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## **Late Bronze Age Alalakh and Cyprus: A relationship of metals?**

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*The excavations at Tell Atchana (ancient Alalakh) brought to light the capital of a small Bronze Age regional state called Mukish dating from c.2200-1300 BC. The archaeological finds represent aspects of its lively international discourse with far-flung areas such as Cyprus, Crete, Mesopotamia, Hittite Anatolia, and Egypt. This paper aims at sparking a dialogue on the notion that objects and the technical knowledge of making them elucidate long-distance relationships deeply embedded in the social order. The production of fine artifacts such as metalwork, glass, faience, and ivories was under palace patronage. At the same time, trade, diplomacy, warfare, and interregional networks all contributed to the transport of materials across great distances in the ancient Near East. Several analytical techniques have aided in the reconstruction of these trans-regional activities. In particular, Lead Isotope Analysis, ICP-MS, the use of Scanning Electron Microscopy (SEM) and polarizing light microscopy, have highlighted the technical knowledge and artistic choices of Alalakh's artisans in the production of objects of power and prestige. Within this framework, new information is presented about the sources of raw materials in the Amanus and Taurus Mountains.*

It is an honor and a pleasure to be here in Cyprus at James Muhly's conference. His seminal publication, *Copper and Tin*, became the catalyst for my dissertation research at Columbia University and many decades later I still refer to his work if only to look up references to Alalakh metals. While we have disagreed about the tin deposits in Turkey (Muhly 1993, Yener 2000 and references) and there are new tin mines identified now at Hisarcık near Kayseri (see below, Yalçın and Özbal 2009<sup>1</sup>), Jim and I have always enjoyed warm, collegial relations. He has been a worthy adversary-- thank you Jim for all your inspiring work.

This presentation focuses on the many 2<sup>nd</sup> millenium BC interactions between Cyprus and Alalakh, a much-discussed and well-known archaeological fact for a long time. Just to illustrate this relationship with 2009 season finds, Cypriot pottery continued to be found at various loci from the MBIIC through the LB II<sup>2</sup> (Fig. 1). An especially important early connection found in 2008 is a White Painted V Framed Broad Band style jar (Fig. 2) dated to the local transitional MB II-LBI. Instead of reiterating the oft-

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<sup>1</sup> The important tin source within the Erciyes volcanic complex is at Hisarcık, Kayseri and have brought the location of tin deposits to within miles of the Kanesh trading system. The Hisarcık source is reportedly a mining complex and moreover Sarp and Cerny (2005) announced the identification of a new mineral, Yazganite, containing tin associated with arsenic and iron. We eagerly await news of this mineral which contains 1.55% tin and the antiquity of the mining operations there.

<sup>2</sup> I thank Mara Horowitz and Ekin Kozal for help in identifying the ceramics of Alalakh.

repeated ceramic parallels, however, this paper discusses information stemming from new sets of research aims at Alalakh. This includes the fine-tuning of its chronology in general and in particular, certain examples are given of material culture, analyses, and environmental information that will augment the discussions about Cypriot-Alalakh interconnections.

The excavations of Alalakh represent the first phase of long-range, broadly-based archaeological investigations in the state of Hatay, Turkey, once known as the plain of Antioch and today called the Amuq valley. Tell Atchana is located at the south center of the valley close to the bend of the Orontes River and The site was once the capital of a small regional state called Mukish. The cultural dynamics of the second millennium BC are encapsulated in the local sequences for the Middle and Late Bronze Age dating from c.2200-1300 BC. The exotic materials found at Alalakh were aspects of a capital city indicative of its lively international discourse with far-flung areas. These included Cyprus as well as the Aegean, Syro-Mesopotamia, Anatolia and Egypt. The field projects in the Amuq have now presented an opportunity to examine the various dimensions of these traditions in this culturally rich and historically significant region of the northeastern Mediterranean.

The new round of research at Tell Atchana, ancient Alalakh, began in 2000 and six seasons of excavations have been completed from 2003-2009 (Yener 2010). The last four seasons were conducted under the auspices of the Turkish Ministry of Culture and Tourism, Koç University in Istanbul, and the Mustafa Kemal University in Antakya. Alalakh was originally excavated by Sir Leonard Woolley from 1936-39; after World War II the work continued from 1946-49 for the British Museum and Oxford University (Woolley 1955). The current project's reactivation of research at Alalakh was designed as three tiers of investigation. The first tier is the on-going exploration of regional and interregional transformations. To that end, the Amuq valley sites originally surveyed by Robert Braidwood in the 1930's were revisited and geoarchaeological surveys continued from 1995 to the present (Yener 2005 and references).

The second aspect of the comprehensive restudy was to continue refining the chronology of 2<sup>nd</sup> millennium BC levels represented at Alalakh. By so doing, a more nuanced understanding will emerge at the site level of research, that is, defining household economies and the management practices of the palace as a complement to textual information. The third arm of research is aimed at sparking dialogue about the nature of evidence, interpretive modes, and practices within disciplines such as archaeology, instrumental analysis and history. The comparisons at the heart of this conversation concern the varying roles of artifacts and cuneiform texts at the Bronze Age capital, Alalakh. This aspect emphasizes the notion that objects and the technical knowledge of making them magnify relationships deeply embedded in the social order. The production of fine artifacts such as sophisticated sculpture, metallurgy, glass, faience, and ivory carving were under palace patronage. This paper will argue that exchange during the time when an elite social class was in residence in Alalakh and just beginning to emerge in Cyprus included far more than just pottery and would benefit from the study of other material production.

Alalakh has yielded material evidence reflecting the specialized skills of its ancient population not only to make high status items, but to organize production and the

importation of exotic materials, and control technical knowledge (for the concept see Baines and Yoffee 1998, Helms 1993). In particular, exquisite examples of silver-plated bone artifacts and colorful ivory-inlaid furniture were found at Alalakh. Thus a myriad of pigments, mother of pearl, and silver plating on bone inlays were played off each other and juxtaposed with the brilliant white, red and blue/green ivory materials. These polychrome traditions constituted the visual hyperbole of indigenous MB Alalakh furniture styles (Yener 2007b).

Ore sources and production techniques of metal artifacts of power and prestige from Alalakh have been the topic of investigation over the last several years (Özbal 2006, Kuruçayırılı and Özbal 2005). Results of lead isotope analysis on a number of copper based samples demonstrated the Taurus Mountain sources as the major supplier, rather than the closer Amanus sources (Yener 2010)<sup>3</sup>. Given the extraction and supply of silver, gold, copper and tin from the Taurus Mountain mines to the Amuq sites going back to the 4<sup>th</sup> millennium BC, the network was well-established and well-traveled for thousands of years. The results of lead isotope ratios revealed scores of isotopic similarities, but three artifacts are mentioned here that bear particular relevance to the topic. The Judaïdah high tin bronze figurine silver helmet dated to 3000 BC, the LB Hala Sultan Tekke silver samples from Cyprus, and a Mycenaean stag vessel (Yener 2007a, Yener et al 1991, Sayre et al 2001, Sayre et al 1993) were all supplied by the 'silver mountains' of Hittite, Akkadian and Babylonian legend, the Taurus.

However, were the precocities exchanged mostly metal related? The common impulse among archaeologists has been to point to ceramic evidence, architecture, and metal. The inclusion of vitreous materials and the reinterpretation of old data are vital to expanding our understanding of this dynamic international period in the Eastern Mediterranean. This paper presents evidence from the recent study of glass and faience. These and other vitrified materials were found in great profusion at Alalakh mostly in the form of beads and vessels but also production debris. King Idrimi was a vassal of Baratarma, king of the Hurro-Mitannians, and painted Nuzi ware are often associated with their cultural sphere. Some elaborate painted versions were decorated with rosettes and papyrus reeds and were given a special name by Woolley; he called it Atchana ware (Woolley 1955: Pl 102-7). Nuzi ware also comes in glass, such as examples from Tell al-Rimah, and several fragments of similar vessels have been found at Alalakh (Woolley 1955: 298) previously and in the 2009 season (Fig. 3). The polychrome (red-yellow-blue-white) zig-zag pattern on one of the fragments is identical to the Rimah vessel, while the others approximate willow and plant motifs paralleled by frescoes from the Alalakh Level VII palace. Another example of glass from 2003 was a Mitannian-style seal fragment (Fig. 4) with an inscription (a-a-am-me-DINGIR = "Where is 'Ammu, my god? Collon 2010) suggesting it belonged to royalty.

Glass production technology and the types of furnaces that may have been used have long been a topic of interest for archaeologists working in the eastern Mediterranean and

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<sup>3</sup> Muhly (1972) discussed various textual references mentioning copper from Kel Dağ (also known as Jebel el-Akra, Mount Cassius, Mount Hazzi) the majestic mountain down river from Alalakh at the mouth of the Orontes River on the Mediterranean coast. This mountain is often associated with the weather/storm god, Teshup and his manifestation Baal-Sapan known at Ras Shamra-Ugarit. Indeed, in 2006 a survey undertaken in collaboration with H. Pamir of the Mustafa Kemal University at Yayladağ at the foot of Kel Dağ have turned up mines and sites with copper slag, copper production residues and Bronze Age pottery.

Egypt. The majority of Near Eastern glass tends to have a soda, lime, and silica chemical composition, ( $\text{Na}_2\text{O}-\text{CaO}-\text{SiO}_2$ ). The furnace temperature would be held above 1300 degrees centigrade for several hours while the mixture liquefied. The temperature would subsequently be reduced to increase viscosity before removal, cooling and solidification. Production of ancient glass is believed to have been an imitative industry wherein metallic compounds were added to achieve the appearance of precious and semiprecious stones (Moorey 1994).

Faience, found in many sophisticated forms at Alalakh (Lilyquist 1993) is produced with the same raw materials as glass but employs a different set of processes. Frit describes an unglazed object with a polycrystalline core, as well as the first stage of production in glass technology. A batch of frit is calcium, silica and flux mixed together in a crucible and heated at approximately 750 degrees centigrade to initially release impurities. Glaze is a layer of fully fused glass that is separate from the material it encases. The earliest examples on beads were likely a result of high temperature fusion of alkali on silica.

Faience, unlike glass, never reaches a homogenous, liquid state. The materials are merely sintered for several hours at 850-1000 degrees centigrade. Experimental archaeology has demonstrated that these temperatures could have been achieved by pottery kilns typical of the ancient Near East (see discussions in Caubet et al 2007). Sintering entails that minimal portions of the material are liquefied, cementing together the remaining matrix during the cooling phase. Faience may then be modeled by hand or pressed into a mould prior to hardening.

While it appears that some furnaces specifically for glass have been found in Egypt at Qantir (see Rehren's contribution in this volume, Shortland et al. 2007), other production zones are still as yet uncertain (Rehren et al. 2001). Early attempts to distinguish Egyptian (mostly from Amarna) from Levantine glasses through compositional analysis were successful in achieving separate clusters (McGovern et al. 1993). Later refinements in analysis yielded nuances between Brak and Nuzi (Mesopotamian) and Egyptian glasses by using Cr and La ratios (Shortland et al 2007: fig 4). Recently the use of strontium isotope ratios have been successful in suggesting separations between Brak and Nuzi glasses (Degryse et al 2009), although a third mystery site still is as yet not identified<sup>4</sup>.

During Woolley's excavations, glass production debris had been unearthed and stored in the Woolley dig house depot on site. The amorphous glass debris suggested the possible existence of a workshop operation producing glass or faience. In 2003 and 2004, craft quarters were excavated which yielded a diversity of furnaces dated to the LBII. Representing a diversity of shapes, sizes and materials these structures all had differing "furniture" that is, internal components perhaps indicating a variety of thermal functions. Some were obviously ceramic kilns but others have unusual shapes. One impressive square kiln had 12 hot air flues leading to the lower chamber, while others were oval, oblong and contained only one chamber (Yener and Yazıcıoğlu 2010). In the hopes of understanding the function of these installations, samples were collected from the kiln linings and other vitrified materials. Scattered throughout the area were vitrified slag globules, ash, and other evidence of high temperature events such as crumbly, brittle, reddish-yellow clay components of the kilns.

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<sup>4</sup> Samples from Alalakh were sent to Katherine Eremin and her team and we await the results of these analyses.

Preliminary analyses of these materials revealed that they represented the product of silica encountering high temperatures. While some vitrified slag had not reached a liquefied state needed to make glass, the possibility existed that they may be the remnants of a frit batch mixed prior to the addition of alkali flux in a two-step glass-making process. Analysis of the vitrified material from one of the thermal installations indicated that the furnace was certainly hot enough to produce glass.

To ascertain the chemical composition, the sample was examined with the scanning electron microscope (SEM, Fig. 5). Portions of the slag sample that were not embedded were ground into powder for X-ray diffraction (XRD) that would indicate mineral phases and crystallography. Although not definitive, XRF showed the composition to be consistent with glass and faience and the XRD yielded peaks of crystalline mineral phases (Fig. 6) as opposed to an amorphous curve for pottery (Hisset, unpublished paper). Even if further analyses indicates that they are an accidental formation or even more important, prove to be the outcome of an intentional process for making faience or glass, it is important to note that the knowledge and control necessary to achieve and maintain such a high thermal event did exist at Alalakh.

Glass beads from Alalakh show a diversity of coloring and varieties. One in particular has a bright shimmering hue which is quite unusual. While it has not yet been analyzed, the use of chromite as a pigment was revealed to have played an important role in several LB vessel fragments from Deir 'Alla in Jordan, rendering similar shiny effects. When analyzed, the Deir 'Alla vessel fragments yielded high levels of chrome (Groot et al 2006) prompting the authors to note its importance as well as query the source of the chrome since Jordan does not have a known chrome source.

Due to the high temperatures necessary, chrome was not a metal which could be smelted in antiquity and myriad chrome mines encountered during our archaeometallurgy surveys in the Amanus Mountains in the 1980-2006 were never given much attention. However, as a colorant for glass, the relevance and importance of these mines became apparent. The chrome mines are located in the east facing Amanus mountain range, which run NS blocking the Amuq valley and Alalakh from the Mediterranean Sea. These mines (Figs. 7 and 8) were important sources of chrome during World War II when great quantities of ore were extracted and intensively guarded.

Copper based metal finds from graves, as well as floor contexts demonstrate interesting metallurgical practices at Alalakh. From Woolley's excavations, twenty copper based and silver artifacts had been previously analyzed from Middle and Late Bronze Age levels by Moorey and Schweizer (1972). Using wet chemical methods and optical emission spectroscopy as well as X-ray fluorescence, the main alloying elements tin, arsenic and antimony were sought after. Only one knife blade was a ternary bronze from Late Bronze Age II levels with 1% As and 17.5% Sn. Arsenic levels hover around 0.9-0.8% in a majority of the tin bronze samples which is suggestive of low detection limits for arsenic in comparison to later techniques.

New analyses by H. Özbal of forty-three bronze weapons, tools and ornamental artifacts as well as ore and slag, using atomic absorption, augmented some of the trends detected previously. He concluded that 53% of the artifact samples contained more than 2% tin fitting into the traditional definition of bronze. Interestingly, 18.6% of the samples also contained over 1% arsenic as well. Most of the samples contained arsenic

from 1-2%. These bronzes also contained 2% tin (Fig. 9). This was confirmed by Selover (2010) with 15 samples taken from Alalakh toggle pins.

Contemporary bronzes from Tarsus and Mersin in the kingdom of Kizzuwatna also exhibited the same use of both arsenic and tin, reflecting distinctly similar strategies with the above defined production practices for bronzes at Alalakh (Özbal and Kuruçayırılı 2006). A number of factors may explain the prevalence of ternary bronzes at Alalakh in its corner of the Hittite empire, such as the accessibility of alloying metals and ores (variously tin, arsenic, lead or antimony). For example, the frontier zones of the Hittite Empire were perhaps not within the imperial distribution or production nodes during the period towards the end of the empire and scrap metal was used. But a particularly cogent reason for the prevalence of ternary bronzes may simply be production habits, that is, bronze was just made this way in this corner of the northeastern Mediterranean. In fact, this region may have had access to Yazganite from Kayseri, mines which yielded 3rd and 2nd millennium pottery (Pehlivan and Özbal personal communication)<sup>5</sup>. However, unless more bronzes from centers within the Hittite core region are analyzed, distinguishing Hittite production practices from its immediate vassals and peripheries will be difficult to ascertain.

Iron fragments are amongst the many metal finds at Alalakh. Iron ore (Yener 2007c: Fig. 105) from the Palace Level IV and samples from new excavations in LB contexts are presented here as an homage to Jim Muhly's *Coming of the Age of Iron*. The sources of the iron artifacts are as yet to be determined, but the Amanus Mountains are replete with iron mines (Çagatay et al 1991). However, another intriguing possibility has recently arisen. Today, the Orontes River runs 500 meters west of the site and a quick experiment with a hand-held magnet revealed that the river's sands contain magnetite, an iron ore. Özbal (personal communication, 2009) suggests that it contained at least 20% iron content. Tylecote's (1981) prescient article on the iron sands of the Black Sea was one of the major contributions in rethinking iron-containing sand as a possible source material in the beginning of iron metallurgy.

To make the Orontes River even more intriguing, a series of sediment cores initiated by D. Ryter of the USGS suggested that the river looped around Alalakh in the Middle and Late Bronze Age. This gives more credence to the use of the Orontes as a river transport in the Bronze Age and it would also bring explanatory power to the anomalously high amounts of Cypriot ceramics at Alalakh. This was confirmed by Kozal (2010) who found that Alalakh had more Cypriot pottery types and quantities than any of the excavated sites on the coast of Turkey.

In conclusion, the excavations at Alalakh provide a unique laboratory to integrate three levels of research: interregional, the site and the artifact. The finds that suggest palace patronage of crafting luxury items from raw materials certainly link the site to Cyprus. In terms of relational associations, intriguing signs of specialized production and some type of fluid but unspecified form of exchange; maybe ideas and religious practices, technical knowledge, as well as perhaps exchange of spouses and crafters, existed between various regions and Alalakh. It is within this context that the metals and minerals of this corner of the northeastern Mediterranean begin to make sense.

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<sup>5</sup> The Hisarcik pottery identifications were made at Kültepe/Kanesh by Professor Kutlu Emre, former director of excavations.

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