ASSENDELVER POLDER PAPERS 1

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11 CERAMIC PRODUCTION
Assendelver Polders

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Abstract The paper presents the background, reasoning and methodology of the analysis of pottery technology carried out on the ceramics from the Assendelver Polders. It builds a preliminary model of the ceramic tradition as a whole, and gives some clues concerning the way the pottery of the individual sites relates to that overall tradition. It next attempts to use the technological analyses to achieve an insight in the chronology of the pottery, and compares sherds with complete vessels in this perspective.

11.1 INTRODUCTORY REMARKS

This – first – report on the ceramics of the Assendelver Polders must necessarily serve more than one purpose. First, it is to sketch the context in which ceramic production in the Oer-IJ estuary took place. Second, it is to introduce the approach to pottery which we have chosen and the analytical consequences which derive from it. Third, it is also to present some of the first – tentative – results of the analyses undertaken.

After relatively wide reading among the ethnographical literature of pottery-making, we believe that each manufacturing organization and technique is intimately tied to a number of social and economic variables of production. Moreover, it seems that the different states in which a pottery-making system may be found to operate, are limited. In other publications, one of us has distinguished six or seven of these organizational states (van der Leeuw 1976, 1977, 1984b, 1984c). Of these, four seem to be related to the ceramic production on the Roman frontier. They will be discussed, and their relation to the ceramics from the Roman Iron Age in the Assendelver Polders will be pointed out.

As both the contextual hypotheses and the approach chosen for the analysis of the ceramics are a bit different from usual approaches, and certainly from the approaches chosen in the analysis of Iron Age materials from the Netherlands or western Europe (e.g. van Heeringen, 1979), a theoretical and methodological introduction is in order. It will be kept as brief as possible, but it should allow the reader to read this chapter without reference to other publications, except as a matter of ancillary interest.

A comparable amount of attention is devoted to the way in which we have implemented this kind of approach in this specific case. One of the many new problems with which we were faced in this project was the creation of a happy union between computer-oriented analysis of materials and the technological approach taken, which had never been tested in this manner. Moreover, the number of sherds was comparatively large, although not larger than in some situations in the Near East which have been analysed in the past, by the senior author. As a consequence, it was impossible to begin sorting the pottery after procuring the entire collection. This presented problems of standardization, adaptation of criteria, etc.

However interesting all the above topics might in themselves be, what we aim for are results which may be used in our interpretation of the processes taking place in the Assendelver Polders. Thus, the third part of the essay will be devoted to an overview of some of the results achieved to date. This overview is necessarily incomplete, as certain analyses remain to be done. Moreover, the presentation of the results is *tentative: it represents the present state of our working hypotheses on the subject*.

11.2 POTTERY MAKING IN PRE-INDUSTRIAL SOCIETIES

Pottery-making must be seen in the context of the other activities of a society. Its level of organizational complexity is related to that of the society in which it occurs. The degree of social differentiation, the amount of interaction among the participants in the society, the degree of craft specialization in general, the amount and nature of trade, and a number of other aspects are closely related to the organizational mode of the pottery-making subsystem.

In the case of the pre-Roman and Roman Iron Age in North Holland, the societies which we are studying are generally dependent for their subsistence on husbandry, cultivation, hunting, gathering and fishing. They are at least partly sedentary (the herdsman semi-sedentary?), very slightly socially differentiated (see Brandt et al. 1984; Brandt & van der Leeuw, this vol.), and show some economic differentiation as well as some craft specialization. The disperse settlement pattern seems to indicate that the amount of interaction is limited, with only a few slightly larger settlements and predominantly single homesteads. All in all, the level of organizational complexity seems very low.

The imported pottery (which essentially occurs only in the Roman period), on the other hand, comes from areas which traditionally show all the characteristics of more complex societies. The 'simplest' of the imported kinds, the Belgic ware, comes from northern Gaul, Belgium and adjacent Germany. Areas which, even before the Romans invaded them, had a more complex social structure than the people in the Assendelver Polders. Even though the Romans did transform that structure qualitatively, it seems that the level of organization was retained, if not increased after conquest (Roymans 1983). The other kinds of imported pottery come essentially from the Roman heartland (Italy, Gaul, the Mediterranean and later the area around Trier) which, evidently, was also very highly organized.

It is in this light that one should interpret the following general ideas on the organization of the manufacture of indigenous and imported pottery, which have been developed independently of, and essentially prior to, the knowledge we have gained in the Oer-IJ estuary.

As one of us (van der Leeuw) has argued elsewhere, based on work done by Balfet (1965), in an argument picked up by others such as Peacock (1982), there are organizational constraints involved in pottery-making which effectively limit the number of conceivable modes of pottery manufacture. Thus, technological analysis of pottery has to take the economic and organizational aspects into account. Balfet distinguishes three such forms, van der Leeuw has distinguished six (1977) or seven (1984b, 1984c), and Peacock has mentioned seven. Probably, one could refine the system and define more modes.

Table 11.1 presents some characteristics of each of six organizational modes relevant to this paper in abbreviated form. It is based on rather extensive ongoing research in the ethnographical literature, and on ethnoarchaeological research on Negros, Philippines. The variables presented in the left hand column have been drawn from comparative study of a wide selection of ethnographically observed situations. Each of the other columns represents one mode. In most ethnographically documented cases, the values found for the *economic* and *organizational* variables seem to fit one or the other of the modes as they have been presented here. These variables have therefore been used in defining the modes. The values of the *technological* variables have been drawn from the specific examples documented in the table, and would sometimes differ for other pottery-making situations which belong in the same organizational mode. This is because there seem to be several technological solutions to the same organizational constraints.

Peacock has argued in general terms that the 'simplest' indigenous pottery of the Roman period (such as we have in Assendelft) is due to some mode of household production such as represented in the first three columns (1982). Elsewhere, a larger number of such vessels is produced following slightly different techniques, such as is the case with the Belgic ware (Willems 1977; Peacock 1982). This mode of production is represented in the fourth column. The imported Roman pottery, it seems, may have been produced in the fifth and sixth mode (Peacock 1982).

The evidence which we have for the manufacture of pottery in the Assendelver Polders according to the first two modes is mainly negative. In the excavations which we have undertaken so far, which were quite extensive, we have not found any evidence for kilns or other firing apparatus. That seems to fit admirably with the fact that in all the ethnographic cases known for the first two modes, there are no firing provisions. On the pottery excavated, there is no evidence of any tools beyond a simple piece of wood, bone or stone, and a support on which to stand the vessels during construction. The raw material used to make these vessels consisted of the clay as dug up in and around the settlements, in clay pits which we have excavated. This clay was used without any preparation or addition of nonplastic materials (section 11.5.1.1). This, too, seems to point in the direction of the simplest modes.

In Schagen-Lagedijk, a Roman settlement somewhat further north, and dating to the second and third century AD, we find the same clay pits, but the clay has been mixed with nonplastic materials which did not originally occur in it, such as various kinds of ground shell, sand, small fragments of stone, and organic materials. Altogether, six different kinds of tempering material have been identified. Pottery made with each of these tempering materials was found in one and the same house, indicating that the inhabitants must have obtained pottery from several sources. We therefore assume that in Schagen-Lagedijk, where the total assemblage of finds is much richer than in Assendelft, and where we have considerable numbers of imports, there must have been some trade in pottery. The pottery found there shows the use of some scraping/cutting and some polishing tool, and a few fragments of a kiln have been found (but we cannot as yet prove that it was a pottery kiln). Tentatively, we assume that in Schagen-Lagedijk, the (native Roman Iron Age) pottery was made according to the third of our modes.

For the moment, we will follow Peacock (1982) in his assumptions about the organization of the manufacture of the Belgic ware, Roman utilitarian pottery and terra sigillata. We have initiated a programme of research into the various imported wares, but it is not sufficiently far to draw upon its results for the present argument.

11.3 WHY DO WE STUDY THE TECHNOLOGY OF ANCIENT POTTERY?

Inevitably, the answer to the above question lies in our reasons for being archaeologists, for studying the past. Most would concede that such study is aimed at 'knowing' something about the past, at 'knowing' which processes were important to shape that past, and to some extent, the present. Some would also concede that it is their aim to gather some knowledge about the humans who lived in the past. They may skip the next few lines; those who are not interested in humans should read on.

We would grant the nonbelievers that we are not interested in what went on in, and between, individuals. But we think it might be coherently argued that past processes which involve human actions were constrained by decisions made by those humans. We do not need to know what motivated these decisions in order to describe the processes, because we can compensate for that ignorance by describing them in statistical terms. But we do need to know the elements which may have constrained the decision-making processes within that past society, so that the result is, indeed, structured and nonrandom. Thus, we need to know (a) the options open to the humans concerned, and (b) sources of bias towards, or away from, certain options.

If we can thus unite on the need to learn something about the constraints to which decision-making in past societies was subject, we may ask the next question: how can we do this without some notion of the way in which our (human) objects of study

Table 11.1
Overview of six common states of the pottery making system (after van der Leeuw 1977).

	variables	household production	household industry
economy	time involved	occasional	part-time
	number involved	one	several
	organization	none	none
	locality	sedentary or itinerant	sedentary or itinerant
	hired hands	none	none
	market	own use	group use
	raw materials		
	clay	local	local
	temper	local	local
	water	local	local
	fuel	local	local
	investments	none	none
	seasonality	production as needed	season without other work
	labour division	none	none
	time involved per pot	high	high
	status	amateur	semispecialist
technology	manuf. techniques	hand/small tools	hand/small tools
	tools		
	sed. basin	none	none
	wheel	none	none; rotary support
	drying shed	none	none
	kiln	open firing	open firing/impermanent
	raw materials		
	clay	wide range	wide range
	temper	wide range	wide range
	water	any	any
	fuel	wide range	wide range
	range of pottery	narrow	narrow
	range of functions per pot	wide	wide
examples		Kabyles, N Africa	Cameroon Tanzania

perceived the world around them? We cannot. If we were to try just that, we would not fail to fall in one of two traps: determinism or vagueness. If our grounds for ignoring past constraints to decision-making, and thus ignoring past perceptions, are that these past perceptions are irrelevant, we imply that humans are governed by some 'invisible hand', some 'big brother'. We imply the absence of relevant human decisions which have an impact on the process, and argue that the process, and the humans partaking in it, are determined uniquely by other constraints. If, on the other hand, our grounds derive from the 'practical impossibility' to gain an inkling of past perception, we willingly relinquish the claim that our picture of the past is anywhere near accurate as far as it concerns human activity. Our only hope is to try our best, and set up an argument which makes the best of, truly, rather scant materials available to achieve the aim.

Thus, this paper, and indeed this volume, is written from the conviction that the study of past perception is a necessary and probably viable enterprise once we find the right way to go about it. It is argued that the study of past technologies is one way to approach at least part of the perceptive system of extinct societies. Clearly, any activity such as manufacture, which purports to transform matter in a more or less repeatable way, must distinguish the actions undertaken in the process as circumscript and controlled actions. That permits us to conclude that reconstruction of manufacturing actions is reconstructing part of the perceptive system.

Such reconstruction has to take into account the two sides of the interaction be-

individual industry	workshop industry	village industry	large-scale industry
full-time	full-time	part-time/full-time	full-time
one	several	several	many
none	(guild)	certain	certain
itinerant	sedentary	sedentary	sedentary
none	some	some	labour force
regional	village/town	region (wide)	regional and export
local	neighbourhood	neighbourhood	neighbourhood/distant
local	neighbourhood	neighbourhood	neighbourhood/distant
local	local	local	local
local	neighbourhood	neighbourhood	neighbourhood/distant
few	some	some	capital
all year except winter	all year/good weather	all year/good weather	all year
none	some – considerable	some – considerable	detailed
medium	medium – low	medium – low	low
specialist (many techniques)	specialist	specialist	specialist (few techniques)
hand/small tools	mould/wheel	mould/wheel	wheel/cast/press
none	when needed	when needed	needed
turntable	various kinds	various kinds	kickwheel or similar
none	needed	needed	needed
impermanent	(semi-) permanent	(semi-) permanent	permanent
wide range	narrower range	narrower range	narrow range
wide range	narrower range	narrower range	narrow range
any	any	any	any
wide range	narrower range	narrower range	narrow range
wide	narrow or wide	narrow or wide	narrow or wide
wide	narrower	narrower	narrower
Tibet	Bergen-op-Zoom Farnham Haarlem	Tzintzuntzan Temascalcingo Djerba	Wedgwood Delft

tween humans and matter/energy. It must be based on a firm understanding of the constraints set by the raw materials and the means to use energy which are employed, and it must assess the decision-making process, i.e. it must be able to recognize alternatives between which choices might have been made in the past. On the other hand, it must be able to recognize the alternative which was ultimately chosen on the basis of the traces which this alternative left on the pottery.

As such, the above is a pretty tall order. But let us see whether we have the means to fill it. What would it require?

– Knowledge of the kinds of energy at the disposal of the extinct society studied. Knowledge of the way in which, and the degree to which, these kinds of energies were controlled, and how they could thus be applied to the raw materials. The major sources of energy are known, i.e. those which derive from human or animal activity, from wind, gravity, the sun and fire. We know of a large number of ways in which each of these kinds of energy could be applied, and of the degree to which they could theoretically be controlled.

– Knowledge of the physico-chemical properties of the raw materials involved. For many categories of raw materials, such knowledge is indeed available through the achievements of modern natural science.

– Knowledge of the various traces which the diverse modes of applying energy leave

on the raw materials. Such knowledge is partly available through ethnography and ethnoarchaeology, and can be implemented by means of experiments.
– Knowledge of the nature and meaning of the traces on the excavated sherds. The former can be achieved through study of these traces, the latter by using ethnoarchaeological knowledge, physico-chemical knowledge and experiments in the interpretation of the former.
In conclusion, we may assume that the means to achieve the stated end are generally available. Certainly, there are many details missing, but they seem within our grasp once we have sorted out a number of major sources of variability. Provided, notably, that we direct our experiments at defining variables, and not at imitating solutions. Only the former approach gives us information of the kind required for the model-building which is to follow.

11.4 HOW DO WE STUDY THE TECHNOLOGY OF ANCIENT POTTERY?

If we therefore agree that the enterprise of reconstructing certain categories of perception through the study of artefacts is viable, the next question is: 'How do we actually do it?' Before responding to that question, we have to stress the limits of the framework into which this response will fit: we will only attempt to reconstruct perceptive categories, for the moment, in so far as the evidence for them is inherent in the pottery itself. We will, for the moment, not occupy ourselves with the circumstantial evidence inherent in the way in which the pottery is found in the excavation (distribution, sherd size, etc.).

Another preliminary remark is in order: the following description of our approach is an idealized one, which discerns certain steps which, in actual practice, are not only set in this order, but in a much less organized one. Describing such a process, as all students of scientific method know, is an almost insurmountable task if one were to aim at presenting the exact sequence in which ideas are generated. We shall not attempt the impossible and idealize.

The first step after cleaning and numbering the material (in such a way that all sherds have individual identification numbers) is to determine the general 'ball park' one is working in: which major kinds of techniques have been used in manufacturing the pottery concerned (e.g. hammer-and-anvil, coiling, mould construction, throwing). This is done on the basis of general knowledge concerning the shapes and the traces on the surface of the pottery left by such techniques. Rounded vessels with round-like patches of cord impressions on the exterior, for example, are prime candidates for the hypothesis that they have been manufactured with the aid of a hammer-and-anvil technique, like much of the Woodland pottery of the Mississippi valley in the U.S.A. Thrown pottery, on the other hand, will always or almost always show horizontal, spiralling, impressions of the fingers or a tool. . .

Next, the research is split into two parts. The first is concerned with an analysis of the raw materials concerned. X-ray diffractograms are made, which betray the general nature of the minerals present in the pottery, both in the clay and in the nonplastic fraction of the paste. Thin-sections are cut, which permit one to study the nature of the minerals in the nonplastic fraction in more detail. With the aid of such thin-sections, one may determine the nature of the nonplastic inclusions, but also their size and shape, the position they have in the sherds, etc. If need be, Differential Thermal Analysis (DTA) and Thermo-Gravimetric Analysis (TGA) may be applied to study the behaviour of the clays in the fire. For such tests, however, one needs to have raw clays from the original clay beds at one's disposal.

Other aspects of the physico-chemical properties of the paste used may be derived through analytical and experimental approaches which are not quite so encompassing, cheaper, and more readily available for mass analysis. Thus, it may be useful to use an incident light microscope which enables one to distinguish categories of raw material which have been defined and analysed by other means. Firing tests may, in a very simple way, determine whether sherds belong in one of a series of groups with different

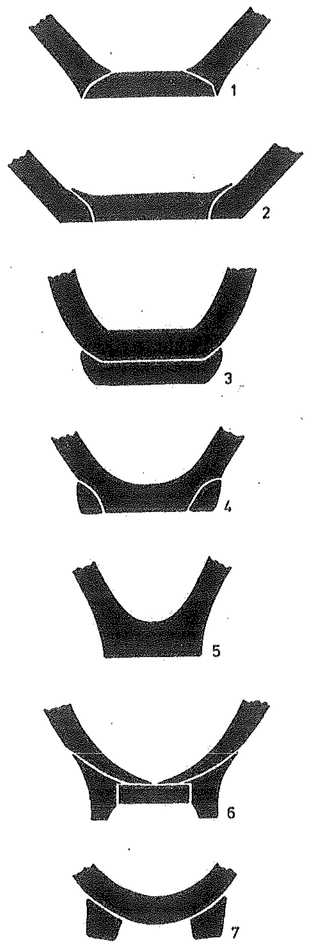


Fig. 11.1
Different ways of constructing the bases of the vessels found in the Assendelver Polders.

thermal characteristics, etc., etc. In a later contribution, we will report on the experiments undertaken with the pottery from Assendelft, so that the reader may gain an insight in the kind of approach we imply.

In each individual case, the exact approach will differ, dependent upon the nature of the materials involved and on the questions one needs to solve. Thus, virtually none of the above techniques are useful in analysing terra sigillata, because the raw materials are divided into such fine particles that they give few results (except DTA/TGA) of sufficient accuracy. Thus, for such pottery, neutron activation and/or X-ray fluorescence are the most profitable analyses.

The other line of research followed at this point is an analysis of the traces which the manufacture of the pottery left on that pottery, of the shape of the pottery, and of other attributes which betray the manufacturing technique involved.

This line of research is usually executed by taking the ensemble of sherds, and sorting, and resorting, and resorting . . . them in a certain sequence so that the correlation of all major dimensions of variability may be determined. Each researcher follows his/her own sorting procedures. In the pilot study undertaken for this project, the senior author's approach has been to sort first all sherds into bases, lower wall fragments, fragments of the maximum diameter, fragments of the shoulder, of the neck and of the rim . . . In addition, this first sorting is used to separate all fragments which are too small to distinguish any traces, all those which have lost their surface(s), and all handles and other ancillary parts of the vessels.

Next, the bases were examined, which often show the clearest marks of the manufacturing techniques represented in the collection of sherds. This second sorting thus gives one an impression of the techniques used at a somewhat more detailed level than before. One does not only separate 'wheel made' from 'coil made' or 'mould made', but also the different variations which occur in each technique. In the case of the Assendelft material, the pottery is generally coil-built, but we may distinguish six different kinds of bases, depending upon the way in which the parts which make up the base were joined (cf. fig. 11.1). This knowledge is usually sufficient to have some 90% certainty about the major groups of manufacturing techniques present in the collection.

The next step is thus to separate these out from all the other piles of sherds (which were sorted by vessel part). One goes through each of these categories in turn, looking for differences in the traces of construction: joining of coils, size of coils (fig. 11.2), differences in traces of throwing and/or moulding, etc. It is not possible in all cases to identify these differences immediately with different kinds of techniques identified on the bases. Appendix 11.1 gives the general nature of the variations concerned. Evidently, the rims are a case apart, and for the Assendelft pottery a very difficult case. We have had to forego systematic attempts to study the build-up of the rims for lack of clear and unambiguous traces distinguishing the different techniques (but this in itself may be significant for the mode of production, see section 11.6.1.6).

The next series of sorts was aimed at determining whether – and if so, how – the potters treated the surface directly after manufacturing the body of the vessels. In a number of cases, not only where coil-built pottery is concerned, pottery is scraped on the inside and/or outside surface to reduce the thickness of the wall before firing, for example. These traces are noted, and so is the nature of the tool with which this action is executed (fig. 11.3).

Then follows a similar series of sorts (still maintaining the original categorization of the pottery in various vessel parts), concerned with the final surface treatment: smoothing, polishing (fig. 11.4) and such actions are the subject of this sort. In the case of the Assendelft pottery, we also distinguished at this level the peculiar way in which the Iron Age potters added a layer of very thin, often somewhat lumpy, clay slip to the exterior of the lower part of the larger vessels (fig. 11.5).

Next, we sorted on decoration technique and, within the categories which this creates, on motif. The variations encountered are, as always, presented in appendix 11.1.

After we have thus identified the major axes of technological variation in the collection, the same is done for other axes. First among these is, in our case, shape. The shape of all the different parts of the vessels is thus inventoried. In other collections, any number of sets of axes of variability may be added, such as traces of wear, fracture patterns, etc. All depends upon the problems which one attempts to define and resolve by means of the analyses.

At this point in the procedure we undertake what is generally the most difficult task of all, and certainly the most difficult part of the approach to sketch in coherent terms. It entails combining the variations encountered in the different sets of axes of variability into models of manufacture (and use, and discard, etc.) of the various 'products' in the collection. Under the term 'product' we group all those examples of a certain construction procedure, size and shape, which we encounter among either the complete vessels found, or those glued together, or those which our imagination may construct on the basis of the sherds found even though these sherds may not stick together.

It is this step which requires not only insight into the significance of the traces left by specific tools and actions, but also into the coherence of the variables and into the nature of the system state which one is studying. It entails knowledge of physico-chemical properties, mechanics of pottery making, ethnographic examples as well as a good sense of experiment.

One illustrative example of the kind of reasoning involved is drawn from our analysis of the imported Roman pottery found in Velsen: blobs of wet slip, which fell from the bottom half of the vessel during construction, onto the top half of the same vessel

Fig. 11.2
A coil could be reconstructed from sherds found at a site in the Uitgeesterbroekpolder, neighbouring on the Assendelver Polders. Coils of different width were used in the pottery, varying from about 0.5 cm to about 1.0 cm before they were squeezed onto the vessel.

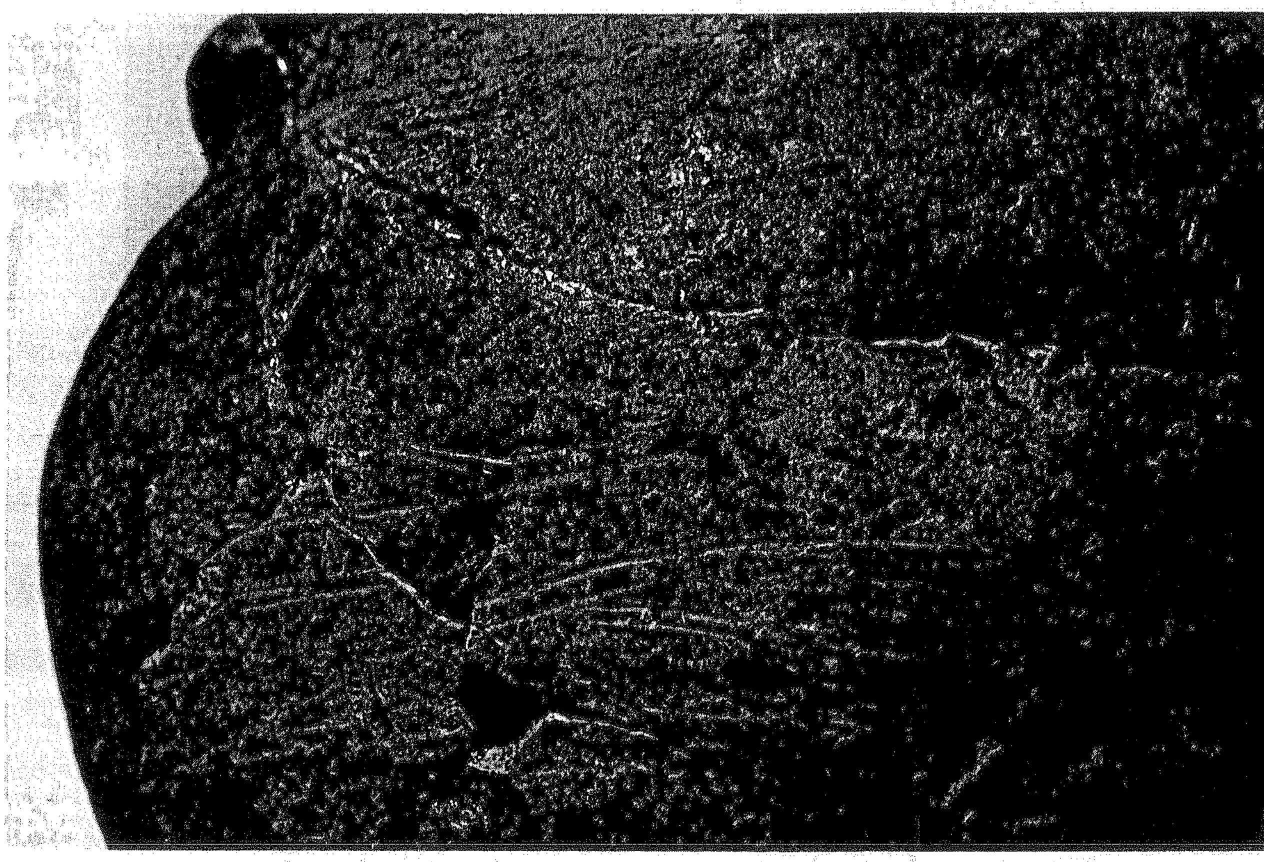


Fig. 11.3
Traces of scraping with a sharp tool occur on the outside surface of this vessel. They are often recognized by parallel scratches caused when larger (nonplastic) particles hooked behind the tool and scratched the surface.

indicate that the vessel was made in reverse order, the top part first and the bottom last.

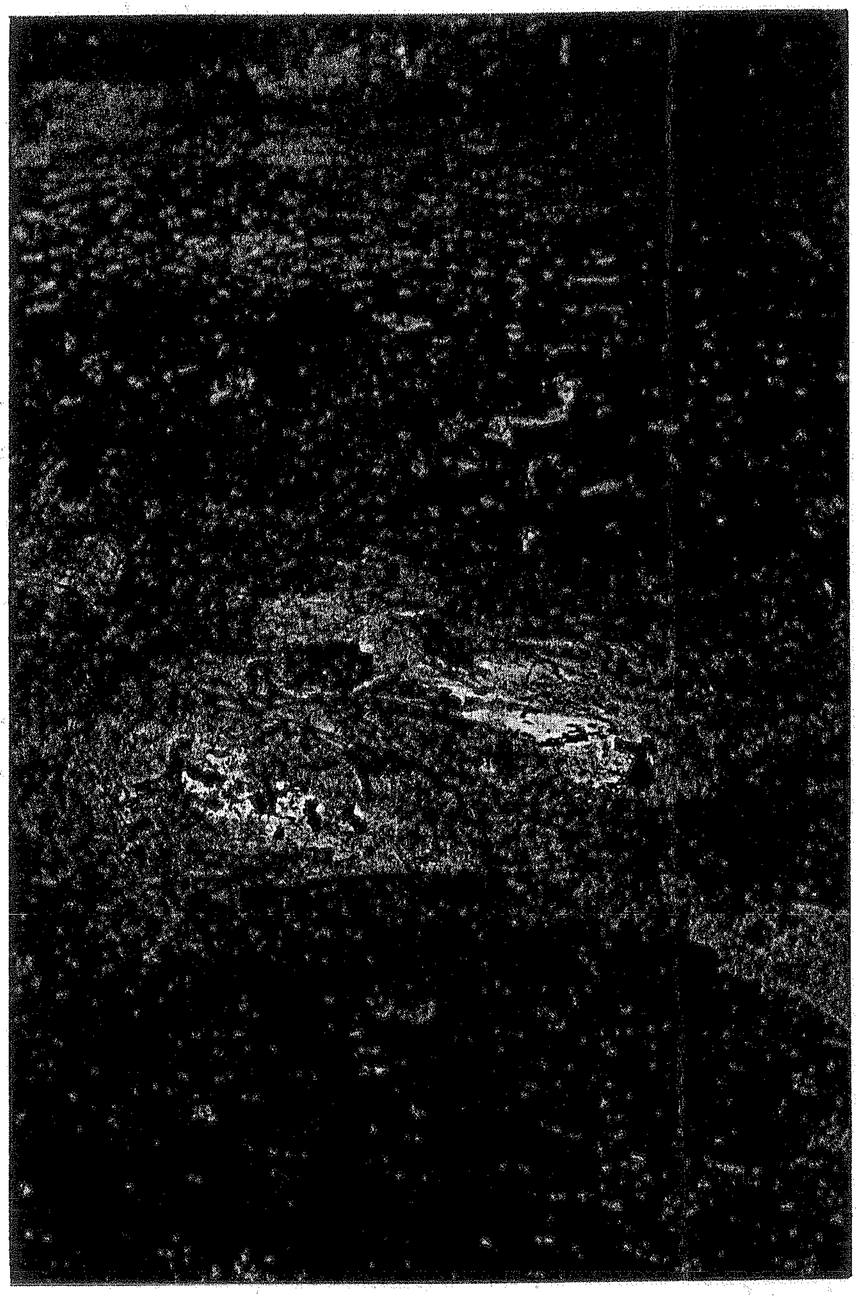
Another example comes from Assendelft and shows the use made of the physico-chemical research on the raw materials. Clays with a certain coherence and stiffness will allow the potter to make the lower part of the vessel all in one: base and lower wall. This, the potter does by shaping a little bowl in his/her hands, between the thumb and the fingers. That bowl therefore rarely exceeds the distance between the root of the thumb and the tip of the middle finger in height. Near the base, it is somewhat S-shaped because the fingertips of the potter kept the base in shape while (s)he put the bowl on a flat surface (so that it could be built up further by means of another technique, such as coiling). The combination of a certain shape of the vessel and a certain assessment of the possible stiffness of the clay will thus lead the analysing expert to look at the fracture of the base to see whether it shows any joins of coils. If not, the above technique has been used, but if there are indeed joins to be distinguished on the fracture, the shape is due to a different series of actions which have to do with a way of coiling.

Because the phase in which the models are construed requires that one has information at one's fingertips concerning all the products in the collection, and concerning all aspects of all parts of all products, it fundamentally conflicts with a finds-processing procedure which processes sherds or pots individually, then puts them into bags and boxes in lots, and proceeds to look at the next batch of sherds.

As the mass of material in Assendelft forced us to use a finds-processing procedure of the kind just described, we decided to derive such models as we needed from a pilot study. The group of sherds chosen for this study came from the excavations the senior author executed in Schagen-Lagedijk in 1978.

This pottery turned out to differ slightly from the Assendelft ceramics. It is made in basically the same way, but by people who made pots more often, with somewhat different tools, and with much more control over what they did. The way in which

Fig. 11.4
Highly polished surface of a vessel. Polishing was executed on leather-hard clay, with a rounded smooth pebble or a similar tool.



the results of the pilot study, gained by employing a procedure such as the one just described, were adapted to sequential analysis of the Assendelft pottery sheds light on an essential function of the models of manufacture used.

Basically, the operation is a logical one which uses the general insights gained into the nature of the manufacturing process, to outline a set of conceivable variations within that general framework. Variations which need not necessarily have been observed but which, logically, could be encountered if the same technology were to be applied to slighty different clays, in order to make slightly different shapes, by means of slightly different tools and actions. Thus, we add certain categories of variation on each dimension of variability. Categories which are coherent among themselves and consistent with the already existing ones. (In the same manner, incomplete models may be completed by coherently extending the arguments on which they are based. It is one of the essential functions of argument by analogy in general, and model-building in particular, that they allow this kind of extension and/or completion, cf. Apostel 1968).

The extended and/or transformed model was next used as a basis for the deductive

Fig. 11.5
Lumpy clay slip was applied to the bottom part of the larger vessels.

step of deriving a set of analytical categories from it, which in turn form the basis of the sequential processing of the finds encountered after the pilot study was done, e.g. the finds from the Assendelver Polders themselves. The resultant analytical categories are presented in appendix 11.1. They were used in coding all the individual sherds for computerized processing. An example of such a coding is given in fig. 11.6.

11.5 A MODEL OF POTTERY MAKING IN THE ASSENDELVER POLDERS

Although our studies of the pottery from Schagen-Lagedijk, Assendelft and Velsen – studies which are closely related – have not been wrapped up, and although we notably lack the final results of the raw material studies, we feel we may at this point in time contribute to the discussions with a presentation of the results in two ways: First, we have firm ideas concerning the general nature of the raw materials used, the nature of the manufacturing technique, and the major problems of a technological na-

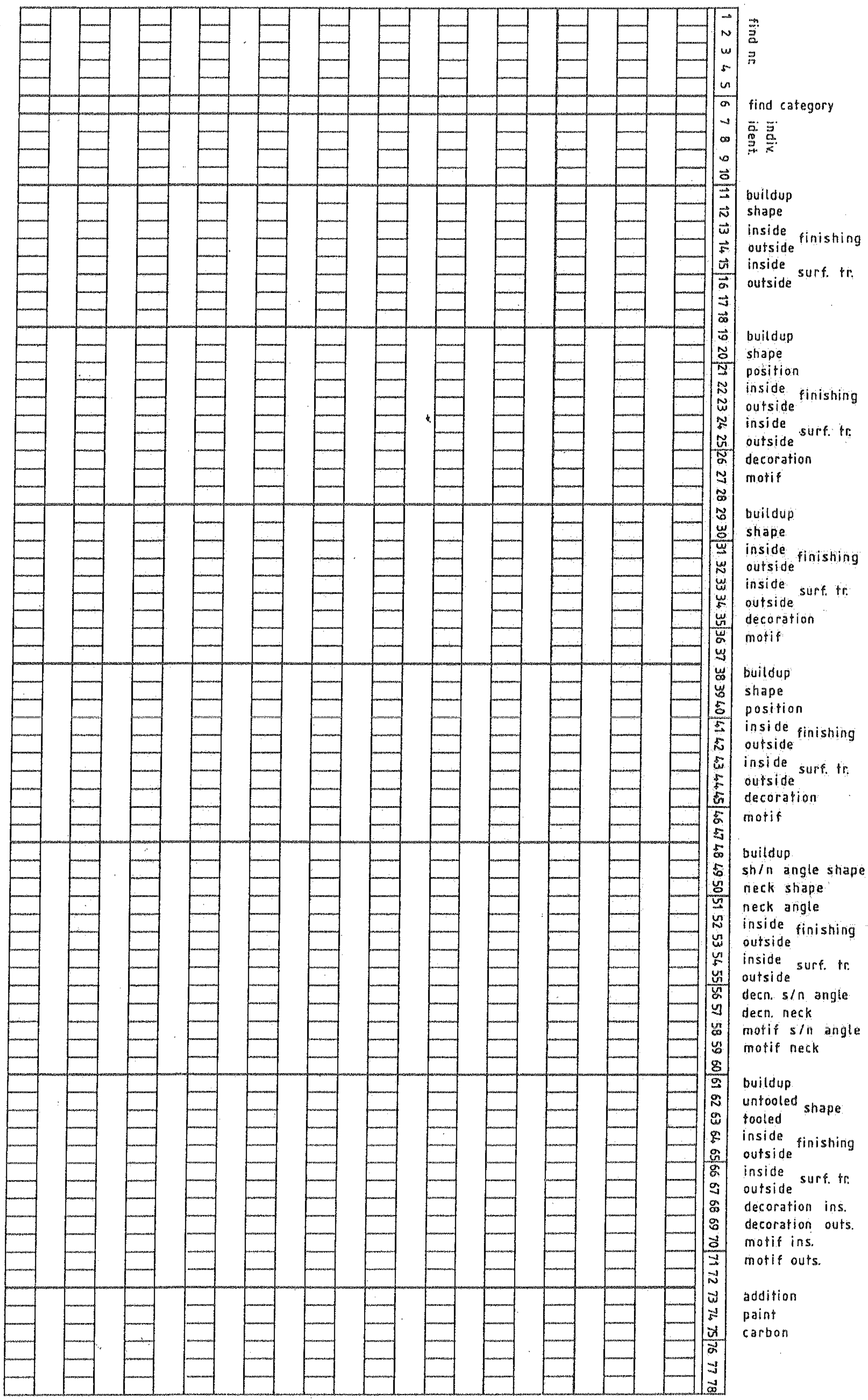


Fig. 11.6
Coding sheet as used in the ceramic analysis. The column headings refer to the coding manual (appendix 11.1).

ture which faced those potters in the Roman Iron Age in the province of North Holland which did not use Roman or Roman-derived techniques and tools. In other words, we may at this moment present a general model of the tradition which is sufficiently coherent to allow us to manipulate data with it.

Second, we have done experimental and ethnographic research aimed at predicting how the technology and organization of this approach to pottery manufacture might change if the system were subjected to the need to expand.

11.5.1 *A general, static model of indigeneous pottery making in and around the Assendelver Polders*

11.5.1.1 Raw materials

The analysis of the raw materials from which the pottery has been made, has so far focused mainly on sites C and F in the Assendelver Polders. It is from these sites that the random samples have been drawn for analysis in a number of ways: (1) the clays by means of X-ray diffraction analyses, (2) the nonplastic inclusions by way of microscopic inspection of a sawn and polished cross section under incident light, and (3) by means of thin-sectioning. Moreover, as we found in the thin-sections that a majority of the body of the sherds consists of diatoms, we have done (4) a study of the diatoms present. Finally, (5) a number of refiring experiments were done on the sherds. X-ray fluorescence analysis of the sherds is still to take place.

The X-ray diffraction photos demonstrate clearly that the clays used are essentially *montmorillonitic* and/or *micaceous (illitic)*, with an addition of feldspars and quartz. Among the 20 samples randomly taken, we did not find any with kaolinitic clays or other clays with a relatively intact crystalline lattice. We therefore conclude that the clays used are secondary clays, clays which have been transported from their place of origin to the deposits where they were eventually dug and used. Such clays are essentially less plastic than primary clays.

A superficial inspection of a number of thin-sections (altogether 160 were randomly chosen from among the material excavated in the first two seasons) made it clear that a considerable number have diatom shells as their main nonplastic component. Diatoms must have grown ubiquitously in the estuary during the period in which sediment was accumulating, as they nowadays do in a similar brackish delta in Zeeland, the southernmost coastal province of the Netherlands, near the Belgian border. Our experience is, that they feel just like clay, so that it must have been very difficult for the ancient potters to distinguish diatom-rich clays from diatom-poor ones (report to be published in the third volume in the series).

Analysis of the diatoms in the sherds, and of those in samples of clay taken in and around the settlements indicated, further pointed out that the clays were essentially dug in and around the settlements. *The potters did not have preferred clay beds.*

Although indistinguishable to the touch or to the naked eye, diatoms do make a considerable difference to the properties of the raw material the potter has to work with. A clay which feels rich (heavy), and which does not contain diatoms is plastic, can absorb a considerable amount of water without losing coherence, and can also be tempered with a considerable amount of nonplastic materials and retain its plasticity. A clay with many diatoms will feel and look the same, but it does not have similar plasticity, and cannot be mixed with anywhere near as much nonplastic material and/or water without losing coherence.

Another important component among the inclusions in the sherds, which was visible under incident light, are rather large nodules of iron oxides (notably limonite, $HFeO_2$), sometimes more diffuse than others at times, and occurring in many colours ranging from yellow to red and black. These nodules were observed everywhere in the clays. They originate near the surface (due to reed growth and worm activity) where the iron in the soil is oxidized and thus becomes insoluble. Further down, the iron, which is present everywhere in the secondary clays, is in a reduced and therefore soluble state, and could not form the nodules concerned. We must conclude that the clays were dug in shallow pits.

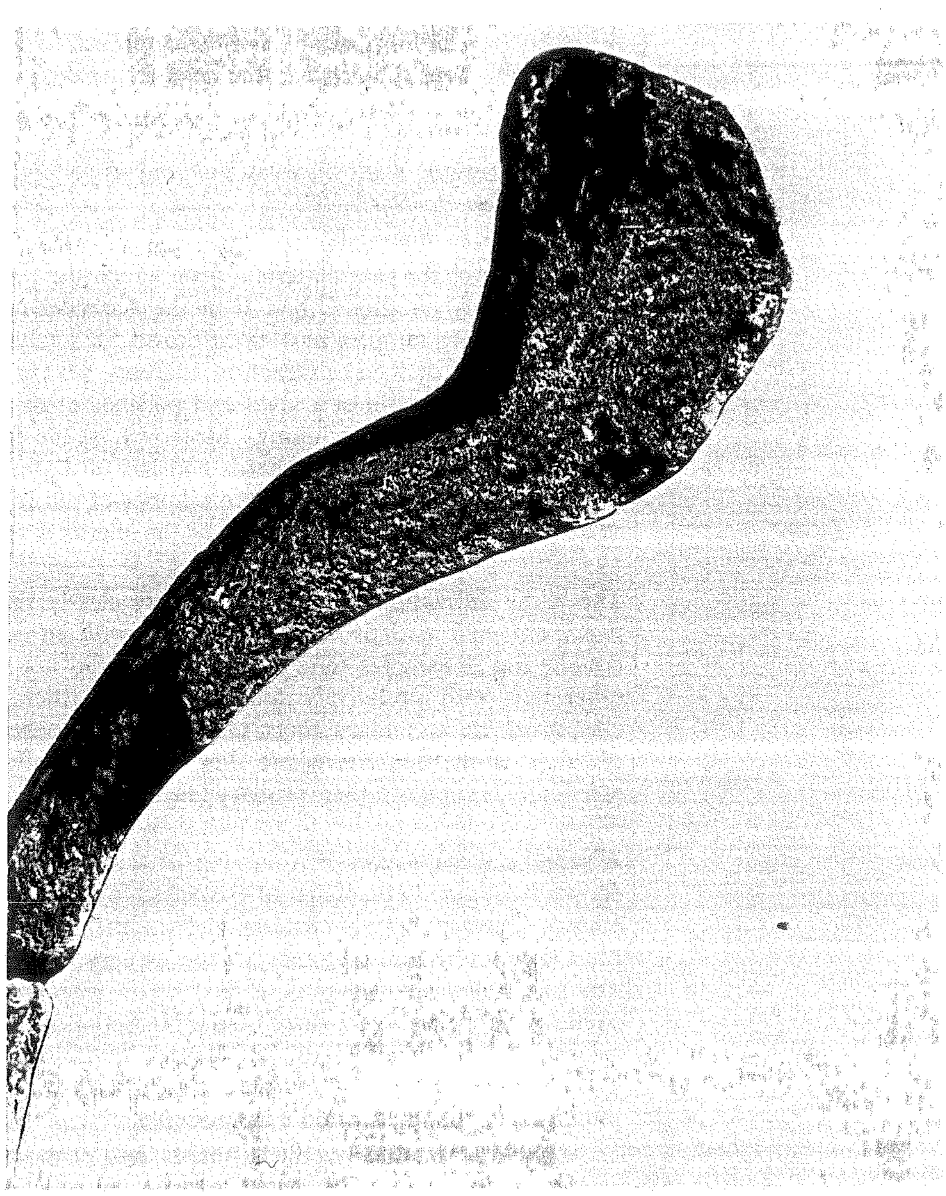


Fig. 11.7
On the fracture of this sherd, one can see a folded rim and two coil joints.

Examination of the thin-sections under a polarized light microscope further revealed the presence of smaller nonplastic inclusions, consisting mainly of quartz grains of different sizes, vegetable matter (voids), and feldspars. The quartz particles, generally more or less rounded, covered a size range on both sides of the 7 micron mark. Their shape and grain size distribution (which is uninterrupted) indicate that the grains were deposited along with the clays and the diatoms, and that no special effort was made to add quartz as a nonplastic (tempering) material.

The vegetal materials cover a fairly wide range of sizes. Their specific nature is difficult to determine because the remaining voids are too small to make any casts of the imprints in question.

In conclusion, we assume that the raw material used in the manufacture of the pottery is dug from just below the surface in the direct environment of the settlements. This seems consistent with the clay pits which have been found near one of the settlements. The raw material seems to have been used without any modification (levigation or addition of tempering materials). Because of the large number of diatoms present, it

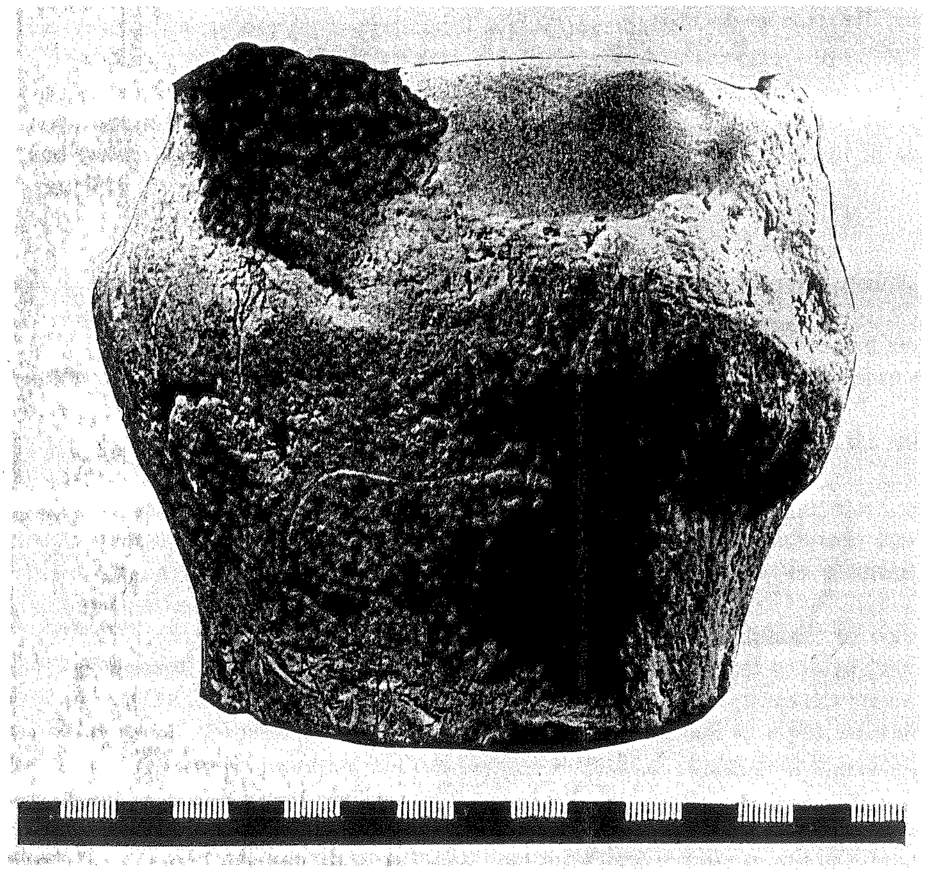


Fig. 11.8
This small vessel shows on the outside still the impressions of the fingers which held the clay on the outside while on the inside, the thumb was squeezing it into shape.

is not very plastic, and does not bear mixing with much temper, anyway.

As such, the raw material constrains the techniques used in manufacturing the pottery. Without changing its nature drastically by adding and removing components, the clay is not suitable for manufacture of vessels on a potter's kickwheel. Neither is it suitable for making thin-walled vessels. It could not have been worked in a stiff enough state to allow for hammer-and-anvil construction because there is not enough plastic matter in the raw material to permit the addition of enough temper to make it sufficiently stiff for such a technique.

On the other hand, the clay is eminently suitable for construction either in a mould or by means of coiling.

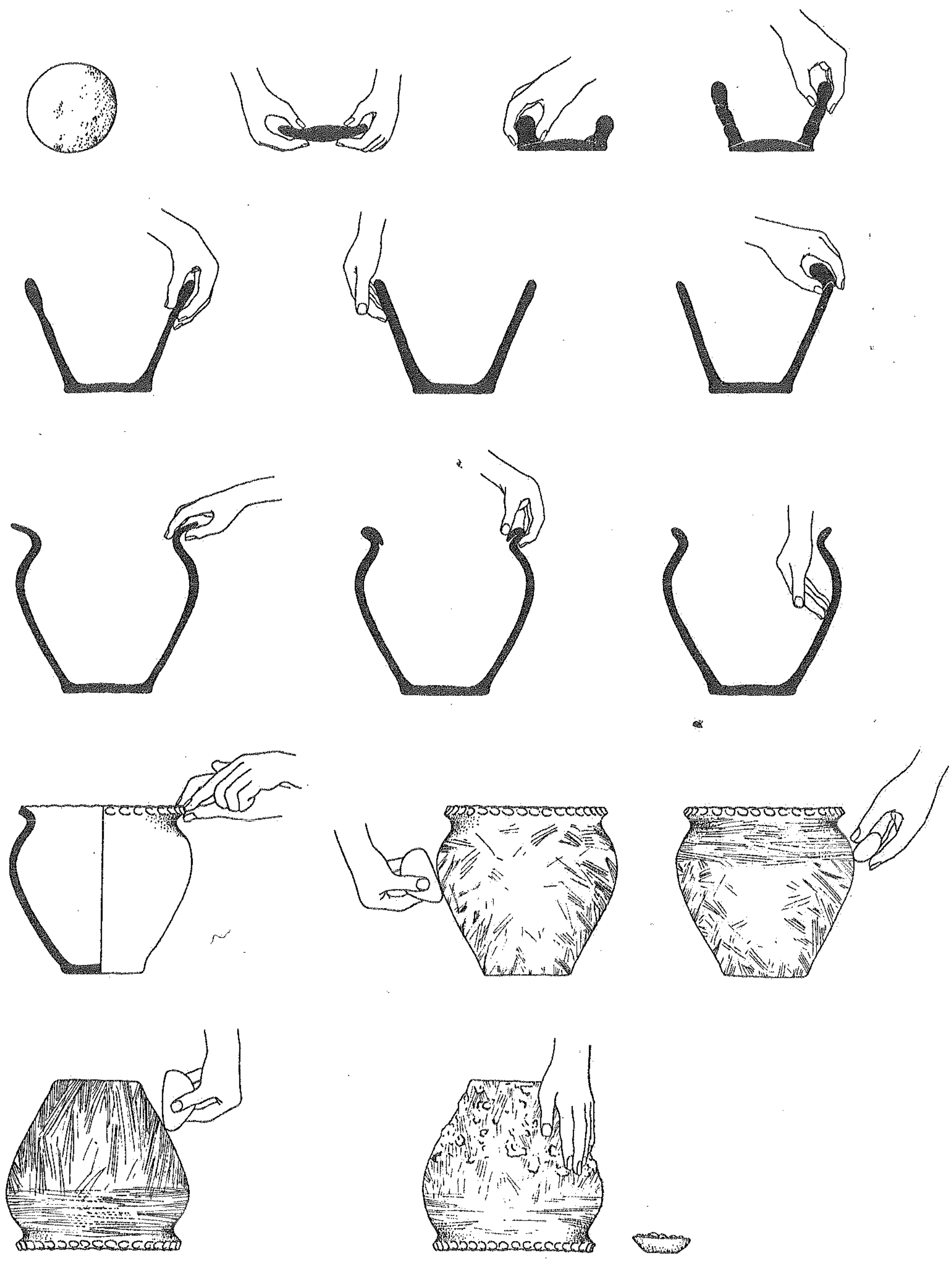
11.5.1.2 Making the vessels

On the basis of a large number of observations on the pottery itself, such as fracture patterns, the visibility of coils on vertical fractures (fig. 11.7) and visibility on the surface of the fingerprints connected with this technique (fig. 11.8), we assume that the pottery with which we are concerned was indeed made by means of a coiling technique. The systematic correlation of traces on the body of the sherds which has been described above (section 11.4), leads us to reconstruct the shaping procedure as follows (fig. 11.9):

1 The potter begins by placing a round flat disc or a small bowl shaped between the fingers, on a flat surface. This forms the base-to-be.

2 The potter then rolls, on a flat surface or between the hands, a coil. The diameter of the coil may vary, but thick coils have to be treated in a slightly different way from thin ones. These differences will be discussed later.

Fig. 11.9
Generalized reconstruction of the various stages of the shaping procedure. The stages are described in the text.



3 Next, the coil is affixed to the base by smearing clay from the base onto the coil and vice versa. The potter aims at reaching a uniform thickness of the wall, and at removing any air which might occur between the joins.
4 A next coil is rolled, placed on the last one, and fixed.
5 The last step is repeated a number of times. The general shape of the vessel is controlled by affixing the next coil either to the inside, or exactly on top of the last one. In the first case, the pot will tend to become narrower, in the last case, it always becomes wider, just as when the coil is affixed to the outside of the last one.
6 A last coil is added, which is then shaped into the rim by means of a variety of techniques which will be discussed later.
7 If handles are to be added, the potter rolls thick, short rolls for them and fixes them. Care is taken to create a good bonding between the two parts, if necessary smearing paste around the handle and over some of the surface around it.

8 If necessary, the vessel is then decorated either by impression or incision, or by adding appliques to the surface. The number of decorated vessels is low.
9 The vessel is left to dry for a while until it is leather-hard.
10 The potter may now choose to polish the surface with a very smooth pebble or some such tool, creating the glossy surface some pots show.
11 The vessel is left to dry until it is bone-dry, and ready for firing.
12 The vessel is fired, in all probability rather briefly in an open fire, but in some cases possibly in a firing pit.

11.5.2 *Changes: possible modifications of the manufacturing technique as predictable from the model*

11.5.2.1 The relationship between paste composition, shaping technique and shape
Any modifications of shaping technique and shape are constrained by the nature and possibilities of the raw materials used. To form some idea of these, we have undertaken a number of experiments (which are to be reported on at a later date, when the series is complete). The preliminary results indicate that:
a. the clays used in the Assendelver Polders have little tolerance for the addition of water and/or tempering materials. The margin of plasticity within which they can be used is narrow. Outside it, the clay tends to desintegrate, either due to a surfeit of water, or to a surfeit of nonplastic solids.
b. Within the margin of plasticity, the clays are such that it is difficult to control shape if, as was the case in Assendelft, the potter has no additional tools at his/her disposal to keep control of shape. Clay has to be squeezed into shape, as drawing clay out makes it lose its coherence. Thus, the potter who adds a coil to a pot, or indeed the potter who does any shaping at all, has to cope with the problem that, in squeezing the clay into shape, it 'escapes' from the fingers in all directions.

Imagine one has a little ball of clay between one's thumb and forefinger. When squeezed, the ball will become thinner, but at the same time it will expand in all directions perpendicular to the fingers used: sideways and towards top and bottom. By implication, when the potter squeezes any part of the pot, the shape of the vessel will change by enlarging the diameter of that section of the vessel, as well as making the vessel taller at that specific point. One squeeze is not important, but the cumulative effect makes that it is very difficult to control the shape of a vessel under construction.
c. When the potter builds, the clay is necessarily malleable, even plastic. Thus, while building the upper part of a pot, the lower part might give way under the weight of the upper part, possibly even combined with pressure which the potter exerts on that part. The moister the clay, the greater the risk, but also the taller the pot, or the wider the upper part of the pot in relation to its base, the greater the risk.
d. With the clays used in Assendelft, it is very difficult to make wide bases. The clay cannot be worked in a stiff enough state, and therefore is not really coherent enough to construct a wide base which does not crack during drying. The problem may be seen as follows: if clay contains much water during shaping, it will shrink more during drying than if it contains little water during shaping. A base is very liable to crack during drying if it is made flat and large. Shrinkage in the vessel wall occurs mainly in a vertical direction, but in the base, it is mainly horizontal. Therefore, considerable tension is created during drying of vessels which have a sharp angle between base and wall. The tension is proportionate to the amount of water that has to disappear from the clay, to the size of the base, and to the sharpness of the angle with the wall (hence the fact that so many cooking pots, which are subjected to similar thermal tensions, are round-based). Within the constraints of the clay used, the potters in the Assendelver Polders could not make very wide bases (fig. 11.10).
e. Nevertheless, they needed large vessels with a relatively wide opening (many of these were found) (fig. 11.11). Thus, the only shape which is achievable for such vessels is one which flares outward quite considerably from the base: the base often seems almost too small to keep the vessel in balance. The plastic nature of the clay in turn limits the potter to wall shapes which have at most a 45° angle from the vertical

Fig. 11.10
Cracks in a vessel occur when shrinkage can accumulate and/or occurs differentially for different parts of the pot. The base is particularly susceptible when it is flat, as shrinkage in the wall then occurs perpendicular to shrinkage in the base.

axis of the vessel. If the potter does not stay within that limit, there is a good chance that the vessel will succumb during construction.

On the other hand, in view of what has been said about controlling shape in the absence of specific tools to do so, and in view of the consistent occurrence of large vessels, we may expect some adaptation of the system to occur on this point. Within the same technological tradition, such adaptations could take the following form: (1) use of as little squeezing of coils in build-up as possible, (2) use of a clay which may be worked in a stiffer state, so that wider bases may be introduced, and larger vessels made without increasing the risk of collapse, (3) use of techniques of joining the coils which have an effect contrary to the uncontrolled expansion of shape, (4) making the lower part of the vessel thick in first instance, and then scraping it after it has dried, so that the end result is a wall of reasonable thickness.

Eventually, the above problems could even exert pressure towards fundamental changes in the technology used, as most other techniques for pottery making are designed to cope with these problems better than coiling. Using a mould, for example, eliminates them rightaway. To a lesser extent, so does a wrap around (parts of) a vessel during construction (van der Leeuw 1976). By using the wheel, the centrifugal force takes over the function of mould or wrap, but with fewer additional constraints: the potter is left free to determine the shape, while the velocity of the wheel guards against collapse, and allows the potter to modify the shape without risking permanent

1.11
vessels with a relatively
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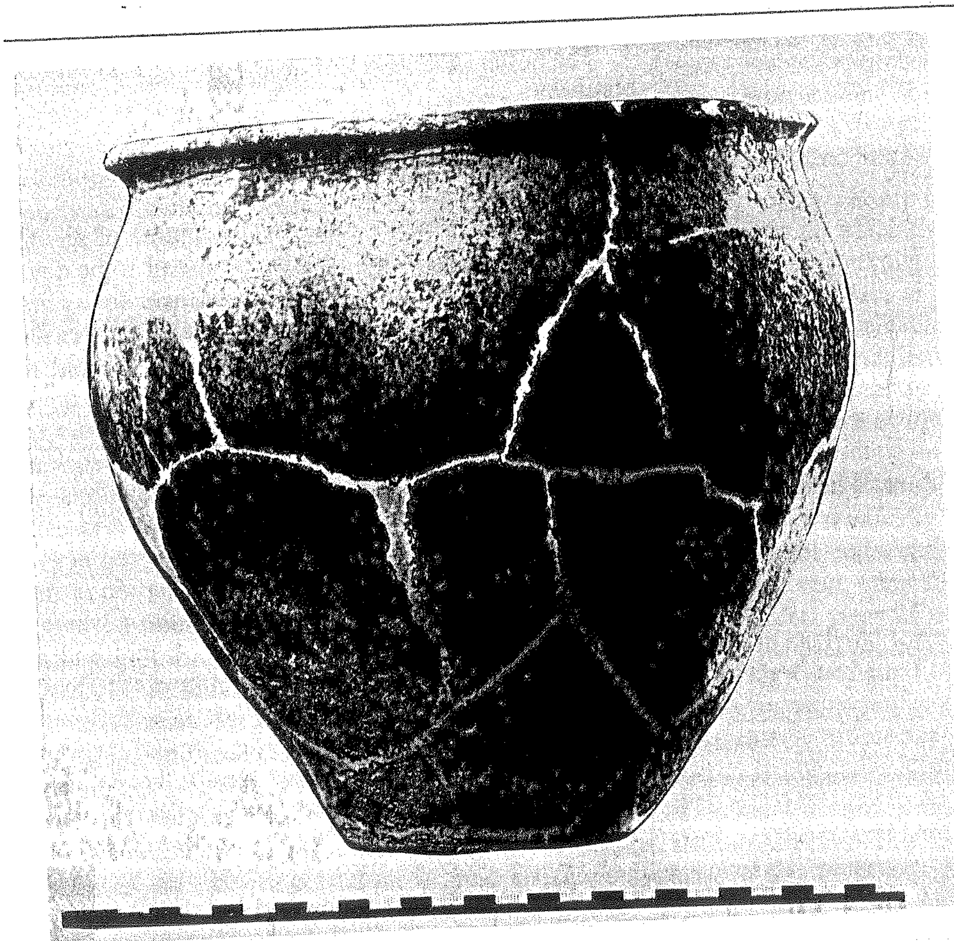
f the pottery in the Assen-
Polders.



deformations. But it requires more highly plastic paste than was available. Hammer-and-anvil techniques solve the same problems to some extent: because the clay is used in a dry state, there is no risk of collapse or deformation. By using a standard anvil, the potter is also able to control the shape, albeit less effectively than when using a wheel. The general shape of vessels made in that tradition is rounded, with a rounded base.

11.5.2.2 Time

The actions undertaken in manufacture represent different time expenditures. In general terms, construction is much cheaper than polishing. The other main investment of time is in repairing, or correcting, pot construction which was initiated wrong. Most potters know how difficult it is to get a pot to 'go right' after making a structural mistake. For example, when more paste has been used on one side of the pot than on the other.

Thus, when the system is *not* under stress, one would expect (a) that a considerable number of vessels is polished, and (b) that there is a certain tolerance for lopsided pots, or vessels which have a base which is too thin, or too thick.

As pressure on the system mounts, and people make more pots, the following changes will occur:

1 The potters will take better care not to expend energy on vessels which have construction deficiencies. Such vessels are given up before they are finished. The clay is reused, so that they disappear from the record.

2 The potters will develop more insight in the how and why of each phase of the construction, so that they will effectively avoid mistakes.

3 The potters will develop more experience and routine, so that the various phases

of construction become better integrated.
4 The potters will leave out time-consuming phases of the process, such as burnishing/polishing.

11.5.2.3 Technical aids
Another problem often found in the routine of day-to-day pottery making is, specifically when making larger vessels, the use of some device on which the vessel may turn around during manufacture. Although there are a number of ethnographic cases where vessels are being made without such an aid, these cases all pertain to potters who make relatively few pots, generally for their own use and that of their relatives or friends. As soon as production increases, having a rotary device becomes important, even in a tradition which is inherently independent of such a tool, such as a hammer-and-anvil tradition (van der Leeuw 1984a). The nature of such a device may differ: it can consist of a simple mat, or a large potsherd, or a flat stone, etc.

What dictates the efficiency of the tool is how easy it may turn. If there is much friction, the potter has to interrupt the shaping activities repeatedly in order to turn the pot. If it goes lightly, the mere manipulation of the pot under construction is often sufficient. Thus, a potsherd as base has the advantage that, generally, its roundness reduces the friction on a level surface. A mat and a flat piece of wood are hard to move, unless the total surface of the pot (and thereby the base shaped on it) is reduced. A third solution is to use a tool which is either moved by a helper, or with the feet (van der Leeuw 1976). We may expect any of these modifications to occur as pressure on the system mounts and crosses certain thresholds.

A similar facilitating device would be any one which made it easy for the potter to remove clay from the pot, either at the base (if option 4 is used in the construction of the vessel), or on other parts of the surface, such as the rim. The rim, being the last part of the pot which is given its shape (at least in this tradition) is always uneven, because the excess clay which was pushed up during construction accumulates there. Smoothing the rim with the fingers, and spreading the excess clay, takes time. Cutting it off would be much handier. Thus, both a scraper and a knife would be possible technological adaptations.

The third of the major time-consuming parts of the construction process is the firing. It requires the collection of fuel (peat?), and keeping sufficiently high temperatures over some length of time. Ethnographic evidence indicates that whenever the size of the batches of pottery fired together is small, the firing is short. Larger batches, however, take considerably more time to achieve the right temperature all the way through. To conserve fuel, the potters might want to fire in a pit, or even to use some kind of (possibly very simple) kiln-like construction, which reduces heat loss. As the production grows, therefore, a kiln may be introduced.

11.5.2.4 Organization
A modification of a completely different nature would be in the organization of production. Instead of everyone making their own vessels, pressure on the system might result in the emergence of some who made pots better, quicker and/or cheaper than others. Thus, one would expect as one possible adaptation the emergence of (semi-)specialists, people who made pots regularly. Such a reorganization might have considerable advantages: permanent setup for making the pottery (kiln, or even permanent use of the same open pit), more routine, and thus increasingly efficient production, better use of the time if there are no interfering activities, etc. Increasing specialization would also have its effects on the technology used, and on other aspects of the manufacturing process. First, one could expect consistent use of the same clay and temper sources, so that the composition of the paste would be more standard, more selected, requiring less preparation and maybe allowing for techniques not possible with other clays. Second, one would expect that the increase in routine would make the products of the potters better, i.e. more standardized in quality, more regular in shape, possibly better finished

(if there is sufficient competition). This might show in the characteristics of the shapes produced, but also in some technical details which need considerable experience, such as the handling of the coils to be added to the vessel under construction. Third, increased routine and competition might lead to specialization on one or two products, or to the obverse: diversification of the production of a workshop, so that more special-purpose vessels are made.

11.6 DETAILING THE MODEL (figs. 11.12–11.18, see back cover)

Another line of research has attempted to discover coherence in the variability within the tradition. Such research has taken two lines: (a) statistical analyses defining the nature of the variability encountered in the material (aiming at transforming an intuitive model into 'hard' data), and (b) comparative study of the material from different periods (aiming at testing the predictions made on the basis of the model).

11.6.1 *Data on pottery manufacture in the Assendelver Polders*

Altogether, for the purposes of this part of the research, we have analysed some 8,500 sherds systematically. Of these, the large majority came from site C and site F, two of the three multi-period sites excavated.

By far the majority, at least more than 90% of all the sherds, are of the rough indigenous pottery. The number of imported Roman sherds is infinitesimal in comparison (they are discussed by van Beek, this vol.).

It is striking that sites D and H show a different pattern from the others: here, there are relatively more imported pieces, and a larger percentage of the indigenous ware is burnished: ca. 10% on site H and ca. 30% on site D. The importance of this difference will be discussed later.

Although all sherds were kept, there is a considerable bias in favour of shoulder- and rim sherds. Partly, this may be due to the fact that very small sherds were only kept if they showed some kind of significant feature. Thus more small sherds were collected which had rims. The statistics may also have been biased by the ease with which lower wall sherds could in some cases be confused with shoulder sherds. We found with some simple tests, that in cases of such confusion, there was a tendency to code lower wall sherds as shoulders, instead of vice versa.

In the following discussion of the pottery, we will treat each of the following categories: bases, lower walls, maximum diameter sherds, shoulders, necks and rims.

11.6.1.1 Bases

Of the possible *base constructions* (fig. 11.12a) summarized in appendix 11.1, only no. 1 seems to occur in masses. The total pattern is one of a unimodal distribution where the potter begins with a flat slab of clay, on the edge of which he adds his first coil. It is possible that modes 3 and 4 are aspects of the same way of working: the potter placed a little cup, made in the hands, on some clay which was fixed to the support used. When the pot was later cut away from this device, that could be done quite close to it (mode 3), or further away (mode 4). Last of all, the little bowl could be placed directly on the rotating device, and later cut away from it. This would result in mode 5. Beware, however: in a number of cases, this last mode is function-bound: it includes the bases of the 'pedestalled bowls' which occur in the assemblage in low numbers.

Base shapes (fig. 11.12b) are frequently of modes 2–4, much less frequently of mode 1. Modes 3 and 4 are the result of shaping with the fingers only, while mode 2 is the result of using a scraping tool. Modes 1, 5 and 6 are special cases. The former is specific for highly sophisticated, symmetrical, polished and well-made vessels (which, as is to be argued below, are thought to be later in time). The latter include, again, the 'pedestalled bowls'.

As to the *treatment of the surface* (fig. 11.12c) of the vessel bases after manufacture, we clearly see that it is rare. Only at site D, were some 20% of the bases trimmed and/or burnished.

11.6.1.2 Lower wall sherds

There are two basically different *kinds of coiling* (fig. 11.13a) to be distinguished among lower wall sherds, and indeed among all the wall sherds of the assemblage. The great majority has been made with 'thick coils' which, in the wall section, show up as 3–5 cm high oblongs. The minority was made with 'thin coils', some 1 cm in diameter, and generally round on the vertical fracture. These two approaches have consequences for the degree/facility with which the potter can control vessel shape (cf. section 11.5.2.1). In the case of 'thin coils', there is very little pressure to be applied to the coils during shaping, and the shape is therefore better under control (ibid.). The vessel wall, in such cases, may be thinner. But the amount of work and routine involved is much greater. Among the 'thick coils' control is more difficult.

As to the *shape* (fig. 11.13b), most vessels have a straight or a convex lower wall. Maybe there is a relation with the size of the vessels, but this needs to be examined on the complete ones. Generally, again, the lower wall had an angle of between 30° and 45° with the vertical axis of the vessels. The reasons relate to the construction (see section 11.5.2.1).

As to the *treatment of the surfaces* (fig. 11.13c), there is little tooling on the inside, whereas on the outside, most vessels have a coat of slip applied to them at the last stage of manufacture, so that traces of tooling are no longer visible, even if they occurred. Both on the inside and on the outside surfaces of vessels are traces of burnishing.

11.6.1.3 Maximum diameter sherds

There are relatively few of these sherds. This may be due to the fact that most vessels were so constructed (fig. 11.14a) that at this point, two coils joined. After discard, such coils would be more liable to come apart than joins elsewhere on a vessel, because of the particular, pronounced concave shape of the fragment. If 'thick coils' were used, the oblongs are either all higher on the outside and lower on the inside, or just below the maximum diameter they are higher on the inside and lower on the outside, and above the maximum diameter their structure is the other way around. As usual, a small group of sherds showing 'thin coils' is also present.

As to *shape* (fig. 11. 14b), we coded the inside shape and the outside shape of these vessels separately, in the opinion that separate decisions are involved. As it turned out, only on site D is there a number of sherds with a pronounced inside angle and a less pronounced outside angle. The specific technology through which this was achieved is not yet known.

The *surface treatment* (fig. 11.14c) consisted in between 5% and 20% of all cases of tooling, on either side or on both sides. Although not as many sherds of this category have been covered with slip as is the case for the lower wall sherds, such cover still occurs on a considerable number, so that it is impossible to see whether they have been tooled on the outside. Polishing on the inside surface is, again, markedly prominent on the sherds from site D.

Decoration (fig. 11.14d) occurs in only few cases. On site C and site F, it is mainly in the form of incisions in point, line or field motif, and on site H in the form of finger-impressions.

11.6.1.4 Shoulder sherds

Build-up (fig. 11.15a) of the majority of shoulder sherds is, again, in 'thick coils', and only 4–8% of the sherds are built up in horizontal rolls.

Virtually all the shoulder sherds are *shaped* (fig. 11.15b) convex. One might suspect that those coded as 'straight' in fact are lower-wall sherds which have mistakenly been included in the 'shoulder' category.

The *position* (fig. 11.15c) of the sherds, as far as determined, would seem to average an angle of 60° with the horizontal plane of the rim.

Finishing (fig. 11.15d) and *surface treatment* (fig. 11.15e) show more or less the same pattern as the maximum diameter sherds.

Clearly, what little *decoration* (fig. 11.15f) there is centres more on the shoulder than on the maximum diameter. Sites B and C have relatively high numbers of incised sherds, in point, line and field motifs.

11.6.1.5 Neck sherds

The *angle* (fig. 11.16a) between shoulder and neck is generally rounded both inside and outside. The few exceptions, with either an abrupt angle on the inside or on the outside, or on both sides, occur in sites C and F. The majority of the neck sherds are *built up* from coils which have been pushed down on the outside, up on the inside (30–50%), but a certain component of horizontal coils was observed (ca. 10% on sites C and D; ca. 5% on sides F and H) (fig. 11.16b). The *shape* (fig. 11.16c) of the neck is generally concave, except some straight and convex neck sherds on site C (20% of each). The *angle* between the neck and the plane of the rim is generally 60° on sites D and E, and 90° on sites C, F and H (fig. 11.16d). The *finish* of the neck sherds is between 10% and 60% (site F) untooled (fig. 11.16e). Sherds tooled on the outside account for some 2–20%, and those tooled on the inside for around 10% (fig. 11.16f). The inside surface of the neck sherds is polished or burnished in 5–32% (site D) of cases, with the large collection on site F having some 20% of sherds polished/burnished on the inside. There may have been some initial confusion about the category 'smoothing', so that it may be overrepresented to the detriment of polished/burnished on the first two sites excavated (B and C). Polishing and burnishing on the exterior surface occurs on D in some 50% of cases, on C and F in 30-35% of cases, and on B and H in 20% of all cases recorded. There is rarely any *decoration* above the shoulder-neck transition.

11.6.1.6 Rim sherds

Attempts were made in the first season to reconstruct exactly in which manner the clay was compressed in order to shape the rims. We seriously considered the possibility that most rims had been folded over. The difficulty with doing that in experiments without the use of a 'fast' wheel made us reconsider that hypothesis later. We conclude that there are two categories of rims, (a) those generally shaped without folding over, between the thumb and the index finger, probably with the aid of a wet piece of leather or cloth, and (b) those which have pronounced angles, and which must have been shaped either with the use of a knife or with the use of a flat piece of wood. We have some preference for the first of these two solutions, but cannot be sure in all cases.

The *shapes* themselves fall, for the 'untooled' rims, in three main categories, made up of types D, H, E and I, types M, N, P and J, and types A, F and G. It is noteworthy that almost all rims at site D are of categories N and P. It should also be remarked that categories E and I are the angular versions of categories D and H respectively (fig. 11.17).

But more important is a general remark about the rims. Sorting these rims into standardized categories was extremely difficult, as with many kinds of entirely hand-made pottery. *This in itself is significant:* the potters themselves probably never thought of categories of rims in the same pronounced terms as we are used to doing. Rather, we would think that the exact shape of the rim is (a) due to the desired neck shape, the amount of clay left over at the edge, and the way in which each potter was used to getting it smooth as quickly and as simply as possible, (b) not really something of much importance to the potters. Thus, with unstructured material such as these rim sherds, it would seem foolish to attempt either to make very well-defined categories, or to attach much chronological importance to the rim shape.

Most rims are untooled, but there are a few which seem to have been tooled (fig. 11.18). These occur notably in relatively high percentages on site D, but also on the

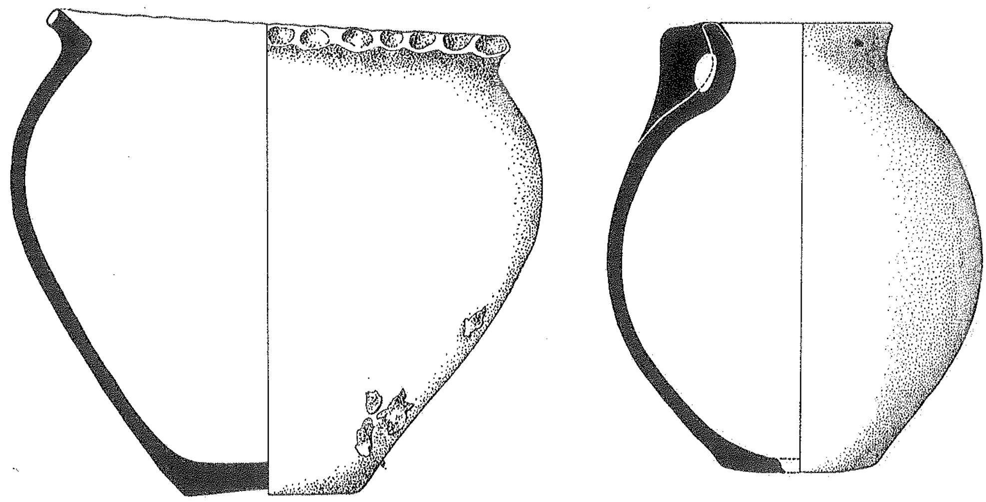


Fig. 11.19 (left) and fig. 11.20 (right)
Comparison of the basics of the shape of an early and a late vessel.

others. Their categorization is subject to the same restrictions as mentioned for the untooled sherds.

11.6.1.7 Conclusion

If we compare these data to the model presented in an earlier section, we may conclude the following:

– The potters used a relatively small number of the options theoretically open to them in manufacture.

– Generally, the spread of various states over the attributes concerned is unimodal or at most bimodal.

– There is some indication that the projections for a situation where the model came under stress have correlated in the ceramics studied: tooling, burnishing, definition of shape, etc. What needs to be done next is to see whether these attribute states do indeed correlate, and how significant these correlations are. Clearly, this cannot be done on the basis of the individual sherds which have traces of only a few attributes. Such a study of correlations will have to be undertaken on the basis of complete vessels.

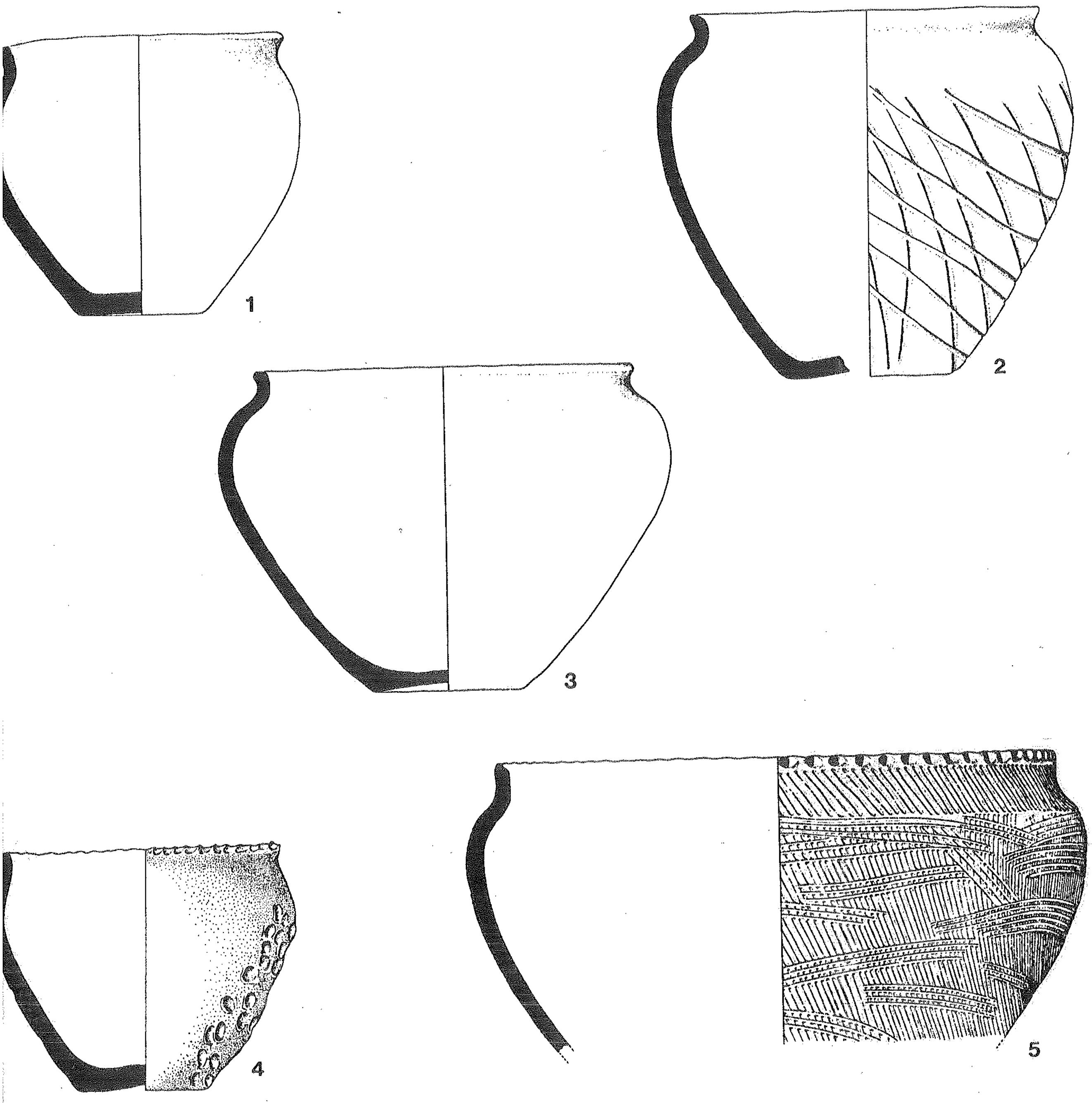
– There are differences between the sites, but except for the contrast between site D and the remainder, such contrasts need to be enhanced by (a) study of larger quantities of sherds, and (b) study of the multiphase sites, so that the ceramics may be broken up into batches on the basis of stratigraphy.

Neither of these last suggestions, nor the study of the complete shapes, could be done on the basis of the material from the first two campaigns alone. In order to strengthen the argument in this paper, we have therefore next included a study of all the complete vessels from three campaigns, including the pottery from the 1978 campaign in Schagen-Lagedijk, and the complete vessels collected in the Assendelver Polders by the AWN.

11.7 COMPARISON BETWEEN COMPLETE VESSELS

A comparison between the finds from different settlement phases in the Assendelver Polders, and between the pottery from the Assendelver sites on the one hand and the ceramics from Schagen-Lagedijk on the other, permits us to see a glimpse of the actual developments in the pottery-making system between about 300 BC and AD 300.

For such a comparison, we have focused on the larger vessels, for the following



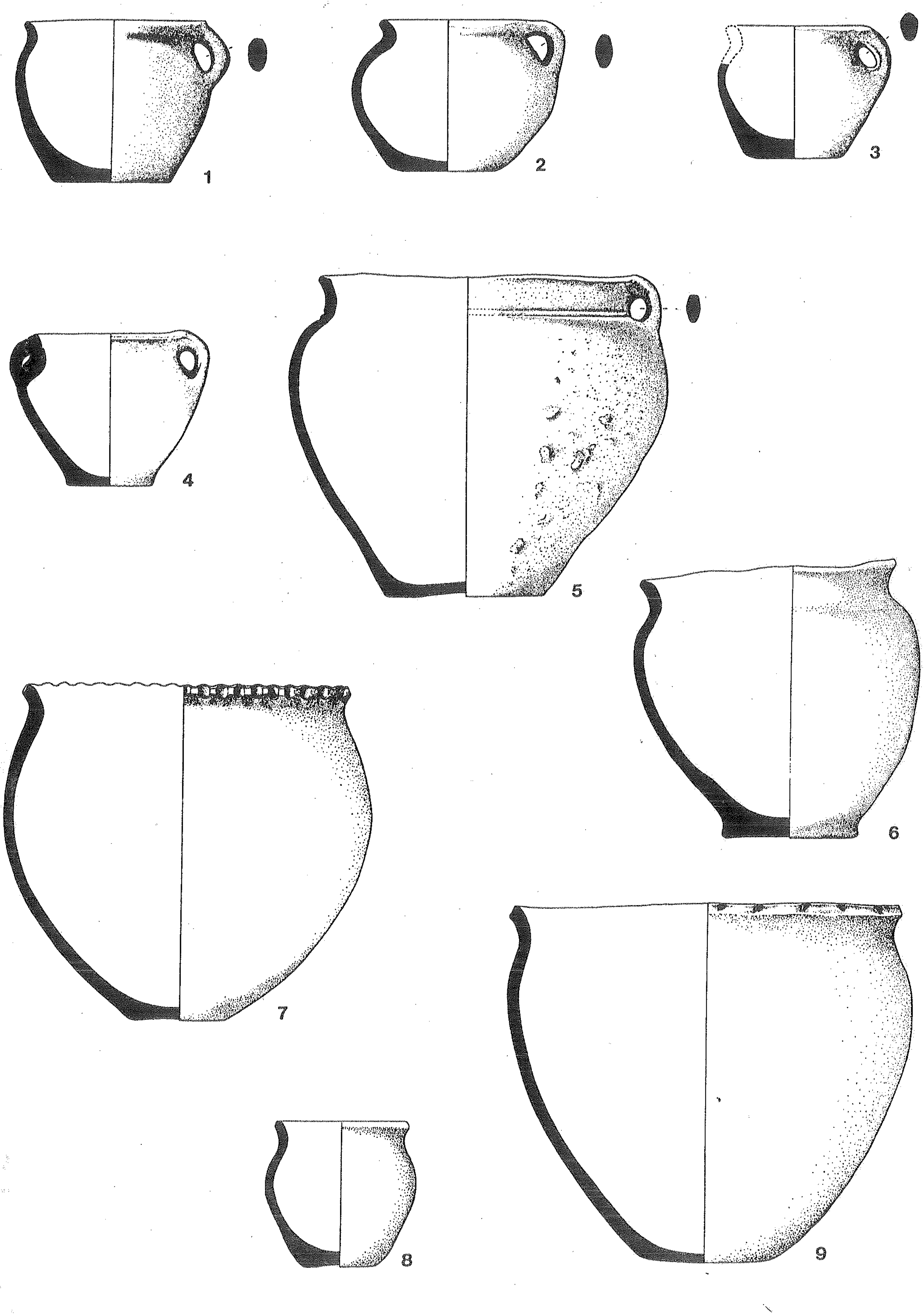
ig. 11.21
n 'early' service as used in the ssendelver Polders.

reasons. The raw materials used for large and small vessels are essentially the same, and so is the basic technology. However, for any potter, experienced or not, making larger vessels is more difficult than small ones, because (a) they use more clay, which (b) has to be kneaded in one batch, otherwise the paste will not be homogeneous, (c) therefore the whole process of manufacture has to be executed before parts of the pot dry to any appreciable degree. As (d) the paste has to be used relatively stiff, so that the pot does not collapse during manufacture, the time allotted to construction of the vessel is even more limited.

Moreover, and partly as a consequence of the above, there is much more variation in shape among the smaller vessels. As the aim of our comparison is to test the model of the pottery-making system under some stress, vessels with comparable shapes need to be placed side by side.

ig. 11.22 (next pages)
. 'late' service as used in the Asendelver Polders.

For our comparison, we will use vessels of the pre-Roman Iron Age, the Early Roman Iron Age (Assendelft) and the later Roman Iron Age (Schagen-Lagedijk). As to the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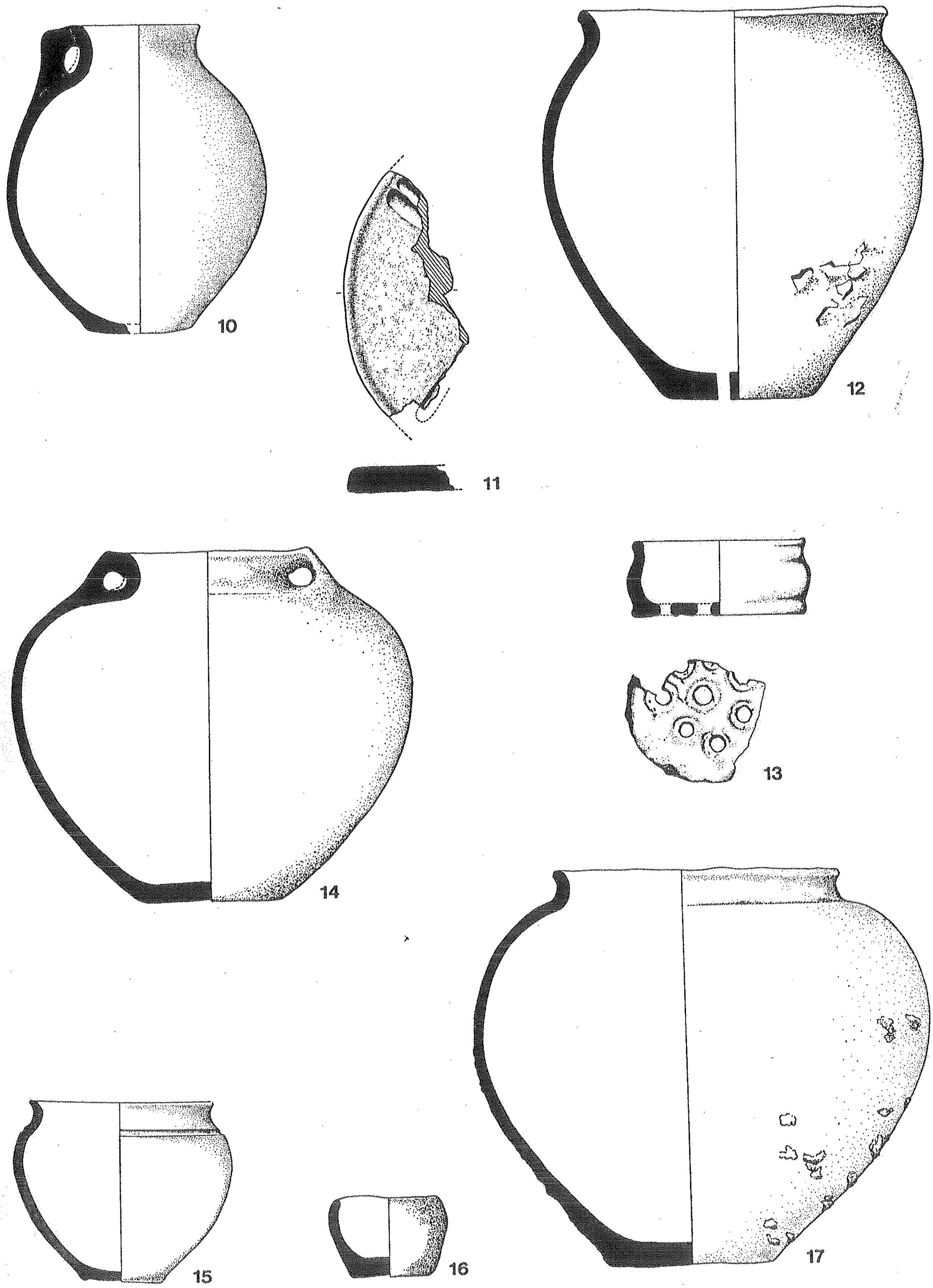
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raw materials used, comparison leads to the following conclusions:

	pre-Roman	Early Roman	later Roman
nature:	secondary	secondary	secondary
provenience:	local, from anywhere	local, from anywhere	local, from fixed locations
modification:	no additions	organic nonplastics	various specific additions
plasticity:	plastic	plastic	plastic

Comparing the basics of the shape of the vessels (cf. figs. 11.19 and 11.20), we see that the diameter of the base increases little with time, that the maximum diameter stays more or less the same, but is reached somewhat lower, and that the diameter of the neck decreases somewhat. Throughout the period concerned, the vessels are often somewhat lopsided, but the tendency towards this decreases markedly with time. This lopsidedness does not threaten the balance of the vessels on a flat, level surface.

As to the function of the vessels, which we believe was one of the components of the aim of the potter at the outset of the manufacturing process, we can but guess. It is interesting in this context to compare a 'service' as was in use during the pre-Roman Iron Age with one drawn from our excavations of (Early) Roman Iron Age settlements (figs. 11.21 and 11.22). The increase in the number of differently shaped pots is quite marked, and we assume that this increase has to do with the number of distinguished functions which pottery served in the society. The larger vessels, however, do not differ much in size or shape throughout the period concerned, and we assume that their function has remained more or less the same. As a consequence, we interpret the differences from a technological point of view.

The build-up of the vessels does differ somewhat. Noticeable is that the base of the vessels becomes wider through time, so that the vessels stand more stably. From a point of view of manufacture, this requires (a) an adequate, preferably turnable, support during manufacture, and (b) better control over drying, so that cracks are avoided, such as occur even in some very narrow-base (early) vessels (fig. 11.10).

Equally, there is a marked development towards more symmetry around a vertical axis (figs. 11.19 and 11.20), and toward more regularity in general. Here, the crucial step is probably that the potters manage the lower part of the wall better. Presumably, this argues for (a) more routine, and an increased number of pots made by any one potter, (b) better tools, e.g. a support which is stable and may be rotated, and (c) more suitable pastes, which are due to modifying the raw clay by addition of the right amounts of nonplastics and water. Together, these changes give the potter more control over shape.

Increasing control over the thickness and shape of the wall is also in evidence. The vessel wall is, towards the end of the period, more regular and in general thinner and thus easier to dry and fire. There are essentially three approaches to achieving such a change: (a) use of thinner coils, (b) slight adjustments in coiling technique, and (c) scraping the vessel. The latter technique is relatively risky, as the potter has to judge the thickness of the wall almost by intuition. It also entails an extra treatment of the vessel which is moderately time-consuming. Lastly, to obliterate the traces, a time-consuming extra action burnishing/polishing or applying slips is the only option. Thus, sometimes, the potters must have chosen for thinner coils and more effective coiling. This must, again, have required a better routine.

Finishing the vessels usually entails some form of surface treatment in a leather-hard condition. We observe polishing/burnishing and covering the lower surface of the vessel with a lumpy clay slip. The former technique is very time-consuming, the latter much less so and may have been introduced as an 'easier' alternative. Both are effective in masking traces of scraping the exterior surface, and the use of both decreases with time.

In summary, we see a development from vessels showing less control over the structural aspects of construction, and made with a considerable investment in time (notably on surface finish and decoration), towards vessels with better structural characteristics the surface of which is treated in this same manner, and ultimately towards vessels with good structural caracteristics but much less time spent on carefully finishing the surface.

11.8 WHAT IS TO COME

These preliminary remarks on the pottery from the Assendelver Polders leave much to be desired, and have aimed at showing how we think about ceramics, how we approach our analyses, and what kind of results may be achieved.

The next step will be to analyse the material from the remaining campaigns, and from various excavations in the environment (Schagen, Velsen, etc.). Together, these analyses will present a detailed and encompassing picture of the history of ceramics in the coastal area of the Netherlands.

Evidently, a technological analysis like this one is only the beginning, and analysis from other perspectives must follow: function, economics, role as symbols, etc. Some of these are presently being undertaken alongside further technological analyses by Ineke Abbink and Tineke Spruyt, funded by the Province of North Holland and ZWO. They will be reported on in a later volume.

Lastly, it would seem extremely useful to compare with the pottery from areas further south, where different technologies developed, partly prior to, and partly under the influence of Roman pottery making.[1]

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