NASCA POTTERY CONSTRUCTION

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When reviewing the ethnographic literature on methods of ceramic manufacture, one is immediately struck by the range of processes and combinations of techniques that can be employed to produce essentially the same vessel shape. Choice of construction methods is influenced to varying degrees by climate, resource availability, technology, and local economy; but it is clear that cultural preference also plays an important role. If we consider a globular jar form, and eliminate the use of the potter's wheel and molds, this vessel shape can still be produced by drawing, coiling, or paddling, or by any combination of these methods with or without recourse to a variety of specialized techniques for starting and completing the pot. Further, ethnographic accounts and practical experience make it clear that there is nothing straightforward about traditional methods such as coiling; there are several distinct techniques encompassed by this term, which are often overlooked when subsumed under a single heading. When considering the construction methods used for any prehistoric ware, we do well to remember Anna Shepard's caution:

> We have to look beyond familiar examples to realize how many methods were employed and how often curious practices were incorporated into custom. Many pottery-making methods remind us how often procedures which seem illogical or impractical are followed, and we realize anew the danger of reasoning from the "self-evident" when human nature is concerned. (Shepard, 1976, p. 54)

The reader will find support for the preceding observations in standard works like Shepard (1976), Rye (1981), and Arnold (1985). Arnold, in particular, has assembled a large number of studies that demonstrate that pottery production methods are conservative traits which, to a large extent, are culturally determined. Forming techniques and their associated motor patterns are among the most conservative aspects of a ceramic complex; as such, they are diagnostic of a particular group in time and space, and may therefore reflect stability, movement, innovation, contact, trade, and exchange (Arnold, 1985, p. 236).

It is not my purpose here to review the ethnographic and archaeological literature. References not directly applicable to the central focus of this study have been kept to a minimum. Where possible, I have simply cited one or two recent works that offer good bibliographic coverage of a subject.

NASCA CERAMICS

The Early Intermediate Period Nasca culture of the Peruvian south coast has been the object of numerous studies since it was first identified in the early years of this century (Proulx, 1970). Past research on Nasca ceramics has focused on vessel shapes and decorative modes, and nine stylistic phases have been defined (E. Wolfe, 1982). The basic technology involved in pottery manufacture, however, has received little attention. Proulx (1968, pp. 23-24) has provided the most detailed published account of pottery construction methods based on his examination of sherds from phases 3 and 4 in the Ica and Nasca valleys. He concluded that, aside from modeling and appliqué used to fashion decorative relief and slip casting for panpipes (Dawson, 1964), the basic method of manufacture was coiling.

The study presented here used X-ray analysis as a means of identifying ceramic construction methods. Because this research was carried out on complete vessels, it was possible to identify two or more construction techniques on a single specimen. The study, however, was limited to forming processes, and does not cover other aspects of ceramic technology, such as paste, temper, firing, burnishing, or painting. Proulx (1968) remains the published authority on these important subjects and on utilitarian pottery; the research reported here is confined to Nasca polychrome ware. Before proceeding to a discussion of the sample and results, it would be best to review briefly the methods and principles employed in this study.

THE RADIOGRAPHIC APPROACH TO CERAMIC ANALYSIS

X-rays have been used informally in archaeology for several decades (e.g., Titterington, 1935), but recent years have seen a surge of interest in radiographic experimentation, with particular focus on ceramic analysis (Heinemann, 1976; 1978; Alexander and Johnston, 1982; Foster, 1985). Radiography can be used as a nondestructive procedure to study tempering agents and manufacturing techniques, and to address questions of authenticity and conservation. It has the additional advantage of allowing large numbers of specimens to be processed at a relatively low cost. Applied studies are still few in number, but have demonstrated considerable potential (Rye, 1977; 1981; Braun, 1982). A drawback to radiographic analysis is that the specimen is reportedly not suitable for thermoluminescence dating after exposure to X-rays (Rye, 1977, p. 209).

Conventional Film X-rays

X-rays are electromagnetic radiations of short wave length, which have the ability to penetrate solids. Objects of differing densities absorb X-rays at differential rates, and the effect is transferred to a photographic plate on which the object rests. When X-rays are dispersed while passing through an object (an effect called scatter), edges are obscured, presenting a hazy appearance on the film image. This effect can be partially overcome by increasing the kilovoltage, which will sharpen edges but only at the expense of contrast in the rest of the object. Exposure times and dosage levels vary according to the thickness of the objects being examined and whether the objective is internal contrast or edge clarity. This study found that reasonably good contrast can be obtained for sherds 3-6 mm. in thickness at settings ranging from 55-65 kV at 3.2-4 mAs. Depending on the equipment and nature of the materials, some experimentation is required for each sample group. Photographic films range up to 35 × 43 cm. in size, allowing for large vessels or several sherds to be recorded on a single plate. The examination of film X-rays requires the use of a light table or similar aparatus. The main advantage in using conventional film X-rays over other radiographic methods is availability. Radiology departments in local hospitals can provide the necessary services, and many universities maintain X-ray equipment in their natural science departments.

Xeroradiography

Xeroradiography is a variation on conventional film X-ray, which differs primarily in developing methods. Instead of film, an electrostatic charge is placed on a selenium-coated aluminium plate. After the plate (and the object on it) has been exposed to X-rays, the residual charge is developed by spraying the plate with a negatively-charged powder and then fixing the image to paper by pressure. The resulting print is referred to as a xerogram. Xeroradiography can be used for many purposes, but is most widely employed today in mammography (J. Wolfe, 1972). When applied to ceramic analysis, this technique offers greater contrastive detail and edge clarity because a portion of the charge is so dissipated that scatter is no longer part of the image formation process.

Xeroradiography is a more specialized technique than conventional film X-ray, and the necessary equipment can be difficult to locate, but most cities should have one or two such facilities. The standard plate size is 22.5 × 33.5 cm. The image is fixed on paper, and no additional equipment is required for examination. As with film, X-ray dosage levels and exposure times will vary according to the thickness of the objects being examined. In this study it was found that the preferred setting for sherds 3-6 mm. in thickness was 125 kV at 20 mAs; again, some experimentation is usually required for best results.

Since conventional film X-ray has the advantages of greater availability and larger plate size, it may be the preferred technique for studies in which edge clarity and subtle tonal contrasts are less important (e.g., temper analysis). Film X-ray can theoretically produce the same results as xeroradiography but, in practice, is more cumbersome to use. I found that xeroradiography is the more useful method for research on ceramic manufacturing techniques.

CAT Scans

A third X-ray technique, computerized axial tomography, also known as CAT scans or CT's, deserves brief mention. CAT scans produce a cross-section or profile image by measuring density variation within the image plane, and recording it by means of computer-assisted triangulation. The density and width of any given point can be determined with great accuracy. Since the profile and wall thickness of a vessel can be readily determined by xeroradiography, CAT scans offer no particular advantages in these regards. Heinemann (1978) first proposed CAT scans as an auxiliary to ceramic analysis; Alexander and Johnston (1982) reported it to be of limited use, a conclusion with which this study generally agrees.

Principles of Identification

An X-ray of almost any sherd will reveal localized light and dark areas of various shapes and sizes in the matrix. These may represent mineral tempering agents, organic materials, or air pockets, collectively referred to as inclusions. Colour in X-ray imagery is dependent upon density; a pebble will appear as a light spot and a small void as a dark area relative to its surrounding matrix.

The application of radiography to the study of manufacturing methods was first proposed by Rye (1977; 1981) and was based on the Principle of Preferred Orientation. This principle states that the application of directed pressure to plastic clay causes inclusions to take up preferred orientations. Orientation is dependent upon inclusion shape and size, the plasticity of the clay, and the intensity and direction of applied pressure. Such orientations occur only when the clay is in a very plastic state during the gross forming processes of vessel construction. Finishing operations confined to the surface will not obscure the basic internal patterns. It then follows that the motion of forming coils will produce horizontally-oriented inclusions (diag. 1); vessels formed by drawing a lump of clay upward by hand will have vertically-oriented inclusions (diag. 2); and vessels produced by direct shaping or in a mold will exhibit no preferred orientations (diag. 3). All of the inclusion types (mineral particles, voids, and organic matter) are visible under X-ray imagery. Rye (1977, pp. 208-209) has tested the orientation principle on ethnographically known Papuan pottery, and has found it to hold true, although, as he points out, there are several prerequisites:

(1) that the analysis be applied to enough sherds to reveal general trends rather than normal individual variation from one vessel to the next;
(2) that a full range of sherds, including body sherds, be studied;
(3) that the largest possible sherds be used to obtain the best assessment of preferred orientations of inclusions;
(4) that the radiographs be studied in conjunction with surface evidence visible on the sherd;
(5) that inclusions are of sufficient size to be visible without magnification; and
(6) that the inclusions in the pottery are not equiaxial.

A series of independent experiments conducted at the University of Calgary confirmed Rye's orientation principle. A number of clay tablets and vessels were constructed and radiographically examined together with several ethnographic specimens. Some practical experimentation of this nature is recommended to anyone interested in pursuing similar studies. However, these experiments also demonstrated that Rye had carefully chosen his wording, for the orientation is indeed preferred and not absolute. Particles that happen to lie on or close to the surface can be pulled out of their original positions during scraping and other finishing processes. Further, it was found that some inclusions inside the matrix can vary 5-30° from a perfectly horizontal or vertical position, especially such flexible organic inclusions as grass. Nevertheless, it can be stated with assurance that the majority of inclusions will exhibit sufficient true orientation to determine accurately the nature of the pressure and stresses applied to the plastic clay.

THE SAMPLE AND THE STUDY

The sample for the current study consisted of 30 Nasca polychrome specimens of unknown provenience from museum and private collections (see Appendix). Phases 1, 7, 8, and 9 were not represented in this sample. Vessels were grouped according to shape and relative age as shown in Table 1. The vessel shape categories defined by Proulx (1968) were used in this study (figs. 1-9). Depending on complexity of form, from three to eight xerograms were produced for each vessel. In all instances they included two side views (the second exposure being taken at a 90° angle to the first) and, where applicable, vertical and oblique shots were obtained. These procedures provided maximal coverage of each specimen. A total of 115 xerograms and 13 conventional X-rays were used for this study.

TABLE 1

Vessel Shapes and Phases

Shapes	Phases					
	2	3	4	5	6	Total
Conical-bottom bowls	1	1				2
Flaring bowls		2	3			5
Cupbowls		1	5	3		9
Vase forms			1	4		5
Head jar			1——			1
Collared jars				2		2
Double-spout bottles		4				4
Head-and-spout bottle					1	1
Effigy vessel	1					1
Total	2	8	10	9	1	30

Temper often plays an important role in studies of this nature. However, the mineral particle inclusions in Nasca polychrome are mainly small and equiaxial in shape, and are therefore not conducive to demonstrating preferred orientations. Temper consists of sand; mica inclusions are native to the clay sources of the region. The suggestion that mica inclusions caused occasional vessel spalling as a result of differential thermal expansion is probably correct (Proulx, 1968, p. 23); however, besides mica, which occurs as both muscovite and phlogopite, calcium-rich diatomaceous earths also occur in the area, and may have contributed to the process (ONERN, 1971, pp. 71-72, 80). Organic inclusions are present, although not common, in Nasca polychrome ware. They may have been introduced fortuitously when the clay was being prepared, or they might represent initial mixing with organic-bearing bentonite clays of the region (ONERN, 1971, p. 71); in either event, they played no major role as constituents. When present, they are useful indicators of orientation. For the most part, orientations exhibited by voids or air pockets were used to determine vessel formation processes in this study.

Radiographic results are seldom absolute in detecting the precise manufacturing procedures followed for each vessel. A certain degree of ambiguity is frequently present. Occasional specimens are extremely clear, but what emerges from a sample is a composite list of the range of forming processes characteristic of the ware in general. Such are the results of the present study. Radiographic analysis has demonstrated that the primary vessel construction methods employed by Nasca potters were variations and combinations of coiling and drawing. Ancillary techniques included direct shaping, paddling, and scraping.

It should be noted that ceramic nomenclature in general is not standardized. A potter's terms for the tools and methods employed are indicative of the place and time in which the skills were learned. Ceramic terminology is more a matter of folk tradition than rigid definition. The terms used in the following discussion will be first clarified, after which the reader will be given some indication of the range of possibilities inherent in each technique. With this comparative background in mind, an account of the selective choices made by Nasca potters will then follow.

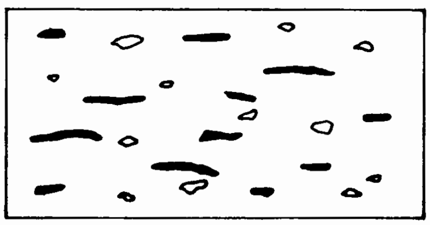
Coiling

To the uninitiated, coiling may sound facile and even childish. It is not until some serious attempts to produce serviceable vessels have been made that one acquires an appreciation of the complexities, variations, and necessary skill involved in this method. Coiling is one of the most versatile forming processes used by traditional potters. Coils of uniform thickness are produced by a rolling motion when the clay is held in a vertical position between the palms, or the clay is rolled across the thigh or a flat surface. Shepard (1976, pp. 57-59) presents a concise discussion of coil use, and Chroman (1974, pp. 74-86) provides examples of the wide range of possibilities inherent in this technique. To summarize, coils can vary from a few centimetres to over a metre in length and may range from 0.5 cm. to more than 5 cm. in thickness depending on the size of the vessel and the desired wall thickness. Small coils may be applied in finishing procedures to fasten spouts and handles, thicken rims, or produce collars. Entire vessels may be constructed from coils or they may be used in conjunction with other construction methods. Once formed, coils may be applied in a continuous spiral or by individual rings, and may be superimposed vertically or overlapped to form oblique planes of juncture. The coils may be bonded by any of several methods. Coil junctures may be totally or only partially erased. When left visible, they provide natural structural decoration, and when partially obliterated, present surface relief texture.

To reduce production time, coils may also be flattened before application, a technique of some importance in arid climates where speed is essential because of rapid moisture loss. The coiling technique is not limited to cylindrical shapes but may be used to construct oval, irregular, and even square forms. There are several advantages to working with coils. The clay need not be as plastic or finely textured as required for other methods, and coiled pots do not have to be completed in one sitting. This latter characteristic allows the construction of very large vessels built by adding section on section over a period of time. Leach (1969, pp. 65-66) provides an interesting account of coil-building large vessels in Japan, which might serve as a possible analogue for Middle Horizon urns (see also Litto, 1976, p. 56).

The radiographic identity of coil use may be revealed by a preferred horizontal or spiral orientation of voids and inclusions. The extent to which seams are visible between coils depends on how thoroughly the coils were fused. On well-made coiled vessels, there may be no such traces left. When present, they appear as either very thin lines marking the actual points of juncture between two separate coils or as more diffuse and discontinuous, roughly elongated voids usually lacking sharp linear edges. This latter type denotes incomplete fusion in coil interiors. In either aspect, coil lines can range from a few millimetres in length, and may occur in slightly oblique, as opposed to horizontal, positions due to variations in thickness or method of application. Diagnostic features of coiling are shown in diag. 1 and figs. 10-12.

Diagram 1. Coiling



Most vessels in the Nasca sample examined in this study showed some use of coils, but in no instance was coiling the sole method of construction. Bases were always made by a different method, and coiling was generally confined to the upper body. On conical-bottom bowls it was evident that a single coil had been applied and flattened to produce the sides, while in other cases, the only coil used appeared as a finishing addition to the rim. When multiple coils were used, it was seldom possible to determine their precise number, but even the largest specimens (up to 20 cm. in height) did not appear to have incorporated more than 5 coils, with 2-3 being the best estimate for the majority. The average is then 3-4 cm. of height per coil, which, combined with the average 4-6 mm. wall thickness, indicates the use of coils with a 1-2 cm. diameter. Two of the vases in this sample exhibited heavy, oblique and cross-hatched scoring appearing in bands on their inner surfaces. Scoring of this type is often applied to bond preflattened coils quickly (E. Mould, pers. comm., 1985). This evidence suggests that Nasca potters used fairly narrow coils for building most polychrome vessels, but may have employed larger preflattened coils on occasion.

The absence of spiral orientations in the clay matrices indicates the use of individual coil rings for building purposes. Judging from the diameters of these vessels, coil lengths ranged from 10 to 40 cm. Of the 27 vessels in this sample for which reasonably clear orientation was present, only 9 showed evidence of multiple coil use to form more than 50% of the vessel height: a flaring bowl, 4 cup bowls, 2 vase forms, a double-spout bottle, and a head-and-spout bottle (Tables 2 and 3). In this sample, the use of coils as a primary forming method does not correspond to any particular stylistic phase or secondary technique.

TABLE 2

Primary[a] Construction Methods and Paddling

	Coiling >50%	Drawing >50%	Direct shaping >50%	Paddling
Conical-bottom bowls			2	1
Flaring bowls	1	2		2
Cup bowls	4	4	1	3
Vase forms	2	2		5
Head jar		1		1
Collared jars		2		
Double-spout bottles	1	3		
Head-and-spout bottle	1			
Effigy vessel		1		
Totals[b]	9	15	3	12

[a]A technique is classed as primary when it accounts for more than 50% of vessel height.

[b]Orientation patterns could not be determined for three of the vessels in the sample.

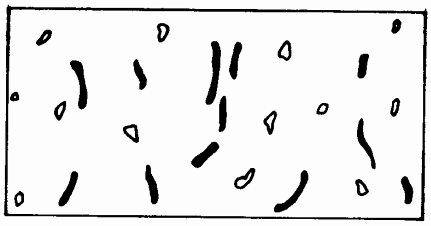
Drawing

Elegantly simple in concept but requiring considerable skill in practice, drawing raw clay into form is another widespread practice among traditional potters. Drawing refers to squeezing the clay and stretching or pulling it upward. This process is also referred to as direct shaping, modeling, or pinching. Shepard (1976, pp. 55-57) discusses variations of the drawing theme, and Rye (1981, p. 73) provides a set of photos illustrating the stages involved in drawing a vessel.

Drawing can be used to construct a pot of almost any size or shape. In practice the process provides the best results when very plastic clay is used and the vessel is completed in one sitting. Entire vessels may be made with this method, or it may be used in conjunction with coiling and a variety of secondary forming processes. Drawing a complete vessel offers a distinct advantage in the absence of seams, which eliminates a possible source of structural weakness. When the base is formed by a different method, a thick ring of clay may be added from which the vessel walls are drawn, a process sometimes referred to as modified coiling.

As revealed in X-ray imagery, the pressure applied in the drawing motion causes voids and inclusions to take on a preferred vertical orientation (diag. 2),

Diagram 2. Drawing



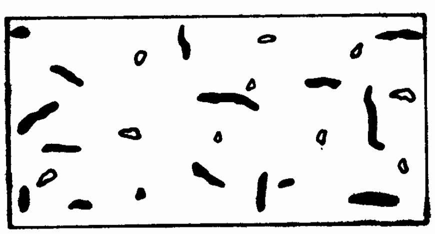
as opposed to a more horizontal one in the case of coiling. Drawing and coiling involve different motor patterns, characterized by vertical and horizontal pressures respectively. A drawn vessel can sometimes be identified by its profile, which may show a thick base relative to wall thickness. In an ideal cross section there is a gradual decrease in thickness from the centre of the base to the rim, a result of the upward pulling motion. Secondary processes, such as scraping and paddling or the addition of a coil to thicken the rim, however, may easily alter the original profile (figs. 3, 12, 13, 15).

As with coiling, some evidence of drawing was present on many vessels in the sample, but, again, no vessel was made exclusively by this method. There were 15 vessels in which drawing accounted for more than 50% of total height: 2 flaring bowls, 4 cupbowls, 2 vase forms, the head jar, 2 collared jars, 3 double-spout bottles, and the effigy vessel (Tables 2, 3). In this sample, drawing showed no particular correlation with phases or finishing methods.

Direct Shaping

The method consists of hand beating and pulling a ball or disc of clay into the desired form. This does not involve regular or rhythmic applications of pressure, which would result in preferred orientations; hence, random inclusion orientations on X-rays are characteristic (diag. 3). Direct shaping is a commonly

Diagram 3. Direct Shaping



employed technique among traditional potters for fashioning the base of a vessel that is then completed by drawing or coiling, but small pots may be entirely formed by this method. The terms "pinching" or "modeling" may be preferred by some to describe this shaping process. In this study, however, modeling has been reserved as a sculptural term, and pinching is used by others to describe a more directed or controlled application of pressure than is implied here (e.g., Rye, 1981, p. 70).

Random orientations in the bases of all vessels in this sample suggest that direct shaping may have been the only method of basal construction used by Nasca potters. The possibility that a form of basal support or template was also in use is currently being studied. Limited to its role as a basal construction method, direct shaping was a secondary technique among Nasca potters. However, there were three instances in this sample when it assumed primary status. Direct shaping was the sole method used to construct a tiny cup bowl (Mis.574.Q) and the bases of the two conical-bottom bowls accounted for more than 50% of their heights (Tables 2, 3).

Paddling

Paddling, sometimes referred to as beating, is a secondary shaping technique used to thin walls, consolidate the matrix, bond joins, and provide form. The paddle itself may be flat or curved; have a wide or narrow blade, which may be incised with a design, wrapped in cord, or smooth; and is usually fashioned from wood. It is frequently used in conjunction with an anvil, which may consist of a smooth, rounded stone or similar object made of wood or clay, that is held against the interior of the vessel opposite the area of paddle impact. The force of the blow can vary from extremely hard applications to gentle taps. A paddle may be employed without the use of an anvil, in which case the tips of two or three fingers are held against the interior vessel wall to receive the strokes. The amount of paddling used on a vessel can vary tremendously. Some potters construct a rough form by direct shaping, drawing, or coiling, and then use paddle and anvil on all surfaces to give the pot its final height and shape, wall thickness and strength. This operation requires great skill as the vessel is rotated and struck with uniform rhythmic precision. In other instances paddling may be confined to the vessel base. Some potters have been observed adding a few gentle taps to the vessel exterior in a sort of absent-minded ritual of completion. Shepard (1976, pp. 59-60) supplies some ethnographic examples of paddling, and Rye (1981, pp. 84-85) discusses paddling characteristics.

In X-ray imagery, the effects of paddling may appear as a series of rounded dark areas corresponding to anvil or finger tip placements. Voids in the clay are frequently flattened, and small, radiating cracks can appear around larger mineral temper particles as a result of thermal expansion stress in the densely packed matrix (diag. 4). While heavy paddling

Diagram 4. Paddling

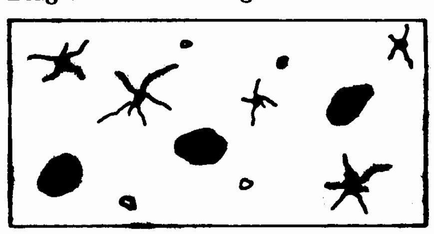


TABLE 3

Individual Vessel Descriptions

VESSEL	PHASE	COILING +=>50% of vessel height	DRAWING +=>50% of vessel height	PADDLING +=Present	TOTAL
Conical-bottom bowl					2
Mis.572.Q	2	Low sides formed of a single coil; base, probably formed by direct shaping, accounts for most of height.			
Mis.579.Q	3	Low sides formed of a single coil; base, probably formed by direct shaping, accounts for most of height.		+ A few facets on outer sides and some concavities on inner wall.	
Flaring bowls					5
Mis.573.Q	3		+ Orientations indicate vessel walls formed by drawing.		
KC-1	3	Orientations unclear.	Orientations unclear.	+ Facets around base angle.	
KC-2	4	Upper third of vessel built with 1-2 coils.	+ Lower two-thirds of vessel drawn.	+Facets around base angle.	
Mis.578.Q	4	+ Vessel walls built with 2-3 coils.			
FC-1	4	Orientations in rim area suggest at least one coil was used.	Orientations unclear.		
Cupbowls					9
Mis.574.Q	3-4		*Direct shaping* Small vessel completely formed by direct shaping.		
Mis.576.Q	4		+ Preferred orientation vertical, walls drawn to height.		
Mis.582.Q	4	+ Upper two-thirds of vessel built with 2-3 coils.	Lower third of vessel drawn.		
Mis.584.Q	4	+ Vessel walls built with 2-3 coils.			
KC-3	4	One coil added to finish rim.	+ Lower three-fourths of vessel drawn.	+ Facets on base angle.	
KC-4	4		+ Clear vertical orientation, walls drawn to height.	+ Facets on base angle.	
Mis.58.Q	5		+ Clear vertical orientations, walls drawn to height.		
Mis.586.Q	5	+ Vessel walls built with 3-4 coils.		+ Facets on outer body, concavities in interior basal areas.	

Mis.565.Q	5	+ Series of fine, horizontal orientations and thin (4 mm.) walls suggest use of multiple narrow coils.			
Vase forms					**5**
Mis.583.Q	4	Upper third of vessel built with 1-2 coils.	+ Lower two-thirds of vessel drawn.	+ Numerous facets on base angle, a few facets on upper body.	
Mis.562.Q	5	Horizontal orientations in rim area and thickened rim profile suggest this vessel may have been finished with 1-2 coils.	Orientations in remainder of vessel unclear.	+ Outer facets and inner concavities over all areas; vessel could have been shaped by paddle and anvil.	
Mis.563.Q	5	1-2 coils used to complete the rim.	+ Lower three-fourths of vessel drawn; central zone of interior scoring may indicate ring addition.	+ Outer facets and inner concavities over lower third of vessel.	
Mis.564.Q	5	+ Walls constructed with 3-4 coils, possibly preflattened, 2 bands of inner scoring present.		+ A few facets on upper walls, numerous facets around base angle.	
Mis.577.Q	5	+ Walls constructed with 3-4 coils.		+ Inner concavities and some outer facets on lower fourth, concentrated at base angle.	
Head jar					**1**
KC-5	4-5	Upper third of vessel constructed with 2-3 coils.	+ Lower two-thirds of vessel drawn. Note: base missing.	+ Some outer facets and inner concavities present on lower two-thirds.	
Collared jars					**2**
Mis.571.Q	5	Possibly 1 coil added in upper body just below shoulder; 1 coil used to fashion collar.	+ Walls drawn.		
Mis.585.Q	5	Possibly 1 coil added to upper body just below shoulder; coil used to fashion collar.	+ Walls drawn, heavy scraping on inside above shoulder obscures area.		
Double-spout bottles					**4**
Mis.561.Q	3	Possibly a single coil added to upper body just below shoulder.	+ Lower three-fourths of vessel drawn.		
Mis.568.Q	3	+ Lower two-thirds of vessel walls formed with 2-3 coils.	Upper third of walls just below shoulder is drawn.		
Mis.569.Q	3	Upper third of vessel walls below shoulder formed by 1-2 coils.	+ Lower two-thirds of vessel drawn.		
Mis.580.Q	3	Upper third of vessel walls below shoulder formed by 1-2 coils.	+ Lower two-thirds of vessel drawn.		

Head-and-spout bottle				1
Mis.567.Q	6	+ Vessel walls built with 2-4 coils.		
Effigy vessel				1
Mis.566.Q	2	Head fashioned with 2-3 coils, face modeled.	+ Chamber drawn.	

may alter internal orientations related to the primary forming process, experimentation has shown that this is not always the case, and light applications will not seriously obscure the original pattern. The radiographic characteristics of paddling are only important for interpreting the complete vessels with enclosed forms, such as bottles. Open vessels, such as bowls or vases, and fragmentary specimens may be easily inspected by hand. If paddling was used, a number of small depressions or concavities are often present on the interior surface, while a series of small flattened areas or facets appear opposite them on the exterior. Where light paddling was applied, exterior facets are often the only visible evidence. However, it is common for all surface traces of paddling to be completely eradicated by diligently applied smoothing and burnishing procedures. In fact, when unintentionally present, paddle marks reveal a degree of carelessness on the part of the artisan.

Twelve vessels in the current sample exhibited evidence of paddling. In six cases, interior concavities and exterior facets were both present, while evidence on the remaining vessels was limited to exterior facets more indicative of light paddling. One vase, a Phase 5 specimen (fig. 14), exhibited interior concavities and exterior facets over all areas from the base to the rim. This is the only vessel on which surface markings suggest that it may have been entirely shaped by the paddling technique. Evidence for paddling on the remaining vessels was largely confined to the lower basal areas, where it was presumably applied to strengthen the base and seal joins (fig. 15). As Tables 2 and 3 illustrate, paddling does not correlate with any particular phase or primary forming method.

The use of a curved paddle, to which the vessel shape conforms, will not leave exterior facets (Rye, 1981, p. 84). The facets observed on the present sample are discreet and distinctly flattened areas characteristic of a flat paddle with a smooth, undecorated blade. The concavities noted on the interior surfaces of these vessels often nicely fit the tips of two fingers, but the possibility of anvil use cannot be excluded. That neither paddles nor anvils have been identified in Nasca deposits is not surprising, for they may be fashioned from objects at hand and easily discarded. Even if curated, as is often the case with a potter's favoured tools, a flattened stick or smooth river cobble encountered out of context would not readily suggest its own function, nor would either be of any interest to an antiquities dealer.

The high incidence of paddle markings in this small sample is likely fortuitous. Obvious examples of paddled vessels in much larger collections are not common. Further studies may yet reveal that paddle use was geographically limited, and may even have been confined to a zone within a valley system such as the inland areas of Ica. The nature of the current study limits the trait list of manufacturing techniques to a simple presence/absence format, and does not allow meaningful comment on frequency distributions.

Scraping

As a means of thinning the walls of a vessel and sealing joins, scraping is one of the most universal methods employed among potters. The scraping tool or rib may consist of a sherd or a small piece of gourd, shell, wood, or bone. When used to bond joins, the edge of the tool may be serrated or scored, and it is usually applied in short vertical or oblique strokes when the clay is plastic, leaving a series of narrow, shallow incisions on the interior and/or exterior vessel surfaces. Such markings may appear in bands, which correspond to additions during the building process. When thinning is the objective, the working edge of the tool is smooth, and the clay may be in a leather-hard state. A series of shallow, contiguous channels are left on the surface by this process. These marks may appear in short vertical, horizontal, oblique, or random overlapping strokes; long vertical or horizontal channeling is indicative of more methodic efforts. The surface markings of scoring or thinning may be entirely removed by later smoothing operations. Rye (1981, p. 86) also discusses attributes of scraping.

Smooth-edged scrapers may also be used to apply pressure against the vessel interior while the pot is rotated to cause the walls to bulge outward at a given point. This procedure is usually done after the clay has begun to set up but before it stiffens. In this aspect, scrapers assist in the final shaping process. The identification of this type of scraper use would be extremely difficult, especially after surface smoothing.

As with paddling, the radiographic identity of scraping is of importance only when the markings occur on the interior of closed vessel forms. In such instances, they appear as previously described, with narrow light areas denoting ridges between thinning channels.

Scraping is not uncommon on Nasca vessels. In this sample, two vases (Mis.563.Q and Mis.564.Q) exhibited evidence of interior banded scoring (fig. 15). Thinning channels were observed on vessels in virtually every shape category, where they were most frequently noted on the basal areas. Because they are such simple devices, the archaeological identification of pottery-scraping tools is largely dependent on context. As yet they have not been identified in the published literature on Nasca.

CONCLUSION

The primary building methods used to construct Nasca polychrome pottery were variations of coiling and drawing. Vessel bases were formed by direct shaping. Secondary techniques included paddling and scraping. Modeling and occasional appliqué were used for relief features. Dawson (1964) has demonstrated that slip casting was also practiced, but the technique appears to have been confined to the manufacture of ceramic panpipes.

Some Nasca vessels from the later phases, such as the double-spout, step-fret-chambered bottles of Phase 7, suggest that slab building may have been added to the repertoire of ceramic techniques, perhaps as early as Phase 5. If this speculation is eventually substantiated, it will be of interest to learn which methods of slab construction and join sealing were used. Spherical chambered bottles also pose special questions of their own. When building what amounts to a hollow clay ball, the potter has numerous options. The methods chosen by Nasca potters to close a bottle form are currently being studied. Suffice it to say here that at least two separate techniques were used, one involving a fitted clay cap set on the shoulders of the vessel (figs. 5, 8) and the other a small clay plug tapped into place between the spouts.

It should also be noted that the specimens used in this study generally reflected the quality of their internal construction on their painted exteriors. Vessels in which the clay was not thoroughly wedged, joins not completely fused, or surfaces not properly smoothed, also tended to exhibit less attention in their decorative finishes. In these cases, motifs were often slightly off centre or unbalanced and accidently crowded; brush strokes were applied in a more haphazard fashion, leaving ragged edges; and burnishing was not as uniform or thorough (fig. 5). Pieces featuring the painted quality and detailed precision of motif execution for which the polychrome ware is world renowned also tended to have beautifully crafted structural interiors (fig. 13). Thus, we appear to have a case of being able to judge a book by its cover.

The current study was limited to a small sample of 30 vessels and largely confined to stylistic phases 3, 4, and 5; conclusions must be correspondingly limited and not tax the descriptive summaries presented in the text. With these qualifications in mind, we may note that none of the primary or secondary techniques identified in this study appear to correlate with one another nor with shape or phase divisions. The crosscutting of stylistic boundaries suggests cohesiveness, stability, and continuity in the core of the ceramic tradition. The extent to which each of the primary and secondary techniques was employed singly and in combination may be taken as a relative measure of free choice exercised within the greater tradition. Whether these decisions were made at the individual, community, or valley system level remains to be determined. The choice of methods used appears random and eclectic only when viewed in isolation. For example, if one considers the full range of possibilities inherent in the coiling method (only some of which were touched upon earlier in this paper), it can be seen that Nasca potters were quite selective in the way they used coiling. Choices made among equal alternatives reflect cultural preferences, and in this selectivity lies the uniqueness of the Nasca pattern.

The processes of ceramic construction that distinguished the Nasca potters from and linked them to their contemporaries in the Andean world remain the subject of further inquiry. Similar studies are required for several traditions before valid comparisons can be made, and the Nasca data are far from complete. A larger sample and an assessment of the Nasca ceramic craft from an ecological viewpoint are sorely needed. Christopher Donnan's study of Moche ceramic technology (1965) offers the best comparative data, but such a comparison would be premature at this time.

With the exception of some recent studies, the ethnographic literature on ceramic manufacture in the Andean world is disappointingly vague and, taken as a whole, limited in coverage. Fortunately, the subject has enjoyed renewed interest in recent years, and the corpus of literature is growing. General surveys, such as those by Linné (1925) and Willey (1949), are worth consulting, but Litto (1976) presents the most detailed firsthand accounts. Arnold (1985) provides the most recent and extensive bibliographic coverage of manufacturing techniques and related subjects. The work of Tschopik (1950) and Arnold (1972) in the southern highlands offer the best ethnographic analogues for Nasca techniques and provide an interesting contrast with traditional north coast methods (Collier, 1967; Litto, 1976).

The current study has not answered all of the questions that may be posed on the subject of Nasca pottery construction, but fresh data have been presented that open new avenues of inquiry. A set of diagnostic criteria has been established and, while these may be elaborated upon, an understanding of the basic processes involved has been achieved. The gaps in this work are evident, and point the way for future research. Finally, the potential of the radiographic approach in ceramic analysis has been demonstrated, and it is hoped that this work will stimulate similar studies in other areas.

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5 May 1986
revised 12 November 1986

APPENDIX

Specimen Locations

Ethnology Department, Glenbow Museum

Catalog numbers:

Mis. 58.Q	Mis.567.Q	Mis.576.Q	Mis.583.Q
Mis.561.Q	Mis.568.Q	Mis.577.Q	Mis.584.Q
Mis.562.Q	Mis.571.Q	Mis.578.Q	Mis.585.Q
Mis.563.Q	Mis.572.Q	Mis.579.Q	Mis.586.Q
Mis.564.Q	Mis.573.Q	Mis.580.Q	
Mis.566.Q	Mis.574.Q	Mis.582.Q	

Museum, Dept. of Archaeology, University of Calgary

Catalogue numbers:

Mis.565.Q
Mis.569.Q

Private Collection, Jane Kelley, Calgary

Catalogue numbers:*

KC-1 KC-3
KC-2 KC-4
KC-5

Private Collection, Calgary

Catalogue number:*

FC-1

*Note: Catalogue numbers for private collections were designated by the author for the purposes of this study.

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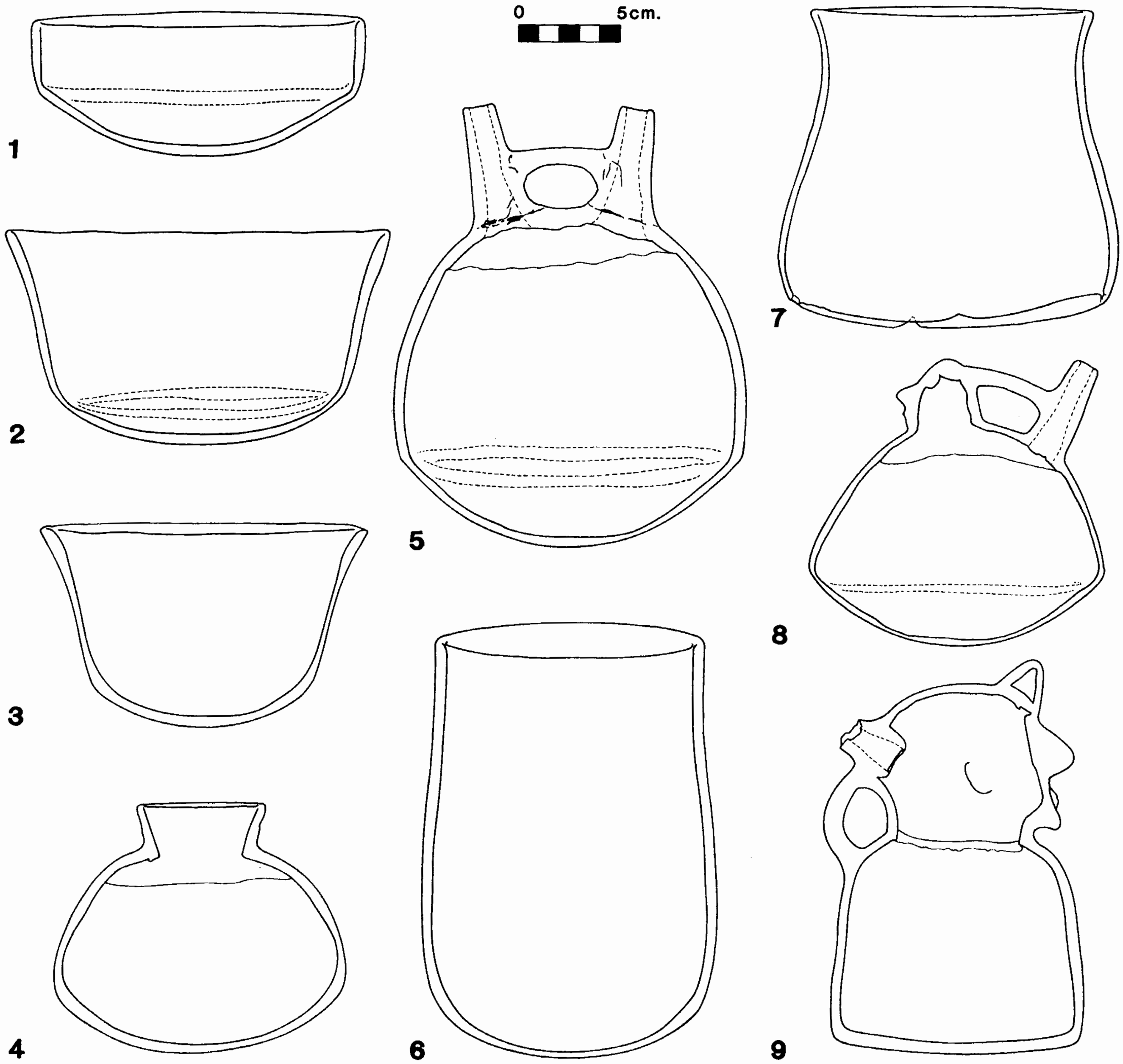


Vessel shape categories. Dotted lines at the base of figs. 1, 2, 5, and 8 indicate a dark band on the X-ray related to extra pressure having been applied to seal the wall-base juncture, a trait suggesting separate production of base and upper body. A solid line at the shoulder of figs. 4, 5, and 8 indicates an unfused seam. Dotted lines in the spouts of figs. 5, 8, and 9 indicate the inner profile. **Fig. 1.** Conical-bottom bowl (Mis.572.Q), base formed by direct shaping, walls fashioned from a single coil. **Fig. 2.** Flaring bowl (KC-2), lower 2/3 of vessel walls drawn, upper 1/3 fashioned of 1-2 coils. **Fig. 3.** Cup bowl (KC-3; see fig. 12), lower 3/4 of vessel walls drawn, one coil added to finish rim. **Fig. 4.** Collared jar (Mis.571.Q), walls drawn, possibly one coil added to upper body just below shoulder, one coil used to fashion collar. **Fig. 5.** Double-spout bottle (Mis.568.Q), lower 2/3 of vessel walls formed of 2-3 coils, upper 1/3 below shoulder was drawn. Irregular lines around spouts and bridge represent poorly fused junctures. The construction quality of this vessel is reflected in a poorly painted exterior. **Fig. 6.** Vase (Mis.564.Q), walls built of 3-4 coils. **Fig. 7.** Head jar (KC-5), lower 2/3 of vessel drawn, upper 1/3 built of 2-3 coils. The base is missing, angular line indicates appliqué nose. **Fig. 8.** Head-and-spout bottle (Mis.567.Q), walls built of 2-4 coils. **Fig. 9.** Effigy vessel (Mis.566.Q), chamber drawn, head fashioned of 2-3 coils, face modeled. The top line at the neck represents an unfused seam; the jagged line below it indicates the ragged lower edge of a thick lip of residual clay around the vessel interior. The spout is broken; a modeled ear is indicated by a curved line on the side of the head.

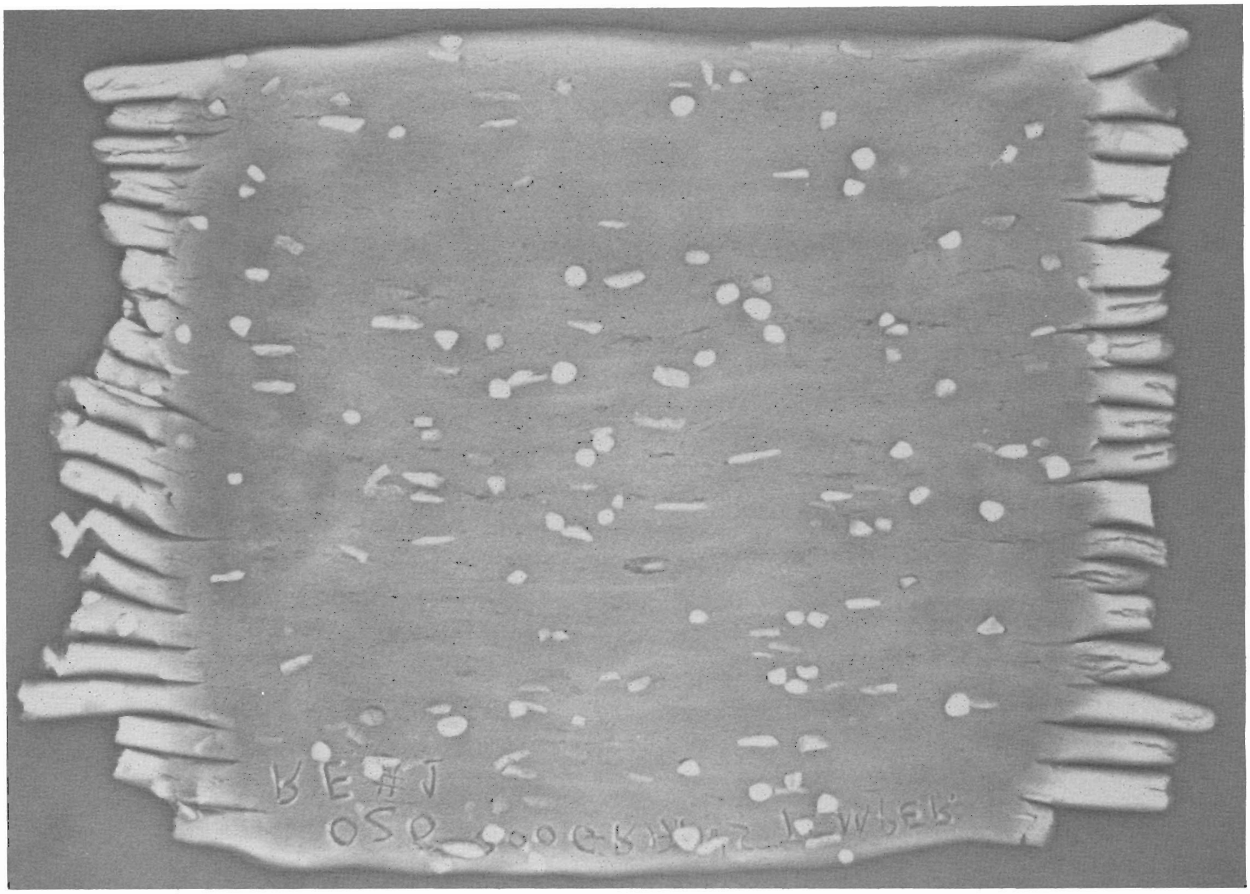


Fig. 10. Xerogram of an experimental tile built of coils showing types of coil lines and the preferred, horizontal orientation of elongated mineral temper inclusions. Equiaxial particles will not reflect forming pressures.

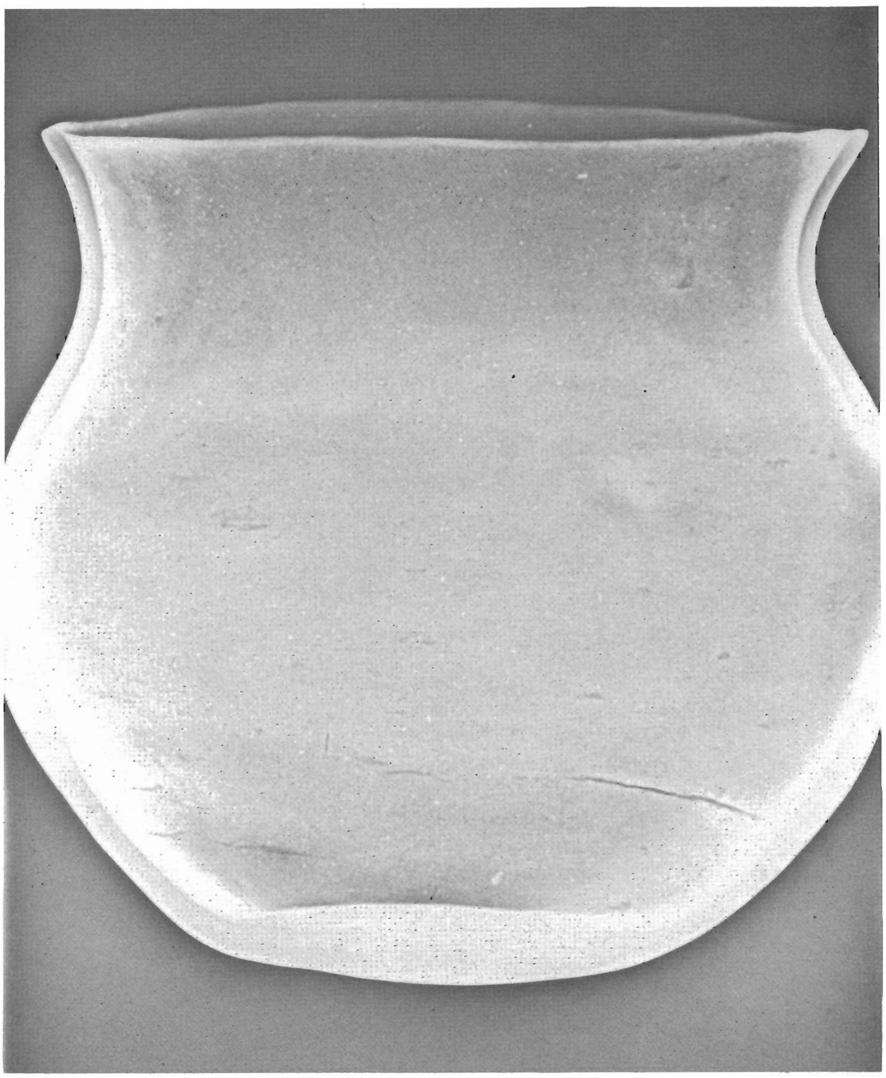
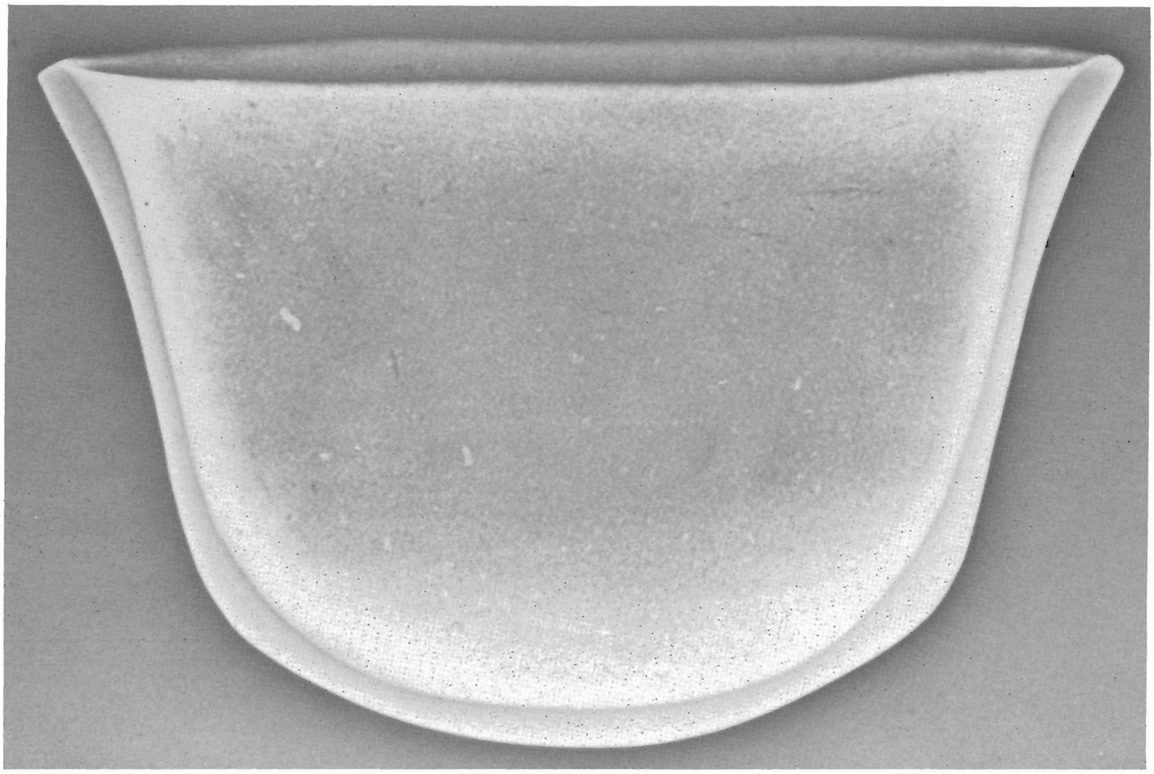


Fig. 11. Xerogram of an ethnographic specimen (height 21.4 cm.) from the American Southwest made by coiling (Jane Kelley collection). Mineral temper inclusions are not suited to display orientation patterns, but coil lines clearly demonstrate the primary forming pressures.

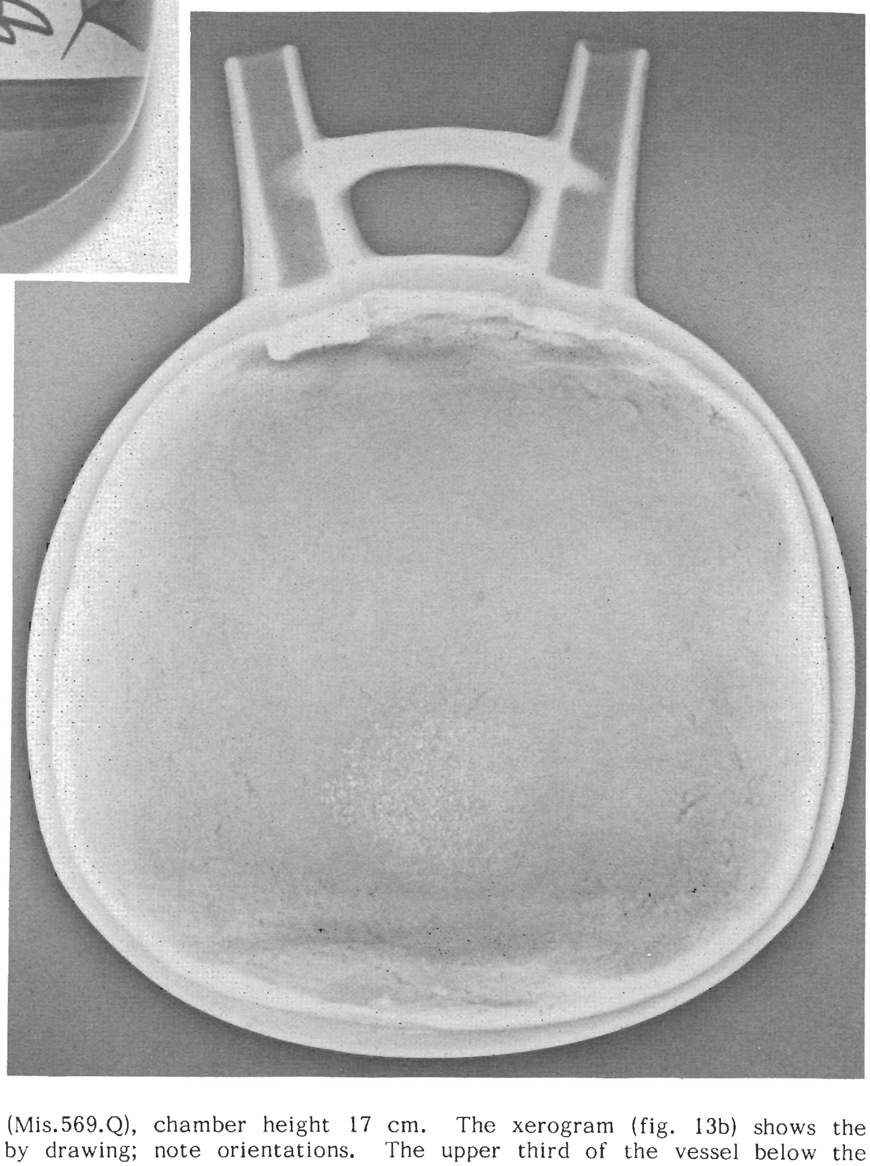
12a



12b

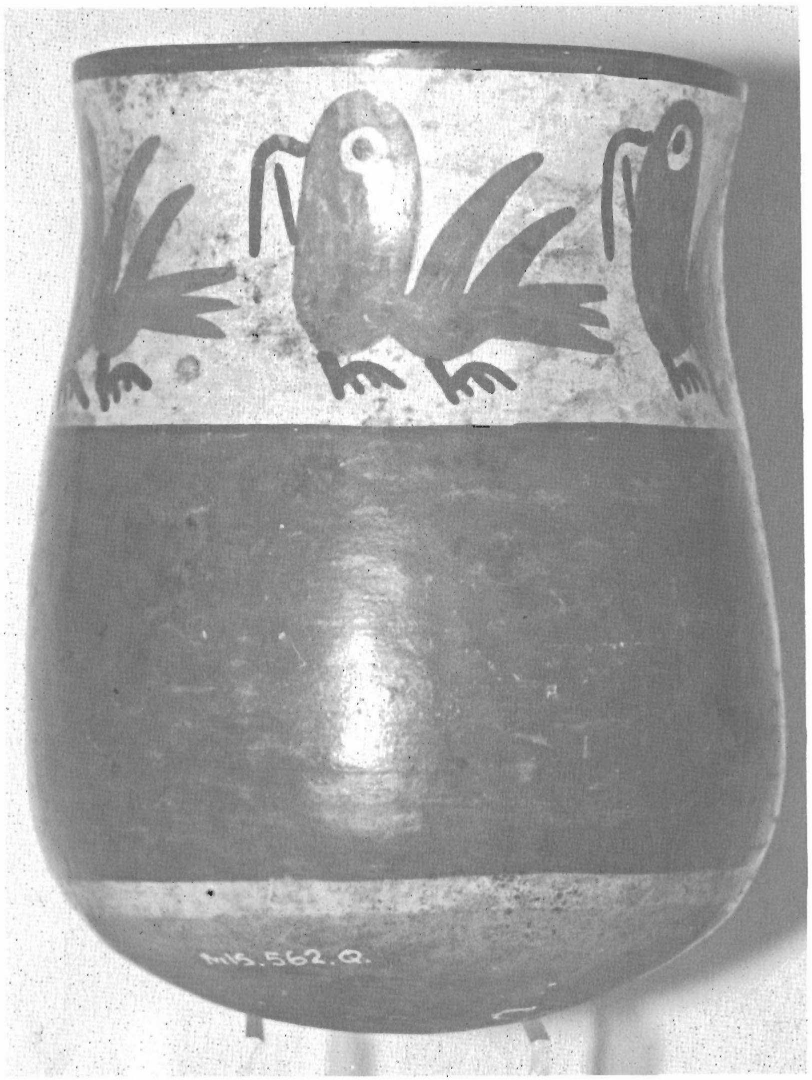
Fig. 12. Nasca 4 cup bowl (KC-3), height 9.5 cm. The xerogram (fig. 12b) shows the lower three-fourths of the vessel formed by drawing; note orientations and lower profile. Horizontal orientations below the lip and the thickened rim profile indicate a coil was added to finish the vessel.

13a

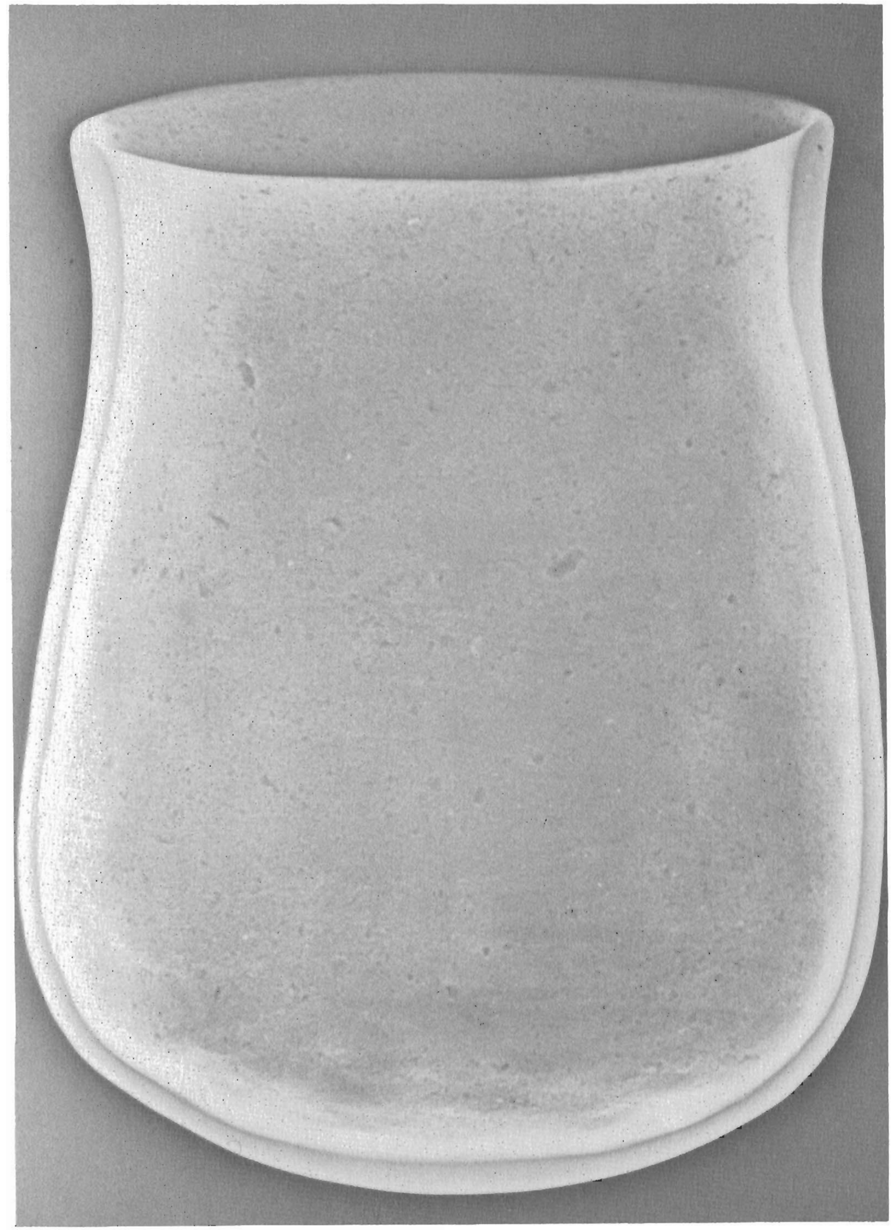


13b

Fig. 13. Nasca 3 double-spout bottle (Mis.569.Q), chamber height 17 cm. The xerogram (fig. 13b) shows the lower two-thirds of the vessel formed by drawing; note orientations. The upper third of the vessel below the shoulders was finished by coiling. The potter was probably unaware of the mass of mica particles seen in the lower centre of the X-ray.



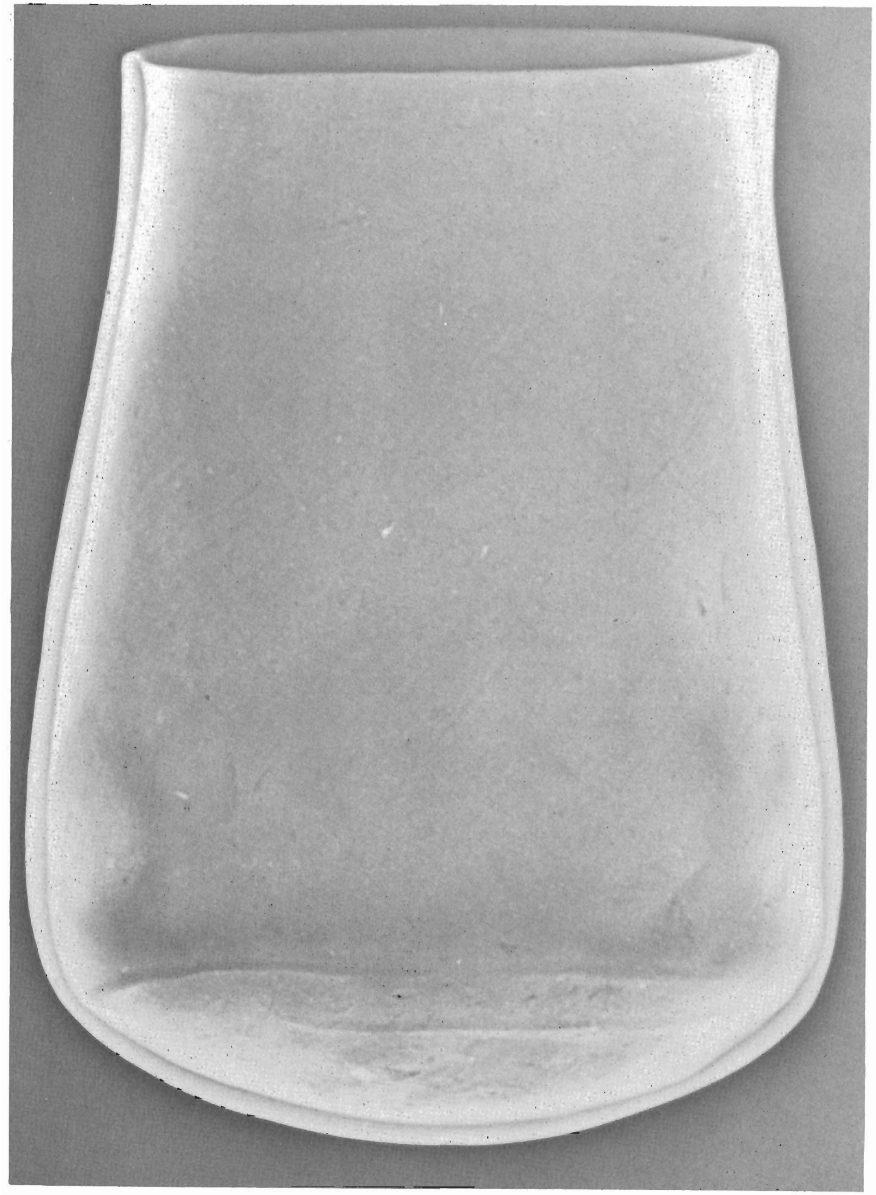
14a



14b

Fig. 14. Nasca 5 vase (Mis.562.Q), height 16.6 cm. The xerogram (fig. 14b) shows that this vessel was extensively paddled on all surfaces; note flattened voids and area of undulating wall thickness.

15a



15b

Fig. 15. Nasca 5 vase (Mis.563.Q), height 15.8 cm. The xerogram (fig. 15b) shows the lower 3/4 of the vessel was formed by drawing; note preferred orientations. Orientations and thickened rim suggest that this vessel was finished with a coil; central band of cross-hatched scoring may indicate point of ring addition. The darkened zone across the base is an area of heavy paddling; dark lines at the bottom denote incomplete fusion between base and walls. The base may have been made separately and allowed to dry partially before the walls were added.