The Aim of Laboratory Analyses of Ceramics in Archaeology

April 7–9 1995 in Lund Sweden

In Honour of Birgitta Hulthén ass. prof. emer.

Editors: Anders Lindahl and Ole Stilborg

Konferenser 34

Kungl. Vitterhets
Historie och Antikvitets Akademien

Abstract
The Aim of Laboratory Analyses of Ceramics in Archaeology. Kungl. Vitterhets Historie och Antikvitets Akademien. *Konferenser 34.* Stockholm 1995. 172 pp. ISBN 91-7402-258-X.

This volume contains the papers read and discussed at the workshop "The Aim of Laboratory Analyses of Ceramics in Archaeology". The workshop was sponsored by the Royal Academy of Letters History and Antiquities and the Phillip Sørensen Foundation. It was held at Odengården in Northern Scania in April 1995. The theme of the workshop is of interest to archaeology, archaeometry, ethnoarchaeology and in particular to ceramology. The workshop stressed the need for broad studies of ceramics in both archaeological and ethnografic contexts in order to reconstruct the relations between raw materials, handicraft, use of the products and the social setting. As an answer to the need of closer collaboration between ceramologists SAC "The Society for Archaeological Ceramology" was formed.

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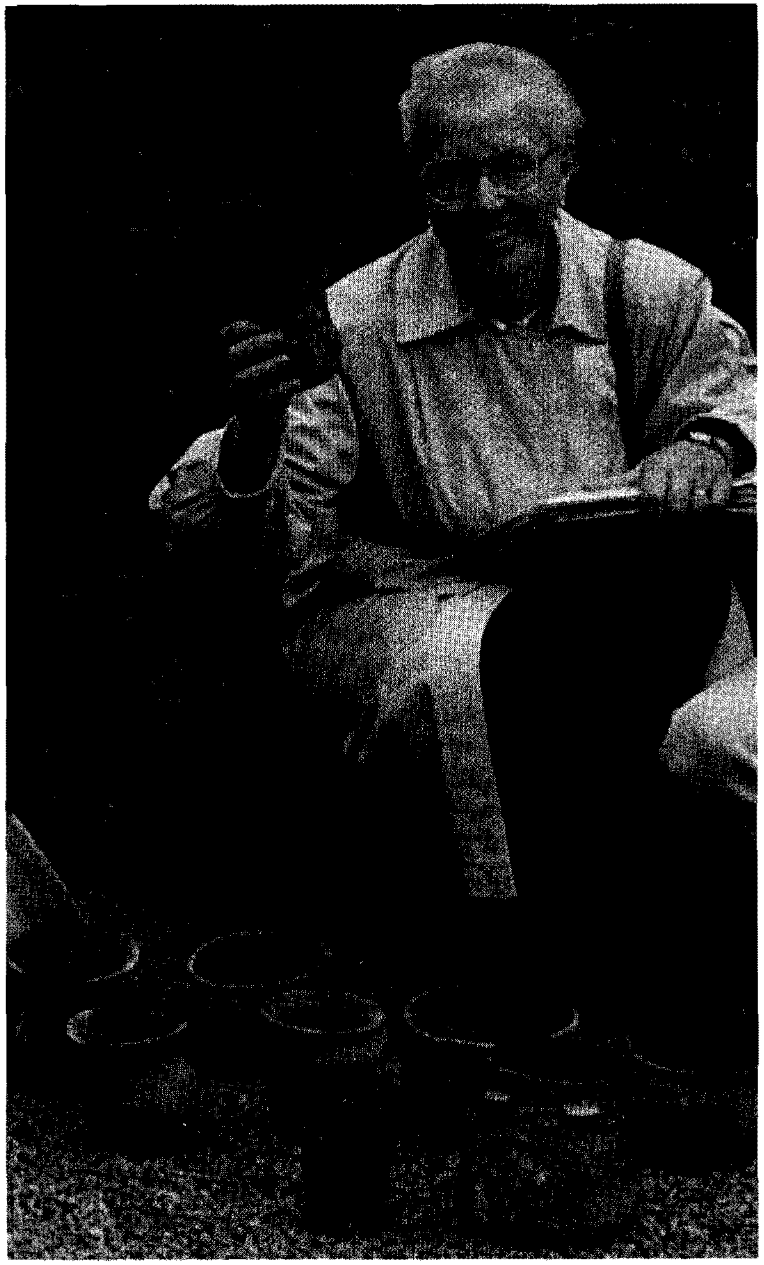
ISBN 91-7402-258-X
ISSN 0348-1433
Distributed by Almqvist & Wiksell International, Stockholm, Sweden
Typesetting: Editorial Office, Uppsala University
Printed in Sweden by Gotab, Stockholm, 1995
English revised by David Gaimster



Birgitta explaining the prehistoric pottery craft to visitors at the Helsingborg Museum 1993.
(Courtesy Helsingborg Museum. Photo: A. Åsgrim-Berlin)

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possible by the use of ceramic-technical analyses to discern connections between sites. In most cases this will not be feasible using other more anonymous or more easily spread materials (such as metal objects).

One of the problems in the use of ceramological analyses are that optimal results depend on archaeologists and ceramologists alike making a great effort to establish a good collaboration. It is not possible to translate all "ceramological" into "archaeological". Therefore, a good collaboration entails, that the archaeologist not just respects the specialist knowledge of the ceramologist from a distance, but allows himself to put questions to all the aspects of the pottery analysis, which is most often not understandable even to the most well-educated archaeologist. Archaeometric analyses will not attain their real value until they are actively incorporated into the archaeological interpretation of the finds material. They should not be accepted by the archaeologist at face value, but be critically examined in line with other data from the excavation. The collaboration is essential for the rational use of the economic frames for the analyses as well as for achieving the best results from an archaeological viewpoint.

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KVHAA *Konferenser* 34:147–160. Stockholm 1995

The Ceramics and Society Project: An Ethnographic and Experimental Approach to Technological Choices

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Introduction

The study of African material culture and technology goes back almost a century in Belgium. As early as 1907, an extensive survey of central African pottery was published at the Museum of Tervuren (Coart and de Haulleville 1907). This tradition was carried on by ethnographers and archaeologists working in the same area. As in other parts of the world, their occasional collaboration provided new ways of interpreting pottery.

Meanwhile, one has witnessed an increased sophistication in the laboratory analyses of archaeological vessels. Both archaeometry and ethnoarchaeology have undergone independent developments, however, resulting in a widening gap between these two disciplines.

Convinced that much could be gained by trying to systematically combine ethnoarchaeological data and laboratory analysis, we have started a new project—"Ceramics and Society"—at the University of Brussels.[1] It consists, on the one hand, of a comparative study of traditional pottery production systems in Africa, and on the other hand, of a laboratory examination of the materials collected in the field. Using these data, our aim is to examine the cultural meaning of stylistic variations in pottery, be it from a technical, morphological or ornamental point of view.

Due to the orientation of the present workshop, we will focus on a number of technical aspects. In this field, our investigations follow three main directions:

(1) evaluating technical variability at each stage of the manufacturing process;
(2) assessing the reasons underlying this technical variability;
(3) developing analytical methods allowing the reconstruction of technical procedures from archaeological pottery.

The first two directions have already been examined during an extensive ethnoarchaeological fieldwork in southern Cameroon. Between 1990 and 1992, one of us worked in 21 ethnolinguistic groups (Fig. 1), comparing all pottery traditions, testing the materials and measuring the effects of each transformation process, in order to untangle the reasons underlying technical choices (Gosselain 1993, 1995). The promising and somewhat astounding results of this survey justify more fieldwork in other areas of Africa, but already suggest new perspectives in the study of pottery technology.

The third direction, the reconstruction of technical procedures, is still at a preliminary stage. It is clear, however, that the use of a controllable ethnographic and experimental material is the most appropriate way for reaching tangible results. We presently feel that archaeometry could benefit from a complete reorientation. Artefact characterisation, although necessary when techniques are being developed, often leads to meaningless classifications. The real question, the origins of variations, still remains unanswered.

What follows is an overview of our most significant results and of the research strategies we propose to develop in this particular field for the next few years.

Raw materials

Concerning raw materials selection and processing, two important conclusions can be drawn from field and laboratory investigations (Gosselain 1994, 1995). Firstly, artisans satisfy themselves with a very wide spectrum of clays, regardless of their manufacturing techniques or the way pots are used. Secondly, processing techniques are not justified by techno-functional requirements but governed by traditions and/or individual perceptions of a particular clay's appropriateness. In this respect, technical behaviour is clearly a matter of choice and allows an assessment of social identities.

Data collected in the field as well as in the ethnographic literature show that three main types of clay processing are being used and sometimes combined in Sub-Saharan Africa, each one knowing multiple variations (Tab. 1).

In order to reconstruct these techniques, ethnographic material (sediment, temper and pottery) collected in southern Cameroon, as well as experimental material, are currently being examined. This collection of samples will be extended as fieldwork progresses in other regions of Africa.

The effect of these different processing techniques on ceramic pastes are first carefully studied (i.e. homogeneity of the matrix and type, morphology, frequency, size distribution and homogeneity of non-plastic inclusions). Some techniques, such as tempering with bone, shell, chaff, husks, dung or grog, are quite easy to identify, although problems may arise, for example, when trying to differentiate grog from natural argillaceous inclusions (Cuomo di Caprio and Vaughan 1993; Livingstone Smith *et al.* in press; Whitebread 1986). Other techniques prove more difficult to characterise, due to the natural variability of the sediments and the irregularity of the anthropic phenomenon.

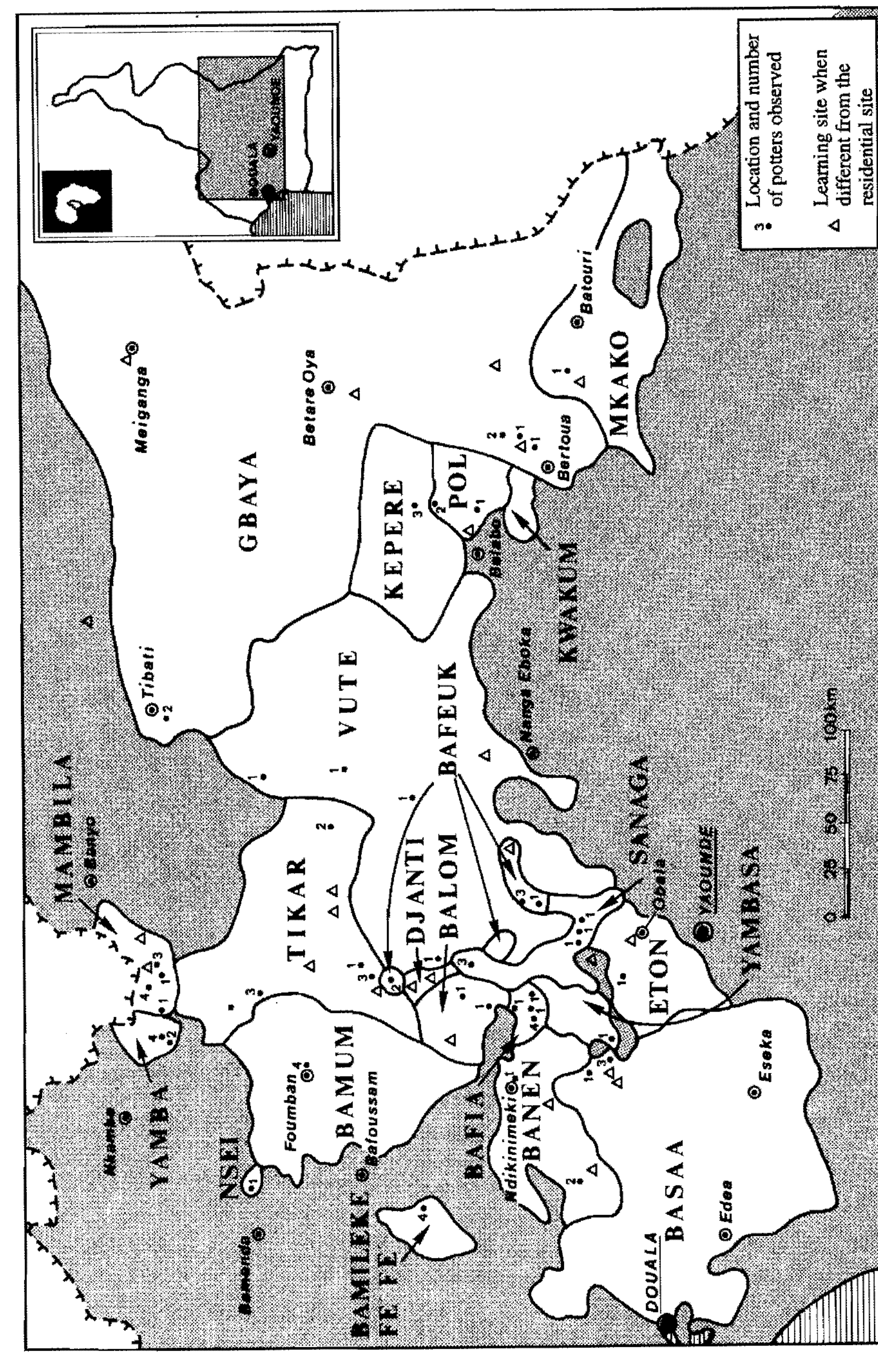

Fig. 1. Populations surveyed in Southern Cameroon between 1990–1992.

Table 1. Main processing techniques in Sub-Saharan Africa

Pre treatment (optional)
Souring
Levigation
Soaking
Drying
Mixing, adding or removing (optional)
Mixing different clays (up to 5)
Adding non plastics:
a) mineral matter (sand, crushed rocks, volcanic ashes, calcite, termite heap)
b) organic matter (straw, chaff, husk, dung, shell, bone, feather and blood)
c) grog
Removing non plastics:
a) crushing/grinding and hand sorting
b) crushing/grinding and sieving
Homogenization (compulsory)
Pounding (different kinds of tools)
Grinding and hand kneading
Hand kneading
Foot kneading

For example, there are presently few ways of identifying mixed sediments or differentiating between natural and anthropic sand addition in coarse fabrics (Gibson and Woods 1990, pp. 30 and pp. 251; Livingstone Smith and Jadin 1993; Rice 1987, pp. 410). The real problem is that we lack reference material to which archaeological samples could be compared. Our first aim is therefore to build up a collection of verified technical characteristics to provide a guideline for reconstructing raw material processing.

The analytical work will be undertaken using standard analytical methods (X-ray diffraction, optical microscopy, scanning electron microscopy and computer assisted image processing) with a view to evaluate their suitability and standardise their use.

Shaping

Shaping, the next stage in the manufacturing process, could be one of the most relevant criteria for approaching cultural identity. In southern Cameroon, for instance, ethnolinguistic boundaries and/or groupings can be broadly reconstructed according to the ways artisans shape their pots (Fig. 2). An overview of the ethnographic literature indicates that this situation also prevails in other Sub-Saharan regions (Gosselain 1995).

Up to now, more than 50 different techniques have been recorded across the African continent. These can be grouped in 6 main categories, of which some

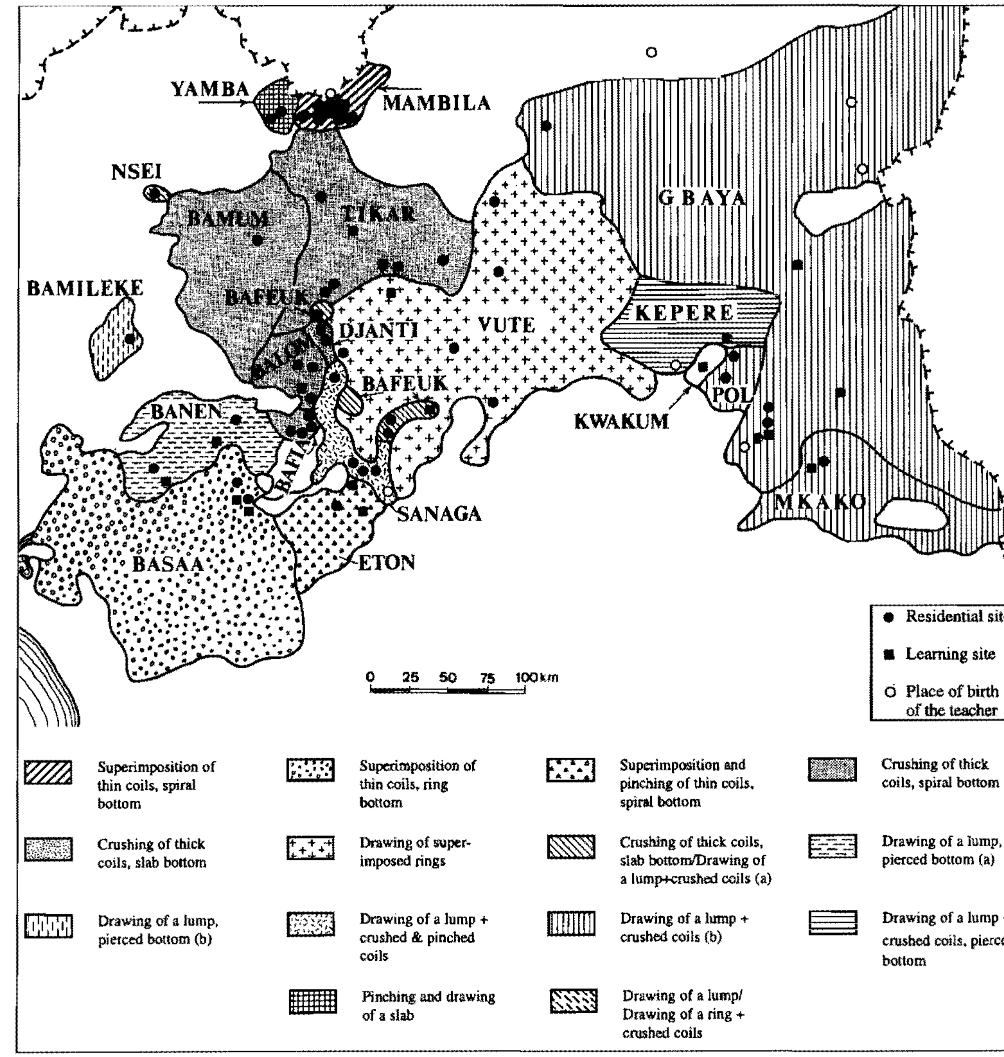

Fig. 2. Schematic distribution map of shaping techniques and linguistic groups in the fieldwork area.

are well known to archaeologists—as pinching, moulding, drawing of a lump or coiling, whereas others seem specific to Africa: pounding in a concave mould and drawing of one or several ring(s) of clay. A differentiation is made according to the way these categories are combined and/or the way clay is added when shaping either the whole pot or only a part of it. For example, a coiled or moulded bottom can be joined to a body previously shaped by drawing, while the upper part is made by crushing, pressing or superimposing thin or thick coils (Fig. 3).

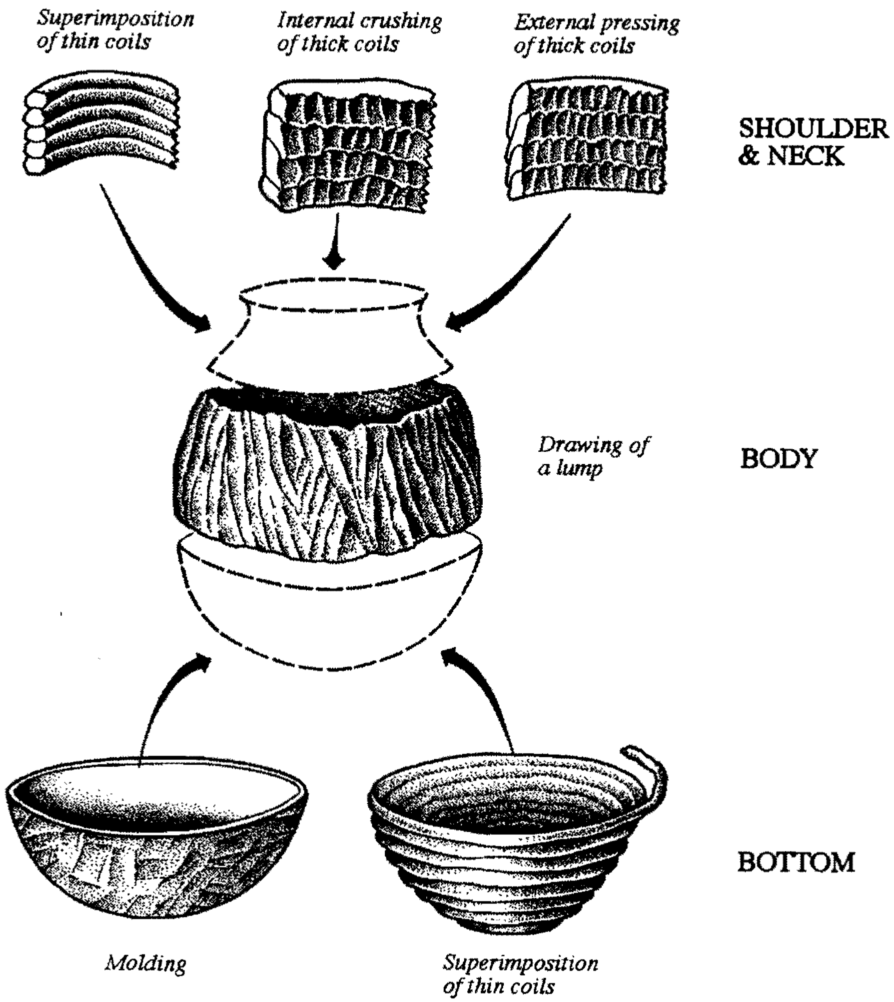

Fig. 3. Variations in the shaping of different parts of a vessel.

As already showed, these technical variants have an influence on particle and void orientation (Rye 1977, 1981). However, traditional methods of investigation, such as radiography or macroscopic examination, only allow a gross estimate of the procedures (Balfet *et al.* 1983; Carr 1990; Tartaglia 1989). Better results are achieved when combining these methods to thick-section radiography and/or thin-section polarising microscopy (i.e. Courty and Roux 1995; Gibson and Woods 1990, pp. 36; Glanzman and Fleming 1985; McGovern 1986; Vandiver 1987, 1988; Vandiver *et al.* 1991; Woods 1985). The accurate reconstruction of the way clay was manipulated in the shaping process is then possible and allows the recognition of variants of cultural significance.

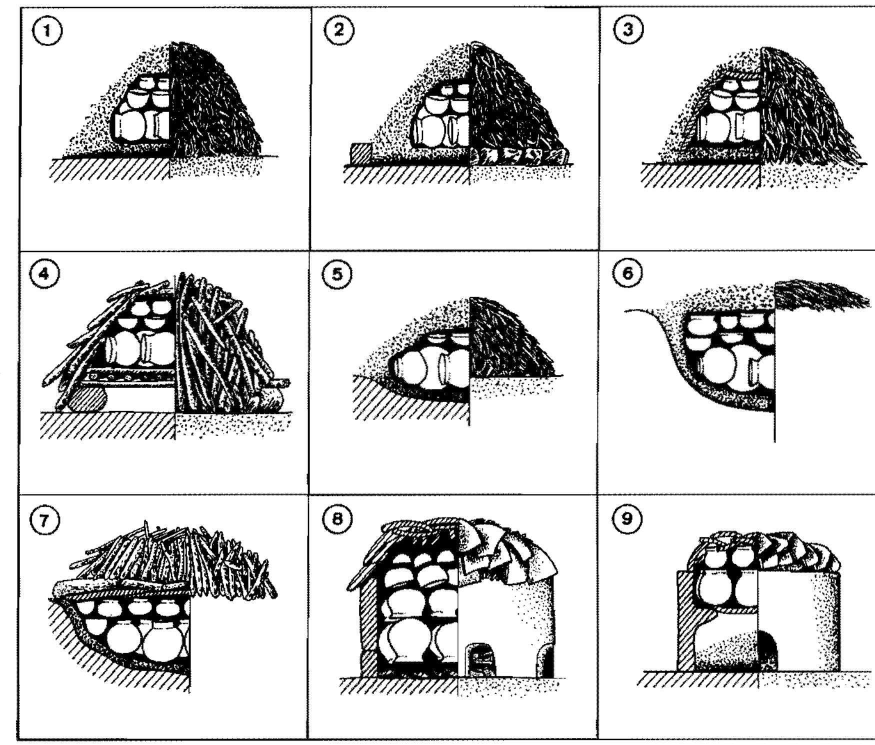

Fig. 4. Main firing structures recorded in Sub-Saharan Africa: (1) bonfire, (2) surrounded bonfire, (3) bonfire with fireproof materials separating the pots from the fuel, (4) elevated bonfire, (5) depression, (6) pit, (7) pit with fireproof materials separating the pots from the fuel, (8) oven, (9) updraft kiln.

As for the other steps in the manufacturing process, we are currently applying these analytical techniques to ethnographic and experimental material. Our aim is to establish a collection of verified technology-dependant characteristics to provide a guideline for future archaeological reconstruction.

Firing

The study of firing techniques has always been one of the leading topics in the archaeometry of pottery (Maniatis and Tite 1981; Matson 1939, 1971; Shepard 1936; Tite and Maniatis 1975; Tite *et al.* 1982), but much remains to be done in this field.

In Sub-Saharan Africa, at least 9 types of firing structures are used (Fig. 4) with a considerable number of variations in fuel selection and the way pots are arranged inside the structure (Gosselain 1995). Thermometric measurements

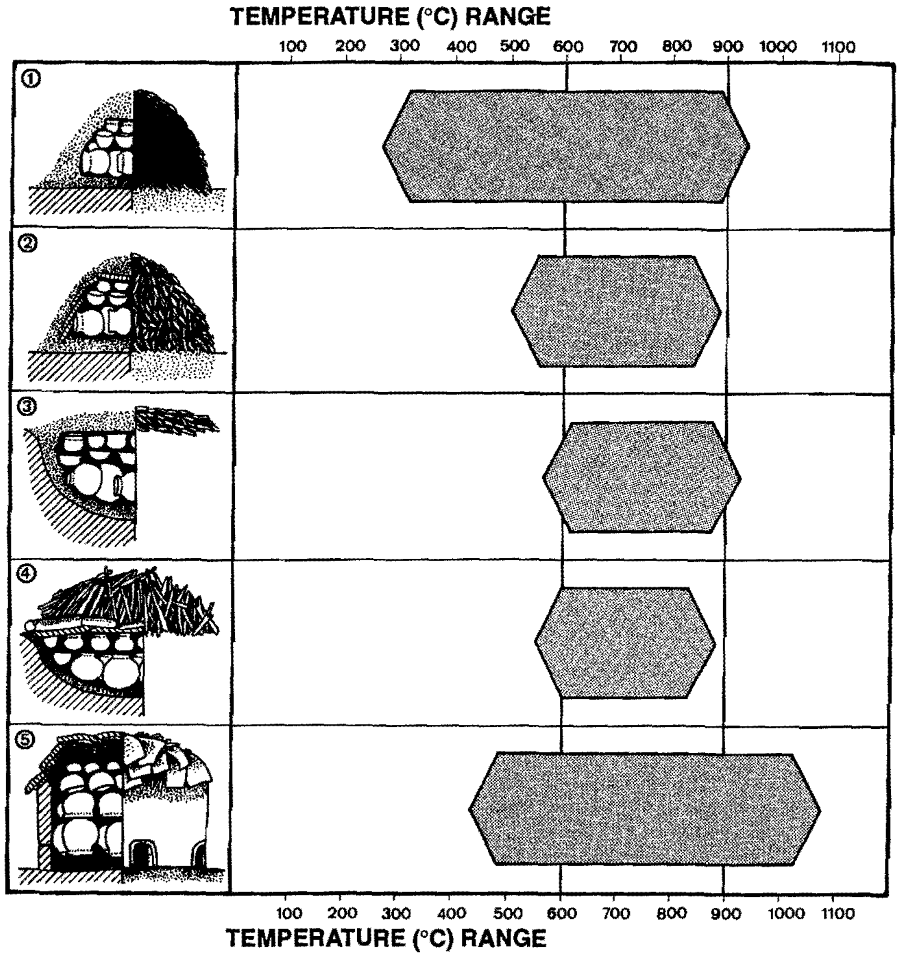

Fig. 5. Temperature range for five kinds of firing structures, based on data collected in the field during ethnoarchaeological enquiries.

demonstrate that various traditional techniques, from open firing to updraft kiln, may produce similar firing conditions. Indeed, temperature range and time of exposure to temperatures may be identical (Fig. 5) (Gosselain 1992a, 1995). It must therefore be stressed that the estimation of firing temperature alone is of no use for identifying firing techniques from archaeological material.

The heating rate seems to be the only variable allowing the distinction of the following three categories (Fig. 6): (1) open firing; (2) open firing with fireproof materials separating the pots from the fuel and pit firing; (3) pit firing with fireproof materials separating the pots from the fuel, oven and updraft

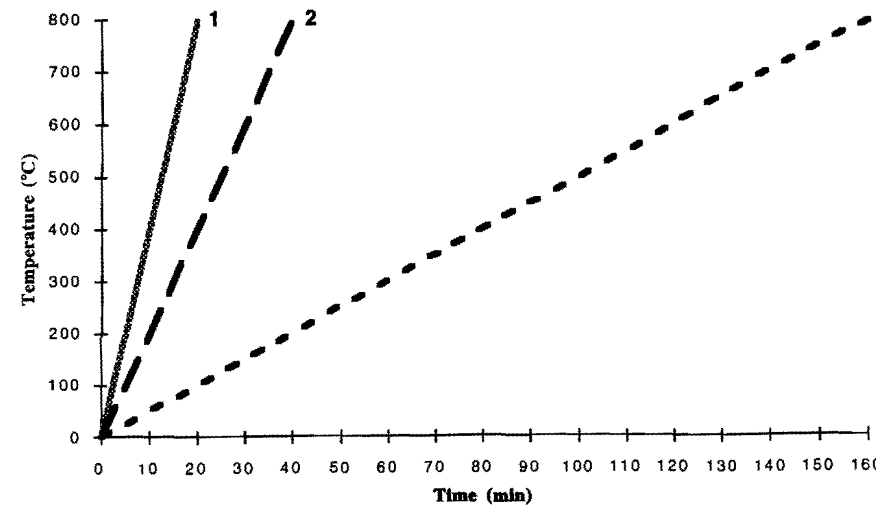

Fig. 6. Heating rate estimation for the three main categories of firing structures: (1) open firing, (2) open firing with fireproof materials separating the pots from the fuel / pit firing, (3) pit firing with fireproof materials separating the pots from the fuel / oven firing / updraft kiln firing.

kiln firing. Of course, more ethnographic data are needed concerning the temperature parameter, but our efforts will essentially focus on the heating rate estimation. For example, the swiftness or slowness of thermal ascension might have different effects on paste micro structure: the development of cracks and overall porosity. Such effects should be identified, although it is clear that clay processing techniques, type, size, distribution and abundance of non-plastic inclusions, as well as clay types and their relative moisture contents all have an influence on the development of micro structures. The potential impact of all these parameters must therefore be assessed before any archaeological material can be analysed.

We have to keep in mind, however, that a detailed reconstruction of ancient firing procedures cannot be assured by characterising only one of its aspects, be it heating rate, temperature range or firing atmosphere. A more realistic approach is to take all parameters into account and to check how their combination allow the differentiation of various techniques.

This could be achieved by analysing the ethnographic material at our disposal and testing experimental material in various controlled conditions. At this time, polarising and scanning electron microscopy seem to be the most appropriate methods of investigation (Maniatis and Tite 1981; Tite and Maniatis 1975; Tite *et al.* 1982). The enhancement and quantification of the observed phenomenon's will be realised with the help of computer assisted image processing.

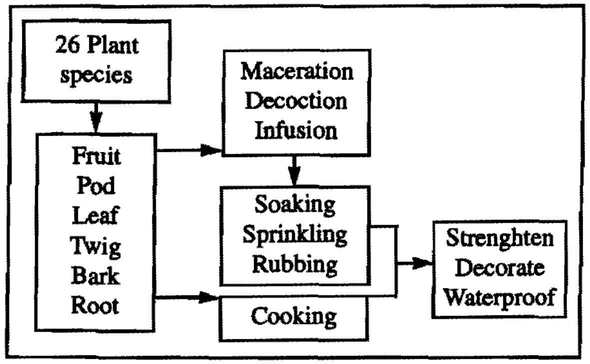

Fig. 7. Various possibilities in the preparation and application of organic coatings (based on data collected in the field and in ethnographic litterature).

Post-firing treatments

Post-firing treatments—i.e. organic coating, smoking or soaking—constitute one of the most unrecognised stages of the manufacturing process. Field observations as well as data collected in the ethnographic literature indicate that these treatments are widespread in Sub-Saharan Africa and submitted to countless variations. For instance, an organic mixture may be prepared by boiling, soaking or infusing parts of at least 26 plants or trees, and either sprinkled on the pots when they come red-hot from the fire or rubbed on after cooling (Fig. 7).

A preliminary study of materials collected in southern Cameroon shows that coating practices allow an increase of thermal effectiveness, by waterproofing the vessels. This should not come as a surprise, since the phenomenon was already demonstrated by Schiffer and other scholars (Schiffer 1990; Schiffer *et al.* 1994). However, waterproofing doesn't appear as an indispensable modification in a traditional context of use. Moreover, the selection of ingredients and processing techniques is free of any techno-functional constraints—they are in fact equivalent in use—but is often governed by symbolic concerns. In some societies, for example, post firing treatments evoke the handling of babies after delivery or the curing by traditional healers of those diseases which are characterised by discharges (Gosselain 1992b, 1995; Maret and Gosselain, in press). As for other stages of the manufacturing process, technical variants may correspond to cultural differences, so that their identification on archaeological pottery could be useful.

For this purpose, some organic mixtures as well as contemporary and older pottery collected in Cameroon were analysed by planar and high performance gel chromatography (Diallo *et al.* 1995). These analyses are still preliminary, but two important results can already be pinpointed. Firstly, coating properties

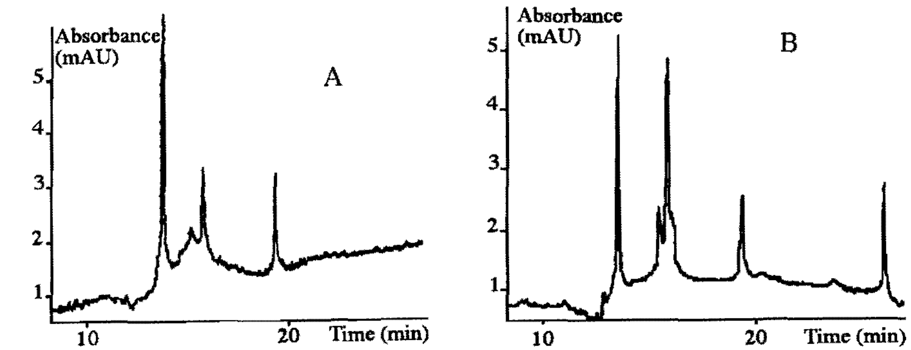

Fig. 8. Separation by high performance gel permeation chromatography of aceton-water extracts of walls of Cameroonian vessels. (A) Contemporary sample (never used before analysis), (B) +/– 50-year-old sample.

arise from the pyrolysis of procyanidins, a group of condensed tannins present in all the plants used in southern Cameroon. Secondly, products deriving from pyrolysis of procyanidins are detectable in both contemporary and older pottery (Fig. 8).

At this stage, the question however remains (1) whether plant species and processing techniques can be differentiated, (2) whether pyrolised products change according to surface temperature at the time of application and (3) whether their structure changes or remains stable after pottery use and discard.

We are presently investigating these topics in order to provide new avenues in the technological study of ancient pottery.

Conclusion

In recent years, considerable efforts have been devoted to characterise so-called "technological features" in pottery: strength, resistance to thermal shock or abrasion, porosity, heating effectiveness, and so on. It is believed that a change in such physical properties always results from adaptation to functional constraints and so reflects changes or evolution in the daily life of prehistoric people (i.e. Braun 1983; Bronistky 1986; Neff 1992; O'Brien *et al.* 1994; Schiffer and Skibo 1987; Steponaitis 1983). Using concepts, testing procedures and theories related to ceramic engineering, many archaeologists now feel authorised to tell whether pottery was produced by nomadic or sedentary people, whether food processing constituted an important or minor activity, or whether some societies reached a higher technical level than others.

Careful archaeological and ethnoarchaeological studies cast serious doubts on this purely materialistic approach. We see that technical choices are best explained as culturally learned behaviour rather than adaptive strategies. Regardless of their aims or the materials at their disposal, potters are free to choose among a very wide range of options but, as put by Sackett, "the choices they make are largely dictated by the technological traditions within which they have been enculturated" (Sackett 1990, p.33). In this respect, variations in the way vessels are made may provide a clue for approaching cultural identity in archaeology, whereas the mechanical properties of the products only appear as a side effect. (For instance, two potters partaking in the same technical tradition may produce pottery with very distinct physical properties, simply because they live nearby—and therefore exploit—different clay sources).

Given the potential meaning of technical diversity, we have to turn our efforts to a precise reconstruction of ancient manufacturing processes. It is now time to switch from mere characterisation studies to the recognition of procedures from which technical evidences were generated. In other words, we have to give up technical typology for a more dynamic and comprehensive approach to pottery production.

Much has already been done in this regard, but we still need to systematise and rationalise our investigations. Meanwhile, a dialogue must be established—or re-established—between archaeometrists, archaeologists, and cultural anthropologists, for ceramology clearly lies at the junction of these three disciplines. By combining ethnoarchaeology with experiments and laboratory analysis, the "Ceramics and Society Project" is a step in this direction. The scope is very wide, however, and only extensive collaborations will allow this project to reach its full potential. We hope that the present paper will give rise to such fruitful co-operations.

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1. This project is supervised by Prof. P. de Maret and funded thanks to the grant "Action de Recherche Concerteé" provided by the Direction générale de l'Enseignement superiéur et de la Recherche scientifique—Ministère de l'Education et de la Recherche-Communauté Française de Belgique. Previous research was funded by the Université Libre de Bruxelles and conducted in collaboration withy the Université de Yaoundé and the MESIRES (Cameroon).

KVHAA *Konferenser* 34:161–169. Stockholm 1995

Seeking the Past in the Present: Archaeological Implications of Ethnographic Pottery Studies in Kenya

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Introduction

Today, potting is widely practised in most parts of the world by peasant communities. Indeed, in Africa pottery is widely made and used by most ethnic communities. In fact, pots are the most ubiquitous material objects of the African household, regardless of the socio-economic status of the household owner. This phenomenon results from the fact that pottery products serve numerous functions, including carriage, storage, ritual purposes as well as serving food. In addition, Wandibba and Barbour report that pots are used as dye containers for fabrics and as tubs for bathing babies (Wandibba and Barbour 1989).

In Kenya pot-making is localised, depending on the availability of suitable clay or, sometimes, of sand for tempering. Sometimes, pot-making is confined to particular clans. This is the case with Avaloogoli (Wagner 1970) and the Kipsigis (Peristiany 1939). Lindblom also reports that traditionally, certain clans among the Akamba were prohibited by taboo from making pots (Lindblom 1920). On the other hand, Peristiany states that among the Kipsigis, potters and blacksmiths belong to one clan and that no one will marry into a family engaged in either of these occupations (Peristiany 1939).

The purpose of this paper is to give an overview of the socio-cultural aspects of pottery production in Kenya. We know that pottery is generally assumed to be an important vehicle through which people express their culture. This assumption is based on the fact that the pottery of any one culture has its own peculiarities that distinguish it from pots produced by another culture. The paper focuses on socio-cultural aspects because many of these do not fossilise in the archaeological record, thereby masking a lot of information that the archaeologist could glean from his/her potsherds. The basic question, therefore, is how can the archaeologist reach the ancient people behind the sherds?

The paper begins by way of a brief overview of the pottery making communities in Kenya. It then examines the raw materials and the manufacturing techniques. This is done with a view to putting later discussions in proper