Sequential Slab Construction; A Conservative Southwest Asiatic Ceramic Tradition, ca. 7000-3000 B.C.

Pamela Vandiver

Résumé
Afin de saisir les techniques de fabrication et de production de la poterie utilisées entre 7000 et 3000 avant J.-C, dans le Zagros, région montagneuse du Sud-Ouest asiatique, et afin de spécifier les modes de changement technologique, il fut procédé à l'examen macroscopique de 40 000 fragments et à l'analvse des microstructures de 4 000 tessons. Pour mieux évaluer tant la rapidité des changements technologiques observés que le rôle de certains facteurs contraignants (propriété des argiles, disponibilité des matières premières) et pour mieux apprécier l'importance à accorder aux phénomènes de transmission culturelle, il fut nécessaire de déterminer la structure des argiles, des dégraissants, puis d'entreprendre des simulations et d'analvser les résultats de celles-ci. Trouver et développer certaines normes qui puissent être comparées avec les structures observées dans les poteries anciennes devint une nécessité. Ces normes purent être établies grâce à des simulations faisant appel à certains types de matériaux et de procédés technologiques, à l'observation de leurs effets sur la structure de la poterie, à l'examen de poteries grossières provenant de deux milieux actuels (Cucume en Turquie du Sud-Est et Mehrgarh au Pakistan) et également à celui de la structure de poteries fabriquées avec des techniques utilisées par des artisans et artistes contemporains. Les sites d'où provient la poterie étudiée sont 1) Hajji Firuz, Dalma et Pisdeli tépés dans le nord du Zagros, 2) Ganj Dareh, 3) Sarab, 4) Seh Gabi dans le Zagros central, 5) Choga Sefid, Tepe Sabz, Tepe Farukhabad dans la steppe longeant le Zagros méridional, 6) Tepe Yahya sur le plateau iranien. Pour déterminer l'extension géographique des techniques observées dans le Zagros, de la poterie provenant d'autres sites d'époque néolithique et chalcolithique du Proche-Orient fut examinée : Hassuna, Samarra, Jéricho, Halaf Chagar Bazar ainsi que celle de sites localisés aux franges de la zone de culture proche-orientale tels que Merimde et Mostegedda en Egvpte, Mersin en Turquie du Sud-Est et Mehrgarh près du Bolan Pass au Pakistan.

Abstract
To reconstruct ceramic production technology in the Zagros region and to specify the pattern of technological change, the macrostructures of 40 000 and microstructures of 4 000 pottery sherds from six village farming sites were investigated. Standards were used to model pottery-making processes as well as raw material properties and variability. Sequential slab construction was found to be a conservative production technology for chaff- or vegetal- tempered wares made from an unplastic, composite mixture of clay, chaff and water. This tradition persevered through the production of fine wares wherein grit temper replaced chaff, and the clay body was aged to become fully plastic. A measure of just how conservative this tradition was can be found in its widespread use at 3000 B.C., and in two examples of modern practice even though the materials and working properties no longer constrained pottery to forming only by s.s.c. The role of other technologies in the development of pottery technology is discussed.

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Trouver et développer certaines normes qui puissent être comparées avec les structures observées dans les poteries anciennes devint une nécessité. Ces normes purent être établies grâce à des simulations faisant appel à certains types de matériaux et de procédés technologiques, à l'observation de leurs effets sur la structure de la poterie, à l'examen de poteries grossières provenant de deux milieux actuels (Cucume en Turquie du Sud-Est et Mehrgarh au Pakistan) et également à celui de la structure de poteries fabriquées avec des techniques utilisées par des artisans et artistes contemporains.

Les sites d'où provient la poterie étudiée sont 1) Hajji Firuz, Dalma et Pisdeli tépés dans le nord du Zagros, 2) Ganj Dareh, 3) Sarab, 4) Seh Gabi dans le Zagros central, 5) Choga Sefid, Tepe Sabz, Tepe Farukhabad dans la steppe longeant le Zagros méridional, 6) Tepe Yahya sur le plateau iranien.

Pour déterminer l'extension géographique des techniques observées dans le Zagros, de la poterie provenant d'autres sites d'époque néolithique et chalcolithique du Proche-Orient fut examinée : Hassuna, Samarra, Jéricho, Halaf, Chagar Bazar ainsi que celle de sites localisés aux franges de la zone de culture proche-orientale tels que Merimde et Mostegedda en Egypte, Mersin en Turquie du Sud-Est et Mehrgarh près du Bolan Pass au Pakistan.

INTRODUCTION

Along with the domestication of animals, cultivation of cereal crops and sedentism, pottery technology has been established as a characteristic of Near Eastern cultures in the Neolithic period and wheel forming as a trait associated with urbanism (1). The significance of pottery has long been recognized as a symbol of the level of cultural attainment, but no studies have sought to determine the details of the forming technology at one site or to devise a regional scheme of technological development and test its geographic limits. Well-fired pottery, because of its durable rocklike hardness, is preserved in great quantity, and thus more accessible to technological reconstruction than clay-based architecture which weathers, or metal artifacts which corrode so easily that few remain.

It is not possible to study the beginnings of pottery because of the problem of poor preservation of low-fired or unfired vessels. Given suitable burial conditions, low-fired pottery recrystallizes as clay. Some preliminary observations, however, can be made. Small amounts of poorly consolidated clay or ceramic vessel fragments dated between 7000 and 6400 B.C. have been found at several prepottery Neolithic sites. For instance, at Abu Hureyra about 42 sherds and one unfired whole bowl were found (2). At Ganj Dareh, Level D, P.E.L. Smith found a variety of functional types of fire-hardened ceramic, from large basins and storage jars to small

(1) CHILDE, 1951 : 175.

(2) MOORE, 1975 and pers. comm., Fall 1984.

vessels, of which there remain about 200 sherds (3). At about 6400 B.C. production of well-fired pottery was firmly established, based on an increase in the number of sites with pottery and the presence of large quantities of pottery (4). Thus, despite partial preservation and analytical difficulties, inference suggests the most probable generalized scenario for technological innovation of ceramics is one of a two step process in which forming developed first and independently of firing. A period of time when people did not choose or did not know how to make pottery was followed by a period when clay vessels were formed and sunbaked, without being consolidated by firing. This was followed by the emergence of pottery as a mature pyrotechnical craft.

The subject of this study is the development, not the innovation (5), of pottery in the Zagros region before the rise of urbanism. Pottery sherds number in the thousands from the early level at Sarab (6), and in the hundreds from basal levels at Seh Gabi (7), Hajji Firuz (8), Chagha Sefid (9), Tepe Yahya (10) and other sites (11). That these finds have common characteristics was first recognized by R.H. Dyson (12), who called them "the software horizon". The software pottery consists of vegetal- or chaff-tempered coarseware used for such utilitarian purposes as storing foodstuffs, cooking and other food preparation and serving (13).

The appearance of "software horizon" pottery, however, is similar to that of other early West Asiatic coarsewares. The purposes of this study were to identify whether an underlying technocomplex existed based on ecological constraints or cultural choice, and to determine the degree of similarity of pottery-making among sites as well as the temporal and spatial extent of such similarities. The sites chosen for this study are shown in figure 1. Some archaeologists have considered the development of village farming to be the result of bands occupying and in similar ways exploiting like ecological niches with a wide range of resources (14). Others have considered the development of farming to have

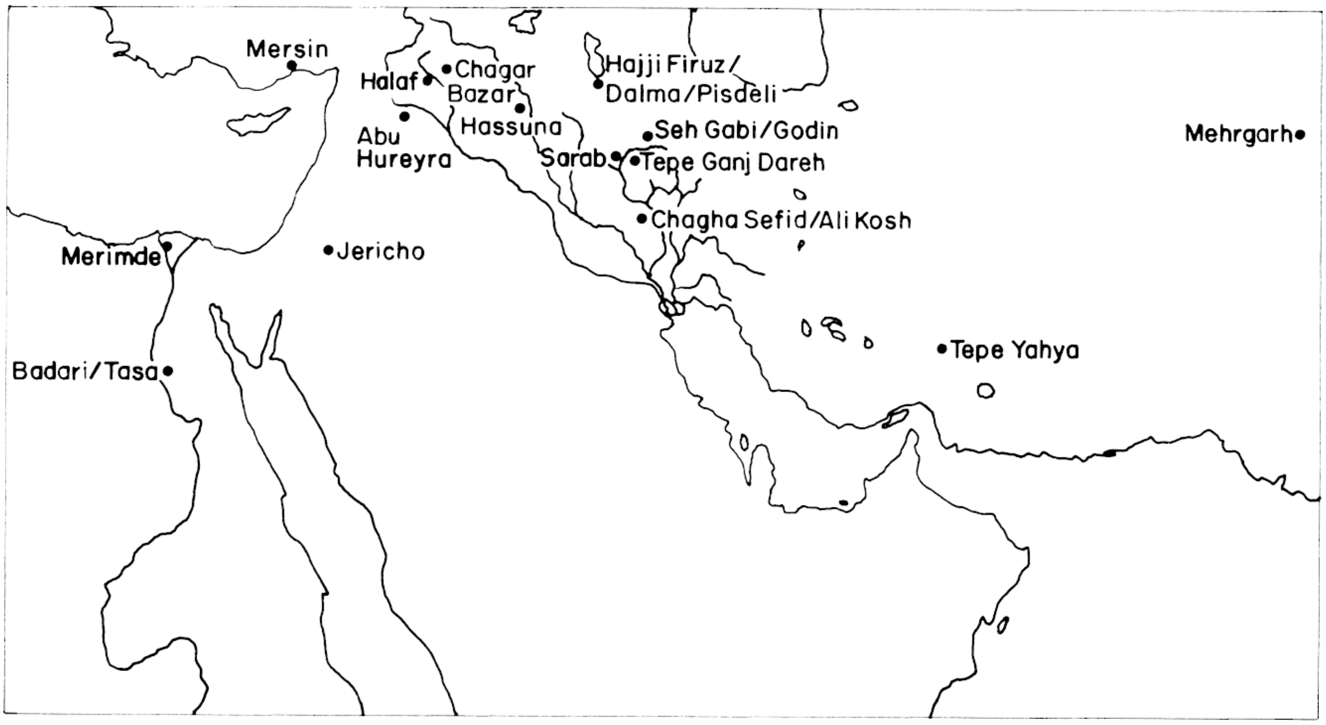


FIG. 1. — Map of near eastern pottery-producing sites included in this study.

(3) SMITH P.E.L., pers. comm., Spring 1985; SMITH P.E.L. and YOUNG, 1966; SMITH P.E.L., 1974, 1978, 1983; SMITH P.E.L. and CREPEAU, 1983; MEADE *et al.*, 1968; YELLON *et al.*, forthcoming.
(4) WATSON, 1965; MELLAART, 1970.
(5) WHITE, 1962; SMITH C.S., 1973.
(6) MACDONALD, 1979.
(7) YOUNG and LEVINE, 1974.
(8) VOIGT, 1976, 1983.
(9) HOLE *et al.*, 1969; HOLE, 1977.
(10) LAMBERG-KARLOVSKY, 1969-1972, 1970; BEALE, 1978; LAMBERG-KARLOVSKY and BEALE, 1986.
(11) BRAIDWOOD *et al.*, 1952.
(12) DYSON, 1965.
(13) HENRICKSON and MACDONALD, 1983.
(14) REDMAN, 1973.

moved to the Zagros from Anatolia and the Levant, combining with husbandry which developed separately in the Iranian highlands (15). If software horizon pottery was a complex and specialized technology with a particular configuration of traits from among many other possible ceramic technologies, then the argument that communication and contact were instrumental in the development of a settled, agricultural way of life is given support. From the degree of similarity of styles of ceramic technology, one may argue for a directional process of development and interaction (16) so long as sufficiently fine resolution in intersite dating can be achieved (17). The longevity of a pottery-making tradition can provide a baseline for the range and extent of cultural continuity and technological conservativism.

ANALYSIS OF OBSERVATIONS OF POTTERY STRUCTURE USING AN APPROACH BORROWED FROM MATERIALS SCIENCE

The present study began with a simple question, "How was early coarseware made ?" To answer this question involved establishing a typology based on technological criteria. The paradigmatic view of modern materials science is that the processing of raw materials in specified ways produces particular macrostructures and microstructures (18). These structures in turn result in new materials with such desired properties as superconductivity or high temperature performance. Cohen (19) refers to this fundamental concept as investigating structure-property-processing relationships (fig. 2). The materials scientist views this relationship from the point of view of developing properties; whereas the examiner of ancient objects has only the remaining structure to study. The processes of manufacture and properties which were desired in the final object must be determined. The methods of materials science can also be adapted, that is, the examination on increasingly finer levels of scale from macrostructure to microstructure the structure-property-processing relationships. For the archaeologist, processes are more than the methods and sequences of manufacture, organization of craft or the selection and use of raw materials. Processes are the ways people do their work, whether using technology tacitly or as a conscious decision-making process. Properties are

(15) HOLE, 1973.
(16) BINFORD, 1969; RENFREW, 1979; LAMBERG-KARLOVSKY, 1984; LECHTMAN, 1984; LECHTMAN and MERRILL, 1977, LECHTMAN and STEINBERG, 1979; CAVALLI-SFORZA and FELDMAN, 1981.
(17) DYSON, 1965; WATSON, 1965; HENRICKSON, 1985; LEVINE and MACDONALD, 1977.
(18) COHEN, 1978.
(19) *Ibid.*

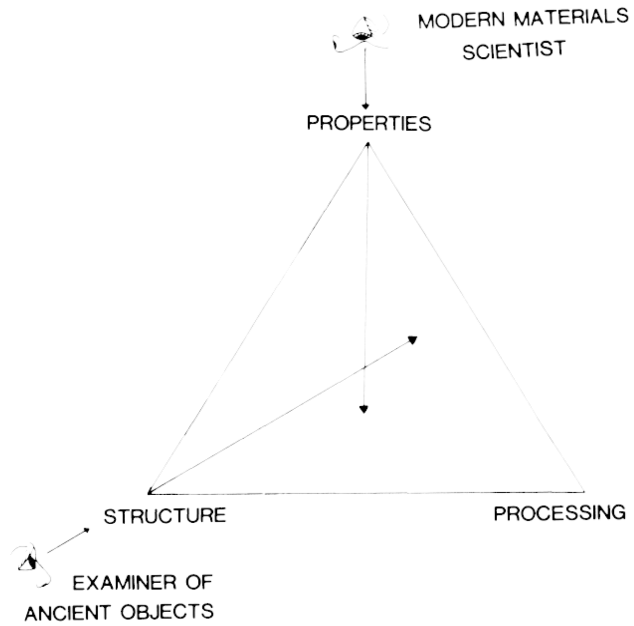
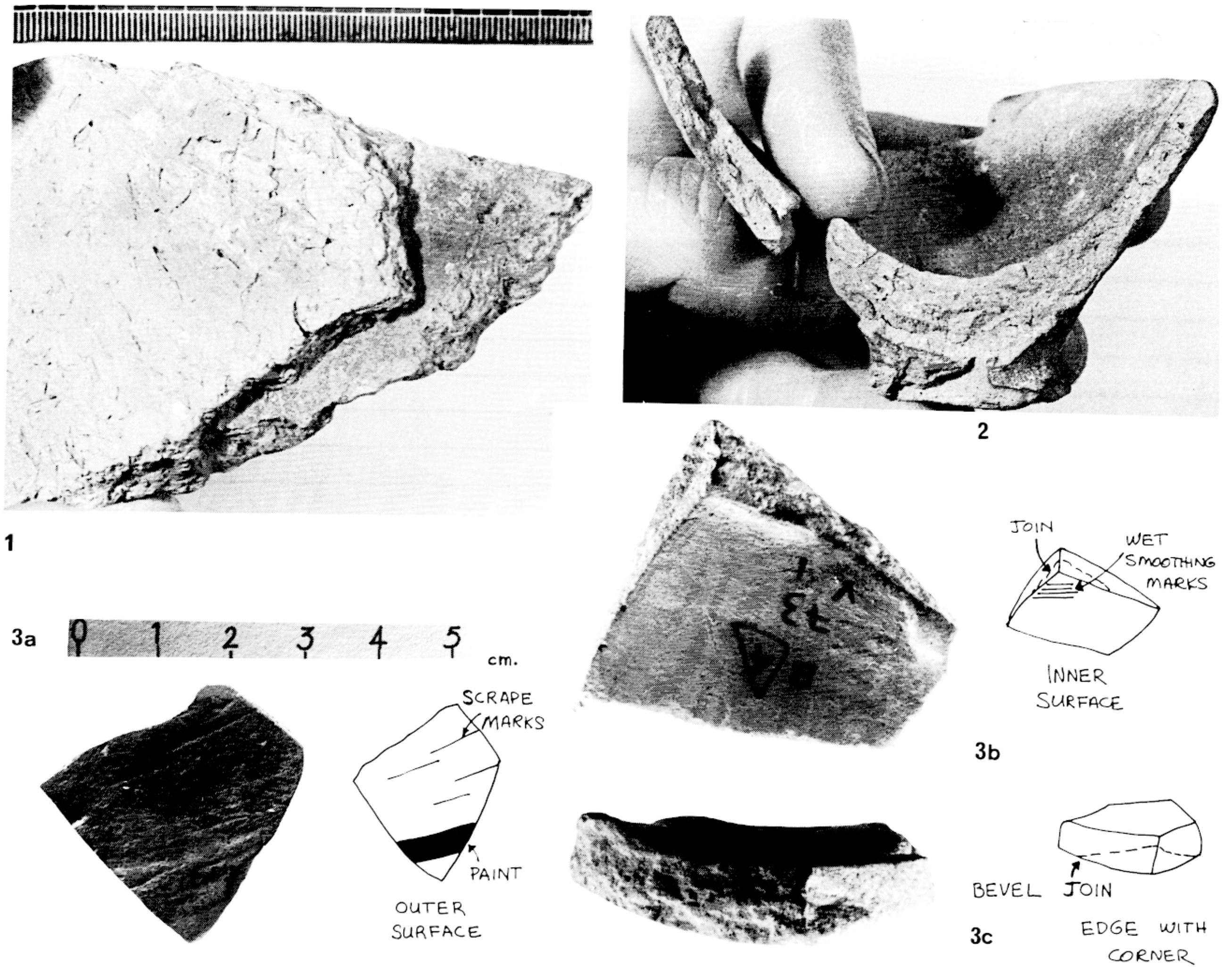


FIG. 2. — Two different points of view of the structure-properties-processing relationship.

measurable as the behavior and suitability of materials and objects for particular functions, but exist on another level as a kind of knowhow, as a knowledge of the way things work, whether the "thing" is natural, manmade or an interaction of both man and nature.

POROSITY AS A KEY TO ASSESSING STRUCTURE AND PROCESSING

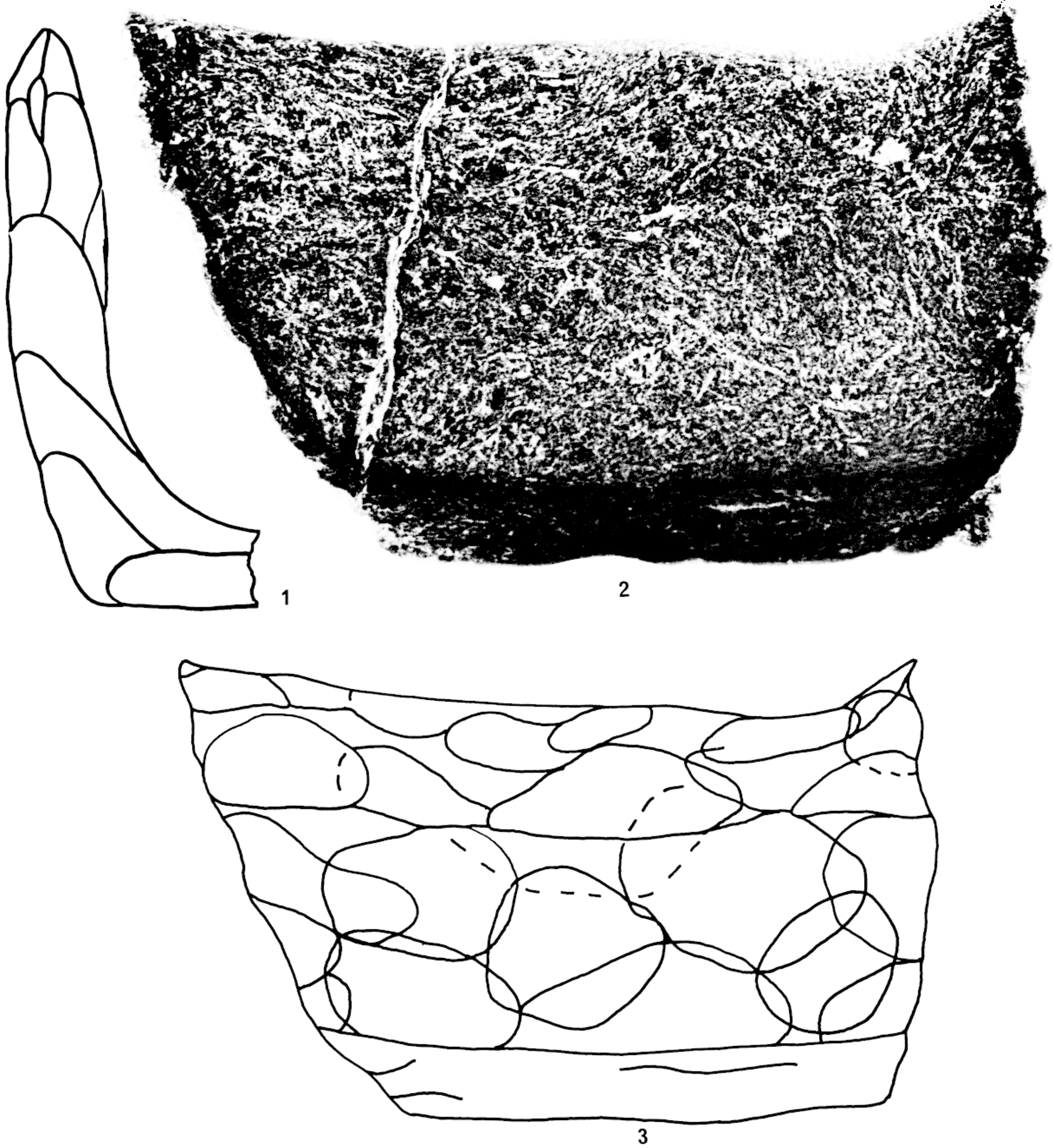
Plate I contains examples of sherds with a macrostructure typical of sequential slab construction. Step fractures on surfaces wrap around corners to the cross-section or edge of chaff-tempered coarseware from Tepe Yahya, showing the pressing together of two layers, each made from a different lump of clay (Pl. I : 1). In a fractured cross-section of a small bowl, several preformed slabs have been built up such that the base is thicker than the rim (Pl. I : 2). The foot is added, and two layers are present in the smaller wall fragment. The details of joints can be seen even in grit-tempered fine ware (Pl. I : 3) as the sherd is rotated from outer to inner surface. We are, in the sense used to describe modern literary criticism, "deconstructing" these sherds in painful detail to learn about particular examples of the forming as well as the tradition of forming. Criteria used to recognize joints are shown in figure 3. They include cracks and voids at joints, cracks and indentations on surfaces, stepped fractures, and the alignment of pores left by burned out



PL. I. — Photographs and drawings of vegetal tempered coarseware sherds from Tepe Yahya showing : 1 : a view of a basal sherd from a large jar (XC 8N'71, Per. VII) made of two layers, each of which has broken in a different place. When seen in profile, there is a step fracture; 2 : the cross section of a small bowl built over a convex mold with a double wall having the base reinforced and built of smaller slabs (c TT5(7), Per. VII); 3 : an exterior, side and interior view of a Tepe Yahya black-on-buff fine ware sherd (B(4)1973, Per. VI) showing a bevel join which continues around a corner from one edge to another.

vegetal material in coarse wares or the shape and alignment of pores in fine wares. The type of joint and extent of working of a joint can be determined by characterizing the porosity — the shape of pores and the amount of elongation. Finally, the shape and size of preformed elements, or slabs, can be detected using xeroradiography to look into the wall of a pot. A profile sherd of a Seh Gabi cookpot made by sequential slab construction is shown in Plate II. The light areas are pores from burned-out vegetal material and from porosity found at joints. The dark lumps are lithic inclusions. A double thickness was used in the base, with three layers at the left side of the base. A double wall was made near the base, and smaller-sized, more elongated slabs near the top. The wall was built in two sections, as shown by the uninterrupted line on third way from the rim. Time was allowed for partial drying in between working sessions so that the lower section of the body would not deform or buckle when more clay was added for the upper section. The break at the section join is more pronounced than those of other slabs because the join is mostly of a straight-across butt type and because the lower part had begun to dry and shrink, particularly at the upper edge where the greatest evaporation occurs, before the upper section was added, thus leaving a concentration of porosity. Using these techniques of optical microscopy of the surface and edge structure and xeroradiography of internal structure, the sequence of manufacture can be reconstructed.

These observations are based on isolation of porosity as the underlying structural characteristic indicative of variation in processing. Porosity decreases with increased forming pressure, and is inversely proportional to forming pressure :
Porosity = 1/(Forming Pressure)*, where the exponent X depends on the forming pressure. Thus, the



PL. II. — 1 : Drawing of a cross section showing microscopic observations of the slabs used to build the wall of this cook pot from Seh Gabi, N° '73 AA21 302. 2 : A xeroradiograph shows the spatial distribution of the slabs seen in cross section. The base was built in two and three layers, and the wall was built of overlapping rounded slabs, larger at the base than near the rim. The construction stopped about two-thirds of the way to the top for a period of partial drying before the top section was constructed. 3 : A drawing tries to illustrate these features.

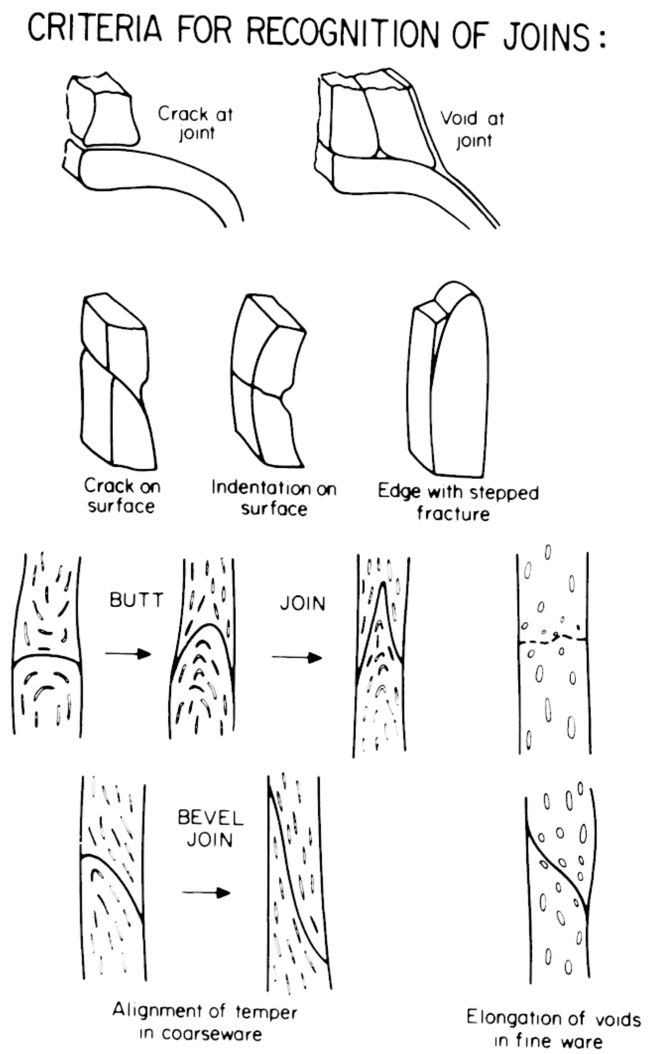


FIG. 3. — Criteria for the recognition of joins in coarse and fine ware pottery include surface features such as cracks and voids at joins, cracks and indentations on the surface, and stepped fractures where two elements have been joined together. Alignment of temper in coarse wares and rounding and elongation of voids in fine wares are indications of joins. The effect of working a join is the elongation of the join line and the extension of void patterns left by the burnout of organic temper.

FIG. 4. — A scale of the differences in relative porosity produced by different forming methods. Lower forming pressures result in greater porosity.

forming method can be related to an increasing amount of porosity as the forming pressure is decreased (fig. 4). Processing of modern ceramic materials by hot isostatic pressing produces a density of nearly 100 %, with slip casting, as of "closed forms" for dinnerware, occurring at a lesser forming pressure with products having greater porosity. The use of a potter's wheel in which a wall is raised by centrifugal force, as well as industrial processes such as jiggering and jollying of "open forms" (20) occur at a lesser forming pressure with considerably more porosity. The processes of modeling or hand forming and the construction of forms on a supporting device, such as a turntable or tournette, produce even more porosity with a lesser forming pressure, but the distribution varies with method. Clay and clay body type is the other variable controlling very fine scale porosity which must be characterized to determine processing method. The porosity produced by handforming of low-fired earthenwares is in the range of 10-15 %, even though for a pure, untempered montmorillonite clay shrinkage of 20 % is common (21), and swelling bentonites are observed to swell to five times their original dry volume. The average clay particle size of montmorillonites is submicron, implying that a large number of water films between particles must disappear during drying, causing greater shrinkage than a larger particle-size clay, such as a well formed illite or kaolinite. One potential problem in the application of this approach to higher fired stoneware and porcelain ceramics, however, is that structural changes during firing may change the amount and distribution of porosity. Porosity is a more reliable indicator of method of manufacture for low-fired earthenwares than for higher-fired wares because fewer changes in structure during firing occur at lower temperatures (22). As the temperature of firing is increased, the formation of glass during sintering causes pores to become round in shape and to decrease in size. Figure 5 shows that not only the amount of porosity but also the shape and alignment of pores is indicative of the type of forming and the details of the forming process (23). For example,

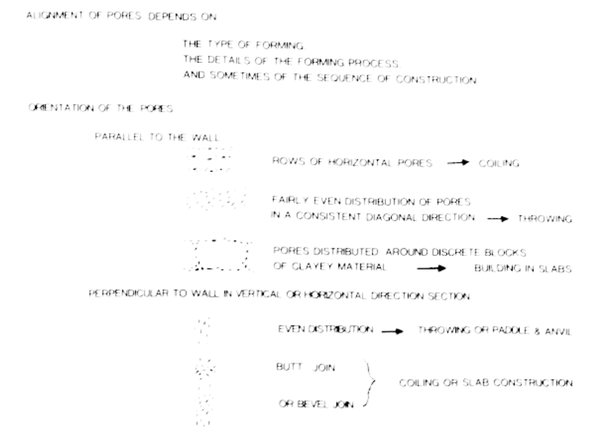


FIG. 5. — The distribution and alignment of pores vary with different shaping processes. Different patterns of alignment can be produced by one method in vertical and horizontal cross sections.

(20) KINGERY and VANDIVER, 1986 : 153, 243.

(21) SINGER and SINGER, 1963.
(22) KINGERY and VANDIVER, 1986.
(23) RYE, 1981.

when viewed from the surface evenly spaced horizontal rows of horizontally elongated pores parallel to the wall of the pot indicate coiling, whereas a fairly even distribution of pores elongated in a consistent diagonal direction indicates throwing, and pores with a random orientation distributed around discrete blocks of clay body are evidence of slab building. In cross section (24), coiling and slab joins are similar in appearance but not in distribution. Both cross sections of throwing and paddle and anvil methods produce pores elongated vertically. Standards for each of these processes were studied (25).

METHODS OF INVESTIGATION AND RESULTS

Preliminary investigation included application of a variety of analytical techniques which failed to characterize production technology because too small an area of sample could be studied, because extensive sample preparation limited the number of samples which could be examined or because the porosity of coarseware was too great (26). These unsuccessful techniques included dye penetrants, fluorescent dyes, thin section petrography, scanning electron microscopy, radiography, ultrasound and CAT scanning.

The techniques which were most useful included low power microscopy of surfaces in raking light (27), microscopy of fractured and polished cross-sections which established the presence of joins, and xeroradiography (28) which established the spatial extent of preformed elements. Macrostructural observations of the edge fractures of coarse wares have been made by Egami *et al.* and Scott (29) who have published drawings of sherd cross-sections which show breaks at intervals. Hole, Voigt and MacDonald have observed tongue-and-groove effects and joins in cross-sections as evidence of handforming (30). This author observed and drew ultrasonically cleaned and scrubbed cross-sections of sherds which not only showed the same shapes and pattern of joins, but also could be used to reconstruct the sequence and pattern of pottery manufacture. The limit of resolution of most unaided eyes is about 0.1 mm. Examination of porosity and other structural features at higher magnification was necessary.

(24) VANDIVER, 1985.

(25) VANDIVER, 1982, 1985, 1988; VANDIVER and KOEHLER, 1986; VANDIVER and LACOVARA, 1985-1986; KINGERY and VANDIVER, 1986.

(26) VANDIVER, 1985.

(27) PYE, 1968; SHEPARD, 1954; REDMAN, 1973; SEMENOV, 1964.

(28) ALEXANDER and JOHNSON, 1982; GLANZMAN, 1983; FOSTER, 1983.

(29) EGAMI *et al.*, 1962, 1977; SCOTT, 1967.

(30) HOLE, 1977; HOLE *et al.*, 1969; VOIGT, 1976; MACDONALD, 1979.

Using a hand lens (Bausch and Lomb Coddington 10x magnifier) and binocular zoom microscope (Bausch and Lomb Stereozoom 7-280X), a sample of 40,000 sherds were examined. Of these, 4,000 sherds and whole vessels were drawn, and the type of join and size of preformed construction element measured. Sampling statistics for each site are found in Appendix I. After several hundred cross-sectional drawings were made, five types of joins were isolated (schematized in figure 6 : butt, bevel, and three

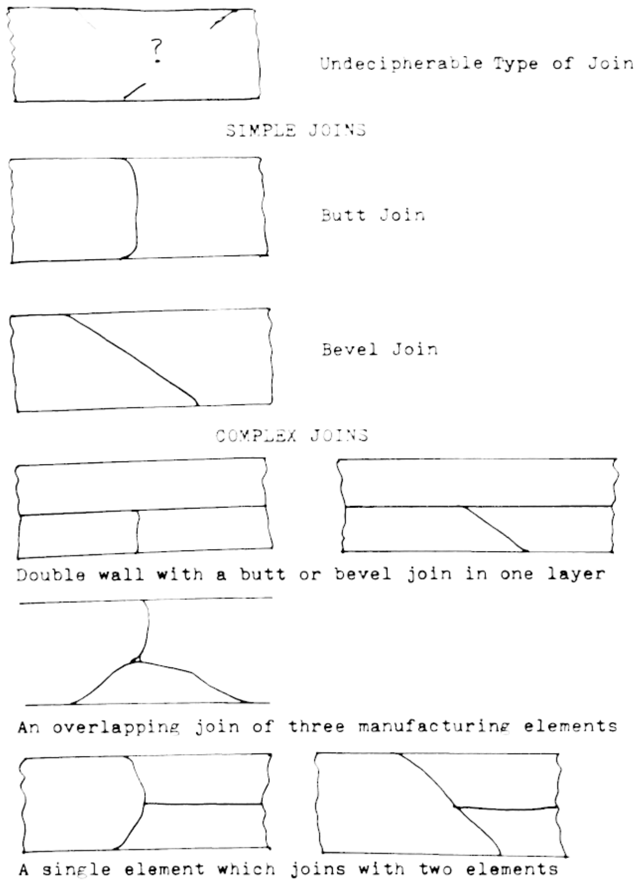


FIG. 6. — Types of joins found in near eastern Pottery which has been constructed from coils, strips, slabs and lumps.

more complex types, two layers joining to one, two layers with a join in only one layer, and a join with a reinforcing strip or the beginning of another slab. Three-or-more-layered cross-sections were simplified to two layers. Unfortunalately, I did not record which of the complex joins had butt and which had bevel joins; in further work this distinction should be recorded. In order to reconstruct the sequence of manufacture, the types of joins were grouped according to the part of the pot in which they were found (fig. 7). Complex joins are more common in bases. Collection and preservation bias is evident, however, because the sample size of bases is smaller than of walls, with rims being the most common, except where decoration occurs on the walls. The size of

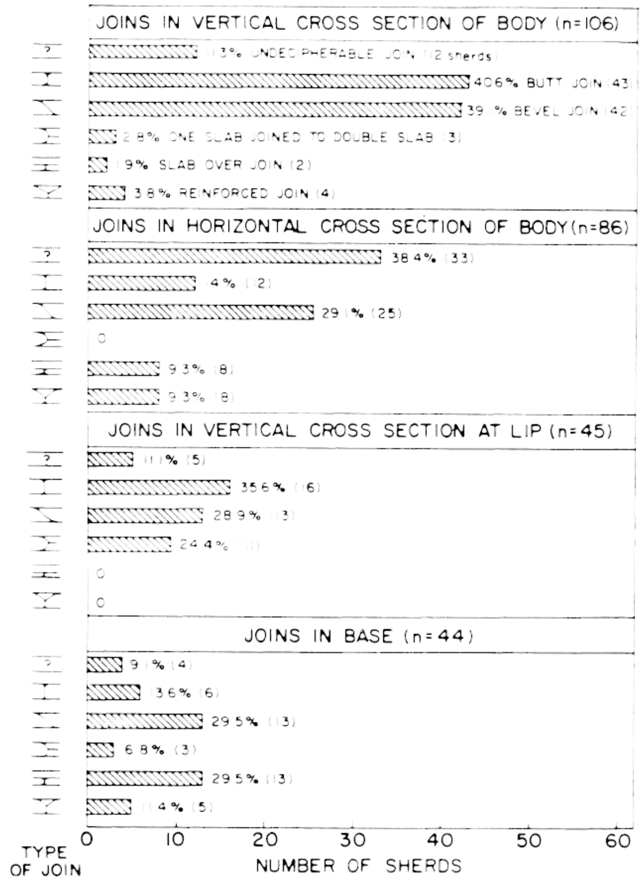


FIG. 7. — **Frequency and type of join vary depending on the part of the pot in 195 sherds from Hajji Firuz each over 50 mm in length from Operation V (1961), phases F2-L, the early phases (n is the number of sherds examined). Butt and bevel joins are equally common in the vertical cross section, but in the horizontal section joins are harder to find and bevel joins predominate. At the rim simple joins are common; whereas the greatest number of complex joins occur in the base.**

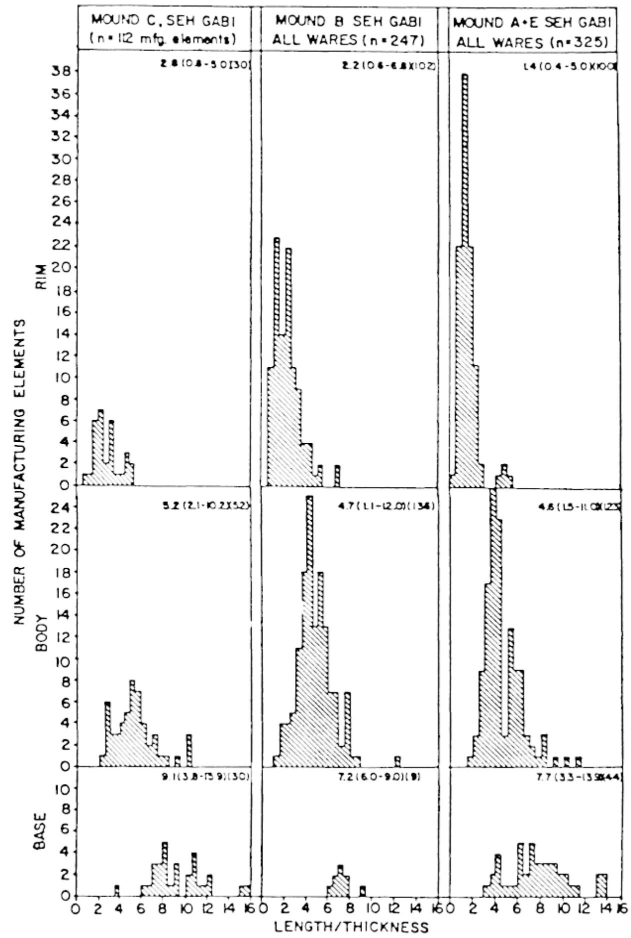


FIG. 8. — **Relative size of slabs used in the rims, bodies and bases of wares from Seh Gabi in the Shahnabad (Mound C), Dalma and Seh Gabi (Mound B), and later Periods VI and VII (Mounds A and E). Each plot shows the ratio of the length to the thickness of slabs versus the number found. In the upper right of each plot is given the average ratio, the range and the number of slabs measured. The rim has a smaller ratio than the body and both are smaller than the bases, which are much fewer in number.**

individual preformed manufacturing elements was measured for four parts of pottery : at the rim, base and for horizontal and vertical planes in the body. Relative size is plotted in histograms as the ratio of the length or thickness versus the number of complete elements discovered (fig. 8). This ratio was used in order to be able to compare different sizes of pottery. Larger elements were consistently used for the bases than for the walls, and the smallest elements were used at the rims. There is one exception to this pattern, where at Ganj Dareh elements stayed in the same proportions from the bottom to the top of pots. At Ganj Dareh unusually good preservation is coupled with three separate sorts of ceramic forming technology, each using a different clay resource and being used for a different functional type of pottery (31). Thus, near the beginnings of this technology is found considerable diversity in technology. Once a pattern for that technology is established, it is applied to similar problems such as various functional types of ceramics. The shape of slabs was isolated using two methods, examination of surface texture in raking light using a 10x magnifier and xeroradiography of about 400 sherds and pots. For forty sherds cross-sections sliced like bread were xeroradiographed and drawn to determine the size, shape and juxtaposition of slabs (Pl. II-VII).

Samples of clay probably appropriate for pottery-making had been collected from most sites by archaeologists. These were used to test the range of composition as well as working, drying and firing properties (Appendix IIA and B). By visual and tactile inspection, these samples appeared highly likely candidates for pottery clays (Appendix IIB). To test the variability of clayey resources used by ancient people at each site, small samples were taken from unfired clay objects, such as sling balls, clay discs, jar sealings and architectural fragments. These clays were tested for variation in clay type (determi-

(31) VANDIVER, 1985.

ned by differential thermal analysis and x-ray diffraction), particle size of clay (scanning electron microscopy), composition (emission spectroscopy and energy disperse x-ray analysis) and forming and firing properties (determined by plasticity and firing tests). Samples of software horizon pottery were run for comparison, two examples of which are shown in Appendix IIA. The clay type was consistently montmorillonite or in one case an extremely fine, tenth micron particle-size illite, which is indistinguishable from montmorillonite. Calcia was the major compositional variable. If present in sufficient amount (25-30 % or more), it prevents samples from firing to rocklike hardness, even though the raw material was fine and worked like a clay. In other words, raw materials which looked like and acted like plastic clays and which were used for unfired bricks, jar sealings and sling balls needed to be empirically tested to find out if they were suitable clays for fired pottery. Thus, making pottery required a specialized knowledge and a special skill in the selection of suitable pottery clays. This specialized knowledge does not require a social organization with part time specialists, socalled craft specialists, but it does require cultural transmission of hands-on experimental type as well as of an evaluative or judgmental set of criteria. Choice of raw material involved empirical tests and analogical reasoning from the properties of one earthy type to another. This specialized knowledge involved cognitive differentiation within neolithic cultures, in which some people knew how to assess the various uses to which various earthy resources could be applied, be they plaster- or clay-based or made from some combination of the two. Such cognitive differentiation suggests, but does not require, craft specialists.

The variability of earthy raw materials found in these tests (Appendix II) accords well with that observed in the field. Near the tells in this study, clays and silts from both recent alluvial and ancient seabed sediments have variable lime and alkali content, and occur in lens-shaped deposits or layers a few meters to a kilometer across, implying considerable variability in resources on a local scale. This is contrary to a commonly held view that suitable pottery clays are ubiquitous at Near Eastern archaeological sites.

In order to determine the manufacturing methods and to establish a technological typology for each site, standards were established both for materials and processes (32) Replications of surface textures, internal structures and whole objects were made using local clays, mostly from Tepe Yahya, and analyzed in the same way as ancient sherds and pottery, according to the criteria established in Appendix III. The analyses of replications served as standards to identify methods of construction. It was critical to know the working, drying and firing properties of clays in order to understand some of the problems of manufacture and some of the decisions of potters working within the constraints of their raw materials. Modeling of only certain processes was sufficient (33) when coupled with expectations based on knowledge of some science and technology of ceramics (34). Full scale replication of all aspects of village pottery-making was unnecessary. The same methods were used by Binford in the study of processed bones (35). In effect, methods are applied to reconstruct technology with the intent of understanding the critical technology in a way that is similar to the experience of ancient people. This is different than projecting a modern mental set of how pottery technology was practiced or sacrificing the rich fabric of detail to an imposed and simplified model (36).

Examples of clays from each site were analyzed by x-ray diffraction and differential thermal analysis and were identified as montmorillonites (Appendix II). The chaff temper varies within sites far more than from one site to the next. From 5-25 vol% of pores can be attributed to burned out vegetal material. This vegetal material measures from 0.2-20 mm in length and 0.1-5 mm. in width. A variety of different morphologies of grasses or straw, chaff and other vegetal material was used to reinforce the clay. The most common characteristics of the pores are the blunt ends which imply cutting to size and the intact longitudinal striations of the vegetal material.

One interesting result of this study involved the microscopic characterization of dung from various animals. The residual voids left by burned out organic material allowed comparison with the morphologies of various tempering materials suggested as additives to coarsewares, such as wheat chaff, cut grass, dried grass and straw, sheep and goat dung, cow and donkey dung. In dung from ruminants, the masticated fibers are broken, twisted or splayed, and the ends are uneven and frayed. In contrast to this, the impressions left by burned out temper in pottery show the imprint of fibers which were parallel within individual bladelet segments, and the ends tend to be straight across. The size range of fibers in sheep and goat dung is too narrow and on the small side of the distribution of sizes found in coarsewares (37). Thus, dung was not added as temper to early coarsewares.

(32) For details, see VANDIVER, 1985.

(33) MATSON, 1965.

(34) KINGERY, 1982.

(35) BINFORD, 1981 and later evaluated by BINFORD, 1982, and BINFORD and SABLOFF, 1982.

(36) RICHTER, 1923; NOBLE, 1965; FRANKEN and KALSBEEK, 1975.

(37) VANDIVER, 1985.

AN EXAMPLE OF SEQUENTIAL SLAB CONSTRUCTION AS AN OPTIMAL, BUT CONSERVATIVE TECHNOLOGY

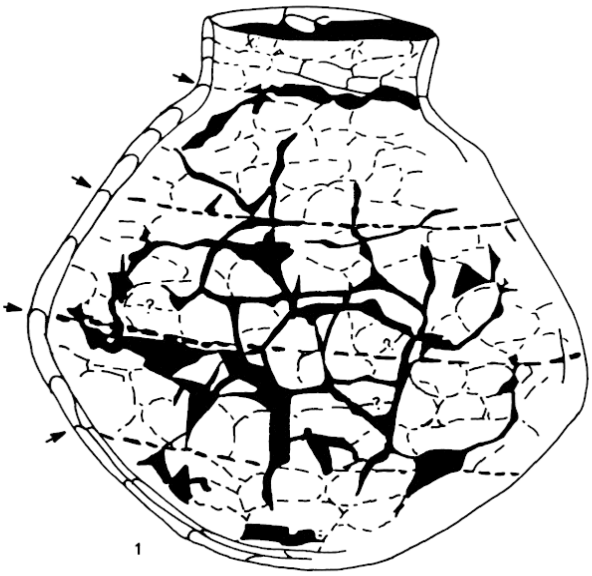
Sequential slab construction is building of vessels by stacking slabs on top of one another in particular ways, as illustrated by examining a storage jar from Hajji Firuz (Pl. III : 1). These slabs are larger at the base of the pot than in the body (Pl. III : 2). Smaller ones are used for the body, and even smaller elements at the rim of a vessel, but the sizes represent a continuum and are not discrete for different parts of a pot. These slabs are combined in double and even triple wall thicknesses, particularly at or near the base of vessels. Slabs are made as preformed elements of nonuniform shape and joined in butt, bevel and complex joins of three or more elements. These joins have been counted and measured in fractured and polished sections at the rim and base as well as horizontal and vertical sections of the body. The ratio of height to thickness for elements used to construct rims is about 1-4 (1-2, or even 3, would be expected for coils, so this number is quite similar). Three to eight is common and is found in walls, and 5-10 for bases (fig. 8).

In examining the surface texture of this vessel, the size of lumps used to make the pot can be seen and felt in the undulations of the surface which for the wall are often about the size of the palm of a hand, an easy size of slab to work. This jar is fragile and could not be taken apart to determine the types of joins, so they have been schematized as butt joins. For the other Hajji Firuz pottery studied, butt joins occur most frequently in vertical walls at section joins where vessels were allowed to partially set up prior to continuation of the building process; in other words, these butt joins occur where no more clay could be supported without plastic deformation of the wall beneath. The section join in the midline of this jar can be seen in raking light. Smaller elements used in the neck can be seen (Pl. IV : 1) as well as very fine, parallel-grooved wipe marks remaining on the surface (Pl. IV : 2) and the pores left by vegetal temper. The surfaces were finished by wiping, by application of a slip coating, sometimes up to 3 mm thick, and usually by burnishing of surface as for example (Pl. IV : 2) in a variety of diagonal directions. Many of the surfaces, particularly interior ones, are now pitted, weathered and worn, and it is impossible to determine their original condition. Of those surfaces with intact decoration or marks from forming and finishing, such as fingerprints or impressions, a slip is always present, and usually there is evidence of burnishing or wiping, or both. The final working of the wall by painting or wiping over it with slip, and smoothing and burnishing the surface is a common characteristic of coarseware.

One result was that round-bottomed shapes with flaring sides were made in molds, and can be recognized using criteria set forth in Appendix III. Large slabs used for bases were resting either on a flat or curved surface, such as a basket or hollow in the ground. At Hajji Firuz about twenty sherds with negative basket impressions in the base have delaminated from an outer surface layer which has a positive but less distinct basket impression. At Mehrgarh, J.-F. Jarrige has reported about five similar sherds, in addition to some with basket straw still embedded in the wall. This impression appears to have been only in the base and lower wall. The wall was built up to just beyond the base, often after a period of partial drying, the wall was constructed with smaller elements, often having the lower part of the wall being doubled in thickness. To build a larger pot required more sections. The storage pot from Hajji Firuz was built in five sections (Pl. V). Lastly, the rim was formed and leveled with small bits of clay. In these early wares, a conception of pottery making very different from our own seems to be defining the form; the rim form is not the same shape all around, and pottery is not symmetrical, or even round.

No evidence of paddle and anvil or coil construction was found. Sequential slab construction is a very different technology from coil construction. Athough short coils are occasionally found as reinforcements at joins, attached to the base as a ring-coiled foot or, in one instance from Dalma, the rim. To confirm that coils were not used, a sherd from a large painted jar was first radiographed, then sliced. The slices were xeroradiographed once more so that the edge image could be compared with the surface image of the spatial distribution of preformed elements. Another example of sequential slab construction (Pl. VIII) is shown of a fragment of the large pot B from Ganj Dareh which was made in essentially the same way as the small, delicate bowl from level SI-2 at Sarab (Pl. VI : 2), one of many which are similar in size, shape and technology. In Plate VII are two examples of so-called "fine wares", although they both contain chaff. One is a black-on-buff sherd (SG71 610-6) from Seh Gabi with an unusual glossy glaze. The section join is present near the middle of the cross section. The porosity at the joins is clearly visible and shows that sequential slab construction was used. In the other example from Tell Halaf, there is almost no chaff, but the slab joins are still visible.

Another source of support for the commonality of the method of sequential slab construction is provided by two ethnographic examples of this method. One was first recognized by M. Voigt. In preparing a lecture D[r] Voigt re-examined slides thought to be a modern example of coiling only to discover that sequential slab construction was the method being used. The potter, Mrs. Boztepe of Çumçume near the Euphrates River in southeastern Turkey, was building several large storage vessels from strips and slabs, carefully working over the surface. Interviews were conducted with three observers. The clay body



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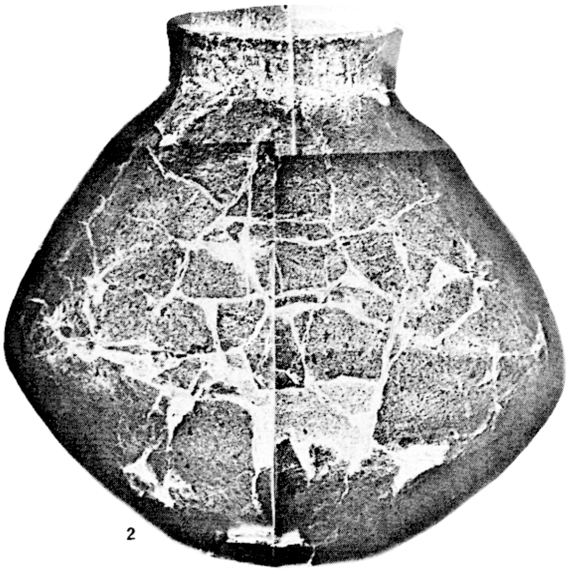

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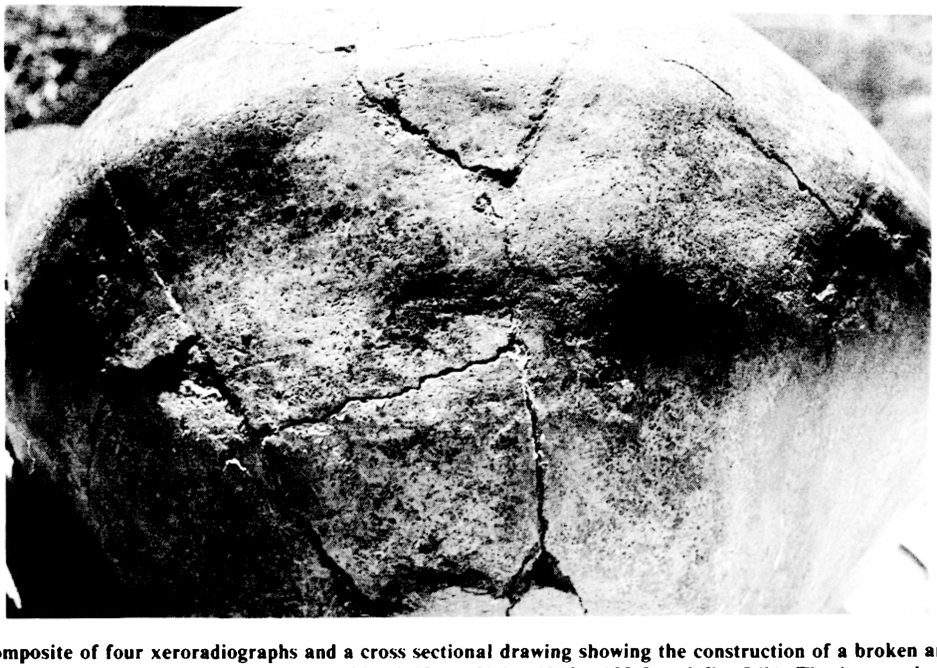

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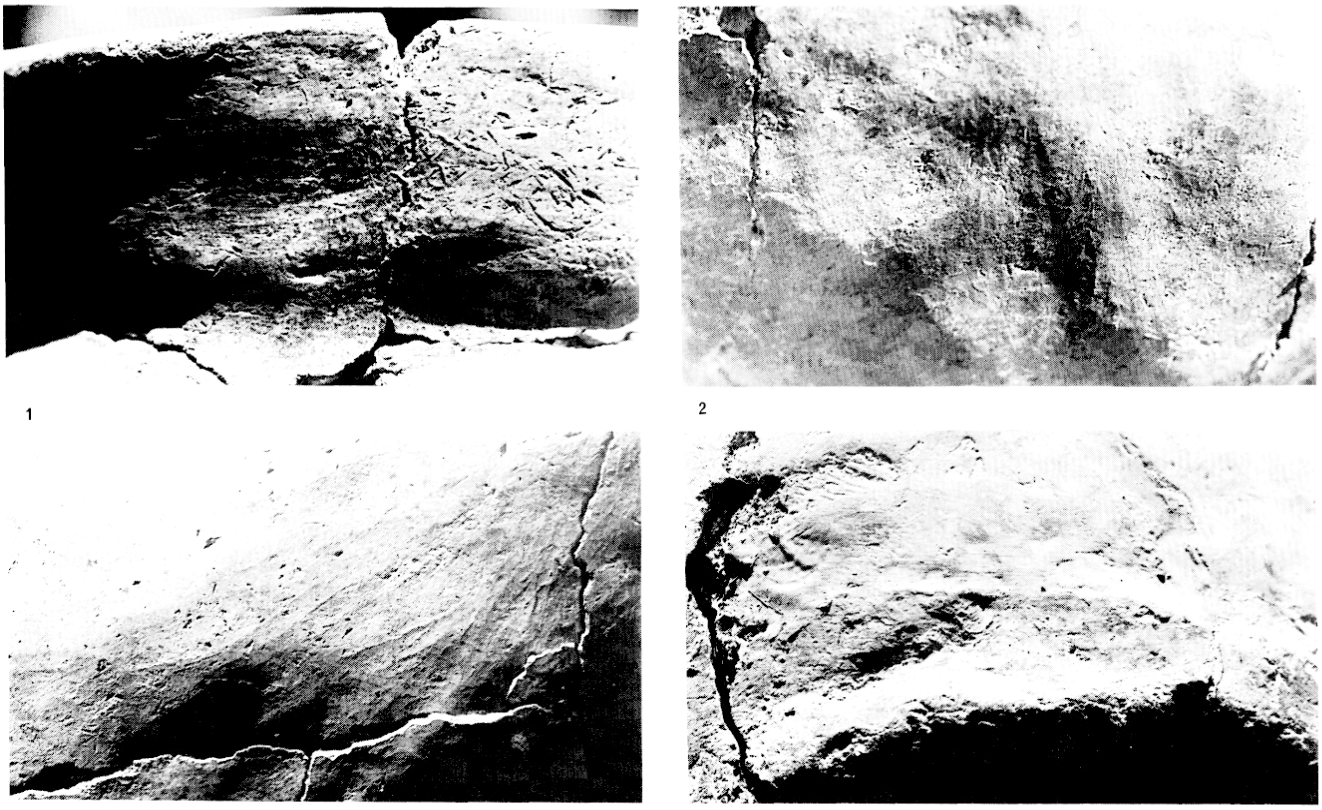
PL. III. — 1, 2 : A composite of four xeroradiographs and a cross sectional drawing showing the construction of a broken and mended storage jar from Hajji Firuz (University of Pennsylvania Museum № 69-12-15, Voigt 1983 : 132-2 and fig. 86b). The jar was built of slabs in five sections. The base was probably formed in a mold. 3, 4 : The collared jar from Hajji Firuz is asymmetrical, the walls are uneven in cross section and the surface texture is lumpy. These lumps seen in raking light correspond to the slabs seen in the xeroradiographs and the line just in the middle of the jar is a section join.



1 2 3 4

PL. IV. — The surface texture in raking light shows 1 : small elements used to construct the rim and the circumferential but irregular wiping of the neck and rim; 2 : wiping and smoothing of the surface in two directions at right angles to one another; 3 : burnishing and working of the surface slip layer in a somewhat diagonal direction and; 4 : wiping of the lower surface near the foot where the foot has thickened and buckled during forming from the weight of the upper wall.

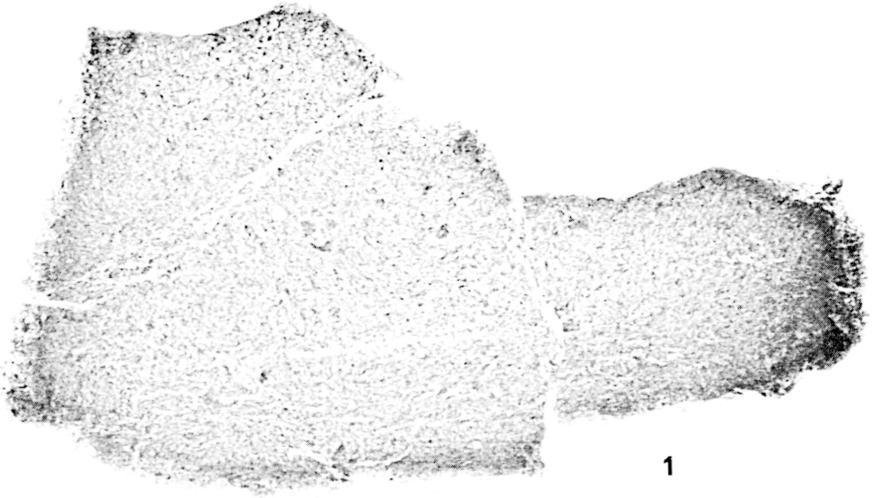
was a mixture of ground clay, cut straw and water. One of these pots was preserved and has been examined and xeroradiographed (38). The other example, from Mehrgarh, is documented by C. Jarrige, who recognized the same method being used for large unfired storage vessels measuring almost two meters in height. Even though this method of construction seems at first very unlikely, the essential features of it are being used by some modern art potters, such as Rudolf Staffel in making a porcelain bowl (Pl. VIII : 3).

EXTENT OF TECHNOLOGY

Geographically sequential slab construction has been shown to be the pottery technology practiced in the central Zagros region, and it extends as far east as the Iranian plateau. This conclusion is based on a large sampling of ware types and form classes from well excavated sites having large quantities of pottery with good context and dating as well as long sequences. From a survey of smaller amounts of pottery (39), sequential slab construction was found in all sherds examined from as far east as Mehrgarh in Pakistan (40), and as far west as the Badarian/Tasian and Delta pottery of Egypt (41), a distance spanning some 4000 km. The same method was used for coarse- and finewares at Mersin in the neolithic and chalcolithic periods (42), even though many of these are grit tempered at an early time. Wares from Jericho, Hassuna and Samarra cannot be differentiated by technology from Zagros region wares, and in fact there are instances where sherds could be substituted one for another without anyone recognizing the trade.

(38) VANDIVER, 1985 : 131.

(39) VANDIVER, 1985 and forthcoming.
(40) JARRIGE, 1985; JARRIGE and MEADOW, forthcoming.
(41) BRUNTON, 1937; JUNKER, 1929-1940.
(42) GOLDMAN, 1952-1963.



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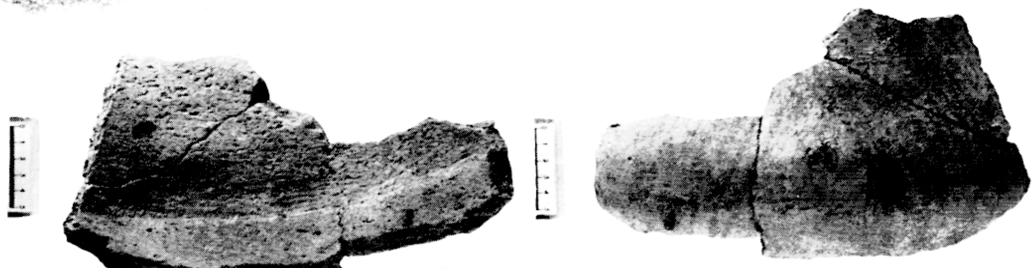

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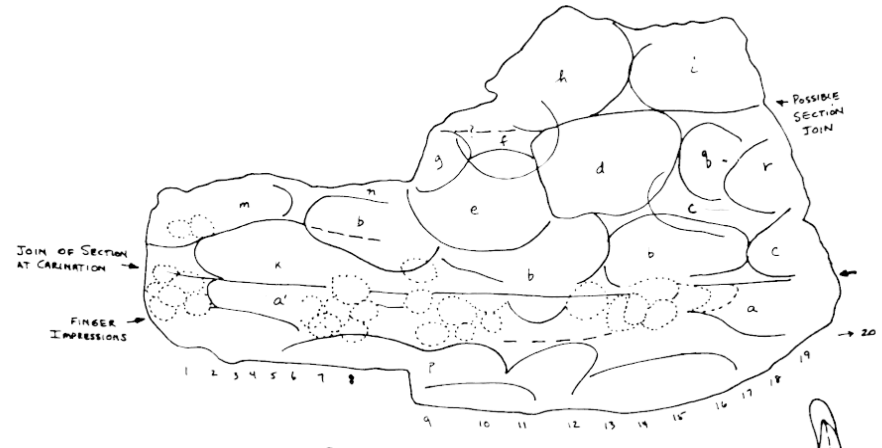

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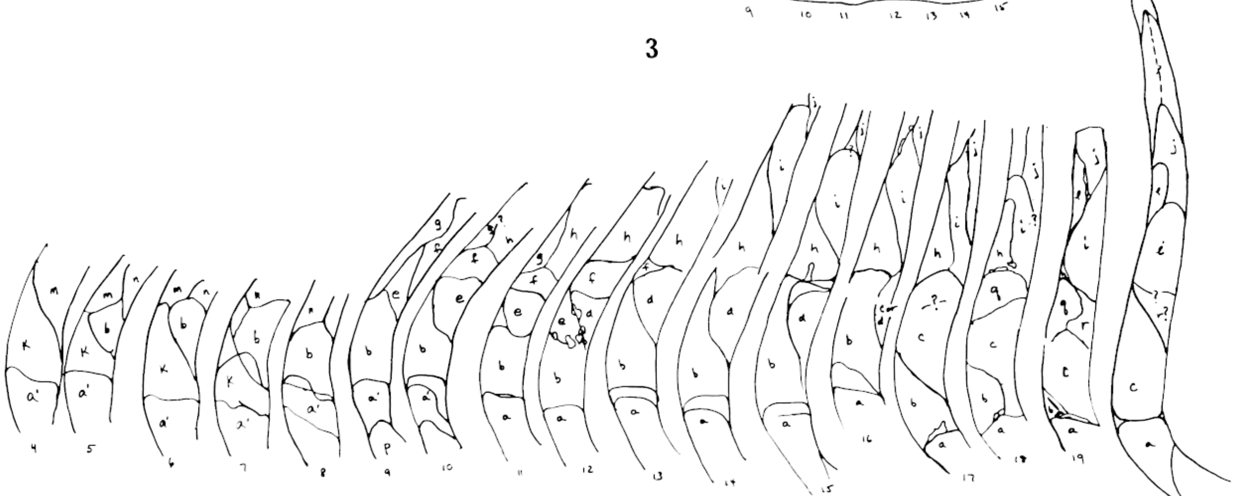

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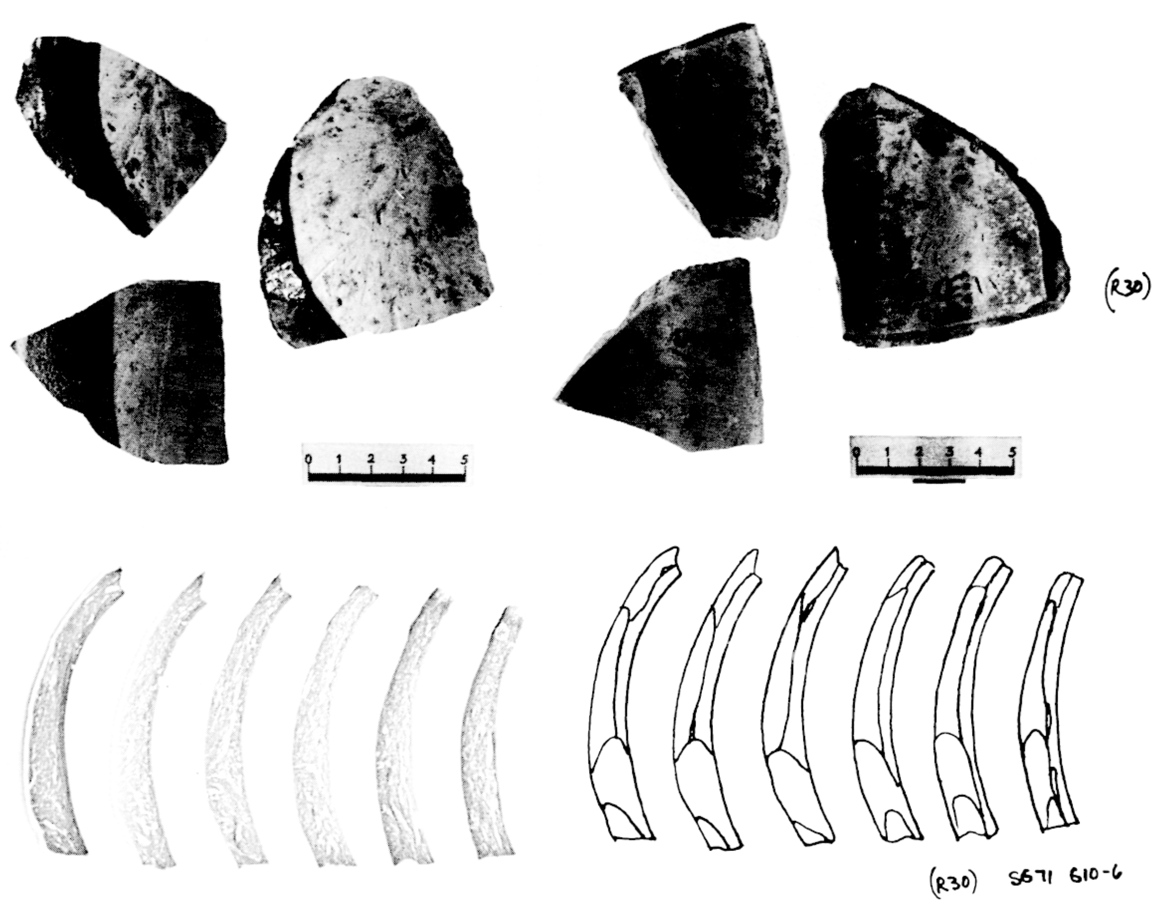
PL. V. — 1 : xeroradiograph and 2 : Photographs of a fragment fo a large vessel from Hajji Firuz. The xeroradiograph shows the section joins, the slabs and the inside surface texture of finger impressions at joins which are drawn in dotted circles. 3,4 : This sherd was sliced into 20 sections like bread, each of which radiographed and the radiographs were drawn, with each slab being given a letter, so that the spatial distribution of the slabs could be tracked through the vessel wall.

PL. VI. — 1 : Xeroradiograph and drawing of fragment from large storage jar from level D at Ganj Dareh (GD69 463 31018, pot B) showing slabs used in wall construction. 2 : Photograph of the interior of a bowl profile from Sarab (Level SI-2, R6a) with scale shown in centimeters. The radiograph shows major porosity to be concentrated at joints in the wall. Sections made from this delicate sherd show the progression of slabs through the wall.



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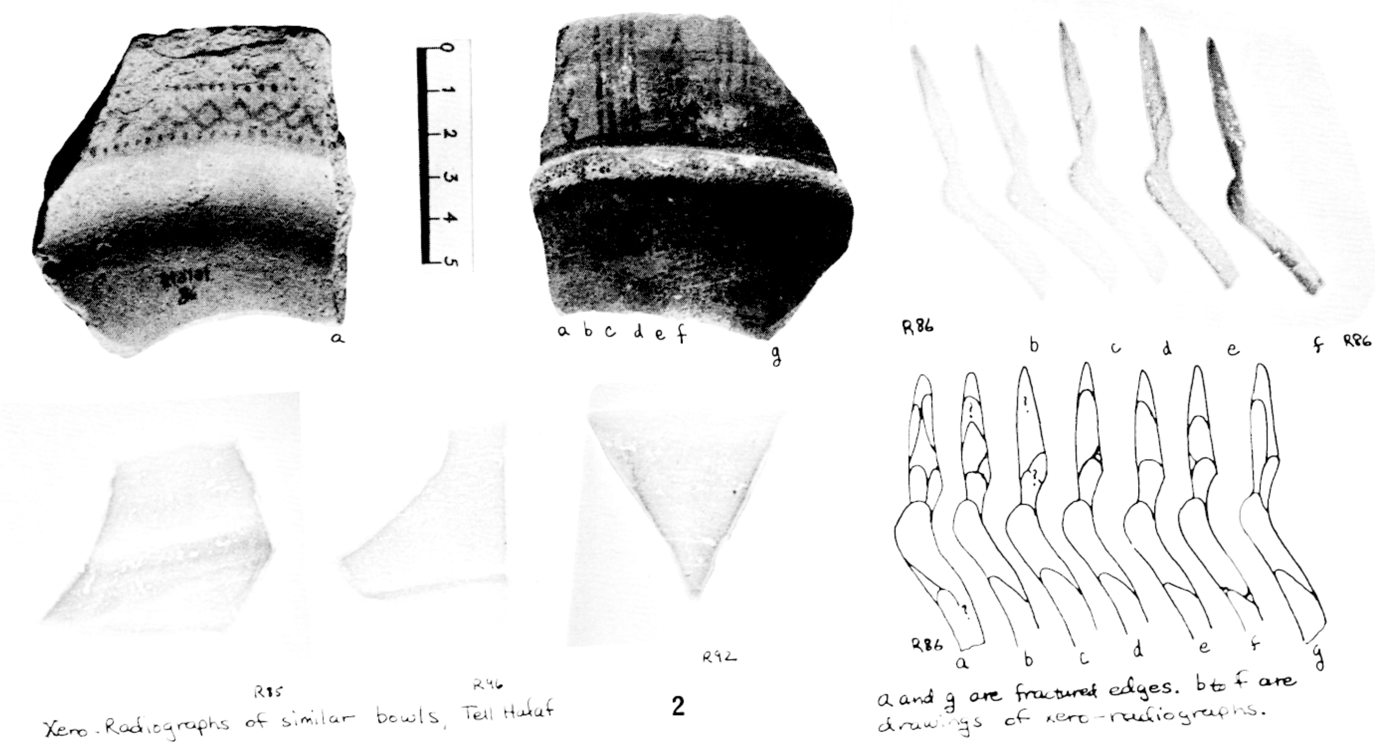

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PL. VII. — Two later examples of black-on-buff ware bowls; 1 : from Seh Gabi (SG71 G10-6, or R30) and the other 2 : from Tell Halaf (R86) showing section joins and slabs construction.

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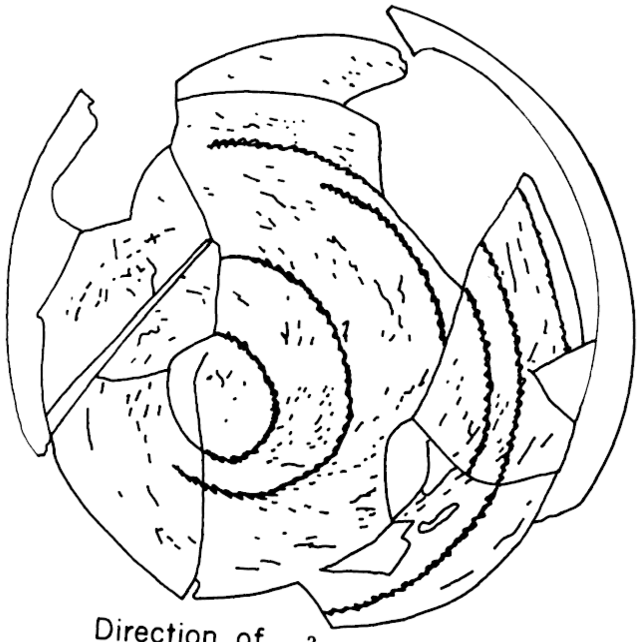

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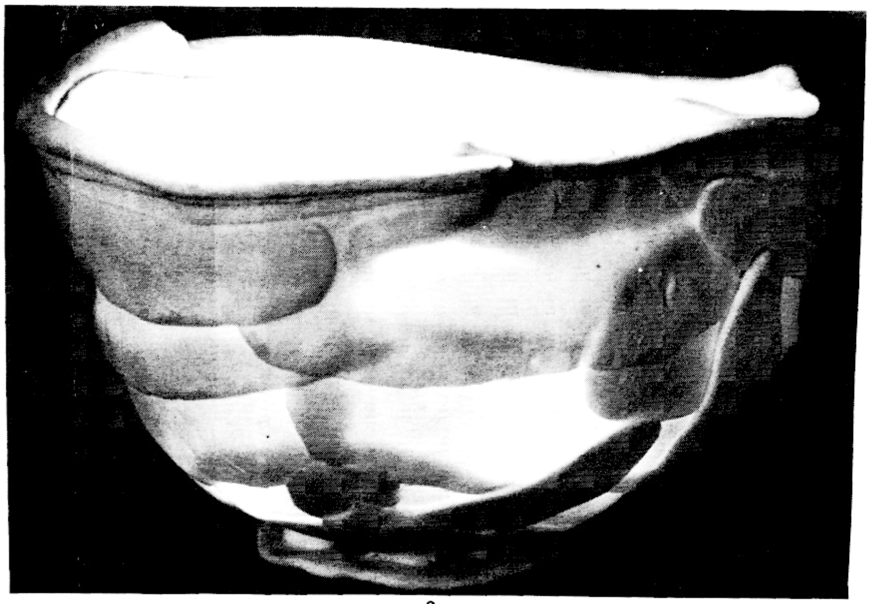

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PL. VIII. — 1, 2 : View and drawing of bottom and lower wall of a fractured and mended, thrown third millennium B.C. small jar from Godin Tepe. Note that there are many circumferential rings from throwing on a potter's wheel (12 may be counted up to the widest diameter). However, the pores are aligned at a steeper spiral than the throwing ridges because a lot of hand force was used to raise this vessel, indicating that the wheel had more limited energy than a modern wheel with a fairly large and heavy flywheel. 3 : A modern handbuilt, translucent porcelain bowl, called "Light Gatherer" by Rudolf Staffel using slab construction methods photographed in backlit conditions (Courtesy of Helen Drutt Gallery, Philadelphia; Will Brown, photo credit).

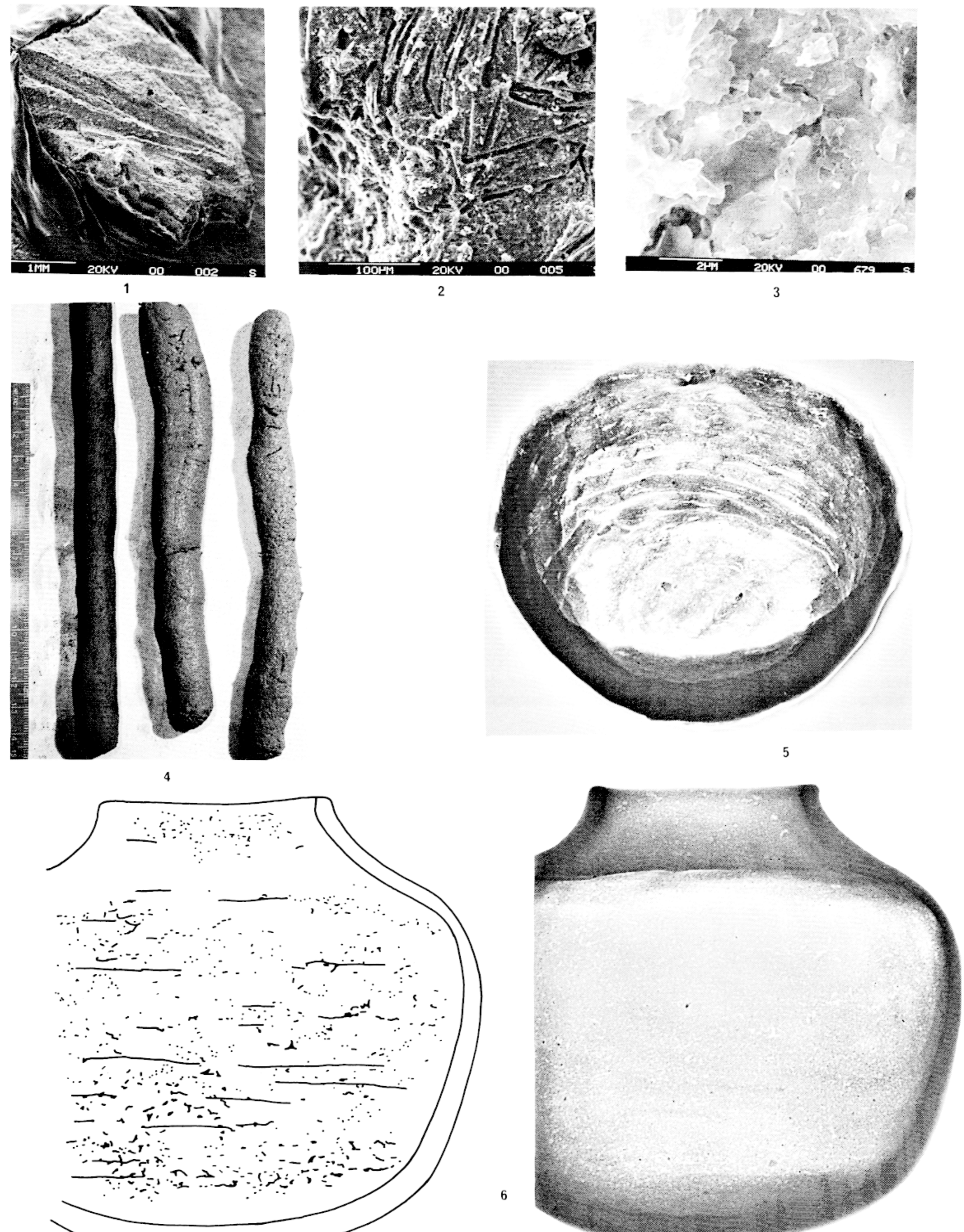
TECHNOLOGICAL CHANGE

The most remarkable result of this study concerned the working properties of montmorillonite clays. Raw clays consist of montmorillonite (Pl. IX : 3) of variable calcia content which were mixed with fiber and grit tempers. The fibrous temper amounts to between 5 and 25 vol%, as does the range of grit. A fundamental change in the use of these materials occurred between 5500 and 4500 B.C. The software horizon clay body was a fiber-reinforced composite, much like fiberglass, except that the fibers were present during manufacture, but not use; they burned out during firing. Sequential slab construction was optimized to use the chaff- or vegetal-tempered, montmorillonite clay body. The change to a grit-tempered clay body with entirely different working properties freed the technology to adopt different forming methods, but conservativism did not permit such innovation in a method which had been proven optimal by tradition.

Montmorillonite has an extremely fine particle size, less than a micron, which gives good plasticity but which is accompanied by the disadvantage of high shrinkage during drying, thus a coarse particle size tempering material is required to reduce the danger of cracking caused by the high drying shrinkage. The clay body of the early coarsewares was a composite body made of ground clay mixed with short lengths of grass, straw or chaff, occasionally some sand or other gritty materials and water. The clay body was not allowed to stand before use in a wetted condition so that the fine clay particles would wet, a process which takes about one to two weeks. Even though montmorillonite clays are known for their excellent plasticity, the software clay body was not plastic, but extremely "short", that is having low yield point and low extensibility. Because the clay particles were not completely wetted through, they agglomerated. In forming this composite body, the preformed elements were patted out as lumps, slabs and rarely as strips. The size had to be kept small to prevent cracking, and the amount of extension was limited for the same reason. The fibers increased the yield point and added stiffness and toughness. Even though coarseware pottery has been sometimes described as coil-made, coils could not be formed in replication attempts because of the effect of the fibrous temper. When the temper is aligned, the body is quite strong, but forming a coil causes the clay to delaminate from the fibers, thus fracturing the coil. Likewise, this clay body could not be thrown because the required extension is too great.

About 5500 B.C. changes in temper and clay preparation altered the working properties of the clay body. Replication study showed that once a fibrous temper was replaced by grit as the sole temper, the montmorillonite-based clay body could no longer be worked unless it was aged because it would crumble like dry dough if one tried to increase workability by keeping water content low and, with a higher water content, it had no strength to support its own weight. The stress-strain diagram for a low yield point, short plastic range clay has only a limited range of workability. Unaged montmorillonite behaves in this way. Additions of grit increase the yield point, limit the creep deformation so the clay will stay where it is placed, but such additions also act to limit the already limited extension possible. They do not, however, substantially increase bending moment or the toughness. The montmorillonite clay body cracked easily when formed into slabs. The wall buckled rather than supported superimposed slabs. Aging allows the fine particles to wet through and thus unwetted agglomerates, or lumps of powder, cannot act as sites for crack initiation. Aging changes the stress-strain diagram to show a higher yield point, longer plastic range but with considerable slope, so there is a longer range of workability with greater possibility of controlling plastic deformation. Optimal properties of workability are attained with an aged plastic clay giving a long plastic range combined with sufficient grit temper to give a relatively high yield point. Keeping the clay in a wetted condition, probably in a shaded, protected place for a period of about one to two weeks, aged the clay to full plasticity. In the arid climate of much of West Asia aging required intentional effort. Thus, the change from chaff-tempered coarsewares to grit-tempered fine wares required a technological change in the way clay bodies were prepared, not a change in the selection of another clay type or use of other tempering additives. Instead of mixing dry, ground clay with chaff, water and occasionally sand to produce a composite body with a short working range for use in coarseware, the grit-tempered, fineware body was mixed with water and allowed to age, producing a plastic clay body.

When the vegetal temper was no longer necessary to hold the body together and largely was replaced by a grit temper, the technology could have become independent of sequential slab construction. Most of the more rapid forming methods, such as throwing and coiling, require the greater extension capable with an aged grit-tempered body. Any of the more rapid forming methods, such as molding in sections, coiling or throwing on a wheel could have been used, but were not for about 1300 years. Such novel methods were not prefigured in any of the activities of pottery making or related crafts. The technical choices which had been made became tacit as tradition limited the range of possible changes, because those future changes had to fit in with the acceptable patterns of motor movement, of thought processes and of cultural, as well as materials constraints. Instead, a turntable was used for shaping walls of small vessels which had been built by sequential slab construction, for turning rims and applying banded decoration. Thus, we come to understand the conservative nature of pottery



PL. IX. — Microstructures of the fired clay jar from Hajji Firuz showing 1 : a lump of clay at 23x with an embedded piece of chaff 2 : fine fibers of organic matter burned out of the fire clay at 250x 3 : well aligned, sintered but still visible fine montmorillonite clay particles interspersed with a network of lots of slightly rounded, bur irregular shaped pores 4 : Coil forming of a chaff and vegetal tempered clay body using Yahya riverbank clay is difficult because the coils break (middle), even when more water is added (right). Example with no chaff is shown (left). Radiographs of coil formed vessels made by author show 5 : residual evidence of coils and chaff and 6 : horizontal elongation of pores in an example using aged clay with no chaff.

forming technology, as well as the gradual nature of technological innovation.

In tabulating the many synchronic examples of sequential slab construction and in observing diachronic changes in manufacture, a narrative description of the change in pottery technology with time was formed. Although at first the early methods of handforming chaff-tempered coarse wares seem unlikely, they are quite efficient, complex and optimal, and continue as the prime means of constructing pottery when a turntable is introduced about 5500 B.C. for decorating and finishing. Even when the potter's wheel is introduced about 3400 B.C. as a means of forming small cups, most pottery is still made by sequential slab construction. Molds, for which only indirect evidence is available, appear to be present from the beginning of pottery making as a means of forming and supporting bases, and these devices continue to gain in numbers of functions with time. The function of turntables, perhaps initially rotated molds, on the other hand, changes from that of wiping rims, to banding decoration and eventually to the shaping of preformed, slab-built vessel walls and rims. By about 3400 B.C. recognizeably modern methods develop : coil building in spirals, building with preformed sections for the foot, rim, body and neck, and forming on a potter's wheel. The old methods persevere, such that the new methods are examples from 2500 B.C. at Godin, and using Landsat image processing of polished cross-sections T. Davidson has confirmed the sequential slab manufacture of Halaf pottery from several different sites in Syria.

This narrative description presents a very different view of technological change from that in the archaeological literature in which the development of pottery is seen as evidence of neolithic production and wheel thrown pottery is seen as a technological revolution which is synchronous with urbanism. Pottery production technology is found to be a conservative tradition with a gradual development in which technological innovation takes place not by trial and error, but by analogical reasoning, that is, by modification of what is being done successfully to serve a new purpose.

The sequential slab construction is far more conservative and persistent than heretofore imagined. Other studies have differentiated ware types by variations in form, color and decoration, without recognizing the commonality of forming technology.

ORIGINS OF SEQUENTIAL SLAB CONSTRUCTION

Sequential slab construction could not have grown out of nothing (43); what were its precursors?

(43) FRANKLIN, pers. comm., 1984.

Before pottery was made, clay-based pigments, small clay figurines and other clay objects were made and have been considered possible technological precursors of pottery, but they do not have the same vegetal-tempered clay composition or working properties of raw materials or the same sequence of forming methods as pottery. Thus, we must look elsewhere (Table I).

TABLE I

Structural similarity of features of pottery technology to those of other craft technologies

TECHNOLOGY	SAME AS OR DIFFERENT FROM POTTERY	
	SAME	DIFFERENT
Architecture*, "chineh" or wet lump construction and sundried bricks may have developed simultaneously with pottery		
Raw Materials	X	
Additives (vegetal)	X	
Forming	X	
Firing		X
Special Case: Ovens, all four features are the same (Amiran 1965)		
Plaster**, developed before pottery		
Raw Materials		X
Additives (rarely chaff temper is found in plaster)		X
Forming	X	
Firing (firing takes place before, not after forming)	X, BOTH	
Hypothetical Fuel Mixtures of Straw and Clay, for which there is ethnographic but not archaeological precedent, but no one has really looked		
Raw Materials	X?, expectation	
Additives	X?, expectation	
Forming	X?, expectation	
Firing	X?, expectation	
Clay Figurines and Objects+, developed before pottery		
Raw Materials	X?, probably	
Additives		X
Forming	X?, probably	
Firing		X
(based on author's preliminary data of surface textures, chemical and x-ray diffraction data from some sites)		
Clay-Based Pigments++, developed before pottery		
Raw Materials		X
Additives		X
Forming		X
Firing		X

* Aurenche, 1981.
** Aurenche, 1981 and Kingery, Vandiver and Prickett (forthcoming).
+ Schmandt-Besserat, 1974 and 1977.
++ Vandiver, 1983 and forthcoming.

Three possible precursors are architecture, fuel and plaster. The composition is similar, and methods of building in lumps, layers and slip coatings are the same as for pottery. The raw materials have the same working properties. Fuel in a dry region with no trees might have been compounded by mixing dried grass and straw with clay to prolong burning, as in Korea with coal dust and clay. The clay acts in both cases as an extender to slow the burning. However, there is no known archaeological precedent for such use. In theory, charcoal lenses without evidence of wood charcoal, but with a very fine ash would provide such evidence in the future. Another possibility of a precursor technology is plaster. Athough a different material, the two materials clay and fine limestone are often found mixed. There is evidence of a similar sequence of manufacture at Ali Kosh, where molded plaster bowls were made in baskets using lumps and a thin surface layer. At Hajji Firuz and Mehrgarh bases of pottery are mat and basket impressed. There are other examples of the similarity of plaster and clay vessel construction from Abu Hureyra. Thus, mud bricks and wet construction by lumps of mixed straw and clay ("chineh") and plaster bowl manufacture present a model for the development of sequential slab construction. This is preliminary evidence that clay and plaster vessels and architectural vessels shared working properties of the prepared raw materials and a common method of construction.

CONCLUSIONS

Examination of 40,000 pots and sherds demonstrated that a common production technology, sequential slab construction, was the main forming technology over a 3500 year period over a geographic range from Egypt to Pakistan, Turkey to Mesopotamia, based on a study of pottery from 15 sites. Sequential slab construction is a special technology, one which a casual observer would not recognize. It is based on particular raw materials and methods which developed out of a prior history of working earthy materials. Thus, because certain technological choices had been made, certain possibilities of forming were not possible within that established framework. This technology was extremely conservative for a long time and over considerable geographic extent. This implies more communication and cultural cohesion in transmission and maintenance of tradition and acting over considerable spatial extent than expected. In areas where the technological continuity breaks down, the hypothesis that interaction, for instance intermarriage, raiding, transport of captives, migration, etc., does not occur or does not occur as frequently as within the core area.

This analysis of neolithic and chalcolithic West Asiatic pottery manufacture is analogous to the process of "deconstruction" of literary texts, but aimed at the details of artifact examination and interpretation rather than literary criticism. This approach involves examination of structure-properties-processing relationships on many levels of scale, from macrostructure to microstructure, using the methods and strategy of materials science. One further element was required to determine the nature and extent of a ceramic complex: development of a technological typology with reference standards.

A similar developmental sequence of pottery forming methods has been established for four sites or groups of sites in the Zagros region — Tepe Yahya, Seh Gabi-Godin Tepe, Hajji Firuz-Dalma-Pisdeli, Chagha Sefid-Sabz-Farukhabad — and parts of this sequence have been documented at several other sites. A narrative description of the technological changes which occurred during this time period include the use of molds to support bases and to form thinner, rounded bases, the aging of clay and change in the type of temper to make fine serving wares, and the introduction of a turntable or other rotatable device to wet first smooth, then to form rims and to apply banded, horizontal lines of decoration. Later turning was used to shape walls of pottery which had been constructed by sequential slab construction. By 3200 B.C. walls of small vessels were shaped and thinned by rotation of the vessel on a true potter's wheel in which the walls were raised using the centrifugal force of the rotating wheel. The introduction of the potter's wheel is fixed as Jemdet Nasr period at Tepe Farukhabad and period IVC at Tepe Yahya, and after Godin VII-VIII period at Seh Gabi considerably earlier than previous studies of Egyptian and other potter's wheels (44).

Within the framework of this synchronic and diachronic study, changes occurred in the details of forming and timing of the sequence of development of pottery technology. For instance, in Egypt at Merimde and Badari individual slabs are distorted by working of the walls to thin and form them, thus the walls are thinned and shaped once they are built, which is different from the practice of leaving a constructed wall as built found in the Zagros. In Pakistan at Mehrgarh the slabs are often shaped like strips and not well joined, but the strips once formed are not worked. At Mersin grit temper occurs sooner than at other sites, and the neolithic and chalcolithic period pottery consists of part which is grit tempered and part which is vegetal tempered. Within the framework of sequential slab construction, it will now be possible to restudy the minor changes in pottery technology in order to differentiate variations in styles of making pottery which may identify the juxtapositions and interactions of different cultural groups. The preliminary conclusion is that the similarity in pottery construction implies a cultural relationship, not merely a similarity in raw materials constraining cultural choice.

There are several conclusions that can be drawn from this overview of pottery technology. One conclusion is that the technology of making pottery was remarkably conservative, which implies very effective means of cultural transmission and a focus of West Asiatic societies on questions other than efficiency of technology. Slab construction was an optimized technology which persisted through the development and demise of various types of fine wares as well as regional and stylistic changes in vessel form, decoration and function. Second is that the rate of technological change increased toward the end of the period. The spread of both turntables and the aging of clay each took about 1000 years (5500-4500 B.C.); whereas, the adoption of the potter's wheel took only about 200 years (3200-3000 B.C.). Thus, there is another line of artifactual evidence that a greater degree of cultural interaction and integration, particularly in terms of

(44) HOPE, 1981, 1982; AMIRAN and SHENHAV, 1984; VANDIVER and LACOVARA, 1985-1986.

communication and reception of that communication, occurred as part of the process of urbanization.

The process of technological change can be differentiated from change in the formal characteristics and decorative elements of pottery. Changes in production technology were extremely slow, with a substantial part of the old technology surviving the incremental change. In other words, the process of technological change in this example proceeds gradually by analogical reasoning with what has gone before rather than by revolution, as is now often touted to be the case with modern technology. Known techniques and materials were modified to better suit a purpose deemed socially important, that is the storage, preparation and serving of grains and other foodstuffs.

Structural comparisons to other crafts suggest that a commonality in the construction of many types of earthy paste, mixtures of water with various fine particled sedimentary materials. The precursors of pottery configured the way software pottery was made, what it was made of and also constrained the range of choices for future development, in a processual determinism. Pottery technology probably developed out of prepottery neolithic plaster technology or out of or along with architectural technology. The construction methods were used for plaster bowls, athough the materials differ in type and preparation. In common with architecture are the same composition, raw material preparation and working properties of wet mud brick, or chineh, as coarseware pottery. The construction techniques using preformed elements without standard sizes to be stacked on top of one another and the application and smoothing of a surface coating are structurally isomorphous, more so than the comparison of pottery with any other technology. The origins of architectural and pottery technology are not to be found in clay-based pigments, the manufacture of figurines, or the making and cooking of food.

One further conclusion from this study is that we perceive the neolithic of West Asia from the point of view of the classes of excavated artifacts. We ask questions of how objects were made and when crafts became sufficiently complex or diverse in activities or standardized in steps or manufacturing elements to require parttime specialization. What we fail to realize is that there was a technology of earthy pastes, using a large variety of resources, from limestone , gypsum, steatite, quartz, hematite, etc., to sediments of the above in a wide diversity of mixtures both with one another and with water or other liquid organic binder, to form such materials as plasters, pigments and ceramics, in similar ways for a wide variety of purposes — beads, sling balls, jar sealings, loomweights, daub, bricks, vessels, etc. This variation in "soft stone" technology within a site ought to be encompassed, rather than studying an artifact type before we are sure there was any craft specialization at the village level. In addition, we ought to be asking questions which distinguish between the kinds of activities which involved subsistence practices, the cook and storage pots and serving dishes studied here, and those which required special organization, such as plastered, painted floors and walls, and use the special types of activities and organization required by such productions as a model to test the complexity of subsistence practices.

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APPENDIX I

Sampling Statistics

Site	No. of Sherds with Join Types Determined	No. of Slabs Measured	No. of Sherds Radio-graphed	No. of Sherds Sectioned and Radio-graphed
Tepe Yahya	402 coarseware	347 c	71 c,f	7 c,f
	402 fineware	256 f		
Hajji Firuz	373 c	207 c	42 c	15
Dalma	73 c,f	39 c,f	24 c,f	-
Pisdeli	112 f	46 f	24 f	-
Ganj Dareh	61 c	72 c	12 c	-
Sarab	772 c	128 c	15 c	-
Seh Gabi, Mound C	55 c	112 c	15 c	-
B, Dalma	355 c,f	247 c,f	57 c,f	7
A and E	325 c,f	267 c,f	28 c,f	-
J-Ware	-	-	35	-
Chagha Sefid	292 c	215 c	73 c,f	3
	294 f	147 f	-	-
Sabz and Farukhabad	241 c,f	167 c,f	-	-
Halaf, Chagar Bazar	153 f	82 f	25 f	.
Merimde	7 c	42 c	7 c	-
Mostegedda	31 c,f	62 c,f	.	-
Hassuna	6 c	36	-	-
Samarra	28 c	36	-	-
Jericho	134 c	79	-	-
Mersin, Neolithic	58 c	11	-	-
Chalcolithic	292 c,f	9	-	-
Mehrgarh	555 c	356	-	-
Totals	4754 (100%)	3383(71%)	422(8.9%)	41(0.9%)

Note : About 40,000 sherds were involved in this study. Standards, replications and ethnographic examples add 85 samples to those radiographed. The number of sherds and whole pots examined microscopically but not measured is estimated by volume to be 10 times the number measured for Tepe Yahya, Hajji Firuz, Seh Gabi and Chagha Sefid, Sabz and Farukhabad.

APPENDIX IIA

Variation in composition and properties of clays

APPENDIX IIA. Variation in Composition of Potential Pottery Clays from the Zagros Region by Energy Dispersive X-ray Analysis

Major Elements	Si	Ca	Al	Fe	Mg	K
Pottery Samples:						
Yahya Coarseware	1.0	0.58	0.32	0.21	0.08	0.12
Yahya Fineware	1.0	0.08	0.27	0.13	0.10	0.10
Unfired Clay Objects:						
Yahya geometric disc	1.0	0.46	0.29	0.18	0.21	0.14
Hajji Firuz wall	1.0	0.42	0.25	0.17	0.08	0.08
Hajji Firuz jar sealing	1.0	1.32	0.32	0.26	0.10	0.21
Seh Gabi roof element	1.0	0.30	0.34	0.13	0.05	0.20
Seh Gabi sling balls	1.0	0.74	0.33	0.19	0.07	0.26
Chagha Sefid brick	1.0	1.27	0.41	0.18	0.14	0.23
Potential Pottery Clays:						
Rud-i Gushk riverbank clay	1.0	0.38	0.29	0.17	0.08	0.13
Sarab clayey soil sample	1.0	0.39	0.28	0.14	0.11	0.17
Ganj Dareh virgin soil beneath the mound	1.0	0.59	0.28	0.09	0.13	0.16
Ganj Dareh streambank clay	1.0	4.50	0.75	1.00	0.25	0.50
Mehmeh River clay	1.0	1.54	0.38	0.12	0.08	0.15
Mehrgarh riverbank clay	1.0	1.20	-	-	-	-

Note the variation in calcium content. Composition was determined by energy dispersive x-ray analysis, backgrounds subtracted and ratioed to silicon as 1.0 by elemental peak height to give relative variation in the major elements. Each clay was analyzed by emission spectroscopy to confirm these approximate values and to check for any other elements, such as lead or phosphorus, which would alter the properties (Vandiver 1985 : 112).

APPENDIX IIB

Variation in the Properties of Clays

Potential Pottery Clays	Clay Type *	Plasticity '	Particle Size **	Firing ++	Distribution of Lime ***	Usable as a Pottery Clay?
Clays from Objects:						
Yahya Geometric Disc	M	Good	Fine	Hard	Fine/Homo/Hi	Y
Hajji Firuz Wall D	M	Good	Range	Hard	Fine/Homo/Hi	Y
Hajji Firuz Sealing	M	Good	Coarse	Hard	Fine/Homo/Hi	Y
Seh Gabi Sling Balls	M	Good	Fine	Hard	Fine/Homo/Hi	No
Seh Gabi Roof, Mound B	M	Bad	Too Coarse	Hard	Agg/Heter/Hi	?
Chagha Sefid Brick	M	Bad	Too Coarse	Powder	Poor/Heter	No
Clays from Sites:						
Yahya Riverbed Clay	M	Good	Fine	Hard	Fine/Homo/Lo	Y
Rud-i Gushk Clay (between survey sites 47 49, near Yahya, M. Prickett, 1986)	M	Too Much	Very Fine	Hard	Fine/Med	?
Sarab Soil SV4	M	Crumbled	Too Coarse	Powder		No
Ganj Dareh Soil #172	M	Good	Range	Hard	Fine/Hi	No
Ganj Dareh Clay #59	M	Good	Range	Powder	Fine	No
Mehmeh River Clay (1969, near Farukhabad)	M	Too Much	Very Fine	Powder when boiled	Heter	No
Mehrgarh Clay, 1986	M	Good	Fine	Powder	Heter	No

The amount and distribution of lime, alkali and clay phases on a local microscopic scale, as determined by S.E.M., gives a range of working and firing properties, even though the clay type is the same.

* M = Montmorillonite, identified by differential thermal analysis and x-ray diffraction.

' Plasticity was measured by a ring test, run 5 times. When the clay deformed under its own weight with low added water content, the clay had too much plasticity to work. The usual reason was extremely fine, sub-tenth millimeter average particle size.

** Particle size : very fine = below 1/10th micron, fine = 0.0-10 micron, coarse 10-50 microns.

++ Samples were fired to 900 °C for one hour. Hard fired means Mohs 5-6. Powdered means powdered during or just after firing. Nondurable means clay body disintegrated after boiling in water for one hour.

*** Size of distributed particles of lime, finely distributed or poorly distributed in agglomerated lumps, is followed by distribution, "homo" for homogeneous and "heter" for heterogeneous, and amount of lime as high, medium or low. High indicates lime content is too high (see Appendix IIA) to form a fired ceramic. Above 840 °C high lime bodies decompose to powder (Gourdin and Kingery 1975). About 30 wt% CaO in a clay body will cause decomposition of the fired clay body, unless the calcium oxide has reacted to form a glass or other crystalline phase.

APPENDIX III

Criteria for determination of the use of various forming methods in early West Asiatic Pottery

I. Use of Molds : the function of a mold is to shape and support, particularly at the base so that the pot can be thinner and lighter and during forming support more weight without deformation.

A. If a concave, female or open-faced mold is used, the following traits may be found :

Basal slab is upturned to form wall as seen in cross section,

- Large angle (about 135 degrees or greater) measured on interior of pot between base and wall makes wall difficult to support when building the wall by free modeling methods,
- Dimpled or indented base which shows that slabs fit an irregular contour, rather than a flat surface,
- Indented mold impression evident in profile near base,
- Negative impression of basket in base and wall,
- Probably rounded bases had to be supported in basal molds, for example, Dalma and Chagha Sefid red slipped wares.

B. Convex or male molds result in the following traits :

- Slabs built toward base, and base may be plugged,
- Interior surface may have near hemispherical, open pores from entrained air and a rough surface texture, unless a finishing operation has caused the surface to be reworked,
- In cross section there will be less porosity on the inner surface, and it will be aligned parallel to the wall but randomly. Temper may likewise align.

C. Counter evidence for molding consists of an outer layer of base being scraped away, leaving incomplete or wedge-shaped slabs in cross section.

II. Use of a Turntable, Tournette or Slow Wheel : that is, a rotatable support, such as a strong flat leaf, matt, basket or board, as well as a socketed turntable, that can be turned by a force applied to the pot or support, but this support will immediately or very soon cease motion. There are probably a great variety of devices which are only beginning to be separated according to function. The following traits are found :

- Handbuilt wall made of slabs or strips or coils has a rim which has been wiped with parallel circumferential, very fine striations about 0.1-0-2 mm high and wide, and which continues all the way around the rim. If the pot is thick and heavy and could not have been spun on the ground without a support, further evidence for a wheel is found.

  Handbuilt wall has a rim with a symmetrical shape all the way around the rim. Early coarseware has a variable rim shape from rounded, and squared off to pointed, which change may occur over a few centimeters distance.

  If speed was involved the shape of the rim may be undercut or flaired or the shape may particularly well fit the size and shape of fingers.
- Banded decoration in horizontal strips, made by incising, painting or even wiping methods.
- Handbuilt wall with elongated, well-worked joins and deformed slabs, spiral-shaped slabs all in the same diagonal direction of rotation, lowered porosity at joins which have been worked, and alignment of pores in slabs in a diagonal direction which is the same as the direction of turning. In general, the diagonal direction of the aligned porosity is greater than the direction of throwing ridges or circumferential finger indentations, as compared with the horizontal base, due to the great amount of force which must be applied through the hands compared with the force of a rotating wheel (for an example see Vandiver, BES, 1985/6 : 80-83).
- Internal parallel shaping ridges with a constant upward diagonal direction and constant width which are symmetrical around the centerline of the handbuilt pot. Similar-sized preformed elements are also often found. However, these two alone do not confirm use of a turntable, but only add circumstancial support.
- Small-size thrown pot in which the direction of elongation of the pores is steeper than the throwing marks with respect to the base (P. Vandiver 1985/6 : 82-83 and R. Henrickson 1986).

III. Throwing on a Potter's Wheel : a device requiring a wheel shaft, socket and basal support where the centrifugal force of the wheel is used to raise the wall of the vessel. Usually, energy is stored in a mass such as a weighted single wheel or separate flywheel.

A. External Characteristics :

Circumferential ridges usually slightly less that the width of a finger spiral continuously from the center of the base upward past the maximum diameter of the body.
- Fairly symmetrical shape such that the lip is more or less centered over the maximum diameter of the body and over the base.
- Sticky, wet appearance of the surface, especially the ridges or other features uplifted from the surface and at the interior of the base which is an indication of water used as a lubricant during forming.
- Wall which is thicker in the lower wall than at the rim and which gradually thins from one to the other.
- Reworked base in which clay has been removed from the base by scraping, or trimming by turning on a wheel, at a dryer stage such that coarse particles are dragged along and through the surface.
- String cut bases may be produced on either a potter's wheel or socketed turntable. There are usually few turns, often only one, of the wheel represented by this manipulation.

B. Internal Characteristics :
- Diagonal alignment of temper and pores in the wall when viewed normal to the surface;
- No evidence of joins in fractured edges of sherds, or, if a join is found, it is symmetrical horizontally around the centerline of the pot and placed where two sections were joined, as for instance a neck to a body or at a carination. Such a join should then be found consistently within a form class and ware type.

IV. Spiral Coiling from a Lump or with a Strip of Clay : use of a linear element either preformed or pinched out of a lump of a clay held in the hand, to build a wall rapidly which is being supported on a turntable and rotated slowly beneath the hand; the wall is constructed by adding one element at a time in a spiral.

A. External Characteristics :

Spiral join line indented in the surface in which the height of the coil is 2-5 times the thickness of the wall.
- Form class of small size, usually breakers or shapes with flairing or near vertical wall.

  Coil volume which corresponds to a handful of clay.

B. Internal Characteristics :
- Evidence of joins in fractured cross section; most of joins are beveled in same direction and somewhat worked.
- Elongation and alignment of pores in a diagonal direction but less consistently than in a thrown vessel.

APPENDIX IV

Frequency of join types in coarse and fine wares by site and period

Types of Join	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Number of [illegible]
Tepe Yahya:						
Tepe Yahya Coarsewares:						
Per. VIIC and B	?.3%	18.?	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Per. VIIB	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Per. VIIA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Per. VIB	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Per. VIA	21.7	24.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Per. V	17.9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Tepe Yahya Finewares:						
Soghun Plain VII-VC	27.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Soghun Painted VI-VC	26.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lapui, Per. VI-V	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Black-on-Buff VI-VA?	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Blk-on-Smooth Buff VA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Black-on-Red VA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Plain Orange fine and coarse, Per. V	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Hajji Firuz, Dalma and Pisdeli (Sixth through Fourth Millennia B.C.) of the Hasanlu Excavations:

Types of Join							
Hajji Firuz Coarsewares, Early Phases F?-L, Operation V (196?):							
Sherds Smaller than ?? mm.							/ [illegible]
Vertical Body	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

(26% with no joins)

Types of Join							
Horizontal Body	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

(and ??.? with no joins)

Types of Join							
Larger than ?? mm.							/ [illegible]
Rim	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Vertical Body	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Horizontal Body	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Base	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dalma Plain, Red Slipped and Painted (Operations II and IV, 196?)	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]
Pisdeli, Coarse, Fine Plain and Painted, and Impressed (Operations I and II, 196?)	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]

Types of Join							
Chagha Sefid:							
Sefid Phase:							
Jaffar Painted, CA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jaffar Plain, CB	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jaffar Painted, CB	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Khazineh Red Slip, CB	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Surkh Phase:							
Jaffar Plain, CC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jaffar Painted, CC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sefid, Chogha Mami Transitional and Sabz Phases:							
Jaffar Plain, CC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sefid Red Slip, CA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sefid Black Slip, CA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Susiana Black-on-Buff	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Susiana B-O-B Late, CC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sabz Black-on-Red, CC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Tepe Sabz, Bayat Phase:							
Susiana Plain Buff	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Susiana Blk-on-Buff	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Tepe Farukhabad, Farukh Phase:							
Susiana Plain Buff	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Susiana Blk-on-Buff	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Types of Join							
Seh Gabi (Godin):							
Mound C Coarseware (Shahabad Period)	1?.?	1?.?	4?.?	[illegible]	1?.?	[illegible]	[illegible]
Coarsewares, Mound B Dalma Wares, Dalma and Seh Gabi Periods:							
Plain Buff Coarseware	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Red Slipped CW	[illegible]	2?.?	[illegible]	1?.?	[illegible]	[illegible]	[illegible]
Red Over White Slip	7.?	2?.?	3?.?	7.?	1?.?	[illegible]	[illegible]
Red Slip, Impressed	21.?	17.?	[illegible]	?.?	1?.?	[illegible]	[illegible]
Plain, Impressed	?.?	??.?	4?.?	4.?	1?.?	?.?	12?/6?
Pitted Plain	7.?	10.?	34.5	?.?	[illegible]	?.?	11?/6?
Painted Geometric	1?.9	1?.?	5?.?	?.?	?.8	?.?	1?6/4?
Painted Streaky	?.?	1?.?	6?.?	?.?	[illegible]	?.?	[illegible]
Painted Bichrome	4?.?	7.?	4?.9	?.?	[illegible]	[illegible]	[illegible]
Mound B Totals	1?.?	1?.?	4?.7	6.?	1?.?	4.?	7??/???
Coarse and Fine Wares, Mounds A and B, Periods VI-VII:							
Unsmoothed Buff C/B,	?.6	??.?	??.1	?.?	1?.?	1?.?	1??/??
Red/Buff Slipped C/B,	?.?	42.?	37.?	4.?	?.?	2.?	1?3/??
White Slip C. (B)	13.9	4?.?	2?.4	?.?	?.?	7.7	2??/??
Fineware, Buff and White Slip (A B)	2?.?	4?.?	1?.6	2.1	6.7	14.?	1??/7?
Fineware, Black-on-Buff Painted (B)	33.6	??.?	24.6	?.?	?.?	?.?	2??/8?

Types of Join							
Sarab:							
Plain Buff Coarsewares:							
SI-1	22.6	18.3	51.2	1.1	5.?	1.6	???/???
SI-2	9.3	24.3	54.2	9.7	2.1	1.4	14?/8?.
SI-2a	11.7	13.0	47.4	10.0	11.7	?.?	1??/6?
SI-2b	15.5	22.4	47.3	15.5	3.5	5.7	317/18?
SV	12.1	13.6	56.8	3.0	3.8	10.6	1??/6?
Red Slipped and Painted Coarsewares:							
SI-1 and 2A	18.4	21.6	46.8	4.?	5.2	3.7	190/??
SI-2A and 2B	21.1	19.9	47.4	4.0	3.6	4.0	251/12?
SV-2, 3 and 4 Slip	16.1	11.9	51.9	5.8	11.7	2.6	429/126
SV-3,4, Painted	7.?	25.3	51.6	6.6	2.2	6.6	126/21

Types of Join							
Ganj Dareh:							
Small Vessels	6.4	12.8	27.2	8.0	14.4	5.6	125/45
More complex joins with 4 slabs meeting or 3 or more layers, 25.6%							
Large Vessels, Basins	9.4	20.?	14.1	10.9	12.5	4.7	64/16
More complex joins with 4 slabs meeting or 3 or more layers, 28.1%							

Sites Outside the Zagros and Iranian Highland Region:

Types of Join							
Jericho, Neolithic							
Coarsewares, A, I-X	0	14.?	47.?	6.3	25.?	6.6	288/1??
Painted Ware	0	36.8	47.4	0	15.8	0	19/9
Hassuna, Level Ia, Neolithic							27/6
Coarseware	0	3?.4	?1.4	5.4	?.4	?.4	
Samarra-type from Hassuna, Neolithic							
Incised Coarseware	0	26.?	?1.?	8.?	1?.4	4.?	??/15
Painted and Incised	0	3?.?	47.4	?.?	?.?	?.?	??/??
Halaf Black-on-Buff Ware							
Tell Halaf	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Chagar Bazar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mostagedda, Neolithic, Upper Egypt							
Coarseware	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Black-Topped Redware	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Merimde, Neolithic, Egyptian Delta							
Coarseware	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mehrgarh, Neolithic, Pakistan [illegible] of the Bolan Pass							
Coarseware, Per. IB	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Coarseware, Per. IIA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Coarseware, Per. IIB	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Coarseware, Per. III	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Red and Buff Fineware, Period IIB	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Fineware, Per. III	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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