clay, however, was often modified by the ancient potter. Inorganic clastics (temper) or organic materials might be added to the clay body, to improve its workability, driving and firing properties, and functionality (Rye 1981). If these inclusions are relatively “pure” (e.g., quartz, calcite, or strontium), the dihedral effect on the chemical composition of an ancient sample will be spread across the range of elements and correction factors (e.g., least-means fitting) can be readily applied. The addition of complex heavy minerals, which are unpredictable to enhance or diminish certain elemental concentrations, are less easily corrected for statistically.

A range of univariate and multivariate algorithms—means and standard deviations, and correlational clustering, and principal components analyses of at least 15 elements—are used to define local chemical groups of ancient pottery, with widely divergent samples (outliers) being excluded. Archaeological and geological criteria are important in refining and testing these groups, whether they are well-dated pottery types, clay jars per year, or about 20 jars per day. Is it conceivable that so many amphorae could have been imported? To be sure, the overland route through the Sinai, with a well-defined chain of waystations, does not appear to have been in operation during the Middle Bronze Age (see Oren, this volume). Sea transport, especially for heavy loads, would have been an excellent alternative. The harbor at Tell el-Dab'a, although long since silted up, was reached via the Pelusiac branch of the Nile. Based on a systematic program of subterranean drilling by J. Dorrier (unpublished; see Bietak 1991a:28, figs. 1, 2), an intricate system of waterways has been defined around the site, and a harbor area has been located where ships could have been moored. Corroborating this finding, the contemporaneous Kamose stela mentions ships docked together in the harbor of Avaris (see Redford, this volume).

The importation of two million Canaanite Jars by sea over several hundred years is certainly possible, even if shipping had to be confined to those times of the year when the weather and prevailing winds and currents were favorable. Cargoes might vary, but shipment by Canaanite Jars had the added advantage that they could be used as ballast in the holds of ships.

Local production of Canaanite Jars, using native Egyptian clays, might also help to explain the numerous amphorae at Tell el-Dab'a. Although all of the latter are stylistically and technologically similar to their Eastern Mediterranean counterparts, the NAA study readily resolved this issue.

Figure 5.2. Eastern Mediterranean, showing Middle Bronze Age sites and regions referred to in the text. The "Canaan group of Middle Bronze Age sites" includes: (1) Gaza, (2) Tell el-Ajul, (3) Tell Jemneh, (4) Tell el-Far'ah South, (5) Tel Haror, (6) Tell Beit Mernau, (7) Lachish, and (8) Ashkelon.
from specific geochemical regimes, clay beds within a single deposit, or others. For example, cooking pots, as well as walls and kilns of mudbrick (sunbaked clay), are usually made of local clay and are not transported to another site. The NAA analyses of such samples should then serve to confirm a hypothesized local group based on other pottery types. This approach is essential when an ancient clay source has been totally exploited or systematic clay sampling has not yet been carried out in a region. The Middle Bronze Age NAA pottery study includes 578 pottery and clay samples from well-defined archaeological contexts at the key site of Tell el-Daba, the ancient "Hyksos" capital of Avaris (below), in the northeastern Nile Delta (Bietak 1986, 1991a). To date, an additional 760 pottery and clay samples from 55 coastal and inland sites of Syria, Lebanon, Jordan, and Israel—including Ras Shama/ancient Ugarit, Tell Kuel, Tell Mardikh/ancient Elah, Hama, Byblos, Sidon, Kafr Kana, Megiddo, Tel Aphek, Jaffa, Ashkelon, Tell el-Ajjul, Tell Beit Mirsim, Beth Shan, Pella, Jericho, Tell el-Fakhar, Kirbet Um el-Damani, and Ruq el-Hirob (West) in the Baal el-Velay of Transjordan, and Bab edh-Dhra', et al. (Fig. 5.2)—have been analyzed. Another 119 pottery and clay samples have been tested from sites along the Middle and Upper Nile—Kahun and Dabush near Lisht, el-Amarna, Abydos, et al.—that range in date from the Old to the New Kingdom (ca. 2700-1700 B.C.). Previous Brookhaven projects (e.g., Kaplan 1980; Brooks et al. 1974-4880), accounting for 1298 pottery and clay samples from 79 more Levantine and Egyptian sites, complete the data bank for this region.

The days that have thus far been analyzed date from the Lower Cretaceous period to recent times and derive from deposits throughout the Levant and Egypt. The red beds of the southern Palestinian coast region, the yellow limestone-derived clays of the Palestinian hill country, Transjordanian siltstones and kaolins clays, Egyptian alluvial and marl clays, and so on are well represented in the data bank.

In general, our Old World data bank has excellent temporal and spatial coverage of other regions of the Near East and Mediterranean, including the Sudan, Greece, Iran, Iraq, and parts of Turkey. This wide areal coverage, coupled with large numbers of samples for locally defined groups, enables us to apply powerful multivariate statistics to determine the archaeological origin of the Canaanite jars at Tell el-Daba.

It is quite common for the elements in clays and minerals to covary with one another. For example, in nature the high correlation (r=0.99) of iron (Fe) and scandium (Sc), both trivalent ions of about equal size, is well known. Univariate statistics can be very misleading if this relationship goes unrecognized. Two Palestinian clay sources of importance in this study—the red loess clay of the southern coast and the yellow hill country clay—have similar univariate distributions, but have clearly distinguishable Sc/Fe ratios (Brooks et al. 1974-48-80).

If the variance-covariance matrix for many elements of a presumed local group is calculated, a new set of standardized orthogonal coordinates (eigenvectors) can be defined in multidimensional Mahalanobis space that takes advantage of elemental correlations (Harboorte 1931-413241). For the statistical calculations, the oxide data (Table 5.1) were converted to logarithms, since many chemical elements appear to be lognormally distributed in nature, and are also standardized by this procedure (Harboorte 1976). The Mahalanobis distance of a given sample from the origin or centroid of the group is directly related to the probability of the group membership of that sample, assuming a multivariate normal distribution (Snyre 1976).

Using the oxides of 15 elements in the calculations, it has been estimated by comparisons of the large Brookhaven New World pottery data bank (about 10,000 samples) against the Old World data bank (about 5000 samples) that the accidental assignment of a sample at a Mahalanobis distance probability (MDP) of 1% is unf for these two archaeologically and geochemically distinct regions (Harboorte 1931). With the data bank, a series of similar 1% regions, which are the same or related geological processes have been at work, this unique chemical "fingerprinting" is not ensured. But with high correlations between many elements, such as is characteristic of Levantine clays and potteries, it is possible to achieve extremely good results. An MDP above 5% for a sample tested against a group with a high sample number to ratio variable is a strong guarantee that it belongs to that group.

Table 5.1. Neutron Activation Analysis data for selected local Egyptian and Eastern Mediterranean groups: the imported southern Palestinian group of Semi-Pottery pottery types at Tell el-Daba (labeled DARABEL), the Egyptian Nile alluvial clay and pottery group for Tell el-Daba (DARAE), the "Gaza group of Middle Bronze Age sites" (GAZAGR), an Egyptian mud clay that outcrops north of the Fayyim at Qasr el-Sagha (FAYMAR), an Egyptian hill country limestone-derived clay and pottery group (HILLCTR, including clays collected in the vicinity of Yatta, Hebron, Tell el-Falaha, and Amein), and local pottery groups further to the north along the Eastern Mediterranean coast (Sidon, Byblos, and Tell el-Fuusa, as well as inland (Megiddo, several Crete Valley sites (Tell el-Mudeje, Kefela, and Tell el-Jadid), and the Tell el-Qal Valley of Transjordan). For other sites and regions, see the text and Figure 2. Data are expressed as mean percentage by weight (PCT) or parts per million (PPM). The statistical spread (1 standard deviation) is 10-20% of the tabulated value for all elements except the more mobile alkaline and alkaline earths, which change as high as 70%.

GROUP & NcO & PCT & C2O & PPM & NO & PPM & SO & PPM & CO2 & PPM & O2 & PPM & H2O & PPM
GAZAGR 0.855 1.65 49.3 1.45 550 18.9 33.7 73.8 1.71 560 11.30
DARABEL 0.673 1.46 35.8 1.36 604 18.5 33.7 75.6 1.65 547 7.15
HILLCTR 0.337 3.44 80.2 4.21 119 25.1 24.2 59.2 1.40 471 4.25
MEGIDD0 0.469 1.20 55.7 1.02 267 17.1 36.5 59.8 1.53 557 4.81
SIDON 0.267 0.60 69.3 1.45 3408 17.2 32.2 61.5 1.66 617 5.64
BYBLOS 0.317 0.60 52.2 2.52 278 19.4 36.1 78.3 1.56 515 7.64
BIN HANI 1.469 2.52 107.9 5.31 627 32.6 35.1 75.3 1.56 528 4.70
ORONTES 0.532 3.91 139.0 5.38 1211 27.0 61.7 140.9 2.64 785 0.65
BAQAHI 0.279 2.58 72.4 3.58 421 29.6 29.7 64.0 1.47 597 5.82
DARABG 1.671 1.77 45.5 1.20 659 34.1 34.4 72.8 2.22 579 7.64
FAYMARL 1.581 1.20 49.1 2.56 294 29.9 45.0 92.0 2.09 568 9.06

GROUP & TIO & PPM & TFe & PPM & C2O & PPM & MO & PPM & FIO & PPM & CO2 & PPM & CaO & PPM & SmO & PPM & Y2O & PPM
GAZAGR 8.41 1.68 154 551 5.12 23.5 12.1 6.78 5.67
DARABEL 7.66 1.62 149 847 4.92 21.1 15.9 6.52 3.39
HILLCTR 7.41 0.90 123 435 4.75 15.9 9.4 5.62 2.54
MEGIDD0 5.41 1.27 192 822 4.23 20.1 20.1 5.92 2.43
SIDON 6.52 1.62 149 622 4.32 24.6 20.4 6.82 3.17
BYBLOS 9.55 1.36 163 757 5.27 28.6 12.5 7.38 2.79
BIN HANI 11.09 1.38 493 1570 7.52 40.1 12.6 6.32 2.76
ORONTES 20.61 2.52 174 311 6.07 26.9 8.8 12.50 3.98
BAQAHI 8.85 1.78 136 304 6.22 26.6 8.4 6.52 3.05
DARABG 6.67 2.06 189 1409 8.93 42.3 15.9 7.41 3.25
FAYMARL 10.30 2.34 155 388 6.81 24.8 15.9 8.09 3.36
Figure 5.4. Dendrogram, based on a hierarchical aggregative clustering algorithm and the Neutron Activation Analysis means of the oxides of 15 elements for each group (Table 5.1). The mean Euclidean distance (MED) to each node in the dendrogram is listed along the ordinate. It has been empirically established that an MED less than 0.68 is usually indicative of group membership (here, only GAZAGRP and DABAPAL). Note that the imported southern Palestinian group of Syro-Palestinian pottery types at Tell el-Dab’a (labeled DABAPAL), almost three-quarters of which is comprised of Canaanite jars, forms a cluster with the red burn clay groups of pottery from the “Gaza group of Middle Bronze Age sites” (GAZAGRP). More distant groups include the Egyptian Nile alluvial clay and pottery from Tell el-Dab’a (DABAEG), an Egyptian mast clay that outcrops south of the Fayyum (FAYMARL), a Palestinian hill country limestone-derived clay and pottery group (HILLCTR), and local pottery groups farther to the north along the Eastern Mediterranean coast (Sidon, Byblos, and Tell el-Hani), as well as inland (Megiddo, several Orontes Valley sites, and the Baq‘ah Valley of Transjordan). For other Egyptian and Eastern Mediterranean groups, see the text, Table 5.1 caption, and Figure 5.2.

The Neutron Activation Analysis Corpus of Tell el-Dab’a Canaanite Jars

To date, 273 Canaanite Jars from Middle Bronze Age levels at Tell el-Dab’a have been analysed by NAA. This constitutes 48% of the Daba corpus of NAA analyses. The corpus also includes a range of other Syro-Palestinian pottery types—e.g., highly polished jugs and julets, Tell el-Yahudiyeh julets (Kaplan 1980; McGovern et al. 1994), and Levantine Painted Ware (Tubb 1985; Bagh 1988)—that were traded throughout the Eastern Mediterranean, as well as with Egypt, during the Middle Bronze Age. The NAA findings for these types are in close agreement with the NAA study of the Canaanite Jars (see note 3).

Fifteen chemical elements for which consistently reliable data had been collected for each sample at Brookhaven National Laboratory—sodium (Na), potassium (K), cesium (Cs), rubidium (Rb), barium (Ba), Sr, europium (Eu), thorium (Th), hafnium (Hf), manganese (Mn), cobalt (Co), chromium (Cr), Fe, samarium (Sm), and ytterbium (Yb)—were used in the MDP calculations. Not correcting for dilution or concentration effects, 201 Canaanite Jars were determined to have MDPs ranging between 6.8% and 99.8% (average of 56.8%) of belonging to a tight chemical group of 268 Daba pottery vessels, also including the other important Syro-Palestinian types (noted above) that were recovered from Middle Bronze Age levels at Tell el-Dab’a (see Table 5.1).

Thirty-six Middle Bronze Age pottery samples from the “Gaza group of Middle Bronze Age sites” (Fig. 5.2) form a tight chemical group with 14 red burn clay group of the region (Table 5.1). Using the mean concentrations of the oxides of 15 elements, the MDP that the Ebus group of pottery and class belong to the large, well-defined Daba group is 98.8%. Remarkably, all other well-defined local groups in the Old World data bank had a 0% probability of belonging to the Daba...
group. It is virtually certain, therefore, that a large number of the Canaanite Jars found at Tell el-Daba were made in southern Palestine and exported to the northeastern Nile Delta.

The MDPs can be partly represented by two-dimensional graphical representations, such as the dendrogram in Figure 5.5, which was generated by use of a hierarchical-agglomerative clustering algorithm based on the same 15 elements. The dendrogram shows the tight groupings of the MDPs, which are included in the larger Daba southern Palestinian group, and the Gaza group. The Nile alluvial group of pottery from Tell el-Daba, a marly clay deposit that outcrops north of the Fayum (Fig. 5.2) as the Qar el-Sagha formation of Pleistocene date (Tobia and Sayre 1975), is also included. This is a Palestinian hill country limestone-derived clay and pottery grouping (including clays collected in the vicinity of Yatta, Hebron, Tell el-Jihl, Gibbon, and Arabi; and local pottery groups further to the north along the Eastern Mediterranean coast (Sidon, Byblos, and Tell Ibn Hani) as well as inland sites (the Jordan Valley, several Orontes Valley sites (Tell Mishref/ancient Qanna, Selimieh, and Tell `A); and the Baqqah Valley of Transjordan) are all very far from being MDPs.

The relative proportion of amorphous coming from southern Palestine remains very constant in each Middle Bronze Age phase, ranging between 75% and 81%, up until MB IIC, when it drops to 54%. Because of the homogeneity of the red loess clay in this region, it is extremely difficult to isolate specific sites or workshops that produced the amorphous that eventually made their way to Tell el-Daba. In MDP space, it may be noted that the locally defined groups at Tell el-Ajjul and Askheho (see below) are essentially close to many of the Daba specimens.

The only other region that is consistently represented in the MDP data is the southern Levantine/Palestinian elements used in the MDPs. However, MDP and MDC calculations reflect natural variability in clay beds, clay preparation by ancient potters, and the architecture of the settlement or the pottery production in establishing definite and possible proveniences of samples, then there would be fewer questionable proveniences due to the consistent reference groups and more misassignments of individual specimens.

The caution that needs to be exercised in interpreting the statistical results for the early MB IA aphorism is highlighted by a recent followup NAA study of Tell el-Daba pottery vessels that were specifically selected because of their early Middle Bronze Age date and the probability that they were imported from Levantine regions outside southern Palestine. The 20 additional MB IA Canaanite Jars of this followup group are comparable in type, ware, and other features to the larger amorphous corpus but some were excavated from strata d1 and d2 in area F at Tell el-Daba, and of them could be assigned to the southern Palestinian group, in addition to 1 example possibly deriving from southern Palestine, 1 example being made of Qar el-Sagha marl clay, and 2 examples lacking any provenence. Clearly, the relatively high proportion of aphorisms with questionable origins in the followup study (20%) is much less than that for the early MB IA aphorisms in the larger corpus (70%), and accords with the percentages of aphorisms with uncertain provenence in the Middle Bronze Age. As a final note on this followup NAA study, the additional aphorisms from late MB IA strata d1a in area F, 2 definitely from southern Palestine and 2 possibly from this region.

Seven MB IA specimens from Askhelon were also recently analyzed, because this important southern Palestinian coastal site was poorly represented in the data bank. Of these specimens, 4 examples (two Canaanite Jars, a polished jing/jar, and a handmaid cooking pot) fell squarely into the southern Palestinian group, as might be expected from Askhelon's geographic position at a short distance north of Gaza. A Tell el-Yahudia example belonged to the Egyptian Nile alluvial clay group defined at Tell el-Daba, and was therefore very likely an import from Askhelon. The remaining 2 samples (both Canaanite Jars) were of uncertain Provenience. The close correspondence of the Askhelon results and those of the followup Daba study serves to reinforce the main conclusions already reached.

The importation pattern of Canaanite Jars, apparently once having been established in MB IA, continues along much the same lines in succeeding MB phases. The vast majority of the specimens come from southern Palestine, with the occasional possible import from Lebanon. Two major pottery types, made of Nile alluvial clay increasing somewhat toward the end of the period, Inland and coastal Syria is represented by two Canaanite Jars in MB IIA-B possibly originating from the Tell Mandikh/Elba region, and by a single example possibly from Tell Ibn Hani in MB Ib.

A comparison of the results from the macroscopic size observations (see "Short Excavation on Canaanite Jar Fabrication and Fabric, " below) and the NAA analyses is also instructive. There is excellent agreement for the imported (type IV) and Nile alluvial pastes (type I). Queried examples of subtypes Ib and Ic are definitely from southern Palestine. Very occasionally, Egyptian marl fabrics (type II) are confused with imported wares: two MB IA aphorisms, which were classified as subtypes Ib and Ib, derive from southern Palestine, according to the NAA results.

Conclusions

One aphorism definitely was imported from Tell `Ara in northern Lebanon, and another possibly derives from Ruseisel along the southern Lebanese coast. Other vessels present in the northeastern Nile Delta during the period from the later Middle Kingdom through the Second Intermediate Period. To summarize, 24% of the Canaanite Jar corpus (201 examples) were imported from the "Gaza group of Middle Bronze Age sites" in southern Palestine, having been made of the native red clay of this region. By contrast, pottery definitely or possibly originating from Syria or Lebanon is virtually nonexistent in the Daba group that was tested.

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Short Excursus on Canaanite Jar Fabrication and Fabrics

Some amphoras out of 374 examples were assigned to Nile alluvial clay type I (Nile R2 in the Vienna System). Subtype 142 is a reddish-brown paste, with a considerable quantity of quartz inclinations (ranging in size up to 1 mm) and fine to medium-sized organic matter (up to 3 mm) that probably derives from animal dung. Subtype 143, similar in other respects to 142, has large straw voids (sometimes exceeding 7 mm in length). Representing an even smaller percentage of the total amphora corpus, three amphoras were assigned to Egyptian marl ware—types II-a, II-b, and II-c (Marx AS, C, and an unidentified type, respectively, in the Vienna System). Marl II-a and II-c are usually light reddish or grayish in color, and contain moderate amounts of fine calcite that can be decomposed, creating irregular voids in II-a wares and elongated pores with vitrified streaks in II-c wares. II-b wares, on contrast, are reddish-yellowish, and have no visible calcite inclinations and relatively more quartz and other inclinations.

Acknowledgments

The vast majority of the pottery samples in this NAA study were run at Brookhaven National Laboratory between 1984 and 1986 under contract DE-AC02- 76CH03073 with the U.S. Department of Energy. Additional samples have recently been analyzed at the University of Missouri—Columbia Research Reactor (MURR); under the direction of M. D. Glasscock, with support from the Department of Energy and National Science Foundation grants (BNS-8901707 and DMR- 9101061). Statistical evaluation of the data, employing the battery of programs developed at Brookhaven, were carried out on the University Museum VAX computer, with the support of P. Chase. More recently, a dedicated PC, equipped with both the Brookhaven programs and the GAUS programs written by H. Neff at MURR, has been used. The map and other graphics were prepared by P. Zimmerman of MASCA using CANVAS 4.0 on an Apple Macintosh computer.

The authors are especially grateful to Manfred Bietak for his support of this project. The administrative staff at the Austrian Institute in Cairo, the excavation team at Tell el-Dab'a, and colleagues in Vienca, in particular Irmingard Hein and Vera Möller, have contributed to the success of this project. Although space limitations preclude their mention here, we wish to thank the many other individuals who have provided invaluable samples and shared their expertise—at least, they know who they are, and they will be formally acknowledged in the monograph that is now being prepared.
Special Dedication

A larger neutron activation program of analyses focusing on the "Hykos" during the Middle Bronze Age, of which this study on Canaanites in the Near East was a part, was begun by the late Mrs. Joan Huotno, Joan, who chose this subject for her Ph.D. dissertation at Columbia University in the Department of Art History and Archaeology, under the supervision of Professor Edith Porada. She participated in several seasons at Tell el-Dab'a/Avaris in the northeastern Nile Delta, the long-term project of the Austrian Archaeological Institute in Cairo under the direction of Dr. Manfred Bietak, where she collected ware samples from a range of Syro-Palestinian pottery types, many of which were presumably imported into the site. She also traveled to museums and archaeological sites in many European and Middle Eastern countries, as a part of her Eastern Mediterranean sites. Back at Brookhaven National Laboratory, she assiduously processed the samples for NAA, and had already carried out a considerable amount of background research in her health, until she died in the fall of 1987. Since Patrick McGovern had long collaborated with Joan and Gar Harbottle at Brookhaven, with both concurrent and avid support of her work, and Biak, he undertook, in collaboration with Dr. Harbottle, to complete the research that Joan had begun. It is with great affection for Joan, and in recognition of the excellent piece of research that she initiated, that we dedicate this "firstfruit" of the Hykos Neutron Activation Analysis Project to her.

Notes

1. For example, precise physicochemical characterization of a range of archaeological materials from an archaeological site, locational analysis, ethnoarchaeology, paleogenetics, and many other approaches have proved invaluable in reconstructing craft activity and organization, socioeconomic structure and development, ethnic affiliations, foreign relations, diet and disease, and so forth (see McGovern 1989, 1995).

2. The dates cited in this chapter follow the so-called middle chronology of Weingarten (1992) and Kishen (1987) for the start of the New Kingdom/Late Bronze Age.

3. This study is a summary version of a chapter for a monograph now in preparation, The Foreign Relations of the "Hykos": A Neutron Activation Study of the Middle Bronze Pottery from Tell el-Dab'a (Ancient Avaris), Untersuchungen der Zweigstelle Kairo des Osterreichischen Archiologischen Institutes, Vol. 9, Vienna. This publication will provide full particulars for each pottery vessel (regional numbers, archaeological context and stratigraphic information, illustration, NAA data, and provenience assignment based on MED and MDP). The vessels included in each local NAA group will also be documented, together with a more indepth treatment of the statistical evaluation of NAA data.

4. Compare the stacking of the amphoras in the hold of the Uluburun Kaş shipwreck, a Late Bronze Age merchantman that sank off the southern coast of Turkey (see Pulak 1988; Bass et al. 1989).

5. Information on sample preparation, irradiation procedures, and processing of gamma ray spectra can be found in Abascal, Harbottle, and Sayre 1974; Harbottle 1976; Weingarten, Harbottle, and Sayre 1977; and Glasscock 1992.

6. The mean Euclidean distance (MED) is defined as the square root of the sum of the squares of the distances between the log elemental concentrations of any given pair of samples.

7. "Possibly from southern Palestine" indicates that the closest match in MED multidimensional space is a sample from the "Gaza group of Middle Bronze Age sites," which is within a distance of 0.88-0.10 from the Tell el-Dab'a sample. Samples of questionable provenience that are possibly from some site or region are potentially important, but more sampling and further study is needed before any definitive conclusions can be drawn.

References


