Newsletter

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Department of Pottery Technology

UNIVERSITY OF LEIDEN - THE NETHERLANDS

NEWSLETTER

Department of Pottery Technology

II - 1984

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INFORMATION

(1-11-1983 to 1-11-1984)

- In December 1983 the Institute of Pottery Technology moved to the Archaeological Centre of the University. The new address is: Institute of Pottery Technology, Archaeological Centre, Reuvensplaats 4, POB 9515, 2300 RA Leiden, the Netherlands. The move caused some stagnation in the progress of the Institute's activities. The new housing is an improvement on the former one especially with respect to the laboratory and workshop, equipped with a new electric kiln and a new gas kiln.

- As from August 1st 1984 Professor H.J. Franken, Director of the Institute of Pottery Technology and Professor of Palestinian Archaeology, has retired from office. The Institute is fortunate in having found Prof. Franken willing to continue the preparatory work on the Jordanian Pottery Exhibition in Bruxelles (see p. 4) and the research work on pottery excavated on the Ophel Hill in Jerusalem by the British School of Archaeology in Jerusalem under the supervision of the late Dame Kathleen Kenyon (see Newsletter I, p. 5). A. van As took over the duties of Prof. Franken as Director of the Institute.

- The papers delivered by A. van As and L. Jacobs at the Ceramological Conference held on April 21st, 1982 in Amersfoort (see Newsletter I, p. 32) have been published in the first volume of the Dutch series "Nederlandse Archeologische Rapporten" (NAR), edited by the State Service for Archaeological Investigations (Amersfoort 1983). In order to make these papers clear to non-Dutch speaking people, they have been published again in this Newsletter in a slightly different form (see p. 10-16).

- The Institute of Pottery Technology participated in the Symposium on "Ancient Greek and Related Pottery" which took place from April 14th to April 18th 1984 in the Allard Pierson Museum in Amsterdam. H.J. Franken read a paper on "Why did attempts to imitate Greek pottery fail in the Near East?" This paper will be published in the Allard Pierson Series (Vol. 5) at the end of 1984/beginning of 1985.

- During two weeks in January 1984 A. van As and L. Jacobs gave courses in Pottery Technology for archaeology students in Groningen.

- In April 1984 Ian Edwards, Senior Lecturer of Victoria College, Burwood (Australia) visited the Institute of Pottery Technology being enabled to do so by a special grant from the Netherlands Organization for the Advancement of Pure Research (ZWO). Edwards had an important share in the prepartation of the Jordanian Pottery Exhibition in Bruxelles.
- On September 26th, 1984 members of the Society of the Dutch Pottery Industry (Algemene Vereniging voor de Nederlandse Aardewerkindustrie, AVA) visited the Institute of Pottery Technology.
- In 1983/84 the Institute of Pottery Technology was involved in the following research projects. Most of these projects will be continued next year. The results will be published in the Newsletter or somewhere else.

. For dr. M. Beatrice Annis (Leiden).
Analysis of the properties of clays from Sardinia in order to verify the properties ascribed to these clays by the present potters of Oristano (Sardinia/Italy). This research work aims at getting a better understanding of the various factors which affected the organization of the workshops and the activities of the potters.

. For drs. P.W. van den Broeke (Leiden).
Research into the shaping technique and the body of Iron Age and Roman hand-made pottery excavated by the Institute for Prehistory/Leiden in Oss-Ussen (Brabant, the Netherlands) within the scope of a research project financed by the Netherlands Organization for the Advancement of Pure Research (ZWO) in order to set up a typochronology of this kind of pottery in the southern part of the Netherlands.

. For dr. F. Højlund (Moesgård, Denmark).
Study of some pottery fragments belonging to various periods of the second millennium BC found in Failaka (Kuwait) in order to solve some specific problems.

. For Professor L. de Meyer and dr. H. Gasche (Ghent, Belgium).
A reconstruction of the shaping technique of pottery excavated at Tell ed-Der in Iraq.

. For drs. Josine Schuring (Leiden).
Advice for technological research of Roman sherds excavated in the Church

of San Sisto Vecchio in Rome.

. For the Museum of Clay Tobacco Pipes, Leiden
Analysis of the shaping technique of some ancient clay tobacco pipes from Turkey.

. For drs. A.H. Versteeg (Leiden).
Examination of a collection of sherds from Saba and St. Eustatius excavated by dr. J.P.B. Josselin de Jong in 1923. This collection is kept in the Ethnological Museum of Leiden. The technological report of this research deals with the shaping technique, the decoration technique, the firing atmosphere and the body of this pottery. Next year a study will be made of the pottery excavated on St. Eustatius (February - April 1984) by a team of the University of Leiden under the supervision of A.H. Versteeg; the excavation was financed by various institutions.

. For drs. R. van Wageningen (Haarlem, the Netherlands).
A reconstruction of the shaping technique of medieval globular pots excavated by amateur archaeologists in Haarlem. Research of the remaining pottery will complete this study.

. For dr. J.H. van der Werff (Amersfoort, the Netherlands).
A reconstruction of a specific type of amphora excavated in Nijmegen (the Netherlands) by the State Service for Archaeological Investigations (Amersfoort).

. At the request of Prof. L. de Meyer and dr. H. Gasche of the University of Ghent the Institute has worked out a programme for a technological research project in the scope of a Belgian expedition to Iraq. The programme has been accepted by the University of Ghent. This project, which deals with pottery from Tell ed-Der and surroundings, (2nd millennium BC), will be executed in Iraq. This project is scheduled to start in February 1985 and will be carried out in close cooperation with Professor Van der Plas (Agricultural University, Dept. of Soil Science and Geology, Wageningen).

. This Newsletter includes the first of a series of so far unpublished technological pottery studies (see Newsletter I, p. 37), which is entitled: "Iron Age Pottery from Haren, Brabant, the Netherlands" by H.J. Franken and J. Kalsbeek.

H.J. Franken

CLAY - A SOURCE OF LIFE

The Royal Museum of Art and History at Brussels are organizing an exhibition on the art and history of potmaking through the ages in Jordan with the title "clay - a source of life".

After an exposition of the history of the country and the archaeological activities that have taken place in recent years, the exhibition deals with ancient sites in chronological order. Collections of pottery, and other objects from these sites are shown. These collections have been lent by three museums in Jordan, by the University and the Antiquities Museum of Leiden, and by various excavators.

A large variety of potmaking methods is shown. The manufacturing methods employed by the potters in each period from the neolithic to the present day, are explained and demonstrated with the aid of sherd collections mounted on panels and illustrated with drawings.

The archaeological part of the exhibition was taken care of by Professor D. Homès, whose was the initiative for the exhibition, and the pottery studies were done by Prof. H.J. Franken with the advice of various ceramic experts. Stress is laid on aspects of development of the potter's craft, its problems and its adaptations to the demands of the time. The technique of the potter is seen in relation to the cultural, economic and historical background of each period. In this way ancient pottery assumes its place as an integral part of Jordan's cultural history.

The exhibition can be seen from 22-12-1984 till 28-2-1985 in Brussels and from 31-3-1985 till 28-8-1985 in Tongeren (Belgium). The exhibition will travel to Tübingen and Leiden in 1986.

A. van As

THE TABQA PROJECT

In the sixties and early seventies a dam was constructed in the Euphrates near the village of el-Thawra (Tabqa) in Northwest Syria. The antiquities in the area to be drowned (fig. 1) were threatened with destruction. For this reason the Syrian Department of Antiquities made an appeal in 1971 through UNESCO to the international world of archaeology to start archaeological research and rescue excavations in this region, now Lake Assad. Thanks to funds of the Netherlands Organization for the Advancement of Pure Research (ZWO) the Institute of Pottery Technology of Leiden State University could reply to this appeal by starting a research program into the development of the potter's craft from the Uruk period (4rd millennium BC) up to and including the early Islamic period. This research project, the so-called Tabqa project was set up to study the relation between clay composition and different techniques of making pottery in antiquity. It provided a unique opportunity of testing the research methods as developed by Franken and Kalsbeek in their study of Iron Age pottery from Tell Deir ^{c}Allā (Jordan)(Franken 1969). The aim of the Tabqa project was to collect stratigraphically a diachronic series of pottery and to obtain by means of techno-analytical research an insight into the pottery traditions in the Tabqa region. This region lent itself particularly to such research, since it is a geographically restricted area (approx. 80 x 10 km) and it could be assumed that local Euphrates clay had been used. On the basis of large samples of pottery - fragments and complete shapes - an investigation was made as to there was continuity or discontinuity in the pottery traditions.

The Tabqa area was surveyed and excavations took place at three different sites: Jebel Aruda, Tell Hadidi and Ta'as. A small quantity of pottery from Shams ed-Din was purchased for the purpose of study. Pottery could be collected from a succession of cultural periods: the Uruk period (Jebel Aruda), the Bronze Age (Tell Hadidi, Shams ed-Din) and the Byzantine/ early Islamic period (Ta'as, Tell Hadidi).

Some results of the Tabqa project have been published already: Van der Leeuw (1976), Franken (1978) and Kalsbeek (1980). Van der Leeuw,

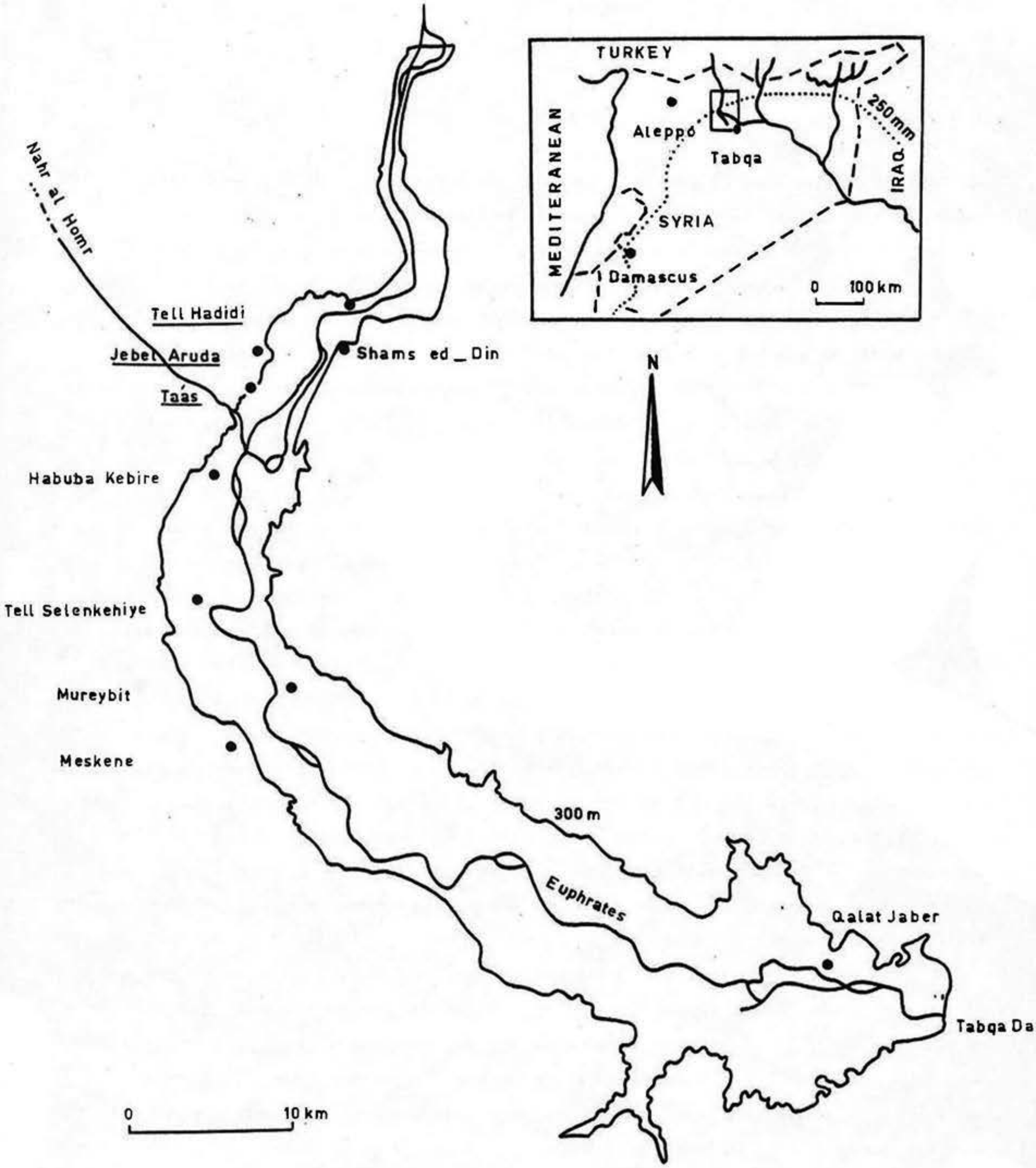

Fig. 1 Map of the Tabqa area, Syria.

initially charged with the publication of the results of the Tabqa project, supervised the 1974 expedition, but withdrew from the project in 1976. His paper concerns the study of the medieval pottery from Ta'as, which is only a part of the total Tabqa pottery repertoire (Van der Leeuw 1976: 187-315). As, however, this study was not complete and data had not been sufficiently evaluated, it was necessary to raise the medieval pottery from Ta'as once again in the final publication of the Tabqa project.

The study of the entire Tabqa pottery repertoire has now been completed by the author and the manuscript is finished. At the beginning of 1985 the results of the Tabqa project will be published in Dutch: "Het pottenbakkersambacht in het oude Syrië, een technologisch-archeologische studie van aardewerk uit het Tabqa-gebied in Noordwest-Syrië en een beschouwing over aardewerktypologie". Later the English edition will appear under the title: "Potters from the Syrian past, technological studies of ancient pottery from the Northern Euphrates Region in Syria and some afterthoughts on typology". This study is in the first place a technological study. Therefore, the aspects with respect to the potter's craft have been emphasized. In order to fit it in the existing archaeological literature some short paragraphs have been devoted to comparisons with pottery excavated elsewhere.

The technological research work comprised the analysis of the shaping techniques and the analysis of the raw materials. The shaping techniques were analysed from the traces left on the pottery. Later the reconstructions were verified by means of experiments. The raw materials were analysed through refiring tests and microscopic research. For every cultural period a separate description was given of the results of the technical analyses. After that the various pottery groups were compared with each other, followed by an evaluation of the results.

Looking over the results, it strikes that all basic techniques found in the Tabqa pottery repertoire were present already in the earliest period (Uruk period): 1. handmade pottery, 2. pottery made in a mould, 3. pottery thrown on a wheel a. in one piece, b. from the cone, c. in coils, d. in cylinders, 4. a combination of a technique in which the base is thrown closed, the use of a mould and throwing. Especially technique 4 occurs in the Uruk pottery repertoire from Jebel Aruda. Most of the middle and late

Bronze Age pottery repertoire from Tell Hadidi has been slowly thrown in coils. The Byzantine/early Islamic pottery from Ta'as has, for the most part, thrown closed. In addition to the basic shaping techniques the secondary characteristics such as decoration and rim finishing were also studied. Shape differences in pottery made to one basic method appeared to have been caused by the secondary technical characteristics.

For the material analyses test sherds were taken from complete pots. However, it did not appear to be possible to correlate specific material groups with specific techniques. Different techniques had been applied with one kind of clay body. On the other hand different clay bodies had been used for one shaping technique. In other words: the tolerance of the raw materials with respect to the shaping techniques was rather large. We may assume that most of the pottery has been made of local Euphrates clay. This clay contains all kinds of components transported by the river from the Turkish mountains and a changing amount of lime originating from irregular lime deposits transported during rainfall by the side wadis to the Euphrates flood plain. The non-plastics in the clay vary in quality and quantity. This fits in with the results of the material analyses. In this pottery study more detailed laboratory material analyses will probably not give more information with respect to the exact provenance of the pottery. Only because of an inexplicable phenomenon a sample of three sherds is being analysed in a laboratory at the moment (see p. 12).

The pottery groups treated in this study are snapshots from a long period of development of various pottery traditions. The continuity found in the use of the same raw materials and shaping techniques was remarkable. In the course of time there had been only minor changes in the rate of occurrence between the different shaping techniques. Conclusions from the numerical evaluation of the techniques could hardly be drawn for various reasons. The shape variations - which play an important part in archaeology - could sometimes be explained by a change in the basic techniques. This was the case with the huge storage jars of the Uruk period and the shape differences in the Bronze Age. The shapes of the Uruk bowls, however, do not differ much from the Bronze Age bowls. They were made in the same shaping technique and the minor differences/variations could be ascribed to differences in the secondary characteristics such as finishing of the rims and decoration.

With respect to the non-pottery finds only a brief description has been given of the registrated objects from medieval Hadidi and Ta'as and the frescos from Ta'as. The non-pottery finds from Bronze Age Hadidi will be published by R.H. Dornemann, who from 1974, was engaged in the excavation work at Tell Hadidi for several seasons. Van Driel who continued the work at Jebel Aruda after 1975 will publish a paper on the objects excavated during the Tabqa project.

The last chapter of the study of the pottery from the Tabqa region contains a study on pottery typology in theory and practice. The type concept as used in archaeology is critically elucidated from the potter's point of view and on the basis of the existing theoretical/philosophical literature on the type concept.

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A. van As

POTTERY TECHNOLOGY AND PHYSICOSCIENTIFIC ANALYSES OF CERAMICS

The last few decades the natural sciences have played an increasingly important part in archaeological research. Archaeologists engaged in pottery research more often make an appeal to natural scientists.

According to Peacock (1970) the aims of the scientific study of ceramics can be conveniently considered under two principal headings: 1. technology, i.e. the methods by which clays were prepared, shaped, finished and fired, and 2. characterization, i.e. the examination of the properties of ceramics with a view to isolating materials of different origin and establishing their source where possible. Especially for the characterization of pottery archaeologists cannot do without the help of natural scientists. Peacock (1970) outlines the major scientific techniques which can be applied to the study of ceramics, such as optical emission spectrometry, X-ray fluorescence spectrometry and X-ray diffraction. These analyses, which are generally very expensive, are executed by specialists in advanced laboratories.

Technological pottery research as executed in the Institute of Pottery Technology does not only include the analysis of the shape, the decoration and the firing technique of ancient pots, but also the analysis of the pottery body. As a matter of fact, characterization of pottery is an essential part of technological pottery research. Therefore, Rye pays ample attention to the material identification in his book on pottery technology (Rye 1981). The primary shaping technique such as paddle and anvil technique, throwing and closed throwing and the secondary manufacturing stages such as burnishing, finishing of rims and decoration, are closely related with the type of clay used by the potter. Not every clay, for example, is suited for throwing on a fast wheel. Or, another example: before painting a pot it is sometimes necessary to provide it with a slip layer as underground, because the high degree of porosity of the pot makes its surface unsuitable as decoration underground.

Since it appears not to be quite clear to some archaeologists which material analyses have to be made to solve the various pottery research problems with which they are faced, I shall enter into the various physico-scientific material analyses connected with pottery technology. In the Institute of Pottery Technology the following two kinds of material analyses are applied:

1. Research of different fresh clay bodies prepared by the Institute itself in order to establish the various physical and chemical processes occurring during firing under controlled circumstances. Such firing experiments are important to get a better understanding of the workability of the clay and of the relations between non-plastics, firing temperature, shrinkage, porosity and hardness. It occasionally happens that the clay used for these experiments is the same as the one used by ancient potters. This was the case with sherds of unfired pots found in medieval Ta'as on the Euphrates in NW Syria during the Tabqa project (see p.5-9). With these sherds a number of typical potter's tests could be carried out, such as the Atterberg test intended to establish the water absorption and the degree of plasticity. Breaking strength tests and tests to measure density and precipitation were also carried out. In this context it has to be noticed that the provenance of a clay can much easier be established with the aid of unfired clay than with fired clay, since the mineralogical and granulary compositions which are important for identification have not yet been changed by the fire then.

2. Study of potsherds from ancient pottery. For this kind of research a (polarization)microscope, an electric test kiln and a very accurate balance are used. Fresh breaks and thin slides are studied in order to establish the composition and character of the non-plastics in the clay. Refiring tests give information about the original firing temperature and the original firing atmosphere. Moreover researches are made into the porosity of pottery. With these rather simple means a lot of sherds can be investigated and about 80 % of the archaeologist's problems with respect to pottery classification can be solved. For the remaining 20 % of the problems - specific ones such as the question of the exact provenance - the physicoscientific approach in a laboratory is necessary. Although this laboratory research work enjoys an increasing interest on the part of the archaeologists, a warning is needed here: there is a tendency to carry out laboratory analyses for reasons of fashion. In such cases the results of these analyses

are just added to archaeological publications as appendices instead of being integrated in the techno-archaeological study concerned. Moreover, often in practice too few sherds are analysed to obtain statistically reliable results, because these laboratory analyses are very expensive. The material analyses as performed by the Institute of Pottery Technology, however, can be carried out at relatively low cost, so that there is no need to restrict the number of sherds to be examined. The results of these "simple" analyses can be helpful in making a better selection of samples for further scientific analyses in a laboratory. The problems can be formulated better and it saves money. The material analyses of the Tabqa-project pottery (see p.5-9), for example, were sufficient to solve the problems with respect to the relation between the pottery body and the shaping techniques. Only some test sherds of recognizable pot shapes of the Jebel Aruda repertoire (Uruk period, 4 th millennium BC) and the pottery repertoire excavated at Tell Hadidi (Bronze Age) showed, after being refired in an oxidizing atmosphere at 1050 °C and 1150 °C resp., a phenomenon that could not be explained from the viewpoint of the potter's craft. Unlike most of the other sherds of which the colour according to the Munsell Soil Color Charts (1954) varied from white (10 YR - 8/2), very pale brown (10 YR - 8/3) to reddish yellow (5 YR - 6/6) dependent on the salt/lime/iron ratio, these sherds showed a light red (10 R - 6/6) to red (10 R - 4/6) coloured layer at the inside which could not be explained as a slip layer. After refiring at 1150 °C this red layer tended to vitrificate and easily flaked off. Only some hypotheses could be given for this phenomenon. The red zone might be explained by the original contents of the pot. The inside might have been bleached by acids of the original contents causing the lime to be leached out of the sherd and the iron content to predominate. This explanation, however, was not very plausible, because the phenomenon could not be correlated with specific pot shapes. Another explanation could be the process of making the pots watertight. Contact with Professor Van der Plas (Agricultural University, Dept. of Soil Science and Geology, Wageningen) resulted in the decision to subject a number of sherds to a physicoscientific laboratory analysis so as to test the above hypotheses or to formulate new ones. At this moment the results of these analyses are not yet known.

Analysis of too few sherds is a weak base for a solid archaeolog-ical picture. We have to be very careful with drawing conclusions. Some examples will clarify this. The sources of variation in the chemical content of a sherd may be found in the craft proper such as uncomplete mixing of differently composed clays or the use of differently composed clays for the various parts of a pot. Wrong conclusions might be drawn by not recognizing these variations. Moreover, the provenance of a clay can only be defined with certainty, if a reference collection of clays for comparison is available. Assuming that the original clay seam has not disappeared, allowance should still be made for the fact that the clay composition can vary locally. Samples taken from one clay area may vary, especially if the clay has been sedimented in small thin layers. In addition, we should bear in mind that a potter may not have mixed his clay and non-plastics well enough so as to get a homogeneous composition. Every clay to which sand, grog, or crushed shells have been added shows differences which may be rather big, so that we should take care not to keep our observations within narrow limits. With respect to the determination of the firing temperature a warning is needed: the temperature in one kiln may differ 200 °C locally.

Material analyses as part of technological pottery studies should precede specialistic laboratory analyses which are especially suited for the solution of specific problems. Only if they are integrated into the technological research work will these two methods of pottery analyses be a valuable contribution towards the solving of archaeological problems.

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L. Jacobs

THE RELATION BETWEEN POTTERY BODY, FIRING METHOD AND COLOUR OF GLAZED COOKING POTS EXCAVATED AT THE AMMAN CITADEL IN JORDAN

In 1976 and following years earthenware from the late Roman, Byzantine and early Arabian times was excavated in the centre of Amman. The work was carried out on request of the Jordan Department of Antiquities by the British Institute for Archaeology and History in Amman under the supervision of the Director Mrs. Christal M. Bennett. The earthenware dug up in the first year was studied by the Institute of Pottery Technology in Leiden. It included a number of cooking pots and fragments thereof, which were clearly distinguishable from the rest. One of the purposes of the technological analysis of earthenware is to define the glaze layer if any. Therefore some aspects of the glaze on these cooking pots will be discussed below.

The colour of the analysed sherds varies from red to greyish black. This means that the pots have been baked in a partly oxidizing (up to 1050 °C), partly reducing (up to 800 °C) atmosphere, certain parts of the same pot being in direct contact with the flames, resulting in a red colour. Other parts have more or less been shut off from oxygen, resulting in a greyish to black colour.

A number of cooking pots and fragments showing the features as discussed above are covered at one side with a glaze layer. These glazes vary in colour and the question arose of what had caused these differences.

It is assumed that in antiquity there were two types of low-temperature glazes with a rather long melting range. One was a lead glaze the other was a strong alkaline glaze, of the soluble variety, which means that its fluxes were not fed into the glaze mixture in the form of feldspar. Such alkaline glazes contain potassium carbonate (K_2CO_3) and/or sodium carbonate (Na_2CO_3), called potash and soda ash respectively, as major fluxes. When potash is obtained by burning vegetable matter, the glazes containing it are called ash glazes. An other source of low melting alkaline fluxes are deposits found on the bottoms of rivers and lakes that have run dry. Some disadvantages of the alkaline glazes, which have a low melting point, are crazing due to the high rate of contraction of the alkaline components, the poor resistance to chemical attack and, furthermore, their lack of mechanical strength, which means that they are soft and have a low elasticity. On the other hand they can develop brilliant colours.

The features on the cooking pot sherds, however, are characteristic of a lead glaze. Except for minute cracks only visible under a microscope the glaze layer has not crazed. This is remarkable for a product fired under the circumstances as described above. (Lead glazes tend to be elastic and form already a light shining surface when heated to 800 °C). In this case we have to do with a transparent lead glaze formed by the interaction of red lead (Pb_3O_4) and silica. Silica was already present in the sherd, more may have been added to the red lead in the form of quartz or flint powder.

Some reduced and dark coloured fragments show a very thin light red layer of about 1 mm thickness, just under the glaze coating. This can be explained by the presence of oxygen coming from the red lead. This oxygen enabled the carbonaceous matter present in the sherd to be burnt out and the iron also present in the sherd to oxidize to a light red colour. Also the fact that even on heavily reduced fragments the lead glaze did not form crusts points to the use of red lead instead of, for instance, white lead or other lead compounds.

The colours which can be seen through the transparent glaze are those of the underlaying sherd. They range from light reddish brown to dark reddish brown (Munsell Soil Color Charts 1954, 5 R - 2/1, 7.5 R - 2/2 and 3/4, to 2.5 YR - 3/4 and 3/6). The glaze coating prevented soot, if any, from affecting these colours. It was found that the darker shades in the glaze were caused by iron oxide (Fe_2O_3). When the firing temperature rises above 900 °C iron is transferred from the sherd into the glaze. The higher the temperature the more iron is transferred, the darker the colour becomes. This was confirmed by refiring tests carried out on cooking pot sherds which had the original coating. In addition to these tests, cooking pot sherds from unglazed parts were painted partly with red lead and refired. Afterwards the test results were compared.

The conclusion was that differences in the iron content of the originally used clays and differences in temperature and firing time are the causes of the colour variations. No colouring oxides were used. The cooking pots from the Amman Citadel have been fired in such a way that no precise control over temperature and time was possible or necessary.

The colour test

A large sherd of a glazed cooking pot was broken into 9 parts. These parts were all covered with red lead on the outside and than fired in an oxidizing atmosphere.

Temperature	M.S.C.C. (1954)	Remarks
700 °C		The original colour changed into yellow. No melt yet but incipient reaction with the sherd.
750 °C	2.5 YR - 3/6	An opalescent transparent glaze similar to the glazes on the cooking pots.
800 °C	2.5 YR - 3/6	No changes.
850 °C	2.5 YR - 3/6	No changes.
900 °C	2.5 R - 3/2	A slight change of colour. Some darker patches. Some iron is taken up by the glaze.
950 °C	2.5 R - 3/2	No changes.
1000 °C	7.5 R - 2/2	There is a clear change of colour. The glaze is a deep dark brown. More Fe_2O_3 in the glaze.
1050 °C	5 R - 2/1	The same as with 1000 °C.
1080 °C	7.5 R - 2/0	Very dark hue.

H.J. Franken and J. Kalsbeek

IRON AGE POTTERY FROM HAREN (NORTHERN BRABANT, THE NETHERLANDS

INTRODUCTION

In 1959 Mr. H.G.M. Teunissen excavated a number of Iron Age pots and pot fragments which are now kept by the Leiden Rijksmuseum of Antiquities. A study into the technical features of this pottery resulted in 1971 in a report that has not been published up to now. A summery of this study is given below.

CLAY COMPOSITION AND FILLER

The clay from which the pots have been made is similar in composition to the clay which is still found near Haren along the river Maas. The very fine sand grains present in the clay should not be considered as a separate filler added to the clay. The same applies to the organic matter which has been burnt out during firing but has left its traces on the pots in the form of small holes. A number of sherds were refired in an electric kiln at a temperature of approx. 1000 °C and appeared to deform by melting. The clay used was not very plastic and the main function of the filler - which was nevertheless added - must have been to eliminate the problems arising during the relatively primitive way of drying and firing. The filler consists of crushed pot sherds and its grain size varies considerably as far as the large pots are concerned. The small pots have a fine and more homogeneous filler, which may point to the use of a sieve.

MAKING TECHNIQUES

Among the repertoire a number of different making techniques are represented. The following techniques can be distinguished.

a. Pots made with the aid of a leather collar (see fig. 1)

The shape of certain pots suggested that they had been made with the aid of a leather collar. This was confirmed by experiments. Such a collar was made as follows: a piece of thick leather was cut into a circular form of e.g. 25 cm in section; in the centre of the circle a round piece of leather of approx. 4 cm was cut out; then the circle was cut through along the radius. By shifting the loose ends over each other and fixing them together the round band of leather was made into a mould (fig. 1: 1, 1a). To form a dish a ball of clay was pressed out with the hands into a circular slab. This slab was then worked into the leather mould and smoothed. The opening in the bottom of the mould was completely covered with clay, so that the base of the dish slightly protruded. After some finishing the dish was left to dry in the mould for a while. By drying it came off from its leather support and could be lifted away.

The shape of the mould was not very symmetrical. It had an oval bottom and was heavier on the side where the loose ends had been fixed together. Consequently it could not be placed upright, so that the side with the overlapping ends took a more horizontal position than the opposite side of the collar. It is self-explanatory that a pot made in such a leather mould takes the shape of the mould. The Teunissen collection includes a number of dishes which clearly show such a shape. Their sides are straight, as the leather was too hard to take a rounder shape. The bases are protruding, unlevel and oval. Another feature is the eccentric place of the bases which are moved to one side, i.e. the most vertical side (relation between slope of the collar and obliqueness of the protruding base, (see fig. 1: 9).

Grog particles stick out only from the inner surface of the dishes. On the outside this was prevented by the leather mould. Of many dishes the outside has been burnished as the smooth surface lent itself particularly well for this treatment. In some cases the surface has not been burnished. Here the outside shows and impressed pattern resembling very much the surface pattern of a piece of leather.

The leather collar was not only used for making shallow dishes. The collection also contains earthenware of a higher form made by building one or more coils of clay upon the part resting in the mould (fig. 1: 6-9). Of some

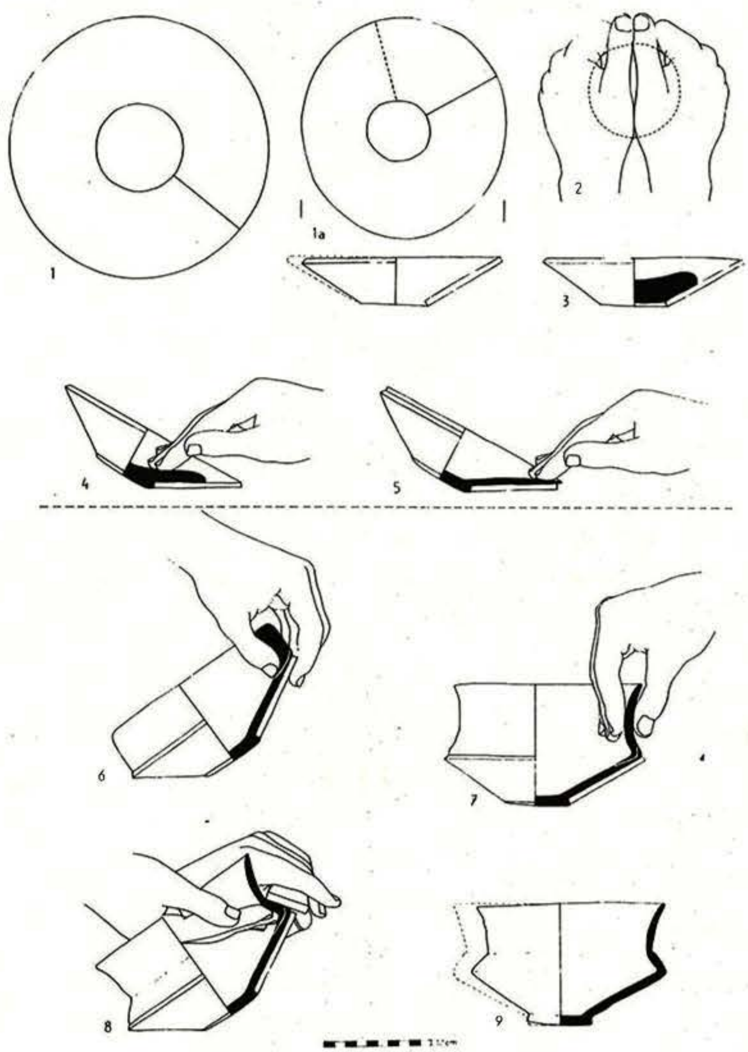

Fig. 1   Pots made with the aid of a leather collar.

forms the wall has been extended in the same direction as that of the part in the mould, producing a wider and higher dish. Of other forms the upper part has been built in a direction opposite to that of the part in the mould, giving the dish more or less the shape of a bowl. Here the transition from the part in the mould to the upper part is sharp. Of still other forms the dish has first been widened in the same direction as that of the part in the mould and then provided with a part of which the slope is opposite to that of the part already fixed, e.g. more vertical. The upper part is mostly only a few centimeters high.

A number of dishes and bowls still clearly show the joins where the parts have been put together. Of some dishes the added part has broken off from the lower part along the join.

There are also mould-made pots of which the freely built part reaches well above the mould. Here a first coil of clay was stroked into the wall of the dish resting in the mould. This straight coil, which slightly slanted inwards, was then smoothed on the outside, for instance with a piece of wood. A second wide layer was worked into the first coil in a more vertical position. The top part of the second coil was eased outwards so that it became thinner and trumpet-shaped. The pot was completed by finishing the built-up part.

Rim profiles are only found on those types of bowls of which the freely built part curves inwards and is not much higher than a few centimeters. The profile was made by levelling the top edge. The rim could not be properly trimmed because of the coarse structure of the non-plastics in the clay. The edge was bent slightly outwards so that a more or less round profiled rim was made. The rims of dishes entirely made in a mould do not have such profiles. They have been trimmed flat using the top face of the mould as a guide. The surplus clay was bent inwards and stroked downwards, which on some dishes resulted in a slightly thickened rim.

b. Pots made in a leather mould with sewn-in bottom (see fig. 2).

A number of pots have been made in a mould with sewn-in bottom. The bases

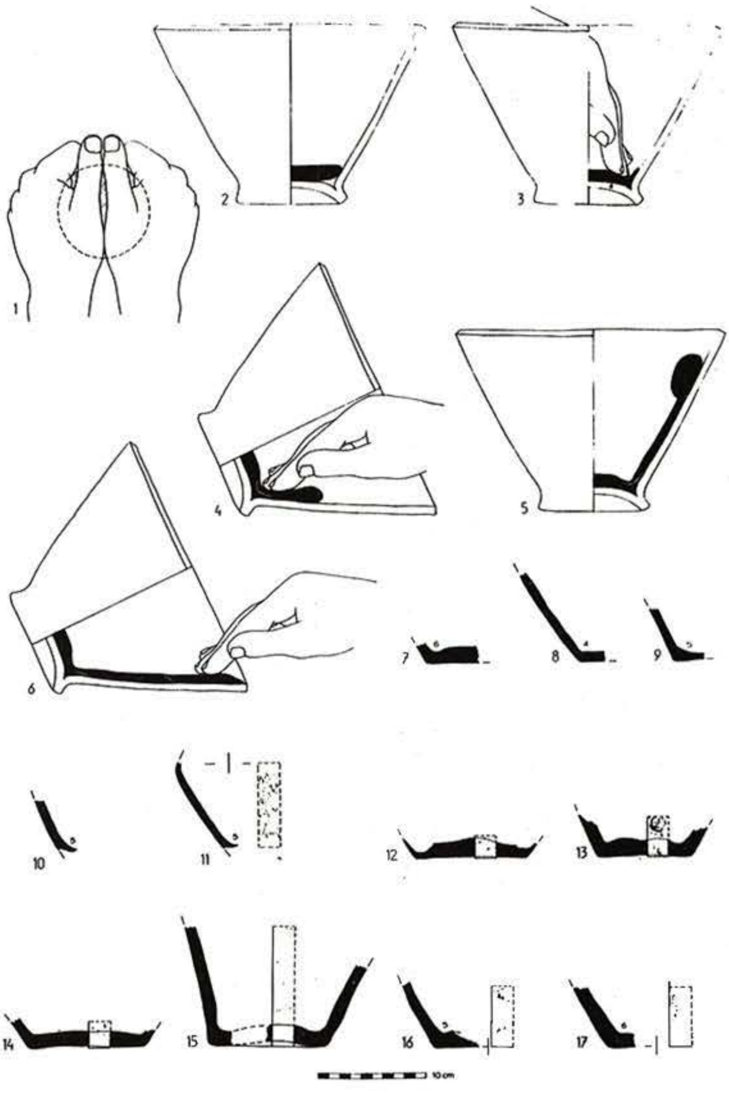

Fig. 2 Pots made in a leather mould with sewn-in bottom.

of these pots are not protruding, as is the case with the open leather mould, but slightly convex.

c. Pots made in a mould of baked clay (fig. 3)

The use of an earthenware mould had a number of advantages over a leather collar. It was much easier to turn the pot round during the building stage. The pots made in such a mould have a round base and belly. The part above the mould was finished while the pot was turned around. The rims are generally not profiled. The bases were left round or flattened by beating them with a piece of flat wood (see fig. 3: 6). Of some pots the bases were pushed slightly inwards so that the pots could stand upright on a flat underground (see fig. 3: 5). The fixing of a separate foot ring (fig. 3: 7a, b) was hardly done.

d. Pots made without the support of a mould: coiled pots

The coiled pots have a rather round profile. The major part of this type has hardly or not at all been finished, so that the joins are still visible as projecting strips on the outside. One gets the impression that the filler added to the clay consists mainly of sand instead of crushed pottery. The outside has a light-grey colour whereas the inside is sooted.

SECONDARY TREATMENTS

A number of pots have undergone further treatment before being fired. The small dishes have been burnished entirely on the outer surface and on the inside only at the top just below the rim. The bowls with a rather vertical upper part are the only ones that have been burnished on the inside entirely. The larger bowls and pots show traces of intentional roughening on the lower part and of burnishing on the upper part.

a. Burnishing

Burnishing was done by polishing the surface of the pot with a piece of wood or a pebble at the firm leather-hard stage. Some bowls show on the inside traces of burnishing at the soft leather stage. The function of this burnishing was to remove any irregularities in the wall caused by scraping. By scraping the wall was made thinner but at the same time the coarse filler particles were shifted out of place so that deep scratches occurred in the surface. In order to remove these scratches by burnishing the clay had to be rather soft. As the traces of burnishing at the rather soft stage of the clay are less affected by erosion to which a pot in the soil is exposed in the course of time, they are as a rule easier to recognize than traces caused by burnishing at a dry state and burnishing on a slip layer.

Some dishes and dish fragments show a greyish coarse texture instead of a burnished black surface. Here the surface coat is broken away from the body. This may have been caused by unequal shrinkage between the body and a slip layer that may have been applied to the dish before burnishing in order to enhance the gloss.

b. Intentional roughening

The outer surface of most large coiled pots of which the wall profile shows a more or less sharp angle has been burnished above this angle and roughened below it. Of pots with a rather smoothly curved profile the transition from the roughened part to the burnished part is rather vague and here the traces of burnishing are still visible under the applied rough layer of clay. This means that the roughening was done after the burnishing. The roughening was done as follows: a mass of clay was applied to the pot by hand and evenly divided over the surface with a stroking motion. By stippling a special typical pattern was obtained. The more water the mass of clay contained, the less rough the surface became.

The roughened pots have no handles. Their inner surface has been made watertight by sooting, which means that they have probably been used for storing liquids. As a damp surface reduces the grip on a pot considerably the roughening, apart from being decorative, may have been brought about to increase the grip on the pot. Small pots do not need to have a roughened surface. Because of their small size they can be lifted easily.

c. Combing

The collection includes a small number of coiled pots of which the covering of the surface has been effected by moving the teeth of a comb over the clay at the leather-hard stage. This has been done either haphazardly or to produce a specific pattern. Combing could not easily be done on rough surfaces, as the coarse ingredients of the filler got stuck between the teeth of the comb. A typical feature are the small ears on the pots decorated with a comb.

FIRING METHOD AND COLOUR OF EARTHENWARE

All pots have been fired in a reducing atmosphere producing a bluish-grey to black colour because of lack of oxygen in the oven. The deep black colour of some smooth-surfaced pots has been brought about by soot formed during heavy firing and settling on the pots. Some freshly broken fragments show a core which is darker than the inner and outer surface. This means that the original colour of the entire surface must have been black. The grey discolouration must have been caused by certain soil substances acting on the sherd in the course of time. Other fragments have a black inner surface and a black core whereas the outer surface is much lighter in colour. There are various explanations for this phenomenon. During firing the outside of a pot is as a rule more exposed to direct heat than the inside, so that reduction is heavier on the inside than on the outside. There is another explanation: when in use the pots became dirty on the inside. Food easily adheres to an unglazed surface. If a pot could not be properly cleaned with water, the foodscraps were burnt away and converted into carbon.

There are also a number of pot fragments showing a reddish discolouration. This may have been brought about by an oxidizing fire burning after the pots had already been baked and, possibly, after they had been in use.

The collection also includes sintered pots. Sintering occurs when a pot is fired at too high a temperature causing it to melt and deform. This phenomenon is mostly found on large to very large pots, which raises the presumption that these pots served as a kind of saggar. These saggars enabled light-tempered ware to be fired which otherwise would not have survived the firing. The ware was protected from the effect of the flames and could be heated more gradually. Assuming that the large pots have been used as saggars, they have as a matter of fact been in direct contact with flames several times, eventually causing them to melt.

CONCLUSIONS

Analysis of the phenomena observed on the pottery of the Teunissen collection has produced three types of pots: earthenware made in a leather mould, earthenware made in a mould of baked clay, and coiled earthenware. These three models have not yet been clearly defined, as the observations have not been completed. The filler - a major factor in the assessment of the phenomena - has not been analysed sufficiently. Further uncertainties are the type of ovens used, the firing temperatures, etc. No pronouncement can be made on the chronological relation between the various wares, because there are no stratigraphic data. On the basis of the technological research only a few suggestions can be made for a chronological classification. The technique of "intentional roughening" may have been replaced by "combing" which, in turn, may have led to the application of ornamental patterns. This would mean that the decorated fragments belong to the last period of occupation. The few handles that have been found may also be included in this period. In order to find an answer to such questions a collection of sherds from a well-documented stratigraphy was required. For this purpose the Institute of Prehistory in Leiden carried out excavations in Haren (N-Br) in 1962 and 1972 under the supervision of prof. dr. G.J. Verwers. The sherds excavated during these periods have been investigated, the above technological results concerning the Teunissen collection being used as reference data. The results of the investigation have not yet been published.

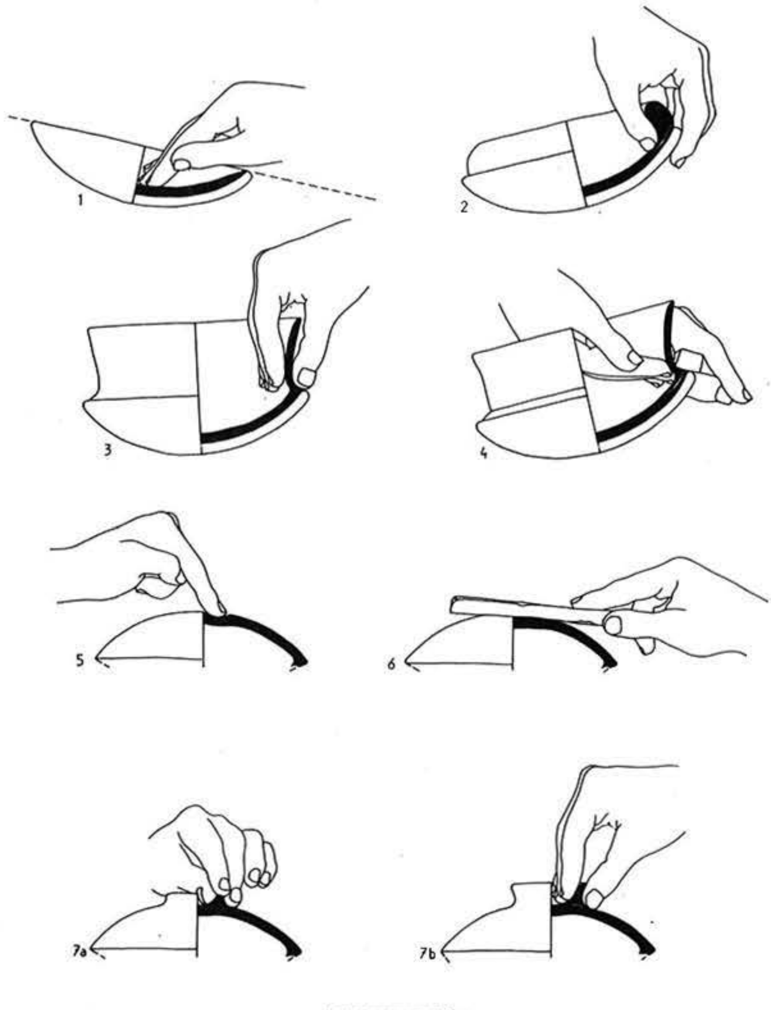

Fig. 3 Pots made in a mould of baked clay.

Josine M. Schuring

TECHNOLOGICAL ANALYSIS OF SOME LATE ROMAN AMPHORAE*

In studying the pottery found during investigation of architectural remains of the Early-Christian basilica which preceded the later Church of San Sisto Vecchio in Rome (Geertman 1968/69) the excavators felt that the traditional means of classifying pottery used in classical archaeology, i.e. shape and decoration, were inadequate (Annis 1983). In an attempt to develop new ways of studying pottery attention was focussed on characteristics of and relationships between clay, glaze, if any, shape and manufacture (Annis 1976). This led to close cooperation with the Department of Pottery Technology.

In 1980, when still a student, I was offered the possibility of studying the Late Roman amphorae from this excavation. Having attended a pottery practicum organized by the Department of Pottery Technology especially for students, I too was convinced that an approach based on material and manufacturing techniques was of more significance than one based on shape exclusively. A conviction that was to be supported by a separate study of methods of research into Roman amphorae, a category of vessels which have been object of study since the last quarter of the nineteenth century.

Roman amphorae are mainly studied in order to gain information on the economic situation in the Roman empire. Which products were transported in which proportions from where to where and in which period? It is, however, not always a simple matter to obtain this information for a number of reasons of which the most important are: first, the amphorae were mass-produced. Because the pots were hand-made differences were inevitable, although the aim of this standardized production was to produce the same shapes. Second, it has been demonstrated that on the one hand highly different regional shapes existed, but that on the other hand sometimes the same shapes were produced in widely differing areas. Third, the shape of the vessel was functional, both in terms of contents and of transport, which was mainly by sea. Therefore, it was less subject to alteration than that of some other vessels in ordinary use.

Starting from the premisses that a relationship exists between shape and material, that a shape results from a sequence of manipulations and that a potter, once he has experienced the best way of producing a particular pot, will hold on to this method (Franken 1975), the first phase in the subject study consisted of a division of the fragments, irrespective of shape according to fabric. At this first stage it is impossible to make an archaeological evaluation of the divisions made, because apart from the explanation based on the ideal situation that different fabrics are always of different provenance, other explanations are possible.

The next phase in the examination consisted of a division of the fragments, within the fabric groups, according to manufacturing technique. In short, the fragments were in the first instance classified according to data derived from the material itself. Only in the final phase was this division compared with other published material.

Future detailed analyses might make it possible to establish type definitions. This can be done only after examining a large number of complete vessels produced in different workshops. The relatively small and fragmentary material from the San Sisto Vecchio did not make it possible to reach beyond the level of 'observations' and 'speculations'. However, the results of the study seem to be promising with regard to the part which could be played by technological analysis in classifying amphorae objectively in determining provenances, and in distinguishing between shapes, which are as yet difficult to separate on the basis of fragments.

In order to arrange the fragments according to fabric first a macroscopic division was made, based on differences between the inclusions and differences between the clay matrices. Although the majority of the fragments proved to contain quartz, it was clear that differences existed in the size and shape of the grains and in the amount of inclusions. A reference collection was made by breaking chips of 50 selected sherds. These chips were refired in a gas-kiln in a neutral atmosphere at 1050 °C to eliminate any possible differences which might have resulted from uncontrollable conditions in the kiln in which the pots were fired originally. After refiring the chips were studied under a stereomicroscope (40X) and then arranged according to colour, to the type, size and shape of the inclusions, and to their percentage by weight (Jacobs 1983). Although some other aspects were studied, the five features mentioned above served as distinctive criteria. In a later stage thin sections were made. All the other fragments were studied in the same way and the observations were related to the manufacturing techniques.

About half of the total number of fragments could be split up into nine fabric groups. A short account of some of these groups follows, stating the more important results and pointing out how some of these may help in future research.

In fabric group A it could be observed that the clay body from which the handles were made was prepared differently by adding more non-plastics. The often mentioned slip coating of these amphorae proved in most cases to be scum, resulting from soluble salts in the clay either naturally present or purposely added by the potter. Two basically different ways of body construction, which could be directly related to the size of the bodies, could be observed: a) throwing separate cylinders which were luted in order to produce a cylinder of ca 60 cm in height with a diameter of 18 cm, and b) throwing from hand-made coils on the wheel in order to produce a cylinder of ca 60 cm in height with a diameter of 36 cm. In addition three different ways of finishing the base before the attachment of the stub were noticed, which could also be related to the size of the body. In addition to the number of bases that had been thrown completely closed, there were some bases that had not been thrown completely closed, while others were twisted close.

The fragments in fabric group A stem from amphorae which belong to a large group of amphorae which were produced from the 2nd century A.D. in the region of modern Tunisia. These Tunisian amphorae have been subdivided in a number of types and variants on the basis of shape alone. Although the differences in size between the extreme shapes is considerable, the subdivision of a large number of amphorae in the middle group is much more problematic. This latter group contains amphorae which generally seem to be similar in shape, and yet differ, one from the other, with regard to shape details. Consequently it has proved to be very difficult to make a subdivision and the one that is in use now is not logical in every aspect (Anselmino et al. 1977). In a large-scale study of this group of North African amphorae, the different manufacturing techniques mentioned above may, together with the four different ways of shaping rims which were observed, serve to provide firmer grounds for a more subjective subdivision.

The larger part of the fragments in fabric group C stem from amphorae of the same shape. Nevertheless three different ways for the construction of the rim could be noticed. For some rims clay was simply folded out and down, and smoothed. In one rim this clay coil was folded double. One complete neck fragment was preserved which showed that the neck was thrown separately and attached later. This makes it unlikely that an extra clay coil was attached from a shortage of clay. It was also observed that the surface of these amphorae was finished differently. In addition publication drawings show that this type of amphora seems to have been produced both with a massive and with a hollow stub, requiring basically different manufacturing techniques. Since a number of different production centres have been located and since a number of amphorae bear stamps, it should be possible to investigate whether any of the different techniques can be related to a particular production centre, thereby providing a means to determine a provenance also for unstamped amphorae and fragments.

The only interesting feature of fabric group D and E is that it could be estimated that mixtures of clays were used in the manufacture of the amphorae.

Examination of the fragments in fabric group G showed that three differently prepared clay bodies were used: one for the body, one for the neck and one for the handles. This could also be observed for the amphorae in fabric group J 1. The shapes in fabric group J 1 resemble closely to shapes which on the basis of a distinctly different fabric were assigned to group F. It is important that both groups will be clearly defined in future, because amphorae of these shapes appear to have been produced both in the Eastern Mediterranean and in North Africa. Concentration on vessel shape alone has clearly proved to be insufficient to distinguish between both (and possibly more) provenances. More attention should therefore be paid to fabric and manufacturing techniques in order to sort out this somewhat confusing situation in which amphorae from different provenances seem to get mixed up.

With this short outline the author hopes to have sketched out some of the potentials of technological analysis in the study of Roman amphorae. Close examination of even few and small fragments seems to have opened some avenues for future research.

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* This article is but a short abstract of a much more comprehensive study of the Roman amphorae found at the San Sisto Vecchio. The complete study, including fabric descriptions and detailed analyses of manufacturing techniques will be published in BABESCH, Bulletin Antieke Beschaving 59, 2 (1984) (in press), Josine M. Schuring, Studies on Roman Amphorae: part I A Historical Survey of Methods of Research; part II Amphorae from the San Sisto Vecchio in Rome.

M. Beatrice Annis

POTS IN ORISTANO

A lesson for the archaeologist

To Diderik van der Waals

INTRODUCTION*

As already set out in Newsletter I (Annis 1983) the study into the present-day pottery production in Sardinia is based on the assumption that the fundamental changes that have taken place in the physical and socio-economic environment of the island over the past 30 years have made themselves felt in the pottery production as well. Starting from this assumption an esentially archaeological inquiry is made. The questions are the following: How do the changes that took place express themselves in the production? Which are the causes that generate phenomena such as resistance and extinction, adaptation and transformation? And which are of all this the archaeologically distinguishable signs?

One of the aspects of the investigation is the reconstruction of the variations that have occurred in the pottery production between the twenties and the eighties (Annis 1983, 21-23). A reconstruction of the technical and formal variety of the repertoire, and also of the relative quantities of the wares and of the shapes belonging to them.

Our search in Oristano for pots that once formed part of the production pattern and of which the production came to an end in the recent past, led us to the convent of the Poor Clares. This order, which lives in seclusion, has been domiciled in the town since the second half of the 13th century; except for some short interruptions it has been living in the present convent from the beginning of the 14th century (Cerchi Paba 1973, 7-29. Sorelle Clarisse 1984, 4-24). When the pottery craft was still a flourishing trade in the town, the sisters were regular customers of the potters. Knowing how such religious communities adhere to traditions, I had good hope of finding something there. That was in the year 1976.

In the refectory, on the dining table, there were a number of earthenware flasks, corresponding to the number of the nuns living in the

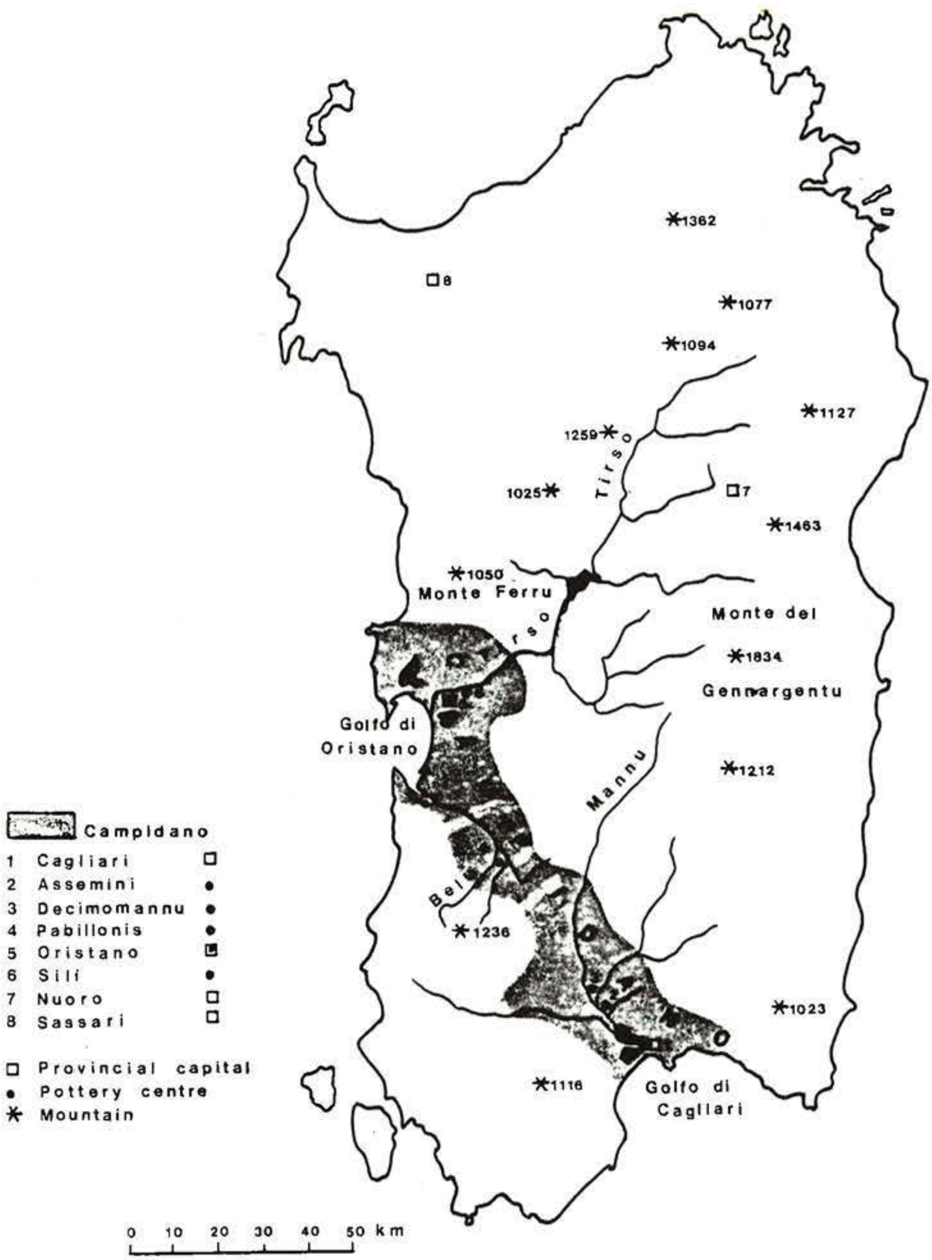

Fig. 1 Map of Sardinia.

Fig. 2 Old and new earthenware flasks in the convent of the Poor Clares in Oristano. (photo Herman Geertman).

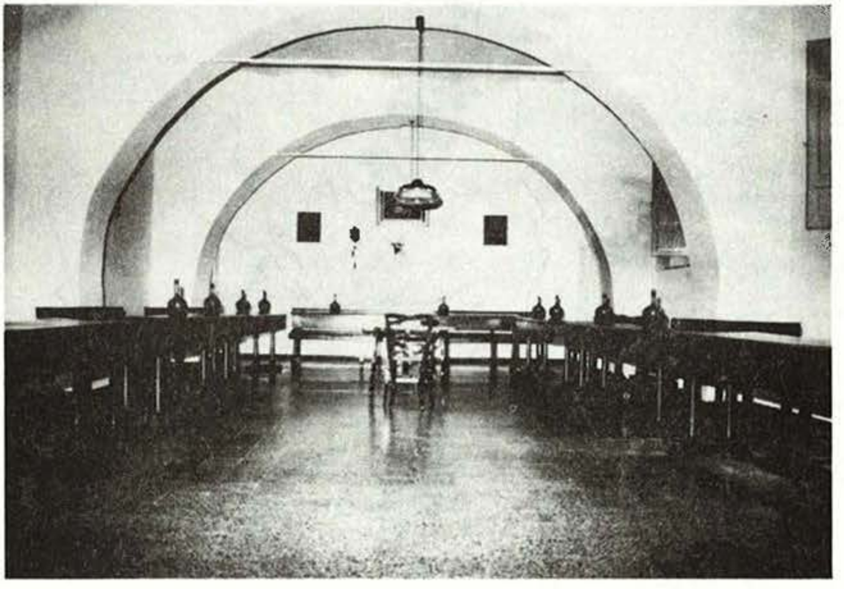

Fig. 3 Refectory of the convent of the Poor Clares in Oristano (photo by courtesy of the Sorelle Clarisse di Oristano).

convent at the time. One of the internal rules of the convent says that each sister should have her own drinking water bottle at table. It is not allowed to drink from this bottle, which is refilled with fresh water every evening, until the following day. I noticed that the flasks, though they all had practically the same shape and were all made of red earthenware clay, did show some differences (Fig. 2). Some of them had a coarse texture and a rusted colour and showed an amber-coloured glaze over a white coating, which only covered the neck and the lip. Other flasks, however, were entirely coated with a shiny, perfectly smooth, colourless glaze under which the body was visible, even and of a lively red-orange colour.

The mother superior of the convent explained to me that the coarse flasks were older and had been made in Oristano. A couple of years ago, however, the last potter supplying his ware to the convent had stopped working and the sisters had not succeeded in finding somebody among his colleagues, meanwhile rather decreased in number, who was able to replace him. Therefore, the mother superior had decided to approach a nephew of hers, the owner of a workshop for fine ceramic craftwork in the neighbourhood of Assemini[1]. This man was charged with making a number of flasks which were to be faithful copies of the sample sent to him. After some attempts he succeeded in copying the shape of the flasks fairly well. As a matter of course the manufact had to meet the requirements of a 'modern' potter, for whom tableware should have a neat appearance and be light and, above all, impermeable. The sisters found the new flasks nicer, handier and much more practical, as they did not cause water stains on the table and did not get covered with the white-grey scale that used to deposit on the walls of the old flasks and had to be removed frequently. And so, by 1984, the old flasks had all been replaced, even though the sisters had noticed very well that the water kept in the new flasks lost its freshness as the hours went by (Fig. 3).

If we are to understand the reason why, according to the rule of the convent, it was not permitted to drink the water until it had been kept in the prescribed flasks for a number of hours, we have to direct our attention to the hydrographic conditions of Sardinia, which until the present day have not been very favourable both as regards the quantity and availability of the drinking water and as regards its quality (Atlante della Sardegna 1980, 234-247, Tav. 73. Brandis 1982). This situation is caused, on the one hand, by climatological factors, such as a rainfall of a cyclonic nature and a rapid evaporation due to the high temperatures and the strong, frequently blowing winds; on the other hand by the lithologic configuration of the island which mainly consists of impermeable soils. All this contributes to the fact that only a small part of the annual rainfall, which in itself is not insufficient, can be used by the population (Atlante della Sardegna 1971, 57-64, Tav. 27, ibidem 64-70, Tav. 28). The Campidano of Oristano and, in particular, the city of Oristano used to take their drinking water from the nearby river Tirso. This situation lasted until 1930, the year in which an aquaduct was built for the city (Atlante della Sardegna 1980, 233, Fig. 1, 234). There are reports from the middle of the last century evidencing that people preferred river water, even though it was turbid, to rainwater and that in the month of March they used to fill the reservoirs in the city with river water (Angius 1853, 287. De la Marmora 1868, 287).

For the transportation of the water from the river to the houses and, after the construction of the aquaduct, from the public fountains to the houses[2] earthenware jars were commonly used, made by the local potters. De la Marmora (1868) gives us a description of these jars and also tells us that the majority of the population of Oristano preferred to obtain their drinking water direct from the river, which resulted in a train of women going up and down along the road to the river with jars on their heads, a picture characteristic of the town.

These jars, however, which are still produced in the town (Fig. 4), though to an incomparably smaller scale, serve more purposes than transportation of water only. During my interviews with producers and customers I was told again and again that the water, when kept in these jars for a number of hours, not only remains fresh, but is also, as they say, "digested in the stomach of the jar, so that it becomes lighter, softer and sweeter". My search for a scientific explanation of the statement led me to the following results. There is a natural ion change between the water and the vessel wall. The wall contains a number of weakly bound ions, notably

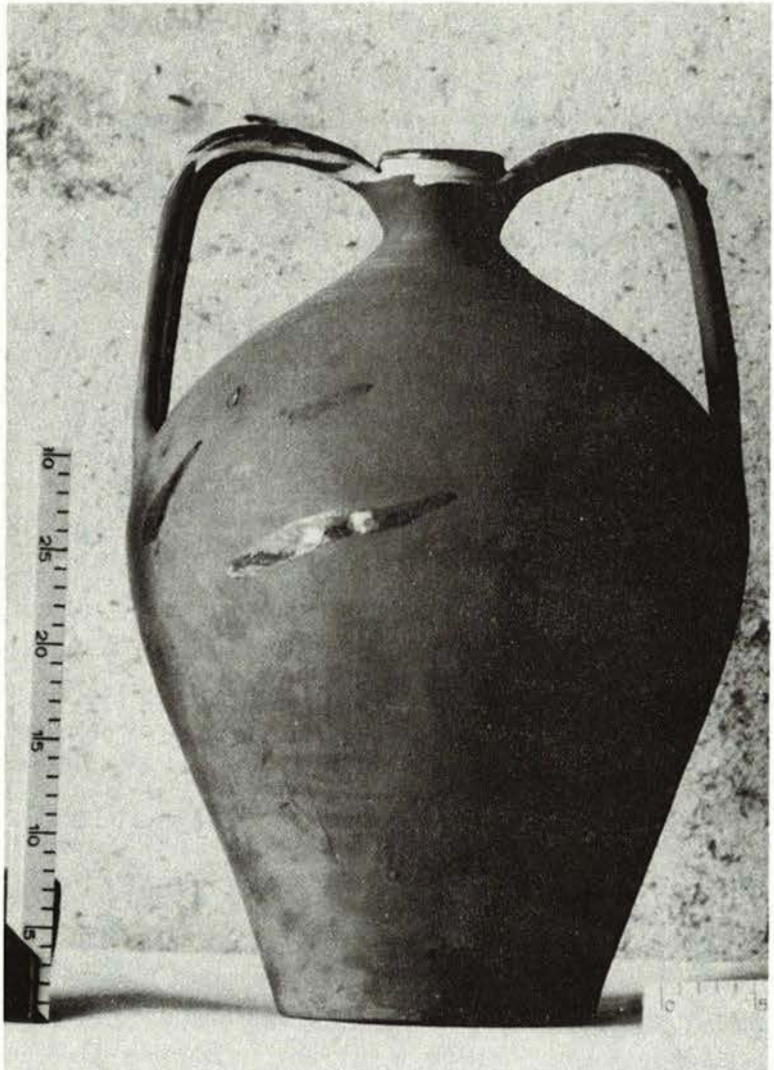

Fig. 4 Water jar, Oristano 1984 (photo Herman Geertman).

sodium and hydrogen ions present in large quantities. These ions are attracted by the water and exchanged with other metal ions (such as calcium, magnesium, iron, zinc, lead) contained in the water which are then taken up by the vessel wall. The metal ions present in the water determine the degree of hardness of the water and may have an effect on its taste. This process causes the white-grey scale on the outside of the vessel wall. The richer the water is in metal ions, the sooner the vessel wall will be saturated, finally ending in the wall loosing its function. This might explain why the water jars used in the mining regions of Sardinia "grow old" sooner and have to be replaced more frequently. In this process the compositions of the water and of the vessel wall both play a part[3].

In the seventies the sisters were no more aware of the hygienic background of the convent rule. The rule had been introduced because of the poor quality of the drinking water available to the population in and around the town. From this environmental point of view, however, it had lost its meaning in 1930, when the aquaduct was built. In this year Oristano was connected with the water from the slopes of Monte Ferru, where a rich and powerful source provided water of excellent quality (Atlante della Sardegna 1971, 59-62, Tav. 27. Ibidem 1980, 234). The two large cisterns of the convent were connected with the aquaduct and they still form an alternative supply of water.

ANALYSIS

From the archaeological point of view the above can be summarized as follows: there is a local ceramic product that has long been used within a certain context and is subsequently first used along with and later replaced by another - imported - product that has the same shape but of which the properties are essentially different. Continuity, change, relation between local and imported ware - all of them phenomena with wich the archaeologist is confronted every day - are present in the microcosmos of the refectory of the Oristano convent.

Witness to the continuity is the shape. Preserved in this case, as we have seen, not for artisanal tradition or functional reasons, but because the consumer wanted it to be so out of respect for an old usage.

There is also continuity in place - the refectory of the convent - and in use. In conformity with the rule, the flasks are still filled - with tap water - every evening and it is not until the following day that the water is drunk. Continuity in use, but not in function. As for the latter, major changes take place.

Witness to the changes are the raw materials - clay and glaze - and their manufacturing techniques: of local origin as to the older flasks, imported from elsewhere as to the new ones. In addition to this and as a consequence of the type of glaze and of its extended application the function of the new flasks has changed. We now have an impermeable product.

There are also changes in the manufacturing technique. From a purely technological point of view the manufacturing method of the new flasks is more advanced. One should bear in mind, however, that this statement only refers to the technical aspects, leaving the functional properties out of consideration, and does not include any pronouncement on a possible superiority in technical skill of the potter of the new flasks in relation to the raw materials available to him (Shepard 1965, 360-363). The new flasks have a ceramic body of a homogeneous, fine and compact texture, which points to a careful preparation of the clay. The relatively thin wall - which shows no traces of stretching of the clay - is indicative of a raw material of good plasticity and workability, properties exploited by the potter in the right way while throwing the pot. The smooth, carefully finished surface also points to the attention paid by the potter to the aesthetical aspects of his product (Hamer 1977, 233-236, 226-227, 297-298, 303-304). The oxidation of the red-orange clay is complete and even, as is the strength of the clay. This points to a well-controlled atmosphere and temperature in the kiln and a well-controlled firing time (Hamer 1977, 121-124, 211. Shepard 1965, 370-371). The colourless, transparent, shiny and smooth glaze adheres well to the ceramic body and suggests a careful preparation of the raw material. Moreover, it shows that a glaze has been used which fits the pottery body with regard to the thermal expansions and contractions, and that there has been a good control of the firing process, in this case twice-firing (Hamer 1977, 147-148. Rhodes 1973, 239-240, 241-244). The result is a fine, light and impermeable product suitable to be used as tableware.

The old flasks, on the other hand, have a ceramic body of a grainy texture with numerous holes, sand grains and coarse grains of calcium hydroxide. One of the reasons for the presence of calcium hydroxide - called slaked lime - is that the firing temperature has not been high enough to cause the calcium oxide in the clay to form a compound with the other components. Consequently, the calcium oxide will absorb moisture again after firing and form calcium hydroxide, a reaction which is accompanied by expansion and causes cracks (popping or spalling) in the surface of the pot (Hamer 1977, 42. Shepard 1965, 22). The relatively thick wall showing traces of stretching of the clay on certain spots points to a rather short clay, lacking plasticity though not to such an extent that it gives problems when throwing on a fast wheel. The clay is workable (Hamer 1977, 226-227, 319-320). The work pressure that evidently was present during the preparation of the clay, is also reflected in the thrown product: the surface is rough and does not show any traces of turning after throwing. The colour of the pot is irregular, from rust-red to grey. Such different degrees of oxidation and an uneven strength of the ceramic body are signs of an imperfect control of the firing process (Shepard 1965, 370-371). The glaze applied over a bright slip layer to the neck of the pot is amber in colour, which is characteristic of the lead glaze commonly used in the production of country pottery (Rhodes 1973, 82). The glaze, which adheres well to the body, is generally shiny, although rough and dull zones, signs of underfiring, do not point to a uniform firing temperature. Other spots show blisters caused by raw lead compounds which have been too thickly applied, or by reduction (Rhodes 1973, 247-248). Furthermore, a network of fine cracks (crazing) shows the imperfect compatibility between glaze and pottery body (Hamer 1977, 147-148. Rhodes 1973, 241-244) The result is a coarse, heavy, permeable manufact, suitable to keep water fresh and purify it.

INTERPRETATION

Archaeologists who would recognize in the replacement of the old flasks the realization of a wish to obtain a product of more advanced technical qualities - e.g. impermeability - would restrict themselves to only one aspect of the reality and possibly not the most important one. We on our part know that this aspect has not been determinant in the replacement and that the nuns discovered the advantages - and the disadvantages - of the new flasks only later on.

A causal relation between the change in the natural environment - the water supply to the town and the convent - and the introduction of the new product cannot easily be substantiated by a future archaeologist in view of the lapse of time between the two phenomena: approx. 50 years. For an ethnoarchaeologist, who has much more data available, such an explanation is even less tenable. The following question, however, is justified: would the nuns have forgotten the function of the rule, if the water supply to the convent had remained unchanged? We may assume that this would not have been the case. What we do know with certainty is that a period of almost 50 years has elapsed between the change in the water supply and the introduction of the glazed flasks. This tells us at least something of the tenacity of a usage, especially within a closed community and in particular when this usage has become a rule.

An important factor in the change is the individual element: the personal relation between the mother superior and her nephew, the potter from outside the town. As we have seen, this element resulted in the introduction of the new product, bringing about changes in the raw materials (clay and glaze) and in the manufacturing techniques. And all this, in turn, has caused the change in function. Although the individual, personal element cannot be observed by the archaeologist, it does not mean that a correct explanation of the phenomena cannot be found through archaeological research. If there had not been a crisis in the pottery craft of Oristano, the sisters would not have gone elsewehere to obtain their flasks. Both this crisis in the traditional craft and the possibility of producing tableware in Sardinia have one and the same cause: the recent fundamental changes in the Sardinian society. Within a sufficiently broad archaeological context the conditions described here must be perceptible. All pottery that used to be produced, not only in Oristano but also in the other production centres of the island, was of the same type: utilitarian coarse pottery (Annis 1983, 21), the ware to which also the old flasks of the convent belong. This type of pottery, which had been made for a long period of time, can easily be defined as regards raw material, manufacturing techniques and shape repertoire[4]. After a period of great activity coinciding with World War II and the first post-bellic years[5] production moved near to extinction in a short time. In 1945 there were about 40 master potters working in the town, in 1975 hardly 4. On the other hand we see that about the sixties not only in Oristano but also elsewhere in Sardinia, and in particular in Assemini, new ceramic wares are being successfully developed which until then had to be imported and had been unknown in the local workshops; these wares include tableware (Annis 1983, 21. Da Re 1983, 176-179).

The major environmental and cultural changes taking place in Sardinia over the past 30 years have caused the disappearance of the structures that were proper to the pastoral and agricultural Sardinian society (Le Lannou 1941. Manconi & Angioni 1982. Imeroni 1928). They have also led to the decline of the old pottery tradition based on these structures. On the other hand the changes have brought about new developments, such as a break-through of the isolation and an increase in internal and external contacts; education; new markets; economic aid from the government; all benefits for those who had and have the opportunity of exploiting them (Brigaglia 1976, 341-348. Idem 1984, 84-102. Idem 1982, vol. 2 pt. 5).

In my opinion the ultimate cause of the introduction of the new pots in the convent in Oristano must be understood in this light.

EPILOGUE

In my discussion I have deliberately made a distinction between function and use. It was my Sardinian investigation that convinced me of the need to bring more clearness in this matter. In classical archaeology these concepts have not been well defined and elsewhere in the archaeological discipline they have not been given sufficient attention either (Howard 1981, 8). As is often the case, it is, in the first instance, the terminology that causes confusion. One speaks of function and functions, of primary function and secondary functions, of types of functions, of function and use, without giving any further definition of what one means by these terms.

What I call the function of a pot is a property inherent to the pot: it is determined by the sum of specific qualities that originate from the raw material and from the manufacturing process, and it depends on this sum[6]. As long as the qualities remain unchanged, the function will not change: it is, so to speak, an inalienable property of the pot. Since the number of potential functions is limited, it follows that through a correct characterization of the qualities of a ceramic artefact its function can be archaeologically defined.

The use, however, that is made of a pot in a certain context depends on the particular circumstances of that context and may correspond only partially or even not at all with the function of the pot. Therefore, when defining the use of a pot not only its function should be taken into account, but also external factors which are inherent in the context. This will make it much more complicated, though not impossible (cfr. e.g. Peacock 1974, 232-244. Renfrew 1972, 286. Condamin et al. 1976, 195-202. Whitehouse 1979. 279-281), to give a definition of the use.

In my view, function and use are two different concepts corresponding to two different realities. They should each be defined again for each individual case and it is self-explanatory that they cannot be derived from one single aspect of the pot, such as its outward appearance.

Let us now return to the investigation in Sardinia, where we have noticed that the function of the water jars made in Oristano is to keep the water fresh and to purify it. A function which is determined not only by the raw material, but also by the manufacturing process and which can be defined properly, both physically (permeability of the pot wall → evaporation → drop in temperature) and chemically (ion change). All pots with these material and technical characteristics have this function. Their use, however, is much more varied, which is expressed in the variety of sizes and shapes. The use is always determined by the type of transport, the domestic organization, the local environment (e.g. the type of source from which the water is taken). The conclusion is that, just as uniformity in shape does not imply uniformity in function - and the case referred to above is one of the examples - difference in shape does not imply difference in function[7].

Distinction between and definition of terms and concepts[8] are only one aspect of a large task of distinguishing and defining with which a discipline such as the ethnoarchaeology is confronted when transferring data from the present-day reality to a reality of the past. Researchers are becoming more and more exacting in their approach to pottery and the questions put by them are becoming of an increasingly complex nature. In this respect we only need to refer to the Mediterranean and the pottery production in Roman times, where we can see that in the course of a few decades research has developed from typological and chronological analyses[9] into an approach in which pottery is considered as a rich and versatile source of information about the economic organization and the commerce of the Roman world[10]. This in spite of the inheritance of historical documents available to us (cfr. e.g. Rougé 1966. Jones 1974). David Peacock, developing and perfecting ad hoc an ethnographic model already partially delineated in previous studies (Balfet 1965 and 1981. Van der Leeuw 1976), recently tried to determine the modes of production that were applied in different places of the Roman empire (Peacock 1982, 6-11). Expansion and coordination of studies in this respect would be desirable. On the other hand it is clear - in the first place to Peacock himself (pp. 160, 165) - how narrow the basis of archaeological data is on which, for the time being, the discussion is to rest. In addition, it strikes us that the main part of the data available apply to NW Europe and Britain and that those applying to other regions, particularly the Mediterranean area, are rather sporadic and fragmentary (Peacock 1982, 185-187 and passim)[11].

Returning to the question of the transferability of data one should consequently realize that essential intermediary work of distinction and definition has to be done, if one is not to run the risk of comparing entities that are, in fact, not comparable at all. Here I particularly refer to a fundamental aspect of the research: "the study of the potter's craft in its entire scope" (Franken 1983, 2-3). A study in which the various techniques are examined in correlation with physical environment and culture. In which the different traditions are traced and attention is paid to their course of development. In which efforts are made to discover the pattern of mutual influences of tradition and innovation and to reveal the causes of such phenomena as resistance, extinction, adaptation, change. In which, consequently, production and distribution processes are viewed and evaluated against their physical and socio-economic background. And all this within the range of both the ethnographic and the archaeological discipline.

Notes

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1. At present, Assemini, approx. 120 km south of Oristano, is the most active and lively pottery production centre of Sardinia. Since about 1950 production techniques have gradually modernized and have been partially mechanized here. These developments went hand in hand with the introduction of decorated and glazed fine wares. See Da Re 1983, 176.
2. Since the fifties the number of private connections, initially a privilege of institutions and well-to-do families, have increased sensibly (Atlante della Sardegna 1980, 226-232, Tav. 72. Brigaglia 1976, 324).
3. The chemical explanation of this phenomenon was given to me by Prof.

A. Bult, Dept. of Analytical Chemistry, Leiden, to whom I express my thanks. Frederick R. Matson states that in the Near East one of the replacement factors of the vessels for water supply is that "some vessels are sweet and can be used for a long time, others grow quickly sour due to the salts or to algae and bacterial growth in the porous vessel walls. In Beirut the individual drinking jars (brecks) that are kept on the window sills to provide cool water, are replaced about six times a year" (Matson 1965, 204).

4. The oldest source reporting pottery activity in Oristano dates from 1692. It is the Statute of the Potters' Guild, drawn up in the Spanish language as a consequence of the Spanish domination of the island at the time (Loddo Canepa 1961, 254-256, 410-425). This document contains only little information on the technical characteristics and the shapes of the pottery. This fact and the essential changes in the socio-economic organization of the pottery production do not allow us to draw one continuous line between the production of that time and the present production without previous archaeological research. But thanks to the more detailed description of technique, shapes and working organization made by Angius (1853, 252-253, 269, 279) and by De la Marmora (1868,287) in the 19th century and much later by Arata (Arata & Biasi 1935, 96-102) it may be reasonably assumed that the tradition found in all these documents is the same as the one found at present.
5. Sardinia has not known many acts of war on its territory, but it was very isolated and autarchic during this period (Brigaglia 1976, 332-333).
6. Within this sum the single qualities may weigh less or more, in other words the sum is not only determined by variable qualities but also by variable proportions. It is even possible that a certain quality is eliminated by another. This is, for instance, the case in Pabillonis, former production centre of cooking pots in Sardinia, where the raw material used for the manufacture of the cooking pots was also used for water jars made to cover the local needs. As a consequence, also the water jars of Pabillonis were resistant to thermal shock, a prop-

erty that does not play a part in the sum of the qualities, as it is eliminated by the closed shape. A discussion of functions, qualities and proportions will be presented in one of the next issues of this Newsletter.

7. In a forthcoming study on Roman amphorae excavated in the Church of San Sisto Vecchio in Rome (Schuring 1984, 164: note 106) the author rightly wonders why it is generally assumed, for reasons of shape only, that amphorae of the same shape have been used for the storage of the same kind of product and that differences in shape suggests difference in contents.
8. An important step towards standardization and definition of terms and concepts was recently made by Balfet et al. 1983.
9. In this respect pioneer work was done during the fifties, first and foremost by N. Lamboglia (1950) for the Western Mediterranean and by H.S. Robinson (1959) for the Eastern Mediterranean.
10. Examples of these types of study are: Carandini 1969. Panella 1972. Carandini, Pucci and Panella 1973. Carandini and Panella 1977. Carandini 1979. Peacock 1977. Fulford 1981. Fulford 1983. Fulford and Peacock 1984.
11. This scholar, faced with the huge mass of ceramic finds excavated by the British Mission in Carthago, is well aware of the research potentials offered by the exceptional excavation conditions, but also realizes that circumstances put a limit to the objectives of his research. As a matter of fact, aspects like manufacturing techniques and sociological implications of the productions are, for the moment, not included (Fulford and Peacock 1984, 1-2).

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