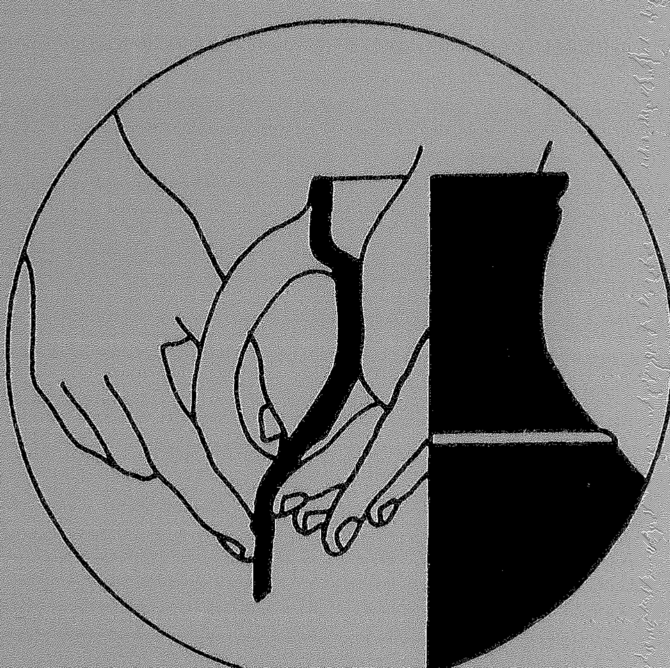
NEWSLETTER

Department of Pottery Technology

VOLUME 18/19 - 2000/2001



LEIDEN UNIVERSITY - THE NETHERLANDS

NEWSLETTER

DEPARTMENT OF POTTERY TECHNOLOGY

LEIDEN UNIVERSITY

VOLUME 18/19 - 2000/2001

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Abraham van As

EDITORIAL

The *Newsletter of the Department of Pottery Technology (Leiden University)* 18/19 (2000/2001) that lies before you contains a range of articles touching on research in which the Department happened to be involved in one form or another.

In this issue you will find a study of the Early Ceramic Age pottery from the Caribbean (Hofman and Jacobs), slip-glazed Attic ware (Franken) and local clay pipes from Mali in Africa (Welling). These ceramic studies either relate technology – utilised raw materials, design and manufacture – to other aspects such as function and style, place the technology in a socio-economical framework, or consider the typo-chronological implications. One contribution in this *Newsletter* does not deal with ceramics, but rather with tannin in earthen architecture (Arkema). This study was however greatly supported by experimental research carried out at the Ceramic Laboratory of the Department of Pottery Technology. Once again, this *Newsletter* pays attention to the ethnographic/ethnoarchaeological aspect of research – so vitally relevant to the archaeological-technological study of ceramics – with a contribution on a Wayana potter from the tropical rain forest of Surinam/French Guyana (Duin). The author made video recordings of the work of this potter that will be edited for educational purposes in the near future. How instructive such a video can prove to be for the interpretation of archaeological ceramics will become apparent from the review of a similar film on the *Women potters of Cyprus* by Gloria London (van As).

In conclusion, it must be mentioned that it has been a pleasure to include in the *Newsletter* not only a contribution from the founder of the Department of Pottery Technology (Franken) but also three contributions based on the unpublished M.A. theses of recent graduates of the Faculty of Archaeology in Leiden (Arkema; Duin; Welling).

C.L. Hofman
L. Jacobs

THE DYNAMICS OF TECHNOLOGY, FUNCTION AND STYLE: A STUDY OF EARLY CERAMIC AGE POTTERY FROM THE CARIBBEAN

Introduction

The Early Ceramic Age (400 B.C. – A.D. 400) in the Caribbean islands is characterised by ceramics of the Cedrosan Saladoid subseries[1] and La Hueca styles. Cedrosan pottery has been found all over the Lesser Antilles from Trinidad to Puerto Rico and La Hueca style pottery occurs contemporaneously but more prominently in the northern part of the Antillean archipelago, between Guadeloupe and Puerto Rico (Fig. 1). In addition, scarce occurrences of this material have been reported on islands to the south like Martinique and Grenada. Conflicting stratigraphic data and radiocarbon dates from Early Ceramic Age sites, together with stylistic differences between the Cedrosan and La Hueca pottery, has led to many debates and controversies among Caribbean archaeologists over the past thirty years. Much of the debate entailed questions about migration, cultural affiliation and categorisation of pottery styles. In this context typological classifications and local chronologies were constructed and revised (Rouse 1992). Ceramic studies carried out for this purpose are often focused on a limited set of variables (mostly decoration and shape). However, sometimes variables of paste and temper materials are also addressed (Arts 1999; van As and Jacobs 1992; Carini 1991; Donahue *et al.* 1990; Goodwin 1979; Hofman *et al.* 1993; Petersen and Watters 1991; Reed and Petersen 1999) in the search for answers to these questions.

The intent of this article is not to elaborate on this debate but, instead, to move closer to the organisation of pottery production and socio-cultural behaviour of Early Ceramic Age society. In this context emphasis is laid on a dynamic set of interrelated techniques (including technological [manufacture and execution], functional and stylistic aspects) characterising the manufacturing process of the Cedrosan and La Hueca pottery. As yet, technological studies have received little attention in the archaeology of the Caribbean (van As and Jacobs 1992; Bloo 1997; Bonnissent 1995; Curet 1997; Hofman 1993; 1999; Jacobson 2002), whereas technology seems to be a significant parameter because it involves the whole sequence of operations of the manufacturing process embedded in the socio-cultural realms of the society (see Gosselain 1998; Lemonnier 1986; 1993; Stark 1998; van der Leeuw 1993). These techniques are regarded to be primarily dependent on the personal choices of the potter and the social and cultural environment in which he/she participates. Technological knowledge is embedded in the society's manufacturing tradition, which passes from one generation to the next, of which some

Newsletter of the Department of Pottery Technology (Leiden University) 18/19, 2000/2001: 7-43.

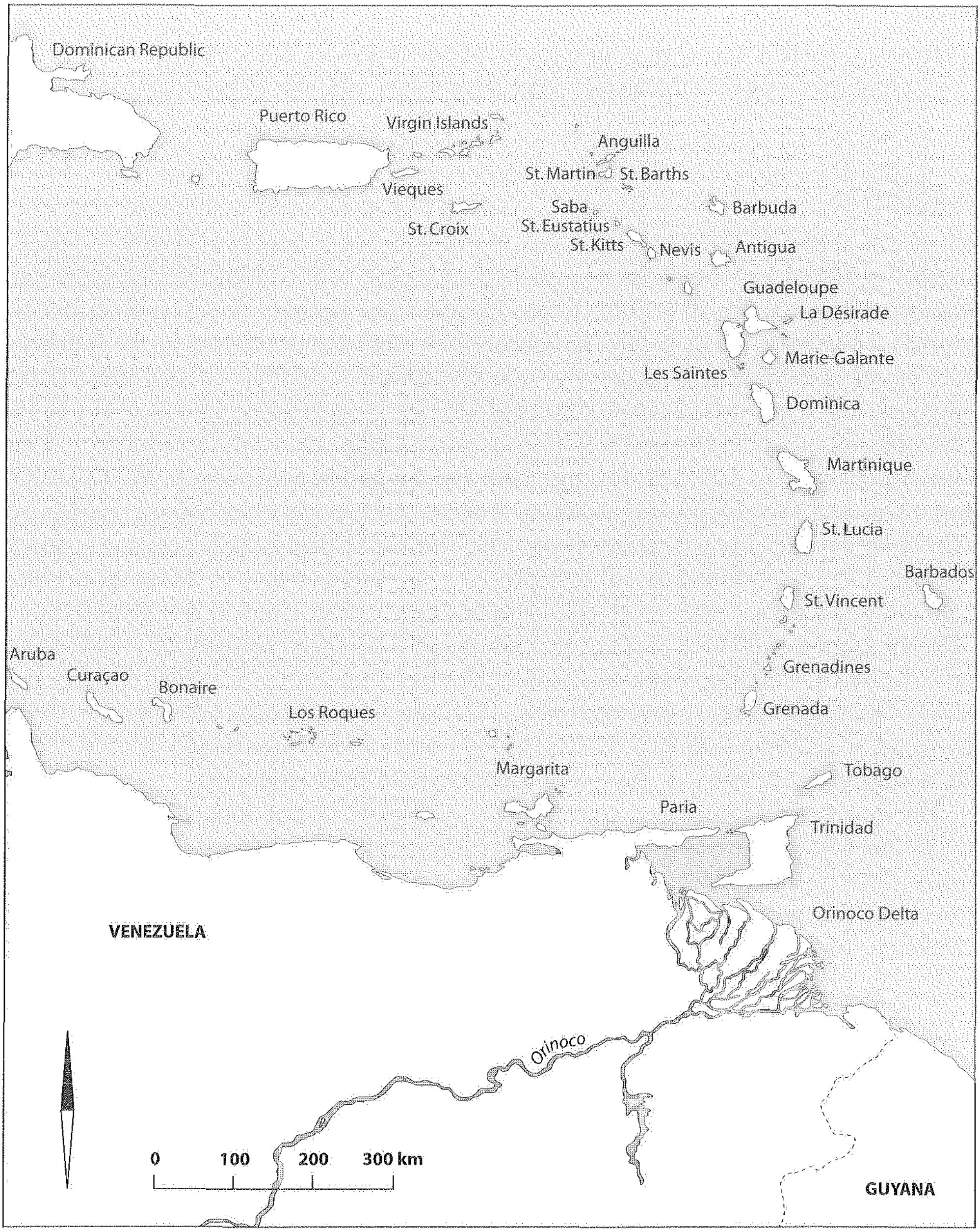


Fig. 1. Map of the Lesser Antilles.

aspects are more stable than others through time (Franken 1995: 98-100; Stark 1998). When surpassing the level of using ceramics as a dating tool for establishing local chronologies or determining the spatial organization of regional developments and viewing it in a wider social context, all kinds of meanings are conveyed by various aspects of ceramic technology, morphology or style in general, including decoration (for the latter see *e.g.* Hodder 1990; Wiessner 1983; 1984; Sackett 1985; 1990). However, decoration is sometimes imbued with more general meaning and expression of worldview, while less significant technological differences may result from different ways of doing things and, thus, may mark social boundaries (Hegmon 1998: 276). If one wants to address these relationships exhaustively one should opt for an integrated approach including technology, function and style (Lechtman 1977; Hegmon 1998: 278).

Recent ethnographic case studies among indigenous people of the Guyana coastal region have shown the relevance of studying the different aspects of the pottery production process (Bel 1995; Hagen 1991; Vredenbregt 2002; Duin this volume). Following a similar approach, it is thought that studying the dynamics of technology, function and style, rather than the analysis of a selection of some of these variables, broadens the range for understanding and expanding our knowledge of Early Ceramic Age society in the Caribbean (see also Hofman 1993).

For the purpose of this study we have used a ceramic sample from the site of Morel, Guadeloupe (F.W.I.). This sample was excavated between 1993 and 1999 by a French/Dutch team of the Direction Régionale des Affaires Culturelles of Guadeloupe and the Faculty of Archaeology of Leiden University under the responsibility of André Delpuech, Corinne Hofman and Menno Hoogland. The sample includes both Cedrosan and La Hueca style pottery (Arts 1999; Delpuech *et al.* 2000; Clerc 1964; 1968; 1970; n.d.; Hofman *et al.* 1999; Rouse 1992).

The present study consisted of two parts.

- A morphological and stylistic study encompassing the recording of qualitative and quantitative features of the Morel pottery.
- A technological analysis consisting of a general reconnaissance of the clays used including a fabric analysis on a sample of archaeological sherds and an experimental program in order to get a better understanding of the different steps in the production process. This analysis has been carried out in cooperation with the Department of Pottery Technology of Leiden University.

Cultural setting

The Cedrosan Saladoid represents the period when the first farming and pottery making groups spread into the Lesser Antilles, the Virgin Islands and Puerto Rico from the Orinoco region in northeastern Venezuela. Most likely, this occurred through migration of Saladoid peoples, although a few have tentatively suggested that these traits diffused from the mainland to the preceramic Amerindians in the islands (Oliver 1999; Rouse 1992; Siegel 1989; 1999). Cedrosan Saladoid ceramics are widespread over a long period of time and yield radiocarbon dates from the second half of the first millennium B.C. to respectively A.D. 400 on the Greater Antilles and A.D. 600/850 on the northern Lesser Antilles. These latter dates are provided from the Golden Rock site, St. Eustatius and the Anse des Pères site, St. Martin, where a later phase of the subseries lasted until the 9th/10th centuries A.D. (Hamburg 1999; Versteeg and Schinkel 1992).

Ceramics of the Early Cedrosan Saladoid subseries can be found from the coastal area of the Guyanas (Wonotobo Falls, Western Surinam) to the eastern coast of Venezuela (Margarita Island), on the Lesser Antilles from Trinidad to the Virgin Islands and part of Puerto Rico, where it is known as the Hacienda Grande style (Boomert 1983; Rouse *et al.* 1985; Rouse 1989; 1992).

Characteristic of the Early Cedrosan Saladoid subseries is the combination of plain, painted white-on-red (*wor*) and zoned-incised crosshatched (*zic*) pottery (Rouse 1989; Rouse and Alegría 1990; Rouse and Morse 1999). *Painted* and *zic* pottery differ in material and shape as well as in decoration. As a possible explanation for the co-occurrence of both decorated wares, Rouse and Alegría (1990) have suggested that they could have been used in different, probably ritual contexts.

For over thirty years it was assumed that the Saladoid series represented the first fully ceramic groups that migrated from South America. The appearance of the horizontally segregated La Hueca style pottery during the late seventies at the site of La Hueca on Vieques Island and its attribution to a separate Huecoid series (Chanlatte Baik 1981; 1983), Huecan Saladoid subseries or style (Rouse 1992) or La Hueca complex (Curet in press) has been subject of considerable controversy in Caribbean archaeology known as the 'La Hueca problem' (Oliver 1999). The discussion focused on whether this material was the product of a different earlier migration, of the presence of a different population of potters or whether it is a variant of the Early Cedrosan Saladoid subseries. Most of the studies have concentrated on at what level both styles are similar or different in a technological and stylistic way (*e.g.* Bonnissent 1995; Carini 1991; Reed and Petersen 1999; Roe 1989). The debate has cooled down in the past few years, but there is still a lack of agreement among Caribbeanists on how to categorise this Early Ceramic style.

Ceramics of the La Hueca style have been predominantly found on the more northern islands of the Lesser Antilles up to Puerto Rico including Guadeloupe (Arts 1999; Clerc 1964; 1968; 1970; Hofman *et al.* 1999), Marie Galante (Barbotin 1987; Hofman *et al.* 1999), Montserrat (Petersen and Watters 1999), and St. Martin (Haviser 1991; Hofman 1999), Vieques (Chanlatte Baik 1981) and Puerto Rico (Rodriguez 1989; 1991). Occurrences of La Hueca style pottery have also been documented for Martinique and Grenada (Petitjean Roget 1981; Hofman 1993). On the islands of the Lesser Antilles pottery of the La Hueca style has been found mixed with Early Cedrosan Saladoid ceramics, while on Vieques Island and Puerto Rico they were horizontally or vertically separated from each other. Major characteristics of the La Hueca style decorated pottery are curvilinear-incised zones, sometimes filled with punctation or crosshatching besides zoomorphic *adornos* on vessel rims (Chanlatte Baik 1981; 1983; Hofman 1999).

The Morel case study

The site of Morel is located on the northeastern coast of Guadeloupe, one of the northern Lesser Antilles of the Caribbean island chain. The site lies directly facing the Atlantic on the beach of eastern Grande-Terre, the northern, limestone island of Guadeloupe (Fig. 2). The coastal landscape has been severely altered by human and natural interference since pre-Columbian times. Nowadays, the former beach is eroded and the dunes have disappeared.

The site has been known since the 19th century but has only been the subject of intensive investigations during the 1950s and 1970s (Bullen and Bullen 1973; Clerc 1964; 1968; 1970) and then again during the 1990s (Arts 1999; Delpuech *et al.* 2000; Hofman *et al.* 1999). The context of the earlier excavated material is difficult to trace. Therefore, the present study only focuses on the pottery excavated during the 1990s' excavations.

The site is composed of settlement and refuse (or *midden*) areas. Its four components (Morel I to IV), roughly dated between 400 B.C. and A.D. 1400, have long been used in Caribbean chronological charts to characterise the ceramic sequence for the northern part of the Lesser Antilles (Rouse 1992). The earliest component at Morel includes Cedrosan Saladoid and La Hueca style ceramics. Stratigraphically, there is no clear segregation between the two and radiocarbon dates from these levels range from 400/200 B.C. to A.D. 400.

Morphology and style

The present sample consists of 35,017 potsherds. A substantial part is composed of *plain ware*. In total 1515 sherds or 4.3% are decorated. The assemblage consists of a variety of fabrics, shapes and stylistic modes. A representative overview of the morphological and stylistic repertoire is shown in Figs. 3-6. The decorated pottery can be divided into the Cedrosan Saladoid related *painted* and *zic wares* (see also Rouse and Alegría 1990; Rouse and Morse 1999) and the diagnostic modes of fabric, shape and decoration of the La Hueca style pottery have prompted us to introduce the notion of *curvilinear incised ware*. Quantitative and qualitative variables that were recorded include: shape (vessel and rim), size and wall thickness, colours (inner and outer surface and core), finishing (inner and outer surface) and decoration and slip.

Plain ware represents 95.7 % in the sample. It distinguishes itself from decorated wares in that, at first sight, it does not show any decorative additions. This may, however, be due to the high fragmentation rate of the sample. This category is characterised by a large variety of restricted, unrestricted and independent restricted vessel shapes with simple, inflected and composite contours. In general, the plain ware has somewhat thicker walls than the decorated wares with an average thickness of 9 mm. Surface colours vary from light brown to brown and greyish brown to reddish brown, and surface treatment includes smoothing and light burnishing. Some surfaces are fairly crude as

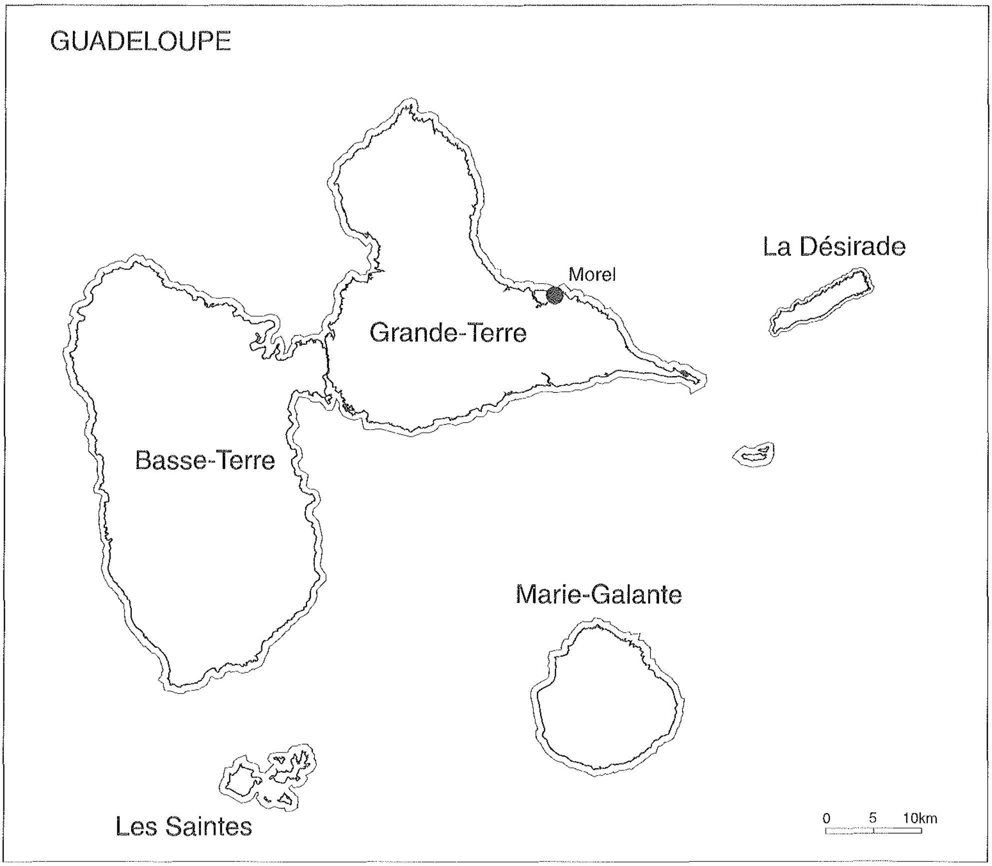


Fig. 2. Map of the island of Guadeloupe with the site of Morel in the northeastern part.

if they were not smoothed at all. Among the plain ware there is also a category of griddles for baking cassava bread. Griddles have smoothed surfaces and unthickened rounded and in some cases low triangular rims.

Painted ware includes a variety of jars, bowls and dishes with unrestricted simple contours, bowls with unrestricted composite contours, jars with independent restricted composite or inflected contours and bowls with unrestricted inflected contours. The most typical vessel type of the Cedrosan *painted ware* is the bell-shaped bowl with an unrestricted composite contour and a thickened rim. The bell-shaped bowl is often decorated with white-on-red paint. Besides this type of bowl, boat- or kidney-shaped vessels, bottles and jars with circular to ovoid shapes and hemispherical bowls do occur. These vessel types have rounded, inwardly thickened or flaring rims. Two different types of handles were distinguished for the *painted ware*, *i.e.* D-shaped and rounded handles and a number of perforated lugs.

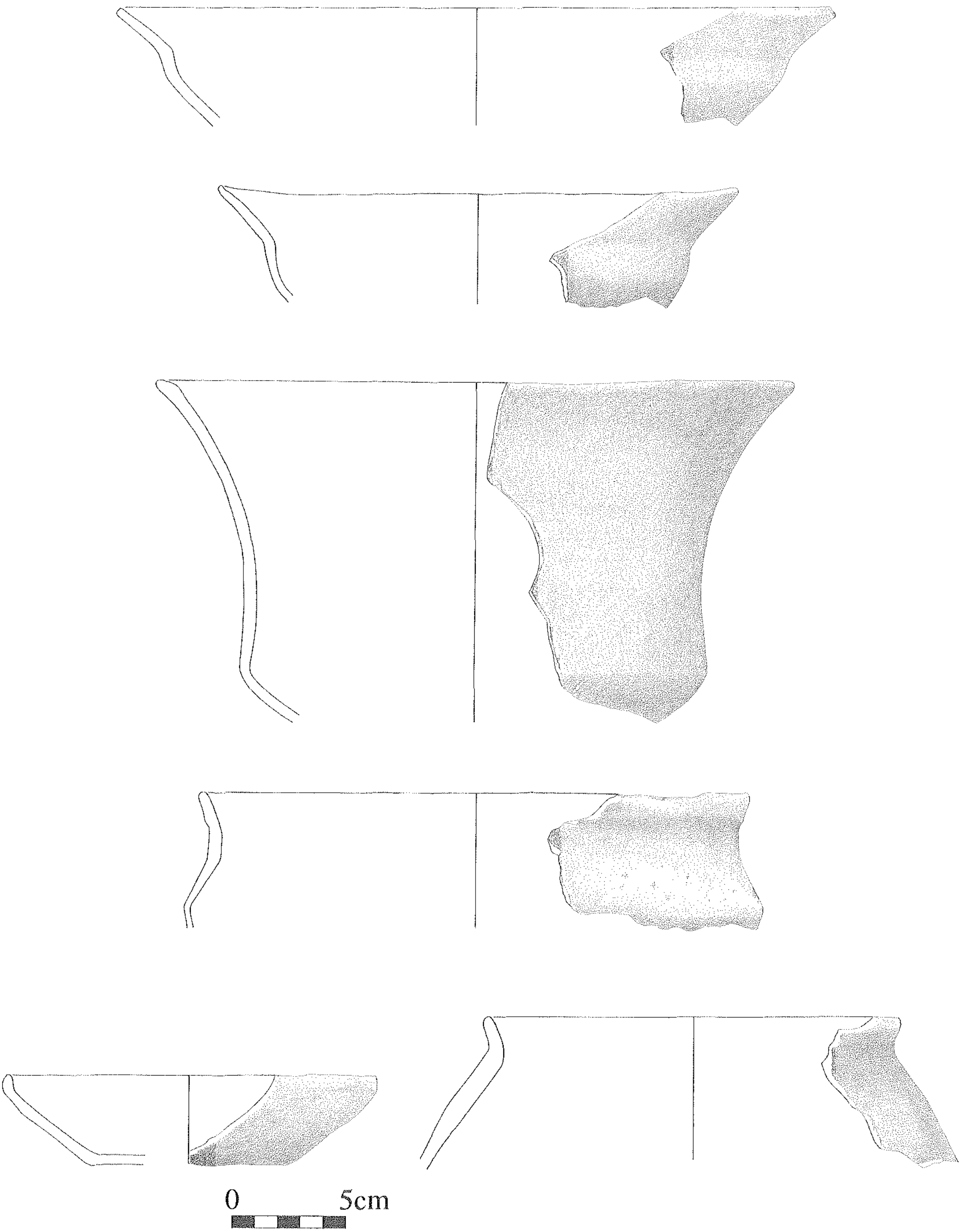


Fig. 3. Plain ware.

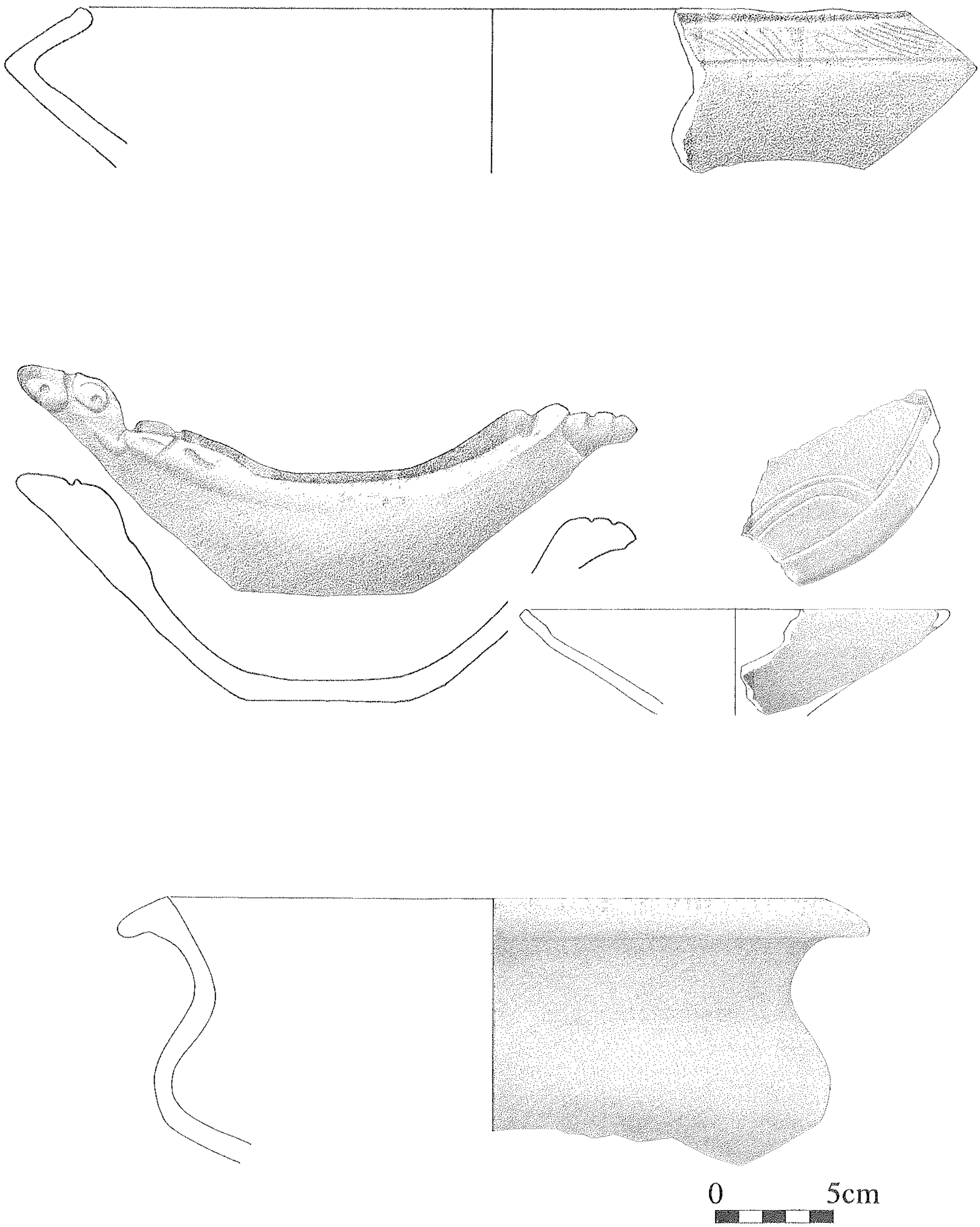


Fig. 4. White-on-red ware.

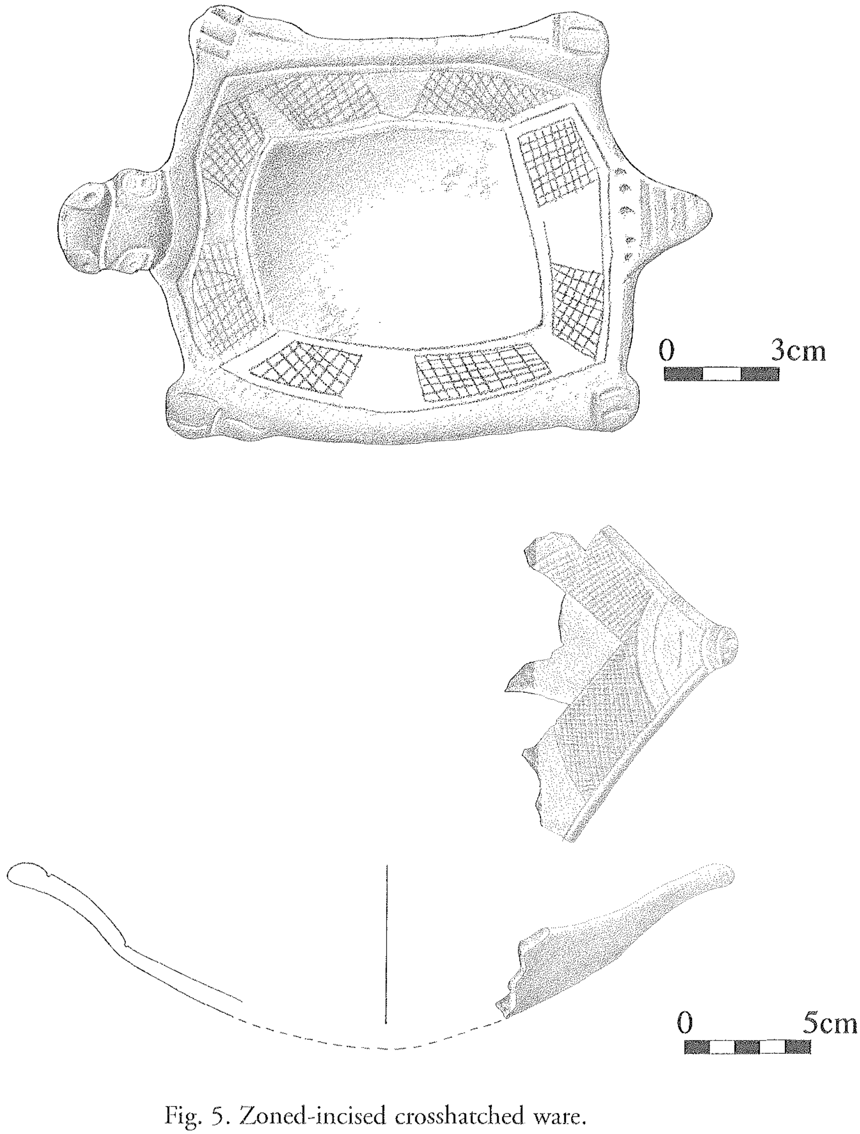


Fig. 5. Zoned-incised crosshatched ware.

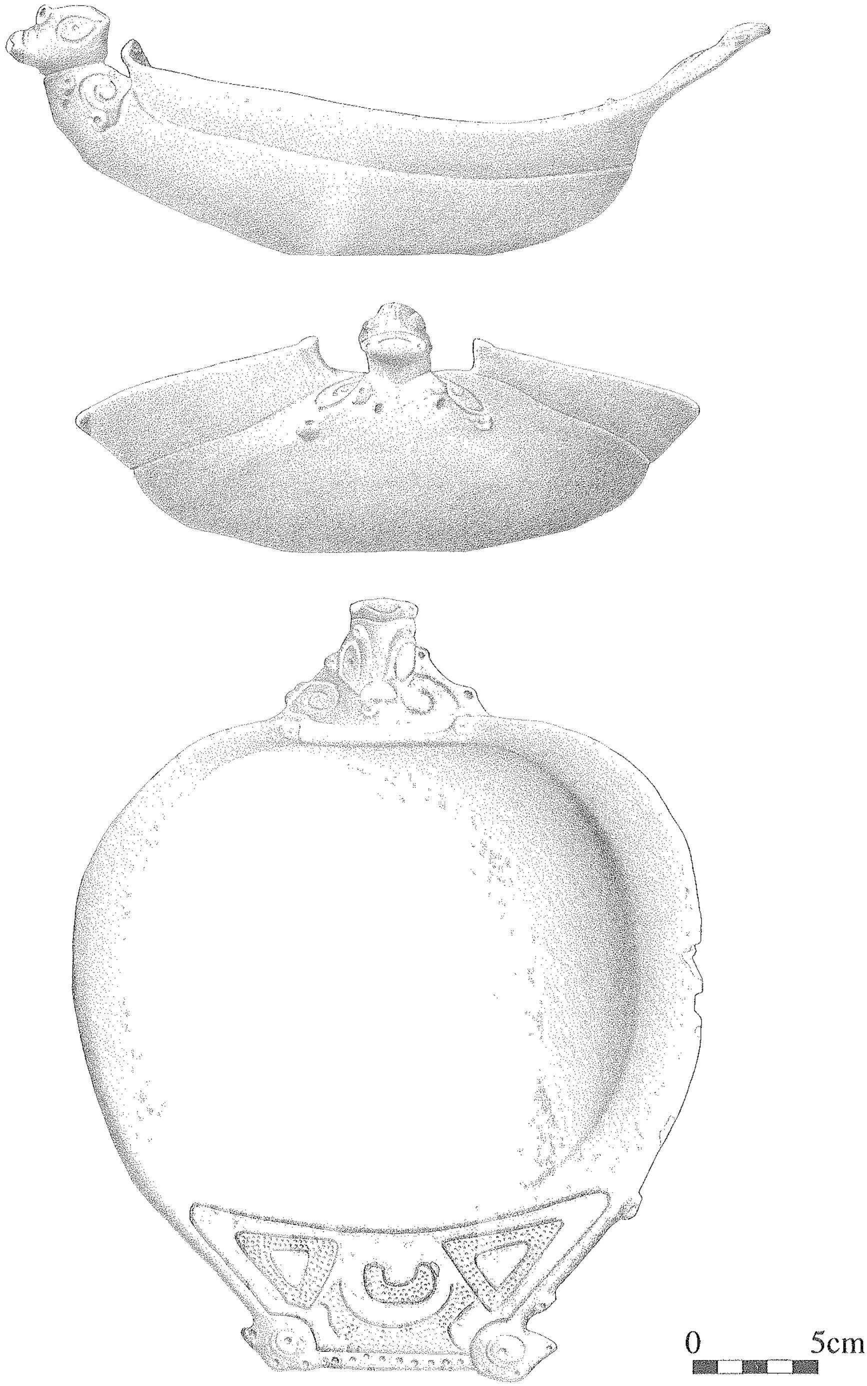


Fig. 6. Curvilinear incised ware.

Most of the surfaces turned out to be light reddish brown to reddish brown and yellowish red, reddish brown and red. In general, the greatest colour intensity and contrasts have been observed within this category. Some though are grey to dark grey or brown to dark brown. Smoothing, burnishing and polishing were all used to finish the vessel surfaces.

Diagnostic decorative modes include bichrome white-on-red (*wor*) or red-and-black painting. The painted motifs are often stylised, geometrical figures. Other modes are linear incised lines (sometimes used to outline painted designs), simple linear incision (occasionally filled with white paint), modelled-incised animal or human heads applied on tabular lugs and nubbins. The latter are rather large and often red slipped. Painted ware generally has black soot on the interior vessel surface.

Zic ware is less common than *painted ware* and is predominantly characterised by hemispherical bowls and dishes with unrestricted simple or composite contours and rounded, flattened and outflaring rims. Some vessels have perforated lugs attached to the vessel wall. Vessels have brown to greyish brown colours and surfaces are often burnished to polished. Decoration modes include fine-line incisions and zoned-incised crosshatching on rims and inside surfaces of the dishes and bowls.

Curvilinear incised ware includes bowls and dishes with unrestricted simple contours, restricted simple contours and unrestricted composite or inflected contours. The latter vessel type is typical for the La Hueca style and represents the body, head and tail of an animal creature with an *alter ego* on the head. The majority of the vessels have mostly flattened rims, otherwise rounded (sometimes slightly tapered). Vessels are rather thin walled, between 4 and 7 mm. Surface colours are predominantly light reddish brown, yellowish red and light yellowish brown. Most surfaces are smoothed to lightly burnished. Diagnostic decoration modes are curvilinear-incised zones. These zones may be filled with punctation or crosshatching. Other typical modes are modelled zoomorphic *adornos*, punctated rims and small nubbins.

The manufacturing process

To understand the steps of the manufacturing process a series of experiments have been carried out by (re-)constructing the different wares. A sample of archaeological sherds of the four wares was selected for fabric comparison and to serve as a reference for the experiments. The purpose of these experiments was not to copy the original vessels, but to follow and understand the different technological steps involved in the manufacture of the vessels of each ware. For the (re-)constructions commercially available clays have been used, which were adapted as much as possible to the properties of the materials used by the Amerindian potters. These properties were deduced from the fabric analysis of the archaeological sherds from Morel and from traces on these sherds.

Clay and temper materials

A great variability in qualitative and quantitative aspects of fabric composition (*i.e.* type of non-plastics, texture, colour, hardness, shape, size, presence of pores and cracks) within and between the wares has been observed. Properties like plasticity, drying shrinkage, cohesion and strength may have differed greatly from ware to ware and could have been influenced by the adjustment of the amount of water, the alteration of the number and size of the grains in the clay body and through the improvement of the organic activity in the clay. The latter could have been achieved by storing the clay in a warm and wet place for a period of time. However, it is difficult to determine whether temper materials were added deliberately to the clays on the one hand, it seems that to improve the clay's consistency, 20 to 35% temper material with specific grain sizes was added to some of the clays on purpose. On the other, these materials could also have been present in the clay naturally[2].

Of the total sample, four representative fabric models have been selected for each ware for descriptive and comparative purposes (Tables 1-4).

Plain ware is characterised by the presence of coarse grains with a size up to 1.5 mm that occur in combination with finer grains of the same grain types. Mudstone dominates in large quantities and is often combined with lesser amounts of quartz. Another *plain ware* fabric with predominantly dark grains like pyroxenes occurs in smaller quantities. Almost all grains are angular to sub-angular in shape and the quantity of grains varies between 15 and 30%.

Painted ware, like *plain ware*, contains relatively coarse grains, some up to 1.5 mm. Mudstone and quartz are the most commonly occurring grain types. In this respect, there is a great similarity with most of the *plain ware* fabrics. Both *plain* and *painted wares* have relatively coarse fabrics.

In the case of white-on-red painted vessels one would expect a finer fabric, because a rough surface with protruding grains would make the painting of motives on the surface difficult. The application of a red slip layer, however, creates a smooth surface on which fine painting is possible.

Grain shapes vary from angular to sub-angular, and a few sub-rounded grains also occur. Grain quantity varies roughly between 15 and 30 to 35%.

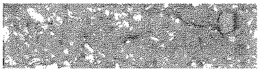
Zic ware is characterised by the presence of mostly fine grains, with an upper grain size limit of about 0.5 mm. Mudstone and quartz are also the dominant grain types. However, some of the *zic ware* fabrics contain combinations of dark grains and quartz, feldspar or calcium carbonate grains. The shapes of the grains are angular to sub-angular and they occur in quantities varying between 15 and 35%.

Curvilinear incised ware, like *zic ware* is characterised by a limited upper grain size of slightly above 0.5 mm. Dominant grain types are feldspar or weathered feldspar in combination with pyroxene, siltstone and quartz. Grain shape varies from angular to sub angular. The overall quantity of grains seems to be a little lower and varies roughly between 20 and 30%.

Despite some similarities between the wares, substantial variability has been observed as well:

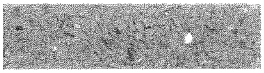
- *Plain ware* in general has a coarser and a somewhat less well-sorted fabric than *zic* and *curvilinear incised wares*. The porosity varies from normal (*plain ware* fabric 4) to high. The rather high porosity is visible from the open structure with long voids (*plain ware* fabric 2 and 3).

plain ware fabric 1. 125% of original size.



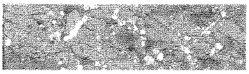
general grain types with their presence * ≈ 2% ** ≈ 4% *** ≈ 6% ~ = eventually	*** *** calcium carb. *** *** mudstone ** quartz * siltstone (tuff) * rockfragments ~ pyroxene ~ iron ox.concretions
prevailing grain size	100 μ - 1000 μ
prevailing shape	angular to sub-rounded
prevailing quantity	15 to 30%
sorting in general	moderately to badly
grain colour in general	light
colour of the total fabric	red MSCC 2.5YR5/6 to 2.5YR6/6
porosity	normal to open with long voids

plain ware fabric 2. 130% of original size.



general grain types with their presence * ≈ 2% ** ≈ 4% *** ≈ 6% ~ = eventually	*** mudstone *** ~ undissolved clay lumps) * iron-oxide concretions * siltstone * quarts * pyroxene * calcium carb.
prevailing grain size	100 μ - 1000 μ
prevailing shape	sub-angular to sub-rounded
prevailing quantity	15 to 25%
sorting in general	moderately to good
grain colour in general	prevailing light
colour of the total fabric	red to dark red MSCC 2.5YR5/8 to 2.5YR4/8
porosity	typical open structure; with long pores

plain ware fabric 3. 120% of original size.



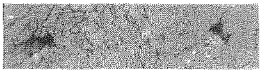
general grain types with their presence * ≈ 2% ** ≈ 4% *** ≈ 6% ~ = eventually	*** mudstone *** *** Calcium carb. *** ** quartz * siltstone * iron ox. nodules
prevailing grain size	250 μ - 1000 μ
prevailing shape	angular to sub-rounded
prevailing quantity	20 to 30%
sorting in general	moderately
grain colour in general	light
colour of the total fabric	light reddish brown MSCC 5YR6/4
porosity	long parallel voids, open structure

plain ware fabric 4. 120% of original size.

general grain types with their presence * ≈ 2% ** ≈ 4% *** ≈ 6% ~ = eventually	*** *** *** pyroxene * siltstone * quartz * iron ox.concretions
prevailing grain size	100 μ - 1000 μ
prevailing shape	angular to sub-angular
prevailing quantity	15 to 20%
sorting in general	moderately to good
grain colour in general	mixed, prevailing dark
colour of the total fabric	reddish brown MSCC 5YR5/4
porosity	normal

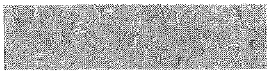
Table 1. *Plain ware* fabrics.

Cedrosan painted fabric
1. 100% of original size.



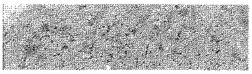
general grain types with their presence * ≈ 2% ** ≈ 4% *** ≈ 6% ~ = eventually	*** *** mudstone * quartz * silstone ~ pyroxene ~ calcium
prevailing grain size	100 µ - 1000 µ
prevailing shape	angular to sub-angular
prevailing quantity	25 to 35%
sorting in general	moderately to badly
grain colour in general	light; red with a white slib
colour of the total fabric	red MSCC 5YR6/4
porosity	typical open structure; cracked surface

Cedrosan painted fabric
2. 150% of original size.



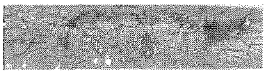
general grain types with their presence * ≈ 2% ** ≈ 4% *** ≈ 6% ~ = eventually	*** mudstone *** iron-oxide silstone ** silstone * quartz * pyroxene
prevailing grain size	100 µ - 1000 µ evt. up to 1500 µ
prevailing shape	angular to sub-angular
prevailing quantity	about 20% evt. up to 30%
sorting in general	moderately
grain colour in general	mixed, prevailing light
colour of the total fabric	red MSCC 2.5YR5/6
porosity	typical open structure; with long open pores

Cedrosan painted fabric
3. 150% of original size.



general grain types with their presence * ≈ 2% ** ≈ 4% *** ≈ 6% ~ = eventually	*** mudstone *** *** *** * quartz * pyroxene
prevailing grain size	100 µ - 1000 µ
prevailing shape	angular to sub-angular
prevailing quantity	25 to 30% ~ (20% ↔ 35%)
sorting in general	moderately to good
grain colour in general	mixed, prevailing light
colour of the total fabric	light reddish brown MSCC 5YR6/4
porosity	long pores; open structure

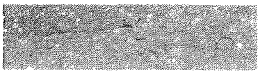
Cedrosan painted fabric
4. 120% of original size.



general grain types with their presence * ≈ 2% ** ≈ 4% *** ≈ 6% ~ = eventually	*** quartz *** mudstone * pyroxene * siltstone * calcium * feldspar * iron/mangan. -nodules
prevailing grain size	100 µ - 1000 µ some up to 1500 µ
prevailing shape	angular to sub-angular and sub-rounded
prevailing quantity	20 to 25% ~ (15% ↔ 35%)
sorting in general	moderately
grain colour in general	mixed, prevailing light
colour of the total fabric	dark red MSCC 2.5YR4/6
porosity	cracked very open structure

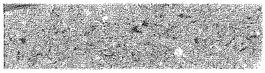
Table 2. *Painted ware* fabrics.

Cedrosan ZIC fabric
1. 180% of original size.



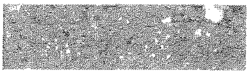
general grain types with their presence * ≈ 2% ** ≈ 4% *** ≈ 6% ~ = eventually	** *** mudstone ** *** quartz * haematite * pyroxene * siltstone * rockfragments * calcium * kaolinite
prevailing grain size	100 μ - 500 μ
prevailing shape	angular to sub-angular
prevailing quantity	15 to 25% ~ (15% ↔ 35%)
sorting in general	moderately to good
grain colour in general	mixed, prevailing light
colour of the total fabric	red MSCC 2.5YR5/6
porosity	normal, long pores

Cedrosan ZIC fabric
2. 180% of original size.



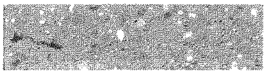
general grain types with their presence * ≈ 2% ** ≈ 4% *** ≈ 6% ~ = eventually	*** mudstone *** quartz ** haematite * pyroxene * siltstone * rockfragments ~ iron-oxide concretions
prevailing grain size	100 μ - 500 μ
prevailing shape	angular to sub-angular
prevailing quantity	25 to 30% ~ (15% ↔ 35%)
sorting in general	moderately
grain colour in general	mixed, prevailing light
colour of the total fabric	red MSCC 2.5YR5/6
porosity	normal, long pores

Cedrosan ZIC fabric
3. 170% of original size.



general grain types with their presence * ≈ 2% ** ≈ 4% *** ≈ 6% ~ = eventually	*** quartz *** calcium carb. ** pyroxene ** mudstone * silstone
prevailing grain size	100 μ - 500 μ some up to 1000 μ
prevailing shape	angular to sub-angular
prevailing quantity	20 to 25% ~ (15% ↔ 35%)
sorting in general	moderately
grain colour in general	mixed, prevailing light
colour of the total fabric	red MSCC 2.5YR5/6
porosity	normal, long pores

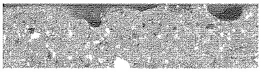
Cedrosan ZIC fabric
4. 180% of original size.



general grain types with their presence * ≈ 2% ** ≈ 4% *** ≈ 6% ~ = eventually	*** pyroxene *** quartz ** feldspar ** calcium carb. * mudstone * siltstone * iron-oxide-siltstone * rockfragments
prevailing grain size	100 μ - 500 μ some up to 1000 μ
prevailing shape	angular to sub-angular
prevailing quantity	30 to 35% ~ (15% ↔ 35%)
sorting in general	moderately to good
grain colour in general	mixed, prevailing light
colour of the total fabric	yellowish red MSCC 5YR5/6
porosity	normal, long pores

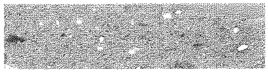
Table 3. *Zoned-incised crosshatched ware* fabrics.

Huecan CI fabric
1. 230% of original size.



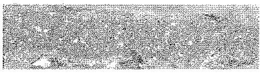
general grain types with their presence * ≈ 2% ** ≈ 4% *** ≈ 6% ~ = eventually	** quartz *** feldspar *** pyroxene ** siltstone * rockfragments * calcium * koalinite ~ mudstone
prevailing grain size	100 - 600 μ some up to 1000 μ
prevailing shape	angular to sub-angular
prevailing quantity	20 to 30% ~ (15% ↔ 35%)
sorting in general	moderately to good
grain colour in general	mixed, light and dark
colour of the total fabric	red MSCC 2.5YR5/6
porosity	normal

Huecan CI fabric
2. 170% of original size.



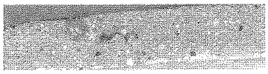
general grain types with their presence * ≈ 2% ** ≈ 4% *** ≈ 6% ~ = eventually	* quartz * feldspar *** pyroxene * siltstone * iron-oxide-siltstone * rockfragments ** calcium (micro fossil)
prevailing grain size	100 - 600 μ some up to 1000 μ
prevailing shape	angular to sub-angular
prevailing quantity	25 to 25%
sorting in general	good
grain colour in general	mixed, prevailing dark
colour of the total fabric	yellowish red MSCC .5YR4/6
porosity	normal

Huecan CI fabric
3. 170% of original size.



general grain types with their presence * ≈ 2% ** ≈ 4% *** ≈ 6% ~ = eventually	*** pyroxene *** feldspar – (partly weathered) ** quartz * siltstone * rockfragments * kaolinite
prevailing grain size	100 - 600 μ
prevailing shape	angular to sub-angular
prevailing quantity	20 to 25%
sorting in general	good
grain colour in general	mixed, light and dark
colour of the total fabric	yellowish red MSCC 5YR5/6-4/6
porosity	normal

Huecan CI fabric
4. 200% of original size.



general grain types with their presence * ≈ 2% ** ≈ 4% *** ≈ 6% ~ = eventually	*** weathered – feldspar *** siltstone (several types) *** rockfragments
prevailing grain size	100 - 600 μ
prevailing shape	angular to sub-angular
prevailing quantity	± 25%
sorting in general	moderately
grain colour in general	mixed
colour of the total fabric	reddish yellow MSCC 7.5YR7/6
porosity	normal

Table 4. *Curvilinear incised ware* fabrics.

- *Painted ware* has, like *plain ware*, a somewhat coarser fabric than *zic ware* and *curvilinear incised ware*. The first category has grains ranging in size from 1 to 1.5 mm. For the other two categories the grain size does not exceed 0.6 mm. Dry scratching in a too coarse-tempered surface would be problematic otherwise.
- *Painted ware* has a more open structure than the two other decorated wares.
- *Painted* and *zic wares* both have a typical longitudinal-pore structure, but with the *zic ware* the pores are finer than with the *painted ware*. *Curvilinear incised ware* has a normal fine pore structure. This could point to the use of different clays and or a different way of paste preparation. It does not seem likely that the relative dense structure of the *curvilinear incised ware* is caused by a better grading. This is because the total number of grains is never more than about 35% of the weight. The mixing of particles of different diameter in various proportions allows a closer packing of the grains than with very well sorted grains of only one diameter. Though the variation in grain size may contribute to the relatively close packing, the main cause of the dense structure lies in the smaller overall grain size of the non-plastics and in the nature of the clay itself. The clay possibly was poorer in organic activity. Moreover the thickness of the vessel wall, which most often is less with the *curvilinear incised ware*, may have had an influence. During drying and relatively quick heating, like in an open fire, steam and gasses more easily could escape from a thin wall, thus causing no extra porosity.
- A porous type of mudstone grains, which improve the structure of the fabric, is dominant in the *painted ware* (*painted ware* sherds 1 and 3) and also, but in fewer quantities and smaller grain sizes, in the *zic ware*. In the *curvilinear incised ware* silicas, such as quartz and feldspar or pyroxene grains are dominant.
- Like with the *plain ware* within the sample of *painted ware* there are some structural differences. There is a group with a very open structure (*painted ware* sherds 1 and 4) and a group with a less open structure (*painted ware* sherds 2 and 3). This difference is not due to the grain size itself but lies in the variation of clay/grain mixtures. The more open structures are the result of strong shrinkage. Very plastic clay eventually combined with a high content of colloidal organic material has a high rate of shrinkage. In this way a porous fabric structure is obtained because the clay around the grains shrinks in contrast to the grains themselves (*painted ware* sherd 4). This way numerous small cracks develop around the grains. Moreover the very fine organic material causes an open structure with long pores (*painted ware* sherd 4). This is due to a process of accumulation of fine organic material, which leaves voids after being burned. In the case of highly plastic clays such voids are even blown up a bit by the combustion gasses that tend to escape from the sherd during firing.

Shaping

Coiling, flattening, slab building, pinching and moulding were used for shaping all the wares. These techniques have not only been applied independently of each other, but also in combination with each other. There is a general relation between the vessel size and the applied shaping technique. Coiling, for example is better suited to large vessels whereas pinching is better suited to small vessels or parts of vessels or *adornos*. The manufacturing of large vessels entails more care and skill because of their weight, the tendency of uneven drying and breaking during firing and handling.

With the *coiling* technique, coils or rolls of clay are built up to establish the vessel circumference and to gradually increase the height (Fig. 7). One starts with the base, then the body is built up by piling the coils. The thickness of the coils is related to the required diameter of the vessel. For example, for a small vessel of 15 cm in diameter relatively thin coils are used (1 to 1.5 cm). For larger vessels the coils would each be around 2 cm in diameter.

Some of the decorated ceramics in the sample are relatively thin and not very large and were thus probably made out of thin coils. The adjustment of the coils is very important. The juncture must alternate each time in relation to the previous connection in order to avoid weakness in the vessel wall. This adjustment is especially important when producing a rather small and cylindrical shape. Alternatively, one may work with one endless coil that is laid in a circle like a spiral; a technique that is only possible when rather plastic clay-sand mixtures are used. The coils are then fixed to each other, pinched and smoothed to obtain a fairly uniform and thin wall (note that a freshly coiled wall with a thickness of 15 mm will reduce to 6-8 mm after smearing, pinching, scraping and smoothing). Vessels of the *painted ware* perfectly fit this range, while vessels of the *zic* and *curvilinear incised wares* are thinner, ranging between 4 and 6 mm.

Evidently, the juncture between the coils remains the weakest part of the vessel, and eventual breaking will take place at these parts. Because these crack patterns are indicative of the shaping techniques these are regarded as diagnostic elements. In the case where crack patterns occur on the juncture parts of the coils, adding a clay slip or water during construction can strengthen these parts. Besides, the addition of sand to the clay could improve the coherence of the coils among each other. Since coiling is an additive technique, there is always a possibility to introduce drying periods. This allows the lower part of the pile to stiffen and to be able to carry the weight of more coils, without being distorted. This possibility makes coiling a rather tolerant technique.

Pinching and *scraping* were applied when the vessel wall was still thick or irregular. Both techniques have a positive effect on the strength of the construction. This is because the joints between the coils are firmly pressed during the action. The combination of coiling with scraping and pinching is rather obvious. Both techniques, however, also occur in combination with other techniques.

With *pinching* the soft clay wall is squeezed between the thumb and fingers to reduce its thickness. To avoid distortion of the original shape this should be done in a controlled way. Pinching, however, can be used independently of coiling, or other techniques. It is used, for example, to make small, cylindrical and globular shapes, which can be used as a base for *adornos*. In this context one can think of small pinch pots.

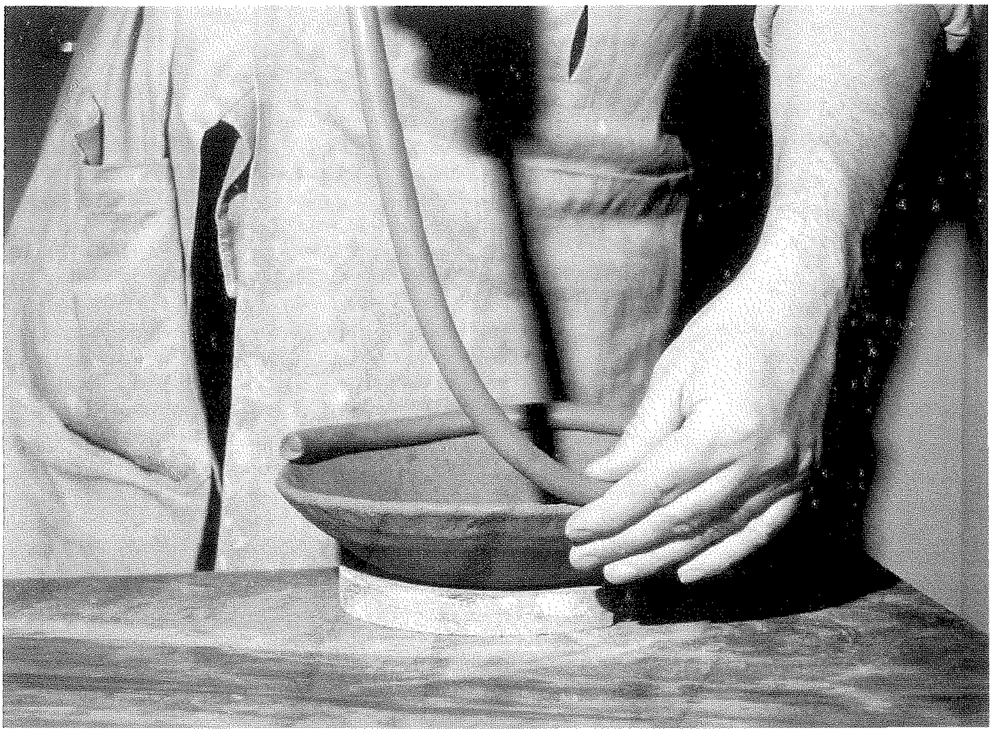


Fig. 7. Vessel built up by the coiling technique (experiment by Loe Jacobs, 2001).

With *scraping* parts of the surface can be removed or thinned-out. This kind of treatment leaves particular traces on the surface, which may be influenced by the nature of the temper materials in the clay, by the stage in which scraping is applied, the way scraping is done and by the tool that is used for scraping (Fig. 8).

For the construction of dish-shaped vessels *flattening* and *moulding* were used, sometimes in combination with *coiling*.

With *flattening*, a lump of clay is flattened either between the hands or on a flat surface to make a vessel base. Clay coils may then be added successively to build up the rest of the vessel.

With *moulding* the soft clay is pressed into a prepared mould. The mould serves as a support for the soft clay and makes it possible, despite the softness of the clay, to obtain rather thin, large and standardised vessels. Other advantages compared to coil building are that this technique is less time-consuming and that even poor clay-sand mixtures can be used. Moreover, compared to for instance coiling not that much skill is required to build a vessel this way.

Fig. 8. Scraping the vessel surface (experiment by Loe Jacobs, 2001).

Moulds could have been made of pottery (these are hardly recognisable in the archaeological record because they can be mistaken for utilitarian dish-shaped vessels); or of calabash or gourd (*Cresentia cujete*; see also Carini 1991: 31 and Hofman 1993: 163). Calabash is hard, light, dry and porous and therefore very suitable to serve as a mould (Fig. 9). The soft clay can be removed easily from the calabash. Because of its porosity the clay will dry rather quickly and then shrink separately from the mould.

Moulding can also be used in combination with coiling. In this case coils will be added to the moulded shape. Shapes that are suitable to be built in a mould are dishes, bowls and base parts. Experiments have proved that the vessels with paired holes, typical of the *curvilinear incised ware* (La Hueca style pottery) are very likely to have been made in such moulds (Fig. 10a). Obviously cylindrical or slightly conical shapes are not suitable to be made in a mould. They are constructed by piling coils.

Junctures or markings between different techniques are practically not visible because the thickness and structure of the vessel walls have been corrected by pinching and/or scraping. The ultimate shape of the vessel could be altered after moulding by

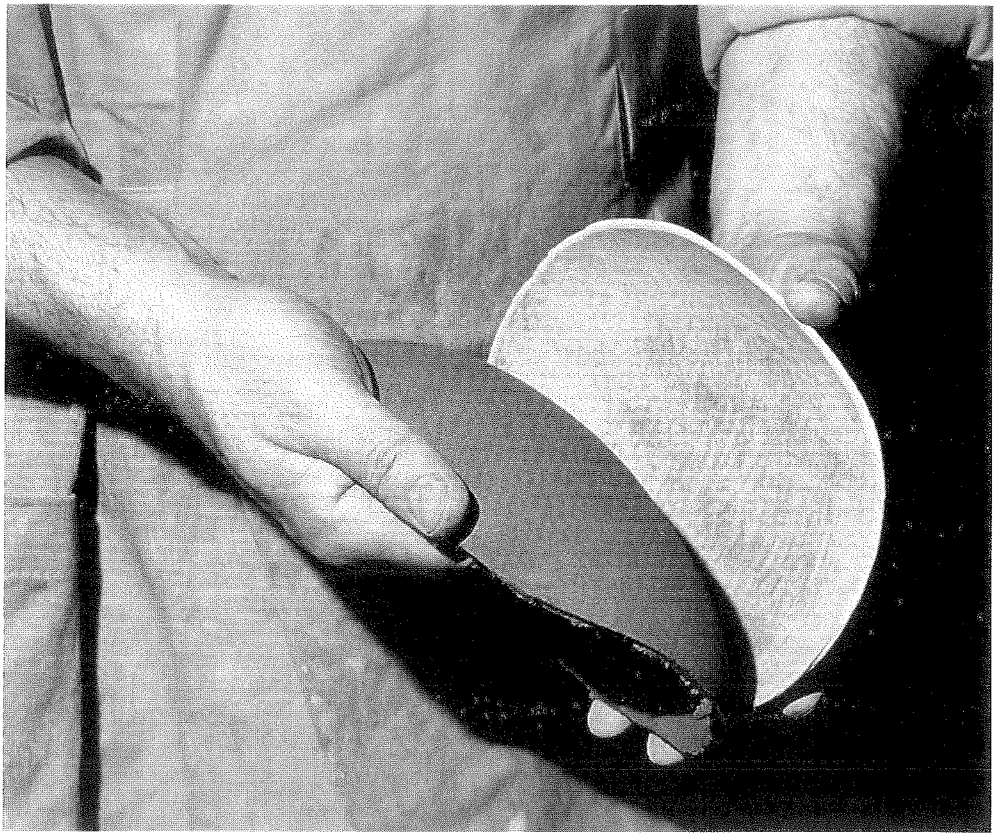


Fig. 9. Calabash (*Cresentia cujete*) used as a mould in vessel construction (experiment by Loe Jacobs, 2001).

scraping or pushing because the clay was removed from the mould in a soft or leather-hard condition. Coils or slabs and modelled parts were added in this stage to alter the final shape.

Base parts seem to be often mould-made, because of their suitable shape, which tends to come apart easily from the mould during drying. Moreover, bases made in this way are very strong and heat-shock resistant and, therefore, well suited as bases for cooking vessels (Fig. 11).

Modelling is regarded as part of the shaping technique because most often larger parts made by modelling are an integrated whole with the vessel shape. It has been used for the manufacture of zoomorphic and anthropomorphic features of both *painted* and *curvilinear incised wares.* With modelling, pieces of clay were pinched and rolled to obtain the desired shape. Next, parts were pressed together, reshaped if necessary, smeared and smoothed. Pressing soft clay in the hand makes small globular and

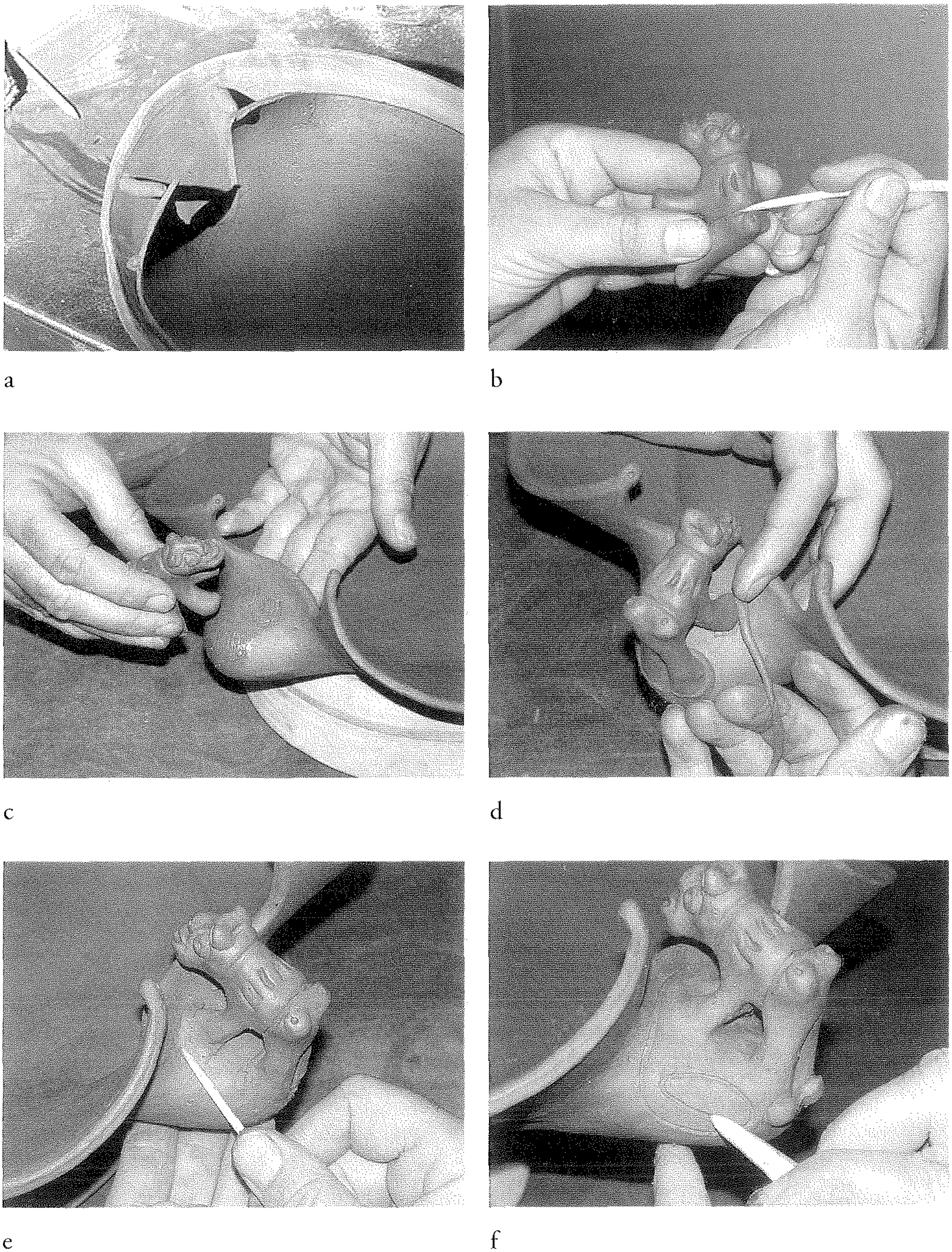
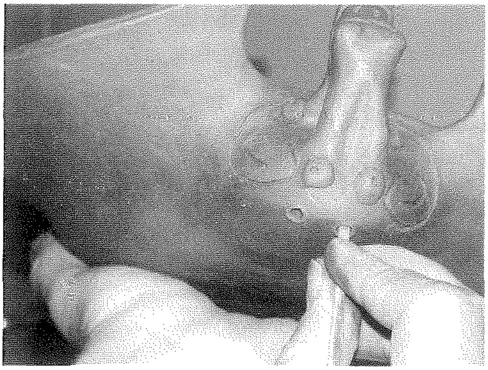


Fig. 10a-f. Building a characteristic vessel of the *curvilinear incised ware* (experiment by Loe Jacobs, 2001): (a) using a ceramic mould; (b) modelling; (c) adding modelled figure; (d) adding small coils of clay to fix the figure; (e) smearing; (f) impressing/incising;



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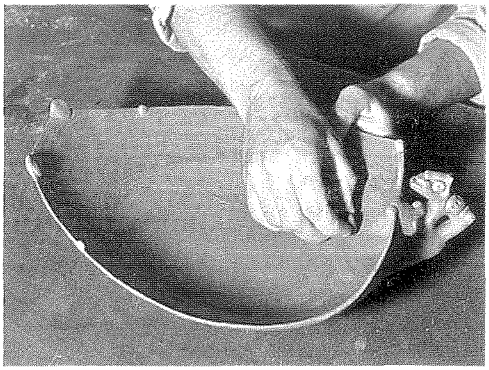

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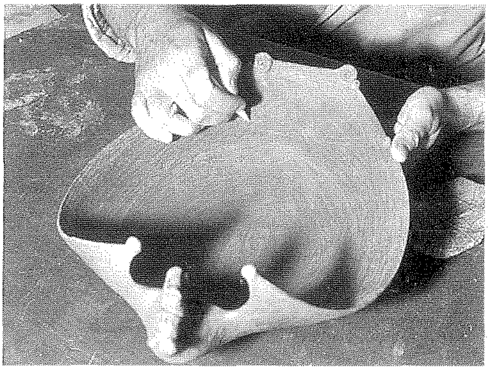

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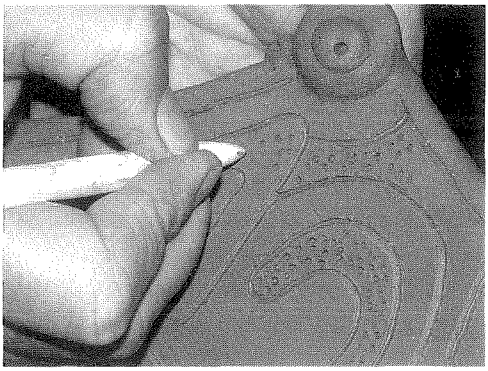

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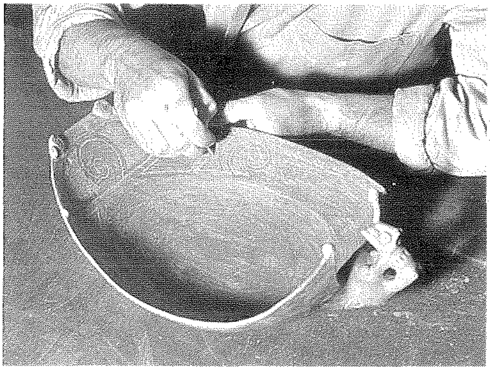

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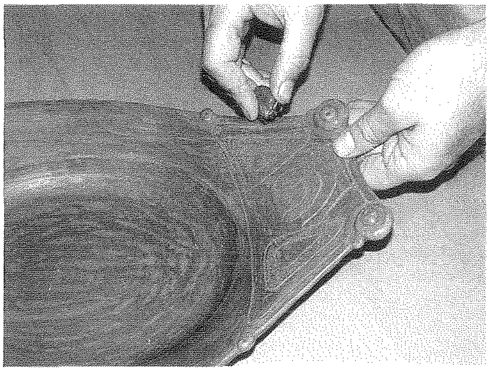

l

Fig. 10g-l. (g) drilling holes with a pointed tool; (h) burnishing; (i) engraving lines for zoned-incised crosshatched (*zic*) decoration; (j) punctation; (k) scratching *zic*; (l) polishing.

rounded shapes. Next, they were eventually reshaped and reworked by adhering and removing small pieces of clay. The surface was further detailed, finished and smoothed with the fingers, or with the aid of tools like *spatulae* made of bone, wood, shell, coral or ceramics (Fig. 10b). Finally, it was often partly polished.

Decorating

Painted, zic and *curvilinear incised wares* are characterised by a number of decoration modes, which have been applied by *excising, impressing, scratching, appliqué* and *painting*. The first three have been applied to obtain different modes of incision depending on the drying condition of the clay.

Excising was applied when the clay was still soft enough to be removed with a carving tool or to be impressed with the point of a *spatula*. Depending on the tool and the way the action was carried out, a wider or narrower mostly U-shaped groove was obtained. The use of a pointed tool would result in a V-shaped groove. Excising has been used on all wares.

Impressing/incising was applied when the clay was in a somewhat leather-hard condition so that part of the material was removed and part was pushed into the vessel surface (Fig. 10f). This technique may involve a repetitive action of the tool or tools. As with excising, a U-shaped groove is also obtained with this technique. It has been observed for all wares; however, the *painted* and *zic wares* have a somewhat more rigid appearance when compared to the *curvilinear incised ware*. Zone delimitation (Fig. 10i) has been executed in a more rigorous and regular way. On *curvilinear*

Fig. 11. Building the vessel base with the aid of a ceramic mould (experiment by Loe Jacobs, 2001).

incised ceramics, the incisions are often deeper and have been applied in a sloppier way. This is a direct result of working with softer clays, probably caused by a difference in clay composition.

Scratching was used when the clay was in a more than leather-hard condition. It implies that little clay material has been removed and the grooves are less deep and V-shaped (Fig. 10k). Scratching was carried out with a sharp pointed tool. Due to the fact that the clay has lost most if not all of its plasticity at this stage crumbling occurs on the edges of the lines, particularly where sandy clay mixtures are involved. This has, specifically, been observed with the crosshatched motifs of the *zic* and *curvilinear incised wares*.

Punctation was applied when the clay was in a leather-hard condition with a pointed tool, like a pointed *spatula*. The point was repetitively pressed into the surface. This technique was observed with the *curvilinear incised ware* where punctation was used to fill out curvilinear-incised designs (Fig. 10j).

Application was used for adding small lumps of clay (known as nubbins) to the surface. Nubbins were then smeared and smoothed to form one whole with the vessel's surface. In a later stage a small impression was made in the center of the nubbin with the aid of a tool. These nubbins occur on vessels of both the *painted* and *curvilinear incised wares*.

Modelled appliquéd decorative elements were pre-modelled and appliquéd to the vessel when both were in a plastic to leather-hard state. This technique is part of the shaping of the vessel and is performed at the same time. Both *painted* and *curvilinear incised wares* have modelled appliquéd elements (see shaping techniques). The representation of animistic creatures seems to have been worked out following defined patterns in which style and technology are closely related. These plastic elements, such as zoomorphic and anthropomorphic *adornos* have been added to the construction, which means that they are composed of loose elements. From a technological point of view there is an assemblage of cylindrical and globular shapes, from which decorative elements have been built up. This includes the joining of small lumps of clay with partly pre-modelled pieces of clay of various shapes. Where necessary these are complemented with amorphous pieces of clay, which are added and smoothed. At the same time, adding (Fig. 10d) and smearing (Fig. 10e) pieces of clay reinforces the joints. At the end, the entire appliquéd element gets its shape through modelling with the fingers or eventually with the aid of a *spatula*. These plastic additions, which are often added to dishes and bowls that had been shaped through coiling or moulding, protrude outside the contours but are part of the shape through their meaning and form. A good example of this is the La Hueca style bowl. This very thin ovoid bowl is probably made in a mould (ceramic or calabash mould). The bowl itself represents the body of an animal (turtle, fish and bird) with head and tail modelled at either side. On the back of the head part two holes are drilled with a pointed tool into the wet clay (Fig. 10g). An *alter-ego* figure, looking inside the bowl, is separately modelled and added to the head of the animal (Fig. 10c).

Painting includes monochrome-red and bichrome white-on-red (*wor*), or black-and-red painting. The monochrome-red slip is sometimes applied to different portions of the vessel: the exterior, the interior and the lip of the pot or on a combination of these parts. On some vessels painting occurs in combination with incision. *Wor* painting has been applied using a negative technique. The surface was polished and then covered with a white baking clay slip in which motifs are applied. The white paint was then partly removed to obtain the required designs. This was probably done by carefully removing thin layers of white paint until the red surface showed up (Fig. 12). This technique was applied when the clay was already in a dry or almost dry condition, but before firing. Polishing was done first, before applying the white slip layer. This might be related to the fact that the white kaolin-like clay does not give a shine after polishing. Besides, the adhesive property of this layer is very limited before firing, and might even come off when polishing. Many of the painted vessels were probably polished, but often the polish was lost partly or completely during firing (due to low firing temperatures the slip remains fairly soft and is therefore not very stable). Firing occurred in an open fire but one tried to maintain oxidizing conditions in order to control the desired red and white colours. The inner surface of the *painted ware* is often covered with black soot. This grey black layer is a mixture of soot with some kind of resin, which was applied post-firing and it is, therefore, not as durable as the underlying slip layer which consists of fired clay. It also occurs in limited zones, being part of the incised decoration on the outer surface of some vessels.

In the case of *zic ware*, the incised crosshatched lines are occasionally filled with a white paint or slip. This is done after the firing process. Vessels of the *curvilinear incised ware* are never painted in the Morel sample.

Finishing

Smoothing, burnishing and *polishing* are common finishing techniques applied to all wares. These techniques have technological advantages but may also have been applied in some cases solely to embellish the vessel surface.

Smoothing was probably done with a rubbing tool or with the fingers when the clay was in a leather-hard stage. The result is a smooth but rather dull appearance (Fig. 7h).

Slightly *burnishing* the surface resulted in a soft glossy appearance. Experiments have proven that when a leather-hard vessel is burnished the surface may loose its shine after it had become completely dry.

Very few vessels have been fully *polished*, resulting in an overall glossy appearance. It should be noted, however, that by shaping the pottery through coiling, pinching or moulding a regular surface cannot be obtained at once and that scraping of the surface followed by smoothing before polishing is very important to obtain a better appearance. The condition of the clay determines the result obtained by polishing (Fig. 10l). When the clay is too soft, little shine will be obtained. In contrast, if the

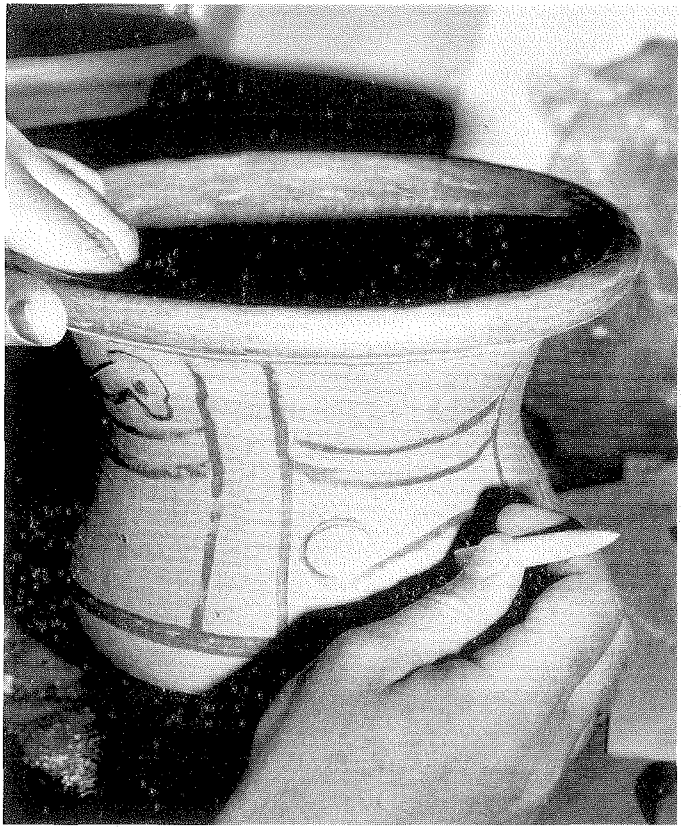

Fig. 12. White-on-red painting (experiment by Loe Jacobs, 2001).

clay is too hard the rubbing tool produces scratches that may damage the surface. The *painted ware* has very glossy surfaces due to the application of slip or paint before polishing.

Polishing is also used to improve the smoothness and density of the vessel's surface. Among the *plain ware*, cooking pots have the advantage that they are easier to clean and that the contents do not adhere to the surface. Another advantage is that they are less likely to break because of the stronger structure. This effect is even stronger when both the inner and outer surfaces are polished. This polish, however, has partly or completely disappeared in many cases either during drying or firing, or through post-depositional processes (*e.g.* due to limestone salts).

Firing

There is no fundamental variation between the wares in firing techniques. Vessels are fired in an open fire in a rather controlled way, under oxidizing to neutral conditions at temperatures in general not exceeding 800°C (Fig. 13). Controlled conditions were particularly necessary for the multi-coloured Cedrosan *painted ware* in order to obtain a good contrast between the colours. This contrast became stronger, with the use of iron oxide as the most important colouring pigment, when oxidizing conditions were maintained during firing. During periods that oxidizing conditions changed to neutral or even reducing atmospheres the surface probably turned grey and colour nuances were lost or became less intense. With the applied firing method, situations like this may occur very localised resulting in a more or less spotted surface. As such, in order to obtain mostly oxidizing conditions at the surface the potters needed good control over the firing process. These conditions may have been obtained by letting in some oxygen in the final stage, by taking away ash and fuel while the pottery was still hot. The fire had to be built up as an open structure, so that the wind could blow through. The vessels were preferably placed up side down in order to obtain a more equal spread of the heat. Alternatively, firing furniture (*e.g.* rocks or broken vessels) could have been used for the same reason in the lowest part of the pile.

Fig. 13. Firing in an open fire
(experiment by Eric Pelissier and David Laporal, Guadeloupe, 1999).

In the case of monochrome *curvilinear incised ware* the surface colours are somewhat less intense and towards light yellowish brown and light reddish brown. More often greyish and blackish-brown areas appear at the surface. In some cases, the colour of the core is partly or completely grey to grey-black, whereas the surface zone shows the lighter nuances. These aspects point to firing circumstances alternating between oxidizing and neutral and a relatively short firing process, like in an open fire without any extra fuel. Probably, less care was taken to maintain strictly oxidizing circumstances.

Conclusions and interpretations: the dynamics of technology, function and style

Already, during the Early Ceramic Age in the Caribbean pottery production was wide spread and potters clearly shared the same basic principles regarding technology, morphology and style. They continued to share these principles over a long period of time. Yet, pottery production was probably rather small-scale, performed at a household level and relied on the personal choices and preferences of the potter embedded in the society's socio-cultural realms. The Amerindian potters used criteria for the manufacturing process based on a collective traditional knowledge that was handed down through generations. This knowledge was in almost complete symbiosis with the technological imperatives; although much more based on an animistic vision of the cosmos. As such, the properties of the selected clay and temper materials, for example, were almost always in close relation to the applied shaping techniques and intended use of the vessel, whether consciously or unconsciously.

The Early Ceramic Age potter was aware of the final product from the very beginning of the production process and carefully selected her/his clays and tools, and then shaped, decorated, finished and fired the pottery as defined by the intended use of the vessel and determined by the local manufacturing tradition. Each ware has next to general technical commonalities its own sequence of techniques (technological, functional and stylistic) in which various processes may have coexisted and variation may have occurred influencing the final product. These variations in technical behaviour may attest to social differentiation related to identity, kinship, post-marital residence, gender, ritual at different levels in the interaction network of Early Ceramic Age groups, and do not necessarily imply static cultural or social boundaries. In this same vein, similarities in technical behaviour may crosscut such boundaries.

Looking back at our sample, similarities and variation in technical behaviour between the wares can be observed at different levels of the manufacturing process. These variations are sometimes of technological order but in some specific cases cultural factors are determinants. Technical constraints must, for example, have played a role in firing the *painted ware* of the Cedrosan Saladoid subseries. In contrast to the other wares, the white-on red and red decorations of the *painted ware* had to be controlled during the firing process in order not to lose their colours. The control over the firing process was less needed for the other wares.

On the other hand, socio-cultural parameters seem to have played a role in the selection of clay and temper materials, in the choices of shaping techniques and in the application of decorative designs.

There is a clear difference in clay composition between the Cedrosan *painted* and *zic wares* in contrast to the La Hueca style *curvilinear incised ware*. The *plain ware*, in general, matches the Cedrosan fabric characteristics. The latter is like the Cedrosan decorated wares tempered with mudstone related to volcanic activity, whereas the La Hueca style *curvilinear incised ware* is tempered with quartz, feldspar and less often combined with fine pyroxene grains that have been added to the clays deliberately or not. The fact that pyroxene is a mineral of volcanic origin makes it likely that a minority of the clays or the temper material was imported to Morel. In this respect, the Morel La Hueca style fabric shows striking similarities in composition and grain types with contemporaneous La Hueca style pottery from the site of Hope Estate on the island of St. Martin where pyroxene is also found in the fabrics (Hofman 1999: 174-176). However, as St. Martin is a composite island pyroxene occurs naturally there. Besides, the Hope Estate fabrics are characterised by some small amounts of wurtzite and sfalerite that seem to be specific for the local clays from around this site area. A test on raw clay samples from the surroundings of the Hope Estate site has showed comparable characteristics between these clays and the fabric of the archaeological sherds from this site (Hofman 1999: 176-177). A local provenience of the Hope Estate clays was, therefore, suggested in this case (Hofman 1999: 181). Because clays are available around the site of Morel they were presumably collected locally. Similarities in the fabric of the pottery from Morel and Hope Estate suggest that the selection of clays and temper materials for manufacturing *curvilinear incised ware* was governed by cultural conventions. This situation is in contrast to the Cedrosan wares, which share similar recipes.

The differences in clay between and within the Morel ware groups seem to be primarily culturally determined, because there are no technological constraints in using either of the clays for either of the wares. The applied techniques are rather tolerant with respect to the materials chosen.

An ethnographic example illustrating the socio-cultural parameters involved in the selection of clays and tempers among contemporary Amerindian peoples in the Guyana coastal region may well be relevant in this context (Bel *et al.* 1995; Jacobs and Bel 1995: 125-130). Among the Palikur of Kamuyune in French Guyana, the preference for burnt and pounded *kwep*, from the bark of *Licania sp.*, used as a temper material is likely defined by ancestral tradition. Next to the fact that porosity increases in its burnt stage it also has the functional advantage of being highly absorptive (Jacobs and Bel 1995: 130). The knowledge about specific clay recipes among the Palikur was passed from generation to generation. A second case study among the Kari'na of the Maroni River in Surinam also attests to the interrelation of technology and ancestral tradition. Among the Kari'na, the clay or *ori:no* is collected by the women from a place along the riverbank where a former village disappeared in the river. A small bowl is made on the spot and is left there or sunk in the water for the *ori:no akï:rï*, the spirit connected with the clay who resides at that place. The clay-spirit is the manifestation of *Okoÿumo,* the water spirit (Vredenbregt 2002: 115). The Kari'na also make use of the *kuwepi* to temper their clays, the *ara:naba:ri* and *kuwepi* trees, from which the bark is taken, are considered forest-spirits that need to be respected. Hence, menstruating women are not supposed to collect the bark since they are not supposed to enter the forest: their 'smell' would upset the spirits. When the bark is burned to form ash and charcoal it is ground in a wooden mortar. The coarseness of the grinding depends on the intended size of the vessel. For large vessels a coarse grinding is needed, while for smaller vessels a finer grinding is required (Vredenbregt 2002: 115-116).

Although the different wares share similar general shaping techniques, of which coiling is probably the most common, variation has been found regarding their application and combination. This variation seems to occur among all wares, and at first sight there is no clear rule to be discerned. However, it should be stated that all techniques might reflect choices of technological order but may also entail socio-cultural behaviour. Palikur and Kari'na oral tradition strengthens the concept that 'everything' is animated in their culture (Bel 1995; Hagen 1991; Vredenbregt 2002). There is a Kari'na story referring to the perception of the coiling technique. The story tells about the forest spirit *kuru:pi* and the bowl, which in fact was a coiled snake (Hagen 1991: 57-58; see also Hoff 1968: 291-295).

Uniformity and symmetry were probably sometimes the determining factors for the potter in choosing one shaping technique over another. The La Hueca style bowls with paired holes, for example, could have been made technologically by the coiling technique despite their very thin walls. However, it is more likely that they were made in moulds. The vast quantities and distribution of this type of bowl among sites with La Hueca style pottery may indicate that this shaping technique was preferred among the potters. Although the manufacturing process was an individual activity, it seems that the potters followed precise rules. Among the Palikur, it was observed that a 100% circular and symmetrical vessel was the highest aesthetical achievement the potter could attain in her work (Bel 1995: 80). The diameter of the base and the thickness of the body of the vessel are clearly related to the shape, size and function of the vessel as well as to the potter's tradition. Drinking cups, for example, were made of thin coils to obtain a thin body, and have large bases. On the contrary, *cashiri* or cassava beer vessels are made of thick coils for a thick body but have bases with relatively small diameters (Bel 1995: 79). Kari'na vessels equally are standardised in purpose and shape. Each of these vessels is made according to its own name (Vredenbregt 2002: 113).

While little variation is found in the decorating techniques among the Morel wares, style variations are much more pronounced. Excising, incising, and engraving occur on both the Cedrosan and La Hueca style wares resulting in similar lines and grooves. Zoned-incised crosshatching, for example, which occurs both on *zic ware* and *curvilinear incised ware* is identically applied resulting in very similar designs. The conditions of the clay, on which some of the decorating techniques are applied, differ between the wares. Modelling and application of small zoomorphic figures and nubbins occur on both *painted* and *curvilinear incised wares*. On the former the grooves were applied when the clay was in a leather-hard condition resulting in a more rigid appearance, while on the La Hueca style they were executed when the clay was soft in a plastic condition. This resulted in a sloppier appearance. This variation also holds true for the application of nubbins and even for part of the modelling of *adornos*. Large nubbins on the Cedrosan pottery have been applied in a leather-hard condition, while on the La Hueca style small nubbins were applied when the clay was still soft. The data suggest that while there is little to no variation in application technique of decoration from ware to ware, the moment of application of the technique, (*i.e.* the condition of the clay), was defined by the potter. However, the type of decoration, its place on the vessel and its relation to a specific vessel shape must have relied on defined functional principles because each ware is characterised by a well-defined set of modes that is not interchangeable. The shape of the typical vessel with paired holes of the *curvilinear incised ware* for example, can be recognised in some cases as an empty turtle carapace. The shell of the green turtle is known to be used as an inhaling object for hallucinogenic drugs in contemporary Amerindian rituals (Harris 1974; pers. comm.). The motif on the turtle carapace may have been a source of inspiration for the crosshatched (*zic*) designs on some of these bowls.

Among the contemporary Palikur, it seems that the application of decorative designs is foremost related to the purpose the vessel is going to serve (Bel 1995: 84-85). The use of slips, natural dyes and pigments and their mixtures for decorating, the tools to apply them and to finish the pottery are similarly related to the intended purpose of the vessels but also, consecutively, determined by tradition. Small red pebbles or *ta:kuwa* among the Kari'na are used to polish the vessel surface. This strengthens the body and closes off its surface, increasing impermeability. Moreover, it also gives the vessel a light, shining appearance. These pebbles traditionally originated from a river where strong and powerful spirits dwelled. The stones are a prized possession of only some women who hand them down from generation to generation (Vredenbregt 2002: 119; see also Hoff 1968: 361).

Besides the fact that style elements and depicted designs may be related to vessel function, the Palikur case shows that the design itself is related to Palikur culture or the Palikur clan system. Each design has its own name based on what is depicted and refers to living creatures in the forest, dances, music instruments and animistic creatures. The latter designs depict fragments of mammals, insects, birds, amphibians, fish and other creatures expressed in lines, dots and circles (Bel 1995: 84, 90-97).

In sum, it can be said that the study of intertwined techniques provides significantly better understanding of the meanings and uses of pottery by pre-Columbian Amerindian peoples during the Early Ceramic Age in the Caribbean. Several stages in the manufacturing process are clearly shared by the different wares and seem to have been part of one Caribbean manufacturing tradition. The variations observed, however, seem to be the result of a dynamic and interchanging set of technical constraints and of the choices and preferences of the potters. The latter may be regarded as the reflection of a specific socio-cultural behaviour, which is also illustrated and supported by the ethnographic examples.

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Notes

1. Rouse has presented, revised, and presented again a fundamental chronological scheme for Amerindian prehistory in the insular Caribbean and adjacent mainland areas (*e.g.* Cruxent and Rouse 1958/1959; Rouse 1939; 1948a; 1948b; 1952; 1986; 1992; Rouse and Cruxent 1963). Rouse has utilized the concepts of style/ceramic style, subseries, and series to trace cultural relatedness geographically as well as temporarily, with the series at the broadest geographic level and the subseries and style at narrower geographic levels (Rouse 1986: 7). The Saladoid series is named after the type-site Saladero in the Lower Orinoco region where this style was first found. The Cedrosan subseries is named after the site Cedros on Trinidad, which is considered the type-site for this local variant.

2. The method used to determine the characteristics of the fabric is the observation of prepared fabric slices through a stereomicroscope with magnifications of 20 to 40 times. The fabric slices were prepared by re-firing them in an electric kiln to a temperature of 750°C under oxidizing conditions. Quantitative and qualitative aspects of these fabric samples are determined by comparing them among each other and with reference materials of known composition. Archaeometrical methods like radiogenic isotopic analysis should ideally be applied in order to identify certain types of non-plastics in the potsherds in comparison to their occurrence in clay sources.

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R.S. Duin

A WAYANA POTTER IN THE TROPICAL RAIN FOREST OF SURINAM/FRENCH GUYANA

Present-day Wayana pottery production

Within the scope of my master thesis (Duin 1998) I conducted an ethno-archaeological study among the Wayana of Surinam and French Guyana beginning in 1996 (Fig. 1). In 1999 and 2000 I returned, in order to continue my study with the Wayana. Today there are circa 1000 Wayana and Apalai living in 21 villages along the Aletani, or upper Maroni river, separating French Guyana from Surinam. With the exception of two conglomerations of over 100 inhabitants, there is an average of 15 to 20 people inhabiting one settlement. It is a Tropical Lowland Culture, practising slash-and-burn horticulture. Their language belongs to the Cariban stock. My fieldwork focused on different aspects of the material culture, but I was specifically interested in architecture and the 'built environment'. During my stay among the Wayana I took part in all activities concerning daily life, and in this way I was also confronted with their pottery production. In fact, I appeared to be lodging with a potters son.

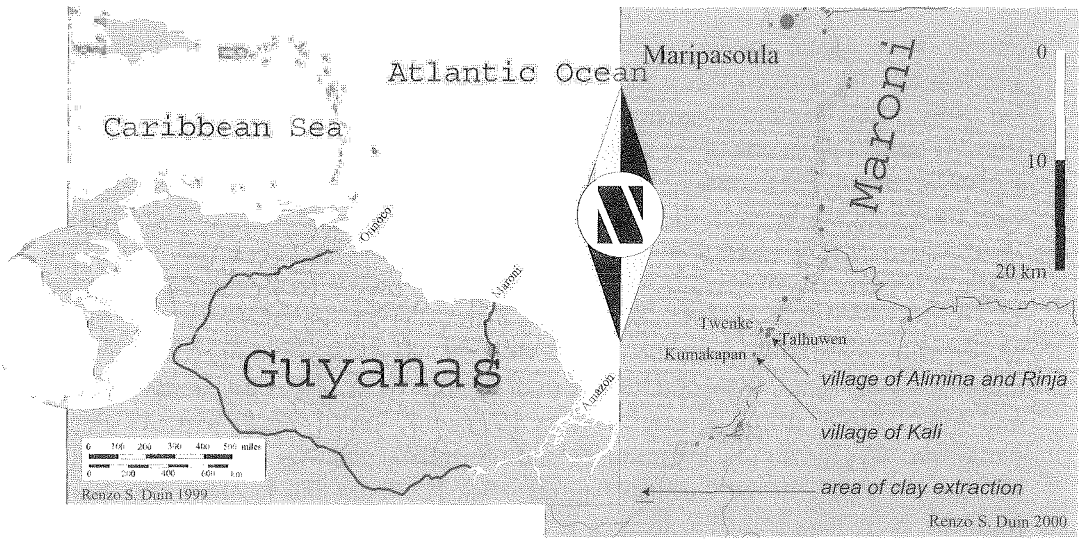

Fig. 1. Map of Wayana area in the Guyanas.

Newsletter of the Department of Pottery Technology (Leiden University) 18/19, 2000/2001: 45-58.

Prior to the fieldwork, I had seen several photographs (Hurault 1968; Darbois 1956) including ceramics. However in the field, ceramics were scarce. Most have been replaced by metal and plastic vessels, cups and dishes. Western products have been adopted by many, for ceramics break easily and water boils more quickly in a metal container. Most ceramics made today are sold to tourists. Some vessels from this stock are used in a manner that differs from its originally intended use. Only elder women use pottery occasionally to cook.

As traditional pottery making is disappearing in many societies, any archaeologist or anthropologist in a position to do so should record the procedures of potters still working (Rye 1988: 14). Hence, I paid several visits to Kumakapan, the village of Kali the potter, in order to study Wayana pottery production: materials, tools, techniques, and firing methods. In 2000 there were two potters, both female, among the Wayana of the Maroni; Kali and Alimina. Kali is in her fifties and some fifteen years younger than Alimina. Rinja, granddaughter of Alimina, is studying to be a potter. Both potters work independently and have no assistants. While manufacturing the vessel they keep contact with the environment and can participate in a conversation taking place in a nearby hut. Kali (Fig. 2) was proud that I showed interest in the pottery production process and well willing to provide information. This article is mainly based on observations[1] of her activities and conversations with kin members. Wayana terms are written in italics for an emic approach.

Production

Pottery (*ëliwë*) among the Wayana is produced with a kaolin clay (*nenuwë*) mingled with a little black clay (*pulune*) that is located in the very same clay bed. Both Kali and Alimina extract their clay nearly twenty kilometres south of their home village, a two hour trip -if not held up in one of the intermediate villages- upstream by canoe. On the occasion of extracting, they combine this with a hunting / fishing trip of one or several days with the whole family. Next, the clay is stocked in a corner of the work hut, which is not exclusively used for pottery production. After a drying period of one to two months this block of dry clay is pulverised in a rectangular wooden mortar (*ako*; whereby *aku* means 'to eat, to chew') with a wooden pestle (*akojep*, literally: 'mother of the mortar', or in a second sense 'tooth of the one who eats'). Pulverised clay is dry sieved in order to remove undesirable inclusions. A required quantity of dry pulverised clay is dry sieved for a second time. Due to irregular maze[2], smaller inclusions such as quartz particles are not sieved out. Wayana do not intentionally add non-plastic additives. In contrast to other Amerindian people in the Guyanas (van den Bel, Hamburg and Jacobs 1995), no ash from the *kwepi*-bark is used as temper. A little water is added by hand to make balls of clay. In general, one clay ball serves to manufacture one vessel. There are more clay balls made than necessary for one session. Leftovers, when dry, are pulverised again.

To form the vessel, a little clay is taken from one of these balls. First a bottom (*iwehe*) is formed in the hand by pinching, or squeezing clay between fingers and

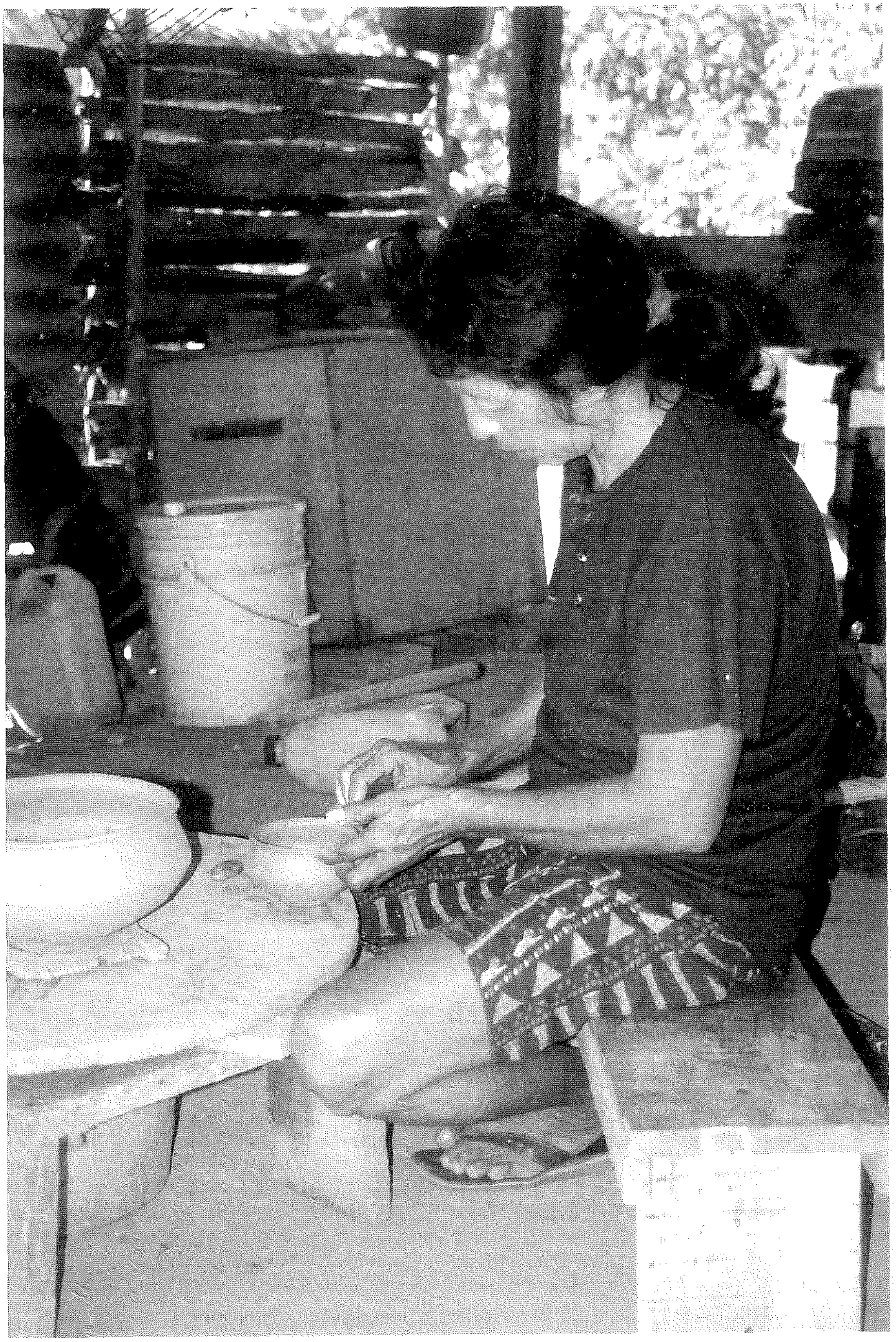

Fig. 2. Kali, the Wayana potter.

thumb. Then clay is taken from the same ball and rolled into coils with the thickness of a thumb (*tïmelemai*). These coils are added to the base, with a little overhang to the outside, and pressed to the preceding ring between fingers and thumb. This technique is known as 'ring building'. Six levels are needed for a 12 centimetre high cooking pot. Wayana do not know the potter's wheel. A small plank or former piece of basketry is used as flat surface support to place a larger vessel and turn it (Fig. 3). In this manner a restricted vessel with simple contour is made. Coils are evened with the thumb, from mouth to bottom. A scraper (*pelo*) is used to smoothen the surface. This *pelo* is a five centimetre long rectangular calabash with rounded corners. Afterwards, an extra coil is added to the opening. By means of the scraper, the lower part of the body is driven outwards, and the wall below the rim inwards. Resulting in an independent restricted vessel with composite contour. In other words, a bowl with a globular wall with corner point and outflaring neck. Instead of a calabash scraper, some Amazonian people use shell for smoothing the superposed coils and shaping the ceramic. For example among the Iawa

> "le mélange de terre et de cendre déroulé en forme de boudins superposés, égalisé à la main et avec des coquillages" (Flornoy 1953: 204).

The rim is rounded and smoothed with a wet fungus (*pijupiju*), that soaks since this water has been used to moister the pulverised clay. To produce a 12 centimetre high

Fig. 3. Cooking pots in preparation and utensils; fungus, calabash scraper, polishing stone.

cooking pot with a diameter of 20 centimetre, an average of twenty minutes is needed before the complex shape is reached. A one-inch coil is reduced to a wall thickness of 8 millimetre. When the potter is satisfied with the form, she places the vessel in her work hut and covers it with a cloth. The vessel is turned upside-down, whereby the neck is supported by a cloth strip. The formative phase has been finished. A second vessel is manufactured.

The following day, the thick clay bottom of the vessel is reduced by means of the scraper. Inside and outside are burnished with a polishing stone (*mele*) -a reddish cobble- when the clay is leather hard. Kali, the potter, explains this is to drive out the water. Burnishing, alike the other activities, starts early in the morning. When the entire surface has been burnished the ceramic is placed aside. Later that day an additional burnishing session may take place.

When, according to the potter, all water is out -after one or one and a half day since the formative phase has been finished-, she starts a fire (*wapot*) just outside her work hut. Firewood is taken from the stock in the kitchen. This fire is increased by means of a fan (*anapamïi*) and both vessels are placed sideways alongside this open-air fire (Fig. 4). Preheating takes place in order to eliminate all free moisture and minimise the risk of shattering during heating with quick-burning fuel. Kali observes the vessels from time to time during preheating, and if she feels it is necessary, some parts of the body are treated with the polishing stone.

After one hour both vessels are shoved in the hot ember by means of a pole, bottom-up. One end rests on a large block of wood or the other vessel to leave space for airflow on the inside. Fresh firewood is stacked in a pile, covering the two vessels. During this open firing process, the first stage is reducing due to an insufficient airflow. Yet when the pile starts to burn down, the vessels are exposed to air, resulting in an oxidised reddish brown outer core. Because the vessel is placed bottom-up the outer-outercore is more oxidised than the inner-outer core. Where firewood rests onto the vessel this results in a reduced spot on the outer-outer core. Unfortunately, no temperature measurements could be taken. After half an hour, once the pile is burned down (Fig. 5), both vessels are shoved from the burning hot ember by means of a pole. When they have cooled off sufficiently to pick them up by hand, both are swept clean. Kali ticks with her finger against the wall to assure it is well fired. *Maka*, it is done, and she places the two vessels in the work hut. In these open-air fires the temperature does not reach high levels. Wayana do not make handles (*tëpeitophem*, literally: 'with helper'). As they explain themselves, handles will break from the body due to low firing temperatures and heavy content -beverage (*oki*), or pepper water (*tuma*) for cooking-.

After firing, *apulukun*-resin is applied onto the outside surface. This resin bears the same name as the tree it originates from (*apulukun*, *Inga alba* (Swartz) Willd.). Resin application gives the vessel a polished appearance. Wayana say this is to strengthen the pottery. After firing the potter may well decorate the vessel by painting, incision, and/or modelling. Although not commonly practised today among the Wayana for "it takes to much time" as they clarify themselves.

Fig. 4. Both vessels are placed sideways alongside an open-air fire during preheating.

Fig. 5. After half an hour, once the pile has burned down, both cooking pots are done.

Colour application on ceramics[3] is threefold: uniform red, white-on-red, or polychrome. This practice differs from slip application as commonly seen with ceramic decoration. When the clay is dry it is pulverised and sieved, as we have seen already for the preparation. This pulverised dry clay is mixed with *mëpu*-resin (*Hymenea courbaril*, L.) and applied by means of a brush (*imiliktop*), consisting of a shaft of wood or bamboo with a feather or cotton tip. Points can be applied with a 'pointer' (*etihtim matop*), a fishbone or sharpened splinter. Red clay (*ëliwë akpiu*) can be found higher on the bed slope; white kaolin clay (*nenuwë*) from around water surface; black/blue clay (*pulune*) found in small patches in the same bed as kaolin; yellow clay (*kuli*) from the riverbed; yellow-green clay (*katawa*) from deep below the riverbed.

Incisions consist of zones filled in with dots, parallel lines, as well as zoned-incised-crosshatch (Fig. 6). Zones filled in with parallel lines named 'without dots' (*etihkapïn*) in Wayana. Zoned-incised-crosshatch is named 'with dots' (*tetihkahem*). It appears figures are zones, filled in 'with dots' or 'without dots'. Depending on the technique utilized, the appearance of the idea 'with dots' consists of zone-punctate (drilling, painting), or zoned-incised-crosshatch (carving, painting). When carving wood, bone and shell, it is not unchallenging to make 'dots'. Therefore the idea of *tetihkahem* is converted into a physical appearance of crosshatch. On the other hand, all three appearances (dots, parallel lines, and crosshatch) can be applied by painting.

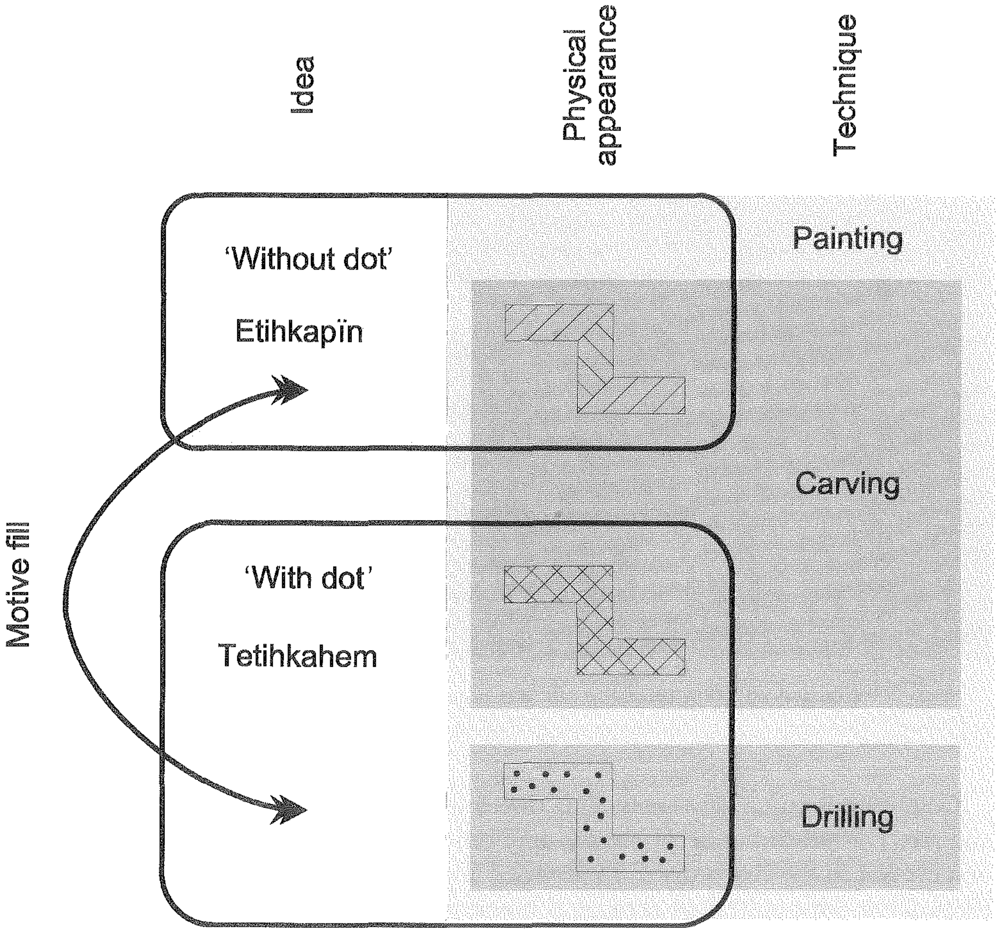

Fig. 6. Motives filled in with dots, parallel lines, or crosshatch.

Use

Most ceramics are used in food processing (Fig. 7). For a more detailed description of the Wayana culinary tradition see "La marmite Wayana" (Schoepf 1979). The following elaboration describes the use of pottery some twenty years ago when plastic and metal vessels were less prominently present. Today, Wayana have found a metal or plastic equivalent for each ceramic item.

First, there are large vessels (*oha*) for cooking and storage of drinks, especially for the large quantities of cassava beer. They have a large volume and a wide opening in order to stir the cassava beer with a small oar (*anekatop*) serving only for this purpose. Large quantities of cassava beer, for gatherings, were prepared and stocked in canoe-shaped

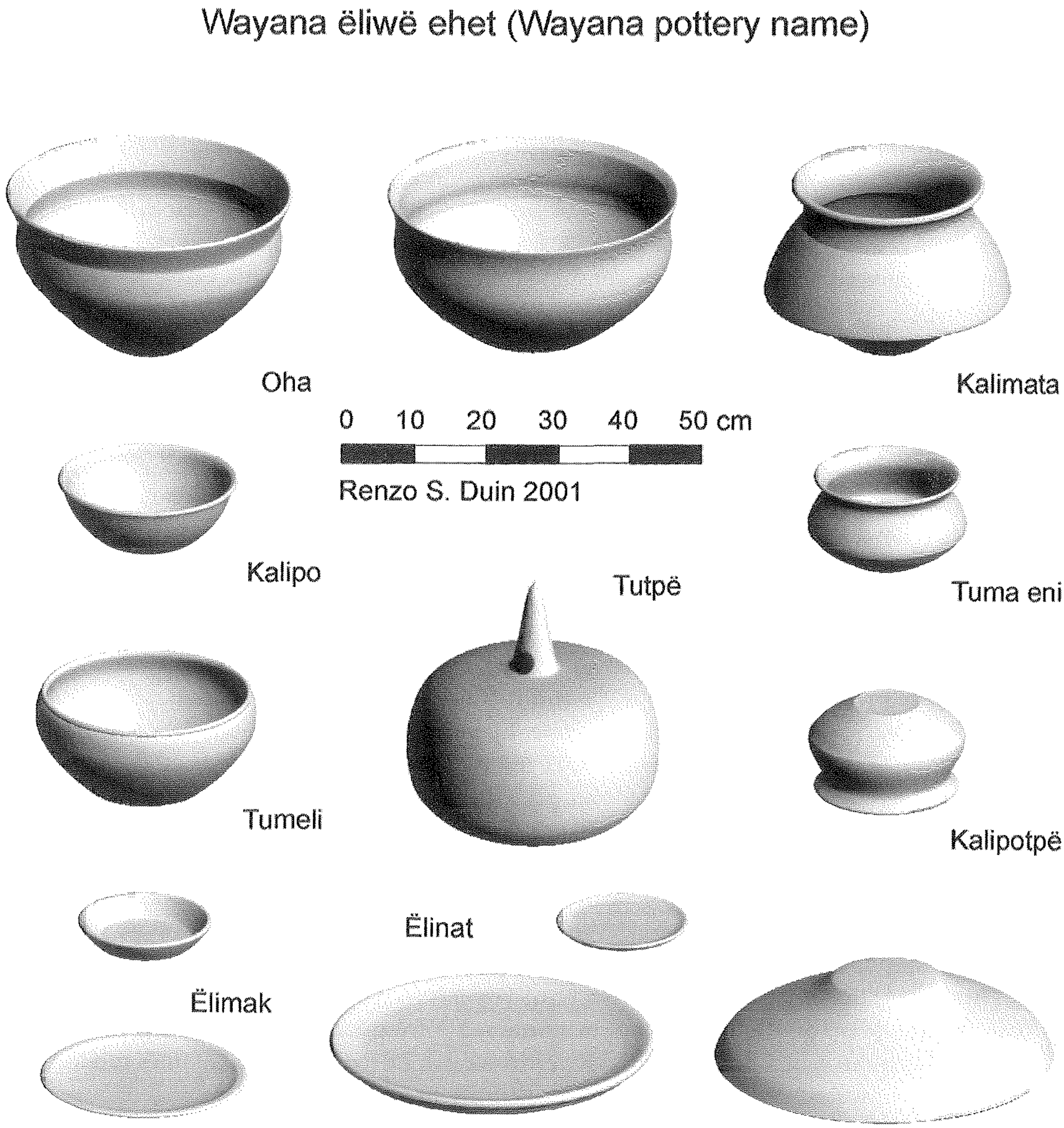

Fig. 7. Wayana pottery types.

wooden troughs with handles at each end (*kanawa* or *okï eni*. *Eni* meaning container and *okï* is the general name for beverage). To transport large quantities from one village to another, massive waterproof basketwork panniers (*maipuli*, literally: tapir) were used. Today plastic barrels are used to prepare, stock and transport beverage. For distribution of drinks through the village, another vessel (*kalimata*) was used.

There are several kinds of beverages. *Kaseli*, or the well-known cachiri, made from bitter manioc (*ulu*, *Manihot utilissima*), is just one of them. Other drinks based on bitter manioc, but with different kinds of preparation, are *hakula*, *sakula*, and *umani*. Sweet manioc (*tapakula*, *Manihot esculenta*) is used to make a drink by the same name (*tapakula*). Sweet potatoes are used to make *napek*, bananas for *palu ewku* or banana juice, and sugarcane for *asikalu ewku*. Just after preparation all drinks contain a very low percentage of alcohol and are consumed like beer in ancient times Europe.

> "Haren dranck maekense van Casari, is dick ghelijck Verkens-Draf, maer is witachtigh ende krachtiger om te drinken als Haerlemmer Bier" (Pietersz. De Vries 1911 [1634]: 190).

It is the common drink of everyone, even of the nippers. Only after three days of fermentation, and longer, does it attain a certain alcohol percentage and is it drunk during gatherings. Secondly, ceramics were used to serve beverage to guests, as described above. Most of these bowls (*kalipo*) have an outflaring rim, other bowls (*tumeli*) have an inward turned rim. Bowls made of split calabash (*kalapi*, *Crescentia cujete*) serve this purpose too. These calabashes are also used to pour out drink in ceramics from the stock. Today saucepans, with an average content of two litres, are used. Thirdly, there are griddles to bake cassava bread[4]. The ceramic one is named *ëlinat*, while the metal replacement is named *pan*. Like all ceramics, the griddle (*ëlinat*) is also made by the coiling technique. Fourthly, cooking pots (*tuma eni*) in which pepper water (*tuma*[5]) serves to cook fish and game. Cooking pots seem to be larger variants of *kalipo*. Finally, plates and dishes (*ëlimak*) upon which food is placed. Food from the cooking pot is taken by the cook and placed upon his/her plate with a little *tuma*, some peppers and a little salt. Then, all who have been invited may eat from this plate. Cassava bread is placed upon another plate. When Wayana eat they do not drink.

Water containers (*tuna eni*[6]) are not mentioned. The Wayana then do not have ceramic water containers. Calabashes (*tutpë*, *Lagenaria siceraria*) are used to store water, although today they have been replaced nearly everywhere by plastic buckets or barrels. These are different from the calabash bowl (*kalapi*). Some are up to sixty centimetres in height, whereby the neck has been restrained during the natural growing process. These keep the water, obtained from a nearby stream or river, cool. Small ones can also be used as musical instrument, though principally used when babies are present.

Beyond food processing are 'former ceramic' (*ëliwotpë*), reused pottery, *e.g.* as a stove, or to mix soot with *apulukun*-resin in order to obtain a black colorant that is used in basketry and woodwork. The 'former bowl' (*kalipotpë*) is placed on top of a circular house as roof weight to prevent palm leaves from being blown away, and to prevent rain coming in. This is a cover to protect. In another case, related to a shaman rite *toimai*, a ceramic was placed in front of a persons face when he died. Yet another small bowl, with white bands onto a plain red, had been dug up and reused to store beads. However, it is beyond the present article to discuss these items in detail.

Symbolism of pottery

Oral tradition tells why women have to manufacture and fire pottery. It was a menstruating woman who approached the 'Mother of the pottery', and the treasure had been spoiled forever.

> "Car jadis, comme l'enseigne les récits mythologiques, les Wayana-Aparai recevaient toutes leurs terres cuites de la Mère de la poterie. C'est elle qui leur prodiguait les platines à galettes de manioc, les grandes jarres à cachiri, les marmites à cuire et les récipients à boire. Mais depuis qu'une Wayana indisposée s'est rendue auprès de la gardienne, le trésor a tari et ce sont les femmes qui doivent façonner et cuire l'argile" (Schoepf 1976: 80).

Pottery (*ëliwë*) is also linguistically related to woman (*wëlïi*) and the female sex and womb (*ëli*). In 1999, Kali did not make pottery because her son had become father of a baby girl. She explained that if her pottery would break during firing, this would cause damage in the lower abdomen -or womb- of her granddaughter. When the pottery (*ëliwë*) breaks, the womb (*ëli*) will break. This according to the Law of Resemblance[7]. Only after a given time period is this taboo abolished. Other Wayana explicate that pottery is heavy and so the baby will become heavy.

In the myth of the Hero Twins (*Mopo Kujuli*) we see how Mopo and Kujuli were sheltered, when they were still in their eggs, under a large vessel (*oha*) by their grandmother Toad. Important elements of this myth are described by de Goeje (1941: 76-81), whereby de Goeje himself notes that this version includes many a hiatus, but the report by Coudreau (1893: 548; Coudreau writes *Couyouri*) is even less complete. Moreover, Coudreau assumes this story is of Christian origin. De Goeje (1941: 77) considers this untrue. Further on in this story, grandmother Toad shelters under a ceramic bowl (*kalipo*) when the Flood arrives. This myth conditions pottery as a metaphor of protection. Furthermore, Kujuli builds the first roundhouse (*tukusipan*). On top of this roundhouse, a ceramic is placed as roof weight and to prevent rain coming in. Protection once more. The roundhouse, in itself a reference to the Universe due to its microcosmic nature, protects against the ferocious environment. We have seen above that pottery is related to the womb, and the womb protects too.

Pottery is mainly used to cook cassava beer and bake cassava bread. Lévi-Strauss, in his Mythology series, presents the symbolism of cooking.

> "The cooking being a cultural transformation of the raw, and the rotten its natural transformation" (Lévi-Strauss 1978: 478).

Cooking, or boiling, is a 'cultural' act whereby both fire and water are used.

> "Boiling takes place inside, whereas roasting is cooking from the outside" (idem: 482).

And as Lévi-Strauss continues, boiling is 'endo-cooking'; in the house for a small, closed group, while roasting is 'exo-cooking; outside the house, offered to strangers.

	culture		nature
non-processed:		raw ↙ ↘	
vs.			
processed:	cooked	roasted	rotten

As a consequence, pottery is symbol of culture. Referring to the protective womb and related to the Universe in which we dwell, pottery is a cultural medium to transform raw into cooked. Pottery is regarded the ultimate cover, *i.e.* protection.

Epilogue

This article is a contribution to the descriptions of procedures of traditional pottery making, as asked for by Rye (1988: 14). Although there is still the odd hiatus in this article concerning Wayana pottery production, *e.g.* temperature measurements and symbolic analysis of the motives themselves, it offers a rather complete portrait of Wayana pottery production, along the upper Maroni, border river between Surinam and French Guyana, in the last years of the second millennium A.D.

Furthermore, this article is a contribution to the development of operational models for interpreting archaeological data, concerning the study of ceramic production in the region studied by Caribbean archaeologists. Possibly the methods and techniques described in this article may give support to specialists in ceramic analysis in developing their hypotheses.

Acknowledgements

First, and most of all, I am gratefully indebted to the Wayana for their hospitality and generous interest in educating me. For the discussions I had with Ronni and his family, especially his mother Kali the potter, Tasikale and Takwali. Secondly, all who have heard my stories and stimulated me to write them down. For their financial contribution in 1998 and 1999, I want to thank the Reiman de Bas, p/a Prins Bernard Fonds, the Netherlands. Thank you to the Prefect of French Gyana who gave me his autorisation to enter the Wayana territories. Finally, thanks to Alistair Bright, for correcting the English text.

Notes

1. In the summer of 1998, video recordings of the manufacturing process have been made too. These recordings have been used to review the pottery production process, and will be edited in the near future for educational purposes.

2. Today plastic sieves are used, replacement of basketwork sieves (*manali*) as they are still in the production of cassava beer.

3. The same techniques are used for decorating the wooden disk (*maluwana*) at the top of the community house.

4. There are three kinds of cassava bread, all made from bitter manioc. As the items used in preparing cassava have no equivalent in English the Wayana terms are not placed within brackets. The manioc root is grated on a *simali* that is placed on a *kuluwata*, pressed in a *tinkïi*, dry sieved on a *manali*, and finally baked – without further additives – on a *ëliknat*; a) *sisiakan*, thin and sun-dried, for long-time conservation; b) *ululakan*, thick, preferably to be consumed within three days; and a variant used to prepare cassava beer (for *hakula*, *sakula*, and *umani*); c) *kutuli*, coarse pancake made from dried *kaseli* that was left to dry in the *kuluwata* after rasping, has to be eaten the same day. Griddles vary in diameter from twenty centimetres – for *kutuli* -, supported by a tripod *mikutu*, up to one meter - for *sisiakan* and *ulalakan* -, supported by three stones (*ëlinat tepu*, also called *ëlinat ahmit*, literally: 'griddle bench'). Schoepf (1979: 60) notes that three former vessels used as support are referred to as 'woman of the griddle' (*ëlinat ipït*) and a cylindrical support of pottery in the centre is named 'penis of the griddle' (*ëlinat ewom*).

5. *Tuma* is a mix of water and *kaseli ewku* (juice received from pressing bitter manioc, that is boiled next, and from which foam has been skimmed) to which red, orange and yellow peppers (*assi*, *Capsicum frutescens*) are added. A lot of peppers for the elders and very few for the children for they do not like their meal spicy. If not finished, the fish or game rests in the pot that will be stored in the kitchen in order to serve for the next meal. Last scraps in *tuma* can be mixed with *kutuli* from the *kuluwata* and cooked to a treacly *tïklewe*, tasty as dip for cassava bread.

6. This is a general name, not to be confused with *tuma eni*, or cooking pot.

7. For the Law of Resemblance see Ahlbrink (undated).

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R.E. Arkema

TANNIN IN EARTHEN ARCHITECTURE: A CASE-STUDY ON THE USE OF TANNIN AS AN AMENDMENT FOR ADOBE PRESERVATION

Introduction

In 1995 the Museum of New Mexico, in cooperation with the Getty Conservation Institute and Cornerstones Community Partnerships organised an Adobe Workshop. The aim of this workshop was to give the participants such as architects, archaeologists and conservators the opportunity to gain some hands-on experience in working with adobe conservation. During this workshop the participants were introduced to Jemez State Monument, a site incorporating ruins of both Indian and colonial origin, where the participants were given some explanation by the conservator on the use of Rhoplex 330. This is an acrylic polymer used as an amendment to the mud for re-pointing and re-plastering. The resulting material becomes very hard and the process is irreversible but the plaster or mortar remains permeable. Some time later, however, it became clear that the acrylic polymer was only used for the ruins of colonial origin and not for the Indian ones: the Jemez tribe, still existing and apparently having some authority in this field, does not want to see synthetic chemicals being used for their ruins; they insist on natural materials. This means that while the maintenance of the ruins can be reduced with the aid of the acrylic polymer, a more intensive maintenance scheme is needed for the ruins of Indian origin.

Terminology

Before continuing, throughout this article two terms will be used that may want some explanation. The most neutral description for buildings made of a mixture of clay, silt and sand is earthen architecture. All over the world different terms are used. In the Middle East the term *mudbricks* is common. In the United States it is common to call all types of earthen architecture *adobe*. In the USA by the term *stucco* is meant an exterior finish and *plaster* an interior finish (Beas 1991: 6) whereas in Great Britain a distinction is made between renders and plasters: a render can be made of a number of aggregates but a plaster is usually made of gypsum (Ashurst and Ashurst 1988: 16, 27-28). For the sake of convenience, in this article the term adobe is used for the mixture of sand, silt and clay or any style of earthen architecture. The term plaster is used to denote any surface rendering.

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Modern or synthetic products are not the only products available nor necessarily always suitable. A wide variety of amendments for a protective coating exists such as bitumen, various vegetable and animal products etc. but the use of 'natural' products in trying to improve the properties is often criticised. It is said these products do not have any effect at all. At best they do not damage the structure but they do not have any positive effect either. Using natural materials may even mean an attack on an already fragile ecology. This is rather illogical as it suggests people applying natural products are basically wasting their time. Most building techniques and methods are the result of many years of trial and error and usually have a very sound and practical reason, although they are not always visible immediately. Although time may be considered more precious now than perhaps many years ago this does not mean people were interested in spending more time than necessary.

When working on old buildings and materials, it is best to respect the underlying philosophy and specific character of the materials. Transposing modern methods and materials over another, older style of building simply because they are today's standard and are 'harder' or 'better' bypasses this principle and seldom works well. Older building principles are usually designed to work with a problem, *e.g.* water is allowed to creep into a wall to a certain degree but is also given the opportunity to evaporate. Modern principles are more directed against a problem, *e.g.* keeping the water out at all costs. This also means that a failure in the defence strategy inevitably leads to problems.

The basic problem in all cases is the required maintenance, which is often too much of a burden. This is not to say adobe is too weak and unsuitable, it offers many advantages but regular maintenance is part of any building. In the case of archaeological sites this is even more true because in most cases the roofs have disappeared exposing the remaining parts to more weathering than designed for. Archaeological ruins are not the only type of structures that are of cultural or historical interest and need preservation. Two more categories can be thought of for which more natural or locally available products may be closer to reality and useful. A second category are buildings that are still lived in or at least habitable but are of considerable age and of cultural or historical value. As these buildings are still in use (re)plastering or repairing the plaster and mortar is the obvious choice. A third category for which cement or modern, synthetically produced and expensive chemicals are not a viable option is present-day, low cost housing. Around 30% of the people in developing countries live in houses made of earth (Houben and Guillaud 1994: 6). Proper and affordable housing for people in developing countries remains a problem. To give just one quote: David Smail, an architect from Zambia:

> "The critical shortage of housing is probably the single greatest problem facing developing countries in Africa today" (Smail 1990: 122).

The situation described led to the idea to write a M.A. thesis on a more natural product (Arkema 1996/1997; 2000). After returning from the Adobe Workshop I decided to contact CRATerre-EAG (International Centre for Earth Construction - School of Architecture of Grenoble, Villefontaine, France). CRATerre-EAG is a well-known organisation active worldwide and dedicated to the use and research of earthen architecture. They agreed to support and supervise the thesis and in cooperation it was decided to focus on one material: tannin. Tannin is mentioned in the literature as an example of a natural amendment to adobe but has never been studied in more detail, except for a small experiment.

As the basis for this research on tannin the empirical experiment was taken as carried out in 1979 by Mr. H. Houben from CRATerre-EAG in Burkina Faso, a country in West-Central Africa, while working on a project there (Houben 1996). At the time an additional structure for temporary use was needed and the opportunity was taken to employ several local techniques for improvement of plaster with natural materials, one of these being tannin. The local technique and materials were used to prepare the plaster. Seeds from an Acacia tree were boiled in water for some time to which a small number of fist-size rocks were added (Fig. 1). This water was then mixed with soil and straw and used for the plaster. Acacias are a sort of tree common on the African Savannah as well as in other parts of the world (except colder regions) and come in many varieties. Acacias are known for their high percentage of tannin. The dried bark of the *Acacia mearnsii* De Willd., also known as Black Wattle, may contain up to 30-54 % tannin (Duke 1981: 7). The experiment was documented photographically but has not been published until 1996. The photos from the report taken several years after completion suggested the tannin amended plaster had hold out better than the unamended plaster.

One of the elements involved in the process that has caused some confusion is the addition of a small number of rocks to the boiling vessel. The pieces of rock turned out to be limonite. Limonite is a mineral consisting of iron hydroxides only (Švenek 1991: 126-127). Tannin is known to react with iron oxides but not iron hydroxides. Iron hydroxides are not soluble in water or acid solution. Three reasons why they may have been added:

1. Boiling stones. It is not uncommon to add a small number of porous stones to a boiling vessel. The boiling is calmer and it may also help to prevent damage to the vessel.
2. Crushing. When stirring, a small number of stones added to the mixture may help crushing the seeds and enhance the leaching out of tannin.
3. A third reason could be that the local population believes that the stones will give their "energy" to the plaster and make it as hard and durable as stone.

In other words, adding any porous rocks may help in the boiling and extracting process but is not a precondition for this particular process.

The questions to be answered in the thesis were: what is tannin and what effect does it have when added to an adobe mixture?

Fig. 1. Preparing the liquid: boiling the seeds for two hours (H. Houben 1979).

Tannin

Vegetable tannin or tannin extract is a common name given to a complex and heterogeneous group of matter traditionally used to turn hides and skins into leather. According to White the term 'tannin' was introduced by Sequin in 1796 to

> "...denote the substances responsible for the leathering ability of various plants extracts; unless a substance can be shown to possess this function, it cannot be termed a tannin." (White 1958: 98).

Part of a brief description given by the *Encyclopædia Britannica*, not based on chemical composition:

> "Tannin, also called tannic acid, any of a group of pale yellow to light brown amorphous substances in the form of powder, flakes, or a spongy mass, widely distributed in plants and used chiefly in tanning leather, dyeing fabric, making ink, and in various medical applications. Tannin solutions are acid and have an astringent taste." (*Encyclopædia Britannica* 1994).

All vegetable tannins are polyphenolic compounds having in common the ability to tan.

They are soluble in water, precipitate gelatinous matter, give an astringent taste (a reaction with the mucus proteins in the mouth) and colour iron salts green-black or blue-black. When an extract displays these features it is most likely to contain tannin (Hegnauer and Hegnauer 1994: 234).

The chemistry of tannin is very complex. Vegetable tannins are the subject of study by different disciplines such as biology, chemistry and pharmacology. As a result, the nomenclature is a mix of terms not necessarily having to do with tanning. Over the years many attempts have been made to classify tannins. A commonly found classification still used today was made by Freudenberg in 1920. He divided tannins into two groups, hydrolysable[1] tannins and condensed tannins, based on the reaction product which appears when treated with acids, alkalis or enzymes. The (poly)phenolic element is seen as the most salient feature for the tanning properties of vegetable tannins (Fig. 2).

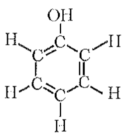

Fig. 2. Structure of a single phenol molecule. All vegetable tannins are polyphenolic compounds of varying composition.

Secondary plant products

Vegetable tannins have a widespread use by man but the original and intended use is of course by the plant itself. Vegetable tannins are part of what is called secondary plant products. Secondary plant products are responsible for the colour, smell and taste of plants and play an important part in the capacity to either attract or repel insects and herbivores.

Together with lignins, another secondary plant product, the effect of this combination is described as:

> "....(tannins)....reduce both the nutritional availability of soluble plant proteins and polysaccharides and the activity of the digestive enzymes and symbiotic micro organisms of the herbivore's own gut; lignins increase the toughness of plants and inhibit digestibility. By complexing, and thus preventing the breakdown of, nucleic acids, proteins and polysaccharides, both classes also contribute greatly to the stability of plant detritus and to the formation of the important humic acid elements of the soil." (Swain 1979: 658-659).

Uses

Vegetable tannins have been used by man for a very large number of purposes and have a long history. The history of vegetable tanning goes back thousands of years. Some people have reported the finding of well-preserved leather at an ancient German site dated 10.000 B.C. (Kay 1958: 161). Pods of the *Acacia Nilotica* and partly processed and finished leather have been found on a 5000-year old tannery site in Upper Egypt (Hillis 1987: 61).

It is impossible to describe all the possible applications but the most interesting for this study is the use in anti-corrosion. At the time when steam engines were common tannin extracts were used in the treatment of boiler water. The extract prevented the interior of the boiler from corrosion (working as 'oxygen scavengers') but also helped in preventing the deposition of hard scales on the boiler tubes. Depending on operating conditions, the extract gave the internal surface a blue-black coloured layer, believed to also help against corrosion but to a limited degree (Knowles and White 1958: 15).

At an archaeological excavation in 1950 in the Hungate district of York (UK) a number of objects from Roman and medieval times were retrieved from a waterlogged silt and clay site which were in a remarkable state of preservation. The iron objects were most striking, they showed no signs of rust and there was no sign of rust in the surrounding soil. All iron showed patches of blue and black colour (Biek 1963: 142). Although more factors were involved the effect was attributed for a large part to the presence of tannin. This remarkable feature led to a study on the use of a tannin extract as a pre-treatment wash primer to prevent iron from atmospheric corrosion. In the 1950's even the cast iron roof of the Big Ben, after mechanically cleaning and prior to its repainting, was given a coating with a tannin extract which proved to be able to withstand several months of winter atmosphere in good condition (Knowles and White 1958: 16-17). This feature has also found its way into conservation. It is not uncommon practice for conservators in museums to treat smaller archaeological objects made of iron with a tannin solution and finishing it off with a micro-crystalline wax, giving the objects a black shine.

Sample material

The literature on the use of tannin in combination with earthen architecture is very scarce and the report from experiment carried out in Burkina Faso did not mention any percentages. The first step was to obtain some tannin and create a few samples to get an idea of the effects and the possible percentages needed to achieve an effect.

Tannin can also be produced synthetically resulting in so-called syntans. These syntans are however, in contrast with vegetable tannins which are basically harmless, considered hazardous products and harmful and were therefore discarded as an option. Vegetable tannins also come in pharmaceutical (very pure) quality, available at a price of ca. $ 60.- per kilo (1995) from laboratory suppliers. The Wattle Bark Industry from

Pietermaritzburg, South Africa, produces several varieties of vegetable tannins from the bark of the Black Wattle (Acacia species) for tanning purposes, distributed worldwide. One of these varieties is ME Mimosa, a light brown, red powder, belonging to the group of condensed tannins. This type was available at $ 1.- per kilo (1995). ME Mimosa is a natural untreated Mimosa extract composed of (based on Information Document 118 provided by the Wattle Bark Industry, September 1999):

Water	6%
Polyphenolic content:	70%
Non-polyphenolic content:	
gums	10%
sugars	9%
nitrogenous compounds	3%
Mineral ashes :	2%

With regard to the above-mentioned arguments it was decided to use ME Mimosa[2] for the experiments as it was probably more realistic and closer to the conditions from the empirical experiment.

At first a range of small cylindrical samples with a complete arbitrary mix of sand and clay was made with tannin percentages of 5%, 10%, 20%, 30% and 40%. From 10% onwards the samples became increasingly difficult to mix with percentages, sticking very strongly to the mixing bowl and utensils and difficult to rinse off. A good comparison here is probably with caramel: the samples exactly resemble the colour and consistency, are very sticky and when held between two fingers make it possible to 'draw threads'. After curing no difference could be noted in sample hardness above 5%. The final result was a very hard material. The tannin percentage to be tried with a proper adobe mixture was therefore determined from zero (control sample) to four percent, in steps of one percent.

The next step was to create a representative sample material that was as neutral as possible, minimizing the influence of any other matter such as iron oxides. However, there does not seem to be such a thing as an average adobe material. Different regions have different soils, climatic conditions and different requirements (Austin 1990: 417). Acquiring ready made bricks, analysing and reconstituting them was not an option either. It would be impossible to define all the materials involved. The process would also be very laborious. Bearing this in mind, for practical reasons a sample material was created with clay, silt and sand of which the composition was known. The materials chosen:

Clay: a pure grey river clay, montmorillonite family.
Silt: clean loess from a quarry, only quartz (particle size ranging from 0.004 to 0.6 mm.).
Sand: washed river sand, mainly quartz (particle size maximum of 2 mm.).

As said, there does not seem to be such a thing as an average adobe mixture but it is possible to create an optimal or more or less representative adobe mixture.

The greatest mechanical strength and resistance to water action can be achieved by reducing the voids ratio and increase contacts between grains. For spherical grains, the Fuller formula can be used to calculate the relative proportion of each grain fraction of a different diameter when arranged in the densest possible environment (Houben and Guillaud; 1994: 80).

Using this formula resulted in a composition of 10% clay, 34% silt and 56% sand in varying particle sizes.

The separate components sand, silt, clay and if desired tannin were added to a mixing bowl in dry state and well mixed. For example, to produce 1 kg. of material which could then be used to form a range of cubes means: 460 gr. of sand in various fractions, 340 gr. of silt and 100 gr. clay. When an amended material was needed tannin was added to this kilogram in the appropriate percentage, *e.g.* 40 gr. if a percentage of 4% was desired. Under continuous mixing tap water was added until the material had the right consistency for moulding. The material was then pressed into a miniature wooden adobe mould giving cubic samples of 4 x 4 x 4 cm. All the samples were left to cure and labelled according to their composition, *e.g.* AS 1% meaning Adobe Sample with 1% of tannin.

Soil or adobe can be subjected to a very large number of analyses and tests based on identification analyses, performance tests, development tests and many more. As standard analyses specifically designed for adobe are still not common, the experiments for this study were chosen based on practicality and to suit the demands. Water and weathering are the greatest enemies of adobe and with conservation in mind a range of tests and analyses was performed of which, this article being a summary, only three of the more important analyses are represented here: the drip test, an analysis on permeability and a test on abrasion resistance.

Drip test

The drip test is a test designed to simulate under laboratory conditions the erosion of adobe material by rain (Ghomari 1989: 59). The principle is to subject a sample material to a constant sequence of droplets of water from a fixed height at a rate of one drop per second for a specific period of time until measurable result. This principle remains constant but the way of carrying out this test varies. Ghomari uses a test bank that could hold five samples simultaneously whereas Beas (Beas 1991: 102 ff.), testing plaster samples, takes one sample (31/2" x 31/2" x 1") at a time which is placed horizontally and subjected to droplets falling from a height of 2.5 metres. Width of erosion, depth of erosion and width of absorption are recorded.

For this test a simple structure was built using square tubing to create a pole placed on a supporting substructure. As dispenser a burette containing 50 ml. of water was attached to this pole (Fig. 3), giving a drop height of 1.5 metres. A burette is a piece of laboratory equipment originally designed for titration purpose and made specifically to give an accurate droplet of water of exactly 0.05 ml. The tap can be adjusted to give the

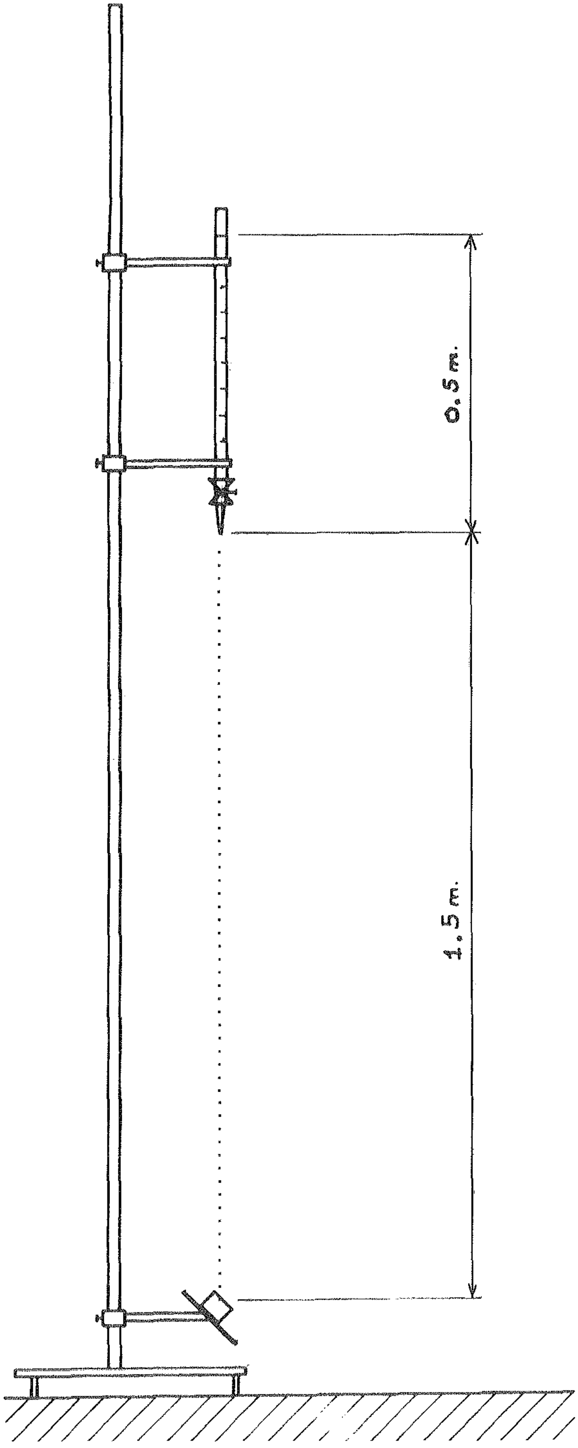

Fig. 3. Schematic drawing of the set up for the drip test.

required rate of droplets. At a rate of one droplet per second this means a total of 1000 droplets. One sample at a time could be tested in this way. Three unamended samples and two amended samples, with 1% and 2% of tannin added, were tested at a horizontal positioning and at an angle of inclination of 45°.

The results of this test were quite remarkable. The unamended samples showed a predictable result: the clay particles loosened and the sample was weakened. The impact of the droplet caused the sample to disintegrate after one full burette (50 ml. or the equivalent of 1000 droplets). The angle of inclination had no effect (Fig. 4). The amended samples with 1% of tannin added, however, showed no effect at all. The amended samples were subjected to a total of four loads of a burette (200 ml.) each and reached a water uptake close to the saturation point but did not show any signs of erosion. This suggests an adequate protection would be achieved with even such a small percentage.

Permeability

A test on permeability is meant to measure the amount of water passing through porous material over a definite period of time. This is a key feature of adobe which is a porous (permeable) building material and an element that must be respected if problems are to be avoided.

Several ways to determine the permeability exist, ranging from simply putting a droplet of water on a horizontal surface and measuring the time for the droplet to be fully absorbed to the ASTM standard E 514-72 "Standard Test Method for Water Permeance of Masonry" which describes an elaborate setup using a wall of at least 1.22 m^2

Fig. 4. Unamended cubic (4 x 4 cm.) sample completely disintegrated after 50 ml. Amended samples did not show any erosion.

(12 ft^2). A method well in between is the Rilem Test Method II.4. Rilem (Reunion Internationale de Laboratoires d'Essais et de Recherches sur les Matériaux et les Constructions) is an organisation located in Paris, France, which by technical committees develops standard methods for measuring the quality of building materials. The Rilem Test Method uses a simple test tube with a surface area of 5.7 cm^2 at the lower end and a total height of water of 9.8 cm which can be easily affixed to a horizontal or vertical surface. The quantity of water absorbed by the surface of masonry over a definite period of time is thus measured. Strangely enough, despite the fact that the Rilem method is often propagated in literature as a suitable method and published documents with photos of the tube exist, it has proved impossible to find the original standard and an official test tube. After contacting Rilem in France they suggested this test may not have reached consensus within the technical committee and ultimately was not published (?). Some improvising was necessary and a similar device was made of 10 ml. syringes with the narrow end cut off. This resulted in a set of suitable tubes with a diameter of ø18 mm. x 74 mm., giving an inside diameter of ø15.8 mm. and a surface area of 1.96 cm^2. The flange was glued to the surface of the samples with a silicon kit. Four samples of each percentage were tested: the tubes were filled to the zero mark with water and a reading was made every half hour (Fig. 5). For the results compared with the absorption from the unamended samples see Table 1.

	after one hour:	after seven hours:
AS 1% upside	- 16%	- 15%
AS 1% underside	+ 84%	+ 41%
AS 2% upside	- 67%	- 59%
AS 2% underside	+ 67%	+ 28%
AS 3% upside	- 83%	- 69%
AS 3% underside	0	- 13%
AS 4% upside	- 100%	- 92%
AS 4% underside	- 49%	- 69%

Table 1. Results of the permeability test compared with the absorption from the unamended samples.

This test yielded some unexpected results as well. The figures show a clear distinction between underside and upper side of the samples. This aspect was as to be expected: when the samples were formed they were put to dry on a flat surface and a concentration of tannin, a thin film, was formed at the evaporation side creating a more dense surface structure. The water uptake increased, however, at points where it was expected to decrease. In short: an overall decrease in water uptake at the upperside of the samples but an increase of water uptake at the underside of the samples till 3%. Possibly,

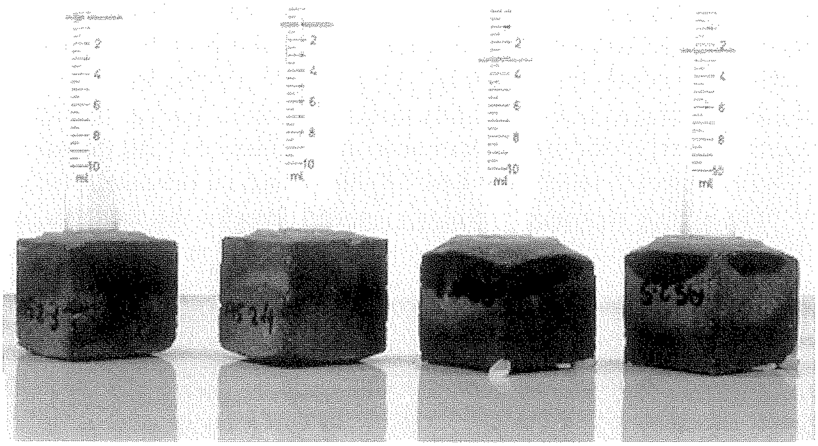

Fig. 5. Samples with 2%. On the left the tubes are affixed to the upside, at the right the tubes are affixed to the underside.

the explanation is as follows: in amended samples it is tannin which takes over the role as primary binder for a considerable part. At smaller percentages of tannin the porosity is only minimally altered and water is allowed to pass freely, the clay particles cannot swell and block the passage ways. From 3% onwards the pores tend to get clogged and permeability is reduced. A maximum of 3% for optimal results is in accordance with other tests. The thin film of tannin at the surface is likely to erode away in practice. Permeability is a key feature of adobe and an element that must be respected when a plaster is applied but a strong hygroscopic tendency may not be desirable either. It is difficult to say what this will actually mean in practice. The full meaning of this can only be judged when a plaster will be applied to a true, outside wall and monitored for a longer period of time.

Abrasion resistance

An abrasion resistance test is intended to simulate erosion by wind-borne particles. An analysis on abrasion resistance can be made in a simple way such as described by Houben and Guillaud where a dry brick is scrubbed with a steel brush several times. The abraded material is weighed and expressed as loss per square centimetre (Houben and Guillaud 1994: 135).

Another method and commonly used in adobe conservation is a technique developed by Darrel Butterbaugh and described by Morgan W. Philips in the article "Acrylic precipitation consolidants". This technique uses a micro-abrasive unit with predetermined settings. Samples are subjected to a metered blast of micro-abrasive, the resulting holes are filled with the abrasive matter and the volumes are expressed as centimetres of material removed per second of blast (Philips 1982: 57). This last method was taken as the basis for an analysis on abrasion resistance but altered somewhat for practical reasons. First of all, it is difficult to create fully identical conditions compared with similar analyses done by other people. For example, Morgan Philips describes an abrasive unit with 0.046 cm. internal nozzle diameter, operating pressure 120 psi[3] (≈ 8.3 bar), working distance 3.8 cm. and as abrasive S.S. White no. 9 glass beads (Philips 1982: 59) whereas Beas, in her thesis, uses 60 psi (≈ 4.1 bar) and a different abrasive: glass beads MS-XL from MDC Industries Inc., Pennsylvania (Beas 1991: 88). This means a one-to-one comparison, however desirable, is not possible. Secondly, filling the holes level with abrasive and measuring the amount was not seen as a suitable option because of the very hard surface of the samples at higher tannin percentages. In the case of small holes this might lead to inaccuracy.

For these reasons the test as described by Morgan Philips was taken as the basis but adapted. This test was not executed at the Department of Pottery Technology but at the Department of Metal Conservation at the ROB, Amersfoort, headed (then) by R. Meiers. The equipment used was a Joke Micromat 100 from Joisten & Kettenbaum, Germany (Fig. 6).

Settings used here:

Pressure:	1.8 bar (≈ 25 psi)
Powder flow setting:	4
Nozzle diameter:	0.75 mm.
Abrasive:	glass beads 70-110 micron
Working distance:	1 cm.

Operation pressure and powder flow setting are relatively low here because higher settings did not work well.

Three samples of each percentage were analysed. All samples were weighed, blasted for five seconds at one spot and weighed again. This sequence was continued until all samples had been blasted at five different spots for 5, 10, 15, 20 and 25 seconds (Fig. 7). Samples with a higher percentage needed a longer period of blasting as they showed hardly any effect at shorter periods. The scales used to weigh the samples were a "Mettler" electronic balance with an accuracy adjusted to 0.01 gram. The results are expressed as loss in weight in grams. An average was calculated and set out graphically (Table 2 and Fig. 8).

The results of this test are fairly straightforward and largely as expected. The results show a linear line in loss of material for all the samples. Adding tannin indeed improves the resistance to abrasion. Higher percentages of tannin obviously increase the abrasion resistance but the results of this test do not show any difference in resistance to abrasion further below the surface for any specific percentage, suggesting an even distribution of tannin throughout all the samples. Adding 1% of tannin does not have too

Fig. 6. The abrasive unit, a Joke Micromat 100 from Joisten and Kettenbaum, Germany.

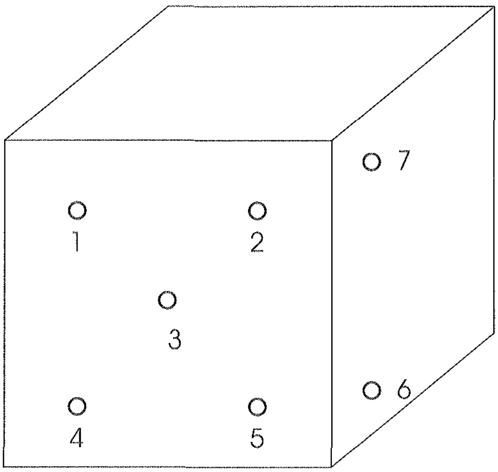

Fig. 7. Sketch of sample and the spots where they were blasted.

	After 5 sec.	After 10 sec.	After 15 sec.	After 20 sec.	After 25 sec.	After 40 sec.	After 60 sec.	Total after 15 sec.	Total after 15 sec.
AS 0%	0.31	0.37	0.47	0.60	0.67			2.42	
AS 1%	0.17	0.22	0.35	0.39	0.48			1.61	
AS 2%	0.06	0.06	0.12	0.14	0.10	0.26	0.39	0.48	1.13
AS 3%	0.05	0.03	0.05	0.07	0.03	0.06	0.14	0.23	0.43
AS 4%	0.05	0.02	0.02	0.05	0.02	0.02	0.07	0.16	0.25

Table 2. Loss of weight averages of micro abrasive test (in grams).

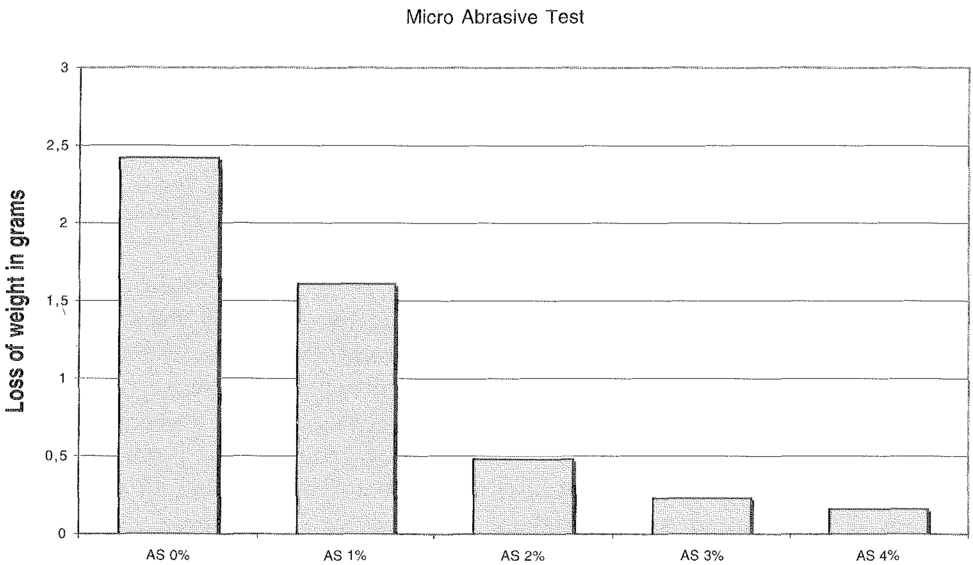

Fig. 8. Average values of the micro abrasive test after 25 seconds.

much influence on the abrasion resistance. A clear distinction can be seen at 2%. From 2% upwards the resistance to erosion is greatly increased and a higher percentage does not result in a significant improvement. In short, for improvement and increased resistance to erosion a percentage of 2% of tannin added would suffice.

Conclusion

The aim of the research was to determine the effect of a natural product, tannin or rather vegetable tannin extract, when added as an amendment to adobe material, somehow as a reaction against the present day emphasis on cement or synthetic products. The research was more specifically directed at the possible use for conservation purposes.

Natural products are often seen as useless or at least are said to have only a minimal effect. They do not improve resistance to weathering but the exploitation of the source may be detrimental to the natural environment.

It will be clear from this study that the use of vegetable tannin extracts does indeed alter and improve the properties of the material. The results of the Drip Test were most striking: amended samples with just 1% of tannin added did not show any signs of deterioration. Unamended samples were completely eroded away. The test on permeability showed the samples remained sufficiently permeable up to a percentage of ca. 3% of tannin. The hygroscopic tendency raised questions with regard to the evaporation but an analysis on evaporation (not represented here) showed water vapour was allowed to pass freely without causing any problems. Adding tannin makes the material much harder as was shown in the test on abrasion resistance. Already a percentage of 2% will greatly increase the resistance.

Higher percentages above 3% will make the material harder but will give a saturated material resulting in a material which is no longer suitable. Permeability and evaporation, key elements when dealing with porous building materials ("the need to breathe"), will be reduced to an unacceptable low rate. Depending on circumstances and use, the maximum lies at 2% to 3%. Higher percentages may only be useful for something like hardening floors.

So how does it work? It would seem that the basic polyphenolic properties in combination with sand, silt and clay are responsible for the effect. Sand, silt and clay are basically chemically inert but all these ingredients have a surface that has a tendency to polarity, most notably clay. One of the best known chemical properties of water is its high polarity. Together with its ability to form hydrogen bonds makes it a good solvent for ionic compounds (Atkins 1989: 736). When all the ingredients are mixed and water is added, the vegetable tannin extract dissolves readily. As a result of the action of water, the H atoms of the hydroxide on the polyphenolic molecules get loosened resulting in a slightly acidic solution and phenoxide ions which are willing to react or adhere. When the water evaporates the phenolic compound polymerises. The phenolic elements bind together to form even larger polymeric polyphenolic compounds but at some points also adhere to the sand, silt and clay. The result is a cross-linking polymeric matrix throughout the material locking all particles in place. The bonding between the phenolic elements is fairly strong but the bonding with the clay, silt and sand is basically a polar bonding. This means that the polymer itself is not easily broken down or dissolved in water (after hardening) but the polar bonding is susceptible to the action of water. The SEM (Scanning Electron Microscope) photos (Figs. 9 and 10) give a good visual picture of the result.

There is some room for irony here. The idea was to do some research on natural products, as a reaction against the present-day emphasis on synthetic chemical products. Tannin extracts are basically a 'chemical' solution much like any synthetic product. Vegetable maybe, but still a chemical solution.

The argument of environment is often held against the use of natural products. Using natural or vegetable materials under marginal circumstances may mean an

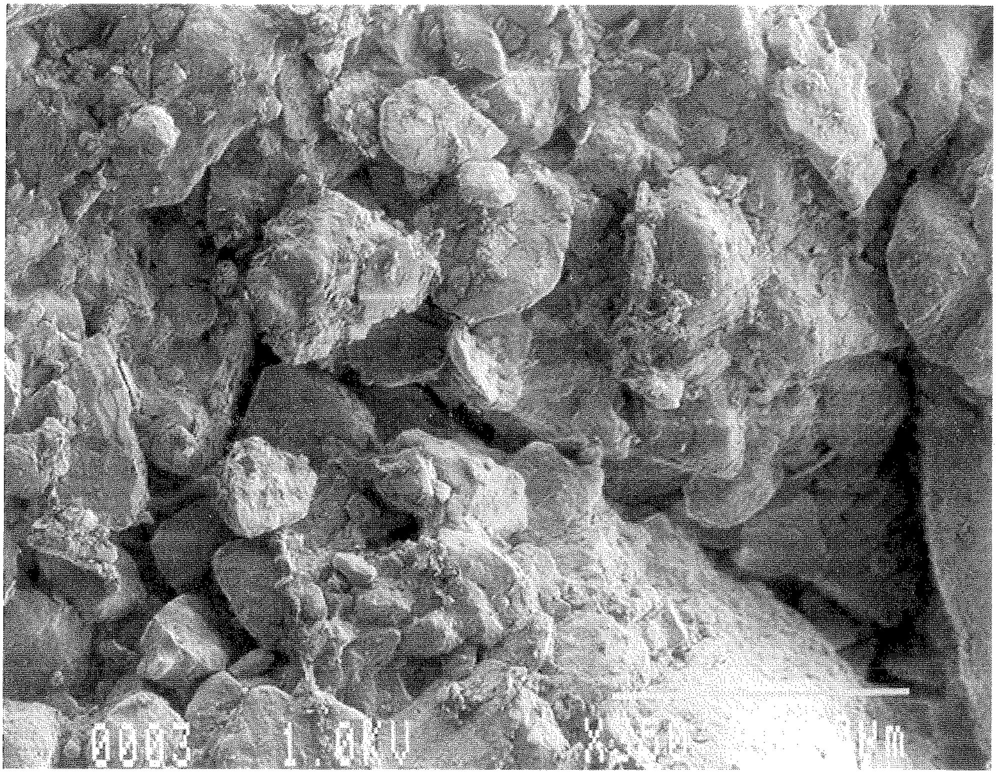

Fig. 9. SEM (Scanning Electron Microscope) photo of surface of adobe sample without any tannin added. Clearly visible different grain sizes, the rather loose structure and the obvious porosity. Magnification 350 x. (Photo taken by T.J. Gortenmulder at the FOM JGM).

infringement upon the natural environment. This argument does not hold in the case of vegetable tannin extracts made of the pods of Acacia species. As a matter of fact, it is quite the opposite.

If only the seeds are used the tree itself is not damaged in any way. Acacias are well equipped to survive under difficult conditions. For this reason the tree is used in several states of India where there is a need for tree planting and plantations but the conditions are less favourable (Singh 1982: 283). In 1991 an article in the French magazine "Ca m'interesse" a research project by French scientists involved in using Acacias to try and stop the advance of the desert was mentioned[4]. In short, using tannin extracted from the seeds of the tree is anything but environmentally unfriendly. Depending on the local situation, it works both ways. Compare the figures 11 and 12 and the potential will become clear.

Based on the results of the experiments and the arguments mentioned above, a vegetable tannin extract may well be a useful amendment to an adobe mixture. Given the

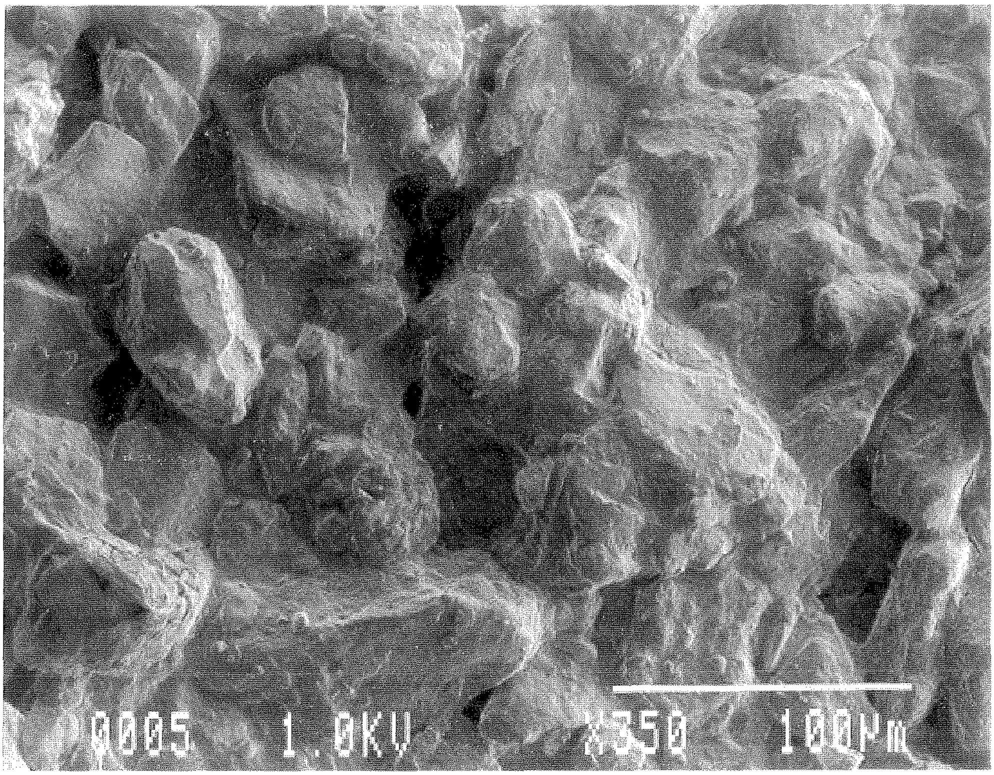

Fig. 10. SEM (Scanning Electron Microscope) photo of adobe sample with 2% of tannin added. From 2% onwards samples (at least outside structure) seemed saturated. Visible the grains embedded in what looks like a paste, porosity hardly noticeable. Magnification 350 x. (Photo taken by T.J. Gortenmulder at the FOM JGM).

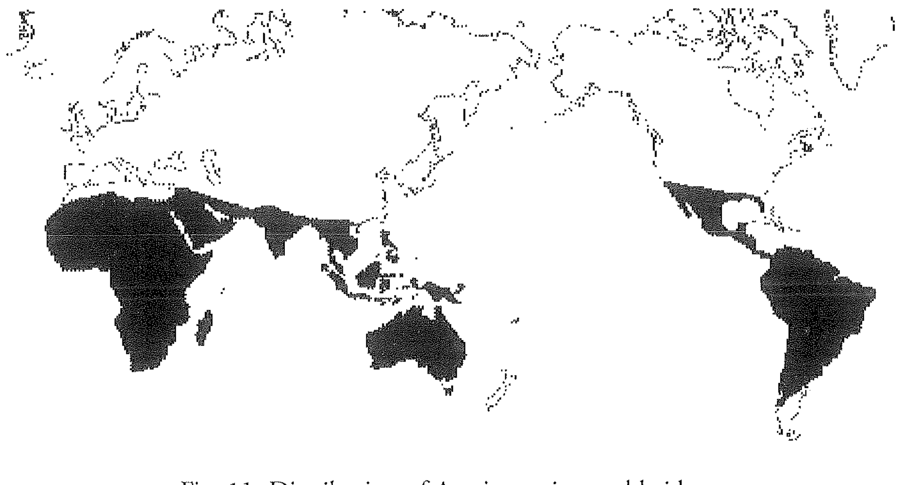

Fig. 11. Distribution of Acacia species worldwide (source: Australian National Botanic Gardens). Compare this map with Fig. 12.

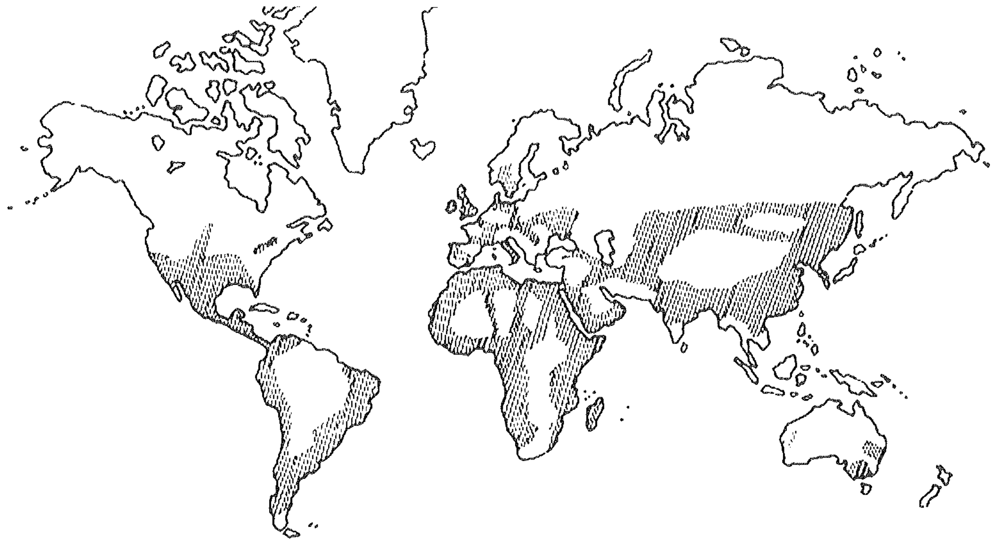

Fig. 12. Distribution of earthen architecture worldwide and the potential will become clear. Note also the different viewpoints: Fig. 11 has Australia and the Pacific at its centre. Fig. 12 is typically Europe-centric (Houben and Guillaud 1994).

relatively low price of tannin it seems a fairly good and cheap solution. The amended plaster or mortar will eventually leach out but the maintenance will be greatly reduced. The use of a vegetable tannin extract as an amendment also remains within the philosophy of earthen architecture. The advantages of building with earth are mentioned by P.G. McHenry, on his website[5]:

- available on-site, worldwide
- processed by the sun
- semi-skilled labor
- low energy cost
- ecologically best
- a viable solution to low-cost housing

Some considerations (but I can think of quite a few more):

1. Adding tannin will change the appearance to give it a very dark-brown colour. Depending upon application and taste, this may or may not be desirable.
2. Any tannin amended material will eventually leach out. The use of a whitewash applied on top of the plaster may even cause unwanted discolouration when the materials start to mix.
3. Tannin is known to react with iron oxide, resulting in an iron tannate complex which is black and hard. Most (sub)tropical soils are rich in iron oxides. At this point it is impossible to say what the effect will mean in practice. This is probably the most important feature that will need more attention in the future.

4. No analysis was made of the adhesive properties because the sample material was amended rather than a different kind and because of the sticky character of tannin. Since the amended material was found to be much harder, the expansion/contraction coefficient may be different from the source it is applied on, especially when applied as a plaster on large surfaces such as outside walls where large temperature changes may be involved.
5. Other types and percentages of clay may affect the results as well. Although in general the amount of clay present in an adobe material is small, this means the bonding properties may vary.
6. The experiment in Burkina Faso and all the experiments in this study were carried out with one example of tannin, a condensed tannin. A hydrolysable tannin extract, though still a tannin extract and having properties belonging to phenolic compounds, may give somewhat different results.
7. To what extent is the application of an amended plaster reversible?
8. Basically, the effect on a longer term remains to be seen. Using any material for conservation purposes is only admitted if information out of the field has existed for a period of at least twenty years. This is a good practice based on bad experience.

Overall, the results of this study may be called positive but this research should also only be regarded as it was intended: an attempt to analyse, on a small scale under laboratory conditions, the effect of tannin on an adobe mixture. It will not provide a cure-all but as Giacomo Chiari wrote, "The necessity of maintenance can never be stressed enough" (Chiari 1990: 271), it may well help reduce the maintenance. Or, as Michael Taylor wrote in his introductory speech to the conservation, maintenance and repair section at the Terra 2000 conference:

> "I personally have come full circle on various approaches in repair and maintenance after working on research projects that tested a variety of chemical additives and consolidants to retard the erosional rates of earthen walls. The tests provided useful information on the behaviour of these applications, in particular that, at least from my limited experience, chemical additives and consolidants are often neither compatible nor cost effective to use. And then there are the uncertainties associated with application procedures and availability of the products. Of course there are certain times when chemical treatments are warranted, especially when dealing with decorated surfaces. However, for most of our maintenance and repair need, I believe that good soil and good craftsmanship work wonders. In addition, there are many naturally-occurring additives such as cactus mucilage and lime, that have been used for centuries to help protect walls, and they definitely warrant more study, application and reintroduction where proven appropriate." (Taylor 2000: 191-192).

Notes

1. Hydrolysis: the splitting of a bond by means of water. For example, the splitting of salts, weak acids or weak bases. Condensation: a reaction in which two molecules combine to form a larger one and a small molecule is eliminated.

2. The vegetable tannin was actually freely provided by P. Driesen, a tannery company from Dongen, The Netherlands.

3. 1 psi = 1 pound per square inch = 1 $lbf/in^2 \approx 6.89476 \times 10^3$ Pa
 Pa = pascal, derivative SI-unit (Système International) of pressure and tension = N/m^2
 1 bar = 10^6 dyn/cm^2 = 10^5 Pa

4. I tried to find out more about this project and the team and contacted the staff of the magazine "Ca m'interesse". They had no further information and suggested to contact Orstom in Paris. They were unable to comply but they suggested to contact Orstom in Senegal. Who had no information but they suggested to contact University Cheikh Anta Diop de Dakar in Senegal. Where they did not have any information but they suggested to... etcetera. Somewhat further up on the trail I decided to leave it at this.

5. http://www.earthbuilding.com

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ON THE SIGNIFICANCE OF LOCAL CLAY PIPES FOR AFRICAN ARCHAEOLOGY:PRESENTING NEW FINDS AND A TYPO-CHRONOLOGY FROM MALI

Introduction

African tobacco pipes exhibit a dazzling degree of variation (*e.g.* Dunhill 1969; Lecluse 1985; Mildner-Spindler 1992). It is the daunting task of the archaeologist to capitalize on this diversity in his/her historiographical endeavours. Key, here, is due recognition of the various dimensions to the attested pipe variety, whether temporal, spatial, social or functional. Up to date, temporal variation has received the most attention. In the archaeological literature on West Africa, there has been a widespread optimism on the usefulness of tobacco pipes for accurate dating of archaeological sites from the post-1500s (*cf.* Mauny 1952a; Ozanne 1962a; Shaw 1985). Yet, only in Ghana, significant achievements have been made in this respect (*e.g.* Boachie-Ansah 1986a; 1986b; Ozanne 1962b; Shinnie and Kense 1989). The formulation of reliable typo-chronologies requires a vast amount of data, which is preferably recovered from multiple, well-dated sites. Considering the current state of affairs in African archaeology, there is still a long way to go for comparable results in other parts of the continent.

As tobacco pipes do not only demonstrate diversity in time but also in space, pipe typologies can similarly be made to reflect geographical divisions, which can in turn be instrumental in reconstructing contact areas. Attempts have been made to bring to light the initial route of tobacco diffusion throughout West Africa (*cf.* Shaw 1960; Ozanne c.1966; 1969; Philips 1983), but also later trade links and migrations might be revealed in this way. Local synchronous diversity in pipe styles and shapes can further be analyzed in terms of social differentiation. On the basis of ethnographic studies, we can assume the likelihood that certain pipes were reserved for specific social classes in terms of gender or status (Ozanne c.1966: 2-3). In addition, we may not exclude the possibility of some pipes being so-called ethnic markers. This is however a very tricky affair to prove archaeologically. Even if we had external evidence for pipes being material statements about (desired) ethnic affiliation, the interpretation of the archaeological record in terms of ethnic divisions still contains many pitfalls. To name but one: Would the increased frequency of a certain 'ethnic' pipe design merely reflect the demographic changes of the corresponding ethnic group or are we witnessing the increased popularity of pipe smoking within this group? Alternatively, there could have

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been a case of cultural dominance. Coexisting groups may have opted to incorporate foreign pipe designs into their own material vocabulary.

A further dimension to be considered is that the diversity in smoking pipe designs might well be rooted in functionality. To some extent, form may follow function. Size variability could possibly be explained in this way. Pipes for communal smoking are likely to be larger than those for solitary smoking. Likewise, tobacco pipes are generally bigger than those for cannabis consumption.

In this article, I will present a preliminary typology of tobacco pipes from Mali (Fig. 1) and discuss its potential for dating and geographical analysis. The main sources for this undertaking comprise Daget and Ligers' (1962) publication, and unpublished survey and excavation material from the Inland Niger Delta. As none of the excavated pipe fragments were retrieved from recognizable contexts, nor subjected to chemical analysis, attempts to social and functional inferences will not be made. Nor will the social impact of smoking, however meaningful, be topic of discussion here (*cf.* Baram 1999).

A pipe typology for Mali

Mali once had a thriving pipe industry, producing besides wooden and metal pipes, large numbers of mostly orange, red to brown slipped stem-socket ceramic pipes, which were highly polished giving them a *terra sigillata*-like appearance. Others were coated with a white slip, occasionally in combination with red or brown paint (*e.g.* Fig. 6.3). To various extents, the pipes are decorated with line incisions, dentates, and/or circular and floral stamping. Some specimens show evidence of unfired white clay inlay. Most specimens have a perforated base for string attachment for easy suspension. Overall, the tobacco pipes are quite distinct from the female produced local kitchenware, which is much coarser, thicker and tempered with grog. Both males and females having been engaged in tobacco pipe production this technological difference is not so much the result of gender separated spheres of socialization (Welling 1999: 74), rather an explanation has to be thought in the unsuitability of the older kitchenware technology for the production of small and refined pipes, such as the first examples in the region must have been. This proposition was confirmed by L. Jacobs of the Leiden University Department of Pottery Technology, who experimented in reproducing the Malian pipes (Jacobs 1999: 98-103). The thin walls created by pinching technique and their tenuous decoration necessitate a refined clay of high plasticity. The temper is small-grained and in most cases makes up a mere 5 to 10 percent of the fabric.

In constructing a typology of these morphologically very diverse pipes, the practical usage for the archaeologist is taken as point of departure. As such, the historically and ethnographically known, metal and wooden pipes are unscrupulously left out. These materials do not survive in the archaeological record and are thus of no concern here. Further, as new forms will undoubtedly be exhumed as archaeological research continues, the final typology was given an open and flexible structure to allow for new types

Fig. 1. Mali.

to be incorporated. In order for new types to be integrated most successfully, a typology should be constructed in a clear, analytical way (Adams and Adams 1991). At the same time this will greatly enhance its transparency. Additional information can be added in a supplementary description.

A third consideration concerns the highly fragmented nature of most archaeological finds. Typologies constructed for complete pipes render most retrieved materials useless as unclassifiable. The archaeologist is thus best served with separate typologies for pipe bases, stems[1] and bowls. Separate typologies will furthermore reduce the number of attributes in any one typology, which will again improve its transparency and applicability. While distinct typologies for pipe bowls, bases and stems are desirable, at present, a meaningful typology of pipe bowls is a bridge too far. The bowl often being extremely fragile, the recovery of (almost) complete pipe bowls is extremely rare. This impedes accurate typology construction, yet at the same time, it renders such a typology less of a priority, as its archaeological demand will likewise be low. We thus focus on analysis of Malian pipe base and pipe stems.

The main source for this typological endeavour is a seminal article by the French researchers Daget and Ligers (1962) entitled *Une ancienne industrie malienne: les pipes en terre*. This well-documented work, geographically concentrating on the Inland Niger Delta, combines basic description and illustration of 281 pipes and pipe fragments. Other references to Malian tobacco pipes in the archaeological literature are found in Bedaux *et al.* (2001), Filipowiak (1979), Insoll (1998; 2000; 2002), Mauny (1952a; 1952b; 1961) and McIntosh and McIntosh (1989). Particularly, Insoll's finds in Timbuktu are important, as it concerns a large assemblage of 306 excavated fragments (Insoll 2002; Clague 2000). Sadly, the taphonomy of the site, consisting of what Insoll calls 'islands of archaeology', stands in the way of a detailed chronological study. Further, the presumed oldest recovered pipes, which are painted, still date only to early 1700s. The study contains an elaborate classification of stem and bowl decorations.

In addition, the typology draws on systematic survey finds in the Inland Delta between Djenné and Mopti and a small excavation at the site of Ladekouna on the West bank of the river Bani, approximately 60 km Northeast of Djenné (see Fig. 2). The survey was conducted by Annette Schmidt over a period of six months in 1994 and 1995. The excavation also dates to 1994 and was co-directed by the Institut des Sciences Humaines, Bamako, and J. D. van der Waals. The site consists of four small tells (site nos. 452.30 to 452.33) surrounding a depression which, for most of the year, is inundated. The tells are 3.8 to 5.2 meter high and on the most westerly a trench was dug, measuring 3 by 6 meters. A 2 by 1.5 m extension was later made in the upper layers to allow easy entry and exit. Due to the poor visibility of the "natural" stratigraphy, the unit was excavated using artificial layers of 20 cm. The top 8 layers contained pipe sherds. After refitting, the assemblage comprised 186 pipe fragments, of which only six were near complete. Of the 186 fragments, 79 contain (part of) the stem and 47 (part of) the base. In order to obtain a statistically more meaningful distribution of the fragments the 8 layers were combined into 4 strata, going from bottom up. Stratum I comprises layers 7 and 8 (n=52); stratum II just layer 6 (n=53); stratum III includes layers 4 and 5 (n=44); and stratum IV layers 0 to 3 (n=37).

On the surface of Ladekouna, pipe sherds were remarkably more numerous. More than 1600 pieces were collected at random from the surface including 238 stems and 485 bases.

The survey revealed twelve tell sites containing pipe fragments to a total of 89. The number of fragments per site ranged from one (four instances) to twenty-eight (Table 1)[2].

The base and stem typologies proposed here are systematizations of intuitive *gestalts* largely based on morphology (Adams and Adams 1991: 42). The typology of the bases is constructed on three attributes, namely *markedness* (unmarked, foot, extended stem), *contour* as seen from aside (rounded[3], flat), and *circumference* as seen from below (circular, square, quatrefoil, amorphous). Not all value combinations are practically possible.

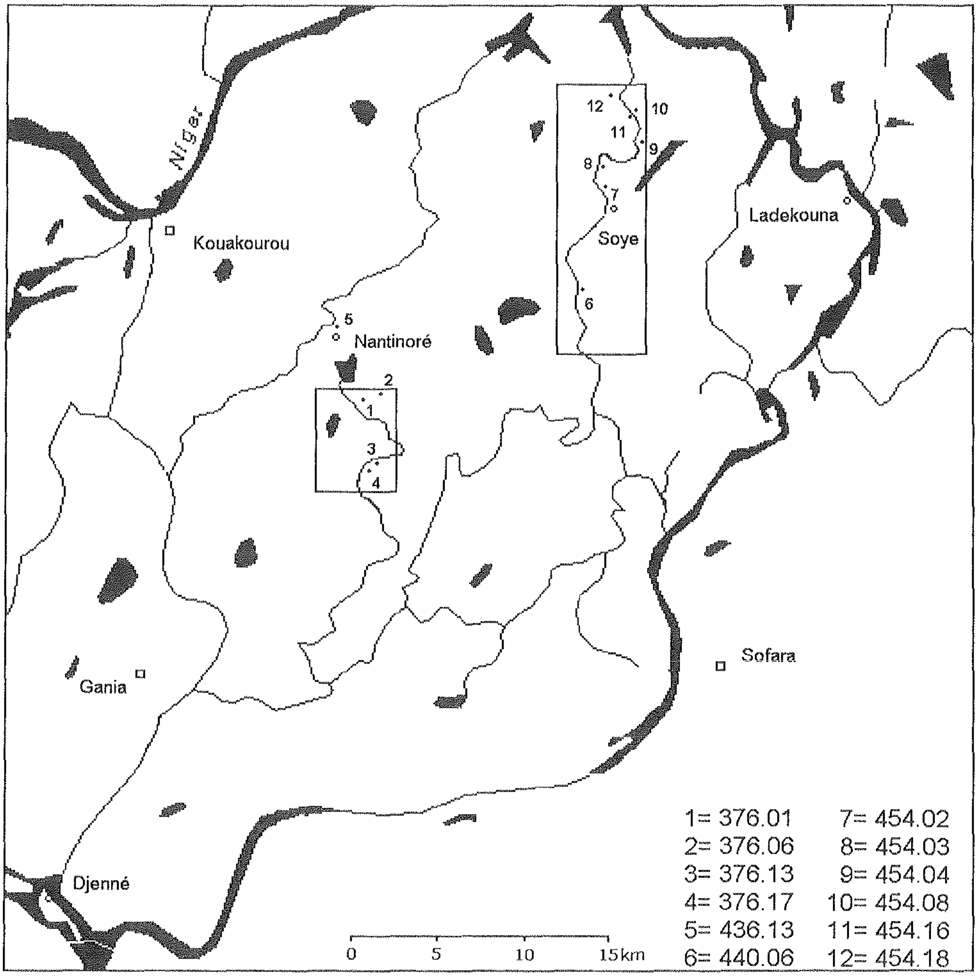

Fig. 2. Survey transects in the inland Niger Delta.

All footed bases are necessarily flat in contour. Similarly, an extended stem implies an amorphous circumference. In Table 2, all conflicting combinations are marked with X. Attested shapes have been assigned a type number. The remaining blanks are viable combinations, but have so far not been found in the archaeological record.

As circular, footed bases make up the large majority of the recovered material, I have made an additional sub-classification of this type into high (> 0.5cm) and low (< 0.5cm). In much the same way, square feet can be subdivided according to height. At present, I have refrained from doing so as the number of square-footed bases is rather low and their internal diversity limited. The height distinction within type I is meaningful, as we

Site	Bases	Stems	Total
376.01	2	6	9
376.06	6	12	21
376.13	0	0	2
376.17	8	11	16
436.13	16	11	28
440.06	1	1	4
454.02	1	3	4
454.03	5	6	11
454.04	1	0	1
454.08	0	0	1
454.16	0	1	1
454.18	0	1	1
Ladekouna (surface)	238	485	>1600
Ladekouna (excavation)	47	79	186
Total	325	616	>1885

Table 1. Recovered pipe fragments by provenience.

MARKEDNESS	**Unmarked**		**Foot**		**Extended stem**	
CONTOUR	Rounded	Flat	Rounded	Flat	Rounded	Flat
CIRCUMFERENCE						
Circular	VI	V	X	I	X	X
Square	X	.	X	II	X	X
Quatrefoil	X	X	X	III	X	X
Amorphous	X	.	X	IV	VII	VIII

Table 2. Schematic representation of the typology of the bases.

shall see, in that the flat unmarked base (type V) seems to have developed out of the round low footed type (Ia), which is the oldest attested base. The high foot (Ib) may also have grown out of Ia, but could equally well have been introduced from outside, or have originated from a combination of internal and external factors. Table 3 shows the base types with their definition, description, associated stems and bowls, regional distribution and provenience in the Ladekouna excavation.

TYPE	DEFINITION	DESCRIPTION	ASSOCIATED STEM TYPES	ASSOCIATE D BOWLS	CONCENTRATI ON AREA	OTHER AREAS	STRATA	FIGURE
Ia	Low circular foot (<0.5cm in height)	Mostly just 2-3mm high. In Timbuktu unperforated and double-angled; In the southern Inland Delta mostly perforated and single-angled.	1a2, 1a3, 1b, 1c1a, 1c3, 2	Ovoid or funnel-shaped	Complete Inland Delta	Ké Massina	I-VI	7.1, 7.2, 8.1, 9.1, 9.2
Ib	High circular foot (>0.5cm in height)	Mostly perforated. Both single and double-angled.	1c1b, 2, 3, 4	Highly variable	Complete Inland Delta, Ké Massina			11.4
II	Square foot	Mostly perforated. In Ké Massina single-angled; In the southern Inland Delta double-angled.	Ké Massina: 1a2 (?) Southern Inland Delta: 4	In Ké Massina: vase-shaped or ovoid. In the southern Inland Delta also composite.	Ké Massina	Southern Inland Delta		12.1
III	Quartrefoil foot	Horizontally incised; possibly one or more radial ridges in between the foils.	4	Ovoid	Niani	Ké Massina, Ladekouna		8.2
IV	Amorphous foot	The foot and stem are made from one piece; Shape varies; Single-Angled.	1b, 4	Spherical or ovoid	Ké Massina			
V	Flat circular, unmarked base	Usually a foot is suggested by a single radial incision some millimeters from the undersurface; Perforated; single-angled.	1b, 1c1a, 1c1b, 2(?)	Ovoid or funnel-shaped (?)	Complete Inland Delta		III-IV	6.2
VI	Rounded unmarked base	The shape of the basis is determined by the stem angle and the shape of the bowl: the leaner the bowl, the sharper the base; Single-angled.	1a2, 1a3, 1b, 1c3, 1d, 4	Spherical to a slender ovoid	Northern Inland Delta, Bamana country	Southern Inland Delta, Ké Massina		9.2
VII	Extended stem	Undecorated	4	Ovoid	Ké Massina, Ladekouna			10.4
VIII	Flat amorphous unmarked base	One specimen from the surface of Ladekouna: a crude black elbow-shaped pipe. The base is notched.						12.2

TYPE	DEFINITION	DESCRIPTION	ASSOCIATED BASE	ASSOCIATED BOWL	CONCENTRATION AREA	OTHER AREAS	STRATA	FIGURE
1a2	Amorphous cross-section; converging contour; firmly attached.	Single-angled; stem angle 30° to 45°; except for a small number of flat and flaring collars, generally no collar; rectangular distal face, the lateral sides of which are the shorter; rounded ribs; incisions along the ribs with at the lateral sides comb stabbing or punctates in between and/or circular stamps; on the dorsal side sometimes a grid pattern. Or completely covered with roulette or cob stabbing; Distal face decorated with fine radial, longitudinal and/or diagonal incisions and punctates in the corners; Red-brown, highly polished slip.	Ia, VI	Sub-spherical	Southern Inland Delta		I-VI	7.2, 9.2
1a3	Amorphous cross-section; converging contour; loosely attached.	Single-angled (northern Inland Delta) or if footed, double-angled (Timbuktu); Stem-angle 30° to 40°; No collar; Mostly undecorated; Red-brown, highly polished slip.	Ia, V, VI	Slender ovoid or non-geometrical	Northern Inland Delta	Ladekouna		9.1, 9.4
1b	Amorphous cross-section; straight contour.	Loosely attached; Single-angled, or double-angled (only in Timbuktu); stem angle 30° to 60°; Some flaring collars; In Timbuktu usually undecorated, in the southern Inland Delta, on the sides mostly longitudinally incisions and/or hatching; Red-brown, highly polished slip. In Ké Massina radial and diagonal incisions, comb-stabbing and with a rounded or quartrefoil collar and in cross-section rounded or straight and radially incised.	Ia, IV (Ké Massina), V, VI	Ovoid (?)	Complete Inland Delta, Ké Massina		II, IV	10.3

1c1a	Amorphous cross-section; curved contour; fully attached no collar.	Single-angled; stem angle 25° to 35°; rectangular distal face of which the sides are convex; the shorter, dorsal side is concave; punctates in the corners of the distal face; Due to the rounding of the ribs, the dorsal corners tend to flare. At the distal end or approximately at the maximum diameter, one or more radial incisions sometimes interrupted by punctates; On the sides mostly one or more longitudinal lines of punctates flanked by incisions; sometimes circularly stamped; at the dorsal side possibly hatching or a grid pattern; Red-brown, highly polished slip.	Ia, V	Funnel-shaped or ovoid (?)	Southern Inland Delta	Timbuktu	II-IV	6.2
1c1b	Amorphous cross-section; curved contour; fully attached; flattened collar.	Single-angled; stem angle 25° to 35°; rectangular or trapezoid collar with punctates in the corners of the distal face; The proximal half of the sides is coarsely hatched; Red-brown, highly polished slip.	Ib, V	Ovoid(?), funnel-shaped (?)	Mopti			7.1, 11.3
1c3	Amorphous cross-section; curved contour; loosely attached.	If a Ia base: double-angled; stem-angle about 30°; If a collar at all: flat or flaring; Except for some possible punctates, mostly undecorated; Red-brown, highly polished slip.	Ia, VI	Slender ovoid.	Timbuktu			
1d	Amorphous cross-section; semi-ovoid contour.	Fully attached; No collar; Completely integrated in the bowl; Lateral contour is a quarter of a circle; Outlined with one or more parallel incisions.	VI	Ovoid	Bamana country	Lake area		

Table 3. Typology of the bases.

In the stem typology, *cross-section* is the first and foremost determining feature. Cross-sections vary from amorphous[4] to rectangular, polygonal[5] and circular. Further distinctions are made on the basis of the *contour* as seen from behind, *attachment* and *collar contour*. With respect to contour, or hind view, in some instances, the sides converge towards the base. In other cases, they (by and large) run parallel. Yet other pipe stems curve with their maximum width at about three-quarter height. A fourth type is semi-ovoid in contour.

Attachment is defined as 1 minus the ratio of the ventral stem length to the dorsal stem length, or in other words: the length of the ventral side divided by the length of the dorsal side. The ventral aspect is defined as the upper side of the stem in case of a horizontal orientation of the pipe and the front side of a vertical stem. The dorsal side of the stem is the side that faces down or towards the smoker when in use. The stem is loosely attached if this index is less than 0.80. When it exceeds 0.80, I consider it firmly attached.

Some stems are embellished with a collar, which may have the additional functional benefit of facilitation attachment of the reed or wooden mouthpiece. The collars can be characterized as flaring, pointed, flat or rounded in longitudinal section. Occasionally double and triple rounded or pointed stems are encountered, giving the appearance of multiple rings being placed over the end of the stem. The collar cross-section is not included in the typology, yet some variation is present, ranging from circular, to rectangular, trapezoid and quatrefoil.

Similar to the method applied to the base typology, all four attributes and their respective values can be accommodated in a cross-table for definition of the stem types. For several reasons, this is not a profitable undertaking. It would result in a complex set of hundreds of types with little analytical value. Many of the types would be represented in the collection by only a few specimens. This fragmentation of the material would highly reduce the statistical validity of geographical and diachronical analyses. Moreover, the sub-classification of the types based on cross-section will not necessarily result in more pronounced types. Both rectangular and polygonal pipes are in many respects internally very homogenous. The stems are loosely attached and are rather straight when seen from the back. The fact that some specimens seem to converge slightly, or have a somewhat flaring collar, appears to be a result of accidental variation, rather than a deliberate attempted to create a distinct pipe. The circular stems show more internal diversity. Still, also these are all loosely attached and rather straight in contour. It could be profitable to further subdivide this type of stems along other lines. The most appropriate attribute for this purpose is however not yet evident. Attachment and contour are disqualified on the bases of lack of diversity. Collar type has larger discriminatory potential. Yet alternatives are found in pipe color and embellishment. Each of these variables has its specific distribution. They do not correlate. There are hence no intuitive *gestalts* on which to base a subdivision of the circular stems. Until one feature is shown to have external significance, in being for instance chronologically or geographically limited in distribution, any sub-classification would be a completely arbitrary matter, having no added value to a classification based merely on stem cross-section. For now, the circular stems will thus not be subdivided.

In order to escape the problems contingent to the cross-tabular method, a taxonomical approach is selected for the stem typology (Fig. 3). This method assures the highest typical homogeneity with a minimal number of types. With the exception of the circular stems, the formulated types can thus be considered internally by and large uniform. Moreover, the typology is constructed in such a way that new types can easily be added. Table 4 shows the stem types with their definition, description, associated stems and bowls, regional distribution and provenience in the Ladekouna excavation.

This is not to say no arguments can be made for alternative typologies. An attribute left out from the typology, yet proven useful in Ghanaian typologies is the angle between the base and the dorsal side of the stem. If the dorsal side of the stem directly connects to the lower face of the base of the pipe, the pipe is considered single-angled. In double-angled pipes the stem attaches some distance above the lower face of the base (York 1973).

Technological and decorative aspects can equally be selected as primary classifiers, in which case, surface finish would be a definite candidate. An indication of its discriminatory potential is attested in the selective usage of white slip: white slip is found largely in the southern Inland Delta and only at stem types 2, 3 and 4. Fabric analysis is less suitable for the purpose at hand. First of all because of the impracticality of classification in the field. Secondly, L. Jacobs' analysis of 34 selected samples of the Ladekouna collection has shown the relative high degree of conformity. All except one were very compact with low percentages of quartz and/or ironoxide siltstone, the range of which can be accounted for by natural variation in the clay sources. One sample, a white type 3 stem, contained a far higher ratio of very fine-grained quartz. The fabric analysis thus neither enhances nor undercuts the morphological typology proposed here (Jacobs 1999: 99-103).

Dating pipes, pipes and dating

For tobacco pipes to be instrumental in the archaeological dating process is the establishment of a solid chronology. For this purpose, using the Ladekouna collection 30 variables were checked for chronological sensitivity[6]. They include eight decorative traits (presence of white slip, paint, incisions, punctuates, comb dragging/stamping, circular stamping, rosette stamping, asterisk stamping), four bowl characteristics (height, shape, presence of relief band, and radial incisions), 15 stem features with regard to both shape and decoration (type, length, attachment, width, width proportional to length, diameter socket, wall thickness, decoration pattern distal surface, decoration pattern dorsal face, presence of longitudinal lines - stamped or incised -, radial lines, hatching, diamond clustering of circular stamps, and grid incisions) , and three base characteristics (height, diameter and type). In light of the low quantity of data available, it is statistically hard as of yet to draw any firm conclusion. Many

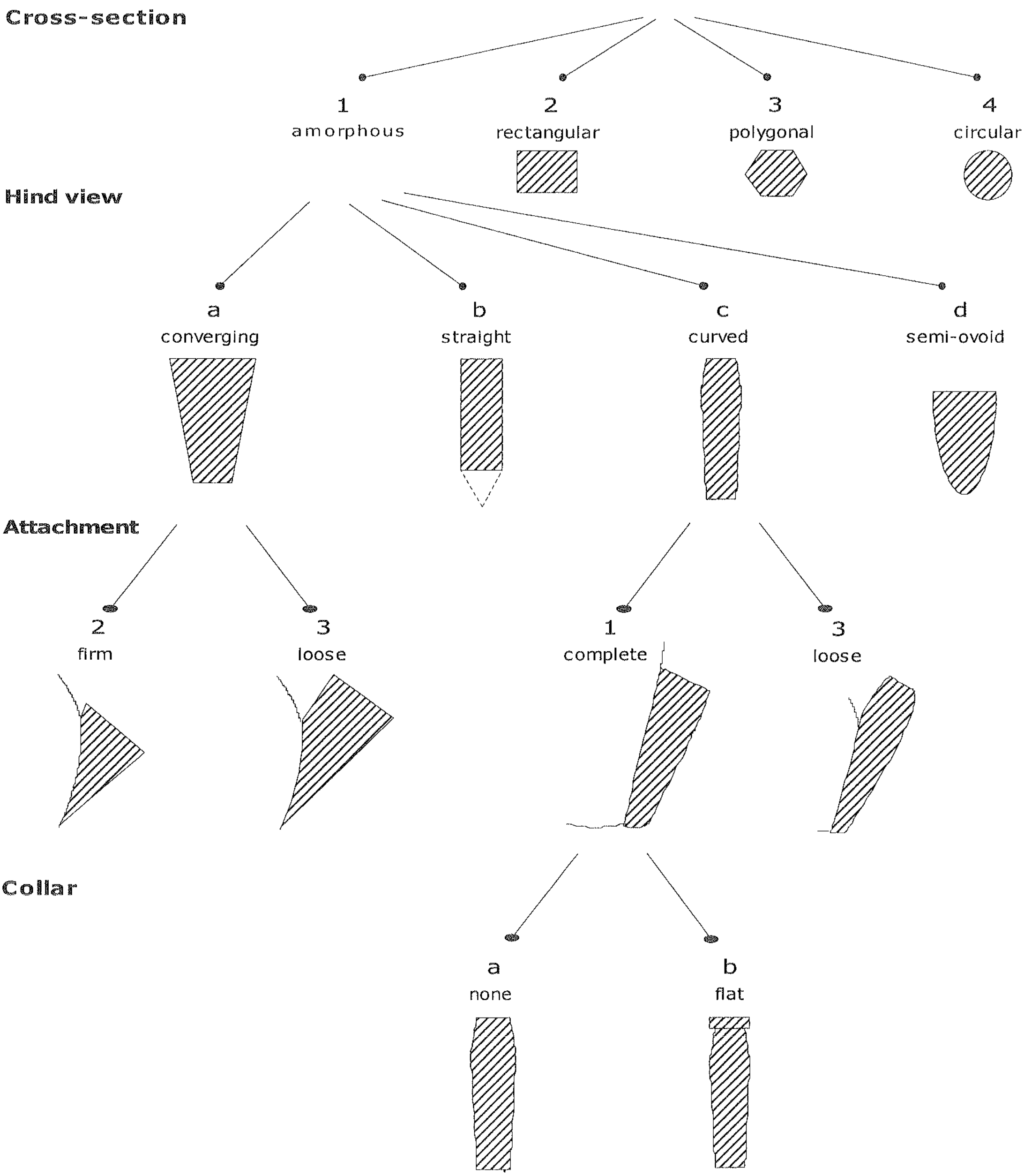

Fig. 3. Schematic representation of the typology of the stems.

2	Rectangular cross-section	Straight or slightly converging contour; Loosely attached; Single or double-angled; stem angle 40° to 60°; no collar or slightly flaring; longitudinally incised along the ribs in combination with radial incisions or hatching and/or circular stamping, sometimes in diamond-shaped cluster; Exceptionally a grid pattern; Highly polished, red-brown or white slip sometimes with dark brown or red paint.	Ia, Ib, II, V(?)	Ovoid; composite; some with pedestal.	Inland Delta	Ké Massina	I-VI	8.1, 14.2
3	Polygonal cross-section	Straight contour; 6-,7-, 8- or 9-angled in cross-section; loosely attached; Single- or double angled; Stem angle 40° to 60°; Usually no collar, some (multiple-) rounded exceptions; Extensively decorated with punctates and stamping on the red-brown or more commonly white slip; Sometimes brown painting on the white slip.	Ib	Ovoid (?); composite; biconical	Southern Inland Delta, Lake Area,			10.2
4	Circular cross-section	Straight contour; loosely attached; Single- or double angled; High variability in collars (none, flaring, pointed, flat, quatrefoil), decoration (radial and/or longitudinal incisions, punctated, comb stamped) and stem angle (30° to 70°); Red-brown polished slip or white, with occasional brown paint.	Ia, Ib, II, III, VI, V, VI, VII	Spherical or ovoid; composite; biconical; some with pedestal	Southern Inland Delta, Ké Massina, Niani	Timbuktu (?)	IV	11.1, 12.1

Table 4. Typology of the stems.

types and traits were not represented in the excavation collection, or only by one or two specimens. Tentatively, we can however make the following inferences:

1. Singular attributes other then those incorporated in the typologies above do not demonstrate chronological change.
2. In time new types are added to existing types rather than replacing them (Fig. 4).
3. Small pipes with an amorphous, converging, firmly attached stem (type 1a2) and a small, low, circular foot (type Ia) are the oldest, in addition to pipes with a larger rectangular stem (type 2); At a later stage larger 1c1a and 1c1b stems, mostly with large flat unmarked type V bases, appear; followed by pipes with circular stems (type 4).

We thus have the beginnings of a typo-chronology, which, in the absence of reliable statistics, can serve as the starting point of an occurrence, as opposed to frequency seriation. Unless we can plot this typo-chronology onto a timeline it can only be useful for relative dating. The outer boundaries for the chronology can be established on the basis of historical documents. A Timbuktu chronicle recounts the introduction of tobacco in the city by Moroccan soldiers in c.1597 (Ozanne 1969). We can equate this date to the introduction of smoking pipes. Elsewhere, I have argued that, though, cannabis was available before that time it was probably not being smoked, and in the same sense, the smoking of local herbs was started following the practice of tobacco smoking (Welling

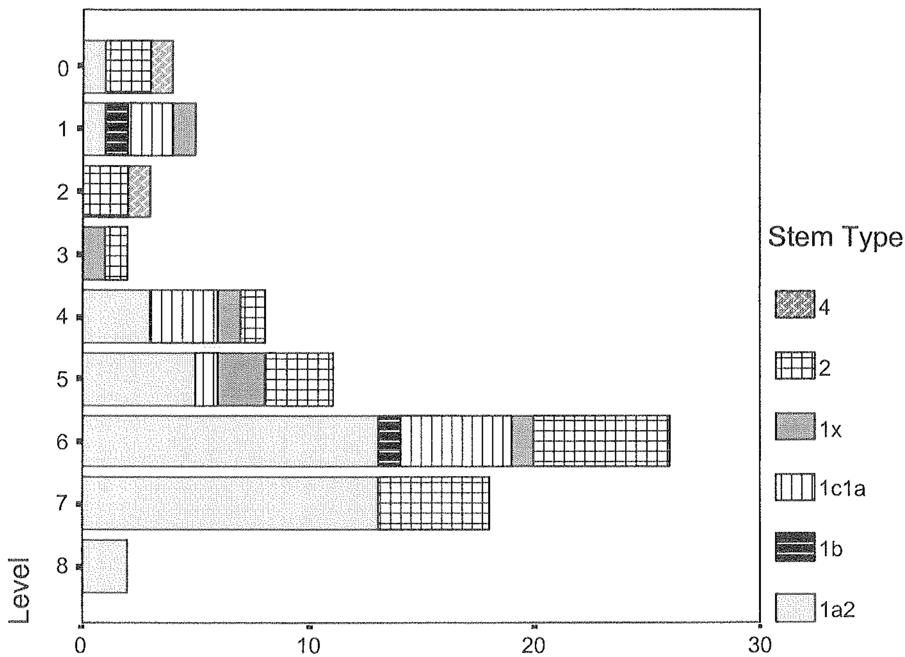

Fig. 4. Stem type count per layer at Ladekouna.

1999: 23-25). The oldest pipes in the archaeological record thus correspond to the introduction of tobacco[7]. A closing date for pipes in the Ladekouna archaeological record is provided by the 1818 prohibition on tobacco and smoking, levied by the council of marabous immediately following Cheikou Amadou's establishment of the Muslim fundamentalist Fulani state in the Inland Niger Delta (Ba and Daget 1962: 278). This proscription will have been difficult to uphold state wide. Hence the finds in Timbuktu (Insoll 2002). Yet even there the ban had its impact. In 1847 a delegation from Timbuktu even took up the issue with Cheikou Amadou in order to have it lifted (Ba and Daget 1962: 278). Archaeological investigation of Cheikou Amadou's capital Hamdallahi significantly did not produce any tobacco pipes (Gallay *et al.* 1990; Huysecom pers. com.). The council's ruling can thus be said to be strictly adhered to in the heart of the state. Ladekouna is situated only about 20 kilometers from this religious and political center. This proximity made it impossible for the Ladekouna flourishing pipe industry.

For more precise dating of the intermediate period, we are confronted with the shortcomings of the ^{14}C method. Its dates are very imprecise for this relatively recent era. One useful date was however obtained from the excavation. It seems to date to the appearance of the first type 1c1a stems placing this event around 1700[8]. The relative stem typo-chronology can thus be tied into the historical framework demarcating three phases (Fig. 5). The base typology may follow this periodization in as far as large flat type V bases are associated with type 1c1a/b stems.

This typo-chronology can be a very valuable tool in the dating of archaeological deposits. Applying this chronology to the survey sites, it seems that five sites had

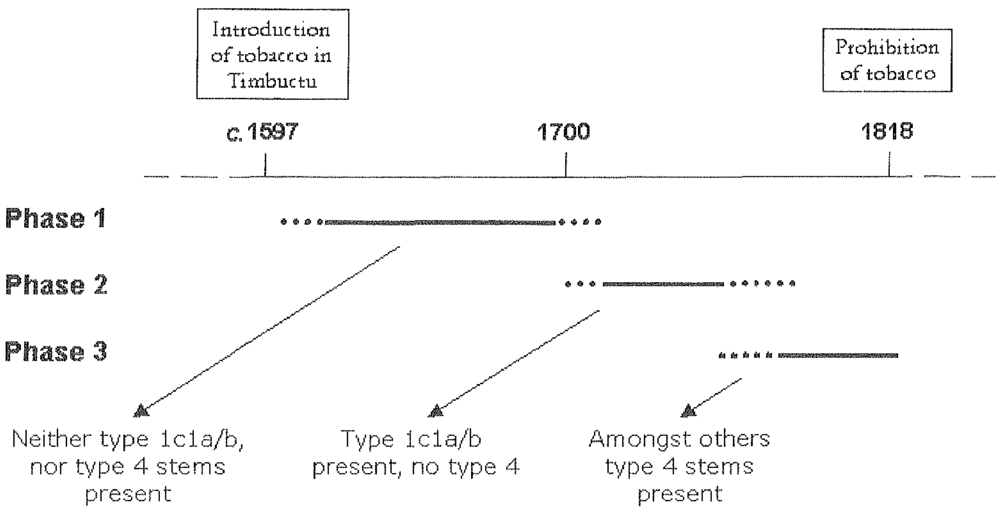

Fig. 5. Stem chronology.

their final occupation during phase 2 as they contained type 1c1a/b stems and/or type V bases (Tables 5 and 6). These are 376.01, 376.06, 376.13, 436.13 and 452.16. At two sites round stems were retrieved, namely 440.06 en 452.03. The final occupation there must have been during phase three times, between 1700 and the early nineteenth century. Of course, the typo-chronology requires corroboration from other Inland Delta sites. Extrapolation on the basis of one excavated site, a midden excavated by artificial layers, add that, is a risky undertaking. Its chronology and geographical limits of applicability need to be tested. Moreover, the typo-chronology is to be expanded as to incorporate the remaining stem and base types. When refined and tested with success, its value is however significant. Archaeological contexts, whether surfaces material or excavation layers, can then be dated on the basis of the presence of certain pipe types, whenever archaeometrical methods are impossible, either for lack of datable material (*e.g.* no charcoal, etc.), or for imprecision of the results (^{14}C dates giving too large a time span). Moreover, dating on the basis of pipe fragments renders instant results. This is a great advantage for the field archaeologist who otherwise has to endure lengthy waits for laboratory results. This is certainly not to mean that the typo-chronology is to replace archaeometrical-dating methods. Indeed, these additional methods are required for corroborating and refining the typo-chronology.

Some geographical inferences

The tables showing the base and stem typologies hint at some regional diversity (Tables 3 and 4). Indeed, the typology was partly constructed in light of regional differences. It is important to note though that many types are encountered throughout a large area. At anyone site one can expect to find a multitude of shapes and styles. Nevertheless, if were to quantify our distribution maps, concentration areas can in most cases easily be identified: Square bases are predominantly found in Ké Massina , but also in the southern Inland Delta (Daget and Ligers 1962); Type 1d stems center in Bamanaland, although a specimen as been found in the lake area (Lecluse 1985; Daget and Ligers 1962: 26 plate B2); Quatrefoil bases abound in Niani (Filipowiak 1979) but have also been recovered in Ké Massina (Daget and Ligers 1962) and Ladekouna, etc.

In addition, there are some regional differences that are not apparent from the typology. As opposed to many pipes from the southern Inland Delta, in Timbuktu the pipes are comparatively small; they predominantly have type 1a3 stems, which are attached to the base forming a double angle; and the bases tend to be perforated for fixing a cord, either for suspension or for securing it to the reed or wooden stem.

A first conclusion we may draw from this geographical picture, is the high mobility of the people. It seems that pipe types have spread from core areas to wider parts. If indeed we assume the concentration areas are the points of origin, we can, for instance, postulate the presence at one point of Bamanaland people (but not necessarily Bamana) in the lake area. One step further is to correlate the geographical origin of a pipe type

Site	Type Ia	Type Ib	Type II	Type III	Type V	Type VI	Type VII	Type VIII	Uncl.	Total
376.01	2	0	0	0	0	0	0	0	0	2
376.06	6	0	0	0	0	0	0	0	0	6
376.17	5	0	0	0	3	0	0	0	0	8
436.13	13	0	0	0	3	0	0	0	0	16
440.06	0	1	0	0	0	0	0	0	0	1
454.02	0	1	0	0	0	0	0	0	0	1
454.03	5	0	0	0	0	0	0	0	0	5
454.04	1	0	0	0	0	0	0	0	0	1
Ladekouna (surface)	167	18	6	1	36	6	1	1	2*	238
Ladekouna (excavation)	41	0	0	0	6	0	0	0	0	47
Total	240	20	6	1	48	6	1	1	2	325

* For two feet the circumference can no longer be reconstructed. They could have been either round or square.

Table 5. Base type count per site.

Site	Type 1a2	Type 1a3	Type 1b	Type 1c1a	Type 1c1b	Type 1x*	Type 2	Type 3	Type 4	Total
376.01	3	0	0	2	0	0	1	0	0	6
376.06	9	0	0	1	1	0	1	0	0	12
376.17	4	0	0	5	0	0	2	0	0	11
436.13	2	0	0	1	1	5	2	0	0	11
440.06	0	0	0	0	0	0	0	0	1	1
454.02	0	0	0	0	0	0	3	0	0	3
454.03	1	0	0	1	0	0	3	0	1	6
454.16	0	0	0	0	1	0	0	0	0	1
454.18	0	0	0	0	0	0	1	0	0	1
Ladekouna (surface)	214	4	31	43	27	0	107	16	43	485
Ladekouna (excavation)	38	0	2	11	0	6	20	0	2	79
Total	271	4	33	64	30	11	140	16	47	616

* Due to extreme fragmentation unsubclassifiable

Table 6. Stem type count per site.

to the ethnic identity of its makers. This last step is very tentative, as we know linking material culture to ethnicity is tricky matter (*e.g.* Hodder 1982). All the more so, when we learn from the ethnographic present, as well as historical documents, that various ethnic groups live and have lived largely interspersed. In this case, an inferred Bamana presence is however supported by historical sources. We know that Bamana troops once raided the country and in the first decennium of the eighteenth century reached as far north as Timbuktu, threatening its very hegemony (Abitbol 1992).

Not only at a regional scale, socio-geographical linkages can be reflected in pipe resemblance. From Al-Ufrani's chronicles, we know the Moroccan invasion army was responsible for the introduction of tobacco in the Inland Niger Delta. Since we have gained some insight in the typo-chronology of tobacco pipes from this area, it would be very instructive if we could compare it to ancient pipes from Morocco. Unfortunately, a study of Moroccan smoking pipes is absolutely lacking. Turkish pipes are better documented (Hayes 1980; Duco 1984). Since during the 16th and 17th century the Ottoman empire extended as far West as present-day Algeria, a comparison of the Malian pipes with Turkish specimens provide a reasonable heuristic alternative for comparison.

A number of parallels are immediately apparent. First of all, the Turkish pipes, as opposed to most European pipes, have a comparable short ceramic stem. As most West African pipes, they come with a hollow reed or piece of wood. Further, the stems are circular, hexagonal or octagonal in cross-section and make a 60-degree angle with the bowl axis. Even more significant is the existence of polygonal stems with a circular collar, much like the one from Kami depicted by Daget and Ligers (1962: 34). In addition, the comparable white and red slip stands out. The highly polished red slip gives the Turkish pipes a *terra sigillata*-like appearance in much the same way as the Malian pipes. Lastly, there are some similar decoration patterns such as the use of rosette and circular stamping, longitudinal 'windows' on the bowl and triangles at the distal end of polygonal stems[9].

There are a number of notable differences as well. The bases of Turkish pipes are characterized by an extended stem, a dish or an unmarked, rounded contour. Each of these base types has rarely if ever been found in the Inland Delta. Also, the shape of the bowls differ. The typically Turkish semi-spherical, funnel- and vase-shapes are equally rare in Mali. Just one pipe from Ladekouna takes the in Turkey common cylindrical shape with a broadened base.

In conclusion, Turkish pipes most closely resemble the Malian pipes with stem types 2, 3 or 4. Besides having a wooden stem extension and possible circular stamp decoration, pipes with stem type 1 just have the red slip coating in common. In Turkey, this kind of slipping became general practice only in the 18th century. In the early period just white and gray clays were used. If we are looking for North-African introduction of red slipping in Mali, we thus have to look for a different source. These findings oppose the chronology established at Ladekouna. Red slipped fragments were indeed recovered from the earliest layers onward. A second chronological inconsistency concerns the circular stems. These are the most common in Turkey from the onset, but only appear in the uppermost layers of the Ladekouna. On the other hand, type 2 stems are found throughout the stratigraphy, showing great similarity in decoration. I am however ignorant of the existence of Turkish pipes with rectangular stems. The lack of polygonal stems in the excavation makes it impossible to tie these to possible Mediterranean introduction. With the current state of affairs, one can hardly say more than that Turkish influence on Malian pipes seems likely and possibly vice versa. This influence could have been direct or via Morocco. A third possibility, of course, would be that both Mali and Turkey were guided by the Moroccan tradition at one time or another. A thorough study of Moroccan pipes is the first step towards an answer to this question.

A final remark regarding the Turkish-Moroccan tradition concerns the sitting smoking position with the pipe resting on the floor. Also in many parts of West Africa this is the common posture, as for instance in northern Ghana where it leaves recognizable use marks (Bellis 1976). It might well have been derived from the Arab world. To accommodate the pipe to this posture, she was provided with a flat base and a bowl more or less perpendicular to it. European pipes, which are smoked in the hand, mostly have a rounded base with a heel and a bowl tilted to the front. This is, of course, not to say all flat-bottomed pipes were smoked standing on the ground. On the contrary, only a small number of the bases from Ladekouna show serious wearing.

A second external geographical comparison that needs to be made is that with northern Ghana. As tobacco was reputedly introduced in northern Ghana from the western Sudan (*e.g.* Ozanne c.1966; Effah-Gyamfi 1985; Shinnie and Kense 1989), a glance on the pipes from this area can also be useful. Scholars tend to attribute specimens with red slip, comb stabbing and roulette decoration to introduction from the North, as these features are a common occurrence in the Inland Delta. There are yet some other similarities, such as the use of circular and rosette stamps, white clay inlay and punctates in the corners of the distal face of the stem. There are however some notable differences as well (*cf.* Effah-Gyamfi 1985). The earliest tobacco pipes from northern Ghana have for instance a high conical foot, funnel shaped bowls and double-angled stems. As we have seen, these characteristics are quite rare among Malian pipes. This puts the matter of a Northern origin to doubt, as shape attributes are supposedly more easily borrowed than secondary features as surface finish and decoration patterns. The pipes, which served as a model for the northern-Ghanaian specimens, are therefore more likely to have had a comparable shape rather than a similar red slip with punctates and/or roulette decoration. On the other hand, in Ladekouna surface finish and decoration techniques remained unchanged in time while morphologically differentiation did occur. Arguments can thus be made for either case.

At a latter stage, the quatrefoil bases are said to have entered Ghana from the Sudan (Ozanne c.1966). In Mali, pipes with this type of base have been recovered in Niani, Sansanding and Ladekouna. But also in central Sierra Leone, these bases were found (Hill 1976). There exists some variation though in the size of the foils, the presence of radial grooves between the foils and the number of circumferential incisions on the foils themselves. Nevertheless, it is tempting to link the distribution area to the eastern diffusion of tobacco, which Ozanne postulated in 1969 more or less without evidence. This argument does however not seem to hold. First of all, this design cannot have reached central Ghana before 1670 at a time when tobacco had long since been incorporated into local culture. One (in Begho) or two (in Daboya) types preceded this model (Afeku 1976; Shinnie and Kense 1989). It is moreover questionable whether the diffusion started in Upper Guinea. As the specimens from Mali and Sierra Leone are undated, it is difficult to establish the direction of diffusion on the basis of age. Still, it might be significant that all (illustrated) pipe bases from the Niani excavation belong to this type. If indeed it was the only type in use at Niani from the beginning of smoking onwards, it can presumably be considered as rather early, for also here tobacco must have been introduced at the turn of the sixteenth century. The Niani area could thus be considered candidate as place of origin of these quatrefoil pipes, centrally located as it is. On the other hand it does not seem likely that such a remarkable form is created without precedent. Such a design develops gradually. It seems hence to be more probable that the Ghanaian pipes with the smaller foils are at the origin of this development. The design could have spread along with the reputation of the Asante state.

Conclusion

In closing, the value of smoking pipes for African archaeology in general has to be considered. In West Africa reports of the smoking of local herbs are wide spread. Moreover, a pre-sixteenth century introduction of cannabis is more than likely. The oldest pipes, as I have argued, are nevertheless a clear indication of tobacco smoking. The role of the pipe as a *fossile directeur* for post-sixteenth century sites remains unchallenged. The tracing of the diffusion lines by which tobacco spread throughout the continent on the basis of morphological analysis of early pipe specimens is proven more difficult however. This is not only caused by the fact that due to the present state of African archaeology many of the oldest pipes may not have been identified yet. We have been able to compare the material from the Inland Niger Delta with known chronologies from Turkey and Ghana. Although certain parallels were evident, it could not undoubtedly confirm the presupposed diffusion line, running from Morocco (North-Africa) to present-day Mali and northern Ghana. In light of this discussion, we should be aware of the great pace at which pipe shapes can change. In a mere 20 or so years a type can have altered beyond recognition. Prototypes can hence be small in number and date to only a limited time span. For the archaeologist, it is thus extremely difficult, if not impossible, to isolate such types, considering the formation processes of the archaeological record and the current (in)sensitivity of archaeological dating and excavation methods. I am therefore inclined to concur with Dunhill who many years ago came to the conclusion that "the actual form of the [African] pipe must have undergone wonderful transformations on its journey, and it is not possible to trace out the evolution of the innumerable pipes to be met with" (Dunhill 1969 [1924]: 135).

The distribution channels of tobacco and the smoking pipe can in most cases not be disclosed on the bases of morphological studies alone.

The formulation of local typo-chronologies seems to be a more fruitful undertaking, particularly if absolute dating can be added to the relative chronology using historical sources, oral traditions or imports. This provides the archaeologist with an important tool in dating surface finds and excavated materials. Notwithstanding this optimism, a word of caution is warranted. Overgeneralization, unduly extension of a local typo-chronology to additional sites can lead to flawed conclusions. There may be both chronological and typological variation, as is also clear from the Ghanaian examples (*cf.* Ozanne c.1966; Effah-Gyamfi 1985; Shinnie and Kense 1989). A critical eye is thus called for.

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Notes

1. I prefer to adhere to the common archaeological term *stem*, yet among pipe smokers and antiquarians this part of the pipe is referred to as shank. *Stem* is reserved for the wooden or reed extension that is inserted into the shank.

2. For a more elaborate description and analysis of the finds see Welling (1999). For additional information on the respective sites I refer to the dissertation being prepared by A. Schmidt at Leiden University.

3. Some slender, 'rounded' bases could equally well be described as 'pointed'.

4. Stems with amorphous cross-section may have a rectangular distal surface.

5. Some authors use the term faceted to describe an angular circumference (*e.g.* Emerson 1999). This designation stresses the presence rather than the number of facets. The number of facets, nor the related attribute of symmetry is taken into account. Logically, also rectangular stems would fall into this category. I thus opt for the term polygonal for this value.

6. For details see Welling (1999: 78-84). The exercise is based on the assumption that the arbitrary excavation layers represent a chronological sequence. Although this may by and large be correct the South section drawing does show indications of a pit once having been dug.

7. There is as of yet no reason to assume the first African smoking pipes to have all been made of wood or metal. Particularly in light of the introduced ceramic examples from Europe and the Arabic world. The oldest clay pipes are therefore most likely to date to the same time as the introduction as tobacco.

8. 90 ± 30 B.P. (Grn 23024) after calibration gives the age ranges 1686 to 1738, 1810 to 1930, and post-1951, of which understandably only the first one can be correct.

9. One of the Spanish pipes in Shaw (1960) has a polygonal stem with rosette stamp decoration. This might well be a Moorish product.

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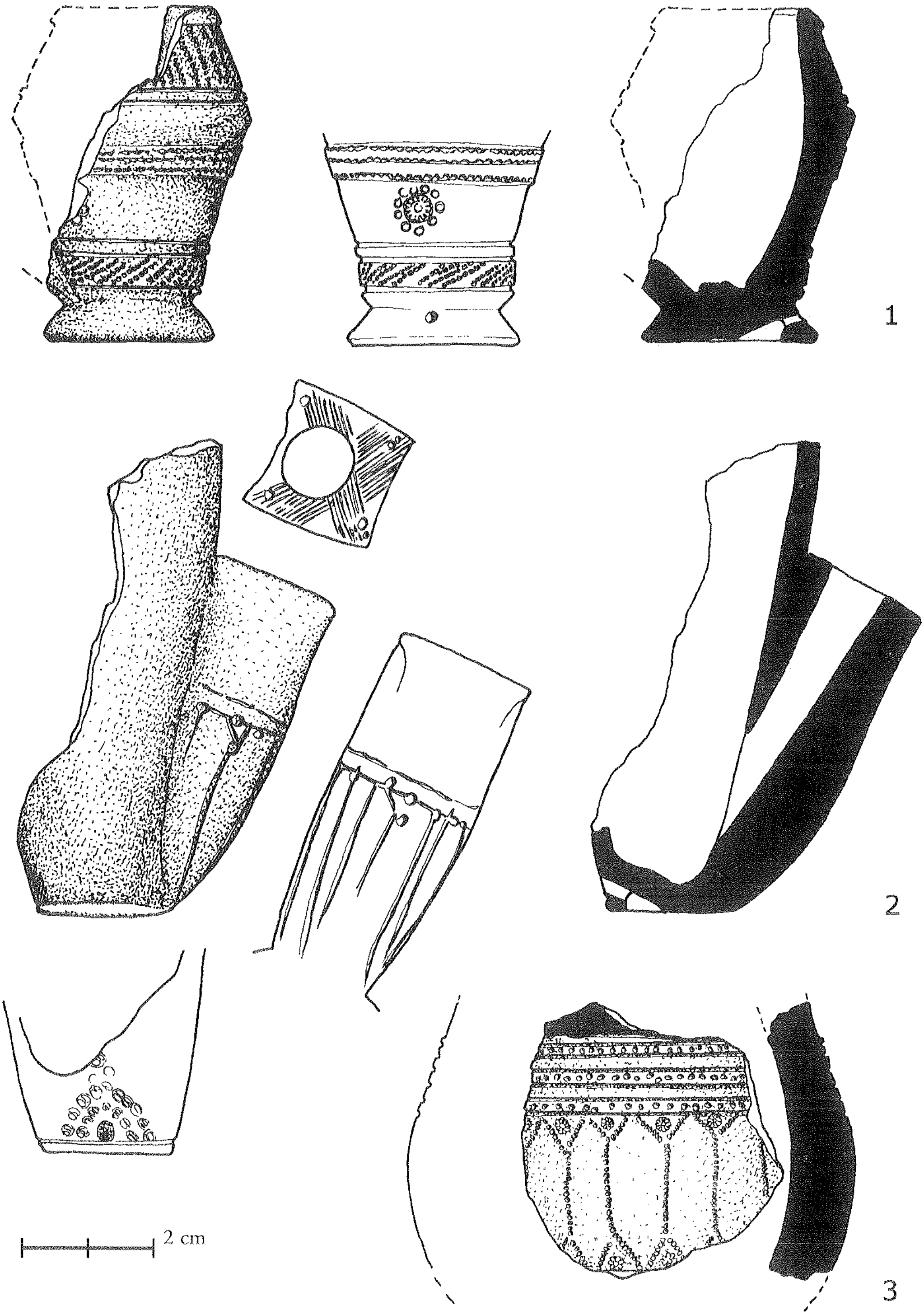

Fig. 6. Surface finds: (1) from site 440.06, base type Ia; (2) from site 376.17, base type Ia, stem type Ic1a; (3) from site 440.06, bowl fragment, white with red paint.

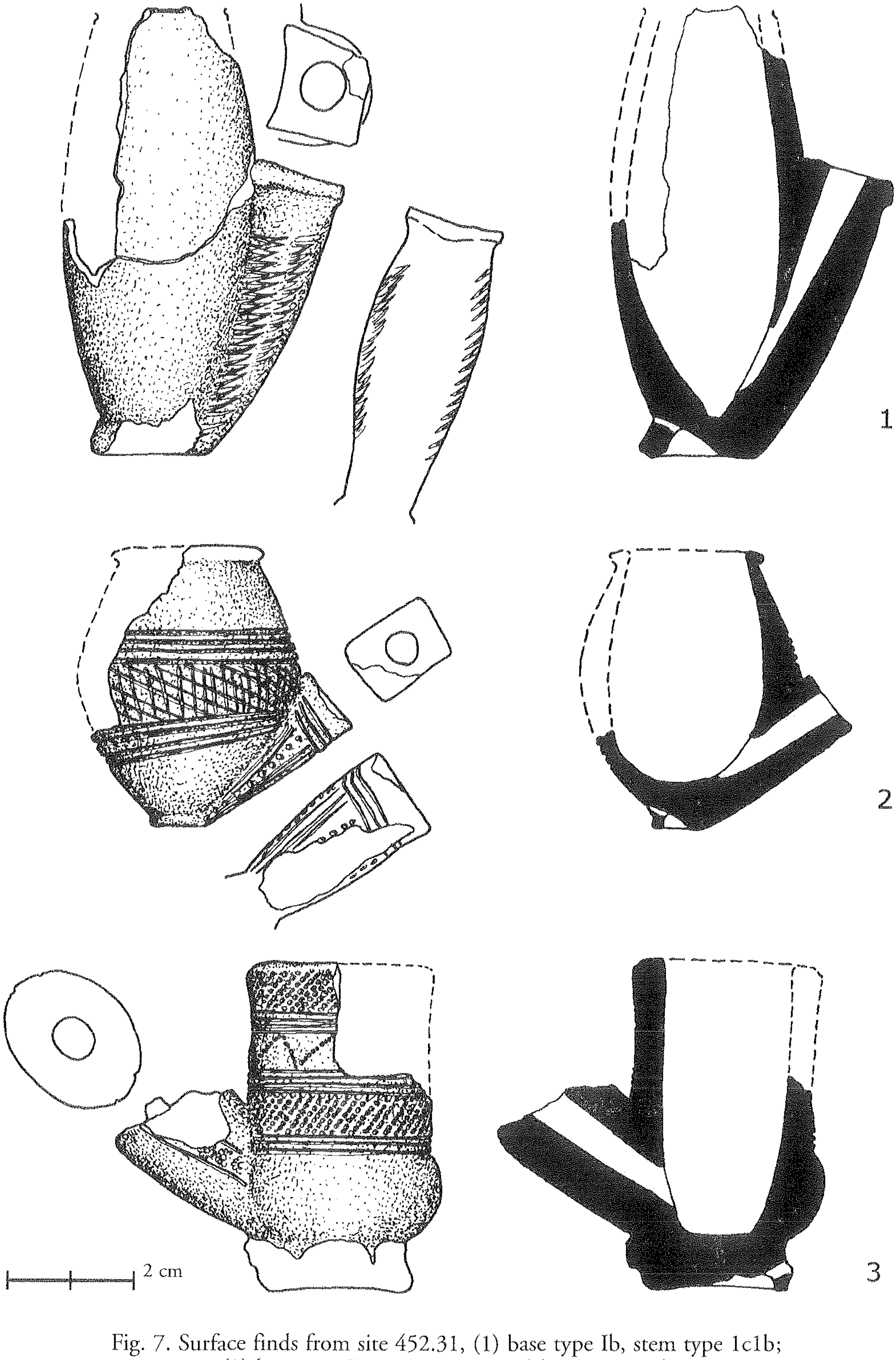

Fig. 7. Surface finds from site 452.31, (1) base type Ib, stem type 1c1b; (2) base type Ia2, stem type 1a; (3) stem type 4.

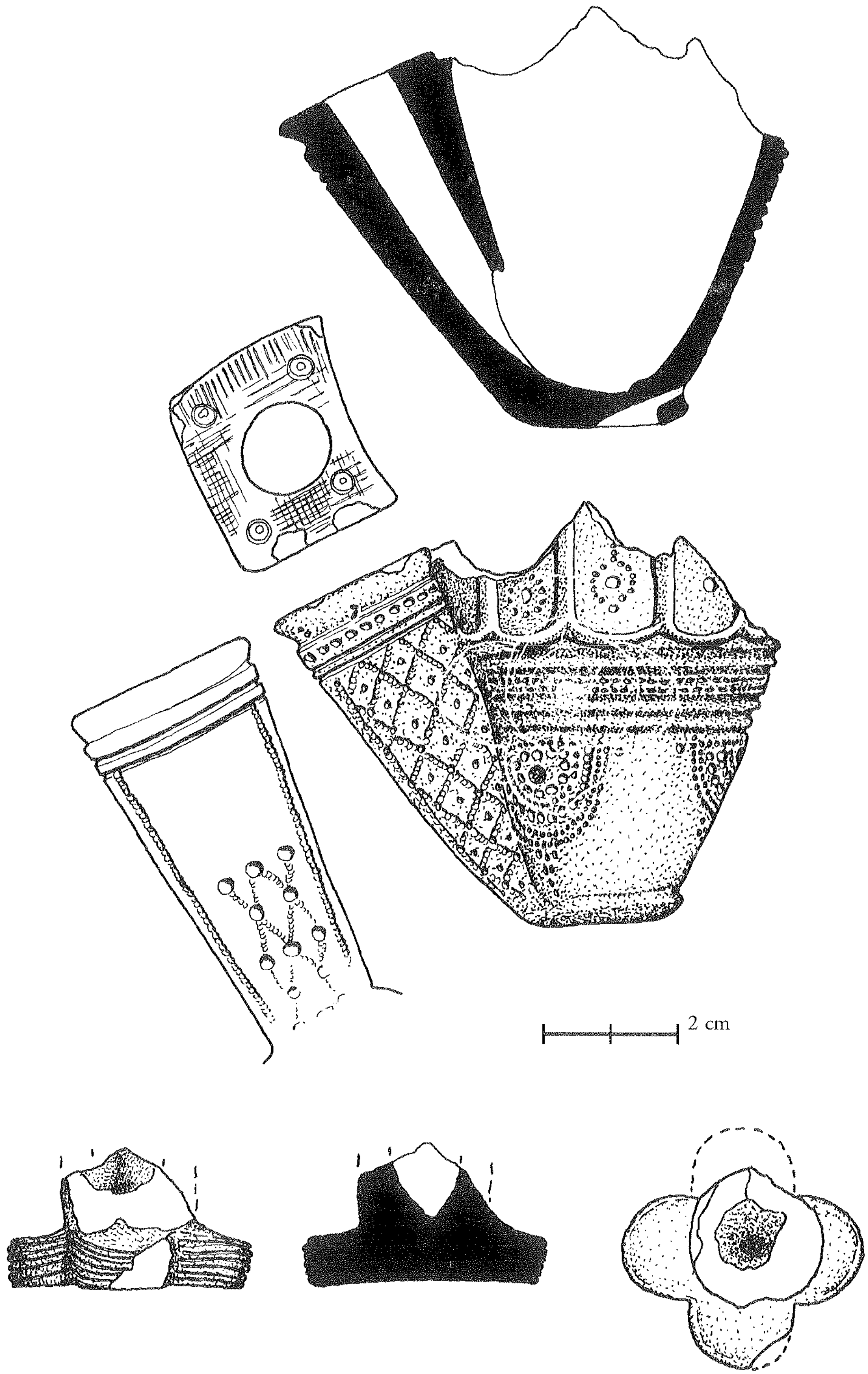

Fig. 8. Surface finds from site 452.313: (1) base type Ia, stem type 2; (2) base type III.

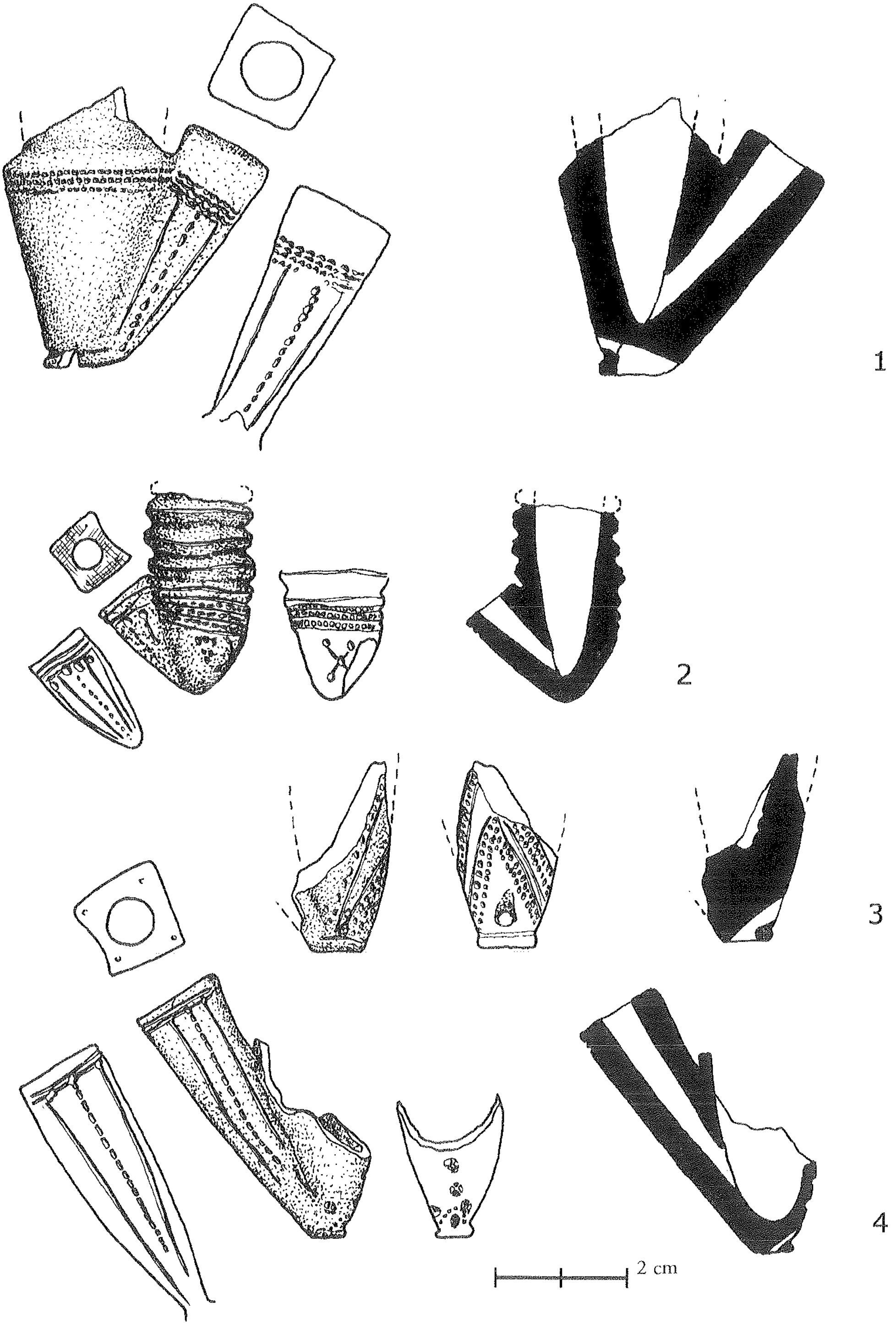

Fig. 9. Surface finds: (1) from site 452.31, base type Ia, stem type 1a3; (2) from site 452.31, base type Ia, stem type 1a2; (3) from site 452.33, base type Ia; (4) from site 452.31, base type Ia, stem type 1a3 transitional to type 1b.

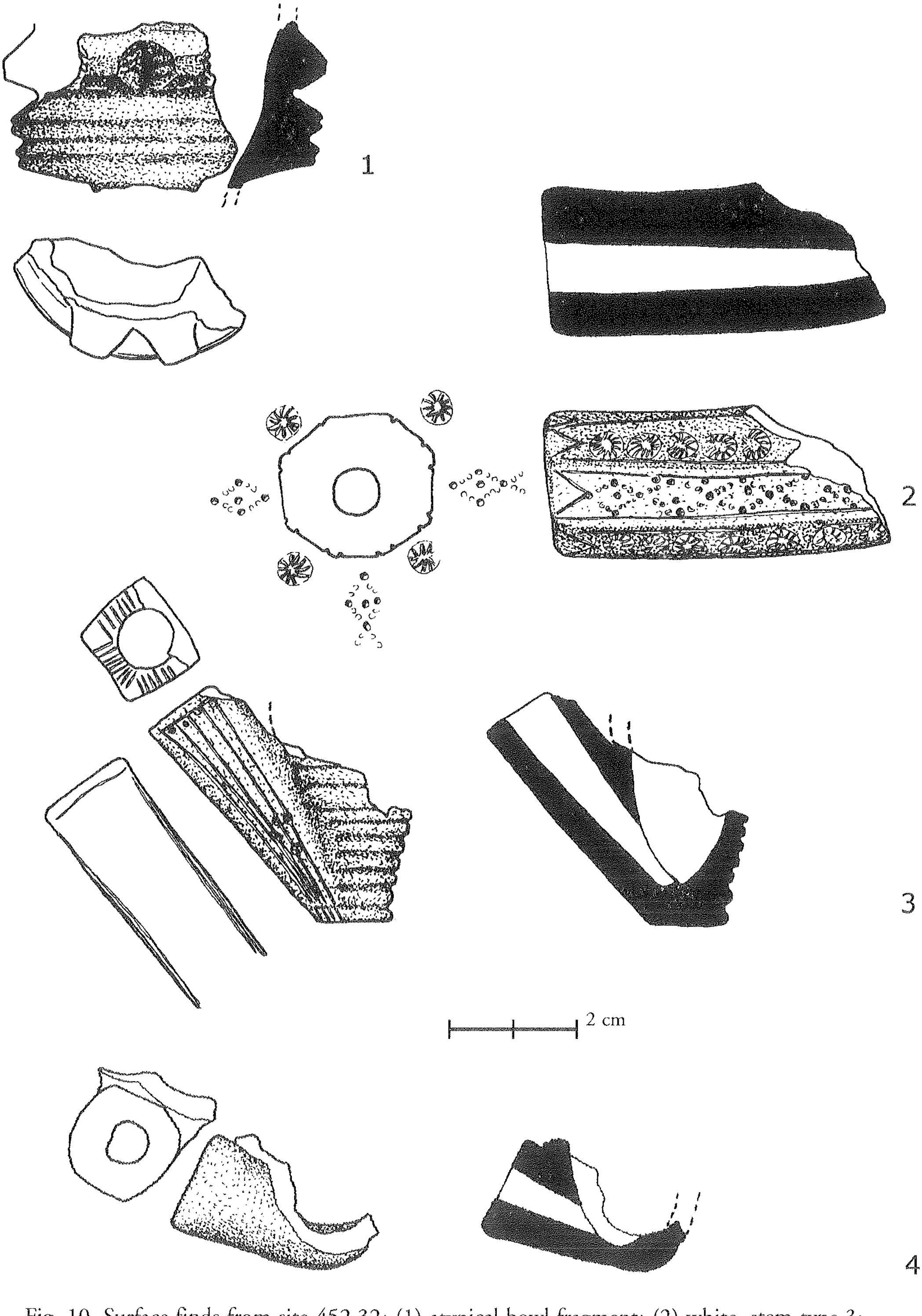

Fig. 10. Surface finds from site 452.32: (1) atypical bowl fragment; (2) white, stem type 3; (3) base type Ia, stem type 1b; (4) exceptional, pale brown, base type VII, stem type 4.

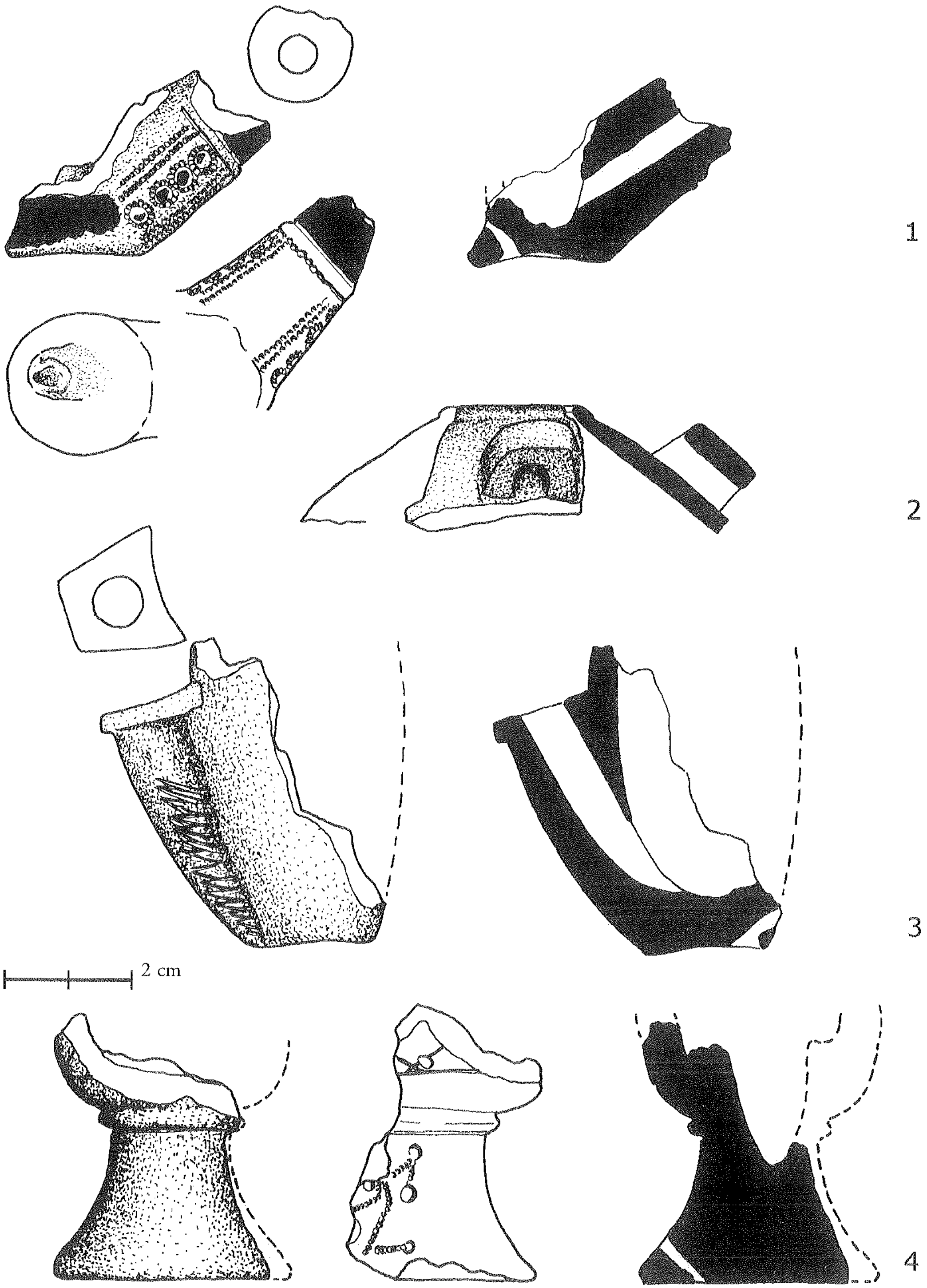

Fig. 11. Surface finds from site 452.32: (1) pale orange with dark brown paint, base type Ib-transitional to base type IV-, stem type 4; (2) exceptional bowl fragment; (3) base type V, stem type 1c1b; (4) white foot, base type Ia.

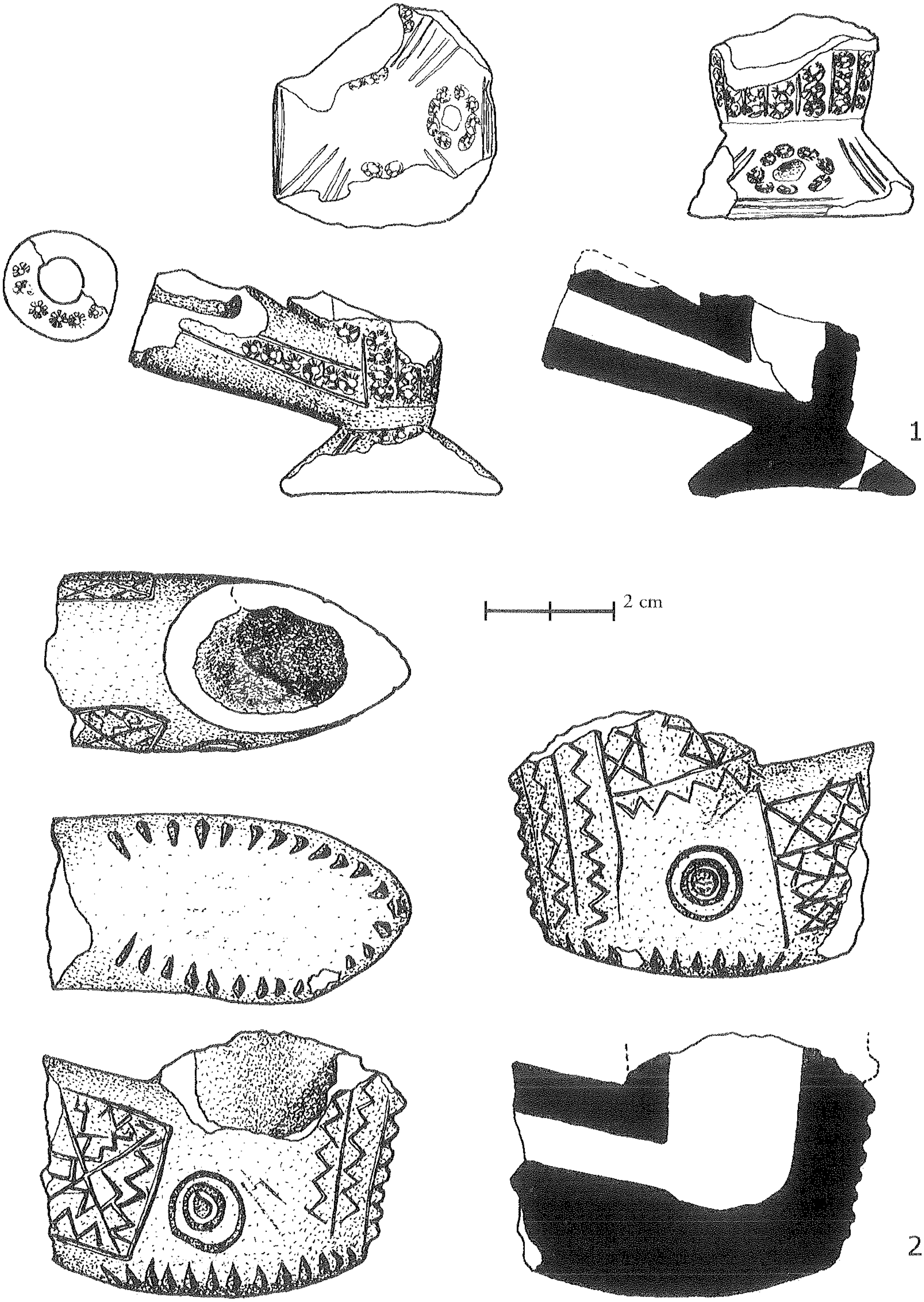

Fig. 12. Surface finds from site 452.32: (1) base type II, stem type 2; (2) exceptional black pipe with white clay inlay, base type VIII.

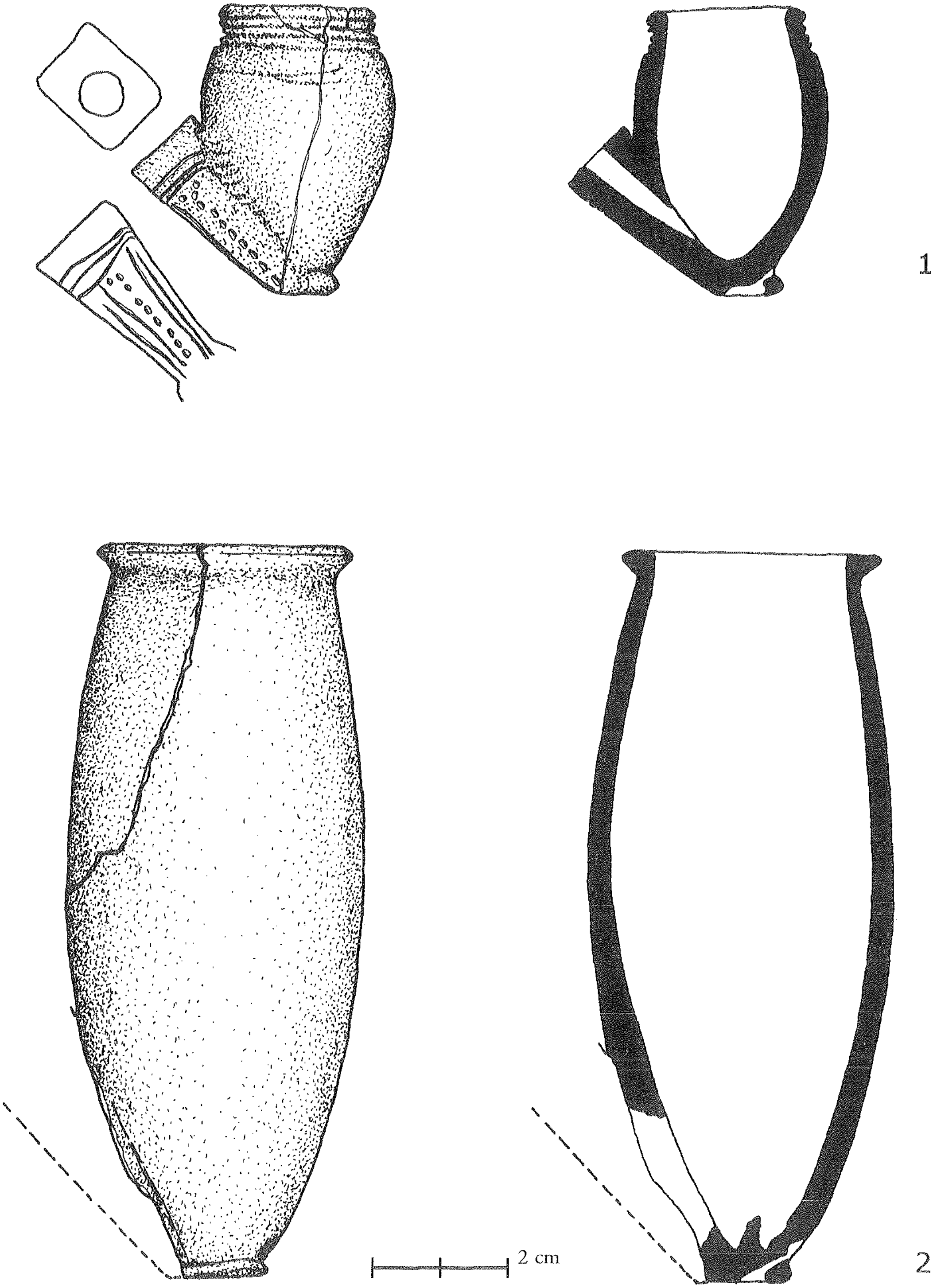

Fig. 13. Pipes from Ladekouna: (1) layer 8, base type Ia, stem type 1a2; (layer 7, base type Ia.

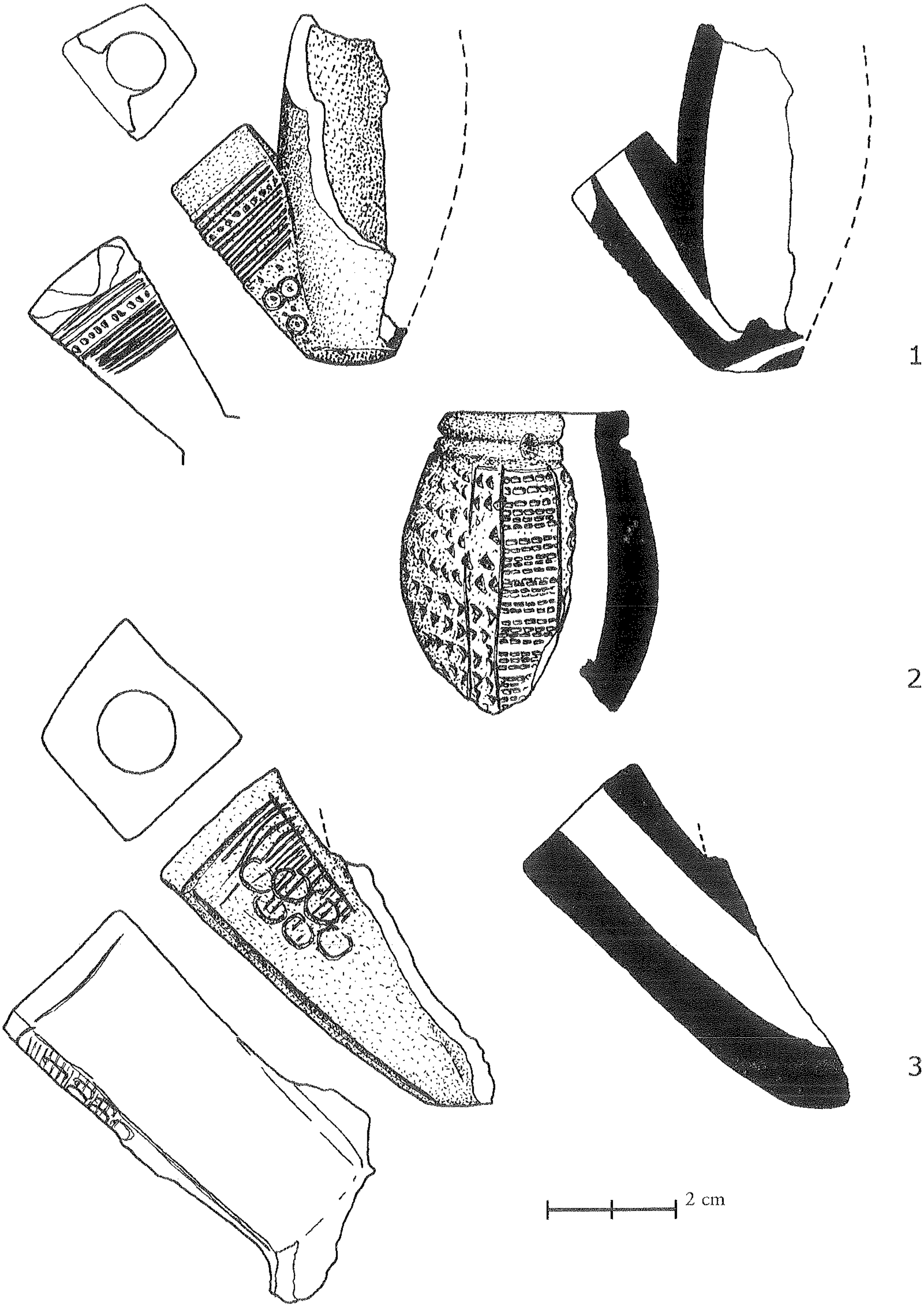

Fig. 14. Pipe fragments form Ladekouna: (1) layer 7, base type Ia, stem type 1a3; (2) layer 7, bowl fragment; (3) layer 7, stem type 2.

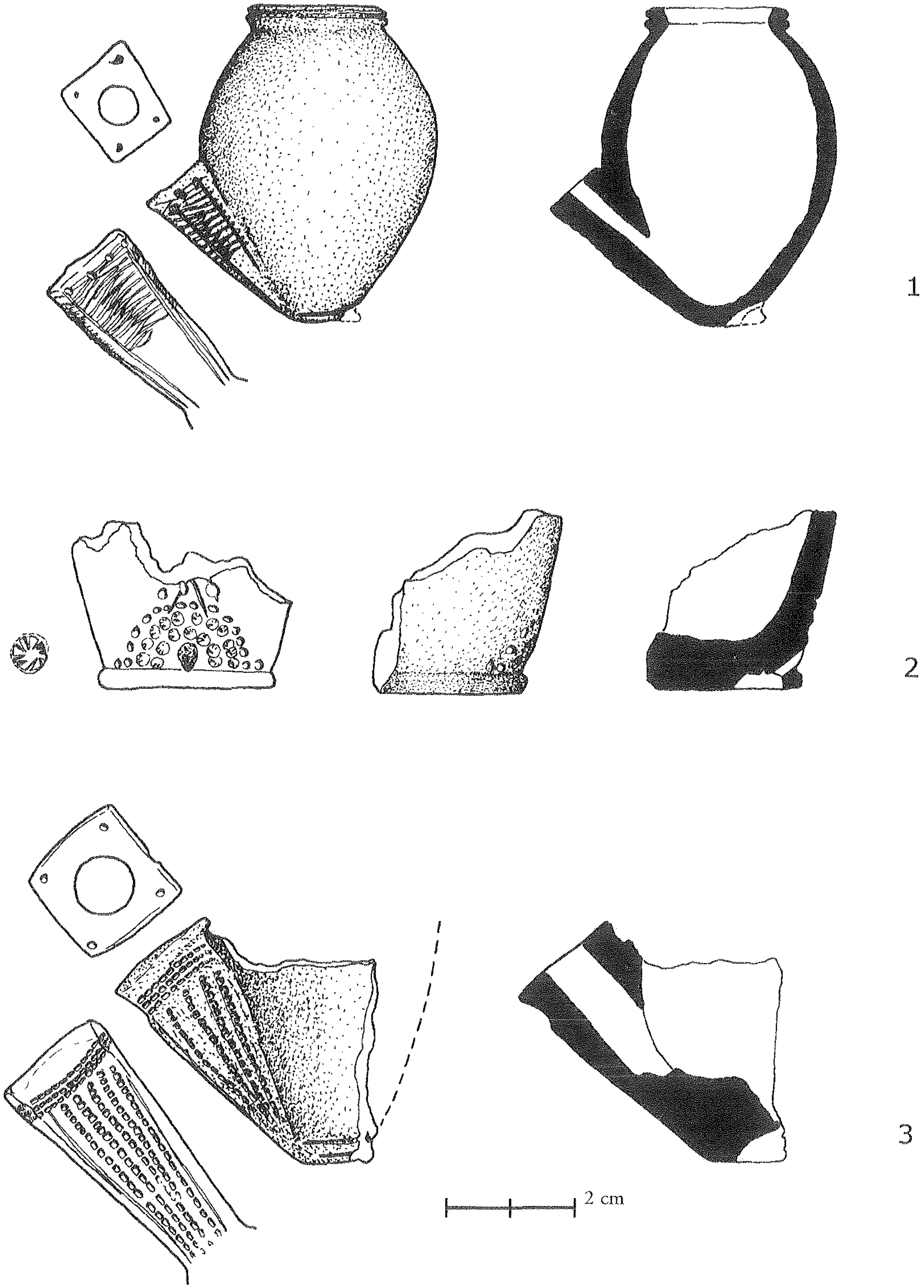

Fig. 15. Pipe and pipe fragments from Ladekouna: (1) layer 6, base type Ia, stem type 1a2; (2) layer 6, base type Ia; (3) layer 6, base type Ia, stem type 1a2.

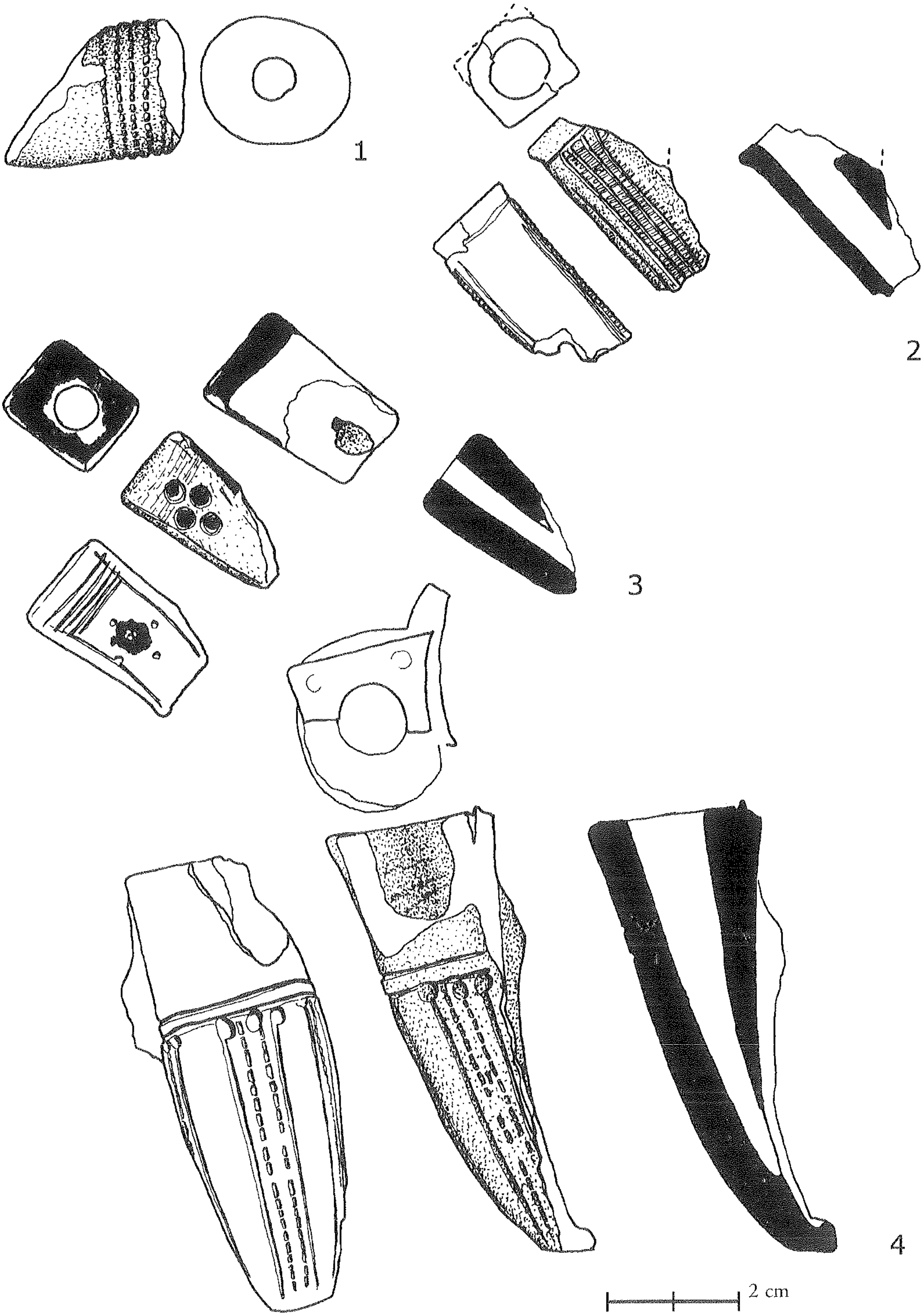

Fig. 16. Pipe fragments from Ladekouna: (1) layer 2, stem type 4; (2) layer 1, stem type 1b; (3) layer 5, white with red-brown paint, stem type 2; (4) layer 6, stem type 1c1a.

H.J. Franken

NOTES ON THE VALUE OF SLIP-GLAZED ATTIC WARES

For G.R.H. Wright, *vir perfecte planeque eruditus.*

In the *Festschrift* for H.-G Buchholz (*Studies in Mediterranean Archaeology*, Vol. CXXVII) G.R.H. Wright published reminiscences on an excavation in which he participated almost half a century ago. This recollection was evoked by a recent publication of a restored vessel, excavated at Euesperides in 1952, a find which excited the expedition members since it concerned fragments of an Attic black figured Lekanis, which he had drawn at the time, and which he now found published in *Libyan Studies*, Vol. 29, 1998, by D.W.J. Gill.

In his circumspective way of expressing himself Wright sketches the archaeological scenery as he had experienced it at that time and contrasts this with the, for him surprising and undoubtedly alarming modern attitude towards what once were 'basic assumptions concerning the quality and chronology of Attic pottery'.

Wright has the rare gift of being able to discuss scholarly issues with great mastery of relevant knowledge in its proper setting and to produce related thoughts from a vast arsenal of true humanistic and classical learning, without ever writing a mischievous remark when disagreeing with others.

Recently I had to write a chapter on Greek imported wares in Jerusalem, excavated between 1961–1967 by the British School of Archaeology under the direction of the late Dame Kathleen M. Kenyon. I had occasion to study several aspects of these ceramics that were supposedly imported from Greece. I described the raw materials used by the potters, while paying attention to the quality of the ceramics and making frequency calculations, (Franken forthcoming). The following is largely based on the study of the technological features of the Greek imports and related aspects. There is no lack of technological studies, published by experts on ceramic technology and chemistry of this pottery, to assist the archaeologist. See for instance Weisz 1985: 76. The same is the case with *terra sigillata* wares, which is a comparable technical subject to which I will refer.

Wright points to the discussions about this pottery and its suggested low value as it appeared in articles in the nineties of the last century, from which I will discuss the following points:

1. technical differences between Greek plain and decorated pottery
2. metallic shapes imitated in clay and decoration derived from precious metal vases
3. cheap pottery for lower class customers

Newsletter of the Department of Pottery Technology (Leiden University) 18/19, 2000/2001: 117-124.

4. vases as profitable ballast and space fillers in commercial ships
5. the suggested low market price
6. the low status of the producers

It is obvious that technical considerations do not play a part in the recent debate on the value of Attic pottery. I pointed out already that there is a great deal of information available on the production of black figured Attic and Corinthian vases. Since the early 20th century archaeologists, art potters interested in ancient ceramics and engineers in ceramic chemistry have tried to unravel the secrets of the Greek potters, especially since it was discovered that the black shiny coating on the surface of these vases is not a glaze. The term glaze used in the production of glazed pottery and tiles refers to an artificial product, a mixture of clay slam, metal oxides, colourants and fluxes. Black 'glazed', Greek pottery is covered by a glassy substance, made from a special type of clay slip. 'Slip-glaze' is a fitting name for it, in German: *Glanzton*.

The question of the price of Attic 'black glazed' pottery seems to have arisen when it was observed that some vessels from Cyrenaica bore price inscriptions. This was interpreted as indicating that Attic pottery in antiquity was surprisingly cheap. From this supposition far reaching conclusions were drawn about its economic and social value and the status of the potters, as well as about those archaeologists in the past who had spent, if not wasted, their time on the study of the painters and the painting of this pottery. Looking at the debate from a technological point of view, what can one say about this modern iconoclastic attack on a great scholarly tradition?

(1) Assuming that plain, not decorated kitchenwares were far more plentiful than decorated wares, one would think that the latter products were more expensive. It is rather unfortunate in the light of present developments in historical archaeology that classical archaeologists in the past have shown little interest in the plain kitchenwares found during excavation. It did exist and this can be demonstrated from the plain kitchenwares that were produced in Corinth and exported in large quantities to Jerusalem, as I discovered, (see below). The plain wares must have been cheaper than the decorated wares. One can also deduce this from a reconstruction of the production of decorated pottery compared with that of plain wares.

Although the Greek pottery production was since long rationalized it cannot be compared with mechanically produced ceramics. It was still entirely produced by manual labour. The following is a sketch in outline of the production. A slip-glazed pot had to be made in the same method as any undecorated piece. This unfired shape had to be put aside to dry. Plain wares were then ready to go into the kiln to be fired, but pieces to be decorated fell into two groups: one, and probably the largest group, had to be covered all over with a black slip-glaze and the other was to be decorated with painted scenes, often derived from mythology. In both cases a clay slip was needed, consisting of very fine clay, free from any non-plastics. The process to obtain such fine slip is called levigation and in this case it could only be made from a special clay called kaoline containing illite which is not very common in nature. The process lasted several days. To produce a good shiny effect it was required that the entire surface of the bone-dry vessel (as dry as it would become in a drying shed) was smoothed with a burnishing tool, for instance an animal rib or a smooth pebble. It needed pressure on an unfired pot and had to be done with care and could take several hours. When the slip was ready to be used it was still wet and had to be applied so that the unfired body would absorb the water without becoming sloppy and collapse. Again the pot had to be dried before it could be stacked in the kiln. Plain wares could be stacked in a pile touching each other. But the slip used on the decorated pots had to melt during the firing to make a surface that sealed the pores in the surface of the clay body. In its fluid state it would stick to anything that touched it and weld it together, just like glazed pottery will do during firing in the kiln. There are several ways to prevent this but whatever method was chosen it needed far more space in the kiln than plain wares. Moreover, each time fresh fuel was added to the fire, ash would flow through the pottery chamber, which is fatal for glazed wares and also in the case of slip-glazed pottery. The pots had to be protected from the free flow of gasses in the pottery chamber. Firing the kiln required a special skill. The kiln had to be heated to about 700°C with a free flow of oxygen but from that point to 900°C the oxygen flow had to be stopped to create a reducing atmosphere in the kiln, which required more fuel than was needed with a free oxygen flow. At this point the slip would have turned into a glassy substance and in its molten condition formed a airtight cover over the pot surface, while the reducing atmosphere had turned the iron in the clay of the pot into black iron (hercynite). When the kiln cools off the slip solidifies, preventing oxygen from turning the iron on the surface into red iron again. The stoker knew when to cut off the free airflow by watching the colours of the glow above the burning fuel.

It can be seen that slip-glazed wares must have been rather more expensive to produce than plain wares. In order to produce painted ceramics the process was even more complicated and per definition more expensive to produce. Before the slip-glaze was applied a painter had to indicate which fields had to be covered with the slip-glaze and where other colouring slips were needed. The white slip was made from a clay with very low or no iron content. The pale creamy colour could be strengthened with potash or tin oxide and it did not have the low melting point. If a shine was needed it had to be burnished with a burnishing tool. Red coloured fields were left untreated, because the red iron would take care of it in the fired product. It needed a very stable hand of the painter and according to the drawings of painters found on several vases, the hand was stabilized with the aid of the shaft of a large feather. Very often the vases were decorated with scenes from mythology and there were clearly canons to be followed, similar to those accepted by the Greek and Russian ikon painters. It is small wonder that painters or schools of painters developed their own techniques of applying the canons, which can be analysed and which is a legitimate part of the study of ancient art. From this it follows that the Greek vases are all individuals and not repeat items such as those turned out in vast quantities by modern porcelain factories.

(2) The next point to be discussed is the question: did the potters try to imitate precious metal vases? This is not an easy question since containers of all sorts of shapes, made in metal, can be produced in clay and vice versa. But like one has to choose the kind of metal, bronze, copper, tin, lead and so forth, that is best suited for the production and function of the required object, the same holds for clays. Secondary clays cannot be used in the production of porcelain. Lean clays are not to be preferred for the production of stylish vases, and can not be used on a fast wheel. A survey of world ceramics clearly shows that the quality of the available raw materials constitutes the limits of what shapes a potter can make. There are plenty of instances from the past and the present showing that potters managed to make egg-shell cups, almost as thin as silver cups but it always depends on the properties of the clays they were using whether potters could do it or not. When the clay permits it a potter can make 'metal' shaped vessels without trying to compete with the work of smiths. Looking for instance at certain styles of teapots produced by porcelain factories and those made by silversmiths one finds practically the same shapes in both materials and which came first? Weisz relates a story that illustrates how much potters depended on what their clay allows them to make. An alchemist called Böttger, born in 1682, was trying to make precious stone. In one of his experiments he used white kaoline, which is found in Meissen, Saxony. He discovered that its properties allowed for the production of porcelain and the local ruler, August the Strong saw the financial potential, and rather than producing or buying vessels of precious metal he set up the Meissen porcelain factory (Weisz 1979 and Berling 1972). It is clear why Delft potters who were trying very hard to imitate Chinese porcelain imports, never could have succeeded, not having the right clay.

I may mention another anecdote, how a potter produced 'silver' cups in a similar unpredictable way. At a symposium on the technology of Roman *terra sigillata*, held in Berlin, a Swiss potter showed a set of perfect imitations of *terra sigillata* and discussed his product. Then he put on the table a set of bowls looking like pure silver made from the same clay materials. This, he said, was the result when by accident the temperature in the kiln went out of control, causing part of his self-made kiln to collapse, and causing a strong reduction in the space where the cups were stored. It shows that the idea that potters can produce anything, simply because a customer wants it, is not valid.

The question of imitation of metal prototypes concerns two aspects. Did the potters try to imitate metal colours and did they want to produce shapes derived from metal vases? I have argued that it is impossible for a potter to produce a special effect if he does not have the knowledge and the right raw materials to do it. The effect of reduction in combination with the use of a slip-glaze may once have been found purely by accident, but that does not mean that potters would have been able to reproduce this effect. It needs a very intelligent approach to the production processes and understanding of what happens during firing to explain failures. In this case the successful production of black slip-glazed vases was not initiated by an accident in the kiln but by understanding of the processes and the idea that it might have artistic and commercial value. It is highly unlikely that it is connected with a wish to imitate varnished silver or gold. Likewise there is no proof that potters applied a cream slip as a base for painting because they wanted to imitate the colour of ivory inlay on metal vases. By itself it is very well suited for the purpose, creating a light background instead of a red one, and it was already used as a means of decoration by Neolithic potters.

The question of imitation of metal shapes (Fig. 1) is also not a simple one. A 'primitive' metal form is not easy to imitate in clay. This is the form with straight sides made from metal sheets. It is supposed that some shapes of Middle Bronze Age pottery in Palestine were imitations from metal prototypes. True straight sections in walls of pots are not easy to produce, due to the fact that shrinkage in the unfired pot tends to cause straight parts to curve, with the exception of cylindrical parts. A pure ball shape can be made in metal but in clay it tends to become oblong when drying. On Near Eastern markets one finds metal cooking pots combining two techniques. The base is battered into a concave bowl shape and the wall is cut from a flat metal sheet bent in the required shape (Fig 2a). It is fairly certain that the basic idea for this shape is derived from ceramic cooking pots that have been produced since the end of the second millennium B.C. This ceramic pot had a very effective design, both in the composition of the clay paste and the shape (Fig. 2b). It was a flameproof pot that could stand a lot of wear. The method of hammering a metal sheet into a curving shape is comparable to what potters do. Depending on the type of clay one is using one throws a pot into its curves or presses it or beats it into the required shape. Such shapes can also be made by casting clay in moulds or trimming it and so there are unlimited possibilities of making the shape one wants to make. Considering the shapes of Greek slip-glaze wares like the Lekanis from Euesperides one cannot *a priori* conclude that its shape is developed after a metal prototype. A cylindrical shape is often the first step when throwing an oval form and the cup shaped mouth and elegant handle as well as the pedestal base are not an uncommon feature in ancient pottery. It is known that when objects are made

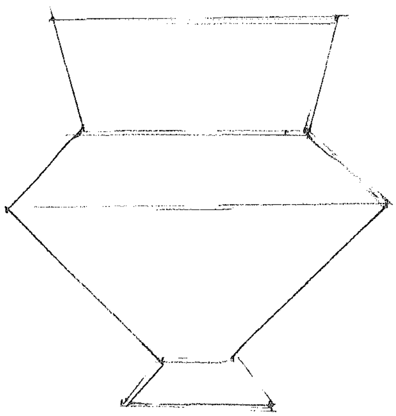

Fig. 1. Imitation of metal shapes.

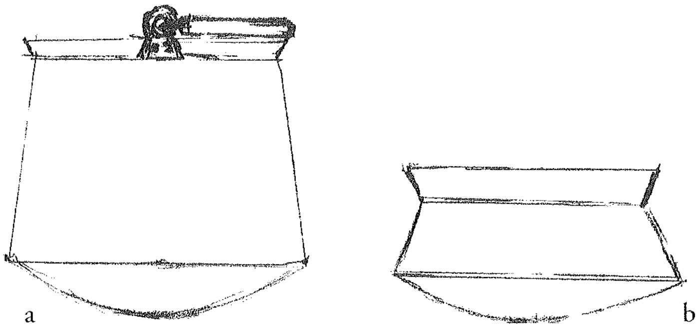

Fig. 2a. The base battered into a concave bowl and the wall cut from a flat metal sheet bent into the required shape.

Fig. 2b. Ceramic cooking pot with a very effective design, both in the composition of the clay and the shape.

in 'new' materials, for instance if a factory replaces glass bottles by plastic ones for their liquid products, at first the new shapes imitate the existing and well known shapes. Using precious metals to replace ceramic forms could have been the same process.

(3) Who were the customers who could not afford to buy vases made of precious metals and instead had to make do with imitation ceramic ones? The case seems to be comparable with the question: who used *terra sigillata*, produced in vast quantities and sold all over the Roman empire. At that time glass containers had appeared and may have replaced certain ceramics in well to do circles. But such questions can only be studied when archaeologists can answer in which quarters of the towns or *castra* plain pottery, decorated pottery, glass or metal objects were found and what their relative abundance was. If such information is not available, one assumes that the free Greek citizen who owned a little property would normally possess an abundance of plain kitchen wares, a large dinner service consisting of decorated and plain slip-glazed pieces, and possibly some pieces of precious metal.

A precursor of the Greek slip-glazed wares is the so-called Kamares pottery, decorated against a black background that has a metallic appearance. It is Middle Minoan pottery from Crete and it was found in the palaces. This cannot indicate that precious metal vases were not available, but it may indicate that what is precious now was not valued in the same way in antiquity.

As for Jerusalem I calculated that there was about one imported Greek decorated piece for every two imported plain pieces, and the import was 3% of the total ceramic assemblage. This is based on pottery found on the ancient dumps of the town. Two things however are clear: Corinthian plain kitchen wares were imported in Palestine in shiploads and Greek potters settled in the country to produce 'Greek' wares for the local markets. Even in the plain wares there must have been a price difference based on quality and taste. This was indeed the case with the traditional Palestinian pottery and the newly introduced Greek ceramics, which nevertheless conquered the market.

(4) The import into Palestine of Attic and Corinthian vases cannot be explained by suggesting that they came as profitable ballast or space fillers. Any ceramic vessel with protruding parts like handles, knobs on lids or bases and flaring rims would never survive the sea journey when stacked in small spaces. There is only one way to make sure that they would arrive undamaged and that is packing them in such a way that no part of the vessel could touch any hard neighbouring object. Greek wine jars were made to be transported in ships, and rims, handles and bases are strengthened and shaped to be stacked together. This feature may not often have been observed but it is characteristic for such vessels, although it was known that the cylindrical shape is uneconomical in terms of jar capacity.

(5) The low market price found scratched on some pieces like the one found at Euesperides needs some comment. To see if this low price can be postulated to represent the normal market price for Attic decorated vases one wants to know why some pieces have a price mark and how often such scratch marks occur. Producers of art ceramics at present as well as in the past maintain a very rigorous quality inspection system. The same can be found for instance in factories of quality glass. As customers we know the sales of second quality products while first quality wares are more expensive. This is by no means a modern feature of the market. Competition between factories or ateliers forces craftsmen and artists to maintain high standards. Every pot is inspected for defects by the master potter when it comes out of the kiln and is either destroyed when not perfect or put aside as second quality. In Eastern countries one can find mountains of broken pottery near the production centres, partly as a result of this system, the rest was already broken in the kiln. Pieces are destroyed for failures no layman would be able to see. Some such quality control system could very well have existed in the Athenian ateliers where second quality pieces were scratch marked with a price label and inferior pieces were immediately destroyed. Good quality pieces would not be marked by such barbaric scratches but classical archaeologists have until recent times paid little attention to the waste heaps found near ancient potteries. Even the study of plain kitchenwares seems to have been neglected in the past.

(6) I have shown that potters producing plain wares were a different group from those producing slip-glazed and decorated wares. Plain wares can more or less be said to have been mass-produced and the skill demanded of the potters was much less developed compared to that found in the other group. The slip-glazed pottery was far more expensive to produce in terms of the required raw materials, skilled labourers and painters, time required to produce each piece, and because the potters had to face competition from other workshops. This was pottery for well-to-do customers. Every household of free citizens must also have had a stock of plain kitchenwares, both sturdy for water transport and storage of oil or grain etcetera, and cooking pots, but also rather porous vessels for keeping foodstuff cool. Slip-glazed and decorated services may

have been rather elaborate as it served for dinner. The gold and silver goblets and plates are put on the table at occasions like the tumultuous wedding of Aristaenetus' daughter to the only son and heir of the rich banker Eucritus (Lucian, *The Carousal*, or *the Lapiths*, Loeb edition Vol. I). The economic status of the producers of art pottery, which it certainly was, may not have been ideal but the painters who decorated the pots did not think of themselves as inferior artisans, as is attested by the scene on a vase from Ruvo (Fig. 3).

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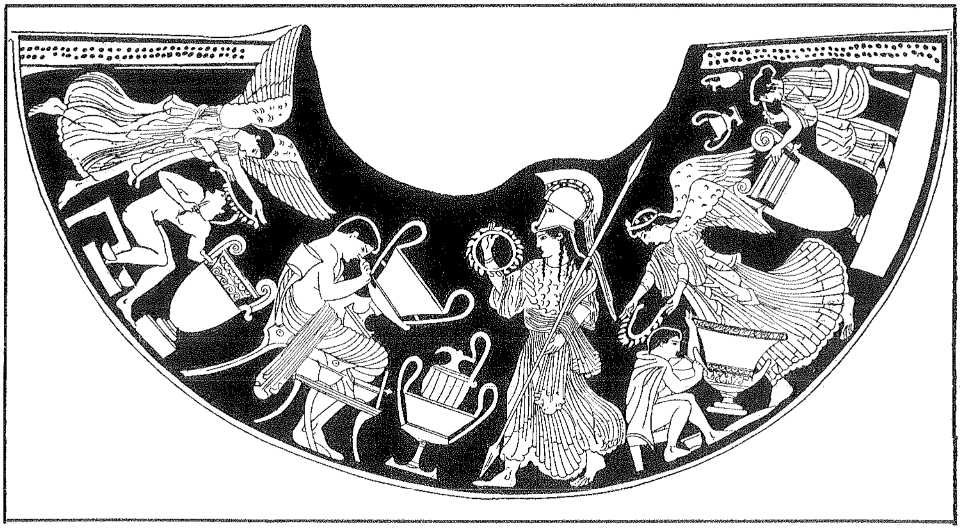

Fig. 3. From an Attic red figure *hydria*, second quarter of fifth century B.C. from Ruvo (Baumgartner *et al.* 1913: Fig. 451).

A. van As

WOMEN POTTERS OF CYPRUS AND CERAMIC ETHNOARCHAEOLOGY: A VIDEOFILM BY GLORIA LONDON

Handmade pottery has been part of the rural economy in Cyprus for at least 6000 years. Intrigued by this tradition, Gloria London spent seven months in 1986 visiting remote villages on this Mediterranean island, to do research into the pottery traditions that had changed little since they were first implemented in the Neolithic age. She was by no means the first visitor to take an interest in the Cypriotic art of earthenware. In the introduction to her book on the potters she observed there (London *et al.* 1990), she relates that certain early travellers (14th and 16th century) had noted the superb quality of the large earthenware wine vats and that an Italian priest, Father Giovanni Mariti, who had come to Cyprus in the 18th century specifically to study the manufacture and storage of wine, mentioned specific centres of traditional pottery manufacture at the villages Kornos and Lapithos. An illustrated account by Émile Deschamps, dating to the end of the 19th century, refers to another pottery-making village, Phini, which in those days was renowned for its *pitharia* or huge stationary storage jars.

Seeing as only a few travellers visited the rural communities on the island, only a very small number of accounts are available on pottery manufacture in the villages. When one adds to that the fact that the work mainly took place in the courtyard of the houses, then it is hardly surprising that few diaries and travel logs even mention it at all. Besides, most travellers were more interested in the contents of the pots than the pots themselves. The first photographs, taken by John Thomson in 1878, depict rural and urban Cypriots and their use of pottery (Thomson 1879). Several pictures for instance show women with their pots at the well. It was another fifty years before Joan du Plat Taylor and Olga Tufnell captured on camera the manufacture of pottery in Kornos (du Plat Taylor and Tufnell 1930). They were pioneers in their time (at the start of the 20th century) in being the first archaeologists to visit pottery centres with the explicit of learning about the past from the present in the vein of Max Ohnefalsch-Richter who did so at the end of the 19th century (Ohnefalsch-Richter 1891; 1893). Nowadays, we would call them ethnoarchaeologists. The remaining descriptions of rural and urban potters on Cyprus are from more recent times (*e.g.* Johnston 1974; Yon 1985; Pieridou 1960). The most extensive and detailed account (furbished with many photographs) of the rural industry on Cyprus is that of Roland Hampe and Adam Winter (1962).

The ceramic ethnoarchaeological study by Gloria London on Cyprus, some results of which have been published in earlier volumes of the *Newsletter of the Department of Pottery Technology (Leiden University)* (London 1985; 1998/1999), was designed to

Newsletter of the Department of Pottery Technology (Leiden University) 18/19, 2000/2001: 125-128.

record the pottery industry and to provide data relevant for most archaeologists whose excavations uncover more pottery and sherds than any other single artifact (London *et al.* 1989: 21). It can be categorized as a long-term field project. In contrast to short-term studies (see also van As and London 1998/1999), long-term projects aim to address specific issues such as for example in Cyprus standardization of craft specialists (London 1991), sources of variation in vessel features and decoration (London *et al.* 1989) and in Sardinia the peculiar properties of the clay and the local specializations in terms of vessel forms (Annis 1998/1999).

During her seven month stay among traditional potters in southern Cyprus in 1986 Gloria London examined rural pottery production for the full season in Kornos on the edge of the Mesaoria plain in the Troodos Mountain foothills south of Nicosia and in three villages (Agios Dimitrios, Kaminaria en Phini) situated high in the forested Troodos Mountains.

By 1986, the potter's craft was an almost wholly female domain. In Kornos, one of the oldest centres of traditional pottery manufacture mentioned in the literature, thirteen women potters operated ten of whom formed a collective called the Kornos Pottery Cooperative, while the remaining three worked operated independently out of their own houses. In Kaminaria, just one woman was still producing traditional pottery, and in Phini only two potters still applied traditional techniques to the production of tourist-oriented wares. Agios Dimitrios was the only place where men were involved in the production of pottery, besides five women. These two men had been taught the trade by their wives. Only 15 years earlier, men had been much more involved in pottery production. The male potters were specialised in the manufacturing of larger storage jars (*pitharia*). These enormous jars had been produced for over 200 years by migratory male potters, now non-existent, called *pitharades*.

Gloria London's study was partly made up of interviews with potters and non-potters, but mainly encompassed observing, recording and quantifying all aspects of the ceramics industry, from clay procurement to product distribution. This approach gave her insights into the rate of loss, number of pots fired together, precise decoration, along with attributes designed to differentiate between village and individual styles in Kornos and the three mountain villages.

The women potters work seasonally, namely from April until November. In the off-season, when the weather prevents the potters from doing their work, they return to their fields and trees. They use local available red clays that are collected by the men and then prepared by the women, who sometimes receive help from their husbands. Agios Dimitrios is the only place where the red clay was mixed with a native white clay. All pottery is handmade. The larger forms are coiled using a slow moving wooden turntable rotated by hand or foot. In some cases, a rope or pieces of cloth were wrapped around the outside, as support during the build-up. The base, once dry, is thinned by scraping. Sometimes, handles and spouts are attached. Decoration involves stamped, incised and combed patterns. Vessel of all types are fired together in permanent kilns. The regional differences are remarkable. In Kornos, the ovens have a permanent domed-shaped roof.

In the mountain villages, on the other hand, the top-loading kilns have a temporary roof of old roof tiles and metal sheetings. This regionalism, that is a Kornos style versus a mountain style, showed up in other aspects of the tradional ceramics as well (London 1987).

Most Cypriotic traditional pottery is designed for daily use, such as carrying or storing water, milking goats, cooking, or storing food. Incense burners are made for ritual purposes and are used throughout the year at various holidays. The utilitarian ware for local use is bought by the Cypriots in their pottery producing villages. Earthenware cooking pots are favourite. Or, according to a young man, who went to Kornos to buy a cooking pot for his bride: "I am looking for the taste of my mother's cooking, and this begins with a handmade clay pot".

Gloria London visited Kornos again in March 1998 during the off season (London 1998/1999), followed by a year long research period in all pottery producing communities in 1999/2000. This follow-up study tried to determine if the traditional industry remained in operation and to learn what was changed or remained the same in terms of vessel shapes, decoration and organization of the industry. It was established that despite the decrease with one third of the number of women potters the Kornos pottery industry survived. In the four villages ten women potters were still active, all of them older than 55 and without younger ones to learn the craft.

In 1986 it was possible to differentiate the wares of each potter in Kornos based on observations of the incised decoration, overall vessel proportion and nuances in manufacturing technique. By 1998 despite the lower number of potters it was more difficult to identify the wares of each potter given that four Cooporative members now shared the same incised combed patterns of horizontal and wavy bands. Equally remarkable has been the influence of the tourist market on the traditional centres of pottery production. The general forms of these ceramics are slightly less graceful. Despite the new vessel form and the new clientele, the decoration applied by the potter of Kornos to this new tourist-oriented ware remained the same as that which used to be applied to the traditional pottery ware.

Since the women potters on Cyprus are the last of their generation and the number of traditional potters decreases annually it will soon be impossible to record their work. This alone makes Gloria London's ethnoarchaeological study one of great importance. The similarities between traditional and ancient shapes, incised decorations, materials, and wood-burning kilns, make for an ideal ethnoarchaeological study of craft specialists. The initiative she took in 1986 to do a certain amount of filming has resulted in an edited 26 minute long videofilm entitled *Women Potters of Cyprus*, set to authentic women's dance music. The film portrays Anna, Maria, Theodora and other women potters performing all sorts of working activities, which can be particularly backbreaking when it comes to the adding of coils to the larger vessels. The manufacture of coil built cooking pots, jars, jugs and other clay containers using a technique reminiscent of ancient pottery are also captured on film. The film is an extremely useful teaching aid, particularly for ceramic studies or ceramic ethnoarchaeology. Therefore, I can sincerely recommend this videofilm to anyone. It has proven to be a valuable addition to my own coursework, particularly appreciated by the students who are all too familiar with the dearth of video material in this field.

The video *Women Potters of Cyprus* accomplished through a grant from the Fulbright Commission and the National Endowment of Humanities administered through ASOR and the Cyprus American Archaeological Research Institute is 26 minutes long. The film (NTSC or PAL format) costs $ 24.95 plus shipping and can be ordered by writing to Gloria London, 7701 Crest Drive NE, Seattle WA 98115, USA (e-mail: galondon@earthlink.net).

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Research projects in cooperation with:

Leiden University/Faculty of Archaeology:

Indian America:

- Morel (Guadeloupe) (Dr. C. L. Hofman);
- Manzanilla site (Trinidad) (Dr. C. L. Hofman).

Theoretical Archaeology in cooperation with the University of Glasgow:

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

The Netherlands National Museum of Antiquities, Leiden:

- Tell Sabi Abyad Project (Dr. P.M.M.G. Akkermans and O.P. Nieuwenhuyse).
- Analysis of Greek *lekytoi* (R. Dooijes, Dr. R. Halbertsma).

The Netherlands Institute for the Near East:

- Iıpınar Project (Dr. J.J. Roodenberg).

University of Leuven

- Sagalassos Project (Prof. Dr. M. Waelkens).

Deutsches Archäologisches Institut:

- Oylum hüyük Project (Dr. B. Helwing).

Working Group on Mesopotamina Pottery:

- A Corpus of Mesopotamian Pottery (2^{nd} millennium B.C.) (Dr. H. Gasche).

Fieldwork:

01-07/06	2000	Riu Mannu Survey Project, Sardinia (M.B. Annis)
22/06-3/07	2000	Oylum hüyük, Turkey (A. van As and L. Jacobs)
20-27/08	2000	Sagalassos Project, Turkey: ethnoarchaeological research in Çanaklı (M.B. Annis)
17-25/07	2001	Oylum hüyük, Turkey (A. van As and L. Jacobs)
20-30/09	2001	Museo Communale Guspini/Montevecchio, Sardinia: organization of the exhibition *Alla ricerca del mondo rurale nella Sardegna antica* (M.B. Annis).

Publications:

Annis, M.A., P. van Dommelen and P. van de Velde, *Alla ricerca del mondo rurale nella Sardegna antica*. Exhibition Guspini/Montevecchio and Villanovaforru (www.Sardinia.arts.gla.ac.uk/mostra.htm)

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Lectures:

14/02	2000	A. van As: *Archeologie en aardewerk*; Instituut Collectie Nederland (ICN), Amsterdam.
16-28/04	2001	A. van As, O.P. Nieuwenhuyse, R. Dooijes, K. Duistermaat and A. A. Hausleiter: *Archaeological Ceramic Research. An Introduction to Methods and Practice of Archaeological Ceramic Analysis*; University of Damascus, Syria
19/04	2001	A. van As: *Identifying ceramic traditions*; Department of Antiquities of the Syrian Arab Republic, Damascus.

Seminars and workshops

02-04/04	2000	M.B. Annis: Nuraghe Orroli Research Project on Bronze Age Sardinian pottery (Dr. Fulvia Lo Schiavo, Rome CNR): seminars: *Ceramic technology and ethnoarchaeology.*
10-13/04	2000	M.B. Annis: University of Groningen (convenor B. Mater); workshop *Change in Pottery Technology and Production in the Light of Urbanization and Colonization.*
17-19/05	2000	Glasgow University, Department of Archaeology. Seminar: *Thinking about traditions: ethnography and archaeology in Sardinia.* Workshop (in collaboration with Prof. B. Knapp, Dr. R. Jones and Dr. P. van Dommelen): *Ceramic Archaeometry and Technology.*