A. van As
Archeologisch Centrum
Rijksuniversiteit te Leiden
Reuvensplaats 4
Postbus 9515
2300 RA Leiden
The Netherlands

**A. van As**

# Pottery Technology: The Bridge Between Archaeology and the Laboratory

## Introduction

In this paper I present some considerations that have kept me occupied for some time at the Institute of Pottery Technology at the University of Leiden, where I succeeded Prof. Franken as director. These considerations stem from certain publications of archaeological ceramics, but above all from discussions with colleagues visiting the Institute.

At present, some archaeologists are too easily inclined to resort to scientific analyses of small samples of pottery. Laboratory analysis of excavated pottery is useful for archaeological interpretation. However, the technological investigation of pottery, as developed by H. J. Franken and J. Kalsbeek in their study of the Early Iron Age pottery of Dayr 'Allā (Franken 1969), is the principle bridge between archaeology and the laboratory because of its explanatory character.

## Archaeological Pottery Studies

### *Descriptive Studies*

The archaeological study of pottery has focussed above all on the study of ceramic shapes. For a long time archaeologists were mainly interested in pottery because they recognized its importance for chronology. In addition to colour and texture, the shape of the pottery vessels was the main characteristic for dating. It would not be difficult to mention examples of these typo-chronological studies. Most of such typological studies of pottery are descriptive, in which the pottery is classified on the basis of various characteristics or attributes with no attempt to explain them. Specifically, the shape, after being described and drawn, is not explained in terms of manufacturing technique. For example, a round base of a pot could have been thrown and scraped afterwards, thrown closed, or made in a mould. In a descriptive typology this is not explicitly discussed.

### *Explanatory Studies*

For archaeology to be a science, the observed phenomena have to be explained. Attempts have been made in the past to explain certain characteristics of pottery technologically. For example, the study of J. L. Kelso and J. P. Thorley was one of the first attempts to examine the manufacturing techniques of Iron Age pottery from Palestine, at W. F. Albrigh's request (Kelso and Thorley 1943). H. J. Franken and J. Kalsbeek systematically elaborated on this kind of approach to make it generally applicable (Franken 1969). The development of technological ceramological research in archaeology helped to change the mainly typo-chronological descriptive kind of study. The maker behind the pot became visible.

The study of pottery technology tries to explain the various aspects of the potter's craft within the framework of the archaeological discipline by examining the relationships between the technical, functional and scientific aspects of ancient pottery. An explanatory analysis of the observed phenomena can be made. Reconstruction of the manufacturing technique of the pottery from the preparation of the clay up to, and including, the firing is the goal and is the basis for the pottery classification (Franken 1983; van As 1984).

In the technological analysis at the Institute of Pottery Technology, the observed features of the pottery are explained independently as well as in relation to each other. In some cases the shapes can be explained by the raw materials, the related manufacturing technique and/or function. As a result, the shapes are no longer accidental. In other cases the various shapes within a pottery repertoire can be considered variants of one and the same manufacturing technique, but the differences apparently reflect, among other things, chronological or regional distinctions. For example, we are now preparing a corpus of Mesopotamian pottery (van As 1989). The diversity of shapes within the second millennium BC repertoire from four archaeological sites in Iraq can be reduced to a very few technological types (van As and Jacobs in prep.). Nevertheless, recording the various shapes is important for establishing tendencies of change through time or local variation. In the same second millennium BC pottery

repertoire we explain how and why the bases of the goblets were tempered with abundant organic material to best resist cracking (van As and Jacobs 1987). In the first half of the second millennium BC (Old Babylonian period) base cracks were repaired with an extra organically tempered clay body added after drying. In the subsequent Kassite period the technology changed: the extra organically tempered clay body was used during the manufacturing technique in order to prevent cracks.

With respect to decorative motives, tradition plays an important part. Changes in the techniques of decoration, however, can often be explained through technological analysis. The relationship between painted Neolithic A pottery and Neolithic B pottery decorated with "herringbone" incisions from Jericho can be explained on technological grounds (Franken 1974: 204-205). Each decoration coincides with a particular raw material. The pottery decorated with "herringbone" incisions has a coarse mineral temper in contrast to the organic temper of the painted pottery. Large amounts of coarse temper reduce the porosity of the sherd, thereby making painting more difficult. Another example of a possible technological explanation for a change in decoration technique comes from Ta'as in northwestern Syria in the Early Islamic period (van As 1984: 138). During this period painting on jars disappears. The jars were painted with a brush and an iron-oxide (red colour) diluted with water before firing. The colour of the decoration is not bright because of the high percentage of lime present in the clay. For this reason the iron becomes volatile above a certain temperature, which causes the pale surface colours. People probably thought the painted decoration not successful enough and returned to a decoration of incisions, as used before.

**Pottery Technology: Its Methods**

To give a technological interpretation of the characteristics of pottery requires knowledge of the various aspects of the potter's craft. Cooperation with a potter is essential for a thorough technological analysis of excavated pottery. Because of their practical experience, potters know how to interpret the various technological features that have been left in the pottery. Potters are also able to verify the reconstructed technique, by practical experimentation with clays of a quality that is comparable with that used in antiquity. For this reason it is important to take samples of clays found in the vicinity of the excavation – clays that could have been used for pottery production in antiquity. "Workability tests" are carried out on these clays – experiments to determine their behaviour in relation to the potter's craft, e.g. the firing colour, the measure of shrinkage when dry or fired, porosity and so on. A visit to local potters, if present in the vicinity of the excavation, is useful for understanding the possibilities of the local raw materials. Even short visits to the potter of Dimini (Greece) (van As *et al.* 1988) and the potter of Örnekköy (Turkey) (van As and Wijnen 1989-90) yielded useful information for our technological analysis of Neolithic pottery from Sesklo and from Ilipinar Hüyük respectively (van As and Jacobs 1988; van As and Wijnen in press). The observations of the potter's workshops near Baghdad were also relevant to the archaeological-ceramological research of Mesopotamian pottery (van As and Jacobs 1986).

Today not only the purely technological concerns of the production of pottery, but also other aspects such as the organisation of production, the function and the distribution of the products can still be taken into consideration. M. B. Annis (1983: 13-14) pointed out that the heart of the question for archaeological-ceramological research is to explain the interplay of determinants of the features that characterise production. It is, in her opinion, the archaeologist's task to distinguish between the various aspects and to define them, and finally to reconstruct these features in order to make the latter explicable and render to them their own historical value. Towards this goal Dr. Annis started her ceramic ethno-archaeological research in Sardinia with the aim of investigating a complete entity, not a fragmentary one like the ancient finds (see the annual contributions on this subject in the *Newsletter, Department of Pottery Technology, Leiden University).*

Beside the reconstruction of the techniques (forming, decoration, firing), the analysis of the raw materials used forms an important part of the technological investigations of the Institute of Pottery Technology. It involves the analysis of the quantity, the grain size and the quality of the (added) non-plastics present in the clay body (Stienstra 1986). Following the successive steps in the process of pottery making, Y. Hemelrijk (1987) classified the so-called non-diagnostic pottery sherds from al-Lāhūn based on elements that are progressively less fundamental for the potter. The study of the size and quantity of the mineral inclusions was the first step. A later step was the determination of the non-plastic inclusions, both mineral and organic. The investigation of both aspects can be achieved within reasonable time and does not demand costly laboratory research equipment. Only precise identification of the non-plastics, necessary in provenance studies, requires analysis of thin sections under a polarising microscope.

The main research methods of the Institute of Pottery Technology described above can be used by archaeologists with simple technical devices. However, analyses executed with costly laboratory research equipment also form an integrated part of the technological research program to solve archaeological problems. These analyses take place in specialized laboratories outside the

Institute of Pottery Technology, when needed.

## The Laboratory

It is not the place here to present a complete survey of the various modern advanced laboratory analysis techniques that can be applied to archaeological ceramics. Most of them are used for the mineralogical and chemical characterisation of pottery: X-Ray Diffraction, the various thermal analysis methods, Optical Emission Spectroscopy, Neutron Activation Analysis, X-Ray Milliprobe, Electron Microprobe and so on (Rice 1987: 375-405). There are additional analyses to determine the physical, mechanical and thermal properties of pottery (Rice 1987: 347-370). Xeroradiography is a powerful method of establishing the manufacturing technique (Rye 1977).

The above-mentioned laboratory analysis methods are an important help within archaeological-ceramological research. But in the research concept of the Institute of Pottery Technology they are no more than an aid. Laboratory analyses alone, unless integrated into the technological research, do not give any explanation for understanding the pottery product. The results of the analyses give precise data (quantitatively or qualitatively) on separate pottery characteristics. A few specific points are worth making in that regard.

1. The precise results of modern laboratory analyses are not always relevant to the potter. Dilatometer measurements are often too precise.
2. Chemical analyses of potsherds, when done with a very small sample are often insignificant, archaeologically speaking. The results are, except in provenance studies, of no archaeological/technological importance.
3. Different methods of characterisation result in different classifications of potsherds. In her study of African Terra Sigillata from the San Sisto Vecchio in Rome, J. M. Schuring could find support for the division based on optical characteristics in the porosimetrical data, but the groups based on chemical composition were problematic (Schuring 1988: 26).
4. Xeroradiography is a useful test for the reconstruction of the manufacturing techniques made on various significant features. But unlike the interpretation of the relevant characteristics, Xeroradiography does not explain the manufacturing technique.

## Conclusions

In archaeology, describing the material remains is not sufficient. Only by explaining them does a vivid picture of life in antiquity arise (although this picture may sometimes remain vague). The study of pottery technology in the broadest sense of the word – meaning all possible aspects of pottery – is an explanatory archaeological study. Modern laboratory research forms part of it, but it is relevant only in the light of the above-mentioned understanding of archaeology. If not, one runs the risk of having modern laboratory analyses of pottery yield only footnotes in archaeological publications. Pottery technology is the bridge between archaeology and the laboratory. It is a *conditio sine qua non*. The results of the technological analysis of pottery form the basis for the selection of laboratory samples.

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