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PAPERS PRESENTED AT THE 1997 ASOR ANNUAL MEETING

LEIDEN UNIVERSITY - THE NETHERLANDS

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INTRODUCTION

Ethnoarchaeology and experimental archaeology

Ethnoarchaeology is the study of extant peoples engaged in any activity relevant for clarifying the human behavior that contributes to the form, finish and function of artifacts. It is a natural partner to experimental archaeology, in which one attempts to recreate ancient artifacts, technologies and associated to learn about the relationship between human and material culture regardless of time and place. Ceramic ethnoarchaeology often involves studies of traditional potters, i.e. those who work without the use of modern technology, for the purpose of investigating a wide range of subjects related to pottery production, decoration, distribution, use, reuse, and discard, among other topics.

Ethnoarchaeological research is relevant for studying archaeological pottery since all potters, past and present work with clay as their raw material. Their primary goal is to create usable containers. Rather than an endless variety of manufacturing techniques and surface treatments, potters worldwide have at their disposal a relatively small range of production strategies and decorative finishes. Within the limited technologies available to potters, however, many variations are possible. Potters learn to cope with the clay and adapt their products to the clay. For example, the global use of coiling to shape pots has been documented, but not in all instances do the potters work in precisely the same way. Variations abound in coil manufacture. Coils can be long or short; thin or thick; added clockwise or counter-clockwise; inside, outside, or on top of the previous coil; coil joins can be left visible, be smoothed away or worked into a decorative pattern; and coils might be used with some other shaping technique such as a mould. These are some of the choices available for coiled wares alone. Within the technique of mould manufacture, a practice used on all continents either in the past and/or present, the possibilities for variation include, but are not limited to: flexible or solid mould; large or small; deep or wide; lined or not; and clay applied on the interior or exterior. Traces of the mould can be intentionally erased or left visible. Each particular set of strategies, which constitutes the technique of the potter inherited from one generation to the next, represents an individual pottery tradition.

One goal of those who study ancient ceramic technology is to identify different yet co-existing traditions of pottery manufacture within a region. If one excavates an assemblage of similar looking coil-made pots fashioned from long thin coils added in a clockwise fashion, and a second contemporaneous group of pots almost identical in appearance, but whose coils were applied counter-clockwise, one might conclude, all

Newsletter of the Department of Pottery Technology (Leiden University) 16/17, 1998/1999: 5-11.

other things being equal, that the work of two individual potters or workshops has been identified. To learn to recognize different techniques and sources of variation in the technology, in the human behavior responsible for that technology and in the resulting product, archaeologists benefit from observing traditional potters at work. But rather than merely observe and record the manufacturing process, ethnoarchaeological projects are designed to address well defined issues relevant to ancient pottery and the society in which it was produced and used, such as: who teaches whom to make pottery; how standardized are the wares of craft specialists versus domestic potters: how is clay prepared or manipulated prior to use (is anything added or removed); or how far do pots travel from the source? Each issue has direct impact for our classifications of archaeological wares and attempts to reconstruct ancient technologies and economies.

In descriptions of ancient wares, archaeologists devote considerable attention to the non-plastics (tempering materials) found in the clay. It is normally aside that in antiquity potters typically would devote careful attention and considerable treatment of the raw material before it could be used. This is generally accepted as a necessary stage in pottery manufacture. After the clay was excavated in antiquity, it would be dried to remove the largest rocks and organic material before it was soaked and sieved. Additional rocks and organic material could then be intentionally added by the potter or an assistant. Whatever was added to the clay was done so with a purpose to either enhance the workability of the clay, its ability to dry and fire without damage, or its post-firing performance.

It is without question that sometimes potters or their assistants add non-plastics. In some parts of the world, potters add carbonaceous inclusions, in the form of shells, calcite, etc., to clay used for shaping cooking pots. Grace Crowfoot (1932) documented this practice among the potters of Samaria some 70 years ago. Another material at times intentionally added to clay for the purpose of souring it to enhance its workability involves the use of organic matter, in the form of chaff, dung, etc. (Matson 1974). As with the carbonaceous material, organics have been used worldwide. Given these examples, does this imply that all traditional potters (today and in antiquity) add(ed) inclusions to the clay or that all inclusions in the clay were deliberately introduced into the clay? Ethnoarchaeological research suggests that the answer is negative in both instances (London 1989; 1991). Instead of the time-consuming task of clay preparation involving the removal of the largest rocks, roots and leaves, it is easier to learn to work with the clay as found in nature rather than try to change it and this is precisely what many potters chose to do. They adopt a manufacturing technique that suits the clay (Franken and van As 1994). Potters create shapes to suit the clay. If attachments in the form of spouts or handles adhere well, the repertoire reflects this ability. On the contrary, if there is poor adhesion, loop handles are replaced by knobs or nothing at all. Studies of thin sections of ancient pottery attempt to differentiate between inclusions which were native to the clay and those intentionally added. While at times it is possible to make such a distinction, the ethnoarchaeological fieldwork suggests that the purposeful addition of tempering material was a less common practice than archaeologists might think. Far easier than adding rocks to clay and kneading to achieve an even mix of the two different materials, is the practice of adding together two separate clays. If a clay as found in nature is unsuitable for use based on the available ceramic technology, it might become workable when added to another clay. Properties inherent in each of the clays can be enhanced by mixing them together to form a new clay body which is amenable for use given the potters' manufacturing technique.

Raw materials that constitute 'good' clay for one potter can be 'bad' clay for another potter. A clay suitable and good for coiling will be designated as a bad or poor clay for wheel throwing. Each of these manufacturing techniques requires a different clay and will result in distinct repertoires of shapes and surface treatments.

Field techniques of ethnoarchaeology

The techniques of the ethnoarchaeologist differ from those of the ethnographer who relies largely on interviews with informants to supply data on a variety of topics, of which material culture is rarely included. In contrast, ethnoarchaeologists carry out interviews to supplement other more pertinent sources of information. Observation and collecting quantitative data are two of the principle techniques of the ethnoarchaeologist. Instead of asking a potter what types of pots s/he makes, a preferred strategy is to learn the repertoire of a potter by watching the work in progress. This practice enables one to learn not only the variety of pots produced, but the frequency of their manufacture, and the time required to make each one. While it is useful to learn who makes which pot types, if one broadens the question to investigate issues related to how often each type is made, how long it takes to make each type, how each type is decorated, how much is earned per piece, the information has greater relevancy for addressing archaeological issues. Such data offer insights into the capacity of the traditional ceramics industry to serve the community. A count of the coil built pots made per person, per week, per season results in a figure which can be used by archaeologists to learn how many pots could have been made in antiquity by potters working at the same level of production, using the same technique of manufacture, but not necessarily the identical clay nor in the same locale. This also provides insight into the number of potteries needed to supply a population in antiquity.

To adequately address these types of questions to develop hypotheses regarding production and organization of the ceramics industry which can be tested archaeologically, requires quantitative data of a representative sample. If one counts how many pots an individual can make in one hour to learn about production scale, the next question concerns how representative is the work of one hour in the overall production rate of that person or the community as a whole? To collect sufficient quantitative data to be able to focus on the broad range of issues archaeologists raise in trying to learn about the organization of the ancient ceramics industry requires long-term fieldwork, i.e. the ability to spend large amounts of time preferably living in the community where the pottery is manufactured. Full-time residence allows one to accumulate a statistically valid sample of pots and potters. Instead of commuting to the village from the city, by living in the pottery-producing village one can also observe and record low frequency incidents, like salesmen coming to pick up an order, clay procurements, firings, etc. Long-term fieldwork can mean the entire pottery producing season, i.e. six months in the Near East if not longer. One can also return repeatedly to the same communities over time to observe change and continuity in the industry in terms of production numbers, costs, decoration, number of people involved with the work, distribution of the finished products, etc. as demonstrated by the studies of Maria Beatrice Annis and Gloria London presented here.

Coupled together with laboratory experiments, ethnoarchaeology can provide information otherwise unavailable. For example, one might collect clay known to be used by potters today, perhaps in the vicinity of an archaeological site and then recreate ancient pottery forms. In doing so one learns about the workability of the clay. By firing the replicas to different temperatures, in more than one type of kiln (permanent kiln with or without a roof), for different lengths of time with various fuel types results in an examination of the impact of firing on the clay as well as the non-plastics as Murray Eiland did for his study in this volume. One can add any combination of inclusions – organic or rocks. Decoration mimicking ancient patterns tests the possibilities afforded by the clay body. An important axiom regarding pottery manufacture is that each step taken by a potter impacts the next stage of the work. Clay heavily tempered with large rocks limits the manufacturing technique as well as the decoration, but it normally enhances the drying and firing. Incised patterns are not the norm on pots made of a clay body with large inclusions. A tool used to incise the design will pull out the large rocks and drag them across the surface resulting in irregularities of the decoration. Therefore a punctate incised pattern is preferable. Paint, like incised patterns, is an equally poor choice on heavily tempered wares since large inclusions do not easily absorb paint. Instead of paint or incised designs, a surface treatment frequently found on pithoi of all eras involves a moulded pattern, which often is in the form of rope or snakes. This is the safest choice. Rope patterns prevail on large containers tempered with abundant large non-plastics for many periods and places. The bulkiness of the moulding accommodates the size of the container, psychologically it appears to strengthen the container itself, but of greatest importance, it suits the clay wall better than most other decorations and surface treatments. As a consequence, rope moulding is the preferred decorative surface treatment on large from all parts of the Near East.

Long-term studies and short-term visits

Ideally ethnoarchaeological projects are designed to address specific issues, such as standardization of the work of craft specialists (London 1991), distribution of finished products (Kramer 1997), sources of variation in vessel features and decorations (Longacre 1991a; London, Egoumenidou and Karageorghis 1989), regional variation (Longacre and Skibo 1994), learning frameworks for potters (Longacre 1991b), use-life of pottery (Nelson 1991), etc. All of these topics require quantitative data to measure, count, and record how far pots travel, how long pots remain in use, variability of the work, who teaches whom, etc. In the best situation, quantitative data can be collected from a representative sample of the population of pots and potters, although this is often difficult. For example, to observe and record how pots break when fired requires watching the kiln during the stacking and then watching the kiln during the unloading phase. This procedure can involve a few hours or 24 hours for each kiln firing. In Cyprus, traditional potters stack the kiln around 6 or 7 a.m. if not earlier and then usually leave the pots until the next morning before they are unloaded. If there is no place to keep the fired pots until they are taken to market, the pots might remain in the kiln for days or months. It is the safest place for the fired wares. Unless the ethnoarchaeologist is present precisely when the kilns are unloaded, it is difficult to learn the rate of breakage or misfires and to know which vessel types were impacted. One can ask the potter, but a fundamental tenant of ethnoarchaeology is observation which affords the opportunity to accumulate far more data than the mere number of misfired pots. As one watches the kilns being stacked, one can learn if pots are stacked inside one another, or if they touch each other and whether or not proximity of the pots impacts the firing color. In over 30 firings observed in Cyprus from May - October 1986, pots were stacked in the kiln so that they often touched each other, but never the kiln walls. Firing color seems not to have been affected if one pot came into contact with another. By observing at least 30 firings (1880 pots), carried out by different people one can obtain a statistically valid sample size concerning the number of pots fired together, the number of potters whose wares are fired together, rate of loss due to firing mishaps, and the firing time. Breakage or other flaws in the fired wares were under 3% (London 1991: 226). The repair and reuse of broken pottery is of considerable interest to archaeologists and is a subject discussed in this issue by Sandra Scham.

Since it is rarely possible to spend six months living in a pottery producing community, short-term studies are more common than long-term field projects. Short-term can mean one hour, day, week or a bit more with the result of identifying the location of pottery production and local clays, the repertoire, and pyrotechnology largely based on interviews with the help of a translator. Often this type of fieldwork is carried out in the vicinity of an archaeological site. Such studies contribute to our general knowledge in that they usually identify locally available clay sources which can then be sampled for experimental work, in the laboratory or in the field as Bram van As demonstrates in his contribution to this collection of papers. Brief visits also record or document a location for future long-term fieldwork by providing visibility and information about an industry that is quickly fading into oblivion, as noted by Hamed Salem below. To make pots in any technique requires considerable skill and a wealth of knowledge that traditionally was passed down from one generation to the next. Although in many parts of the world we are close to the last generation to receive this training in traditional pottery manufacture, ethnoarchaeology is our last opportunity to record what remains of the traditional ceramics industry.

Current studies

In this *Newsletter of the Department of Pottery Technology (Leiden University)* we provide the papers read at a Pottery Analysis and Interpretation Seminar during the 1997

Annual Meeting of the American Schools of Oriental Research (ASOR), held in Napa Valley, CA. The contributions include reports of brief visits, long-term fieldwork and research among potters in different parts of the Near East and Mediterranean.

Bram van As presents an overview of the technological observations made during the short visits together with Loe Jacobs to traditional potters working nearby archaeological sites. Together, they have carried out the technological analysis of excavated pottery since 1985. These short visits generally add useful information to the technological analysis of the ancient pottery excavated at the site.

Hamed Salem's account of Palestinian potters represents the accumulation of several years of brief visits to two entirely disparate pottery producers who work in the vicinity of archaeological sites. He suggests that only the physical aspects, i.e. the properties of the raw materials of traditional pottery production are relevant to assess ancient wares, a view not shared by all. Ethnoarchaeology certainly can contribute to understanding why potters past and present select particular clays and decorate their wares with specific techniques. However cross-culturally, certain potters worldwide decorate large containers with rope moulding, add carbonaceous and organic non-plastics to clay, and use the coil technique to fabricate pots. These are just a few of the most common practices used by traditional potters in different places.

In addition to the short-term fieldwork, long-term studies of Sardinian potters and repeated visits over a period of several years characterize the work of Maria Beatrice Annis. While carrying out interviews and recording observations, Annis studies ancient ceramics technology from a nearby archaeological survey. She samples and examines local clays petrographically to test their workability in the laboratory. From data derived from her interviews, Annis assesses comments of the Sardinians concerning the peculiar properties of the clay and the local specializations in terms of vessel forms.

To follow-up a seven month study of Cypriot craft specialists carried out 12 years ago, Gloria London returns for a brief visit to determine if the traditional industry remains in operation and what has changed or remained the same in terms of the repertoire, decoration and organization of the industry. Until 1986 the wares of each potter and village were identifiable based on certain vessel features involving overall vessel proportions, decoration, and order of the work. Twelve years later, do the same features identify the work of each potter? In 1986, there were fewer than 25 potters. By 1998, only half remain active.

More in the realm of experimental archaeology is the work of Murray Eiland who reports on brief visits to potters in Syria and his attempts to make and fire pots in the field using locally available clays. He learns and records the perils of adding salt to clay.

Finally, Sandra Scham discusses archaeological pottery relying in part on ethnoarchaeological research.

When comparing ancient with traditional wares, it is critical to work with comparable material not only in terms of the manufacturing technique, but also in terms of the social and economic conditions in which the pots were made and used. In the eastern Mediterranean area, coil made wares to a large extent are comparable regardless of temporal or geographic differences since they are normally not manufactured in large scale industrial settings. In Cyprus for example, coiled wares for use locally are made by craft specialists who work in their homes or in a small workspace of the Kornos Pottery Cooperative. In contrast are the Cypriot industrial large scale production centres where pots are made in casts or on a wheel. There is little comparison between most Cypriot Neolithic through Late Bronze Age wares and the current Cypriot industry of glazed table wares made of imported clays and glazes. Certain Bronze Age wares however are comparable to the hand-built wares fabricated from the local clays of Kornos and elsewhere, rather than the more sophisticated later wheel thrown wares. As such it is vital to match the level of organization of the industry when comparing ancient with traditional ceramics, even if this requires a comparison of material from different countries, e.g. archaeological wares from Israel and traditional wares from Cyprus, Jordan, or elsewhere. Since all potters work with clay, where they work is of less significance than their mode of operation. The goal of potters to create usable containers enables cross-cultural comparisons of potters regardless of where and when they live(d) or work(ed).

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A. van As

SHORT VISITS TO POTTERS WORKING NEARBY ARCHAEOLOGICAL SITES

Introduction

Within the research programme of the Department of Pottery Technology at Leiden University, ethnoarchaeology is considered to be a useful discipline for ceramic research in archaeology (Franken 1983). Technological evidence collected from traditional potteries wherever they still exist helps us to deduce the potter's craft in antiquity. In addition, the study of the craft in relation to the natural and human environment, like Maria Beatrice Annis' investigations of complete production and distribution systems in Sardinia (see both Annis' contributions in the *Newsletter of the Department of Pottery Technology (Leiden University)* from 1983 onwards and Annis 1985; 1988; 1996), leads to a better understanding of the importance of the potter in the social and economic life of a community.

This paper includes an overview of some technological observations made during the short visits together with Loe Jacobs, ceramicist of the Department of Pottery Technology, to traditional potters working nearby the archaeological sites where we carried out the technological analysis of excavated pottery since 1985[1]. Like Frederick Matson, we marvelled that as unexpected visitors equipped with cameras, we were always so cordially received in the potters' workshops (Matson 1995: 13). I shall introduce you to potters we met in Armenia, Turkey, Greece and Iraq (Fig. 1)[2].

Armenia

In 1996, we stayed for some weeks in the expedition house of the Joint Belgo-Armenian Archaeological Expedition to Armenia at Voskevaz located in the former Soviet republic of Armenia. Our purpose was to carry out the technological analysis of the vessels from Late Bronze Age / Early Iron Age graves at Akhtamir (van As and Jacobs 1996/97). Workability tests showed that the clay in the neighbourhood of this archaeological site is highly suitable for pot-making. Nevertheless, there are no longer potters working in the entire region. We were told that today, it is very difficult to find traditional potters anywhere in Armenia. This contrasts to the situation as known from the ethnographic documentation of pottery workshops in the 1970s by Mrs. Dr. Sarkisjan (Sarkisjan 1978; Frotscher 1996). According to Rouben Vardanian, one of the Armenian archaeologists of the Joint Belgo-Armenian Archaeological Expedition, some potters should probably still be active in the neighbourhood of Artasat, a town situated ca. 20 km from Mt. Ararat. Artasat, like Dvin, Ani and Garni, was a pottery production center of Armenia during the Middle Ages.

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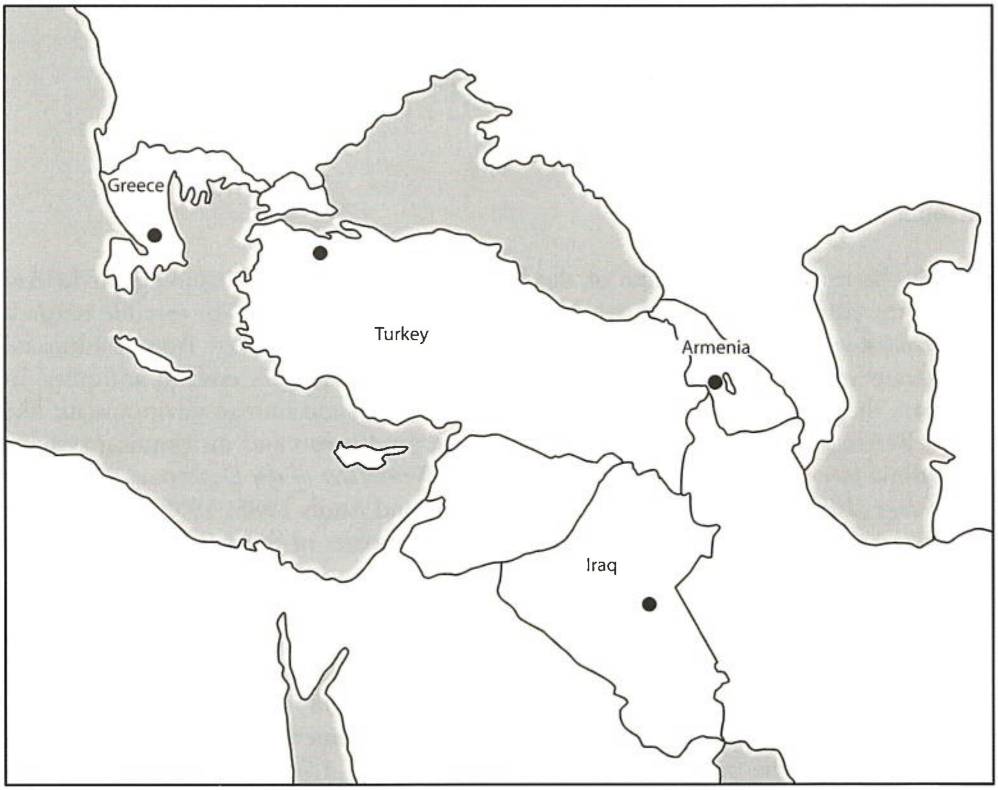

Fig. 1. Location of the pottery workshops mentioned in the text.

Accompanied by Rouben, who speaks Armenian as well as Russian and French, we visited the area around Artasat on a beautiful day in July. Our conversation with Rouben was in French. It was with difficulty that we discovered a pottery workshop. On inquiry in Scha'umjan we eventually found the house of a potter. At our knocking on the door, the sleepy potter let us into his workshop-annex-living-room. The night before he had visited his wife in the hospital in the Armenian capital Erevan. Since it was late when he returned home, he was still resting in his bed. We felt embarrassed that he nevertheless was willing to demonstrate the manufacture of a vessel on the potter's wheel just for us (Fig. 2). The potter used local clay tempered with local sand. Next, he showed us his chamber kiln. Since he was not planning to fire the kiln soon, the pottery chamber was temporarily in use as a storage room (a situation similar to that described by Gloria London in this volume) (Fig. 3). We were surprised to learn that the wood piled up in the courtyard proved to be fuel for heating the house. At first sight, we thought that it would be used for firing the potter's kiln. Our interpreter, however, assured us that the kiln was fired with oil. According to the 57-year old potter, who learned the craft from his father, both the high firing costs and the low selling price of the pottery creates a serious problem for the continuation of his workshop. Therefore he was in a rather sad mood about the near future. Before we left his workshop the potter showed us his ceramic repertoire. Some days later we saw one of his products, a milk churn, in use on the market in Erevan (Fig. 4), ca. 30 km north of the home of the potter. At the end of our visit the potter did not let us go without giving each of us one of his pots. The next pottery we visited proved to be in disuse for the past four years. The workshop was transformed into a farmer's stable. Only the dilapidated potter's kiln and a large overfired pithos reminded us of former days. Based on what we heard and saw during our stay, we conclude that here not much time is left for ceramic ethnoarchaeological research in Armenia.

Turkey

In Turkey, as in Armenia, we were inclined to collect information on the traditional potters' craft as long as this is still possible. Together with my colleague Mies Wijnen, we visited a potter's workshop in the village of Örnekköy situated close to Ilıpınar Hüyük in the plain of Lake Iznik in northwestern Anatolia. Nearby we were investigating the Neolithic and Chalcolithic pottery excavated by the Dutch Archaeological Expedition under the direction of Jacob Roodenberg (van As and Wijnen 1995). Our first visit to the potter of Örnekköy on June 10, 1989, was followed by a second visit on June 3, 1990. One year after our last visit, the potter had ceased his activities, left the village and moved to the nearby town of Orhangazi, where he died shortly afterwards.

Since the Neolithic and Chalcolithic pottery of Ilıpınar phases X-V proved to have been made of local clay, the main objective of our visits was to hear the opinion of a local potter on the quality and workability of these clays nowadays. During our visit, Laurens Thissen, one of the Dutch members of the Ilıpınar excavations, was our interpreter in Örnekköy.

Ahmet Öztürk was born in 1927 in the important potters' town of Konya. Ahmet started working in his father's workshop when he was eight years old. Ten year later he moved to Örnekköy where he set up his own pottery. At the moment of our visit he was working here with help of his son and daughter-in-law. Ahmet, however, was the only one who could actually throw pots on the potter's wheel (Fig. 5). The small and medium sized vessels were thrown from one piece of clay. The large jars, on the contrary, were produced in stages (van As and Wijnen 1989/90). The pottery was stacked into the updraft kiln from inside the workshop (Fig. 6). The entrance to the actual fire chamber was outside of the workshop (Fig. 7). Both wood and olive seeds were used to fire the kiln.

For the manufacture of his pottery Ahmet, like the nearby brick makers in Orhangazi, used local clays. Although, according to Ahmet, all clay sites in the immediate vicinity are suitable to make pottery, he preferred clay taken from the deeper layers of one specific site not far from Ilıpınar Hüyük. The top layer with a large amount of plant roots was very calciferous and therefore not suitable to be used for pottery production since during the heating process, at approximately 750°C, limestone gradually converts into quick lime, forming carbon dioxide gas. During the cooling process, the remaining forms of calcium absorb water and expand, as a result of which the wall of the pot may crumble or even turn to powder. In the workshop a number of water jars exhibited slight crazing around small particles of limestone on the surface (Fig. 8). According to Ahmet this was due to an error. Instead of the clay from the deeper layers, a mixture of the calcareous top layer and the deeper clay layers had been used with the afore-mentioned result. A small part of the Neolithic and Chalcolithic pottery assemblage from Ilıpınar showed the same phenomenon. Obviously, the potters in Neolithic and Chalcolithic times made, like Ahmet, the mistake of using the calciferous clay.

Greece

In September 1988 the Department of Pottery Technology investigated the ceramics from the well-known Neolithic site of Sesklo in Greece (van As, Jacobs and Wijnen 1988). Thin section analysis (Overweel 1982: 105) and limited trace element analysis (Maniatis 1983: 337; Schneider, Knoll, Gallis and Demoule 1991: 15) had shown that clay for the production of the pottery was derived from local deposits. We collected a number of clay samples from the immediate surroundings of Sesklo in order to assess their workability. With the knowledge derived from our workability studies, we can better understand the technological aspects of the ancient wares. The clay samples displayed considerable variety in color and varied in plasticity from very short (white clay), plastic (red and yellow clays) to very plastic (dark grey clay) (Fig. 9).

In order to find out more about the quality of the local clays, we made two brief visits to Kostas Louros, a potter working at Dimini, not far from Sesklo. Mies Wijnen, with whom we collaborated in Sesklo served as interpreter for our talks with Kostas.

Kostas at age 54 had been using an electric potter's wheel for 19 years. Formerly he used a mechanical wheel. Kostas produced various types of jars, plates and bowls on the wheel (Fig. 10). He told us that it became more and more difficult to find people to learn the craft. Both of his helpers were not in full employment, but worked for pocket money. Kostas very much wanted to have Loe Jacobs, our ceramicist, work in his pottery (Fig. 11).

During our first visit Kostas was working on the manufacture of bowls with a wavy rim. The second time he was engaged in throwing small pots. In both cases he used clay imported from the island of Crete. For a short time he had used clay from Thessaloniki. To learn that as a result of repetition throwing (see Hamer 1975: 250, 251) none of the vessels was exactly identical is instructive for students and others who are preparing an archaeological pottery typology. As a matter of fact there were minor differences in size and shape. Only the flowerpots made in mould by Kostas' wife Anna were completely identical.

In addition to the imported clay for the thrown pottery, self-prepared local clays were used for the coarser everyday ware such as flower-boxes manufactured by Kostas' helper Nikos. As to the quality of the local clays, Kostas remarked that the white clay is too sandy to be used by itself. The red clay contains a rather large amount of grit. On the other hand, the black clay is very plastic, but soon shows cracks during the drying and firing processes. By mixing the various clays, he was able to prepare a very suitable clay body. One might ask why this should not have been common practice in Neolithic times.

Iraq

The natural clay from the Mesopotamian flood plain we investigated in Syria and Iraq differed widely from what we found in Greece. In contrast to Greece, the clay beds here are very homogeneous over a large area. The clay generally needed little preparation to render it suitable for the shaping techniques used. In Mesopotamia, for many cultural periods, the methods of potting were fairly basic and only required the strict application of existing methods rather than inventiveness (Franken and van As 1994).

Between 1985-1990 we worked on the preparation of a technological/morphological corpus of second millennium B.C. pottery excavated at several archaeological sites in Iraq[3]. In this context we had the opportunity – in 1985 and 1986 – to pay short visits to the potters and brick workers northeast of Al Thawra (situated in the north of Baghdad) along the road to Baquba. Our interpreter was Mohammed Mursjed, a representative of the Iraqi Department of Antiquities.

Our visits began at the suq of Baghdad where pottery was displayed for sale (Fig. 12). The salesmen told us where the vessels were being made. One cannot miss the potteries and brickworks in this area. From a far distance one already sees the black smoke blowing from chimneys of the many kilns.

Most of the potteries produced water jars which were made in stages on the potter's wheel (Fig. 13). The potters were not very precise in their raw material selection. The local clays used by the potters are neither very plastic nor very cohesive. Consequently, stretching traces easily occur and the pots are prone to crack while drying. After soaking the clay for 24 hours in a shallow pit to which water from a well is supplied through a dug out gully, the potters added fibrous material in the form of seed fluff of great reed mace (*Typha latifolia*) to enhance the coherence of the clay and its resistance to tear. Although the traces of *Typha latifolia* could not be observed in the excavated ancient pottery, we may assume that the potters in the second millennium B.C. prepared the clay in the same way since they used the same sort of short clay. Furthermore, in those days, reed mace is known to have grown on the borders of the Euphrates and Tigris. Leendert and Marijke van der Plas (van der Plas and van der Plas 1997) have drawn my attention to the recent interest of studio potters in paperclay, i.e. clay tempered with fibrous materials, because of its obvious good technical properties (Gault 1995).

Our most remarkable observation in Iraq was the use of crude oil as fuel for the kilns of both potters and brick workers (Figs. 14 and 15). In a oil-producing country such as Iraq, where in some regions the oil is under such a pressure that it comes up to the earth's surface by natural means, this is not surprising. The potters continuously scooped the crude oil from a hole in front of the firing chamber into the fire with help of a bowl or soup ladle. Since the use of oil products was known in ancient Mesopotamia (Forbes 1964) we wondered whether crude oil in a country deficient of wood could not have been used by the potters for firing their kilns. On the other hand, shrubs and dead palm leaves could also have been used. Experimentally we used this kind of local fuel in a small experimental updraft roofed kiln built of stones daubed with clay. A temperature of ca. 900°C was measured after ca. three hours firing (van As and Jacobs 1985: 20). However, since only wall stubs normally survive for ancient kiln chambers, whether or not they were permanently domed is an open question (Moorey 1994: 150).

Epilogue

Our short visits to the various pottery workshops described above were, to be honest, very pleasant 'weekend diversions' (see also Longacre and Skibo 1994: xiii) from carrying out the technological analysis of excavated pottery at the expedition house of the archaeological projects. They served, however, a much more serious purpose. Our experiences with the rapidly disappearing potter's craft in Armenia and Turkey illustrate the urgency to record the activities of traditional potters still at work[4]. Although our visits were actually very short, the relevance of our technological observations for the technological interpretation of the pottery nearby excavated is obvious (see also Matson 1995: 13). At least the ethnographic data help us to develop operational models for interpreting archaeological data (cf. Longacre and Skibo 1994: vii).

Notes

1. Most of the data presented in this paper were published in earlier volumes of the *Newsletter of the Department of Pottery Technology (Leiden University)*. Nevertheless it seemed useful to offer in the context of the Pottery Analysis and Interpretation Seminar during the 1997 Annual Meeting of ASOR an overview and short evaluation of our short visits to local traditional potters at work in the countries where we carried out archaeo-ceramic research.

2. The map (Fig. 1) was drawn by Mady Oberendorff. The photographs have been taken by the author (Figs. 2-15).

3. At present a final publication is being prepared by H. Gasche and J.A. Armstrong in cooperation with the Department of Pottery Technology.

4. For a documentation of pottery workshops in Armenia in the 1970s see the work of Dr. Sarkisjan (see Frotscher 1996). For an important and useful survey of the extant traditional potters in Turkey we refer the reader to Güner (1988).

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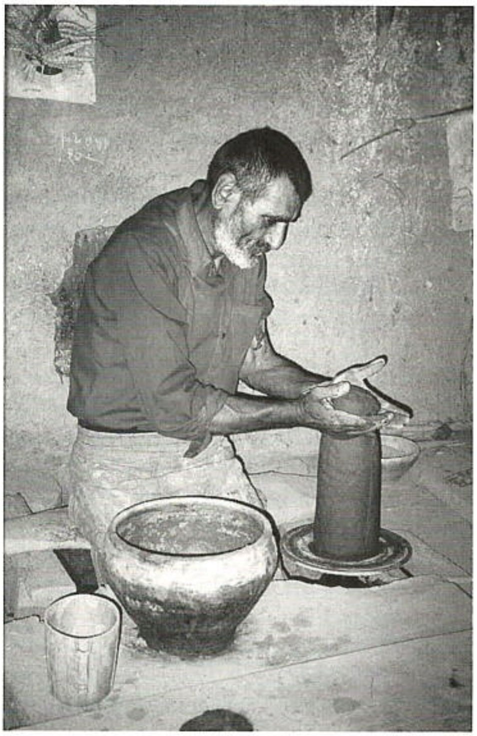

Fig. 2. Armenian potter demonstrating the manufacture of a vessel on his wheel.

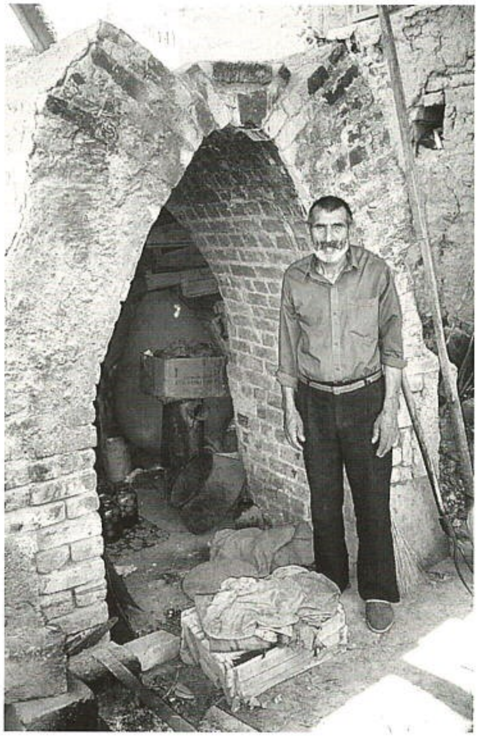

Fig. 3. Potter's kiln, temporarily in use as a storage room (Armenia).

Fig. 4. Milk churn in use on the market in Erevan (Armenia).

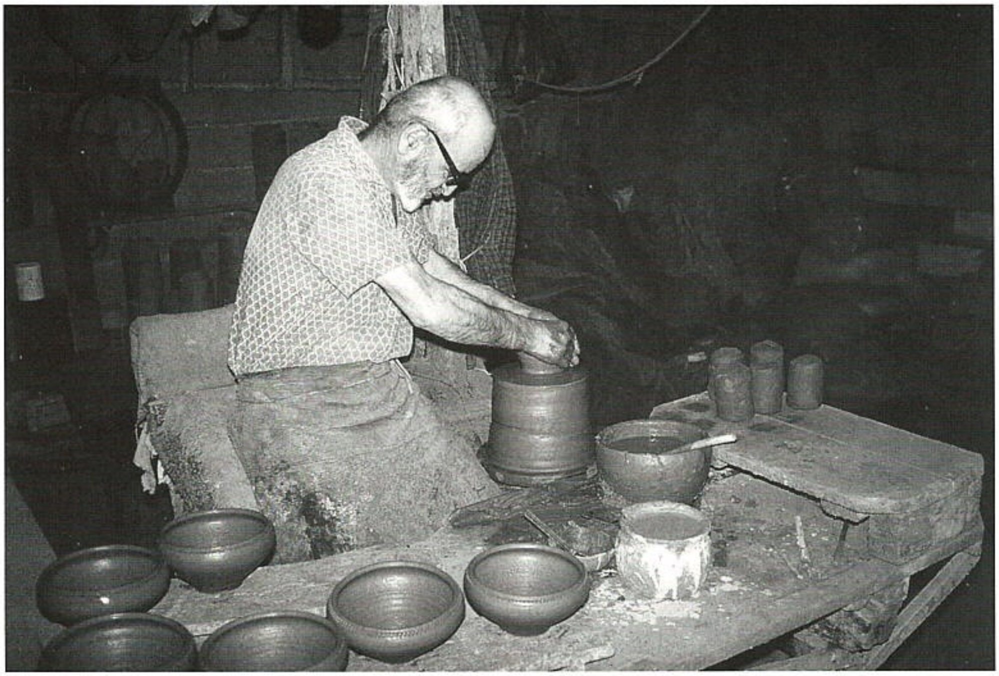

Fig. 5. Ahmet Öztürk, the potter of Örnekköy (Turkey) at work.

Fig. 6. The entrance of the pottery chamber of the updraft kiln, Örnekköy (Turkey).

Fig. 7. The entrance to the fire chamber of the updraft kiln, Örnekköy (Turkey).

Fig. 8. Water jar crazing around particles of limestone on the surface.

Fig. 9. Clay samples collected in the immediate surroundings of Sesklo (Greece).

Fig. 10. Kostas Louros, the potter of Dimini (Greece) at work.

Fig. 11. Loe Jacobs at work in Kostas Louros' workshop.

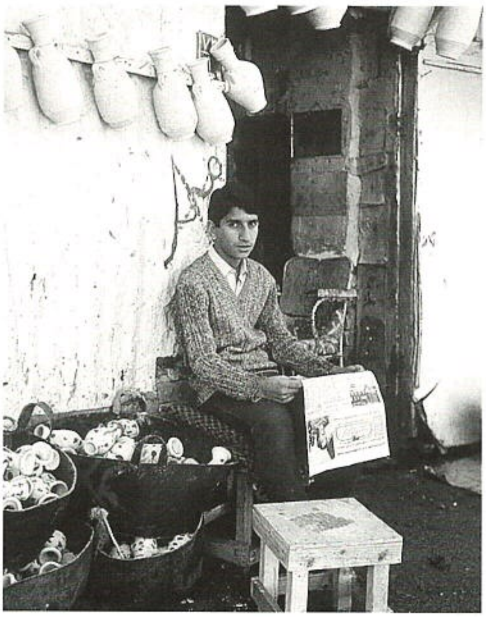

Fig. 12. Pottery displayed for sale in Baghdad (Iraq).

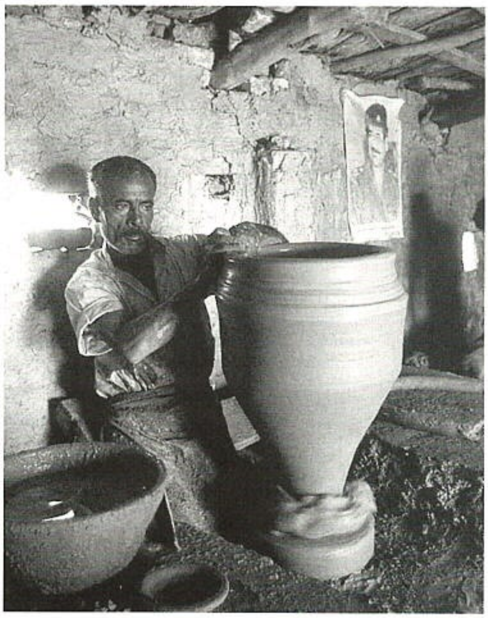

Fig. 13. Manufacture of a water jar made in stages on the potter's wheel (Iraq).

Fig. 14. Use of crude oil as fuel for a potter's kiln (Iraq).

Fig. 15. Use of crude oil as fuel for a brick kiln (Iraq).

H. Salem

ARCHAEOLOGICAL USE OF THE TRADITIONAL POTTERY TECHNOLOGY AMONG THE PALESTINIAN POTTERS

Introduction

Pottery production in Palestine has been minimally recorded in recent history. Reference to pottery workshops is normally absent from the records of the early travellers, early historians, ethnographers and the archaeologists of Palestine. The literature, scattered and brief, dealing with the traditional pottery, starts to appear later in the 19th century and is of minimal use to the needs of archaeologists. Early studies (see London 1985: 8-80 for a review of early studies of ceramic technology) include workshops in Hebron, where pottery production was less important than that of glass during the last century (Scholch 1986: 197). Gatt briefly reported on pottery manufacture and distribution in Gaza where there were about 16 workshops, each having three to four kilns and four potter's wheels. Jars were the basic forms. Fuel to fire the kilns was composed of camel and goat dung. Ships often brought goods to exchange for pottery objects (Gatt 1885, in Scholch 1986: 199 ff). Writers of the Survey of Western Palestine also referred to late 19th century pottery making at Jaba' village (Conder and Kitchener 1881). Limited ethnographic research provides background to the pottery traditions. The work of Einsler (in Glock 1982: 146), is a detailed record of the potters of Sinjil and Ramallah. She recorded handmade pottery production by women in the region. Other records of the pottery craft of the same time were found in Mrs. B. Murray's private letters to her mother in England. As a staff member of the Crowfoot expedition to Samaria, Mrs. Murray made trips to the nearby villages on her weekends, accompanied by a young boy from Sabastiya village. In these letters she briefly describes the workshops and pottery making at Kufr el-Labad, Irtah and Jaba' (between April and June 1933).

One of the earliest attempts to utilize traditional pottery in archaeology was made by G. Crowfoot (1932) who tried to compare the traditional forms made by the female potters of Kufr el- Labad, Ya'bad and Sinjil to those found during the excavation of Samaria (Sebastiya). Unless continuity can be traced in these forms caution must be maintained in connecting them to the Iron Age practices. In the mid 1970s a more systematic effort was made to research the traditional pottery by Glock, Landgraf and Rye. This team collected the data on the traditional pottery, but little has been published from the project (Rye 1976; Glock 1982; 1983). Rye's (1976) brief report indicated two broad traditions of pottery making among the Palestinian potters. The report concentrated on the wheelmade pottery tradition. About 100 persons were found to be working in Gaza, Hebron, Jaba', Irtah, 'Akko, Haifa and Nazareth, as compared to a 1931 census showing 211 potters (Rye 1976). More recently, I have conducted a

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detailed investigation of several pottery production locations focusing on 'Aqabat Jaber (Salem 1986; 1994). During that research, I collected primary data based on short- and long-term visits to several production and distribution centers. The major objective of this ongoing research is to provide living analogues to help us in understanding the techniques, thereby assisting us in explaining the ancient pottery technology, responsible for the Tell Jenin pottery.

The ethnoarchaeological method

Ethnoarchaeology starts with the assumption that no interpretation of the past can go beyond our consciousness learned from the present. Carrying out ethnoarchaeological fieldwork involves learning new ideas that enhance our current awareness thereby increasing the knowledge of the material world surrounding us. By so doing we seek new potential explanations of the archaeological record.

On the other hand, reconstructing the past becomes like creating a science fiction character. At the end the character resembles the human being. They must have 'human characteristics' like legs, hands, eyes, etc. This is because no one can build any new form beyond what he already knows from the present. In a similar way, building the picture of any distinct behavior is influenced by our knowledge of the present. The more we learn about the living cultures, the more we open new possibilities to interpret a specific past and the more the present imposes limitations on explaining the past.

Two important difficulties confront us as we attempt to use ethnographic data to interpret the behavior underlying Early Bronze Age pottery production. The first is that each tradition is found in two distant time frames having no direct cultural continuity. Four thousand years separate the living pottery tradition of Ya'bad and Jaba' from the Early Bronze Age pottery traditions. The risk of using the historical approach is high since conclusions about the socio-economic aspects of the pottery may be misleading. On the other hand, it can be assumed that the material base of this technology in both cultures is the same (i.e. the ways of manipulating natural resources). Therefore, to use ethnoarchaeological data in the study of the Early Bronze Age pottery one should be limited to the 'material' aspects of the cultural traditions, which can be described and compared. We must remain hypothetical about the 'non-material' aspects. This does not imply that the village potters of Ya'bad and Jaba' today do not continue many aspects of the Early Bronze Age pottery traditions.

Here I present some technological aspects of the current pottery traditions which may parallel that of the Early Bronze Age pottery excavated at nearby Tell Jenin. Although the explanation of the Early Bronze Age pottery technology is based studying surface traces of the manufacture, the final interpretations are biased by the knowledge obtained from the living traditional potters.

Traditional pottery of the Jenin region

Two pottery traditions co-exist today in the Jenin region (Fig. 1). These are the handmade pottery of Ya'bad and the wheelmade pottery of Jaba'. While the wheelmade

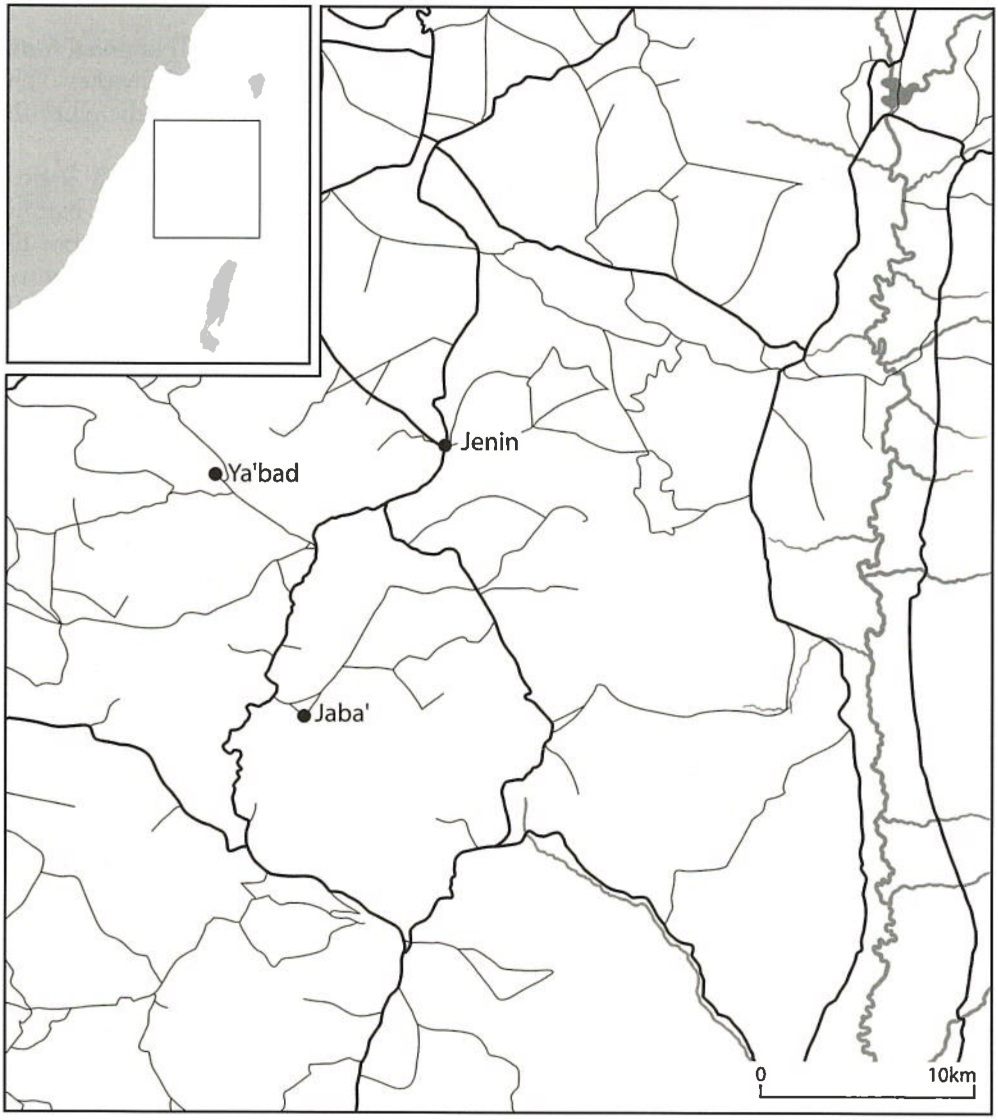

Fig. 1. Location of the production sites Ya'bad and Jaba' in the Jenin region.

pottery continues today, the handmade pottery ceased and was re-established recently by a potter's daughter as 'art pottery'.

The handmade pottery of Ya'bad

The pottery of Ya'bad is not made today for household consumption. Traditional forms of the recent past are now made as 'art forms' sold to local and Israeli markets. The potter who is working today learned the skill from her mother. She is therefore the latest potter in a long tradition.

Red slip burnish ware characterizes the handmade pottery of Ya'bad. Only limited forms are made, mainly the cooking pot, casserole, brazier, frying pan, and bathing bowl (*wadia*). The clay (*trabet fukhar* = pottery soil) of Ya'bad is procured from the nearby fields. It is originally white in colour and includes lime and shells. Clay sources are identified when a new house foundation is opened for construction, or while digging a new well. As a consequence, access to the clay resource is limited. Often the one who found the clay source will barter it to the potter in exchange for finished pottery. The source of the clay preferably will remain a secret between both the landlord and the potter.

Clay is brought by cans (*tanka)* or plastic buckets to the place of work. It is first crushed by a grinding stone (*madras*) into fine pieces. Then it is spread out to dry in the house courtyard. The woman I interviewed and observed believed that it is very difficult to work with the wet clay. She adds calcite (*milah*) to the clay. Calcite is collected by men from the neighbouring villages. The calcite used by this potter is brought from Banat Toreh, a village of about five kilometers away.

The potter adds the clay to the non-plastics and kneads it in a tan box (*lajjan*). She adds two-thirds of the clay to one third of the calcite (i.e. two buckets of clay to one bucket of calcite). Then she wets it with the appropriate amount of water. The paste is then soaked for two days (*ytfashfesh*) before it is kneaded by hand (*'ajeen*). Normally, only the quantity to be used will be prepared. If extra clay remains, it is kept in a clean place and covered by a plastic sheet for later use.

The forming of Ya'bad pots is done in one or more stages (*marat*) depending on the size and the pot form. Cooking pots are made in four stages. Frying pans require two stages, and small bowls are made in one stage. The potter adds one coil *(raf'a)* in each stage. Initially, the potter shapes the base. To do so, or 'in beating the base' (*tabit ka'aha*), the potter cuts a piece of clay from the kneaded pile. The clay ball is placed on a board of carton or a piece of tin and a wall is raised a few centimeters above the base. The shaped clay is left to dry in the shade until it becomes leatherhard which can take the entire morning until noon time. After that, another coil is added (*raf'a*). The coil is made thick to retain moisture. Then it is beaten by both hands raising the wall of the vessel up to the middlepoint of the pot. The shaped half is left to dry until the next morning when another coil is applied to form the neck and the rim.

Handles are attached vertically or horizontally. Horizontal handles are called *qidra* which is also the word for cooking pot. Vertical handles are used on vessels with a wider mouth called *tabakha* or casserole. Both forms serve the same function.

The lid is made in one stage and is fabricated much like the base. It is shaped into a small bowl with a little handle placed in the middle. The shape of the lid rim is cut in an opposite angle to the cooking pot rim to assure that both rims fit well together.

All the forms are slip coated and incised. The decoration involves applying a slip made from the same clay, at times mixed with a red soil (*samaka*) to give it a red firing colour. The vessel surface is coated with the slip, using a piece of cloth. At the same time, immediately after slip application, the surface is burnished with a sea shell (*a'rakah*). The burnishing process is called *tadleek*.

The form is left to dry for a period of at least four days to a maximum of one week. It is identified as completely dry when it „becomes like a hard dry loaf of bread".

To fire (*shawee, masha*) pottery a fire pit is used. To make the pit, the potter digs a shallow small hole into which she stacks the pots upside-down, 15-16 pots each time. However, the potter does not fire more than one form type at a time. The cooking pots are fired separately from the frying pans because they need more heat. The braziers (*kanon*) are also fired alone because they need more firing than the frying pans. The small forms are fired separately, given that they need less firing. Four to five hours is the range of firing time.

Cow manure (*kras zibel*) is the primary fuel. Wood, charcoal and remains from olive pressing (*jift*) are also used as firing fuel. The wood and *jift* are laid under the pots and the charcoals are placed on top. The potter determines how much fuel to add by the colour of the pots. While the pots are black, she continues to feed the fire with fuel. She stops adding the fuel when the pots turn red. Then she waits until the pots cool down before removing them from the pit.

The wheelmade pottery of Jaba'

Today only one potter, Abu Ahmed, is active in Jaba'. The second potter, Abu Munir, ceased making pottery while this report was being written in 1996. The workshop of Abu Ahmed began about two centuries ago. It consists of two clay basins (*joret el-sool*), which are located outside the workshop. Clay is prepared out-of-doors.

The clay of Jaba' is owned by the potters' family and is brought from the nearby lands about 1.5 - 2.5 kilometers away from the workshops. Two types of local clay are mixed together, a white (*el-zamharee* or *howar*) and a red clay (*samaka*). The potter mixes the two clay types in equal quantities resulting in a rosy colour after firing.

To bring clay to the workshop either donkeys or tractors are used. Raw materials are left to dry in the sun for few days until fully dried. If the clays are moist, they will not dissolve in water.

The clay is prepared in the common method (*et tasweel*). First the clay is soaked for one day in a barrel or a soaking basin (*joret es sool*) in order to separate the heavy and light particles. While it is soaking, the potter stirs it, removing stones and other hard objects. Then it is moved to the next basin. In Abu Munir's workshop the basin measures four by four metres and 75 centimeters deep. The prepared clay is left to settle for three days, after which it is moved to an area in front of the workshop, and left to settle for one week. The clay is then brought into the workshop where it is stored in a corner. Abu Ahmed uses a deeper clay basin, which is about four by four metres long and four metres deep. The clay is left for one week to be dissolved. It is used to prepare a quantity of clay sufficient for the entire winter. He prepares three basins a year. He works all the year round, frequently during the winter months.

Manufacturing techniques

The Jaba' potters formerly had a distinctive technique for making the water jar (*jara*). Instead of beginning with the base, the potter starts with the neck. The jar was made in three stages. In the first stage the neck is shaped and left to dry for few hours. This process is called *tajlees*. The lower part is made thick and heavy with clay. Then it is placed on a mould (*kaleb*) and the walls are lifted or raised (*fateh*). The half complete form is placed on the wheel again and the lower part is raised gradually to close the base. During this process the potter uses a metal scraper to pull up the clay.

In Jaba', Abu Ahmed, however, decided to use the more common traditional technique of closing the base first and then he continues with a separate coil. He maintains that this process is easier and faster than the traditional Jaba' technique described above.

The water jugs (*ibreeq* and *sharbah*) are made in three stages and Abu Ahmed uses the same terminology as for the jars to describe each stage (Figs. 2-5). However, there is one difference. The walls are sometimes made thick, and to thin them he shaves (*tamsah*) them again with a thin metal scraper.

Abu Munir's kiln is built entirely from local resources. The kiln had failed many times because of a leak that allowed moisture to penetrate inside. Abu Ahmed's kiln is larger in size, holding more than 500 vessels. During a visit to the potter's workshop we found that he was constructing a new smaller kiln next to the old one. It is built to fire smaller quantities of pottery, since the old large kiln is difficult to use for firing the smaller types of vessels.

Comparison of the two traditional technologies

In conclusion, the two traditions, one in Jaba' and another in Ya'bad, show similarities and differences that may be of significance for understanding the Early Bronze Age pottery manufacture with regard to workshop location, raw materials, and manufacturing techniques, including surface treatment.

Production location

The Jaba' pottery is made in a workshop, while the Ya'bad pottery is made in the house courtyard. In the later case, it is not necessary for the pottery production center to be found in a particular site; rather it can be anywhere in the village. The workshop is usually located in a specific spot outside the inhabited area, as is the case with many Palestinian pottery workshops. Abu Ahmed's workshop is located at the northern edge of the village in a high spot.

Fig. 2.

Fig. 3.

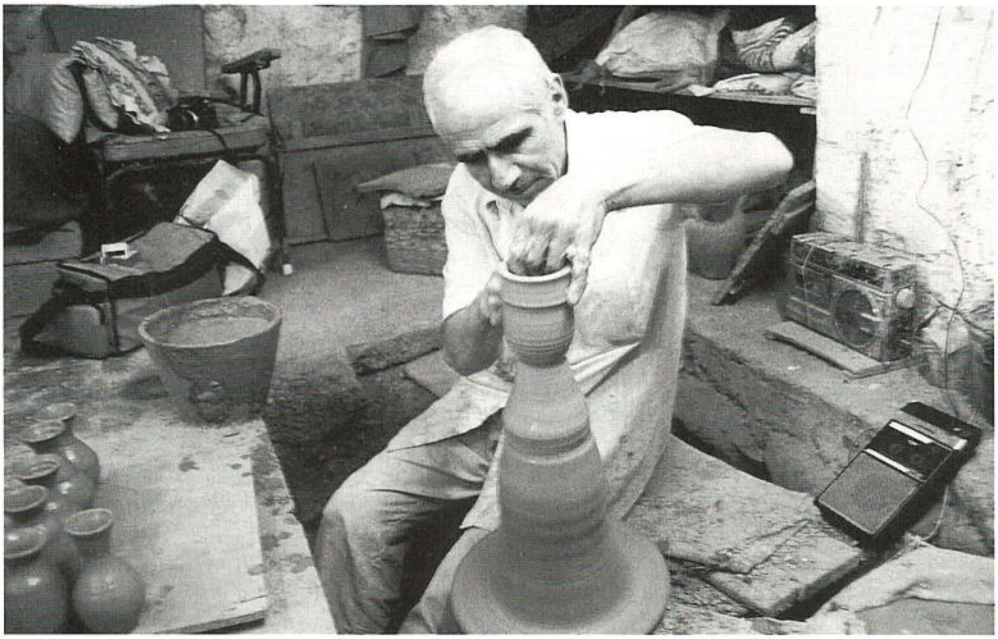

Fig. 4.

Figs. 2-5. Abu Ahmed, the potter of Jaba'at work, building the *ibreeq*.

Raw materials

The coiled pottery of Ya'bad is made from one clay type, while the wheel thrown pottery of Jaba' is made from a mixture of two clays. This mixing of clays is practiced by many Palestinian potters, for example in Hebron, Gaza or 'Aqbet Jaber.

1. There is a permanent primary clay resource for the workshop industry, which is the main factor determining the location for a potter's workshop. Because the handmade pottery is produced on a seasonal basis, the clay need not be available all the year around. The clay resources for the later are discovered by chance.
2. The Jaba' craft specialists prepare their clay in large quantities sufficient for more than one production cycle. The Ya'bad potter prepares her clay only in an amount that she can use at a given time.
3. The Ya'bad potter always adds calcite and grog non-plastics. From a technological point of view, temper is added to reduce the plasticity of the clay. The Jaba' potters achieve this result by mixing two clays together. Recently Abu Ahmed was advised by other potters to add sand to the clay to make it stronger.

Manufacturing techniques

In both traditions, the pottery is made in stages. In Ya'bad the number of stages depends on the vessel size. The larger pots require more than three stages. In contrast, for Jaba' pottery, the number of stages needed depends on vessel form rather than size. Regardless of size, closed forms in Jaba' are made in four stages, while the open forms are made in two stages.

Surface treatment

The potters of Ya'bad always apply a slip to the surfaces which is then burnished. Often a simple incised line may be added. The burnishing is done to provide a nice looking surface by hiding the non-plastics.

The wheelmade pottery of Jaba' is decorated with an incised line or an incised rope design. Recently they have been painting the pots to fulfil the market demands. In certain cases the pot is painted to hide a failure in the production process, such as a firing crack or a bent surface.

The pottery of the Early Bronze Age

The Early Bronze Age pottery from Tell Jenin is characterized by the use of limited resources based on petrographic analysis. Vessel forms and types are limited in number, as were the manufacturing techniques used to create them.

Natural resources

A survey of the clay resources surrounding Tell Jenin and petrographic analysis indicate that local clays were used in making the Early Bronze Age pottery. Samples were collected from eleven clay sources in the mountains and wadis surrounding Tell Jenin to compare with the Early Bronze Age wares and test if these clays may have been used for the pottery.

Two major clay types have been distinguished. The first is a clay known locally as the *Hamra* soil and is the same that the Jaba' potters mix with another clay. One clay sample collected from Marj Ibn Amir lays below the deposits of an archaeological site dated to the Early Bronze Age II period. Petrographic analysis, conducted by Tahani Ali, at the Institute of Palestinian Archaeology of Birzeit University, showed that the ground mass of this clay is rich of hematite and calcite. It also includes lime grits which is a typical characteristic of the majority of the clays from the region, suggesting that the clays originated from the same geological formation.

The other type is a secondary clay with different geological components. The amount of lime non-plastics is higher and larger in size than the *Hamra* deposits. Some samples included quartz and mica.

The clay matrix of the Early Bronze Age pottery shows a great similarity with the natural clay samples. However, the main difference is in the added minerals. The additive is calcite. It appears in about 50% of the Early Bronze Age pottery collection.

Grog was frequently added to the clay. Of the 54 thin sections only 12 lacked grog. Crushed pottery inclusions usually do not occur in the calcite tempered clay. Besides these two tempering materials, the potters sometimes added flints and gabro, but this was not common.

The lime non-plastics are among the natural inclusions. Thin section analysis showed that clay which included lime was not tempered with calcite indicating that: (1) the potters used the secondary clay without levigating it, and (2) the potters were satisfied with the lime inclusions as a tempering agent.

Clearly, the potters of the Early Bronze Age dealt with the clays from the site surroundings in two ways. The first is to use the clay resources accumulated on the wadis and the river bank without resorting to any levigation methods. The clay includes natural minerals like micro-fossils and lime. The second method is to select a 'cleaned' clay or to clean the clay from impurities and then add a tempering agent.

In relating the varieties of tempering types to the Early Bronze Age phases of the site, it appears as if use of clay containing natural lime grits occurred during the early phases of the site. Calcite was added to pure clays during the later phases indicating that the potters were experimenting with the use of different local clays.

Manufacturing techniques

The pottery of the Early Bronze Age was made by hand coiling or turning on the wheel. A combination of both methods is also found. This conclusion is based on a detailed study of the surface markings of the complete forms and a large number of diagnostic sherds. The most common manufacturing method was to build the form from bottom to top. Potters began by making the base. To do so they beat a clay ball on a mat or on a hump of straw, ash or sand. The hump acts as a separator between the clay ball and the ground or the mould to prevent the clay from sticking.

The potter then makes a coil to attach the flat base. A few centimeters of the lower wall are raised during this process. The body is made by adding two to five coils, depending on the size of the vessel. Between one coil and another the incomplete form is left to dry for a short time. The attachment points should remain moist so the top and lower coils can join together. In some cases the drying stage was longer than what is needed and a line of separation could be seen between the two coils. The indications of coiling can be seen in two types of markings. First, many bases show a fracture line at the coiling point where the body attached to the base. Some fractures were as much as two millimeters wide and twelve millimeters long. Second, evidence of coiling can also be identified by bends on the wall, clay slurry, walls and variations of the wall thickness.

The walls of each pot were raised by flattening the clay coil between both hands. The left hand supports the interior while the right hand supports the exterior. Simultaneously, the potters pulled up the clay to raising the wall. Instead of the bare hands, some forms were beaten by a wooden or stone paddle, a technique common especially during the early phases of the Early Bronze Age. At least three coils are added to form the belly. The upper part is built of two or three coils. The shoulder is made from a separate coil. In case of the necked jar (Fig. 6), the neck is made adding another coil which is attached to the shoulder. The coils forming the shoulder and the neck were turned on the slow wheel. The rim was created by adding another coil which was turned on the slow wheel. Rounded rims were formed with the finger tips. Or, they could have been cut with a sharp tool or flattened or grooved by the finger, to give it the desired final shape.

Fig. 6. Early Bronze Age necked jar from Tell Jenin.

After completing the rim, the handles were attached. Three types of handles are found. The most common is the ledge handle which is made from a clay slab, cut into two halves and then attached to the body. These handles occur on all jar types. The other normal handle occurring mainly on jugs and juglets, is the loop handle. It was attached to the upper part of the jug and sometimes rises high above the rim. The third handle and least frequent is a clay knob which was attached gently to the shoulder. One regular technological practice related to all handle attachments is the wide point of attachment between the body and the handle edge, strongly bonding it to the body, (similar to the example of Tell el 'Umeiri in Jordan (London 1991: 385-388).

The other technique used to shape certain jars, bowls and juglets was to turn the entire vessel on a slow wheel. Evidence of this method is discernible from finger print markings left on the walls and the string cut marks on the bottom of the bases. It is clear, as we know from the potter of Jaba', that these forms were made from a clay hump. The potter opens the hump with the curved forefinger while the palm of the left hand supports the exterior wall. The walls are raised by the side of the left and right forefingers in a reverse order (i.e. the left forefinger from the inside and the right one from the outside). The simple rim is made by pulling the clay with the finger tips. In certain cases, the potter inserted the neck and rim made from a different coil on to the shoulder. After finishing the form, the base is cut by using a string. There can be also pulled bases indicating that the potter detached the form from the turntable after it was finished without using a string.

Surface treatment

The majority of the Early Bronze Age pottery from Tell Jenin was decorated. Most common surface treatment applied is the red slip paint which was applied by one of three methods to the surface:

1. the potter used a brush or perhaps a cloth or chicken feather to paint the entire surface.
2. the potter poured the slip over the entire surface.
3. the potter dipped the entire vessel into the slip: a technique reserved for small jugs and bowls.

The second most common method of surface treatment is slip burnishing and/or burnishing: the slip burnish method involved coating the surface with a layer of slip and then rubbing it with a stick or a bone. Alternatively, the surface was burnished directly when it was still green before it had dried further.

Incised patterns are the third decoration, either applied alone or combined with other surface treatment. Most typical are notches at the shoulder of hole mouth jars. The notches are made by pressing the clay with the tip of a cane stick. Chevrons and indentations are incised with a comb or a finger nail.

Pinching and rope decorations are also used to decorate the surface. One of the interesting combinations is the rope and incision technique. A thin rope is added at the shoulder and then a line of notches is applied to it. This technique is also employed by the Jaba' potter.

Conclusions

The ethnographic and archaeological data on pottery traditions of the Jenin region meet at many points: clay resources, clay manipulation, forming methods and decorations.

It is clear that the potters had used the resources nearby the production site. Both the potters of Ya'bad and Jaba' used resources located within two kilometers of the production place. The Early Bronze Age potters did not travel more than three kilometers to obtain the clay.

The manner in which the clay is manipulated is similar both today and in antiquity. The Early Bronze Age potters mixed more than one clay type together in a way comparable to the potters of Jaba'. The tempering material is also the same.

The forming techniques are quite similar. The coiling and turning methods were used to make the Early Bronze Age pottery. One difference, however, is the combination of both methods marks on some jars during the Early Bronze Age. The combined technique suggests that the adaptation to the turning method was gradual. Instead of the combined technique, the traditional potters today work in either coils or turning without combining the two.

Finally, the surface treatment in the Early Bronze Age bears a close resemblance to the two village potteries observed. The wheelmade pottery of Jaba' is limited to few lines of incision, while the potters of Ya'bad always coat their forms with a layer of burnished slip. The surface treatment had both decorative and functional purposes. Both techniques characterize Early Bronze Age wares.

Based on this preliminary research, two major conclusions can be drawn. Only the material aspects (or precisely the technological practices) can be compared in the absence of direct continuity between the past and the present practioners. But when these technical aspects are comparatively addressed, several informative parallels between these temporally distinct practices are identified. This suggests a high probability that today's living potters have not radically changed the technical factors of pottery production. Here we have proposed and tried to demonstrate a means of relating the past with the present, and to stimulate further research along these lines of inquiry.

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M.B. Annis

ETHNOGRAPHY AND ARCHAEOLOGY IN SARDINIA: SOME REFLECTIONS ON TECHNOLOGICAL TRADITIONS

Introduction

Two ceramological investigations in Sardinia have been undertaken at the Department of Pottery Technology of Leiden University (DPTL). One is an ethnoarchaeological project which I have been carrying out in collaboration with Herman Geertman since 1975[1] and the second is a part of an archaeological project – called Riu Mannu Survey – which has been set up in 1991 by Pieter van de Velde, Peter van Dommelen and myself[2].

The ethnoarchaeological study focuses on the social and economic aspects of pottery making and their mutual relationships during a time of radical transformations in Sardinia. Technological analysis, linked as it is to both production and consumption of the wares, has been proved a powerful means of investigation and as such plays an important part in the research.

The objective of the archaeological survey is to explore the developments in political organization and land use in west central Sardinia in different historical periods, from Neolithic to the Middle Ages. In this project ceramic material constitutes the bulk of the finds (about 75% of the collection). As a consequence, pottery analysis and its patterns of distribution in time and space, are crucial for the understanding of the regional structure and organization. Although different in terms of their specific queries and fieldwork methods, the two investigations are both distinguished by a strong methodological component and have some characters in common: their focus on the rural world; their regional scale; and their specific interest in long-term developments.

However, within the shared parameters, the two investigations differ in the specific meanings given to the same concepts in the ethnographical and the archaeological projects. For the sake of clarity and precision, these differences require definition .

In the ethnoarchaeological study the term 'rural' is used to indicate the structure of Sardinian society before the 1960s when farmers and shepherds constituted more than 60% of the working population of the island. The archaeological research focuses on the 'rural' landscapes in contrast to the urban and monumental archaeology which for a long time has been the main interest in Sardinia.

The ethnoarchaeological research is a 'regional' study because all the pottery production centres and workshops within the Sardinian plain of the Campidano are taken into consideration and their distribution systems investigated (Fig. 1). In the archaeological project the term 'regional' indicates the study area of west-central Sardinia, where all major landscape types of the island are represented (Fig. 2).

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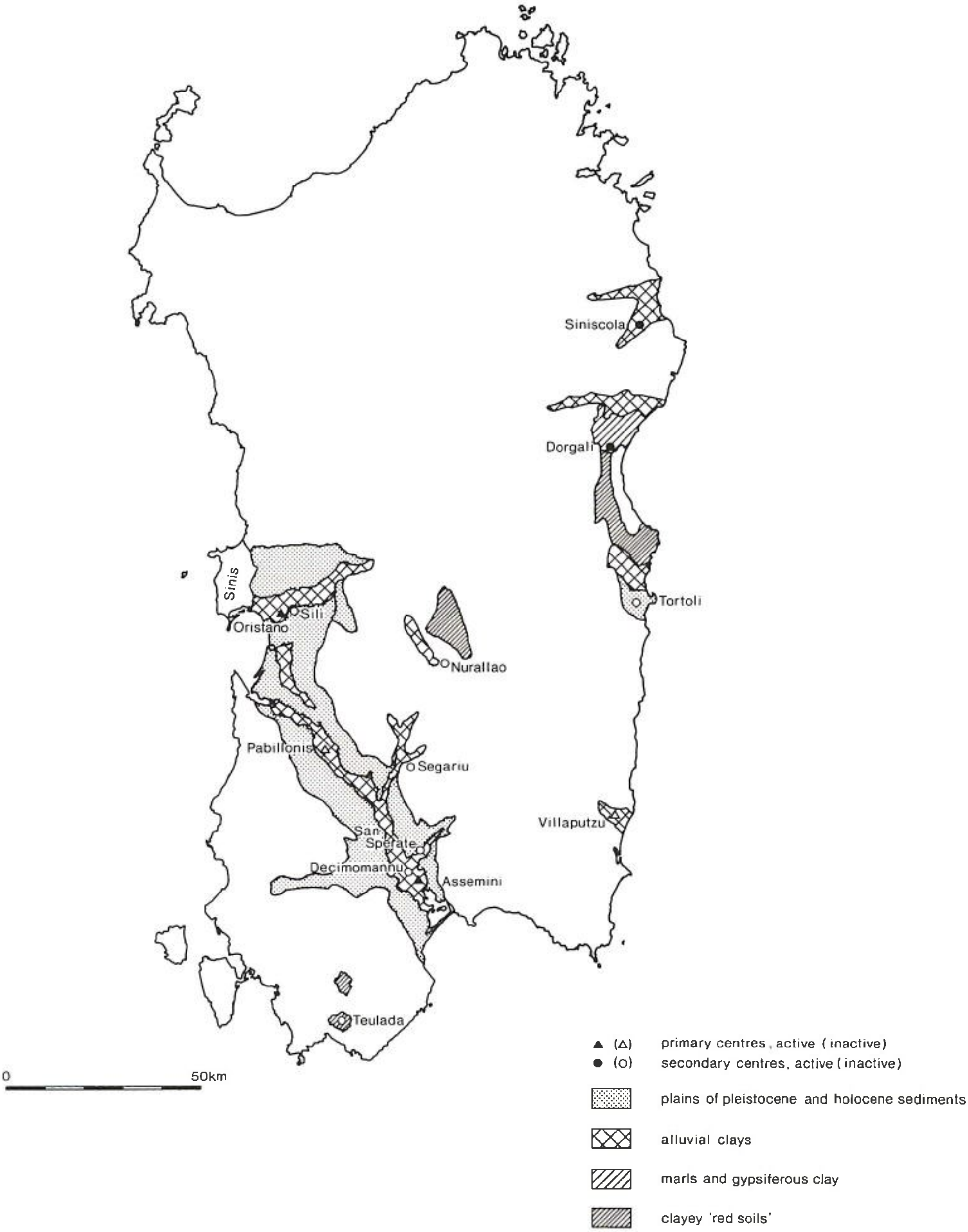

Fig. 1. Sardinia, centres of pottery production and clay sediments (drawing by Peter Deunhouwer).

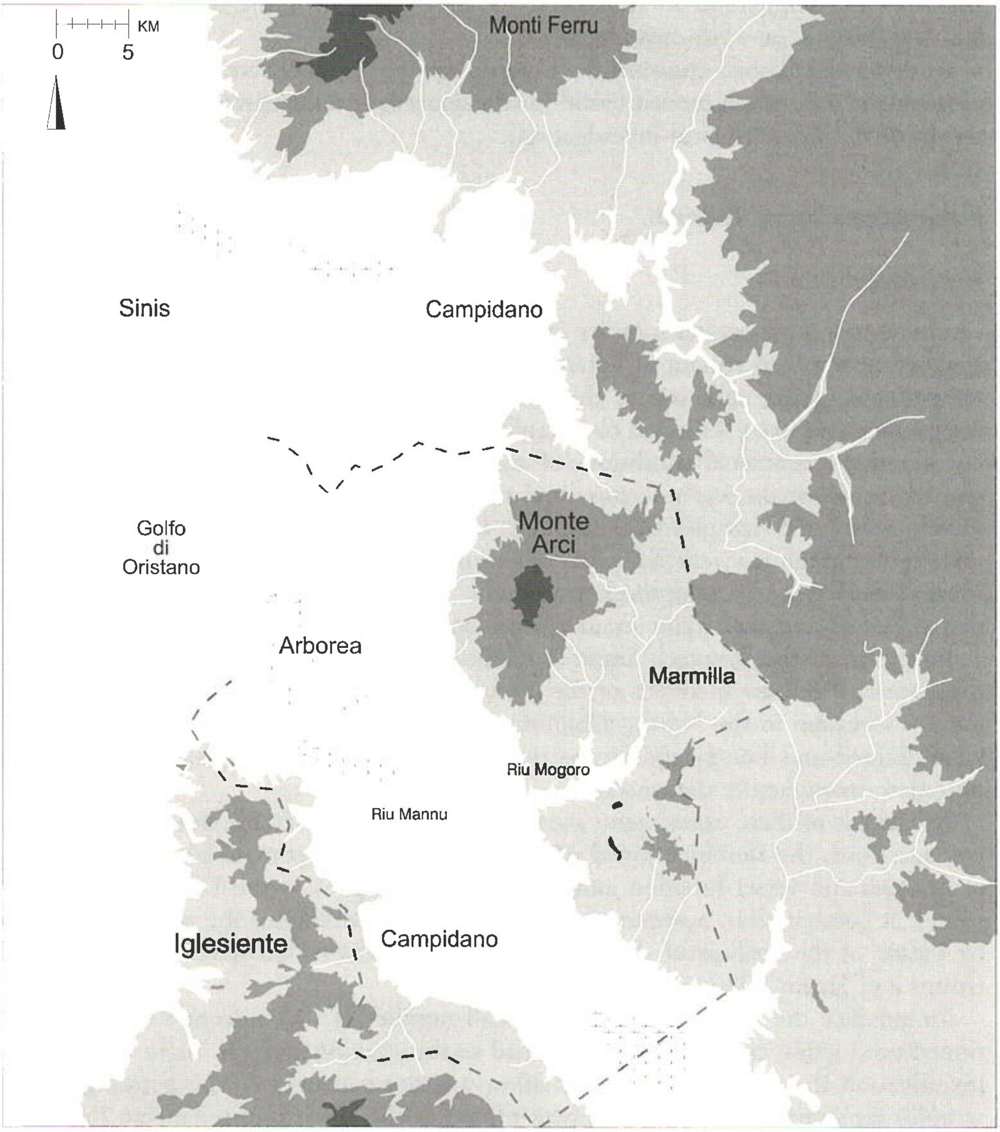

Fig. 2. Map of the principal landscapes of west central Sardinia (drawing by Peter van Dommelen).

As to the 'long-term developments', in the ethnoarchaeological investigation the qualification 'long-term' means a time of roughly two generations (1920-1990), while in the archaeological survey the study concentrates on the social and political organization of the population in the selected region from Neolithic to the Middle Ages (ca. 6000 B.C. - ca. 11th century A.D.).

In this article I shall concentrate in particular on some aspects of the ethnoarchaeological research which proved useful for the analysis and interpretation of the ceramic record of the archaeological investigation.

Ethnoarchaeological research

Experimental studies

Over the past years several samples of Sardinian pottery and raw materials have been analysed at the Department of Pottery Technology of Leiden University. Sherds, clays, tempers and glazes collected in the different centres of production and at different workshops have been subjected to a number of experiments. The analyses were carried out under the simulated conditions of an archaeological investigation: i.e. the ethnographic information was not conveyed to the analysts. It was assumed that only a limited number of samples were available, from which conclusions regarding the relationships between raw materials, manufacturing techniques and function of the vessels were to be drawn. This approach would also enable us to assess the efficiency of the methods used and their value in an archaeological situation.

By means of the 'low tech' research methods used at the Department, the artisanal properties of the raw materials of the three main production locations of the Campidano – Oristano in the North, Pabillonis in the Centre and Assemini in the South – were defined and Loe Jacobs reconstructed the different techniques adopted by the potters to manufacture the vessels.

As a result of these experiments we succeeded to a considerable extent in answering our questions: the aforementioned relationships between raw materials, manufacturing techniques and vessel function and the methods adopted at the Department proved sound. It became clear, however, that without the availability of the raw materials, i.e. by means of the analysis of the sherds only, the results would have been incomplete (Annis and Jacobs 1986; 1989/90).

To enhance the series of the tests, a small number of sherds from the above mentioned production centres where submitted to thin section analysis. As in the previous investigation the ethnographic information was not conveyed to the petrologist. The samples represented clays and tempers mined at the three Campidaneian locations; different workshops; different manufacturing techniques and different vessel functions. Once again the methodological questions posed concerned the possibility to infer the differences in raw materials, technology and products among the three centres, this time however by means of thin section analysis only.

In accordance with the lithology of the Sardinian Campidano where the predominant clayey quaternary sediments (Pecorini 1971: 9-11) do not contain a wide variety of minerals (Exel 1986), the compositions of the various samples resulted to be remarkably homogeneous. As a consequence, a classification of the sherds on the basis of the type and quantity of the non-plastic inclusions did not give any clear answers to the questions posed. However, a classification of the samples on the basis of the matrices, in particular their fineness and mineral composition, made it possible to attribute the samples to their respective place of origin. Moreover, the pore percentages gave an indication of the degree of plasticity of the clays and the grain size distribution attested to the function of the vessels (Annis 1996/97).

The knowledge of the Campidaneian clays and pottery and especially the comparison between the features of the raw materials and the related characteristics of the products, were of great help to the archaeological investigation in the same region.

Ceramic traditions

In their 'Introduction', Bram van As and Gloria London rightly stress the importance to "identify different yet co-existing traditions of pottery manufacture within a region" and "to learn to recognize different techniques and sources of variation in the technology" through the observation of potters at work. A couple of years ago, in his article titled "Theory and practice of ceramic studies in archaeology", Henk Franken wondered "How is tradition to be defined and why does it occupy a central position – the basis for virtually all aspects of ceramic studies – and what are the consequences?" (Franken 1995: 98).

The 'long-term' approach of both my ethnoarchaeological and archaeological studies gave me reason to reflect on traditions too – traditions in people's behaviour in general and in pottery production and use in particular – also wondering what these really are and what one means precisely by the terms 'tradition', 'traditional'.

To start with a definition of terms, for the verb 'tradere' and the noun 'traditio' the *Oxford Latin Dictionary* gives basically two meanings. A more active meaning: 'handing over', 'delivering', material and immaterial things such as goods, possession, knowledge, and a more passive meaning: 'handing down', 'passing on', generally immaterial things, such as qualities, attributes, beliefs, and also heritage (Glare 1982: s.v. tradition).

This handing over, transmitting, entrusting is often seen as the source of continuity in behaviour and even as an opposition to innovation. Traditions, however, do not represent the whole past, they are only selections of fragments of the past. The choices that are made, either conscious or unconscious ones, are made in specific situations, among various possibilities at disposal, because they seem suitable not only for the present but also for the future. Craftsmen who work in the present at a specific location, with a skill inherited from the past and thinking about the future, make (technological) selections that are related to time and space and that consequently must be historically and archaeologically 'diagnostic'. In this process of selection, the 'discarded pieces' – that which has been abandoned – are important too. In particular, when we are dealing with contacts between different cultures, as in case of colonization or conquest, the 'patches', the 'joints' and the 'darns' (Clemente 1999) are also relevant for the interpretation because they testify co-presence and generate new values and practices (van Dommelen 1998b: 15-36). In short, speaking about traditions is dealing with dynamic processes, but these are often neglected to highlight the supposed 'stability' of a situation.

On the basis of my experiences within the changing Sardinian context, I have previously pointed out that in the search of the 'sources of variation in technology' not only the environmental situations, but also the historical factors – economic, social and political-ideological as well – should be taken into consideration. A few examples illustrate in this concern .

From the 1920s to the 1950s there were ten centres of ceramic production in Sardinia (Fig. 1). The production consisted of terracotta vessels, roof-tiles and bricks. The three main centres – Oristano, Pabillonis, and Assemini – were situated in the Campidano and, at least for this region, we can generally speak of a single pottery making tradition mainly transmitted from father to son. As regards the properties of the raw materials and their preparation, the manufacture of the wares, the formal and functional repertory of the vessels and their distribution, the Campidaneian pottery differed only slightly in the various locations. A small number of details made the differences to constitute a 'particular set of strategies' (van As and London, this issue), the 'pottery dialects' (London 1990: 72; Vossen 1990: 26-27), which distinguished an individual tradition from another one and that – as explained above – we were able to 'reconstruct' to a quite satisfactory degree.

A comparison of the Sardinian pottery-making with other ones in the Mediterranean basin resulted in the discovery of particularly strong analogies between Sardinian and Spanish production of ordinary ware. The similarities occurred not only in terms of shapes, technology and equipment, but also as regards both the rationalization of the production and the distribution system in series and units of sale (cf. Vossen 1972; 1984; Vossen, Seseña, Köpke 1981). As I will discuss below, historical and archaeological evidence has recently shown that these resemblances are not to be attributed to a general Mediterranenan *koinè* characterizing the production defined by Vossen as "Männertöpferei in Drehtechnik" (Vossen 1990: 64-66), but to a specific political situation which goes back to the 16th and 15th centuries.

As noted above, the alluvial clays of the Campidano were found to be quite homogeneous regarding their mineral composition. With respect to their artisanal properties, their workability, we discovered that they are quite similar too. The main difference lies in their degree of plasticity: at Oristano and Pabillonis the clays are 'short' and highly thixotropic (Grimshaw 1980: 472-475; Hamer 1983: 295), whereas in Assemini they are 'long' and, thanks to their water absorption capability, more suitable to be worked on the wheel. This of course influences the clay preparation, the processes of throwing, finishing, drying and firing and the shapes and function of the vessels too. As is the norm in pottery-making, in the Campidano as well the artisanal properties of the raw materials predetermined for the potters certain technical constraints that were to be overcome with different methods to obtain the wanted products.

Regarding the methods employed by the potters – which together make up and characterize every tradition, as Henk Franken (1995) rightly states – they were not 'taught' by the master potters to the apprentices, at least not in the sense we are accustomed to think of 'teaching'. The apprentices, even the sons of the masters, had to capture the skill with their eyes and to practice it by trial and error. A potter from Assemini described this situation in a very eloquent way: "When I was a child my father threw me on a heap of clay without giving me any instructions and today I still lie there trying to improve my skill and my work every time". Indeed, I could establish that every potter had in a sense his own technical solutions depending on his physical characteristics, his nature, his economic and social situation. Although prior to the 1960s the master potters "watched carefully" (Franken 1995) the process of pot making, especially in Oristano where they were associated in a sort of guild, there was some room for minor changes. This room increased enormously after the 1960s. Due to the dramatically transforming social and economic context, the potters had to change their mode of production organization from 'workshop industry' to the more flexible mode of 'individual workshop' (Peacock 1982: 6-9), in which each chose his own technical solutions (Annis 1985). In those years it was interesting to observe the variety of selections made by the different potters: from a complete adherence to the terracotta tradition, to different degrees of adaptation and even to real innovations, depending on their mentality and work situation. Only those who were able to adapt to the new social situation could make a living and continue their work. Particularly striking is the case of a potter who was born and brought up in the tradition and who later became a teacher at the Art school of Oristano where he learned to experiment with all possible kinds of materials, techniques and shapes, ranging from majolica to stoneware. When he was able to set up his private workshop, he went back to the Oristaneian tradition from which he came, although, for practical reasons, he imported all the raw materials from the Mainland. Although the teacher had the full capabilities to make majolica or stoneware pots, he adopted for the old Oristaneian manufacturing techniques: the vessels were made from an earthenware red clay and coated with a white slip under glaze, while the traditional forms were adapted to carry a pictorial decoration (Annis 1985a; 1985b; 1988).

In reflecting on 'traditions', I increasingly became interested in the historical and archaeological aspects of the Campidaneian production. As in the meanwhile archives research on the period of Spanish domination in Sardinia (1324-1718) had shown, the ceramic production of the island was organized according to Spanish models (Marini and Ferru 1993: 61-139), we previously pointed out (Annis and Jacobs 1989/90), that the specialization of some today's centres in the manufacture of specific products was not the result of the availability of resources with special properties but could be the consequence of Spanish administrative measures (Annis 1997/98).

More recently, excavations at Oristano under the church and the monastery of Santa Chiara founded in 1343 or a few years earlier, shed new light on the history of the medieval Oristaneian pottery production. In their book "Le ceramiche del convento di Santa Chiara: storia dell'artigianato a Oristano in epoca giudicale e spagnola" Marco Marini and Maria Laura Ferru outline a development of the ceramic production of this town from the middle of the 14th to the early 18th century on the basis of a comparative formal and stylistic analysis of the finds and with references to written sources (Marini and Ferru 1998: 11-43).

During the 14th century Oristano was the capital of the Sardinian Giudicato of Arborea, a small state ruled from the 10th century onwards by the local *Judikes* after about four centuries of Byzantine domination. The *Judikes* had succeeded in maintaining the Arborea independent of the kingdom of Aragon which had conquered a great part of the Island. According to Marini and Ferru the 14th century Oristaneian ceramic production was closely related to the Byzantine and Italian Mainland (Pisan and Genoese) formal and (highly symbolic) decorative patterns. The authors understand the similarities between Oristaneian and Greek and Mainland productions as an expression of the identification of the town rulers to Byzantine and Italian cultural worlds and an ideological opposition to Spain. In the 15th century, when, after a strenuous resistance, the Giudicato of Arborea became part of the dominions of the Crown of Aragon and Castilla (1479), the pottery production rapidly changed to adopt Spanish models (Marini and Ferru 1998: 27-34). In the 16th century only a few shapes of the old tradition survived. Among the survivors, and particularly indicative is the 'disku', a Sardinian name from the Greek (Byzantine) word 'diskos', a type of bowl which still today bears the same name and makes part of the Oristaneian production. According to Marini and Ferru it was during the Spanish domination that the local ceramic production lost its relationship with the upper classes and consequently its cultivated character and became ordinary and rural. The Spanish and local aristocrats preferred their stylish tin-glazed majolica which they mainly imported from Spain and from Italy as well.

Unfortunately, technological research on the excavated material is lacking, but as far as one can see by visual examination only, the formal and technical characteristics of the 20th century Sardinian terracotta ware bear close resemblances to the 16th and 17th centuries products, even in details as the peculiar methods of attachment of spouts and handles and the typical plastic decoration of the ceremonial vessels. A strong continuity in tradition is the use of a white slip under a lead glaze, a technical solution that never changed and characterized centuries of Oristaneian production. Our experiments have attested that the red alluvial clay of Oristano repels tin glaze while it is highly compatible with the kaolins of Nurallao, a village in the centre of the island from which the current potters obtain their slip. We also learned that the thixotropic nature of the Oristaneian clay made it unsuitable for throwing thin walls, which is important to make fine table ware (Annis and Jacobs 1986). Consequently one could conclude that during the Renaissance period, when in Spain and in the Italian mainland the production of majolica flourished, some technical constraints prevented, or at least made it difficult for the Oristaneian potters, to change their production to majolica. On the other hand, this does not explain why during the centuries of the Spanish domination, the Oristaneian production never lost its rural character although in the same period 'sgraffito ware' (earthenware red clay covered with a white engobe under a lead glaze, painted with metal oxides and decorated 'a sgraffito') of a high artistic quality was produced in Italy and elsewhere. Furthermore, from the period of Spanish domination to the beginning of the 20th century, Sardinia never produced fine table ware or artistic pottery. This situation cannot be attributed to technical constraints alone, since marls, kaolins and stoneware clays of excellent quality as well as all materials necessary to make glazes are plentiful on the island.

To conclude, the Sardinian picture shows repeatedly that technology is not only a matter of raw materials, but to an even greater extent, it is a social and economic factor which can be influenced by policy and legislation. Consequently, continuity or changes in a technological tradition are intertwined with society and, as Dick Papousek rightly stated, both necessity and possibility together are the social conditions for technological innovation (Papousek 1989).

Riu Mannu Survey

Fabric analysis and clay collection

In the volume 11/12 of this *Newsletter* a first interim report of the Riu Mannu project was given illustrating the general research objectives; the characters of the region with its different landscapes (Fig. 2); the field methods adopted and the criteria of data processing. Particularly the plans for the research into ceramic material were presented and some preliminary results were given (Annis, van Dommelen, and van de Velde 1993/94).

During the past years the project has proceeded. In the autumn of 1999 the last six transects (nos. 20-25) of the core areas were examined bringing the sampling to a conclusion (Fig. 3). Meanwhile several studies have been published. Apart from a few general presentations of the project with updated fieldwork reports (Annis, van Dommelen, and van de Velde 1995; 1996), more specific studies by the three members of the staff appeared in different journals. These included various aspects of the rural colonial history and archaeology of the region in the first millennium B.C. (van Dommelen 1997; 1998a); a detailed explanation of the sampling strategy and fieldwork methods (van de Velde 1996) and an account of the ceramic research design with preliminary results (Annis 1998). In his Ph.D. dissertation on colonialism and rural settlement in the first millennium B.C. in west-central Sardinia, Peter van Dommelen utilized the archaeological evidence collected during the Riu Mannu Survey (van Dommelen 1998b) and Natasja de Bruijn and Heleen Stoetman devoted their Master theses respectively to the obsidian of transect 04 (de Bruijn 1998) and to the ceramic material collected in transect 07 (Stoetman 2000).

As explained in previous publications, according to the approach and the methods applied to ceramological investigations at the DPTL (e.g. van As, Jacobs and Wijnen 1995; Franken 1996/97) and to my ethnoarchaeological work in particular, it was decided from the start of the project to study the pottery not only from a typological, but also from a technological perspective. Accordingly, we carried out fabric analysis and collected clays in the region[3] I can now present a summary account of our investigations on the clays and fabrics. More details on the matter are to be found in the cited publications.

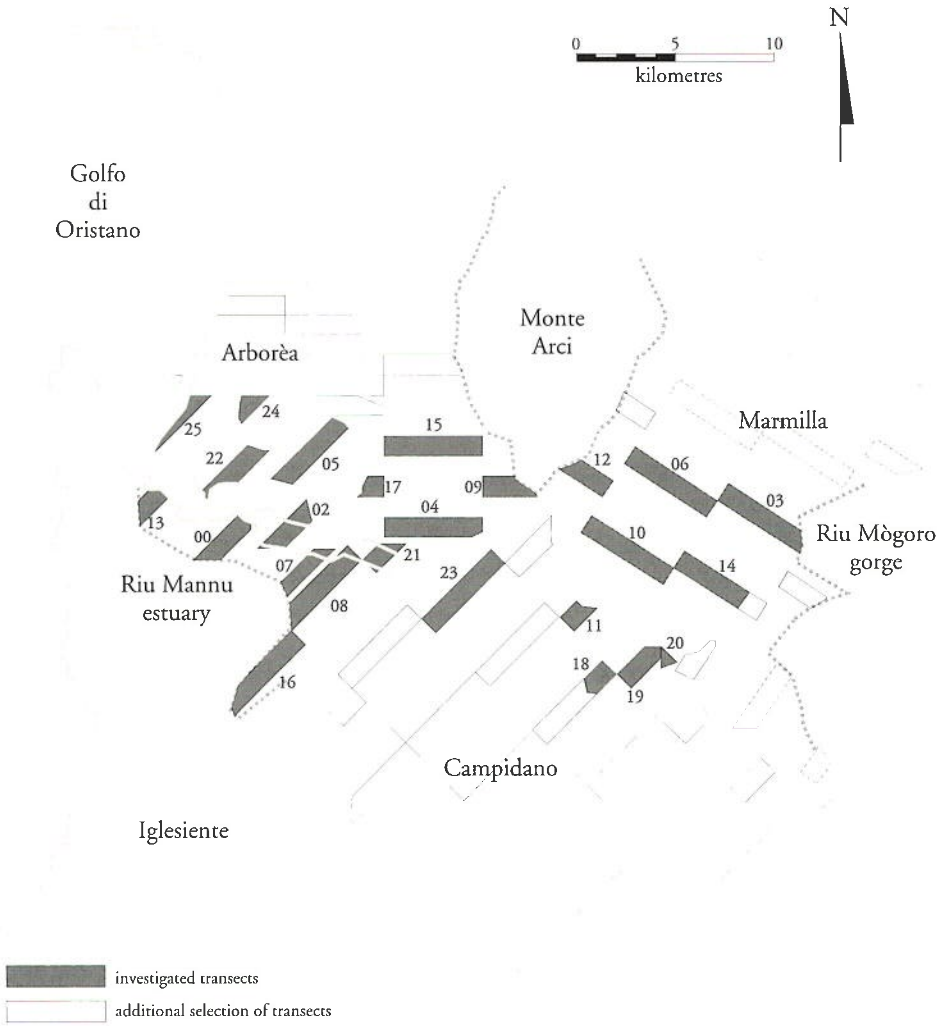

Fig. 3. The Riu Mannu Survey sampling strategy showing the two key areas of the Riu Mannu and Riu Mogoro (drawing by Pieter van de Velde).

Area, transects and sites

A few transects surveyed in the core area of the estuary of the Riu Mannu river are situated in the vicinity of the Punic-Roman town of Neapolis (Fig. 4), the origins of which are thought to be Phoenician (Zucca 1987; 1997)[4]. The chronology of the different sites that are indicated within each transect, ranges from Late Neolithic (04-B) to Late Roman times (05-A), but the majority of the settlements are of Punic and Roman-republican date (roughly 5th to the 1st century B.C.) when this area was very densely populated (van Dommelen 1998b: 115-209). The settlements present different characteristics both in size and period of occupation. At times the finds indicate only one period of occupation, but sometimes the sites were inhabited for several centuries, as in the case of site 05-A which shows a continuous occupation from the Bronze Age to the Late Antiquity. The functions of the various sites range from permanently inhabited Punic-Roman farms involved in agriculture and trading, to store places and simple shelters. A funerary function cannot be excluded for some concentrations (Stoetman 2000: 58-60).

At present only the transects 02 Santa Chiara and 07 Putzu Nieddu can be considered complete as all the ceramic finds found there, whether in concentrations (sites) or scattered (off-site), have been stereoscopically examined (25-50x), thin sectioned and compared with clays collected in the region[5].

Local clays and fabrics

In the specified study area, a number of clay samples have been collected at different spots. These samples have been examined by Loe Jacobs as regards their mineral contents (type, shape, size, amount and sorting of the non-plastic inclusions) and their workability in terms of manufacture and firing behaviour (Annis and Jacobs forthcoming).

Four of the samples, all collected on a spot with the toponym *Bau Angius*, which is in close proximity to transects 02 and 07 compared closely to a local fabric which we had defined and labelled A. The *Bau Angius* clay is a red, alluvial clay, with natural, quite good artisanal properties. A raw material with very similar mineralogical and artisanal characteristics was found to be used in the Neapolis region from Late Neolithic to Roman times. A number of Late Neolithic, Bronze and Iron Age sherds found at various sites in the region are characterized by fabrics quite similar to fabric A, while the great majority of the Punic pottery so far analysed exhibit this fabric. Clearly then this clay was used for a long period of time during which potters were not obliged to their material in order to obtain the desired products. The *Bau Angius* clays, or clays of that sort in the Riu Mannu region, must have been very tolerant raw materials as they were used not only for a long time and in different cultural contexts, but also for both handmade and wheelmade objects and for all kinds of functions. Punic period roof tiles, storage vessels, cooking pots and other utilitarian pottery were all manufactured with these clays since they show the same fabric with slight variations only (Stoetman 2000: 17-20).

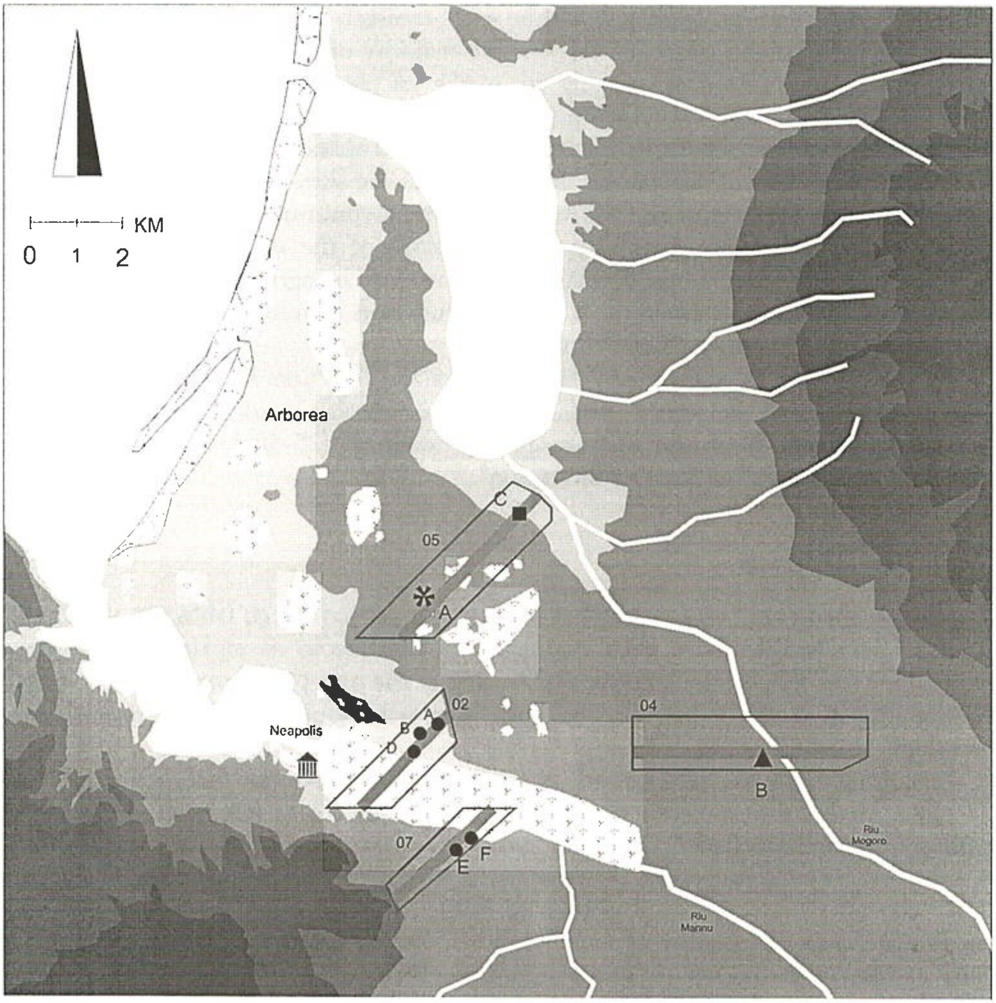

Fig. 4. Map of the Riu Mannu estuary key area showing the transects nrs. 02-04-05-07 where the mentioned sites of the different periods are situated: ▲ prehistoric site; ■ Bronze Age site; ● Punic-Roman site; ✡ multiperiod site (drawing by Peter van Dommelen).

It is possible, although not sufficiently tested yet, that in Roman times we see to a change in this long lasting tradition. Fabric A seems confined to coarse ware only. In contrast, a fabric labelled Q characterizes a quite large group of Roman common ware, locally made and found at different sites. Fabric Q presents features quite similar to fabric A, but with very small inclusions only, which may indicate that the clay was purified before use (Annis 1998; Stoetman 2000: 31).

The sites 04-B (Late Neolithic-Eneolithic) and 05-C (Bronze Age), which are situated in the vicinity of the Riu Mogoro river (Fig. 4), show pottery also manufactured with a red alluvial clay, but the fabrics have a mineralogical composition different from fabric A and well in keeping with the different lithology of the Riu Mogoro basin (Fig. 2).

As it was to be expected, in prehistoric and proto-historic periods the fabrics were far less standardized than in the Punic and Roman periods, which is a clear indication of different ways of organization in the production: from 'household production', to 'workshop industry' and 'manufacture' (Peacock 1982: 6-8; Annis 1998).

Non-local fabrics

While in Prehistory and the Bronze Age only red Campidaneian clays were used, in the later periods imported wares made their appearance in the region. A distinction has been made between Sardinian and overseas fabrics.

A yellowish firing, calcareous fabric labelled B (Stoetman 2000: 20-22) compares closely to a fabric from the most important Phoenician-Punic colony of Sardinia and a main archaeological site on the island, Tharros (Amadori, Antonelli and Grillini 1995; Amadori M., Amadori M.L. and Fabbri 1996). The variation B2 of the fabric B shows a close similarity with a marine clay which we have collected in the vicinity of the archaeological site (Annis and Jacobs forthcoming.).

In addition, there is also the fabric labelled I, which characterizes the Hellenistic 'Black Glaze' pottery (a fine ware produced in the Mediterranean basin from the 3rd to the 1st century B.C.). Black glaze ware found in the Neapolis region is thought to be Sardinian on the basis of comparisons with pottery found elsewhere on the island which bear similar characteristics (Campanella 1999: 93-117; Stoetman 2000, 27-30).

Overseas fabrics

Apart from some sherds of Attic Black glaze pottery (late 5th-early 4th century B.C.) found in transect 02 (Annis, van Dommelen, and van de Velde 1995), other overseas fabrics attested in the area confirm the commercial character of the Neapolis region in Punic and Roman times (Zucca 1987; 1997; van Dommelen 1998b: 146-159 and 177-188) adding some more concrete details to the picture.

The fabrics labelled D1 and D2 come from coastal Tunesia. They represent a long tradition in the manufacture of north African transport amphorae and other utilitarian pottery which, in the coarser variation D1, finds its origin in Phoenician times and has been attested at Carthage from the 8th to the 4th century B.C. (Docter 1997: 173-

191). In the Riu Mannu region the fabrics D1 and D2 follow one another in time and characterize pottery dating approximately from the end of the 5th to the 2nd-1st century B.C. (Annis 1998).

The fabrics labelled C and F belong to commercial amphorae of the type called 'Greco-Italic' dating from the 3rd to the 1rst century B.C. Fabric C and F compare well respectively with 'Greco-Italic' amphorae from the Albegna valley/Ager Cosanus (Central Italy) and (presumably) from Sicily or the Aegean region (Stoetman 2000: 22-23; 26-27). A provenance from Apulia has been supposed possible for a 'Lamboglia 2' type amphora (2nd -1rst century B.C.) classified as 'class 8' by Peacock and Williams (1986: 98-101). This fabric has been found among the off-site material in Transect 07 (Stoetman 2000: 34).

As far as it is possible to make more general statements at the present state of the research, it seems that in Punic and Roman republican times the commercial contacts of the investigated sites were mainly with North Africa and central and southern Italy. Later on – in Roman (late) imperial times (middle 2nd – 6th century A.D.) – the trade relationships with North Africa predominated and the contacts with Italy came to an end. African commercial amphorae and African Red Slip table- and cooking ware were found together with local material of the same period in some late Roman concentrations. This is of course only a very fragmentary picture based on limited data, but the results are in keeping with the development of trade in Sardinia and in the Mediterranean during the same centuries (Tronchetti 1996: 171-178; Vismara 1993: 299-304; Panella 1993: 613-697).

Concluding remarks

To conclude, I would like to add a few general considerations about "Pottery analysis and interpretation" which was one of the themes of the Annual Meeting of the American School of Oriental Research in 1997 at the Napa Valley.

An important lesson I learned from the observation of the Sardinian potters at work is that in pottery manufacture the techniques used are far from fixed and constant, even when they are standardized. On the contrary, they continually modify a bit as they are rather a blend of approximation on one hand – acting roughly and trusting on experience only – and of a balanced calibration of the materials on the other. Substitution of ingredients – what is at hand – is not uncommon, but at the same time careful strategies are adopted in keeping in mind not only the function of the vessels, but also their elegance and beauty. The same attitude, which implies adapting and re-using everything, also applies for the consumers of the wares. According to the Italian anthropologist Pietro Clemente, this is part of the more general ethic of economizing and maximizing resources which dominates in non-industrial, non-consumistic societies where the accessibility to resources is limited (Clemente 1999: 41-68). Dealing with these matters, Clemente (1999: 52) refers to an article by the historian Carlo Ginzburg (1980) in which he underscores that much knowledge and practices are based only upon 'traces', 'symptoms', 'indications'. As a consequence they demand a 'presumptive and divinatory paradigm'. According to Ginzburg, the ancient Greeks attributed these types of activities to physicians, historians, politicians, potters, carpenters, sailors, hunters, fishers and women. This is the reason why, in the understanding of ceramics, archaeometrical and related statistical analyses with their quantitative data may be less informative than an artisanal, historico-anthropological approach. Of course with this I do not intend to lessen the importance of archaeometry and statistics in pottery analysis, particularly when one has to deal with matters of composition and provenance they are indeed irreplaceable. What I would stress is that without a true knowledge of the context of the makers and the users and of their possible consequent behaviour, the interpretation of the scientific and statistical data may be limited or simply wrong. In other words I would like to plead for the complementarity of the two methods in every ceramological research. Recently Bernard Knapp (Knapp 2000) correctly pleaded for a "long-term collaboration between archaeologists and science-based archaeologists" which he considers "essential if both fields are to move beyond their limited horizons and make useful contributions to understanding past social patterns, cultural practices and individual lives". In the same article Knapp also states that "the socio-cultural role of any 'commodity' must be assessed in the context of its technology and production, as well as distribution and consumption".

Indeed, asking ceramics for information about society involves different inquiries into social context and demand, production and use. It is very well known among ceramologists that these aspects are linked to each other in mutual relationships and – what makes things more complex – that each of them includes a fairly large number of variables. Needless to say that the understanding of the place and the role of pottery within the social context it makes part of, is not only a matter of archaeology and archaeometry. Anthropology, history and, when possible, linguistics are necessary as well. Henk Franken's work is a valuable example in this sense. It still inspires the research carried out at the DPTL where the integration of technological analysis of sherds and raw materials, laboratory experiments and ethnoarchaeological research seem to offer good possibilities for the translation of the results of scientific techniques into past human activities.

Notes

1. Herman Geertman carried out the graphic and photographic documentation: I am very grateful to him not only for his work but also for his continuous support. Several articles about the investigation have been published regularly in the *Newsletter of the Department of Pottery Technology (Leiden University)*, from Vol. 1, (1983), to Vol. 14/15 (1996/97), and also elsewhere (see References).

2. Permission for the survey was kindly granted by the Italian Ministery of Culture at the intercession of dr. Vincenzo Santoni, archaeological *Soprintendente* of Cagliari and Oristano provinces. Financial support was given by the Faculty of Archaeology of Leiden University (Pieter van de Velde and M. Beatrice Annis), by the Department of Archaeology of the Glasgow University (Peter van Dommelen) and by the Netherlands Organization for Scientific Research. The local authorities of Guspini provided lodging for the field-workers and storage facilities for the finds. We feel much indebted to the colleagues archaeologists Ubaldo Badas, Donatella Mureddu and Carlo Tronchetti, to the anthropologists Giulio Angioni, M. Gabriella Da

Re and Giannetta Murru-Corriga and to the geologist Rita Melis. We are also grateful to Tarcisio Agus, Gino Artudi, Sandro Perra and Mario Ortu who freely shared with us their knowledge of the area. A final word of acknowledgment is for the numerous *pastori e contadini sardi* who have allowed us to enter their fields.

3. To be able to realize this investigation we fortunately got the permits to temporarily export part of the finds to Leiden: we are very indebted for this to the *Soprintendente* dr. Vincenzo Santoni, to dr. Carlo Tronchetti and to dr.ssa Lucia Siddi. Several graduate students of the Faculty of Archaeology of Leiden University substantially and generously contributed to the fabric analysis. I would like to thank Ayla Çevik, Natasja de Bruijn, Yvette van Groenendael, Benoît Mater, Antoine Mientjes, Heleen Stoetman. Bram van As and Loe Jacobs were of great help in sampling the clays. In general the collegial support of Bram van As and the continuous help of Loe Jacobs and Eric Mulder have been of invaluable importance in this study.

4. Excavations at the site of Neapolis which have been recently (September – December 2000) undertaken by the archaeological *Soprintendenze* of Cagliari and Oristano and of Sassari and Nuoro in collaboration with the Department of History and Archaeology of the University of Sassari will shed light on this and several other aspects concerning the history of Neapolis and its region.

5. All the ceramic material collected at the transects 02 Santa Chiara and 07 Putzu Nieddu has been stereoscopically (10-50x) examined respectively by Peter van Dommelen (Department of Archaeology, Glasgow University) and by Heleen Stoetman (Stoetman 2000). A large number of thin sections has been made by Eric Mulder and analysed by Lara Maritan (Department of Mineralogy and Petrology, Padua University) at the Department of Archaeology of the University of Glasgow under the supervision of Richard Jones.

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G.A. London

POTTERS IN CYPRUS: TWELVE YEARS LATER

Introduction

A visit to the Cypriot village of Kornos during the off-season presents a glimpse of the pottery producing community when the weather prevents potters from their work. Twelve years earlier, a seven month field project among traditional potters in Cyprus examined rural pottery production for the full season in three villages (London 1987c). My return to Kornos village in March, 1998, provides evidence of some changes and continuity in vessel shapes, decoration, and organization of the industry.

Previous field work

In 1986 I carried out a seven month study of potters in southern Cyprus made possible by a Fulbright Award (London 1987a-d; 1989a-c; 1991a-c; London, Egoumenidou, and Karageorghis 1989). Cyprus is an ideal choice for a long-term field project. The rural potters are primarily women who work seasonally, using native clays to shape traditional, utilitarian wares (not tourist items) for local use. Traditional Cypriot rural potters work with a slow moving turntable rotated by hand or foot, not electricity. Hampe and Winter (1962) recorded the potters previously as have Johnston (1974) and Yon (1985). I could build on their studies and earlier reports as well (Ohnefalsch-Richter 1891; 1893; Pieridou 1960; and du Plat Taylor and Tufnell 1930).

Among the results of the initial field work, I found that while several potteries continued, work in one village had ceased and another pottery making village, at Kaminaria, had evaded researchers in the past despite its name which means 'kilns' (London 1987c: 127). Villagers carefully located their home in the forested Troodos Mountains to escape notice. Twelve years ago I observed and recorded potteries in Kornos, Ayios Dimitrios (Marathasa), and Kaminaria while living in the villages (Fig. 1). Residing in the pottery producing communities allowed me to be present when the first clay of the season was excavated. Data collection included observations on all aspects of pottery manufacture from clay procurement to manufacture and decoration, drying, firing (over 30 times), and distribution of the finished product for two villages, Kornos in the lowlands and Ayios Dimitrios in the Troodos Mountains. I recorded quantitative data for the following: time to make each pot type; rate of misfires; overall production quantities; number of pots made per potter in a given day, week and month; variety of types each potter made; decoration; firing times and pots fired each time; cost per pot; etc. (London 1989c). Also investigated were identification of the work of individual potters and villages; standardization in the work of

Newsletter of the Department of Pottery Technology (Leiden University) 16/17, 1998/1999: 57-68.

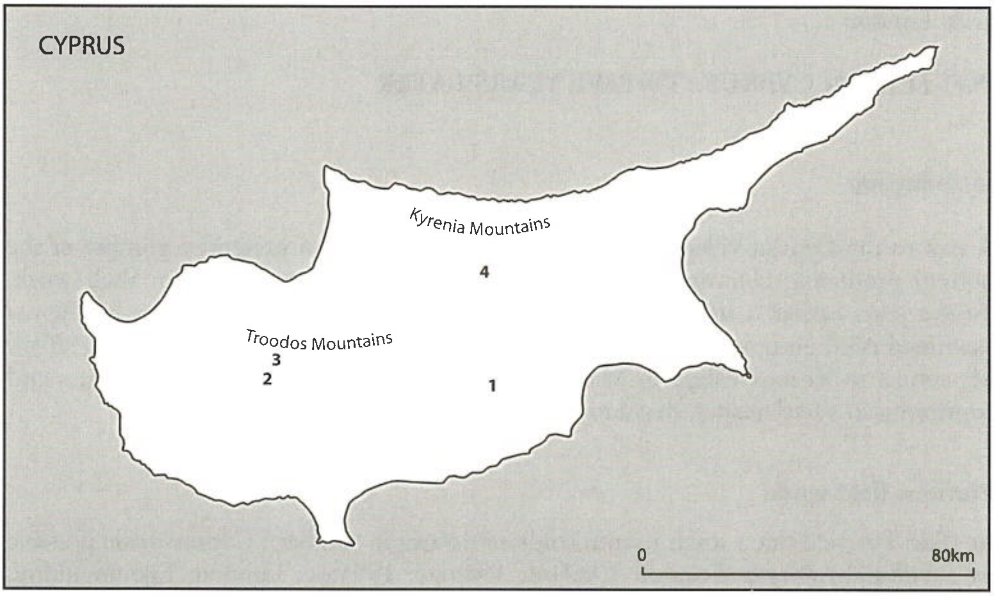

Fig. 1. Map of Cyprus showing the traditional pottery making centers at (1) Kornos, (2) Kaminaria, (3) Ayios Dimitrios, and (4) the modern city of Nicosia.

craft specialists; distribution networks; and organization of the industry. I interviewed the potters, their clients, and other villagers. Census data were assembled for the potters, including members of the Kornos Pottery Cooperative and the private potters, both in Kornos and the mountain communities.

Field work in the Philippines in the town of Gubat (London 1985; 1991c) and Cyprus allows me to compare two distinct communities of craft specialists (London 1986) thereby strengthening the results which may then be used for ancient wares. For example, since potters in the Philippines and Cyprus use the same features to identify the work of individual potters, these criteria are useful for recognizing the work of ancient potters. The attributes involve morphological, decorative, and aesthetic values (London 1991b; 1991c). I have demonstrated the suitability of these findings for assessing pottery from third millennium B.C.E. deposits excavated in Israel (London 1985; 1987b) and Jordan (London 1991a).

Kornos Village, 1998

Kornos is prospering. In 1986 the village consisted of a lower section with an elementary school, church, private houses and small businesses. Upper Kornos was in the formative stage with a growing number of houses. Today there are entire neighbourhoods in upper Kornos with paved roads and streets where some of the younger population tends to live. A new shopping center replaces smaller individual shops, although some of the latter remain. The village has a swimming pool and recreation center, although I did not visit it during the month of March. At the nearby town of Delikipos, urban Cypriots have begun to construct homes in what was formerly a sleepy rural haven from the 20th century.

Kornos Pottery Cooperative

The Kornos Pottery Cooperative in 1986 included most (10 of 13) village potters, a Secretary who managed the clay procurement, firing, and sales of finished wares and a woman to help with some of the heavier work involving clay preparation and kiln stacking. All but one member of the Cooperative made pottery in the workspace belonging to the Cooperative which also included a kiln for firing wares, an office for record keeping and sales, a small room with equipment for clay preparation, and a large storeroom.

Storeroom

Immediately prior to my first visit twelve years ago, in March, 1986, a large storeroom had been constructed adjacent to the Cooperative office. The storeroom was empty and largely unused. On one occasion, two potters used the wide open interior space to build special order *pithoi* for a hotel (London, Egoumenidou, and Karageorghis 1989: 31, Fig. 31). Apparently potters had not been much involved with the details of construction for the stone building. It has a large number of windows which light the interior rather than provide a dark cool environment which helps prevent the clay from drying too quickly. Instead of designing space for double doors, the exit doors are of normal size and shape. Outside the door, a steep slope leads down to the Cooperative's kiln. This configuration requires that potters turn abruptly in a small space to walk up and down the ramp while carrying heavy unfired clay and pottery. While working on the special order flower pot, the potters suddenly realized that the pots could be no larger than the narrow door way. The door was too narrow to accommodate older round bodied *pitharia*, but the potters were careful to measure the door to learn the upper size limit for the pots. In earlier times, after a storeroom was built as part of a house, *pitharia* were put inside first before positioning the doors. *Pitharia* were formerly made on site wherever needed by *pitharades*, potters who specialize in large jars (London 1989b). To facilitate the permanent placement of the large round *pitharia* of wide circumference, there were two possibilities: (1) *pitharia* were put inside first before the doors; or (2) storerooms had double doors. The latter on an older building signal that it was used as a storeroom in contrast to domestic quarters with single doors. This distinction has ramifications for identifying the function of archaeological buildings.

Rather than an empty building used once during my 1986 study, the storeroom was now teeming with pottery. Prior to 1986, all unsold pottery made in Kornos was sold at the close of pottery making season to a shopkeeper in nearby Mosphiloti (Yon 1985: 111-112; Figs. 9 and 10). When people came to Kornos to buy a pot, there was nothing to sell to them. This is no longer the situation. An estimated 700 pots of all size and shapes filled the room. Pots identified included jugs, round bodied cooking pots, casseroles, flower pots wide and tall (some with feet), ovens (medium and large), and large jars with incised patterns. Pots were piled on the floor and stacked up almost filling the space.

Office

In the Kornos Pottery Cooperative Office, both large and small pots were available for sale, but the majority were small decorated pieces. Some stood on the floor while most were on tables. Specific vessel types are described below. Signs in Kornos leading to the Cooperative were slightly better than before.

Clay

Adjacent to the kiln was a small pile of clay remaining from the previous season. It stood exposed to the elements precisely where the clay was delivered from the field in 1986. In March, twelve years ago, when I first arrived in Kornos, I saw a small clay pile exactly where the current pile lay. The clay was used by those potters who started work before Easter. After the holiday, the traditional time for potters to begin work in Kornos, freshly excavated clay was brought to the Cooperative. If this pattern remains unchanged, the uncovered clay, with grass and plants, rocks and sherds strewn across the surface, will be used by the potters in the spring when they resume work for 1999. In contrast, potters in the mountain communities begin their work whenever weather permits even before Easter.

Kiln

During the off-season, the kiln firing chamber serves as storage space in a situation similar to that described by Bram van As in this *Newsletter*. Inside the kiln are large, empty tin cans, old wooden chairs and filled plastic bags. No effort is expended to prevent damage to the interior kiln floor. To protect the kiln exterior, metal sheeting supported by wooden poles covers it. Ropes to hang clothes and clothespins suggest that the area is used for domestic chores. Adjacent to the kiln were bricks and large sherds used to close the kiln door during a normal firing. Scraps of metal, plastic containers, and wood were all in the vicinity of the kiln area. The firebox was empty of wood, although pieces of charcoal were abundant. Wood piled up behind the store-room was plentiful. The workspace where the potters constructed and stored pots contained a variety of chairs, ladders, plastic and metal containers, and various debris. Small sherds were no where to be seen.

Potters and work schedule

Twelve years ago the number of women potters was three times that of 1998 (Fig. 2). Four women remain members of the Kornos Pottery Cooperative. One of the four started making pottery after my initial field work (March - October 1986). She had worked for the Cooperative in performing some of the heavier work such as clay preparing, kiln stacking and unloading. At that time, as the youngest woman, she had

Fig. 2. Two Kornos Pottery Cooperative members making cooking pots in 1986. Only the potter on the right, who is working on the lower part of an oven, was still making pottery in 1988 and continues to do so in 1999. The cooking pots are coil built on a slow moving turntable. Initially the flat bases are left thick and the lower bodies have string wrapped around them to prevent their collapse. Once the upper bodies dry slightly, the string is removed and the bases are scraped and rounded, as seen for a two-handled *stamni* in Fig. 3.

a very young child. She now works in the workspace of the Cooperative and dates her earliest pottery making to the year her child started school in the late 1980s. She continues to stack the kiln for each member of the Cooperative, but she no longer helps each potter to prepare clay. Instead each woman grinds her own clay using an electric machine which was already in use in 1986.

Two private potters are still working. A semi-private potter who obtains her clay from the Cooperative and fires her wares with members of the organization, still works in her private workspace at home. She specializes in small decorated pieces and does not produce enough of the small, time-consuming shapes to fill a kiln. As a consequence, she fires her wares together with the larger pieces made by others. Although no one was making pottery during the cold wet month of March, I was informed that after Easter, in mid-April, work would once again resume.

Pottery types and decoration

The hospitality of the women potters was as gracious as ever before. Potters presented me with pots they had made which stood on the top of refrigerators, on shelves in the kitchen, and on display in their living rooms cabinets. In all instances, the potters had just a few pots at home and very generously gave me one or two. No one who belongs to the pottery Cooperative has a large supply stored at home. A visit to the Kornos Pottery Cooperative storeroom and office revealed a vast collection of fired pots made in the previous year. The pots and brief discussions with the potters allow me to assess what has remained the same and what has changed in Kornos since the initial study period.

Vessel types

Of the larger more utilitarian forms there were: goat-milking pots (three sizes), jugs, flat bottomed cooking pots, small and medium size juglets with three feet and some with a trefoil spout, casseroles, and small *pitharia.* Smaller containers include: incense burners (open and semi-closed) with flat or footed bases, juglets with trefoil spouts, juglets with birds on the handle and shoulder or with lions on the neck, small vases with two hands cupping the body toward the neck, vases with wide mouths, wide-mouthed vase/jugs with scalloped rim and handle from neck to shoulder, plates with little juglets or vases and animals, 'feeder vases' with a spout extending from the body and a moulded human face on the neck, composite vases with one or two rows of miniature vases, vases with a V-shaped opening, and basket-handled ashtrays (Fig. 3).

One difference between 1986 and 1998 was the presence of regular sized goat-milking pots. In previous years, miniature goat-milking pots made by one of the private Kornos potters was the only size of this shape versus in Ayios Dimitrios where regular size goat-milking pots were still made. In contrast, three sizes of goat-milking pots (*galafteria*) were on display in the Kornos Pottery Cooperative office. As for other forms, it was not possible during the brief visit to determine with a precision if there were additional changes. In particular, there is the impression that some of the more decorated vases and plates with plastic decorations might not be exactly as those in 1986. These shapes at times constitute art forms rather than ceramic containers and perhaps for this reason are more likely to change through time due to the needs and pleasure of the potter. Nevertheless diagnostic decorative features serve as an unmistakable signature of the potter who made them. To verify the pot maker, I asked who made the decorated juglets, before realizing that initials had been carved into the clay prior to firing. The question was received with incredulous looks as if to say, "can't you tell yet who made the pot?"

Another difference between 1986 and 1998 was the presence now of medium sized ovens. Nor were large jars with incised patterns common twelve years ago. Some appear to be identical to ovens in shape, but decorated. They seem not to stand well since some maintain the slightly convex bottom of ovens.

Fig. 3. A Kornos potter in 1999 scrapes the base of a coil built pot that is held upside-down on two wooden turntables. Excess clay removed from the base will be saved for future pots.

Incised decoration

Other than the juglets, plates, and special pieces, pots normally have an incised, punctate or moulded pattern. No paint or other surface treatment was discerned in 1998. Nor was rouletting seen, but my brief visit cannot verify that this decorative technique practiced by the oldest potters in 1986 no longer exists. At first glance the wares appear to be almost identical in shape and decoration to those produced in 1986. Several women gave me pots they made recently, in the past summer, if not earlier. Based on these pieces it is possible to compare the incised patterns each potter used twelve years ago and more recently, in 1997 or slightly earlier (Fig. 4).

Potter 1 gave me a vase she made during the previous year, her final season of pottery making. With 32 grandchildren, and nine children (none of whom are potters) she is ending her pottery work. Made of red firing clay typical of Kornos, the small vase (15 cm tall) with a scalloped rim stands on three feet and has an incised wavy band of slightly overlapping circles. This is precisely the pattern as found on her pots made in 1986 (London, Egoumenidou, and Karageorhis 1989: 42, Fig. 50). The two vertical loop handles on the neck/shoulder area were applied after the incised pattern. This order of the work, incised decoration followed by handle application, remains an important detail for differentiating the wares of Kornos pottery in contrast to those of Ayios Dimitrios (Marathasa) where the order is reverse. In the mountain communities, the handle is first applied and the decoration is positioned with regard to the handle (London 1987c: 126-127). In Kornos the handle usually interferes with the incised pattern. My only difficulty in recognizing or identifying this vase as the work of this particular potter concerned the vessel shape itself. She had not made small vases during my previous study, but concentrated on larger utilitarian forms. Rather than conclude I had failed to record that she made small pieces as part of her normal repertoire, the small vase whose form was unfamiliar despite the normal red firing clay, had been made at a display of traditional pottery making in the coastal town of Aya Napa, a popular resort center. Apparently the vase was made with the intention to sell it to people who observed the potters in Aya Napa. Unlike her regular repertoire in the past which was noted for its grace, the little vase is thick walled and heavy in contrast to small vases made by a Kornos potter who specializes in decorated vases. An incense burner made by the same potter who made the vase in Aya Napa, was also heavy for its size. It has a flat base, a heavy oversize loop handle extending from rim to base, an indented rim with three triangular protrusions, and a ring of 15 holes poked into the body. These tourist wares lack the elegance and light weight of the normal repertoire made by this potter in the past.

Potter 2 specializes in small decorated pieces. She is affiliated with the Kornos Cooperative and continues as before. Given the decorative nature of her work, there may have occurred some changes, but equally likely is that in 1986 not all of her styles were recorded. She regularly makes special order pieces comprising different animals, human figures, etc. For the present, her small jars show two lions climbing on the neck, in place of a loop handle. One bears the date 29.10.97, the initials of the potter, a map of Cyprus and the name Kornos written in Greek. The lions are a bit chipped and one has

Fig. 4. A private potter works in the courtyard of her home. Both she and her sister are the last two Kornos potters to make small decorated and multiple vases. The small pieces drying on the board will be added to the larger bodies on the left once they all reach the appropriate degree of dryness.

a tail glued in place, leading to the observation that seconds often remain close to where they were made. This proved fortunate for me. Potter 2 gave me the juglets directly from her living room. Others stood on display in a living room cabinet.

Whereas the lions were not immediately familiar to me, the rest of the incised pattern looks comparable to that on other pots made twelve years earlier. Each lion looks a bit different. The rest of the decoration however bears the unmistakable signature of this particular Kornos potter. The punctate dots, clay buttons or raised dots of applied clay arranged in a triangular pattern (with or without punctate dots), moulded flowers with five or six petals and a raised center, and the raised scallop wavy band as the lowermost element of the pattern designate the jars as the work of potter 2 and no one else. Vessels made in 1986 by this potter displayed birds along with all of the other features mentioned here down to the smallest detail (London, Egoumenidou, and Karageorghis 1989: 29, 30, Figs. 28 and 29). Small vases with two birds are still made by the potter and were on display. One bird sits on the handle/rim join while another sits opposite on the shoulder/body join. Incised with punctate dots into the base of one of the bird vases is a date 11.10 or 11.97. Another bird vase has no date. In height the three vases are almost identical, although the lion jar is a bit taller (15 cm, 15.5 cm, and 16.4 cm). The bases measure 43 and 46 mm for the bird vases and 44 mm for the lion vase. The two bird vases have a total of four (three wavy and one straight) rows of punctate pattern. The lion vase has three rows, two wavy and one straight. The latter is directly above the raised band or wavy scallops, a signature of this potter.

The recent work of four other potters was not examined. Apparently they continue to produce the full repertoire as in the past, according to informal discussions with potters or their friends. A more detailed study would allow one to record the similarities and differences in their work as well.

Discussion

Several immediate results of this brief encounter with the Kornos potters concern continuity and change in the industry. What has remained the same is the nature of incised decoration. Two potters continue to use the precise decoration they used twelve years ago. One of the two has transferred her signature decoration to tourist wares. Despite the new vessel form and the new clientele, her signature remains true to form and unchanged. Market concerns, do however influence vessel form and finish. Although carefully rendered with a nice surface finish, what differs in her work is the slightly less graceful form of the tourist pieces in contrast to her regular repertoire. This in turn implies that it is essential to study traditional centers of pottery production before they are influenced by the tourist market. Another conclusion is that the potter who started in the late 1980s has learned to continue the traditional shapes along with the other potters who persist in the industry. Despite the cessation of work by some potters, the Kornos pottery industry appears to be surviving. A more detailed study of pottery production in Cyprus would provide a statistically valid sample to test changes and continuity in vessel production numbers (quantity and vessel type), decoration, and prices both in Kornos and in the mountain communities.

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M.L. Eiland

CERAMIC REPLICATIONS AT TELL BRAK, SYRIA

Introduction

I was invited to participate in the 1996 field season at Tell Brak, in northeastern Syria (Fig. 1), to examine pottery and select samples for petrographic and chemical analyses (the results will be presented in the final report)[1]. The primary focus of research was to define the raw materials and forming methods used to manufacture pottery recovered from the site. Issues of provenance were not neglected, and local clays and tempering materials were explored in order to define a set of parameters to define a 'local' pottery group. I examined the backlog of sherds accumulated since 1994, and targeted questions that would be important to address when considering the question of change over time. One of the most important issues was whether the local materials could be used to manufacture pottery in a natural state, or if the clay required levigation in order to be used. As a result, a project of experimental archaeology began, which targeted the many variables of forming methods and materials represented in the Tell Brak assemblage.

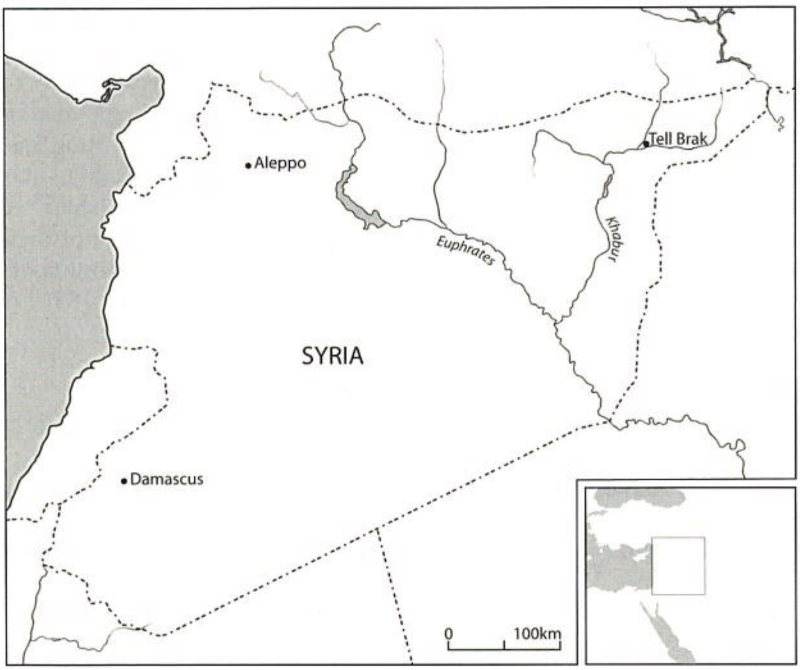

Fig. 1. Map showing the location of Tell Brak, Syria.

Newsletter of the Department of Pottery Technology (Leiden University) 16/17, 1998/1999: 69-83.

The ceramic assemblage from Tell Brak spans the early mid-fourth millennium through the second millennium, with small amounts of Halaf (ca. 5000-4500 B.C.) and Ubaid (ca. 4500-4000 B.C.) pottery brought up from the earliest levels. The most striking aspect of the assemblage is that 'early' ceramics are not necessarily 'crude'. There was a fraction of ceramic production from the earliest levels that used careful preparation of clay, perhaps sieving or simple pit-type levigation, to remove larger minerals and organic impurities from the clay. At the same time the majority of ceramics were made with clay of a lesser grade. This 'archaeological background noise' is of the greatest interest, as it is this material that could feasiblely be replicated, given the limited time and resources available.

Mesopotamian clays

Many of the thick ceramic forms made with this 'lesser clay' have a black core. This trait may not necessarily indicate a crude stage of ceramic development, especially as there are ceramics with a dark core from the Middle-Uruk (ca. 3500 B.C.) through the second millennium[2]. Instead, it indicates that the pottery was not fired long or hot enough to eliminate this dark zone. With many clays of a low firing temperature, such as the high calcareous clays from Mesopotamia, this does not impair function. Water jars, that rely upon a small amount of fluid passing through the fabric to cool the contents, do not require a highly vitrified body (Schiffer 1988). Such a vessel requires a permeable body fabric. Some natural clays contain amounts of organic material that will turn black when fired. Many ceramics from Tell Brak are tempered with 'chaffy' organic material. During the initial stages of firing the clay will darken, only to become lighter over time as carbonized organic material is removed through oxidation. The surface may lighten sooner than the core, as oxidation is dependant upon the porosity of the clay body (which in turn is influenced by temper such as 'chaff'). There is also another reason for the dark core in some ceramics, not related to 'chaff' temper or natural organic material associated with the clay. Some clays hold adsorbed organic material longer than others, and there are some clays that contain amounts of iron and titanium that blacken the fabric (Manning 1975). Matson (1969: 595-596) notes that dark core indicates that a kiln was not used.

There are a number of questions to consider with replication:

1. Is it possible to use local clays without levigation to create vessels?
2. If this is possible, will a black core develop in clays that do not have additional organic temper added to the paste?
3. Why is organic material added to so many of the 'plain' wares from a number of periods?
4. What is the difference between wares that have been open fired and those that have been fired in a kiln?

The most pressing problem was to locate a source (or sources) of natural clay. There are no active potters in the immediate vicinity of Tell Brak, so that finding a clay source near the site relied upon field work. While a clay-sized fraction of material could be extracted from sediments from the mound itself by using differential settling in pots or tubs, the amount of clay that can be recovered this way would inhibit large scale production. Clay from the Wadi Rud, only several km from the site, offers a potentially huge supply of material. The wadi runs a sinuous course. Because a perfectly straight flow in a channel is hard to maintain, small perturbations in flow deflect from one side of the bank, reflecting flow to the other side (Fig. 2). This sets into motion a positive feedback system that leads to a changing, meandering course (Ikeda and Parker 1989). The flow pattern removes material from the outside of the bend of the sinuous channel, and places material on the inside of the bend, where it is deposited in point bars (Fig. 3).

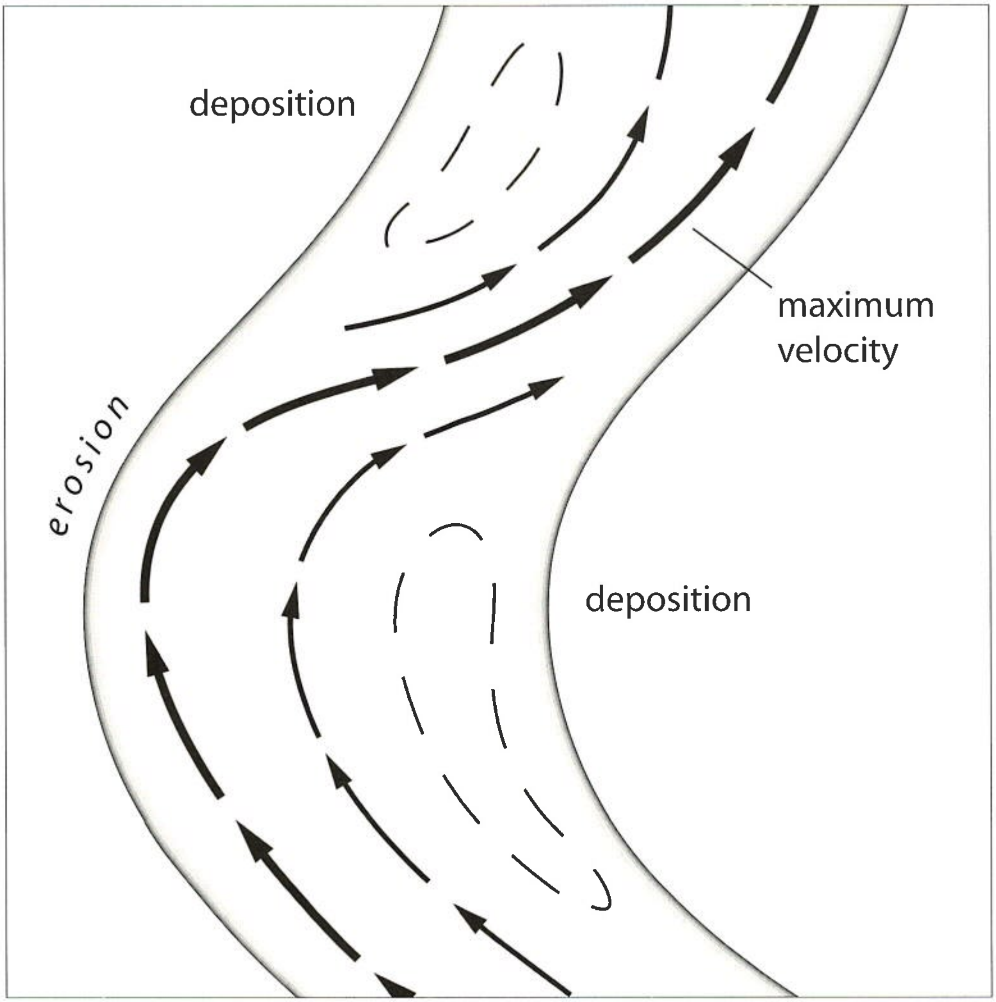

Fig. 2. Sinuous course of a wadi: small perturbations in flow deflect from one side of the bank, reflecting flow to the other side.

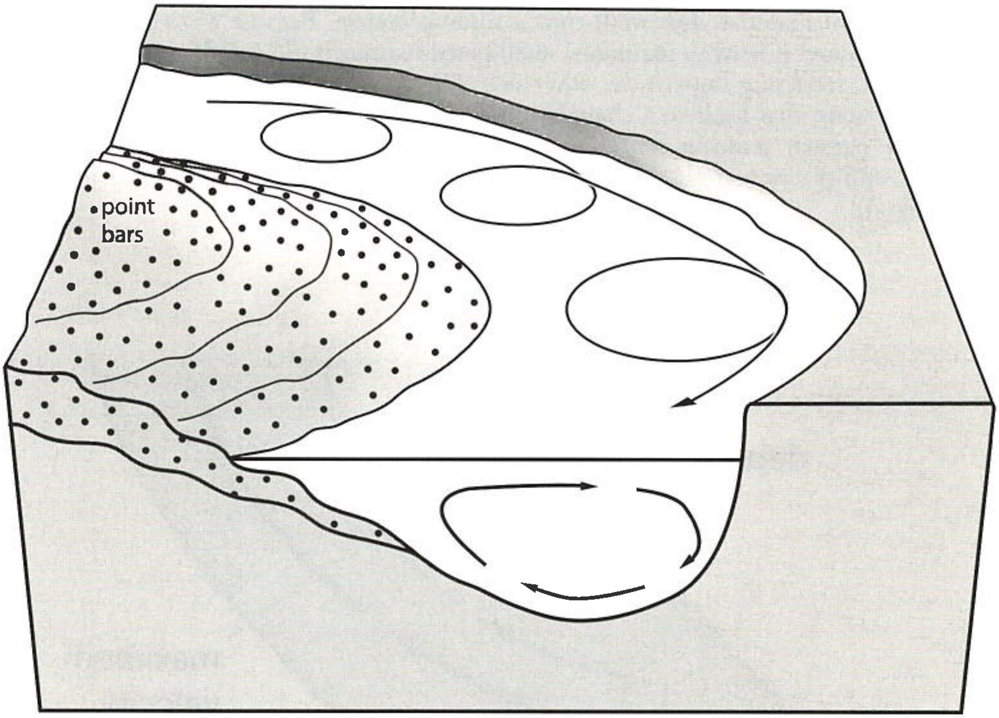

Fig. 3. The flow pattern removes material from the outside of the bend of the sinuous channel, and places material on the inside of the bend, where it is deposited in point bars.

Natural clay accumulates in the point bars, which correspond to areas of reduced flow. Plant roots extend through the point bars, consolidating the clay that is naturally deposited. In such a system, a natural sorting of grains takes place, similar to anthropogenic levigation using a baffled channel. Coarser (and heavier) sediment drops to the bottom, and it is only the finer material that is entrained and deposited in the point bars. Worms and other small detrital feeding organisms thrive in the rich clay/organic paste. There is a large amount of organic material in the water from farming, a situation that may be similar to that in antiquity. The alluvial clay is easy to collect because it is essentially wet mud. Alluvial clays, such as from the wadi, have thus been removed from their place of origin and transported by water. This secondary clay is distinct from primary clay, or clay that has not moved far from it's place of origin. Alluvial clay has been ground finer by transport, is relatively well sorted by particle size, and picks up impurities. These clays are usually more plastic, stickier, darker in color (due to organic material) and less refractory than primary clays.

In preparing clay for the replication experiments, the greatest difficulty in using wadi clay proved to be the organic fraction. Larger bits of organic material and sediment were rapidly removed by hand, and water was added to make a usable paste. The wadi clay was then wedged and left to age for two days. The stacks of clay were covered with plastic, so that they would not lose water, and left to sit under their own weight. The ageing (see Hamer 1983) allowed the clay particles to compress together, giving the clay more strength. It was then vigorously wedged to further compress the clay and remove air pockets. Although it may have been aged longer – perhaps with a further improvement in workability – the result was a more usable clay with low cohesion. Souring, the damp storage of clay, can be used to improve plasticity. It is especially important to sour clay used for applied elements, such as handles. Modern studio potters prize clay with a strong organic odor for handles. Bacterial action breaks down vegetal material, and carbon is released, discoloring the clay. The bacteria also produce amino acids, which flocculate the finest particles and produce a gel which improves clay strength. Due to time constraints, the clay could not be left for several months to sour, but, given time, the wadi clay could improve considerably with souring.

A number of vessels were made with the wadi clay, which was sticky and hard to work. The smell was not agreeable, and on hot days working clay in an enclosed space became difficult, a point that may have contributed to the low status of the potter in antiquity. Due to low cohesion, coil building was relatively difficult and time consuming. Using slabs to form vessels was much easier, which was particularly the case with clay that was chaff tempered. Adding chaff made the sticky clay less prone to stick to the hands or working surfaces. A dusting of chaff on the working surfaces also improved forming. Dung (sheep, goat and cow) was also used. If the dung were used dry, the resulting paste would be too dry to work, and would require further water. It was much easier to soak dried dung. When soaked dung was added to the clay, the resulting paste had similar working characteristics to the chaff tempered paste.

Handles on the freshly formed pottery tended to pull away from the bodies when drying, even when the handle fabric was heavily tempered. Wrapping the wet vessel and handle in a wet towel reduced drying shrinkage and allowed several handles to dry in place with no separation crack. It appears that the Tell Brak potters did not understand how to counteract drying shrinkage by using a heavier temper in the applied element, or by covering the vessels with a cloth, as there are very few ring handles or applied spouts in the entire assemblage. The few examples recovered were almost always separate from the vessel. Some cooking pots had simple ledge handles, which, because of their large attachment area, would adhere better than a ring handle with two limited surfaces for attachment. The surfaces of vessels made with this clay were very difficult to smooth by finger, but were easily burnished with a hard smooth surface. After drying for three days, they were baked in an open fire.

Open firing

The bonfire 76 cm in diameter and bounded by rocks was fueled by dry sheep and goat dung that was ignited by a small quantity of cotton-plant refuse. When some of the workmen heard that we planned a bonfire, they provided cotton twigs and roots averaging 1-2 cm in diameter. This waste is saved as a fuel, and some of the older workers were sure that it was used as a fuel for firing pottery in the past. As there may have been little wood in the region in antiquity, as today, and there is no evidence of bitumen[3] on any ceramics from the site, dung may have been the preferred fuel. The pottery was carefully placed in the core of the heaped dung. There was no attempt to separate the fire from the pottery by using sherds, but the ceramics were carefully placed in the fire to allow for some movement during baking. The dung was easily set alight by the cotton twigs, and a number of workmen reminisced that dung was used in their childhood to heat homes. Sheep and goat dung generate a pleasant vegetal odor that came as a surprise to western members of the expedition. There was great variation in temperature depending upon position and wind conditions. A digital thermometer with a short probe was used to measure the temperature in a number of areas next to the pottery. After fifteen minutes the fire ranged from 218°C - 450°C, depending upon position. After half an hour the hottest region was 670°C. Very hot regions were limited to a narrow advancing front as the fire burned from the outside to the uncombusted dung in the middle of the fire. After an hour the temperature was 480°C-550°C, and the zone of active burning had disappeared. The dung ash was very effective in insulating the core, which took several hours to cool. Dung burned slowly and generated hot ash. The fire required stoking with fresh fuel once.

These temperatures are comparable to dung fired pottery from other areas. Tobert (1982) records open firings from Western Sudan, using goat and cow dung. She used a thermocouple with a ceramic end to record a temperature range from 659°C - 891°C, the average maximum temperature of 763°C. Woods (1982) also records temperatures from dung firings from South West Africa. These firings were found to be fast (often less than 30 minutes) and requiring little fuel. The temperature range was from 818°C - 849°C. This is considerably higher than that obtained from Tell Brak or by Tobert. One of the reasons the firings observed by Woods have a higher maximum temperature is that they were in a pit. The fire may not have as ready access to air, but it would burn longer, and the pit would offer some insulation. Other factors could relate to the size of the fire. The experiments at Tell Brak were of small size. A larger fire could generate more heat. In addition, there is no standard way of recording temperatures in experimental ceramic firings. Some researchers use a thermocouple fixed in place, while others record the hottest temperature of the flame. The readings from the Tell Brak experiments probably err on the cool side, as it was felt that measuring the hottest section of the flame (not near the pottery) would not generate meaningful information.

Kiln design, construction, and firing

A simple kiln (Fig. 4) was also built from a special clay source that was used to produce pottery about 50 years ago and is still used to make ovens. It was located in a village 5 km southeast of the site. We saw several vessels, said to be about 50 years old, made of this distinctive red clay[4]. Most of the vessels from Tell Brak were made of a 'buff' clay, that is consistent with firing wadi clay in an oxidizing atmosphere, and did not resemble the very red body fabric of vessels made using this clay. This is also the case for the mud bricks used in all periods, except for the stunning exception of the Mitanni (ca. 1300 B.C.) structure on the top of the mound, which is made of red bricks. When new this red building must have been a spectacle in contrast to the buff mud bricks of surrounding structures. The 'oven clay' is totally unlike the wadi clay. It is not recently alluvial; so there is no fine organic fraction associated with the clay. It is dry, but easy to crush and mix with water by hand. It is possible to make coils and smooth the surface of the clay. Some workmen's wives still make ovens for local use, and employ a

Fig. 4. Experimental updraft kiln. This picture was taken before the firebox was buried leaving an opening to stoke the lower chamber. The stilts in the opening support a thin board that in turn supports the last horizontal coil spanning the width of the opening. The stilts were removed after the coil dried. In order to give the lower section time to become rigid enough to support the next section. The construction took place over three days. The top section, with no salt, has cracked, while lower sections have undergone little distortion with drying. The lower section with salt temper fared much better at this stage, but when fired the section with a larger amount of salt effloresced.

paste with goat hair and salt[5]. A kiln was constructed using this clay to test these tempers. Several vessels were also made.

An updraft kiln was selected because it was most likely the kind used during the periods of interest on the site, and because it was easily built. This type of kiln is a small technological leap from a bonfire or a simple chimney kiln. The fire is in the bottom chamber, and the heat rises through the grate directly to where the pots are set above. This kiln type has the disadvantage that preferred pathways can develop. These hot spots can cause uneven firings. The lower part of the kiln may also experience higher heat than the upper part. A larger kiln of this type is preferred, as there is greater allowance for an even distribution of heat (Gregory 1995: 29). An updraft kiln will produce an oxidizing atmosphere as long as the firemouth/flue is large enough to accept larger amounts of air with greater combustion. If this point is exceeded, which is indicated by unburnt gases re-igniting upon leaving the flue of the kiln, a reducing atmosphere is achieved. For a simple kiln, a large fire box opening can draw air, but too much cold air will decrease the temperature. Increasing the height of the kiln is the most efficient way of creating a stronger draw (Dawson and Kent 1984: 13-14).

With these points under consideration, there was a question if a small structure, such as the one planned, would work. The kiln was a cylinder 36 cm in diameter, made from clay walls 3.5 - 4 cm thick (slightly tapering to the top). It was 57 cm high, and the chamber for fuel was 20 cm from the base. The kiln was placed in a pit, open at one face, 20 cm deep, so that the grille – that separated the fire from the pottery – was at natural ground level. This allowed fuel to be loaded into the base of the kiln easily, and it was hoped that the pit would also insulate the fire chamber. Because of the small size of the structure, the grille could not be made of clay. Thick wire was used instead. One of the major concerns with building this kiln was the fire chamber. The kiln was sited so that it would receive the prevailing wind, and the large stoke hole was oriented to receive maximum ventilation. A Middle-Uruk period kiln (further details will be in the final excavation report) was uncovered while the experimental kiln was being built. It was sited on the other side of the mound, away from the bulk of habitation, and similarly aligned to receive the prevailing wind.

There were several holes into the portion of the experimental kiln's body that held the pottery so that a thermometer probe could be inserted. Pottery was carefully loaded in the small firing chamber so that up to four vessels stood atop one another. As the projected temperature was low, there was no effort made to separate the vessels using stilts. As for the bonfire, the dung was easily set alight. The most striking aspect of the kiln was that combustion was much faster than for the bonfire. The kiln required a constant supply of dried dung. In retrospect the fire chamber should have been larger. There was also much less spatial variation in temperature. After five minutes the temperature was between 400°C - 500°C. As this was the first firing of the kiln it was also giving off clouds of water. This rapid rise in temperature was intentional, as part of the experiment was to test ceramic faults resulting from thermal stress.

In ten minutes the temperature was 550°C - 600°C. At this stage it was found that placing large pats of cow dung on the top of the pottery at the top of the kiln raised the temperature of the firing chamber. Because archaeological kilns from Mesopotamia are normally reconstructed from the stubs of walls, there is ongoing debate as to whether kilns had a permanent top, a temporary dome that is removed after every firing, or were left open. It has been assumed that the earliest Mesopotamian kilns, with an open top, were minimally efficient (Moorey 1994: 150). Ethnoarchaeological research among traditional rural potters in Cyprus demonstrates the viability and efficacy of permanent kilns that lack a solid roof (London 1989: 225). Kilns in the Troodos Mountains are toploading, round in construction, built of brick or stone, and are often adjacent to a slope to enable easy access for stacking and removing the ceramics. Once a dome-shaped pile of pots is created, a temporary roof is formed by piling on cylindrical tiles, broken pottery, the tops of metal drums, bark and wood (London 1987: Fig. 4; London, Egoumenidou and Karageorghis 1989: 60-63). The majority of the fuel is placed below the pottery in the firebox, but the bark and wood of the temporary roof burn as well. The wares fire red in color and the potters experience the same low rate of loss as pots fired in kilns with permanent roof tops elsewhere in Cyprus. While detailed tests are still needed, it seems that the simple addition of pats of cow dung to the top of an open structure – an act that would leave no archaeological trace – can significantly raise the temperature. After twenty minutes, the clouds of water from the kiln had ceased. An extended gust of wind led to very rapid combustion and temperatures slightly over 900°C[6]. This is of a temperature range beyond even the highest recorded open fires, and represents a significant change in the kinds of pottery that can be produced. At this temperature, depending upon 'soaking time', calcareous clays can show 'continuous vitrification' structures. Below 800°C - 850°C, no vitrification takes place (Maniatis and Tite 1981: 68), as is the case for the experimental bonfired ceramics from Tell Brak. Organic material is also affected by higher temperatures. In experimental firings at temperatures just above 900°C, carbonaceous material begins to undergo complete combustion (Nicholson and Ross 1970). At this temperature range, especially if held for a period of time, the black core would rapidly dissipate. This high temperature in the Tell Brak experimental kiln was held for half an hour, when temperature measurements ceased. At this temperature the area for several meters around the kiln was hot enough to actively discourage further work. The kiln was allowed to cool overnight, but was found to be hot 16 hours later.

'Kiln' fabrics

Different parts of the kiln were constructed using different tempers. Coils made without goat hair were susceptible to surprise breakage during manipulation. The goat hair coils could only be roughly formed, as is clear from the archaeological evidence. Twisting the coil to evenly mix the temper will result in a 'yarn' of hair forming in the center of the coil, which makes further manipulation very difficult. The salt was more problematic. 'Small' and 'large' amounts of salt were used to temper the paste. In both cases the salt paste fared better than the unsalted wares during drying, and both sections had fewer cracks when dry. This may be due to salt voids arresting drying cracks as they form. The section with the 'larger' amount of salt fared badly when fired. After one firing this section was extremely friable, while the lightly salted section appeared slightly less stable than the unsalted section. This may be due to salt migrating to the surface of the kiln and efflorescing near the surface, weakening the fabric as it does so. This effect has been identified in pottery (Matson 1977: 70), and it is unclear how salt is used to good effect in a low fired ceramic matrix such as the oven. Chaff temper was also used. While it did not offer the manipulative advantages of the goat hair, it was indistinguishable from the goat hair after firing.

Bonfire and kiln fired ceramics compared

When comparing the wares from the two firings the most striking aspects were the vessel's surfaces. A comparison of the bonfire and kiln fired ceramics shows the following results (see also Fig. 5). From the bonfire the pots display a wide range of colors ('fire clouding'). Regions on an individual pot could be heavily coated with soot, have a

Fig. 5. Pottery fired in a bonfire (black surfaces) and experimental kiln. The figurine from the bonfire fared badly. The horn and tail were broken. The large 'nose lug' vessel, also bonfired, developed cracks along the base. The most striking aspect of these vessels were the dark black surfaces. The kiln fired ceramics are quickly separated by their lighter color. Even shapes that required the joining of many pieces of clay, such as the 'goblet' survived firing. The vessel with the lug handles shows light carbon staining, but like the other kiln fired vessels is a light reddish color.

glossy black surface, or be almost untouched by the fire. Many applied lugs and handles were fractured from the vessels, and several untempered pots made of natural clay cracked. A figurine of an ungulate fared the worst, as the horns and tail were broken during firing, apparently from great differences in heat. A coil-made vessel shattered completely. Coil forming, with this clay and the inherent structural weakness of the method, may not be suitable for bonfires. Vessels with burnished surfaces could exhibit areas of burnishing in some areas, or there could be zones with a heavy carbon coating, where no trace of a burnished surface survived. Burnish sheen as a factor of firing temperature has been dealt with elsewhere for pottery from Jordan and Israel (Franken 1973; London 1991: 404)

In contrast the pottery from the kiln was of a uniform color, a reddish brown, similar to much of the Middle-Uruk through Ninevite 5 (ca. 3000 B.C.) pottery from Tell Brak. Despite the rapid rise in temperature – to 600°C in ten minutes – there appeared to be no adverse effects to the pottery. There were few areas of light fire clouding, and only a fine dusting of 'fly ash' was on the surface of the pottery, which was easily removed with a damp cloth. Applied lugs and handles survived firing, as did the vessels made of natural clay. The applied elements probably survived firing for two reasons: firstly, great care was taken to minimize drying stress, and, secondly, despite the rapid rise in temperature in the kiln, individual vessels were not exposed to great variations in temperature. From a kiln firing there was a greater degree of control, fewer vessels were broken, and the colors were uniform. The dark core of the bonfired vessels was more prominent, and the boundaries between the black core and the outer surfaces were sharp. In contrast, the lighter black cores of the kiln fired ceramics had diffuse boundaries, indicating a higher temperature. Both bonfire and kiln fired wares generally had a thin body wall (ca. 0.5 cm), while the archaeological ceramics with a prominent black core were commonly over 1 cm thick. A body wall less than about 1 cm will allow combusted material to easily pass through the fabric. Natural wadi clay (which has a large natural organic fraction) generated almost no black core when kiln fired. Vessels tempered with vegetal material gave a light diffuse core with reddish surfaces. With a larger kiln, capable of handling a larger amount of fuel, higher temperatures probably could have reached and maintained for periods of time long enough to remove the core. On the basis of the surfaces of surviving sherds – excepting a handful of examples – all of the vessels from Tell Brak were fired in a kiln or similar structure (perhaps clamps – raw bricks stacked with fuel and a temporary kiln of clay or bricks is built around them – were used for some of the pottery). Ancient potters no doubt realized that considerably more fuel would be required to generate vessels without a black core, a trait that may only be of concern to archaeologists.

An Aleppo potter's shop

The team stayed in Aleppo for several days, and provided the opportunity to observe local ceramic production. In the main suq there was no evidence of pottery production. Near Baron Hotel, there was one pottery shop that offered a number of wares. While there were a number of vessels clearly designed for traditional use, the majority were for decoration only. There were a number of very small palm sized vessels that were aimed at tourists, while other vessels were 'medium' sized, apparently for flowers or purely ornamental purposes. The only employee in the shop was the son of the owner, in his late teens, who made pottery when customers were not in the shop (Fig. 6). When asked, he stated that candle holders were the most popular items, which were often made to order. The business had seen better days under his father, and he was wondering about his future.

The clay was obtained from Damascus, and apparently originated from a number of natural sources to give an 'optimal' mixture. There was a fine grit used as temper from Raqqa. Subsequent examination proved that it was almost pure crushed quartz. The only pigment used was a red slip, obtained from a natural source near Aleppo. To demonstrate, he placed a quantity of clay on an electric wheel. The shop had an electric wheel ever since he could remember. The clay was hard to work, but could be thrown with a large amount of water. As was the case for the wadi and 'oven' clays, it was not cohesive. The pottery was not fired on site, but some 30 km away from the city in kilns that fed on oil. This was done because of the smoke. Like many other areas of the Near East, Syria has undergone rapid changes that factor against the survival of ceramic production in general, and traditional production in particular. No information relating to the use of traditional techniques (or tempers) could be found. While local materials were used to fashion these pots, and 'local' pottery shapes were still being made in

Fig. 6. An Aleppo potter's shop. The son of the owner at work (photo A. van As).

much adapted form, this kind of ceramic production owes more to western tools and technology than to the traditions of the Tell Brak potters.

As an example of an industry that survived until recently, at least until the 1970's, an Iranian case study proves an important point (Gluck 1977: 44-45). In the province of Seistan-Baluchistan, the village of Kalporegan, about 35 kilometers south of Saravan, produced pottery that resembled wares of the fifth to third millennium B.C. A locally obtained hard clay was crushed and sieved and mixed with twice that amount of similarly prepared soft clay. The mixture was left in water overnight. Pottery was formed on a wooden board or dish about 30 cm in diameter, used as a tournette. Small pieces of clay were rolled and applied, or added to the body wall in sheets that were finished with a paddle and scraped. They were then burnished and left to dry. Each woman would make 40 or 50 pots, and communally fire them in a palm trunk and palm-waste fire for 18 hours. Pots were not graded according to differences in color, and were made with no makers' marks. Despite not having potters' marks, the pottery was identified by the owners and sold on the spot.

Ceramic production like this offers a huge amount of information relevant to reconstructing the materials and techniques used to form ancient pottery and for the society at large. While it may be too late to study such 'pristine' ceramic industries in Syria today, there is still the possibility that traditional ceramic production survives in remote areas. Ochsenschlager (1974) was able to observe potters in southern Iraq (Al-Hiba) and suggests a similar treatment of raw materials for Early Dynastic pottery, but how much longer will such industries survive? What can be learned in Syria today? Admittedly there may be little from a technological standpoint – at least compared with what could have been learned several decades ago – but, from a materials standpoint, any information is relevant. A simple explanation of where clay or temper is obtained can give valuable clues to the sources of these materials in antiquity. Particularly from the Tell Brak region, where ceramic manufacture is not out of living memory, there are valuable scraps of information. The source for the 'oven' clay would have required considerable time and effort to locate otherwise. With the increasing use of chemical techniques of provenance determination, such basic information should not be overlooked.

Summary

Replication experiments using local materials and reconstructing local forming and firing is an important archaeological tool. Some of the most significant information from this replication study are as follows:

1. Pottery can be made from clay obtained from the local wadi. There is therefore no need to suggest, as has been the case previously, that much of the pottery from this region is imported. This clay has low cohesion and is sticky. It greatly benefits from added organic temper.
2. Better quality clay is available from 'older' deposits. This clay was apparently not used for vessels or bricks until the Mitanni period. The wadi may have been the preferred source because of proximity to the site and the huge amount of available material.
3. Vessels fired in a bonfire are distinct from those fired in a simple kiln on the basis of their outer surfaces. The development of a 'dark' black core suggests an open firing, while a lighter 'diffuse' black core may indicate a kiln firing.
4. Kiln firing, along with differences in color, allows a wider range of clay/temper to be used. Natural clay with no temper is prone to break with wide variations in temperature as in a bonfire.
5. Adding hair as a temper makes long coils easier to manipulate without the threat of sudden breakage.

There are also several areas for further research:

1. Tests should be made using both untempered and organically tempered clay of varying thickness to determine the relationship between vessel thickness and the development of a black core.
2. The role of salt in ceramic fabrics (particularly ovens) must be carefully investigated.

Notes

1. I would like to thank the entire team of the Tell Brak excavation for making the field season enjoyable and productive. Dr. Roger Matthews, director of the excavation, provided active support. Dr. Wendy

Matthews gave a chronological framework for the ceramics, as well as provided the thermometer for temperature determinations. Special thanks are due to John Gower and Nick Jackson for their help in all phases of pottery and kiln construction.

2. The Halaf and Ubaid 'common wares' are difficult to identify, as few excavation reports of sites from this period have published these wares.

3. Van As and Jacobs (1992: 541-543) note the use of crude oil as a fuel for pottery kilns. They observed modern potters northeast of Baghdad continuously supply crude oil with a ladle to generate a significant flame in the firebox of the kin. In southern Mesopotamia vessels are commonly coated with bitumen, apparently to prevent seepage (Forbes 1964: 88). No vessels were recovered with a bitumen coating at Tell Brak, where plaster was used to seal the contents of a vessel.

4. There have been few students that treat the non-economic geology of the Mesopotamian region. Clay deposits in the region seem to be either 'recent' alluvial clays, or deposits that date to the Pliocene-Pleistocene periods (Berry, Brophy and Naqash 1970).

5. Modern ethnographic research in Jordan shows that clay ovens are made with specially selected clays, with chaff, goat or sheep hair, and small pebbles. Archaeological evidence from Jordan shows that the fabrics do not vary from period to period, but remain constant over time. The ovens are built with rough coils and smoothed, baked in the sun, and fire-hardened by use (McQuitty 1984: 259).

6. This temperature is comparable to a small up-draft kiln built at Tell ed-Der. It was constructed of stones covered on the inside with clay. Local fuel, dried brush and palm leaves, were used to attain a maximum temperature of about 900°C after about three hours firing (van As and Jacobs 1985).

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S. Scham

THE MEANING OF RECYCLING IN A CHANGING WORLD: REUSED POTTERY AND CERAMIC PRODUCTION AT TELEILAT GHASSUL, JORDAN

Introduction

Throughout the years since W. Flinders Petrie suggested that pottery has something to say about cultural changes archaeologists have often been tempted to equate ceramic transformations in the archaeological record *with* culture change. Potsherds remain the most analysed, classified and examined constituents of assemblages and with the development of new methods of physical and chemical characterization are becoming even more significant. Vessel appearance, composition, provenance, manufacture and function can be more enlightening to the specialist in past cultures than many an impressive ruin.

The information that ceramics hold for the archaeologists is obtained by an examination of extremely prosaic questions and many of these questions have been addressed by ethnographic data, which are examined for potential clues on manufacturing methods and materials, among other things. Surprisingly, there are also a number of studies on the breakage and the reuse of pottery. It is safe to say that much of this research has been encouraged if not carried out by archaeologists. Determining the functions of pottery is a major preoccupation in the field and multi-functional material culture is a matter of great interest (Rice 1987: 294, 302-304; DeBoer and Lathrap 1979: 125, 127; Rye and Evans 1976: 123; London 1991: 417). This is perhaps due to a notion that is the subtle product of our own cultural backgrounds. Although prehistorians are well aware of how people in pre-literate societies used and abused their environments (Artzy and Hillel 1988; Butzer 1982), they, nonetheless, credit these peoples with a somewhat exaggerated consciousness of the limitations of their natural resources. Reused pottery, however, has much more to impart than simply the sense of the frugality of its users. Just as the shapes, sizes and decoration of whole vessels caused Petrie to theorize that this variety represented some fundamental differences in culture (Petrie 1904), recycled pottery can contribute to our knowledge of the social structure and economy of a site.

The site of Teleilat Ghassul

Teleilat Ghassul, the Chalcolithic site from which the pottery described in this study was recovered, has been dated to 5530 to 4340 B.C. (Joffe and Dessel 1995: 509-510). Ghassul is in the modern state of Jordan, in the Lower Jordan River Valley,

Newsletter of the Department of Pottery Technology (Leiden University) 16/17, 1998/1999: 85-105.

approximately four kilometers northeast of the Dead Sea and one kilometer east of the Jordan River. It was the first Chalcolithic site in the Levant to be excavated and is still considered unique for its detailed and enigmatic wall paintings, its ivory and stone ritual objects and its very early evidence of copper metallurgy (Lee 1973: 21), among the many Chalcolithic sites subsequently explored (Fig. 1). From the early 1930s until today, the site of Ghassul has been excavated by two institutions, the Pontifical Biblical Institute (PBI) in Jerusalem and the University of Sydney in Australia. The PBI published reports on all of its field seasons with the sole exception of the data from the 1938 excavation which was published in preliminary form only (North 1961).

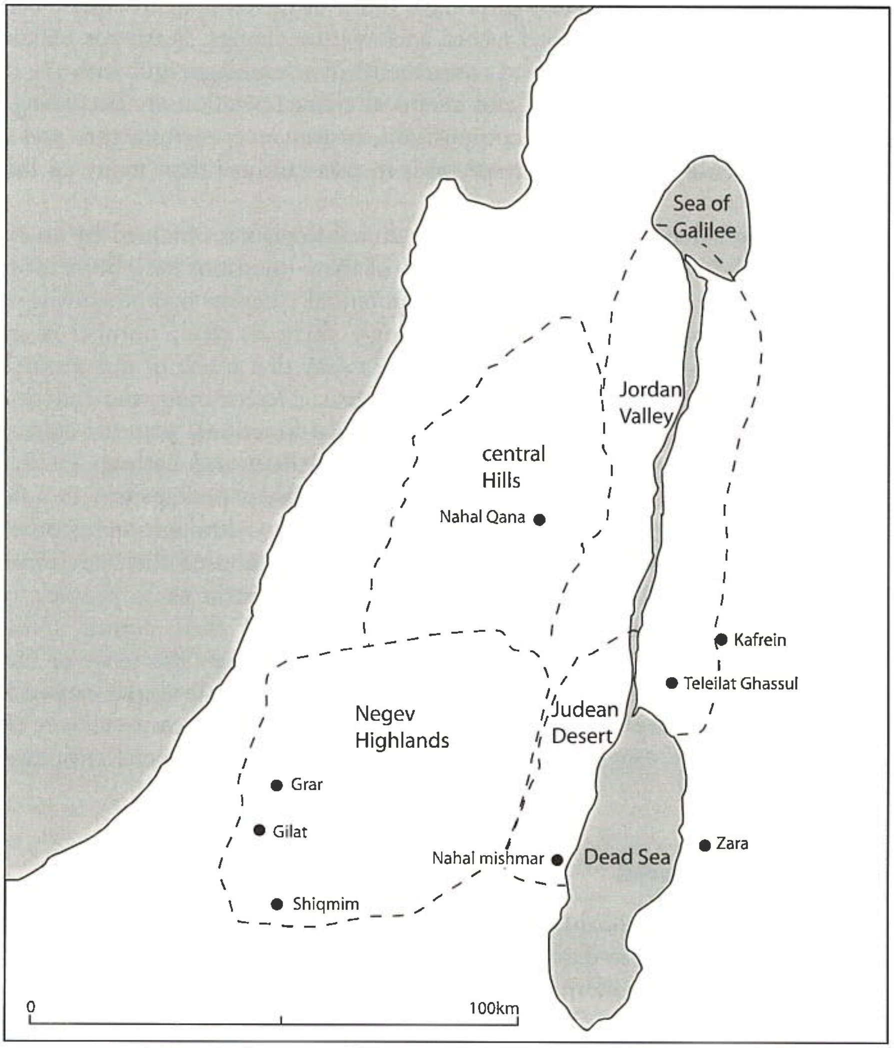

Fig. 1. Levantine Chalcolithic sites mentioned in the text.

In addition to these excavations the author surveyed a 22 square kilometer area around the site of Ghassul in 1995 and 1996. The ceramic evidence recovered in this survey along with the ceramic assemblages saved from the excavations are combined for the purposes of this analysis. The PBI's collection includes 13.124 sherds of which 8764 are numbered diagnostic pieces. No sherds under 3 cm were saved unless they were either decorated or diagnostic pieces.

Ghassulian ceramics

Ghassulian vessels are of four main types – bowls, cups and goblets including the famous cornet cups, smaller jars and storage jars commonly called pithoi (Fig. 2). Other vessels found less frequently, include the so-called churns and pedestal bowls. Painted pottery using a number of geometric motifs is common as well as pottery showing plastic decoration such as finger impressed quasi-appliqués or elaborate snake or rope appliqués. Slips are the norm as are 'grass-wiped' slip treatments (Hennessy 1969: 7). Handles include ledges, loops and the famous eyelet lug handles. Spouts are also common.

Smaller jars are generally globular in shape and either hole-mouthed or short-necked. The larger storage 'jars' (pithoi) are huge (some 3 meters tall) usually round walled and V-shaped with pointed unstable bases. These jars are either hole-mouthed, short-necked or, rarely, may have restricted necks. Shallow and deep bowls usually have V-shaped sides and often show mat impressions on their flat bases.

Cups and goblets are of two types – a small cup with a pedestal base and the 'cornets' that are present in great numbers. Cornets are unstable pointed bottomed cups that range from as small as six inches to as large as one foot.

The 'churns' are oblong vessels about three times wider than they measure in height. They have flat bases, short necks and large loop handles on both sides of the oblong bodies. Pedestal bowls are tall vessels. The pedestals and bowls are often of roughly equal height, although in some instances the bowls are almost flat, and are made like open stands. Other ceramic types evidenced are spoons and animal figurines, in relatively large numbers, and, less abundant, the so-called 'bird vases' small versions of the Ghassulian churn (Lee 1973: 60). Strainers with holes pierced before firing and spindle whorls, with holes incised after firing, are also included in the ceramic repertoire.

Vessels from Ghassul are not entirely typical of Chalcolithic assemblages from other sites in the Levant. Ceramic specialists generally agree that the range of types and decoration at this site is greater than that exhibited elsewhere. In addition, the potters of Teleilat Ghassul managed to extract excellent quality stable clays from their pedological environment. Ghassulian potters developed the technique of sintering their iron rich clays to a very high standard that may evidence the first kilns in the Levant (Edwards and Segnit 1982: 69).

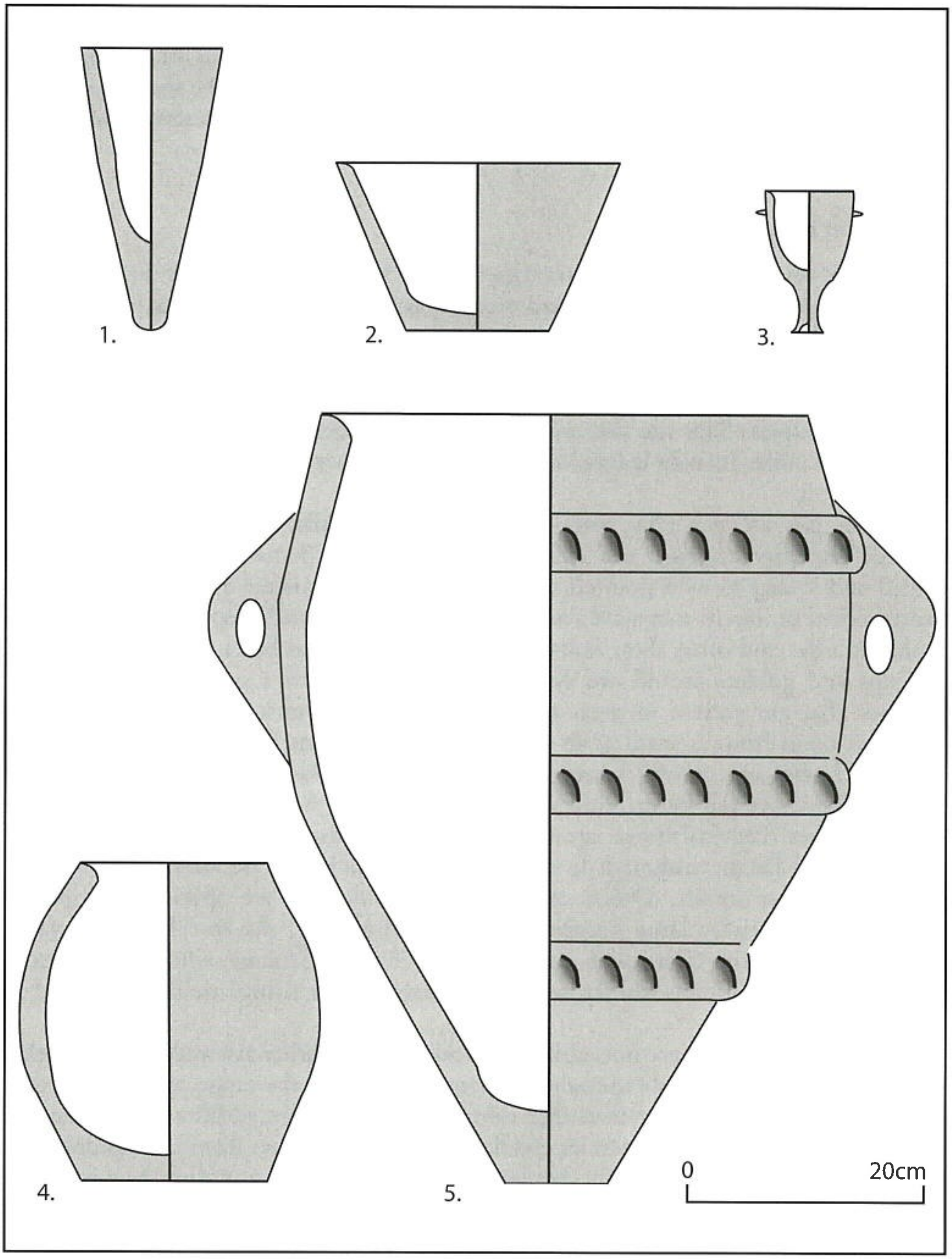

Fig. 2. Ghassulian vessel types: (1) cornet; (2) V-shaped bowl; (3) goblet; (4) hole-mouth jar; (5) pithos.

Repaired pottery at Ghassul

Repaired pottery appears at most Chalcolithic sites, but Teleilat Ghassul may have a higher percentage of sherds showing definite signs of repair and reuse than other locations. Approximately 1.3% of the sherds excavated and saved by the PBI are in this category. Although this does not seem like a significant number, there is generally an inverse relationship between the use-life of a vessel and the archaeological evidence of that type of vessel – in other words, the longer the use life, the lower the production rate and the fewer will be the sherds from those vessels (DeBoer 1984: 557).

Reuse of pottery when it appears in the archaeological record involves a number of issues beyond function. For example, breakage rates of certain vessels and the reasons that they were broken, other than the obvious post-depositional factors, are indicators of kinds of activities, that have taken place in a household. Another matter of interest is whether the repairs themselves were sufficiently time consuming to raise a question of why the vessel was reused rather than discarded. The types of vessels that were reused and repaired can provide evidence of social interactions and modes of production.

Ghassulian pottery production and the Ghassulian economy

Petrographic analyses of Ghassulian fabrics associates them with the Lower Cretaceous group characterized by argillaceous, ferrugineous oolithic, shale-rich clay (Goren 1995). Clays high in carbonates are common in the region. Such clays are not desirable for high firing conditions, i.e. above 700°C, because of their potential for mechanical damage. It appears that the Ghassulians developed an effective technique for dealing with these clays from the earliest periods of pottery manufacture. Ghassulian pottery was hand built using the coil method, and there is evidence of some finishing on a tournette (Homès-Fredericq and Franken 1986).

If analogies with current Middle Eastern cultures are relevant, it can be hypothesized that pottery making at Ghassul, whether it was specialized or not, was a seasonal activity. The rainy winters would not be conductive to creating durable ceramics of carbonaceous material (Arnold 1985: 61-67) – and the height of the summer heat was probably too intense to ensure effective drying. There are other factors affecting the seasonality of pottery making, however, and an important consideration is the kind of subsistence economy practiced.

It is well known that the Chalcolithic represents a revolution of sorts with respect to the crafts that had been perfected during the prior millennium. It is in this period that we have the origin of metallurgy and the evolution of many different craft specializations. From the evidence of the numbers of various crafts produced, we deduce that there were individuals at Ghassul who were recognized as experts in metal working, ivory working, flint knapping – and, most importantly for our discussion, pottery (Levy 1996: 232-234). Concurrently with this major shift in technology, there may have been a similar shift in the economy. The full scale use of herd animals enabled the peoples of the Chalcolithic to establish a mixed agrarian-pastoral economy by the end of the period.

For further discussion of this development, we look to faunal remains at Ghassul and other Chalcolithic sites. The use of faunal assemblages to reconstruct past economic systems is the norm. However, researchers like Zeder (1994) have experimented successfully with using faunal remains to answer questions about social and political organizations as well. Through study of faunal spectra from post Neolithic sites in Northern Mesopotamia Zeder (1994) has reconstructed various kinds of formal communication that existed in this period between formerly isolated farming villages.

According to the concepts in Zeder's analyses as applied to Chalcolithic sites, the percentage of certain types of species, and in particular the decline of wild species entirely, tells us that, beginning with the Late Neolithic, Levantine farmers began to utilize domesticated animals, particularly sheep and goats on an increasingly large scale. Also, cattle may have been the first domestic animals that were raised in any significant numbers but seem to have become, later in the Chalcolithic, less significant .

In the different rainfall zones, cattle are the most steadily exploited animals. Pigs, however, which were found at most Late Neolithic sites throughout the Levant, make no appearance at the more arid Chalcolithic sites. One would assume that, at sites with precipitation more favorable to rainfed agriculture like Ghassul and Gilat, dependence on mobile herding would be less than that at more arid sites like Shiqmim and Grar. Because this is clearly not the case, it suggests that Ghassulian culture had a greater investment in mobile herding than the ecological/optimization models might infer. Also, an increasing dependence on milk and milk products could explain the importance of sheep to their economy.

The sheep to goat ratios demonstrate a slightly greater number of sheep vs. goats at the earlier sites in areas with greater rainfall, i.e. Ghassul and Gilat. This may suggest a very slight drying of the climate in the later part of the period – since sheep have greater moisture requirements. The representation of sheep at Ghassul in particular indicates that this site may have been among the first in the Chalcolithic period to begin a significant reliance on sheep as opposed to cattle. For a culture dependent to some extent on dairy products, caprines are the most bountiful producers. They are also easier to care for than cows. Despite the volume of milk produced by cattle they are not traditionally regarded as efficient milk producers in the Middle East. The pasturage requirement for one cow equals that of ten sheep, and one cow produces less than half as much milk. The fact that cattle were used also as draft animals would reduce milk production. In any event, judging from the kill-off rates for sheep, goats and cattle, as well as the sheep to goat ratios in faunal assemblages it appears that sheep were the primary source for milk (Grigson 1996: 256-257). Along with the development of a significant dairying component to the economy, Ghassul may have also had a burgeoning cottage industry in textiles. The growing of flax is postulated from linen cloth remains found at Tell 3 of the site (Lee 1973: 304). Wool from sheep and hair from goats might similarly have been used to weave cloth.

What does this have to do with pottery making? A number of ethnoarchaeological studies indicate that scheduling conflicts between crafts and farming, hunting or herding greatly influence the season during which potting can take place (Arnold 1985: 99-108). Considering the mix of farming and herding activities at Ghassul, as well as the need for storage vessels occurring during periods of crop and dairy production, spring would probably be the optimum season for pottery making. If it became a specialization of specific individuals, the short fall season would be another good time, for both climate and demand.

Types of recycled Ghassulian wares

After determining how and when vessels are produced, it is not incidental to the interests of ceramic specialists to find out what adventures vessels may have encountered on the way from the prehistoric kitchen to their pottery baskets. George Foster (1960) became one of the first archaeologists to address this problem specifically through ethnographic observation and his study is the prototype of all investigations of ancient pot breaking.

First, archaeologists want to know why pots break. Of course, the simple answer is 'gravity' but the 'why' they have in mind is a good deal more complex than that. They want to know what is intrinsic in a vessel that causes it to break with more frequency than other vessels. Second, they want to know what activity causes pots to break. Perhaps, we may conclude, as Foster did, that the biggest problem was animals and children in the kitchen. This leads to the final question of what pottery is broken – do cooking pots break more often than storage pots or serving dishes?

For Teleilat Ghassul, the material culture that shows evidence of reuse and repair can provide only an incomplete response to these questions. The obvious problem with these data for determining breakage rate is that even the provident Ghassulians can hardly have recycled every broken vessel. Thus, the recycled pots represented in the archaeological record were carefully selected from among the broken vessels. For the rest of the sherds found there, without any clear context indicating that they were intentionally discarded, we will never be able to determine what happened to them and when.

An examination of the broken and reused sherds reveals the presence of a larger variety of vessel types (jars; cups; bowls; cornets; pithoi; plates) than might have been expected since not all the vessels represented are plain utilitarian types. A surprising number of cornets, cups, painted and decorated wares are also represented (chart 1). Nevertheless, it does appear that plainer bowls and jars were more frequently repaired than the more elaborately treated vessels (chart 2).

The plain jars appear to have been the most likely candidates for both repair and reuse. As for decorated cornets and pithoi, it should be noted that these vessels are more likely to be decorated than not. The molded decoration on the pithoi may have a functional purpose as well as stylistic one – since these vessels are often very large the characteristic rope molding has the effect of strengthening the walls.

Determining the function for Chalcolithic vessels is still in the conjecture stage but jars may have been the most multi-purpose of all Chalcolithic vessels. They were certainly used for household storage but may have been cooking and communal serving vessels as well. Thus, it can be assumed that the 'kitchen accident' theory explains the presence of these vessels among those broken and repaired. The bowls and serving vessels, however, seem to be fairly unlikely breakage candidates. It is possible that some of the bowls were used also for heating as well a serving which could explain additional breakage exposure. The blackening on these vessels that J.B. Hennesy considered as evidence of cooking (Hennessy 1969: 9), however, was more likely to have been from being fired in a reducing atmosphere (Homès-Fredericq and Franken 1986).

It is interesting to compare the types of vessels represented by the recycled sherds to those present in the Ghassulian archaeological record as a whole. Of the material from Ghassul that has been published, that from Robert North's excavations, appears to represent the greatest variety of different contexts. Mallon, Koeppel, and Neuville (1934) concentrated their attentions on two of the tells at Ghassul that appeared to contain the largest number of ritual objects (Tell 1 and Tell 3). Hennessy's excavations were undoubtly the most extensive, but the data from his excavations were not published beyond the preliminary report stage (Lee 1973).

Comparing the total assemblage (North's unpublished PBI material) (chart 3) with the recycled assemblage (chart 1) is instructive as to the possible selection process used to determine which vessels would be repaired and recycled. Pithoi are far more frequent in the total assemblage than in the recycled assemblage and jars are less frequent. Jars are less frequent than bowls in the total assemblage although they outnumber bowls in the recycled assemblage by almost five to one. For household contexts, however, jars and bowls in the total assemblage more closely resemble their proportions in the recycled assemblage. The most surprising difference, however, is with respect to cornets, which are not an insignificant presence in the recycled assemblage despite their small numbers in the total assemblage.

If these vessels were used for rituals (Gilead and Goren 1995: 163), and even more certainly for mensal purposes, the question arises as to how they were broken. Certainly, as cups most of them are quite unstable but one assumes that there was some standard method of addressing this problem when the vessels were used. One intriguing possibility is that they were intentionally broken. Ritual breakage of vessels is well known in the Near East from the Egyptian Execration Texts as well as ethnographic parallels (Orton, Tyers, and Vince 1987: 224). Further support for this view is that these vessels were not reused in a typical manner. In any event, one possibility concerning the original use of cornets which is seldom discussed is that they were skeuomorphs. A larger percentage of horn cores from sheep and goats was found at Ghassul than any other type of bone recorded (Lee 1973: 298). Horn cores have been associated with burials at Chalcolithic sites. Whether this might indicate the use of horns originally as vessels is not clear. The obvious relationship between the rather impracticable cornet and caprid horns, however, is attested to by a now famous zoomorphic vessel of a ram bearing three cornets on its back from Gilat (Alon and Levy 1989: 192-193).

Ritual use of cornets, and possibly a ritual breakage of them as well, could explain the presence of so many of these sherds in the recycled assemblage. This leads to a second important point about the recycled vessel assemblage. The usual assumption is that vessels were recycled for use as containers even though they may, after repair, have been entirely unsuitable for containing their original contents. The Ghassulians, however, with their typical ingenuity found more imaginative uses for old pottery. They had two unusual ways of reusing pottery. The first of these is the recycling of sherds as spindle whorls or weights. The second is more extraordinary if not unique – the recycling and refinishing of cornet sherds apparently for use as amulets or pendants. It was suggested above that these vessels were intentionally broken. If so, this particular reuse suggests that they could have been retained 'mementos' of ritual occasions.

Methods of recycling and reusing Ghassulian wares

Having established which vessels were recycled, the next question that must be addressed is how were these vessels repaired and for what purpose. Koeppel suggested that the perforations may be have been made with bone awls (Koeppel unpublished 1936 excavation catalogue, page 7). Experimental archaeological procedures on sherds from Ghassul suggest that the tools most likely to have been used for repairs of coarser vessels were small flint borers and perforators. It took an unskilled repair person (in this case the author) approximately six minutes to drill a hole in the coarser, thicker sherds and two more minutes to tie them together. Experiments on the finer wares were less successful. The large perforators were too clumsy to drill holes without breaking the sherds but the bone tools were not hard enough. Certain specialized smaller perforators may have been the tools used for drilling holes in thinner sherds Although the range of copper objects found at Ghassul does not include awls or similar tools, metal could possibly have been used to drill the holes. For later periods, material from Tell el-'Umeiri demonstrates a similar tendency to repair thicker rather than finer wares. Of 53 sherds with repair holes, only 12.5% measured under 0.60 m in thickness (London 1991: 417). The procedure is a deceptively simple one. First holes in two sherds to be joined must be drilled. Then, the pieces are joined with a vine or hide strip. On larger sherds, several holes may be drilled to obtain a more secure refit. Obviously, the reuse of such vessels is limited to containing dry material and this would account for the fact that no spouted vessels have been found showing signs of such repairs.

There were other types of reuse than the joining method, however, as evidenced by certain base sherds which were undoubtly used to burn oil or fat. Other uses for broken bases can only be surmised. Ghassulian pottery bases show mat impressions, hide and cloth impressions and string cutting. Additionally several smooth bottomed V-shaped bowl bases have been found. The latter bases likely were created with the use of a broken vessel base for molding and turning the new vessel. Besides the uses, ethnographic data indicates that broken pottery might have been recycled for other purposes. Use of broken pottery for tempering material is common but the presence of grog temper in Ghassulian vessels is virtually unknown. Other possible uses could include animal feed dishes (the Ghassulian enjoyed, and apparently also esteemed, dogs as pets), pot stands, pot lids, ladles and scoops, pottery scrapers (in manufacturing), washing up basins and bird and fowl roosts (Rice 1987: 294, Table 9.3).

Explanation in recycling

This speculation leads to the last important question about vessel repair and recycling, that is, why do it? Economy aside, the level of vessel manufacture at Ghassul was high enough to ensure replacement of any vessels barring absolute profligacy by the Ghassulian. Ethnographic data is generally less informative concerning the why question precisely because a real answer to this requires the formulation of a response that goes beyond mere practicalities. Thus, in repairing or reusing a pot an individual might, if asked, explain that the cost of such vessels, the difficulty of manufacturing them, their sentimental value or any other single or combination of factors accounts for the recycling. What such explanations mask, however, is a multiplicity of social, cultural and economic concerns in the society. Some of these factors might be the society's degree of craft specialization, whether its mode of production is domestic or commercial, whether there are clear seasonal restrictions on pot making (not just in terms of climate but also because of the difficulty in getting to preferred clay sources), whether the need for certain vessels can be anticipated (particularly in the case of pots used to store excess foodstuffs), or whether some vessels might be regarded as too 'precious' to discard. Regarding the last factor, we know of historical parallels in the case of ostraca and papyri which concern religious matters. These 'documents' were routinely saved even if damaged because destroying them would bring misfortune (Orton, Tyers, and Vince 1987).

The question of 'why reuse' can be approached in two ways to arrive at a possible synthesis. The first of these approaches is statistical. Table 1 lists the characteristics of those sherds that have a specific provenance. Although the table does not include all sherds used in the study, it does provide a fair indication of the characteristics of reused pottery.

Correlation coefficients were used to discern whether there was a relationship between the presence of repaired or reused sherds in the archaeological record and the attributes of the vessel, both quantitative and qualitative. The correlation coefficients were calculated from raw scores of numbers of sherds showing various characteristics. Each characteristic was ranked from 1 to 4 as follows:

1. sherd type from smallest to largest, 1. handle, 2. base, 3. rim, 4. body;
2. vessel type from smallest to largest, 1. cup/cornet, 2. bowl, 3. jar, 4. pithos;
3. temper type from least to most frequent, 1. organic, 2. ironstone, 3. combination ironstone and limestone, 4. limestone marl;
4. color, from lightest to darkest, 1. buff, 2. salmon, 3. red, 4. dark red with gray core;
5. feel, from harshest to smoothest, 1. harsh, 2. rough, 3. medium, 4. smooth;
6. surface decoration from plainest to fanciest, 1. plain, 2. plain, slipped and/or paint, 3. painted surface decoration, 4. molded or incised decoration;
7. thickness from thinnest to thickest, 1. 30 to 49 mm, 2. 50 to 99 mm, 3. 100 to 149 mm, 4. 150 to 200 mm;
8. texture, from finest to coarsest, 1. smooth, 2. fine, 3. irregular, 4. hackly;
9. context, from most to least frequent, 1. unspecified, 2. domestic, 3. craft, 4. ritual

10. firing, form least well fired to well sintered, 1. very low fired, friable, 2. low fired, 3. medium firing range, 4. well sintered.

The values for the most part were educed from the characteristics of the Ghassulian assemblage as a whole, from North's excavations of the site. Using these assigned values the following correlation coefficients from strongest (both negative and positive) to weakest were derived (Table 2).

Both high negative and high positive correlation coefficients are significant considering that the coefficient of determination is the square of the coefficient of correlation, thus converting negative values to positive ones. Both coefficients only operate between two variables. Thus, the determination coefficient tells us that .94 or 94% of the variation in the numbers of sherds in the repair assemblage can be accounted for by the variation in the types of the sherds. It also tells us that 88% of the variation in the numbers of sherds can be accounted for by the temper of the paste of those sherds. Clearly the coefficients of correlation and determination are useful only in establishing which factors, of those selected for study, seem to have a meaningful impact on the assemblage as a whole. To determine the proportions of the impact of more than one variable it is necessary to turn to the more complex method of multiple correlation-regression.

Multiple correlation-regression is the technique of developing predictive equations when there is more than one independent variable present. After determining which variables are significant, the multivariate analysis is the next step. The purpose of this method is to determine how each of the variables is a successful predictor of the variation in the assemblage, taking into account only the strongest correlations for continued analysis. The linearity of the slope itself and how the actual data fit the expected slope tell us how useful the particular variable is in determining the value of the number of sherds (Shennan 1988: 166-189). The line fit plots illustrate the results of the regression analysis on the factors selected on the basis of their individual coefficients listed above (chart 4).

The line fit plots illustrate the final correlation-regression analysis. The factors that were initially included in the regression were all of those listed in Table 2 except thickness, feel and vessel type, for which not even a partial correlation could be determined. The initial regression analysis eliminated context, texture and color as significant. In the final analysis sherd type and temper emerge as the primary associations with firing and surface decoration, which were less significant factors in explaining variation in the first step (finding the coefficients of correlation and determination), having the least linear slopes. Thus, a change in these qualities of the artifact could not be predicted to result in a consistent change in the number of artifacts possessing these qualities in the assemblage.

What can be deduced from these analyses is that rim and body sherds, sherds with the more common marly paste, sherds with the plainest surface and those which were well fired are most likely to be represented in the repaired assemblage. Both smooth textured vessels and vessels found in domestic contexts are also likely candidates for recycling based on the correlation coefficients.

This leads to the second approach that was formulated to the 'why' question involving a further exploration of those contexts, excluding the most frequent category of 'unspecified', where repaired and reused sherds are found. Even though context was eliminated as a determinative factor for repaired pottery in the correlation-regression analysis, the context of artifacts where known is an indicator of artifact function. Chart 5 includes all sherds from reused vessels in the PBI storerooms and museum, with a known provenance, as well as reused sherds from outlying areas recovered in the survey conducted by the author. Domestic contexts are most likely to evidence reused sherds of all types. No sherds from reused bowls or pithoi were found in craft specialization contexts, although a number of reused cornet sherds was found here. Bowls increase greatly in quantity and cornets decrease slightly in ritual contexts.

The two approaches taken together show that well sintered, plain jars, with the typical Ghassulian marl paste, were most likely to have been reused overall in households. In the craft areas, including presumed pottery making installations, no reused ordinary serving or large storage vessels were found. In the ritual contexts, reused sherds appear in equal numbers for each vessel type present although large storage jars are absent.

Cornet sherds in the ritual contexts are primarily as amulets. The presence of reused bowls in ritual contexts suggests the recycling of these vessels perhaps for offerings. Repaired bowls from the Chalcolithic have been found in association with burials at other sites (Bar-Adon 1980). For quantity of repaired ceramics, the only contemporary parallel to Ghassul is the Badarian culture of Middle Egypt. Whole repaired jars and bowls were commonly found in Badarian graves at Mostagedda and elsewhere (Brunton 1937; Brunton and Caton-Thompson 1928) juxtaposed with jewelry, ritual objects of ivory and other rare materials.

Overall it appears that well sintered, plain jars, with the typical Ghassulian marl paste, in households, were most likely to have been reused. Several different arguments come to mind concerning this scenario. One is that, since most of the reused vessels were jars found in households, domestic production may have been greatly curtailed at this time. These types of simple vessels could be easily reproduced by a skilled home potter. Conversely, it might also be argued that, if production was primarily domestic, the vessels were repaired on an *ad hoc* basis during busy agricultural seasons.

Household or industrial production?

The factors that mitigate against the proposition that repaired pottery is a sign of household production are several. First, in the Late Neolithic, where household production was clearly the standard mode, the reuse/repair of pottery was clearly known but is rarely in evidence. Only in the Wadi Raba stage that immediately preceded the Chalcolithic, very few perforated sherds, possibly not reused, repaired vessels were found. Neolithic domestic potters made use of broken vessels in what might be deemed a more efficient and less labor intensive way – as grog temper in vessel manufacture. Second, the particular vessels selected for repair are precisely those whose production is the most uniform, that is, jars, cornets/cups and bowls. The richness of the Ghassulian pottery assemblage and the high quality of the ceramics has already been noted. To this, is added a strong element of homogeneity in the later phases at Ghassul. The paste and the forming techniques for vessels in frequent production such as jars, bowls and cornets become increasingly systematized. Firing of certain types of vessels also becomes increasingly systematized.

The evidence for standardization at Ghassul is not entirely conclusive. Over time, however, a decrease in the variability in rim diameters, a decrease in low fired pottery evidenced by soft buff wares, an increase in the variety of decoration employed for various wares and an overall increase in production is suggested by the results of these analyses. Generally, low variability, in terms of morphology, high diversity, in terms of surface decoration, and uniformity in color are factors which imply an industrial rather than an *ad hoc* domestic manufacturing system. The scope of that industry usually depends upon the distribution of the wares. Ghassulian pottery cannot be surmised, at this time, to have a broad geographic distribution but the size of the village and the range and quantity of wares produced in the later phases of the site speak of a fairly well established village industry.

If one can assume that the accomplished sintering technique at Ghassul was explicitly recognized as a desirable and advantageous trait, it follows that householders were willing to repair the vessels rather than reproduce inferior replacements. Also, the lack of reuse of vessels like plates and small bowls may show a distinction between 'public' and 'private' vessel uses. In the routine daily sense, people will often balance economy of time with economy of resources to achieve some degree of optimization. In matters of social standing, however, both economies may be completely disregarded. To this extent, the study of Ghassulian repaired vessels may also add to the debate about standardization, diversity and hierarchical social order at the site (Rice 1987).

Since the issue of Ghassulian socio-political organization is one of the more significant concerns for students of this period, any analysis of ceramic modes of production can be looked upon as potentially influencing the discussion. If those archaeologists who support Gilead's view of the Levantine Chalcolithic (Gilead 1988) consider the evidence presented here it, no doubt, merely signals the nature of Ghassul as a large disarticulated site with a number of skilled individuals residing there. Others who are proponents of the Chalcolithic chiefdom theory find in Ghassul much to support their views. Since Levy (1996) bases a major portion of his argument on ceramics, not just their distribution but their manufacture as well. Although, there are ways of addressing this question through analyses of style (Pollock 1983), size of vessels in specific locations (Blitz 1993) or trade (Feinman *et al.* 1989) these types of analyses are beyond the scope of this paper. There is one matter relating to reused pottery, however, that is an interesting *addendum* to this study and perhaps a useful expedition, albeit a very tentative one, into the realm of investigating political organization.

Ceramics and social inequality

Since ancient peoples did not compartmentalize their societies as modern archaeologists do, ceramic specialists often must consider other types of material culure as indicators of social and cultural change. I have already mentioned one of the instances where this is necessary in ceramic studies – that is, when discussing the concept of replacement, the skeuomorph. Additionally, we must remind ourselves that potters are not necessarily the most trend-seeking craftspersons in a society, as Sinopoli (1991) and others have pointed out, and we would do well to investigate the development of other crafts than pottery making at a site for corroboration of our conclusions about the society.

The Ghassulian amulets of reused cornet sherds take us out of the potting shed and into an exploration of other types of artifacts. These items at Ghassul are plentiful in several types of materials. Interestingly, two of the items for which broken pottery was reused, amulets and spindle whorls, and one of the vessel types reused, deep bowls, all appear at Ghassul in materials other than ceramics. Ghassulians routinely produced ceramic items in other materials – or, on the contrary, reproduced items made of other materials in ceramics. Fashioning items in these other materials, stone, shell, bone or ivory, was usually a more time consuming process than the production of ceramics (chart 6). Still, in certain cases, these were the materials of choice for a number of artifacts. One can probably conclude that when a particular tool, vessel or object that was formerly manufactured in one material appears in other materials a technological change has occurred. Therefore, whether the use of one type of material preceded another may be significant. Beyond this, there is the concern of what the new material represents – the triumph of convenience over tradition (i.e., plastic vs. ceramic water jars), simple fortuity – taking material as you find them, or the reproduction of artifacts in a cheaper or more expensive material for status/rank delineation.

In the Ghassulian case, the items in different materials are contemporaneous with the ceramics although stone grinders, mace heads and bowls made of stone clearly preceded ceramics chronologically. These artifacts which seem to have had a ritual significance were most likely to be found in more than one type of material. Does this somehow indicate their status among the material goods of the society? It is difficult to say. It remains unknown which materials would confer greater status – the old fashioned more labor intensive stone or ceramics. We make the assumption, due to the workmanship and their rarity, that amulets of shell, bone and ivory were held in greater esteem. Between stone and ceramics, though, such distinctions cannot be made. For the purposes of investigating the meaning of repaired pottery it is significant only to note the variety of materials used for certain items and, again, question why ceramics were reused for amulets and spindle whorls, when so many prototypes in other materials were made.

Discussion – Ghassul's recycling project

The picture of Ghassul that emerges from ceramic evidence is one of a society expanding its cognitive borders in a number of directions. Levy's view that this eventually led to an expansion of physical borders as well is a provocative one. The possible emergence of a hierarchical social order might introduce the kinds of changes we see in Ghassulian ceramics. A competitive, gift-giving and entertainment social climate would

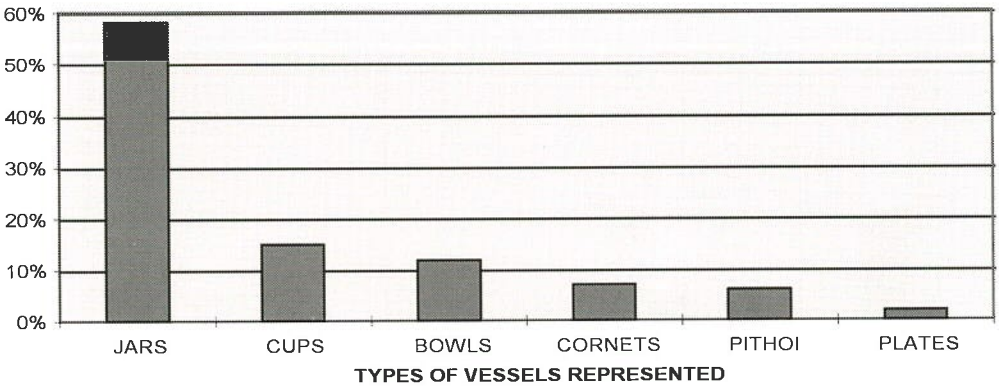

Chart 1. Ghassulian repaired and reused vessels.

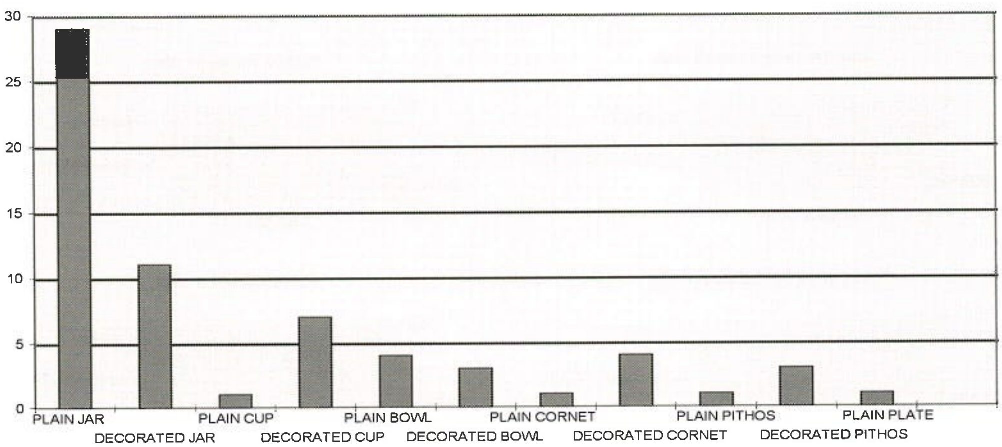

Chart 2. Repaired vessels—type and decoration.

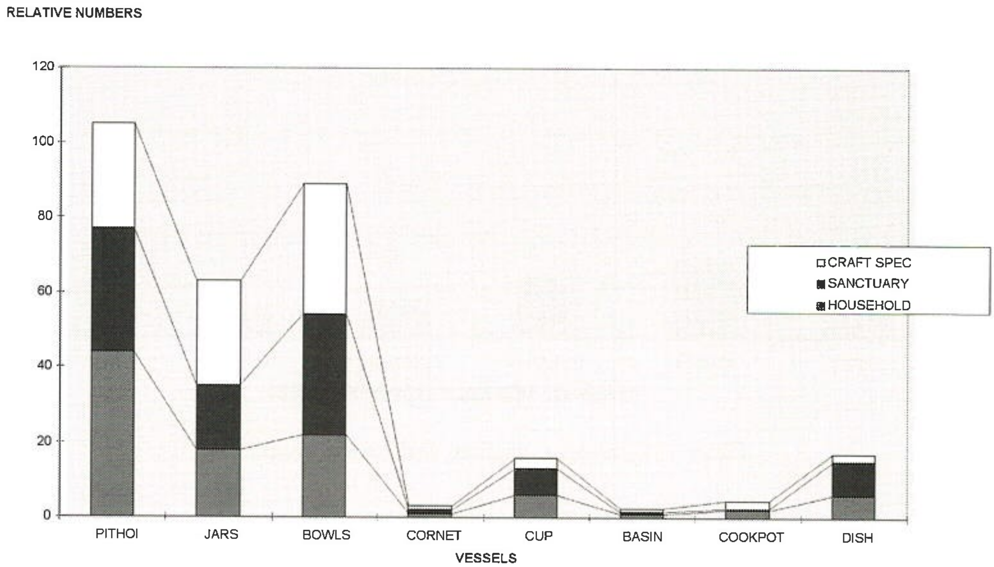

Chart 3. Vessel types and their contexts—R. North excavations.

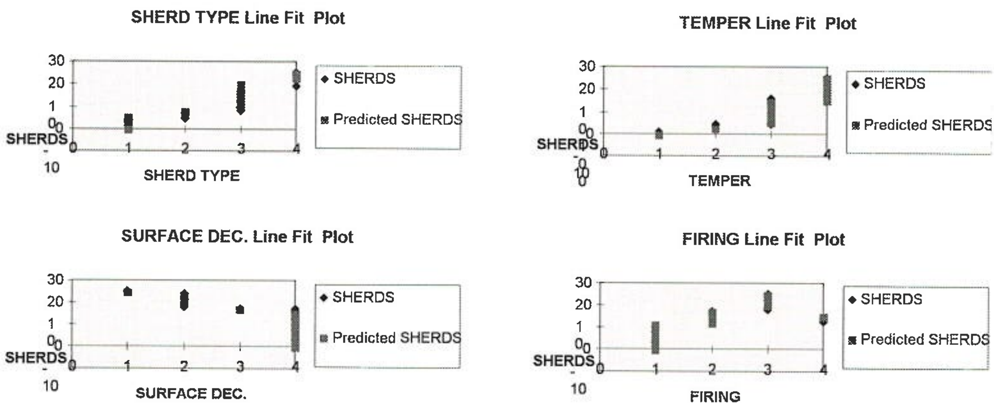

Chart 4. Line fit plots for factors applicable to reused potsherds at Ghassul.

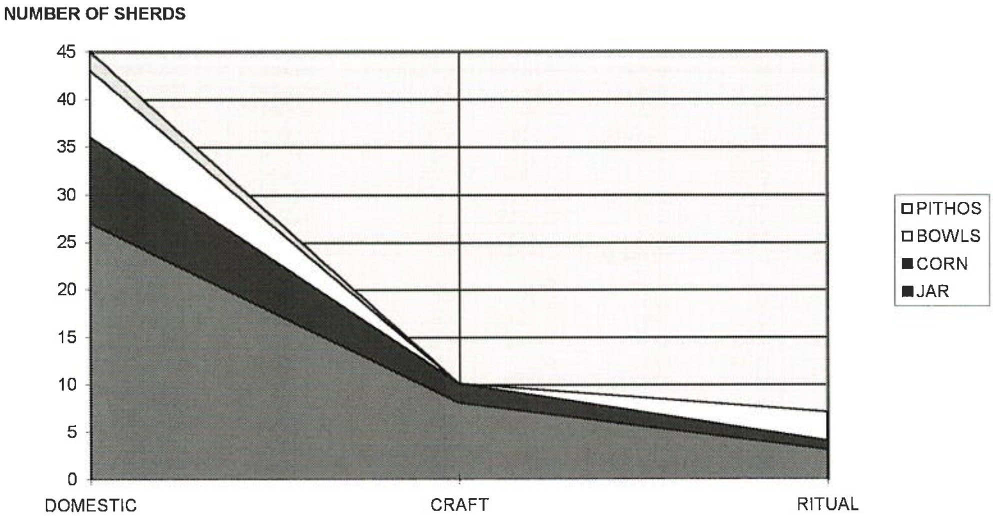

Chart 5. The context in which reused sherds from different vessel types were found.

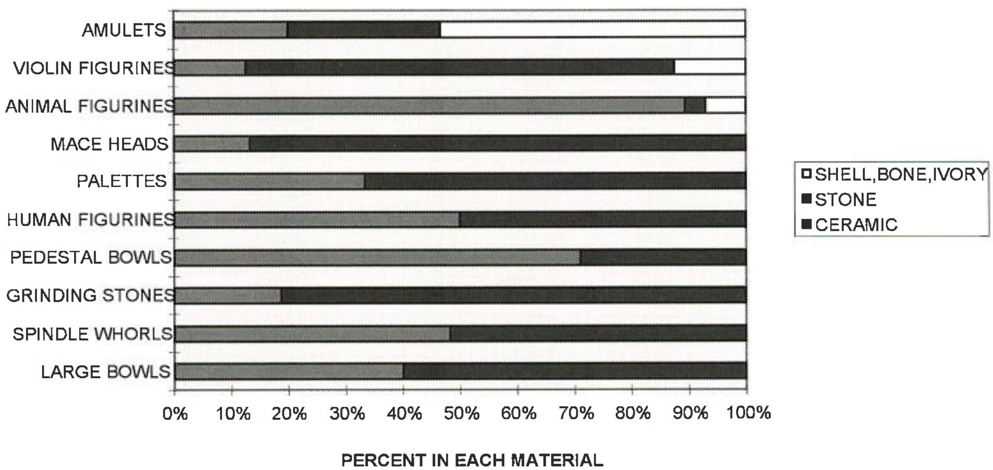

Chart 6. Objects in ceramics and one or more other materials.

SHERD	*COLOR*	*TEMPER*	*VESSEL*	*FEEL*	*SURFACE*	*TEXTURE*	*FIRING*	*CONTEXT*
RIM	RED	O, M	BOWL	FINE	SL., PD	SMOO.	WELL	DOMES.
BODY	BRN/RD	M	BOWL	COARS.	INC.	HACK.	V. LOW	DOMES.
RIM	RED	O, M	BOWL	FINE	PD	SMOO.	MED.	DOMES.
BODY	RED/GR	M	CUP	FINE	PP	SMOO.	V.LOW	DOMES.
RIM	BUFF	M	CORNT	V. FINE	PD	SMOO.	MED.	DOMES.
BODY	RED	O, M	JAR	MED.	PD	HACK.	MED.	CRAFT
BODY	RED	O, M	JAR	V.CRSE	PL.	HACK.	V. LOW	DOMES.
RIM	SALM.	O, I	JAR	COARS.	PP	HACK.	MED.	DOMES.
RIM	RED	O, MI	JAR	COARS.	PP	HACK.	LOW	DOMES.
RIM	RED	M, I	JAR	COARS.	PL.	HACK.	MED.	DOMES.
BODY	RED/GR	M, I	PITHOS	V. CRSE	PL.	HACK.	WELL	DOMES.
BODY	SALM.	I, M	BOWL	MED.	PP	FINE	MED.	DOMES.
RIM	RED/GR	M	JAR	MED.	PP	HACK.	LOW	DOMES.
RIM	SALM.	O, M	JAR	V. CRSE	PL.	HACK.	LOW	DOMES.
RIM	RED/GR	O, M	CUP	COARS.	PD	HACK.	MED.	DOMES.
RIM	SALM.	O, M	JAR	MED.	SL.	IRREG..	MED.	DOMES.
RIM	SALM.	M	JAR	V. FINE	INC.	SMOO.	WELL	DOMES.
BODY	SALM.	M	JAR	COARS.	SL.	HACK.	MED.	DOMES..
RIM	RED	I	CUP	V. CRSE	PD	HACK..	WELL	DOMES.
BODY	RED/GR	M	JAR	FINE	PP	SMOO.	WELL	CRAFT
BODY	SALM.	M	JAR	MED.	PL.	HACK.	MED.	DOMES.
RIM	RED/GR	M	CUP	MED.	PP	HACK.	MED.	DOMES.
BODY	SALM	M, I	JAR	MED.	PL.	FINE	MED.	DOMES.
BODY	SALM	M	JAR	MED.	PP, SL.	IRREG.	MED.	DOMES.
RIM	SALM	M	JAR	MED.	PL.	IRREG.	MED.	DOMES.
RIM	SALM	M	JAR	MED.	PL.	IRREG.	MED.	DOMES.
BODY	SALM	M	JAR	MED.	SL.	IRREG.	WELL	DOMES.
BODY	SALM	I	JAR	MED.	SL.	IRREG.	V. LOW	DOMES.
BODY	SALM	M	JAR	COARS.	SL.	HACK.	MED.	DOMES.
BODY	RED/GR	O, M	JAR	MED.	PP, SL.	HACK.	WELL	DOMES.
BODY	GRAY	O	JAR	MED.	PL.	HACK.	WELL	DOMES.
BODY	SALM.	M	JAR	MED.	SL.	HACK.	WELL	DOMES.
RIM	SALM.	O, I, M	JAR	MED.	SL.	HACK.	MED.	DOMES.
BODY	SALM.	M	PITHOS	MED.	SL., INC	HACK.	WELL	DOMES.
RIM	RED/GR	M	CORNT.	FINE	PD, SL.	SMOO.	WELL	DOMES.
RIM	SALM.	M	CUP	FINE	PP, SL.	SMOO.	WELL	DOMES.
BODY	RED	M	JAR	MED.	PP, SL.	SMOO.	WELL	DOMES.
HAND.	RED	M	JAR	MED.	PL.	HACK.	MED.	RITUAL
BODY	RED	M	BOWL	MED.	PL.	HACK.	WELL	RITUAL
HAND.	RED/GR	M	JAR	MED.	PL.	HACK.	WELL	RITUAL
BODY	RED	M	JAR	MED.	PL.	HACK.	WELL	RITUAL
BODY	RED	M	CRNT.	MED.	PL.	FINE	WELL	RITUAL
BODY	SALM.	M	CUP	MED.	PD	FINE	MED.	CRAFT
BODY	RED	M	CUP	MED.	PD	FINE	MED.	DOMES.
BODY	RED	M	PLATE	MED.	PD	HACK.	MED.	RITUAL
BODY	RED	M	JAR	MED.	PL.	HACK.	MED.	CRAFT
BODY	SALM.	M	JAR	MED.	PD	IRREG.	MED.	CRAFT
BODY	RED	M	BOWL	MED.	PD	IRREG.	LOW	RITUAL
BODY	SALM.	M	BOWL	MED.	PL.	IRREG.	LOW	DOMES.
BASE	SALM.	M	JAR	MED.	PL.	IRREG.	LOW	DOMES.
BODY	SALM.	M	JAR	MED.	PL.	IRREG.	MED.	DOMES.
BODY	SALM.	M	JAR	MED.	PL.	IRREG.	MED.	CRAFT
BODY	RED/GR	M	JAR	MED.	PL.	IRREG.	MED.	CRAFT
RIM	RED/GR	M	JAR	MED.	PD	IRREG.	MED.	DOMES.
BODY	RED/GR	M, I	JAR	COARS.	PD	IRREG.	WELL	CRAFT
BODY	RED	I	JAR	COARS.	PL.	IRREG.	LOW	DOMES.
RIM	RED	M	CUP	COARS.	PD	SMOO.	WELL	DOMES.
BODY	RED	M	CRNT.	MED.	PD	SMOO.	WELL	CRAFT
BODY	RED/GR	M	JAR	MED.	PL.	HACK.	MED.	DOMES.
BODY	RED/GR	M	JAR	MED.	PL.	HACK.	MED.	CRAFT
BODY	RED/GR	M	JAR	MED.	PL.	HACK.	MED.	DOMES.

TEMPER=m-marl, I-ironstone, o-organic, two letters-combination
SURFACE =pl-plain, pd-painted decoration, sl-slipped, pp-plain painted, inc.-incised

Table 1. Ghassulian reused pottery characteristics

FACTOR	RANGE OF VALUES	COEFFICIENTS CORRELATION/DETERMINATION		
1. Sherd Type	smallest to largest	positive	.9668	.94
2. Temper	least to most frequent	positive	.9395	.88
3. Surface Decoration	plainest to fanciest	negative	.9315	.86
4. Firing	least well to most well	positive	.8449	.72
5. Context	most to least frequent	negative	.7232	.52
6. Texture	coarsest to finest	positive	.6514	.42
7. Color	lightest to darkest	positive	.4467	.20
8. Thickness	thinnest to thickest	negative	.3696	.14
9. Feel	harshest to smoothest	positive	.3090	.09
10. Vessel type	smallest to largest	positive	.0171	.00

Table 2. Correlation coefficients between sherd populations and sherd characteristics

conceivably result in the development of more standardized and diverse pottery, the use of ceramics to reproduce, for the 'common folk' the kinds of items prized by their more influential neighbors, and the transfer of ceramic production from domestic 'amateurs' to industrial 'professionals'. Wealth, security and expertise do not necessarily always translate into hierarchy, however, and while it is interesting and useful for the purposes of scholarship to attempt to fit Ghassul into some kind of political framework, more evidence is needed in order to do so. It should be further noted that Levy (1996) has only proposed the chiefdom model for the Chalcolithic Beersheva sites, although he has suggested that 'a similar process' may have occurred in the Lower Jordan Valley.

Cemeteries and burial are generally the main source of archaeological evidence for social differentiation. While we have some indications of 'chiefly burials' from sites such as Nahal Qanah, where the 'oldest' gold in the Levant was found (Gopher and Tsuk 1991), the evidence from other cemeteries is not definitive on this point. Ghassul's cemetery, if there was one, has yet to be found although the site of Adeimeh, which is several kilometers away and has quite different material culture, has been, unconvincingly, proposed (Levy 1996). Thus, although one might view Ghassul as a significant town, a regional center and perhaps a cult center, the level of political organization remains an open question. Due to the diligent cultural resource management efforts and survey work in the past two years by the Department of Antiquities of Jordan (Amr 1996; Waheeb 1997), a number of Chalcolithic sites in the vicinity of Ghassul have been discovered. Excavation of these sites is imperative for two reasons. They appear to hold the key to the Chalcolithic to Early Bronze Age transition in this region and they may shed light on the site of Ghassul and its place in the region.

It is intriguing to view material culture as a witness to political and social transformations. By devising increasingly comprehensive archaeological methods, we greatly facilitate the extent to which this witness can give testimony. Nevertheless, the major part of our work as archaeologists still consists of assigning categories and discerning patterns through whatever complex procedures we choose to employ. Ethnographic analogy is one means through which we can bring our data to life, but it is a very imperfect one for the same reasons that we fail by interpreting the data through our own cultural lenses. If we are cautious in employing analogies, we will greatly reduce the factor of cultural dissimilarity but will never eliminate it.

For all that this paper has focused on the social meaning of pottery, and repaired pottery specifically, it has done little to find the identifying characteristics of the Ghassulian potter. Hodder (1993) has argued that artifacts are the 'rhetoric' through which the 'narrative' of a culture is expressed. He cautions that the two constructs are very different, however, in spite of the archaeologist's attempt to make one, that is, 'rhetoric' stands for the other, that is, 'narrative'. The 'narrator' is the missing element of this exercise and it is too enticing to attempt to fill this void by appointing ourselves or the practioners of living cultures to this task. We may intellectually process material culture, but it was not created to consciously convey such cognitive impressions. The meaning of an artifact, thus, can only be fully translated through the universe of activities and practices related to it, a universe to which our access is limited.

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ANNUAL REPORT (1998/1999)

Research projects in cooperation with:

Leiden University/Faculty of Archaeology:

Archaeological Sciences:

- Use-wear traces on Maya pottery sherds through microscopic analysis and experimental replication (Dr. A. van Gijn and Dr. S.L. López Varela).

Methods and Theory:

- The Riu Mannu Survey Project, Sardinia (Dr. P. van de Velde).

Indian America:

- Pre-Columbian pottery from Guadeloupe (Dr. C.L. Hofman).
- Tannin-project (R. Arkema).

The Netherlands National Museum of Antiquities, Leiden:

- Transitional pottery (5350-5150 B.C.) of Tell Sabi Abyad, Syria (Dr. P.M.M.G. Akkermans and O.P. Nieuwenhuyse).
- Samarra Fine Ware of Tell Baghouz (O. P. Nieuwenhuyse and Dr. A. Caubet/Louvre).

The Archaeological Museum of Aleppo/The Netherlands National Museum of Antiquities, Leiden:

- The Hassuna/Samarra pottery of Tell Boueid II (ca. 5500-5300 B.C.) (Dr. A. Suleiman and O.P. Nieuwenhuyse).

Ethnographical Museum, Leiden:

- Clay pipes from Mali (Prof. dr. R. Bedaux and M. Welling).

The Netherlands Institute for the Near East, Leiden:

- Neolithic pottery of Menteşe, Turkey (Dr. J.J. Roodenberg).

University of Leuven/Sagalassos Project:

- Early Roman pottery of Sagalassos, Turkey (Prof. dr. M. Waelkens).

Syro-European Project at Tell Beydar

- The Late Chalcolithic pottery of Tell Tell Beydar III (Dr. M. Lebeau, Dr. A. Suleiman, and O.P. Nieuwenhuyse).

Working Group on Mesopotamian Pottery:

- Pottery dating from the second millennium B.C. from Iraq (Dr. H. Gasche).

Madaba Plains Project

- Technological analysis of sherds from Tell Hesban (Dr. G.A. London).

Argonne Project

- Research on clay samples (Prof. dr. S.E. van der Leeuw).

Betuweroute:

- Manufacture of replicas of Drakenstein urns (Dr. P. Jongste).

Fieldwork:

23-30/08	1998	Sagalassos Project – ethnoarachaeological research, Turkey (M.B. Annis).
07-29/09	1998	Dutch Archaeological Mission at Tell Sabi Abyad, Syria; Euro-Syrian Archaeological Mission at Tell Beydar, Syria (A. van As).
14-29/09	1998	Dutch Archaeological Mission at Tell Sabi Abyad, Syria; Euro-Syrian Archaeological Mission at Tell Beydar, Syria (L. Jacobs).
01/09-02/10	1998	Riu Mannu Survey Project, Sardinia (M.B. Annis).
05-21/06	1999	Dutch Excavations at Ilıpınar, Turkey (A. van As).
18-26/08	1999	Sagalassos Project, Turkey (A. van As and L. Jacobs).
01/09-06/10	1999	Riu Mannu Survey Project (M.B. Annis).

Publications:

Annis, M.B. (1998), Paesaggi rurali nella Sardegna centro-occidentale: il Progetto *Riu Mannu* dell'Università di Leiden, Paesi Bassi In: P. Ruggeri and C. Vismara (eds.), *L'Africa Romana XII. L'organizzazione dello spazio rurale nelle province del Nord Africa e della Sardegna*, Sassari: 572-587.

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Jacobs, L (1999), Een technologische analyse. In: M. Wellink, *Pijp en tabak in West Afrika. Een archeologische studie naar Malinese kleipijpen* (M.A. thesis), Leiden.

Lectures:

26/03	1998	A. van As: *Archaeological Ceramic Technology: aims, methods and results*; Ege University, Izmir, Turkey.
13/01	1999	A. van As: *In search of technological choice in the production of some ceramic assemblages from ancient Mesopotamia*; World Archaeological Congress 4; January 10-14, 1999; Capetown, South Africa.
09/02	1999	A. van As: *Archaeo-ceramological fieldwork in Western Asia*; University of Sheffield, Great-Brittain.
25/09	1999	M.B. Annis: *Pastori e contadini nella Sardegna centro-occidentale*; Museo archeologico e etnografico, Guspini, Sardinia.
4-14/10	1999	A. van As, O.P. Nieuwenhuyse, K. Duistermaat, and R. Dooijes: *Archaeological Ceramic Research: an introduction to methods and practice of archaeological ceramic analysis*; Department of Antiquities of the Syrian Arab Republic; Damascus, Syria.
15/12	1999	A. van As and L. Jacobs: *Research at the Department of Pottery Technology (Faculty of Archaeology, Leiden University)*; Workshop on Clays, Ceramics and Archaeometry; Kernfysisch Versneller Instituut (KVI); University of Groningen.

Symposia:

10-14/1	1999	*World Archaeological Congress 4*; Capetown, South Africa (A. van As).
15/12	1999	*Workshop on Clays, Ceramics and Archaeometry*; Kernfysisch Versneller Instituut (KVI); University of Groningen (A. van As and L. Jacobs).

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13/06	1998	Prof. Carol Kramer (University of Arizona, USA).
18/03	1999	Dr. Gloria A. London (Burke Museum, Washington, USA).

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