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# EXCAVATION AT HARAPPA—1988

by

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The third season of research by the University of California, Berkeley, project at Harappa was conducted from January 1 to mid April 1988. The project was directed by Dr. George F. Dales (University of California, Berkeley) and Dr. J. Mark Kenoyer (University of Wisconsin, Madison), with Mr. Mohammad Siddique as Representative of the Government of Pakistan, Department of Archaeology. (Additional team members are indicated in the following text).

Three major areas of excavation included the continuation of work in the Harappan Cemetery, a deep sounding and limited horizontal excavations on Mound AB, and a number of trenches and horizontal excavations on the western edge of Mound E. Palaeo-anthropological studies were continued by the team of physical

anthropologists on the human skeletal remains from the Harappan Cemetery. Palaeoenvironmental studies were conducted through the analysis of soils and sediments in and around the site, as well as through the study of floral and faunal remains.

Special emphasis was laid on the conservation of excavated remains and the restoration of artifacts. New museums displays were also prepared and excavated areas of the site were conserved.

During the third season, the training of conservation and museum personnel as well as archaeological training for students from Pakistan Universities was also continued.

## EXCAVATIONS AT HARAPPA 1986—1988

| Area/Operation | Main Features | Expected Information |
|---|---|---|
| Systematic Surface Survey | eroded artifacts; | overall variation in artifact concentrations on surface of site, site topography, eroded structures and concentrations of domestic or craft activity indicators, extent of site. |
| Systematic Soil Survey | | Subsurface soil distribution of natural sediments, profiles characterization of prehistoric topography, prehistoric vegetation, location of riverine sediments and erosion, extent of site; dating of Pleistocene and recent sediments. |
| Harappan Cemetery: Operation I | Debris Layer | overall variation in artifact types, manufacturing debris, fauna, etc. of Mature Harappan period. |
| | Burials | burial customs, relative and absolute chronology, and variation in ornaments and ceramic types, population morphology and variation, disease, status and occupation markers, mortality rate, genetic markers. |
| | Random test pits; 1986, '87, '88 | total area of eroded cemetery, estimates of burial densities, variation in burial practices, relative chronology of cemetery use and erosion, extent of site in southern and western direction. |

| Area/ Operation | Main Features | Expected Information |
|---|---|---|
| Mound AB/ Op. 2 | Test pit; 1986 | (Deep sounding in SW corner) chronological sequence of cultural materials, fauna and botanical materials from natural soil, Early Harappan to Mature Harappan period. |
| | Random test pits | (western low mound) extent of site in SW direction; chronological sequence of cultural materials, fauna and botanical materials from natural soil to Mature Harappan period (no Early Harappan), important carbon samples. |
| | Deep Sounding | (Center of Mound AB) chronological sequence of cultural materials, fauna and botanical materials from Mature Harappan to Late Harappan period, important domestic contexts, floors, hearths, well, streets and drains, some manufacturing debris and raw materials. |
| Mound E/ Op. 3 | Random test pits; | spatial and chronological variation of cultural materials on NW and SW portion of mound, from Mature and Late Harappan contexts. |
| | Top of Mound | spatial distribution of domestic and craft activity areas of Mature Harappan Period; important samples of faunal material and botanical material; many primary context carbon samples for dating. |
| Mound E/ Op. 3 | NW Step Trench; | chronological sequence of cultural materials, fauna and botanical materials from Early Harappan to Mature and Late Harappan period, important architectural structures relating to civic building activities, domestic contexts, floors, hearths, streets and drains; craft activity areas, manufacturing debris and raw materials; many primary context carbon samples for dating. |
| | Kiln Area | chronological sequence of cultural materials, fauna and botanical materials from Mature Harappan to Late Harappan period, continuous sequence of craft activity (e.g. pottery manufacture) and some evidence for domestic activity; many primary context carbon samples for dating. |

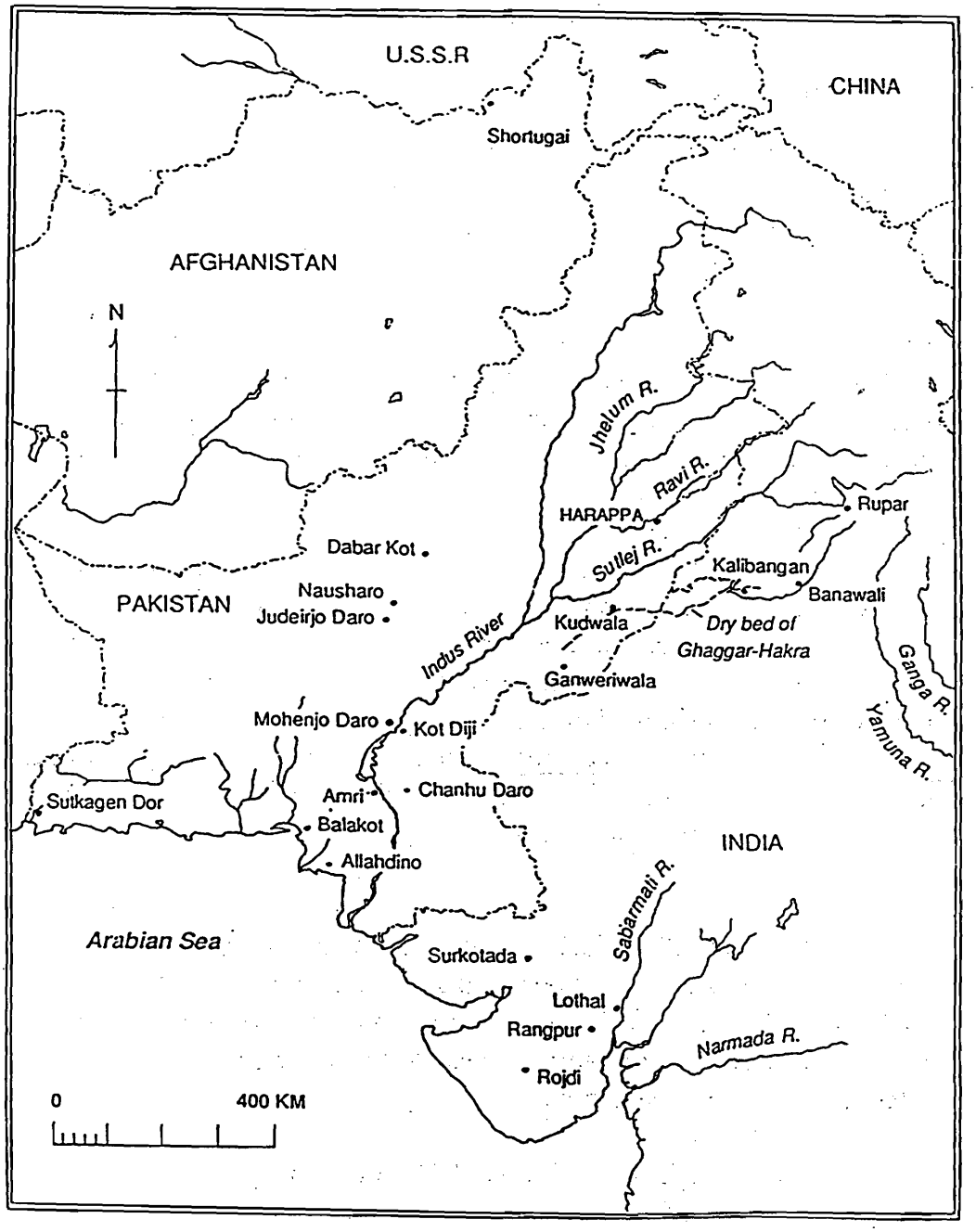



Fig: 26. Harappa: Major sites of the Indus Civilization.

## REPORT ON EXCAVATIONS

### A. Surface Surveys

During all three seasons of research, surface surveys were conducted in various areas of the site that had been only briefly described by earlier excavators. These include the low western mounds and the adjacent plain, the southeastern mound (Mound E) that is covered with heavy growth, and the northeastern mound that is partially covered by the modern town of Harappa (Fig. 27) In addition to these unexcavated areas, eroded sections from previous excavations were examined, as well as all the dumps from previous excavations to give us an idea of the types of artifacts that might have been overlooked by the excavators.

Most of these surveys were conducted in units which correspond to major erosional patterns of the site. However, at plain level where no erosional features were evident, the survey unit was a 50 meter square grid. When concentrations of artifacts were detected, their coordinates within the grid were recorded and their locations plotted on the site plan. A detailed record was made of surface features and artifacts that might indicate areas of specialized activities. Final surface survey distributions are being prepared on a new site contour map.

The limits of the site have not yet been defined, but it is evident from the surface surveys, test pits, and systematic corings made during 1987-1988, that the site is much larger than previously supposed, possibly as large as 150 hectares instead of the 45 hectares which Vats refers to for the mounded area.

On the high western mound (Mound AB or "citadel"), all recognizable dumps from previous excavations were examined along with selected portions of the uppermost excavated surfaces. Because of the complicated erosion of the edges of this mound–due in part to natural erosion and complicated by generations of brick robbing–more detailed surveys will be done when a grid can be installed at smaller intervals, of one to five meters.

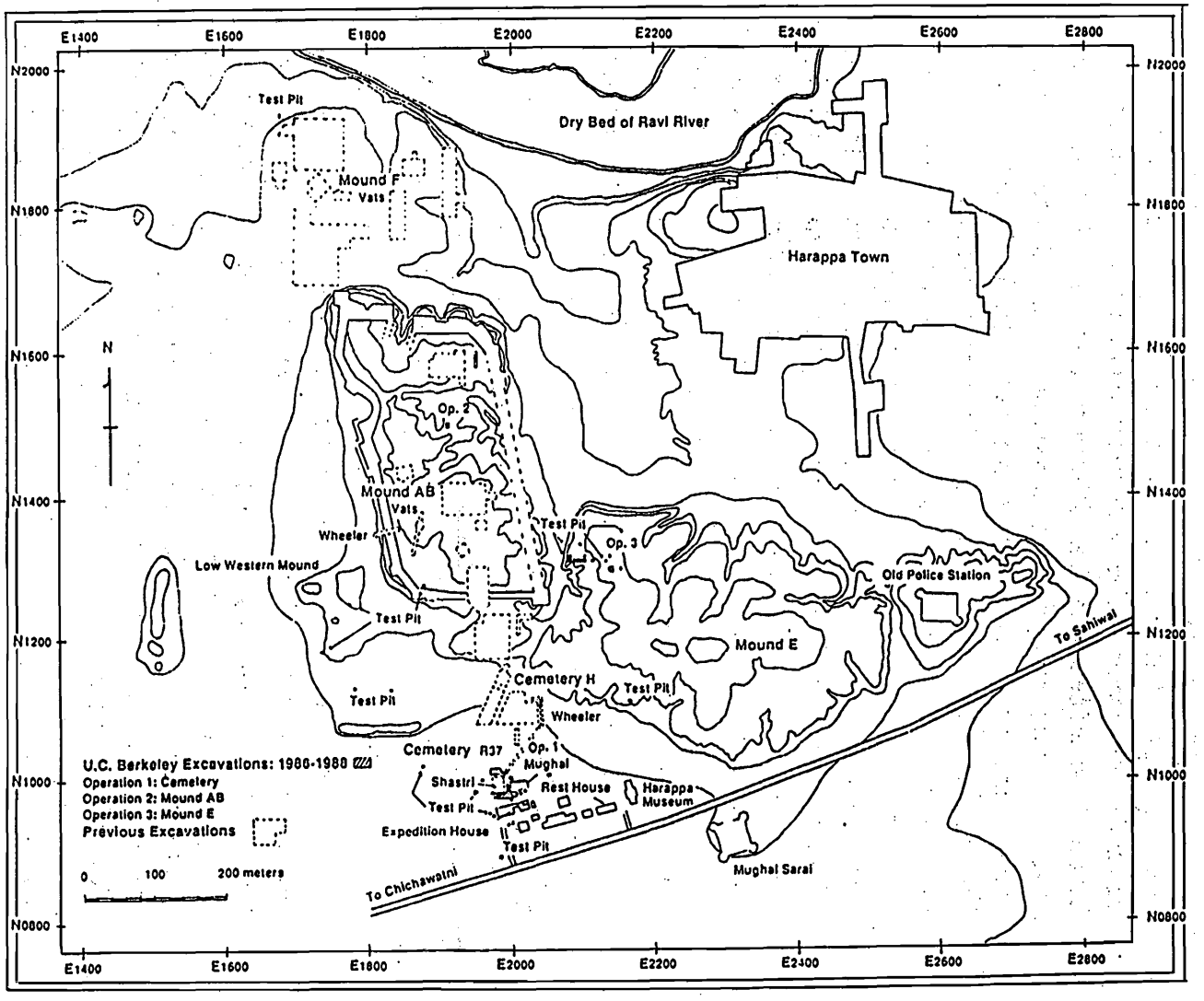



Fig: 27. Harappa: General plan of excavations.

A general survey of the cultivated and inhabited areas to the west and south of the site was made to determine the extent of the cultural debris scatter. The fields and habitations north of the site and beyond the dried bed of the Ravi River were also examined to see if there were any remnants of ancient habitation in that direction. Many hamlets and two larger village mounds were examined, but no Harappan artifacts were discovered. The same situation holds true for the modern town of Harappa where recent construction and debris build-up has obliterated any original Harappan or post Harappan occupational deposits. Modern drains, for example, dug to the depth of one meter reveal only recent debris. Nevertheless, the town is in fact built on a portion of an ancient mound which is highest in the north central portion of the town. Areas to the east of the town have only been examined informally and further investigations of the eastern area and the town itself will be undertaken in subsequent seasons.

Several important features of the site have been revealed by the surface surveys. The low mound to the west of the AB mound is made up of Harappan debris, mostly pottery, with no evidence for structures at the surface level. Localized concentrations of chert debris, agate flakes, sandstone/quartzite flakes and vitrified nodules and pottery suggest that the mound may have been an industrial activity area or dump for the city.

Two small test pits, 1 x 2 meters each,were made on the slope and in the center of the mound. These excavations revealed thick debris deposits that have a complicated stratigraphy, suggesting a continuous reworking by human and animal processes during the course of the deposition. Continued excavations during the second season in one pit revealed *in situ* brick alignments and Mature Harappan pottery filled with ash and charcoal at a depth of 4 meters below surface (161.00 msl). Total depth of the pit is at 159.80. These *in situ* features were lying just above natural soil, and indicate the presence of habitation or activity areas some distance west of the main mound at what may be a very early period in the accumulation of cultural sediments.

On the plain just south of this low western mound, two other test pits revealed the presence of additional Harappan brick structures occurring 0.5 to 1.0 meter below the surface, associated with thick debris

layers. Further excavations will be required to define the relationship of these features more clearly and tie them in with the main habitation deposits of mound AB. Even further west of the main mound are several other long low mounds that are covered with Harappan sherds and artifacts. However, their east-west, or north-south orientation at the edges of modern fields suggest that they are the result of repeated scraping or grading of the adjacent fields to remove potsherds, nodules and saline soil. Test pits will be required in the future to determine whether these mounds are ancient features or if they are the result of historical or modern agricultural activities.

Fields to the west of the known cemetery area showed distinct north-south oriented oblong patches of lighter coloured crops. It was thought that these might represent burials and that there was a western extension of the Harappan cemetery. As will be discussed in more detail below, excavations in the third season revealed that these patterns do in fact represent burials of the Harappan period.

The extensive southeastern mound (Mound E) has many interesting surface features some of which were explored during the third season through selected horizontal excavations and random test pits. Along the southern slopes of the mound are numerous surface indications of *in situ* Harappan structures marked by brick walls, mud brick platforms, sump pits and horizontal habitation deposits. Numerous crafts activity indicators were found along the southern slopes and on the farthest eastern portion of the mound (where the Old Police Station is located). The crafts include copper smelting, agate bead manufacture, stone tool manufacture, shell working and possibly wood working (represented by chert drills). The northwestern slopes of this mound have revealed an ancient kiln, *in situ* drains and habitational debris that reaches a height of 9.5 meters (172.50 msl) above the level of the ancient Harappan surface of the cemetery (163.00 msl). Mound AB is only slightly higher, at approximately 11 to 12 meters above the cemetery (about 175.00 msl.).

Fragments of Cemetery H pottery were found on the surface of the northwest corner of Mound E, but excavations in three test squares (3 x 2.5 meters each) during the second season did not locate any Cemetery H sherds in the first meter of deposit. During the third

season, renewed surface surveys on the northwestern slope revealed more Cemetery H sherds and excavations on the crest and slope exposed stratigraphic deposits with considerable quantities of Cemetery H cultural material. While some of these deposits appear to be slope wash and are mixed with earlier Mature Harappan material, other strata appear to represent undisturbed Cemetery H or late transitional Harappan habitation deposits.

Although the northern and eastern areas of Mound E are continuously being disturbed and eroded by the present day inhabitants of Harappa town, we were able to identify major occupational deposits in sections of the gullies and collect numerous Harappan artifacts such as stone tools, beads, and terracotta objects. The top of E mound is covered with trees and thick aeolian sediments mixed with tiny potsherds and occasional artifacts. Square or rectangular shaped surface features are found scattered across the entire length of the mound and they are oriented in many different directions. Some of these resemble eroded mud brick walls, but there is no indication from pottery or other surface artifacts as to their chronological position, and although Harappan pottery is found all over the top of the mound, it is quite possible that these structures are of later, perhaps recent, date. In 1987, test excavations in a clear area of the northwestern corner of Mound E revealed that at least one group of these features is the result of shallow rectangular pits, probably dug by brick robbers. The dirt and brickbats from the pits were piled along the edges giving the impression of walls. Islamic period coins have been recovered just on the surface. The pits themselves had been filled with aeolian sediments from which fragments of glass and a cowrie shell *(Cypraea monetas)* were recovered. Directly beneath these pits are remains of mud brick and baked brick walls associated with Harappan pottery and artifacts. Additional test pits and continued excavations in this area of the mound in 1988 confirmed the fact that the uppermost layers of baked brick architecture had been robbed of bricks, and an East India Company two anna coin dated to 1843, Victoria Queen, provides a bit of dated evidence for the brick robbing activities. Beneath the disturbed layer however, are well defined Harappan architectural units associated with streets, drains and sump pits.

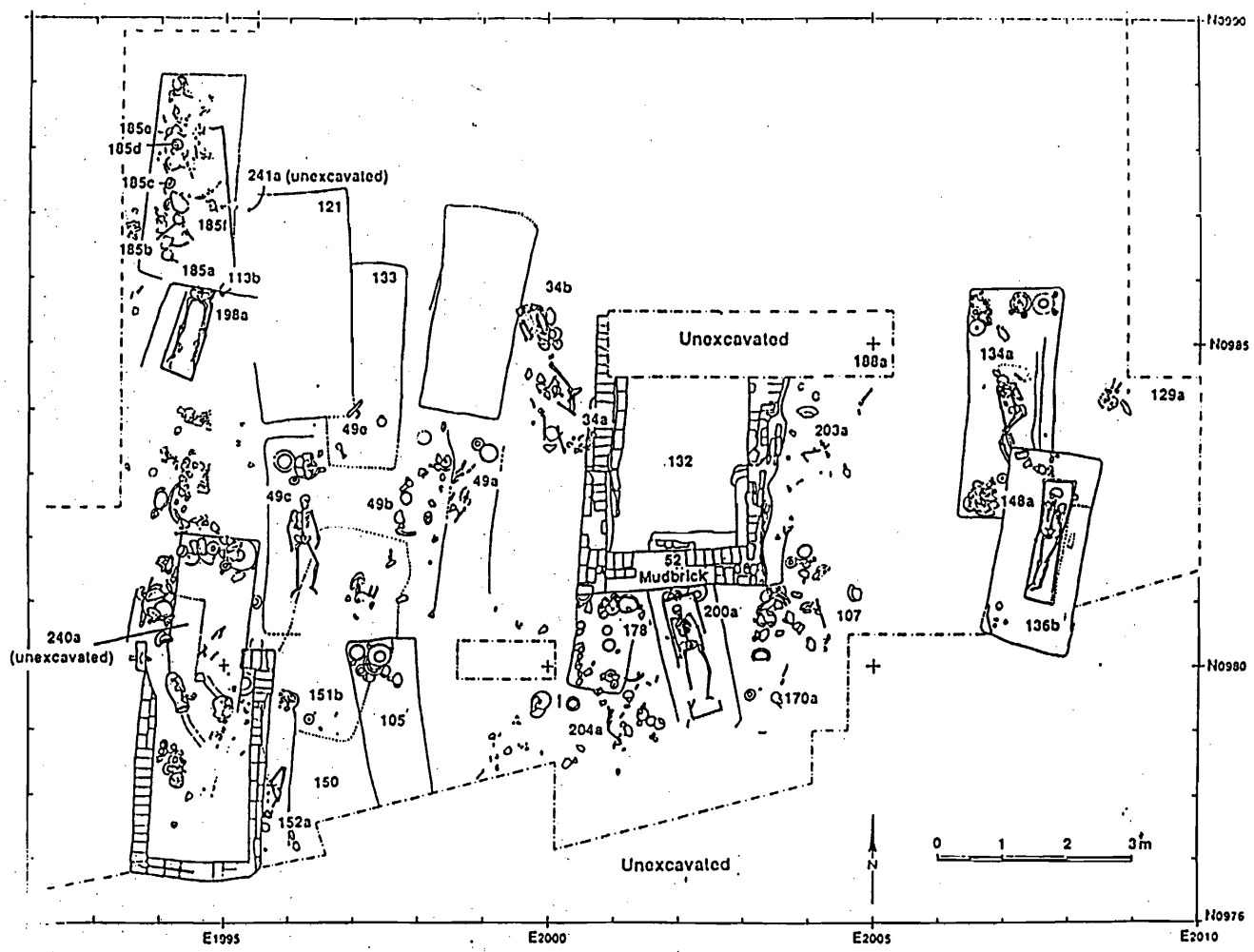



Fig: 28. Harappa: General plan of Cemetary excavations (upper levels).

One additional area of interest is on top of Mound AB at the southeastern corner of the area with the covered drain, excavated by Vats (E1990, N1390). Here, numerous pieces of sawn steatite and a vitreous slag from what may be faience production were found on the eroded sections. The deposits from which these materials are eroding are visible on both sides of the walkway that cuts through the site. They may be the result of workshop debris having been dumped as fill between or inside other structures by the Harappans. Nevertheless, their presence in this area of the site may be significant if this type of production is not found in other areas of the site.

**B. Cemetery Excavation**

I. GENERAL DESCRIPTION

The main focus during the first two seasons and part of the third season has been the delimitation and excavation of the Harappan cemetery (Fig. 28, 29 & 30). This cemetery was first discovered and excavated by K.N. Shastri in 1937-41, and subsequent excavations were carried out by Sir R.E.M. Wheeler in 1946 (Wheeler 1947 and 1968) and Dr. M. R. Mughal in 1966 (1967). Shastri's excavations were never published and most of our information regarding the extent and nature of the cemetery has been gleaned from published reports by Wheeler and Mughal, as well as much appreciated discussions with Dr. Mughal. During the 1988 season, a file containing part of Shastri's original typed manuscript was located. It is currently being prepared for possible publication by the Department of Archaeology.

Except in areas where previous sections and excavations had already exposed the stratigraphy or skeletons, a systematic stratified random sampling strategy was used. A five meter grid was laid out over the entire area selected for investigation and 1 x 2 meter random text pits were excavated in each five meter square to determine the nature of the stratigraphy and to locate human skeletal remains. Nine test pits dug during the first season were directed towards determining the southern, eastern and western extension of the Harappan cemetery. In five of these pits, evidence for burials or human bone were recovered. During the second season, eight out of eleven test pits

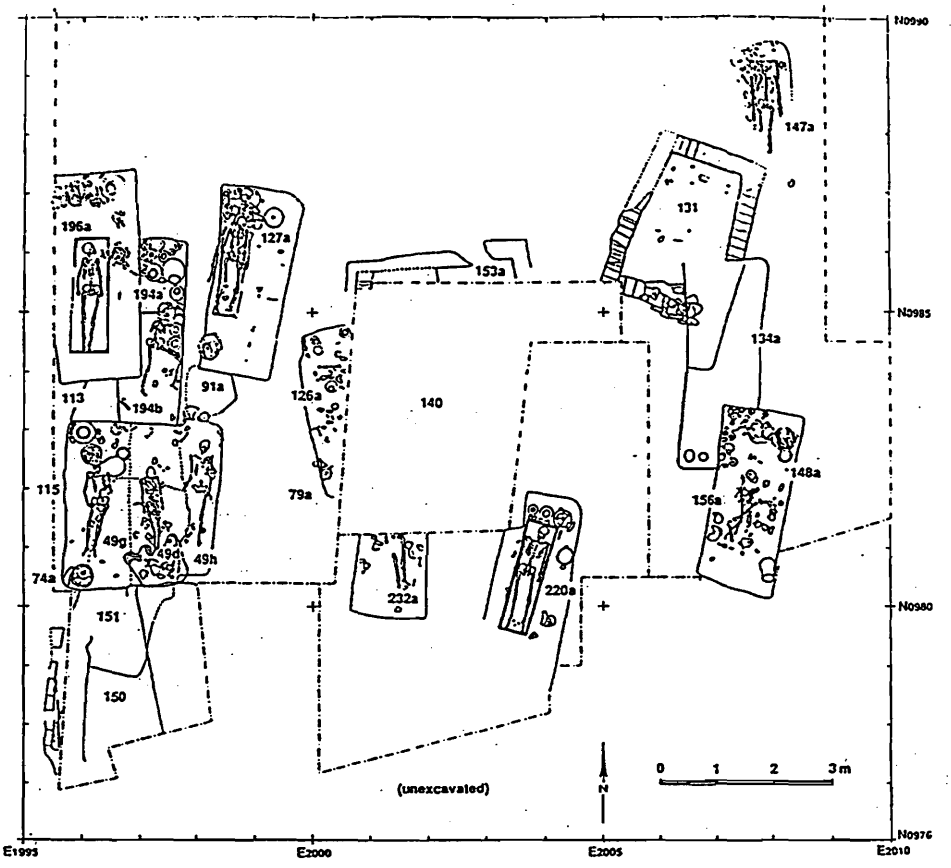



Fig: 29. Harappa: General plan of Cemetary excavations, (lower levels).

turned up primary context or eroded burials. In the third season, six random test pits and several selective excavations were made. Three of the test pits revealed the presence of primary or secondary context burials and the others served to confirm the southern periphery of the cemetery area.

Excavations in 1988 also confirmed the presence of a western extension of the cemetery in fields to the west of the protected site. (Fig. 31) These fields have been irrigated for at least the last 60 years, but distinct north/south oblong patches of lighter coloured vegetation suggested the presence of subsurface features. A test pit (Grid coordinates E1948-1950, N981-982) revealed the presence of

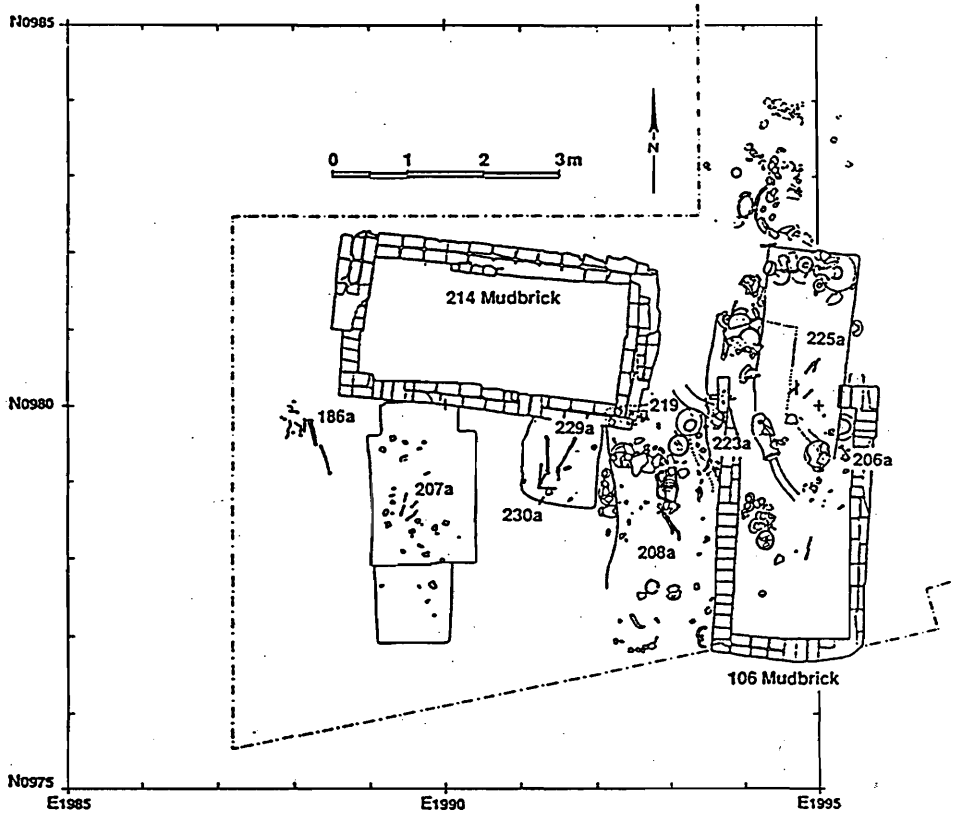



Fig: 30. Harappa: General plan of Cemetary excavations, (upper levels, western extension).

primary and secondary burials, as well as scattered human bone that appears in the fill of the grave shafts and therefore is the result of Harappan activity.

The uppermost levels of debris that protected the cemetery to the west have been removed by the farmers to get to the rich alluvium. This has exposed the uppermost burials to intensive plow zone disturbance and these burials have been almost totally obliterated. However, the lower burials are in quite good condition and even though the area exposed was quite small, it indicated the same type of intensive use of this part of the site for burial purposes. Due to limited time and the presence of standing crops, further excavations were not conducted in these fields. However, another test pit

(E 1968-1970, N 951-952) directly south of the known cemetery revealed the presence of burial pottery, a copper mirror and disturbed skeletal material.

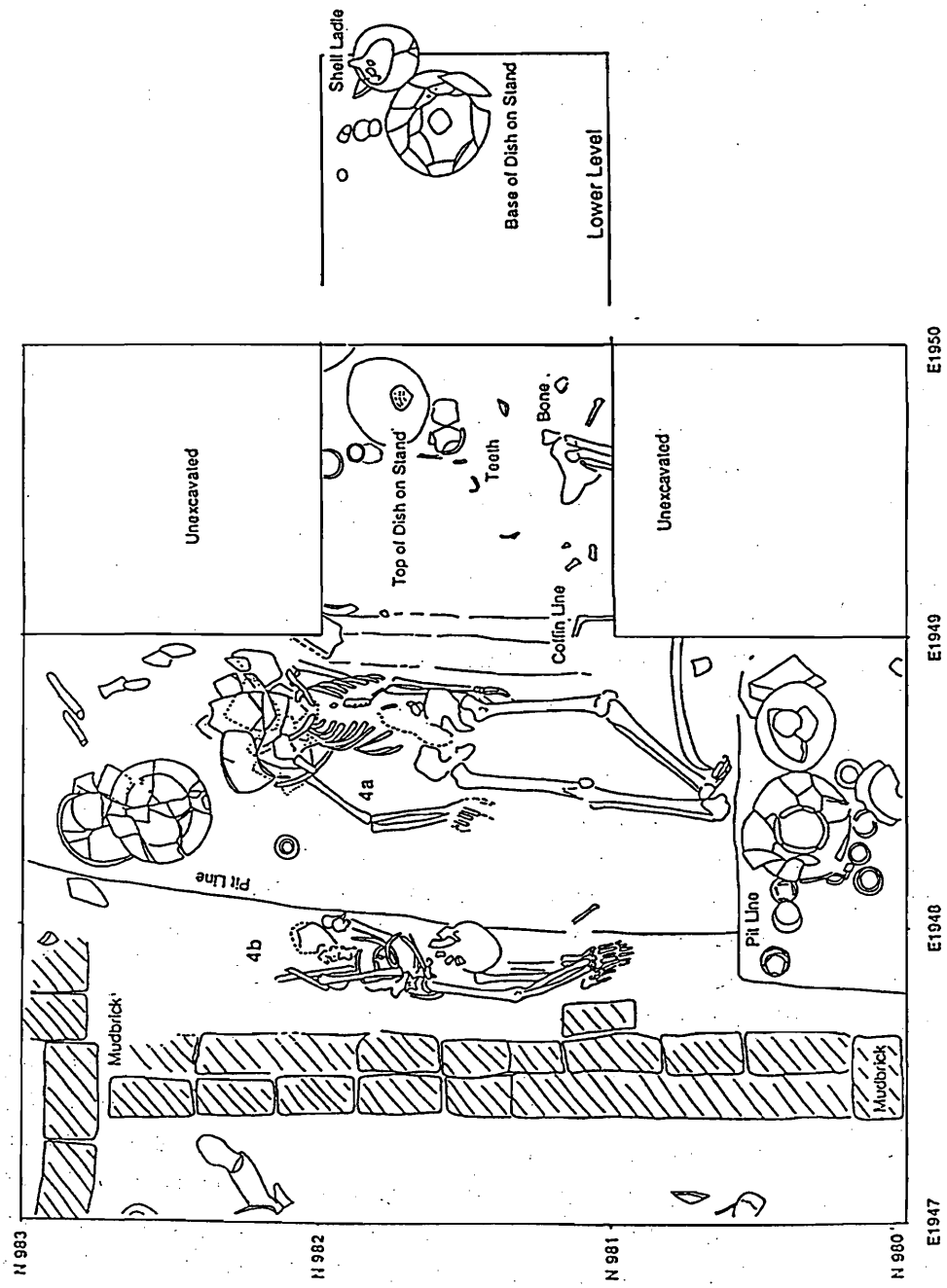



Fig: 31. Harappa: Cemetary excavations, burials in fields west of R. 37.

Two additional, non-random test pits were excavated further to the south ( E1995–1997.75, N 940.50–943; E 1980.25–1983, N890.80–891.80) and these revealed eroded cultural material, including possible burial pottery and some human bone.

The results of the test pits and horizontal exposures in the cemetery area of the site indicate quite clearly that the main concentration of *in situ* burials is along an east-west section just north of the modern irrigation ditch at the northwestern corner of the Museum "campus" (Fig. 27). To the south of the ditch are disturbed and eroded burials, to the east are eroded sediments with a thick overburden of Harappan period debris, while in the west the cemetery extends for another 60 to 70 meters in the area of modern fields. The northern limit of the primary context burials can be defined on the basis of our recent excavations and those of Wheeler. We are currently in the process of determining the total area and calculating the concentrations of burials in the remaining portions of the cemetery in order to arrive at some understanding of the nature of our present sample of skeletal and cultural material. A large amount of skeletal material has been recovered and the total number of burials and groups of scattered bone from 1987 and 1988 are listed in Table 1. However, at this time it is not possible to provide a total number of burials or minimum number of individuals excavated because the detailed analysis of the bones, the stratigraphy and the artifacts must first be completed. At this point it can be suggested that this cemetery may represent only a small segment of the population of the ancient city, and there may be other contemporaneous cemetery areas in other parts of the site. The preliminary description of the skeletal remains is presented below by the physical anthropologists.

In terms of excavation procedures, all of the soil from the random test pits and burial areas was screened and all artifacts, including tiny potsherds and bead fragments were collected for further analyses. The vast amounts of soil from the thick debris layers was carefully examined by hand and the pottery was picked out for tabulation. Details of the systematic procedure for recording and coding stratigraphic layers, archaeological features and artifacts will be presented in the final report.

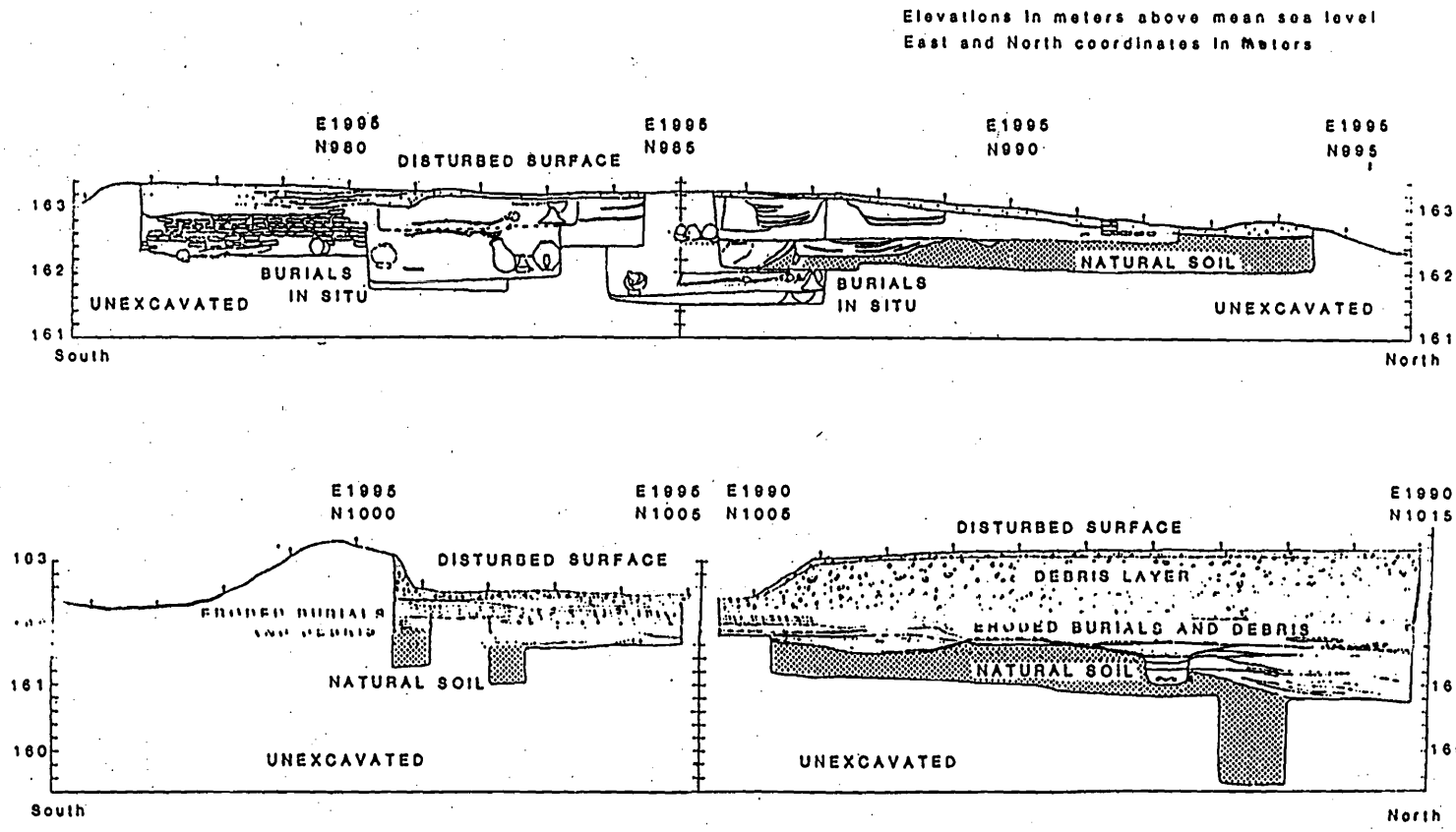



Fig: 32. Harappa: Cemetary excavations, North-south section.

## 2. CEMETERY STRATIGRAPHY

The ancient Harappan burials were dug into natural soil of what may be a Pleistocene terrace or ridge (Fig. 32). The ancient land surface was heavily eroded during the Harappan occupation of the site, resulting in the displacement and erosion of large areas of the cemetery. An area forming an east-west ridge just north of the irrigation ditch is the uneroded A horizon of the Harappan period. The ancient surface slopes away in all directions, but the major direction of erosion appears to have been south to north and also west to east. Eroded burials and debris form layers of variable thickness which lie unconformably on the natural soil. The eroding surfaces of the cemetery were covered by a massive layer of Harappan debris—mostly ceramics—except in the area just north of the irrigation ditch where the ancient A horizon has been identified. To the west, there are modern fields and it appears that through repeated scraping, the farmers have removed all of the overlying debris, exposing the natural alluvium in which the Harappan burials occur.

*Debris Layer:* The massive debris layer is made up of enormous quantities of Harappan potsherds, some 40% of which are the so-called pointed base goblets. Overfired clay nodules, charcoal, animal bone, and a range of small artifacts of stone, paste, faience and terracotta are also found in these layers. This debris layer seems to have been derived from the main habitation areas to the north and east and is the result of intentional dumping, rather than gradual build-up as would happen in a habitation area. No structures or hearths have been noted in this deposit. The chronological period of the dumping cannot be defined at this time, but it appears to span the Mature Harappan period.

*Erosion Layers:* The ancient eroded surface is made up of fine sandy silts and silty clays, with gravelly layers made of tiny potsherds and broken artifacts such as steatite disc beads. There are also pockets of large, sherds and collections of human bone. Most of the material in these layers appears to have eroded out of Harappan burials, although

some of the material is also derived from the edges of ancient debris dumps. This suggests that the accumulation of debris and the erosion of parts of the cemetery were contemporaneous.

*Natural Soil:* The ancient land surface consists of a well developed soil of fine sandy silt to silt-clay loam, yellow-brown to light brown, with distinct horizons of calcium carbonate nodules (kankar). A considerable number of samples of the natural soil have been collected from the cemetery and surrounding areas by coring with a hand powered core drill. These soils are being fully studied by Dr. Ron Amundson and Elise Pendall at U.C. Berkeley and a summary of their report is also presented below.

**TABLE 1.—HARAPPA 1987-88: PRELIMINARY TABULATION OF BURIALS**

| Season | Lot | Feature | General Description | General Context |
|---|---|---|---|---|
| 87 | 13/39 | 23a | skeletons | secondary/wash |
| 87 | 25 | 18a | mandible | secondary/wash |
| 87 | 35 | 29a | misc bone | secondary/fill |
| 87 | 36 | 30a | mandible | secondary/debris |
| 87 | 37 | 31a | mandible | secondary/wash |
| 87 | 38 | 32a | cranium frags | secondary/wash |
| 87 | 40 | 34a | misc bone (9 MNI) | secondary/fill |
| 87 | 47 | 41a | misc bone | secondary/wash |
| 87 | 53 | 49a | partial skeleton | disturbed/in situ |
| 87 | 53 | 49b.1 | skull | secondary/fill |
| 87 | 60 | 46a | misc bone | secondary/wash |
| 87 | 71 | 61 | misc bone | secondary/wash |
| 87 | 72 | 49c | skeleton | in situ |
| 87 | 72 | 49d.2 | skeleton | in situ |
| 87 | 72 | 49h.1 | skeleton | in situ |
| 87 | 72 | 49g | skeleton | in situ |
| 87 | 85 | 74a | skull | secondary/fill |
| 87 | 89 | 34b | 1/2 skeleton | in situ |
| 87 | 90 | 79a | misc bone | secondary/fill |
| 87 | 91 | 80a | skull & bones | secondary/wash |
| 87 | 92 | 81a | skull & bones | secondary/wash |
| 87 | 95 | 84a | misc bone | secondary/wash |
| 87 | 98 | 92b | misc bone | secondary/fill |

Table 1.—Contd.

| Season | Lot | Feature | General Description | General Context |
|---|---|---|---|---|
| 87 | 105 | 90a | misc bone | secondary/fill |
| 87 | 107 | 94a | misc bone | secondary/wash |
| 87 | 108 | 126a | misc bone | secondary/fill |
| 87 | 113 | 122a | misc bone | secondary/fill |
| 87 | 114 | 127a | skeleton | in situ |
| 87 | 116 | 128a | mandible | secondary/fill |
| 87 | 117 | 129a | "skull, vert." | secondary/wash |
| 87 | 118 | 130a | tooth | secondary/wash |
| 87 | 120 | 132a | cranium frag | secondary/fill |
| 87 | 124 | 136a | misc bone | secondary/wash |
| 87 | 124 | 136b | mandible, misc bone | secondary/wash |
| 87 | 128 | 138a | misc bone | secondary/fill |
| 87 | 131 | 142a | misc bone | secondary/fill |
| 87 | 136 | 147a | skeleton | in situ |
| 87 | 137 | 148a | skeleton | in situ |
| 87 | 137 | 148b | misc bone | secondary/fill |
| 87 | 140 | 151 | misc bone | secondary/wash |
| 87 | 141 | 152a | skeleton | in situ |
| 87 | 145 | 156a | skeleton | disturbed/in situ |
| 88 | 159 | 168a | cranium frag. | secondary/wash |
| 88 | 161 | 170a | misc bone | secondary/wash |
| 88 | 180 | 170a | skull | secondary/fill |
| 88 | 162 | 121b | cranium frag. | secondary/fill |
| 88 | 165 | 173a | misc bone | secondary/fill |
| 88 | 170 | 177a | tooth | secondary/wash |
| 88 | 171 | 178a | misc bone | secondary/wash |
| 88 | 172 | 133a | misc bone | secondary/fill |
| 88 | 174 | 126b | misc bone | secondary/fill |
| 88 | 178 | 184a | misc bone | secondary/fill |
| 88 | 179 | 151b | misc bone | secondary/fill |
| 88 | 183 | 185a | skull | secondary/fill |
| 88 | 191 | 185b | skull | secondary/fill |
| 88 | 191 | 185c | skull | secondary/fill |
| 88 | 191 | 185d | skull | secondary/fill |
| 88 | 191 | 185e | skull | secondary/fill |
| 88 | 191 | 185f | misc | secondary/fill |
| 88 | 185 | 186a | articulated arm | disturbed/in situ |
| 88 | 187 | 188a | infant cranium/teeth | secondary/fill |
| 88 | 196 | 198a | 1/2 burial | in situ |
| 88 | 190 | 113a | misc bone | secondary/fill |
| 88 | 193 | 195a=121b | misc bone | secondary/fill |
| 88 | 194 | 196a | full burial | in situ |
| 88 | 197 | 194a | full burial | disturbed/in situ |
| 88 | 197 | 194b | infant burial | disturbed/in situ |
| 88 | 197 | 194c | misc bone | secondary/fill |

Table 1.—Contd.

| Season | Lot | Feature | General Description | General Context |
|---|---|---|---|---|
| 88 | 198 | 200a | full burial | in situ |
| 88 | 200 | 203a | misc bone | secondary/fill |
| 88 | 201 | 204a | partial burial | disturbed/in situ |
| 88 | 203 | 205a | tooth | secondary/fill |
| 88 | 204 | 206a | misc bone | secondary/fill |
| 88 | 205 | 207a | burial (unexcavated) | in situ |
| 88 | 206 | 208a | skeleton | in situ |
| 88 | 210 | 214a | misc bone | secondary/fill |
| 88 | 211 | 215a | misc bone | secondary/fill |
| 88 | 212 | 216a | misc bone | secondary/fill |
| 88 | 216 | 219a | skull | secondary/fill |
| 88 | 217 | 220a | full burial | in situ |
| 88 | 219 | 223a | misc bone | secondary/fill |
| 88 | 221 | 225a | partial burial | disturbed/in situ |
| 88 | 222 | 226a | misc bone | secondary/fill |
| 88 | 225 | 229a | partial burial | in situ |
| 88 | 226 | 230a | cranium frag. | secondary/fill |
| 88 | 228 | 232a | 1/2 burial | in situ |
| 88 | 230 | 235a | misc bone | secondary/fill |
| 88 | 234 | 238a | no bone | burial pit |
| 88 | 235 | 240a | burial-unexcavated | in situ |
| 88 | 236 | 241a | burial-unexcavated | in situ |

## 3. BURIAL TYPES

The Harappan burial customs as reflected in this cemetery appear to have been relatively standardized. The vast majority of the burials are *primary* burials and these are located along the east-west ridge that represents the undisturbed Harappan land surface. All of the primary burials are in distinct rectangular pits oriented north-south (Fig. 28, 29 & 30). One relatively distinctive *secondary* burial has been found in the western extension of the cemetery (Fig. 31; Lot 439, Feature 4b). Also there are numerous examples of bone being collected and dumped or buried in the fill of a grave shaft or on the sloping surface next to a grave shaft in ancient times. Because these collections of bone are invariably mixed with broken burial pottery they possibly represent the clearing of earlier burials to make room for subsequent inhumation. The practice of digging into a previous burial to make a new grave shaft is further documented by the fact that the fill in every grave shaft contains isolated fragments of human bone and often

complete bones; in one case a complete skull. Both of these types of occurrance are grouped together and their context referred to as *secondary context/fill* to distinguish them from actual secondary burials.

Another context for the discovery of human bone is the eroded surface of the cemetery that was subsequently covered by the debris layer. These eroded burials are no longer in situ and are referred to as *secondary context/wash* or *secondary context/debris* (Table 1). Secondary context/debris means that the human bone was found in the debris layer itself, but because all of the human bone in the debris layer occurs at the interface between the debris layer and the eroding cemetery surface, this bone is assumed to have been derived from the cemetery and is probably not a part of the debris that was brought to the cemetery for disposal.

Most of the burials have been disturbed by the intensive use of this area by the Harappans themselves. They dug into previous burials to make room for later burials, disturbing or entirely removing the earlier skeletons and burial pottery. From the preliminary observations of the burials, it appears that there were several methods of burial with a wide variation of burial goods. The most common form of primary burial was extended and supine, with the head to the north and the feet to the south. The orientation of undisturbed burials ranges from 9° East of true North to 2° West of true North. Since these burials are not all contemporaneous, these orientations may indicate a significant fluctuation of true North over time, or simply a carelessness on the part of the grave diggers.

Numerous burials excavated during 1987 and 1988 had traces of wooden coffins, that were approximately half a meter wide and 1.7 to 1.9 meters long. The walls of the coffins were 2 to 3 cm thick. The outlines of the coffins were indicated as dark stained soil and no traces of preserved wood could be identified. Two coffin burials had what appears to have been a lid, and samples were collected for possible identification.

The range of burial goods included quantities of pottery vessels usually arranged at the head and foot of the grave shaft. In

some burials the pottery was placed in the grave first and then partially covered with soil. The body was placed level with the top of the pottery, after which the grave was completely filled with soil. The subsequent weight of the soil often crushed the coffin and underlying pottery, resulting in a disturbed burial. Some of the later burials that cut into and disturbed the earlier burials were furnished with only a few vessels or no burial pottery at all.

Preliminary analysis of the ceramics suggests that the painted pottery is generally limited to the lowest and hence earliest burials, while in the later burials most of the pottery is unslipped and unpainted. There are a few exceptions to these patterns, for example some of the pottery in one of the latest burial groups had what appears to have been an intentional coating of gypsum plaster. In another burial, one of the earliest ones, the painted pottery was covered by a plain red slip that may have been fired. The slip was slightly fugitive, but it is quite evident that the intention was to cover the painted design. There may be several explanations for this covering, among which can be suggested that it was applied to cover over the black design for some religious reason. Ethnographic accounts in tribal India describe some practices where the decorations enjoyed on pottery by the living become taboo upon the death of the owner. On the other hand the covering may have been applied to protect the design from the destructive effects of the soil after burial; or numerous other reasons.

Significant new aspects of Harappan ornamentation are seen in these burials, including shell bangles, a copper ring, steatite/serpentine disc beads, carnelian and lapis lazuli beads, short cylindrical gold beads, black stone amulets and a unique head ornament made of three shell rings, a jasper bead and numerous strands of thousands of steatite microbeads. (This was cleaned and consolidated at the Smithsonian Institution's Conservation Analytical Laboratory and is currently on display in the Harappa Museum). At this stage it is difficult to discuss the presence or absence of significant status indicators, but the overall impression is that persons buried in this cemetery were not from greatly diverse socio-economic segments of society. However, there were some individuals with relatively simple burials, containing modest numbers of pottery and no ornaments, while others had more pottery and quite striking ornaments.

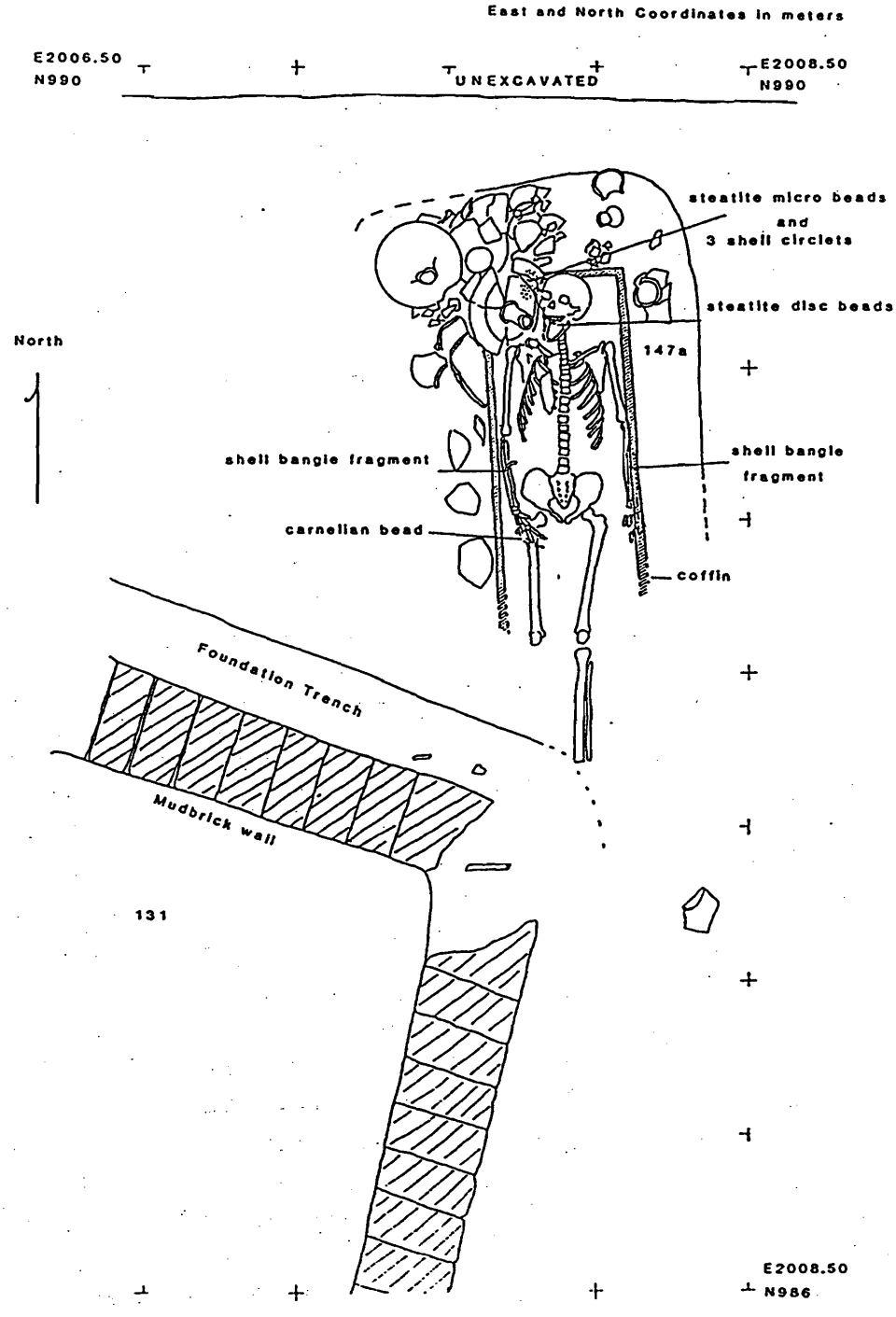



Fig: 33. Harappa: Plan of Adult male burial - 147a.

An example of a simple burial (Fig. 29; Lot 220, Feature 220a) is a man buried in a coffin with no ornaments and only 9 pottery vessels arranged at the head of the pit. The dirt piled on top of this coffin contained a skull and numerous human and animal bones that were derived from earlier burials. Another burial (Fig. 29; Lot 198, Feature 200a) was of a woman, also in a coffin, with two shell bangles on the left arm and five carnelian beads lying on the right side of the pelvis. Beneath her was a collection of some 9 pottery vessels.

In contrast to these burials is a burial of a man (Fig. 33; Lot 136, Feature 147a) who was buried in a coffin with over a dozen vessels arranged at the head of the pit and additional vessels along the side of the pit. On his left wrist was a shell bangle and near the right hand a carnelian bead. The most striking ornament (mentioned above) was found lying to the right of his head: the complex of two or three shell rings, a jasper bead and thousands of tiny microbeads twisted together in circlets or bunches. Another more elaborate burial is of a woman and child who had apparently died after child birth (Fig. 34; Lot 197, Feature 194 a and b). There was no trace of a coffin, but the skeleton looked as if it had been disturbed after interment. This burial had 33 pottery vessels arranged at the head and alongside the body. Many of the vessels were painted with elaborate black designs on a red background. A lead/orpiment rod (orange to yellow mineral) was found near her head, possibly used as a pigment for personal decoration.

Another burial was of an older man (Fig. 34; Lot 194, Feature 196a) who had been buried in a coffin. It is possible that he was also bound in some type of tightly wrapped shroud. Most striking was the fact that he had a magnificent necklace of 340 steatite disc beads and three beautiful stone beads, of jasper, onyx and faience with gold finials (caps on the ends). The pottery with this burial was all of plain or red slipped wares, but two unfired pots were found crushed beneath one of the larger vessels. This is an important discovery that will provide some new data on the types of clays used in the manufacture of pottery.

### C. Physical Anthropology Report

The physical anthropology team at Harappa was closely involved with the excavation and removal of all skeletal

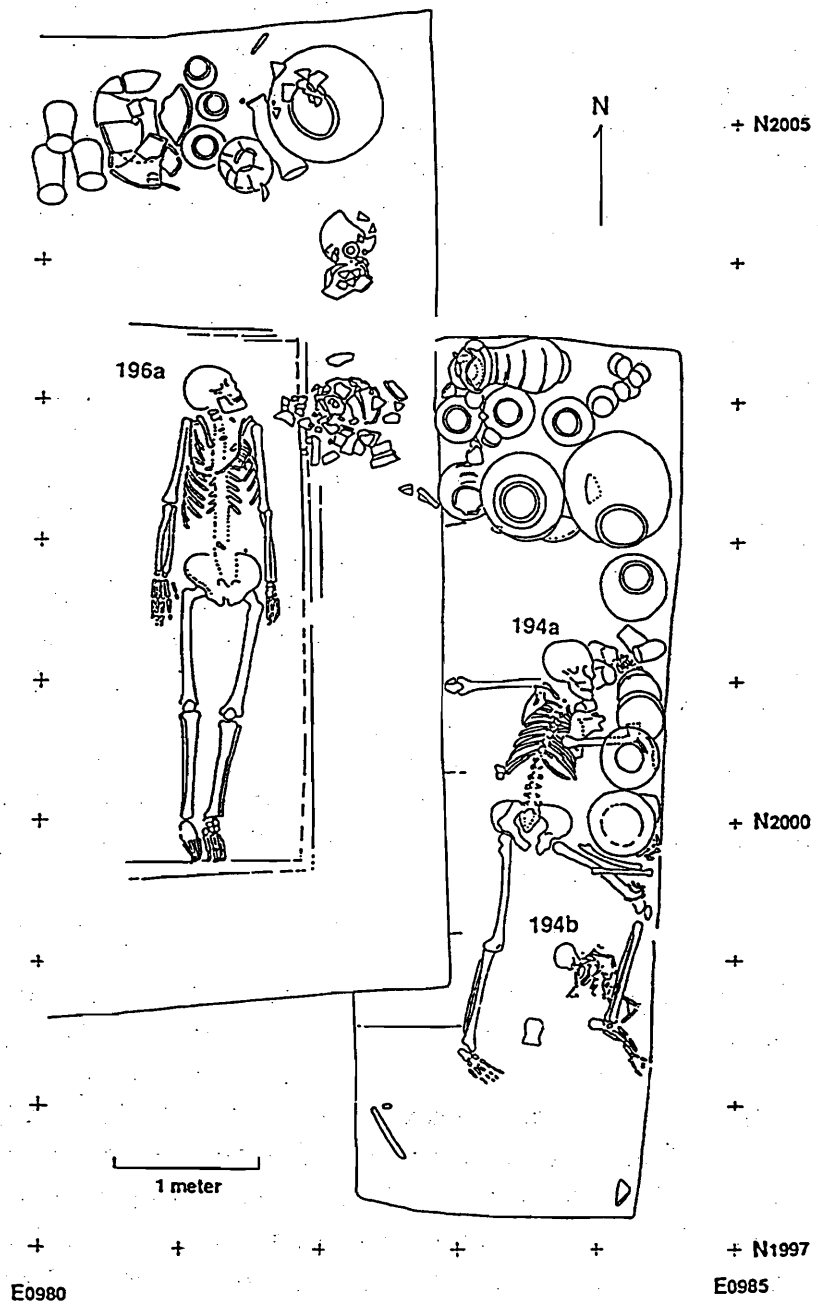



Fig: 34. Harappa: Plan of Adult male burial - 196a. Adult female and infant burials 194a and 194b.

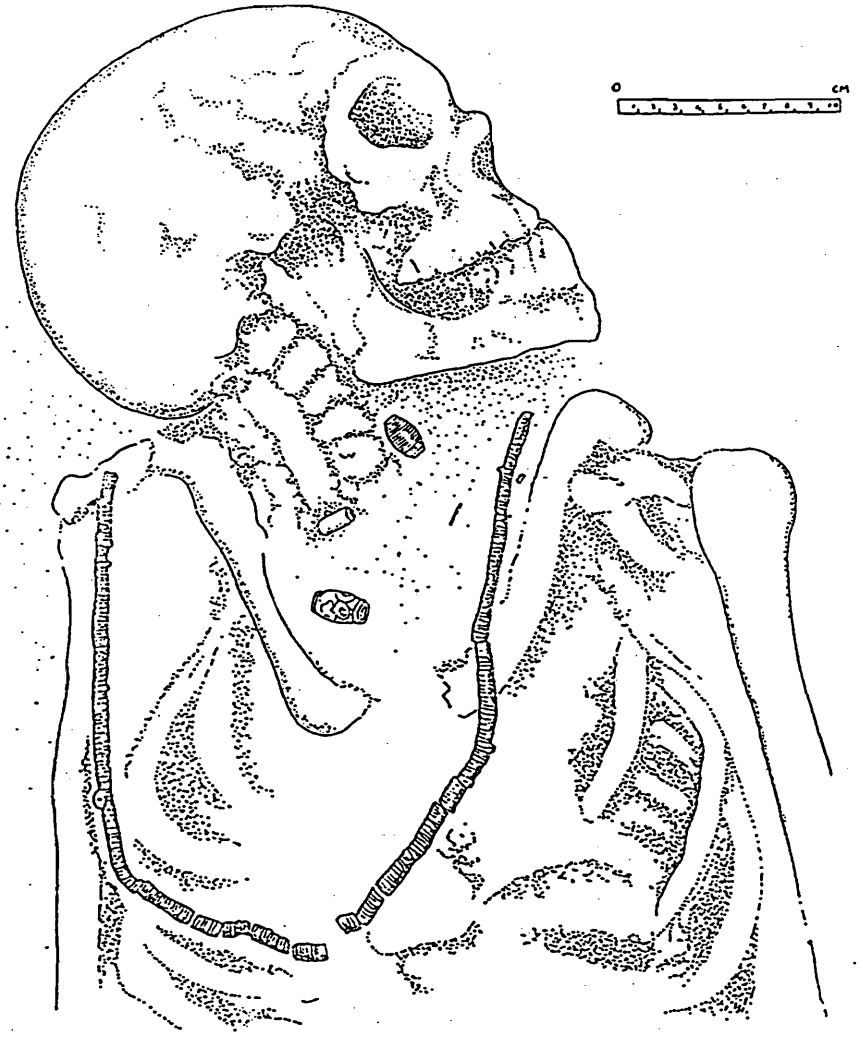



Fig: 35. Harappa: Sketch of Adult male burial 196a.

materials. They also were responsible for the preparation (cleaning, consolidation, repair), identification, inventory and documentation with photographs and radiographs of the various skeletons. Specific samples of bone for stable isotope and trace element analyses, were also collected. The analysis of human skeletal materials has been divided between the four physical anthropologists: morphometric analysis is being carried out by Kenneth A.R. Kennedy, Nancy C. Lovell is investigating paleopathology and paleodiet, John R. Lukacs is analyzing the dental materials, and Brian E. Hemphill is focusing on discrete traits analysis.

## MORPHOLOGY, DIET AND PATHOLOGY

*K.A.R. Kennedy and Nancy Lovell:*

The analysis to date of the skeletal remains excavated during the 1987-1988 seasons has identified a minimum of thirty-four complete, or nearly complete discrete individuals. Many more partial and isolated skeletal finds are still under analysis in the context of their archaeological find spots, so the total number of individuals will be considerably higher when the analyses are completed. As for the thirty-four discrete individuals described fully to date, the paleodemographic distribution is as follows:

| Sex | |
|---|---|
| Males | 10 |
| Females | 17 |
| Sex Uncertain | 7 |
| | N = 34 |

| Age | |
|---|---|
| Infant (less than 3.5 yrs.) | 2 |
| Child (3.5—12 yrs.) | 1 |
| Juvenile (12.5—15 yrs.) | 0 |
| Young Adult (16—35 yrs.) | 18 |
| Middle-aged Adult (36—55 yrs.) | 11 |
| Older Adult (greater than 55 yrs.) | 0 |
| Adults of uncertain age | 2 |
| | N = 34 |

Among the unusual discoveries during the 1988 season, were two infant skeletons. In 1987 no infants were discovered. This absence was noted as "unusual" in the 2nd Preliminary Report, but it is now clear that it was an artifact of sampling error. However, the apparent predominance of females over males, and the preponderance of young adults, requires further evaluation and interpretation, which will be aided by comparison with the sex ratios of burials from previous excavations at Harappa.

Another interesting but enigmatic burial is that of a young woman, positioned face down, with an infant under her lower right leg (see above for the description of the archaeological context of this unusual burial). Examination of the long bone lengths for the infant indicate that it is certainly very young, perhaps a newborn. Scars of parturition ("birth scars") occur on both pubic bones of the female, a sign which is usually taken to mean that the woman had given birth to at least one child a year or more before her death. There is no positive way to establish if the infant with this female is her own, but the circumstances of burial strongly suggest this. The age of the female at time of death is estimated to be between 21 and 25 years.

Preservation is a problem with the Cemetery R37 skeletal materials, since the alkaline soil has destroyed much of the cancellous bone in skeletons buried close to the present day surface (Pl. XXI). The ratio of relatively complete to fragmentary skeletons has been estimated by Kennedy to be about 1:2. The diagenetic problems have prevented the chemical analyses from providing the information we had anticipated(discussed later in this report). However, a study of diagenesis is underway, and we expect that reliable results can be obtained once the sample preparation method has been improved.

**A. Morphometric Analysis**

A preliminary study of the Harappa data indicates that the predominant biological features of this mortuary sample are long and narrow heads, with skulls low relative to length, yet of average height in relation to skull breadth. Faces are generally broad, with a range from narrow to broad, and fairly straight in the vertical plane, but there is some protrusion of the tooth area. Noses are narrow, as are eye orbits. Palates are usually narrow and shallow. All lower jaws are long and narrow. Additional data analyses to be conducted by Kennedy in 1988 and 1989 at Cornell University will involve the following:

— stature estimations based upon statistical regression formulae using long bone lengths.

— identification of markers of occupational stress. These are marks on bone, relating to muscular-skeletal activity, that are recognized as relating to habitual activities during life which produce variations of development in size, shape, and location of ligament attachments. Kennedy is a specialist in the interpretation of these markers of occupational stress.

— comparison of the 1987 and 1988 data with previously excavated skeletal series from Harappa, and with other skeletal series associated with the Harappan Civilization (Mohenjodaro, Chanhudaro, Lothal, Rupar, Kalibangan, etc.).

**B. Paleopathology**

Identification of pathological conditions of the skeletal remains was made in the field through macroscopic and radiographic examination. The health of the new collection of Harappans can be tentatively characterized by a low incidence of traumatic injury, low incidence of chronic infectious disease, and no malignant neoplastic disease. One developmental abnormality, a scaphocephalic skull, was found. No cases of nutritional inadequacy, such as rickets, scurvy, or anemia were identified. However, there are three cases of arrested growth lines appearing on long bones (visible on radiographs), which suggest that growth during childhood was halted temporarily in these individuals. Growth arrest may be caused by malnutrition or other physiological stress such as an acute illness.

Arthritis is the most common condition, and usually appears in the spine, and also in the joints of the knee, hands, and feet (Pl. XX). Arthritic lesions in these locations are common among almost all people of the world, and are usually associated with advancing age. There are several cases of severe arthritis in the neck, including fusion of adjacent elements. This could be associated with unusual stress on the neck vertebrae, such as would occur with carrying heavy loads on the head.

### C. Paleodietary Reconstruction

This aspect of the project was designed to reconstruct subsistence at Harappa using stable carbon and nitrogen analysis. The results of analysis in the 1987-88 academic year were spurious, and the problem, that of diagenetic effects, has been identified. A study of diagenesis has been initiated, and new procedures for sample purification will be used in the coming year. The possibility of differential preservation in the cemetery, as a factor in the isotope results, will also be examined by comparing histological thin sections of bone from burials at different locations and depths within the cemetery. Most of the bone samples obtained in 1987 came from deposits which were closer to the surface and therefore, may have been less well preserved than those obtained in 1988.

## DENTAL ANTHROPOLOGY

*John R. Lukacs:*

This report is a preliminary description of the major pathologies and odontometric features of the Harappan dentition as represented in the sample recovered from the recent excavations; the comparative and interpretive analyses of these data are still in progress.

While human skeletal remains have been recovered from Harappan contexts for several decades,analysis of the dental remains have been sorely neglected and valuable information regarding Harappan dental health conditions and dental morphology were routinely omitted from these earlier investigations.

It is perhaps surprising that our understanding of prehistoric dental variability in the Indian subcontinent is more complete for pre-Harappan (Neolithic Mehrgarh, Baluchistan) and post-Harappan (Inamgaon, western India; Sarai Khola and Timargarha, Pakistan) populations than it is for the Harappans themselves. This incomplete picture of Harappa dental health, tooth size and morphology was part of the rational behind the inception of the University of California

Expedition's excavations at Harappa. The current study of the Harappan dentition will serve to fill a crucial gap in the spatial and temporal database for South Asian dental anthropology.

## A. Materials and Methods

The dental remains on which this report is based were excavated during the winter 1987 and 1988 field seasons from an area commonly referred to as Cemetery R-37. The dental sample on which this study is based was recovered from two different burial contexts—primary and secondary. Primary contexts include undisturbed, or minimally disturbed, burials which contain a compete skeleton in its original burial position. Sixteen primary burials provided dental evidence for inclusion in this investigation. In this report dental remains from primary burial contexts are referred to as the "primary" dental sample. Secondary burial contexts include human remains that have been removed from their original burial context. They usually consist of incomplete skeletal remains that are much more fragmentary than skeletal and dental remains from primary burials. Dental remains from secondary burial contexts that retained teeth in jaw fragments or associations of teeth from one individual are labeled "secondary". Loose teeth from secondary contexts not found in association with other skeletal parts are referred to as "isolated" dental remains. Excluded from this tabulation of dental remains are the numerous fragments of individual teeth, including chips of enamel, dentine and incomplete root fragments.

Dental remains from primary burials comprise 48.1% of the dental sample, secondary dental remains constitute 36.9% of the sample, and isolated dental elements make up only 15.0%. When the dental sample is broken down by sex males (37.4%) and females (38.3%) are equally represented, but nearly one-quarter (24.2%) of the sample comes from skeletal elements of unknown sex.

The range of pathological conditions observed include: abscesses, ante-mortem tooth loss (AMTL),calculus (mineralization of bacterial plaque), caries, hypoplasia (deficiency in enamel thickness due to stress or growth disruption), hypercementosis (accretion of extra

cementum on the dental roots), alveolar resorption (relating to periodontal diseases) and pulp exposure. Standardized methods for quantifying the degree of expression of each condition are thoroughly documented elsewhere (Lukacs 1988b, 1988c). Odontometric analysis of the Harappan dentition utilizes mesiodistal (MD) and buccolingual (BL) crown diameters and their product (MD x BL) the crown area. Methods outlined in Wolpoff (1971) were followed in the metrical portion of this investigation. All measurements were made by the author with a Helios needle-point dial caliper calibrated to 0.05 mm. Crown diameter measurements were routinely rounded to the nearest 0.1 mm.

## B. Dental Pathology

This preliminary assessment of dental pathology at Harappa is divided into two parts. Part one reports the prevalence of dental disease at Harappa on the basis of the number of individuals affected by each disorder (individual count method). The second part provides a more detailed investigation of the prevalence and distribution of dental caries in the Harappan skeletal series (tooth count method).

The prevalence of dental diseases at Harappa are presented by sex and for the total skeletal series (Fig. 48). The sample on which these frequencies are calculated includes all 'primary'context burials (n= 16) and many of the more complete 'secondary' context burials (n= 26). Of the dental disorders documented in this study gross linear enamel hypoplasia was the most frequent, affecting 72.2% of 36 individuals for which observations were possible (Pl. XXIII). The least frequent condition in the series was hypercementosis (4.9%). Dental afflictions of low prevalence in the total sample include abscesses (18.4%) and exposure of the pulp chamber (17.1%). One individual (H87/137/148a) was afflicted by an exceptionally high incidence of dental abscesses, six in the maxilla and five in the mandible (Pl. XXIII). Ante-mortem tooth loss (31.7%), calculus (42.5%), dental caries (43.6%), and alveolar resorption (52.6%) exhibit intermediate frequencies at Harappa.

Sex differences in dental health at Harappa were investigated using the chi-square test of independence. Dental disorders for which statistically significant differences between the sexes exist include AMTL and hypoplasia. The difference in prevalence of caries and pulp exposure between the sexes, while not statistically significant ($p>0.05$), was large and probably of biological significance for the Harappans.

A more precise picture of dental caries prevalence at Harappa is gained by analyzing the data from a tooth count perspective. The overall caries prevalence at Harappa is 6.8% (51; n=751), but noticeable differences exist in caries rate between the upper (9.1%) and the lower (4.8%) jaw, and between the anterior teeth (incisor and canine; 3.8%) and posterior teeth (premolar and molar; 8.4%). It is important to note that if teeth lost prior to death (AMTL) were ultimately lost because of carious decay, then the true caries rate at Harappa would be higher than the 6.8% prevalence rate reported here. The teeth of males and females exhibit similar caries rates throughout the dentition. The one conspicuous exception is the high frequency of caries in the maxillary anterior teeth (incisors and canines) of females. This anomalous deviation from the normal pattern of no caries in anterior teeth suggests important sex based differences in dietary or occupational usage of these teeth among the Harappans.

In addition to mere presence/absence of caries, the size of the lesion and its position on the tooth were recorded. Caries size was classified into four categories: 1) small pit or fissure caries, 2) less than 1/2 the tooth crown destroyed, 3) greater than 1/2 the tooth crown destroyed, and 4) the entire tooth crown obliterated by caries.

Caries location was assessed by noting which surface of the tooth crown was primarily affected. In this analysis caries were scored as occurring on the mesial, distal, buccal, lingual, or occlusal surface of the tooth. In instances where the carious lesion destroyed the bulk of the dental crown mass, the initial location of the lesion remains indeterminate and is recorded as unknown. Three patterns are evident in the caries location data: 1) mesial and distal surfaces are predisposed to caries decay in the maxilla, 2) the buccal surface of mandibular teeth

are primary decay sites due to the buccal groove and pit in mandibular molar teeth, and 3) the high number of unknown caries locations for the maxilla is due to the high percentage of size grade 4 caries: documented above.

One carious lesion that is especially interesting occurs in the RM2 of specimen H87/136/147a. This size-grade 2 caries exposed the pulp chamber of the tooth, resulting in the formation of a small periapical abscess at the disto-buccal root. This lesion undoubtedly caused discomfort in life to the extent that the individual probed and picked at the decaying cavity, probably with a bone needle. This activity practiced habitually over time resulted in the formation of a shallow groove adjacent to the caries lesion. Pressure on the bone needle from the next tooth (RM3) would have been sufficient to create this wear groove. This is the first such association of an interproximal groove with dental caries from the South Asian prehistoric skeletal record.

Two additional observations on caries that provide valuable information for dietary reconstruction include: 1) whether the lesion exposed the pulp chamber of the tooth, and 2) if the caries was located at the dental cervix, the juncture of the tooth crown and root. In this dental sample 49.0% (n=51) of caries lesions penetrated the crown deeply enough to expose the pulp chamber, an event that frequently results in the infection of the pulp chamber, abscessing and subsequent tooth loss. In the carious dental sample 17.6% (n=15) of the caries are located at the cervix of the tooth, while the majority (80.4%) of caries lesions were confined to the 51 caries lesions detected in this study, occurring on the buccal surface of a lower left first molar (H87/71/49c: bag-B).

More detailed statistical analysis of the distributional pattern of abscesses, AMTL, and gross enamel hypoplasia is currently in progress and will be presented elsewhere.

**C. Summary**

The dental pathology profile at Harappa is in agreement with an agricultural mode of subsistence. Prevalence of dental pathology

when assessed by a tabulation of individuals reveals gross enamel hypoplasia as the most common and hypercementosis as the least common dental affliction. Dental caries is present in 43.6% of the individuals examined. Ante-mortem tooth loss (AMTL), calculus, and alveolar resorption occur in the skeletal sample with moderate frequency. Analysis of dental caries by tooth count method yields a 6.8% caries rate.

Sex dimorphism in dental diseases at Harappa are most apparent (and statistically significant) for enamel hypoplasia and AMTL, though both caries and pulp exposure also show distinctly different rates between the sexes. Dental abscesses, calculus and alveolar resorption are disorders for which males and females display similar rates. Further comparative and statistical analysis of the dental pathology pattern at Harappa is in progress and will be presented elsewhere.

The odontometric analysis of Harappan teeth reveals an overall tooth size that falls in the high microdont range. The total summed crown area for Harappa is 1194 $mm^2$, and the tooth material index is 182 mm. Tooth specific indices indicate: 1) moderate reduction of maxillary lateral incisor teeth, 2) slight reduction of upper molars two and three (in contrast to the first upper molar), and 3) a high degree of reduction of mandibular molars two and three (in contrast to the first lower molar).

A clearer picture of the dental health and odontometric status of the Harappans can only be derived through carefully controlled comparative analysis of these Harappan dental data with other prehistoric skeletal series from the Indo-Pakistan subcontinent.

## DISCRETE TRAITS ANALYSIS

*Brian E. Hemphill:*

The analysis of discrete morphological non-metric trait variation has been utilized by many workers in recent years to assess

both population affinities and microevolutionary trends within and between human populations. This method of analysis, which looks at the frequency of occurrence of specific features of the cranial and post-cranial skeleton, is based upon the pioneering studies of Berry (1963, 1967) and Berry and Berry (1967) on non-metric epigenetic variation observed within populations of both mice and humans. In our study of the human skeletal remains from Harappa, forty-eight non-metric features of the cranium are being assessed for presence or absence. These forty-eight non-metric features of the cranium were compiled from the studies of Berry and Berry (1967), Brothwell (1958, 1982), and El-Najjar and McWilliams (1978). A total of thirty post-cranial non-metric features, derived from Finnegan's 1978 analysis are being assessed in the same manner as those of the cranium.

This study of the variation in discrete non-metrical traits among the human skeletal remains from Harappa is addressing the following seven questions:

1) To what other prehistoric populations from South Asia are the ancient Harappans most closely related? That is, from what population did the ancient Harappans come; and where did they go to?

2) What modern populations of South Asia bear the closest similarities to the ancient Harappans with respect to non-metric skeletal features?

3) What is the degree of genetic heterogeneity within the Harappan population as represented by the human skeletal remains recovered during the course of this expedition? Do males tend to be more genetically homogeneous one to another within the populations or do females appear to be more homogeneous? Such questions may give some insight into whether marriage customs among the ancient Harappans were based upon patrilocality, matrilocality, both or neither.

4) Is there a correlation between the appearance of elaborate grave goods, i.e. social status, and specific genetic features which would suggest that wealth was amassed in certain lineages?

5) Is there a correlation between burial location within the cemetery and the occurrence of combinations of non-metric features which would suggest that families or lineages were buried together as was observed by Angel (1967) among the ancient inhabitants of Lerna in Greece?

6) What is the relationship between the cranial and post-cranial non-metric features? Do these two sets of data provide the same information, or is one of them more heavily influenced by environmental factors as has been suggested by Finnegan (1978).

7) Finally, do non-metric features of the cranial and post-cranial skeleton tend to indicate the same populational affinities as those suggested by dental morphology and by traditional craniometric techniques utilized by the other physical anthropologists working at Harappa?

Rather large and representative samples are required for the above research questions to be properly addressed. The Harappa project has initiated this new method of analysis on a South Asian population. Further analysis in the field seasons ahead will yield a more representative sample and more comprehensive understanding of the ancient inhabitants of Harappa.

## CONCLUSION

The above are examples of the kinds of information that are being provided by the physical anthropologists studying the skeletal remains from Harappa, but it must be stressed that the foregoing are strictly preliminary findings. More processing of data is required before definite conclusions can be reached about the ancient Harappans based upon our skeletal sample. It is essential that estimates of sex, for

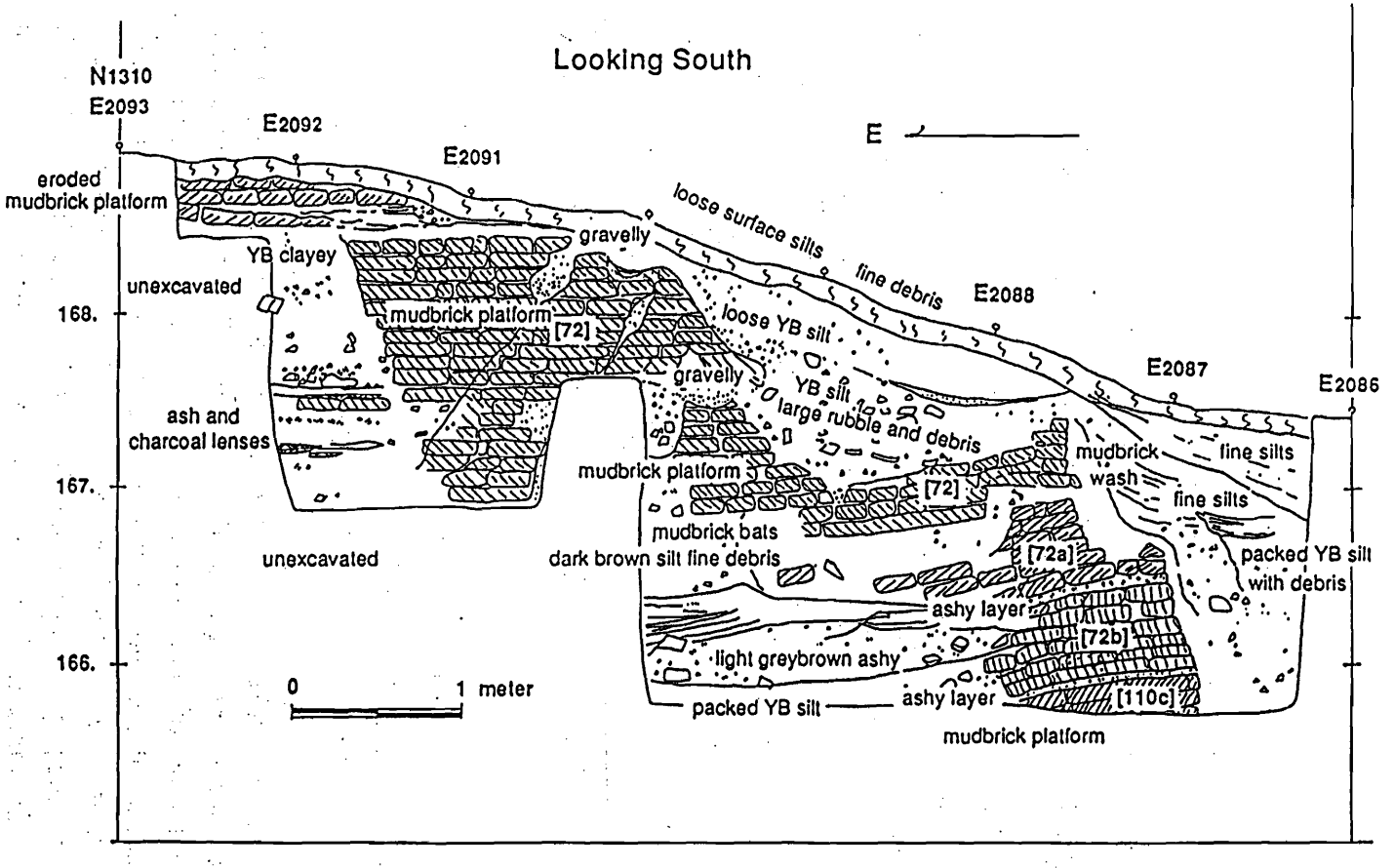



Fig: 36. Harappa: Mound E, North western slope, East-west-section at edge of mound.

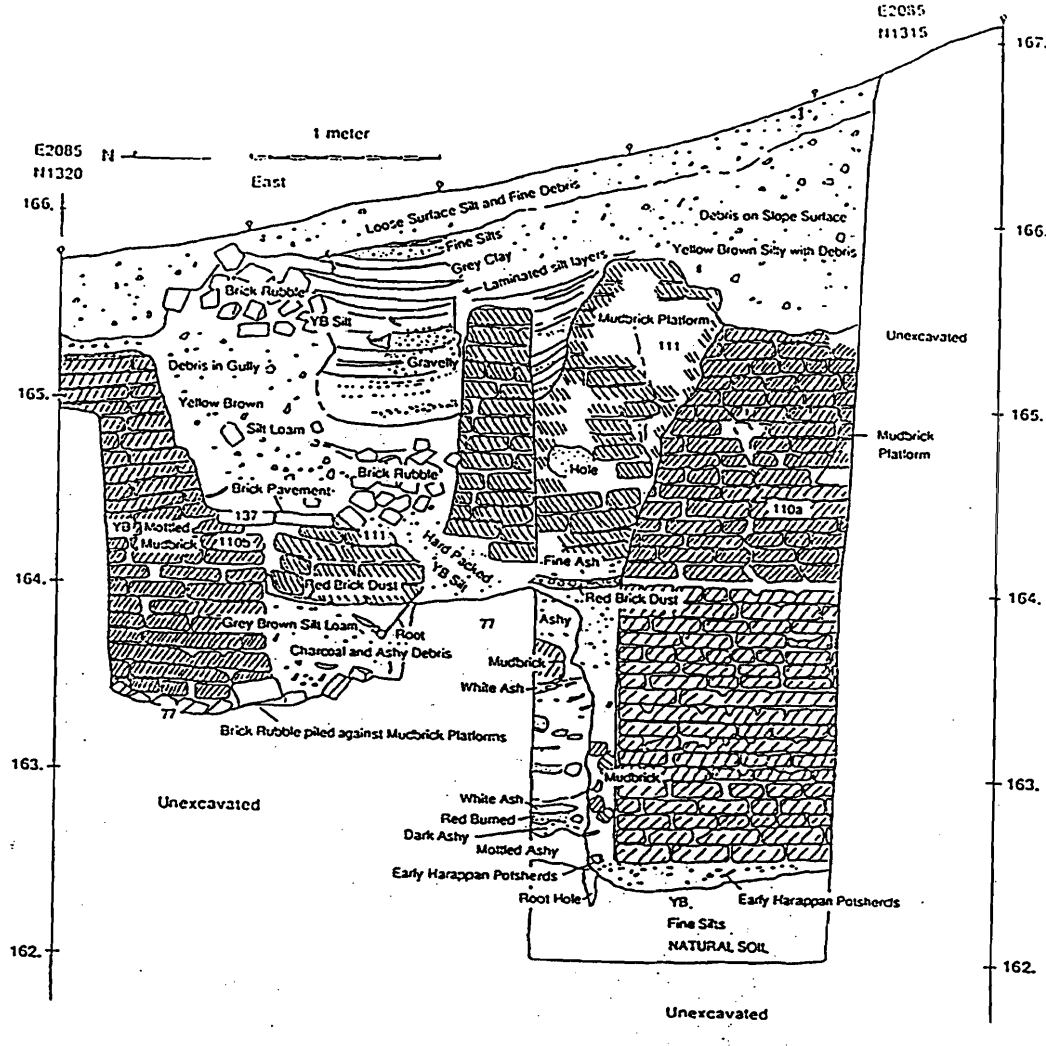



Fig: 37. Harappa: Mound E, North western slope and platforms, North-south section, facing east.

example, be checked by a battery of statistical measures which will support our morphological analyses, or raise questions not perceived at this first stage of field laboratory research. Stature reconstructions, frequencies of pathological conditions, etc., must be carried out by multivariant and regression statistics. When these data are thoroughly analyzed, the physical anthropologists will be in a position to define the biological affinities, diversities, and characteristics of at least that segment of the ancient people of Pakistan represented in the Cemetery R37 excavations.

It is anticipated that the processing of field data will produce a more thorough and comprehensive biological profile of the ancient Harappans than has been provided by previous studies. The ancient Harappans were biologically adapted to an urban lifeway with a nutritional resource base dependent upon food production. The physical variables documented in this study of Harappan skeletal remains therefore provide a data base for physical anthropologists interested in the question of human biological responses to the socioeconomic transition from Paleolithic-Mesolithic lifeways to the demands of village and urban concentrations of people, farming, herding, and cultural changes wrought by the Neolithic 'revolution'. The Harappan skeletal series now assembled will be of great significance to contemporary and future scholars concerned with the problem of documenting and estimating the biological changes taking place in many ancient human populations who had left the earlier hunting-foraging way of life for the food-producing strategy.

**D. Excavations on Mound E**

Excavations on Mound E were begun during the second season by J. Mark Kenoyer and Carl Lipo, but major exposures were not started until the third season. In 1988 additional help in excavations was provided by Shahbaz Khan of the Lahore Museum, Irshad Ali Rind and Qasid Hussain Mallah of Shah Abdul Latif University, Khairpur, Sindh and other members of the expedition. The excavation areas were selected on the basis of surface indicators such as architectural features, surface topography and artifact concentrations. Three distinct areas were excavated: the northwestern slope, the top of the northwestern corner of the mound and the southwestern slope. The excavations on the northwestern slope consisted of a major step trench oriented east-west and extending from the crest to the base of the mound (Fig. 27). Horizontal exposures were made in five by five meter areas, beginning with a 2 x 3 meter systematic random sample test pit. Additional areas were exposed to the north and south of the step trench to delimit architectural features and special activity areas. The total excavated area on the slope is 181.5 square meters, with the depths of the excavations ranging from 50 cm to 6 meters. On the top of the mound, similar test trenches were begun and then expanded. Four

distinct trenches were opened totaling 116.5 square meters, with an average depth of 2 meters. The excavations on the southwestern slope were conducted in a 4 x 6 meter area (24 square meters) where baked brick walls were seen eroding from the mound.

The results of these different excavations revealed the presence of three major periods of occupation. In the lowest levels, the earliest occupation of the site is represented by hearths and possible mud brick architecture of the so-called Early Harappan period (Fig. 38a, b and 39). These levels are overlain by deposits that contain artifacts and pottery that may reveal the nature of the transition from the Early Harappan to the subsequent Mature Harappan occupation. Most of the trench reveals remains of the mature Harappan habitation of the mound. These deposits are comprised of several phases of major architectural activity representing the construction of what appear to be massive mud brick revetments and platforms at the edge of the mound. Some of the platforms are reinforced by baked brick revetment walls (Fig. 38a & b).

Although the detailed analysis of the stratigraphy is still underway, it seems that the edge of the mound was used for both craft activities (pottery manufacture) and habitation. The uppermost levels of Harappan occupation are followed by strata containing pottery of the Late Harappan period, commonly referred to as Cemetery H pottery. Again, the pottery styles suggest that there may be a transitional period between the Mature Harappan and the Late Harappan periods. Future excavations in this area of the mound and the final analysis of the artifacts and pottery will provide a new understanding of the cultural sequences that are represented on Mound E.

**1. Step Trench: Platforms and Revetment Walls**

The excavations on E mound represent only a small portion of the mound and yet they have revealed some important new features that may change our perception of how the Indus cities were built up. The step trench revealed successive platforms or revetments and foundations of mud brick combined with baked brick, extending from the base of the

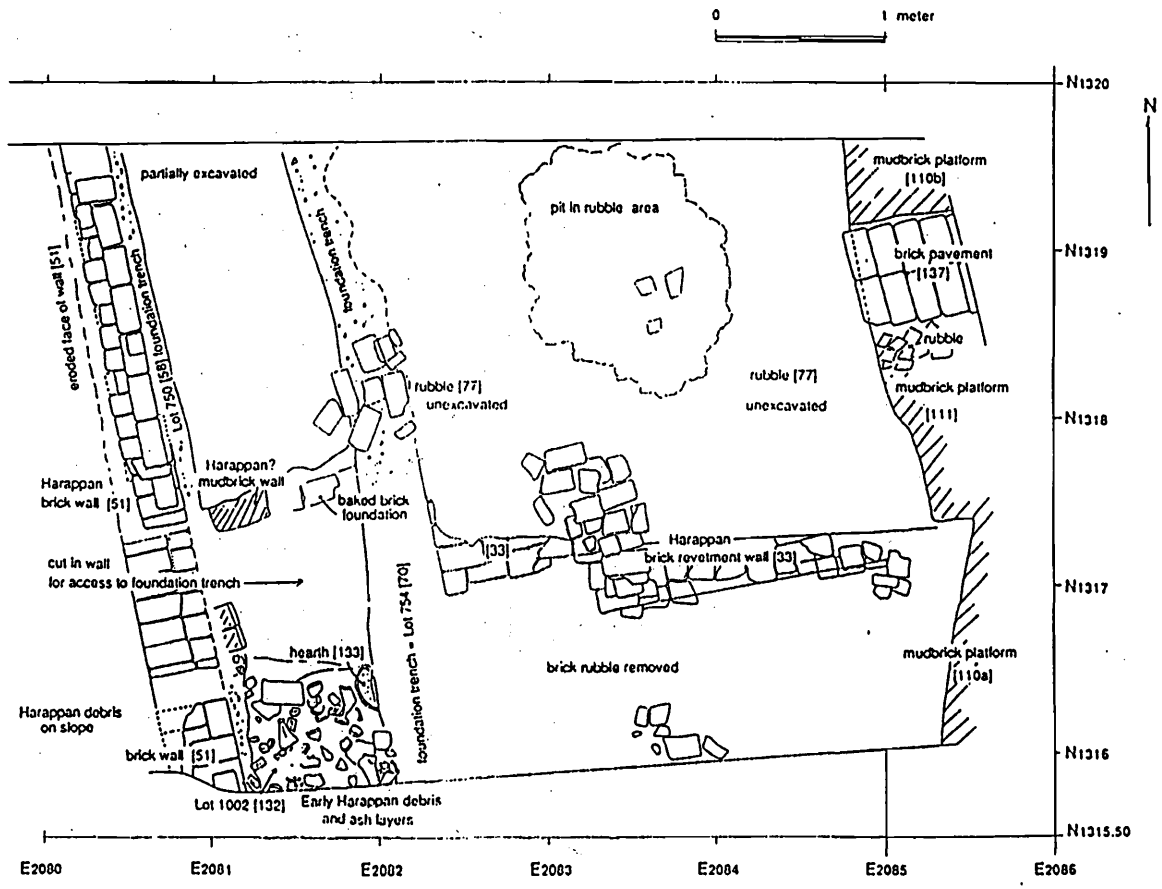



Fig: 38 A. Harappa: Mound E, Northern slope plan view of walls and revetment.

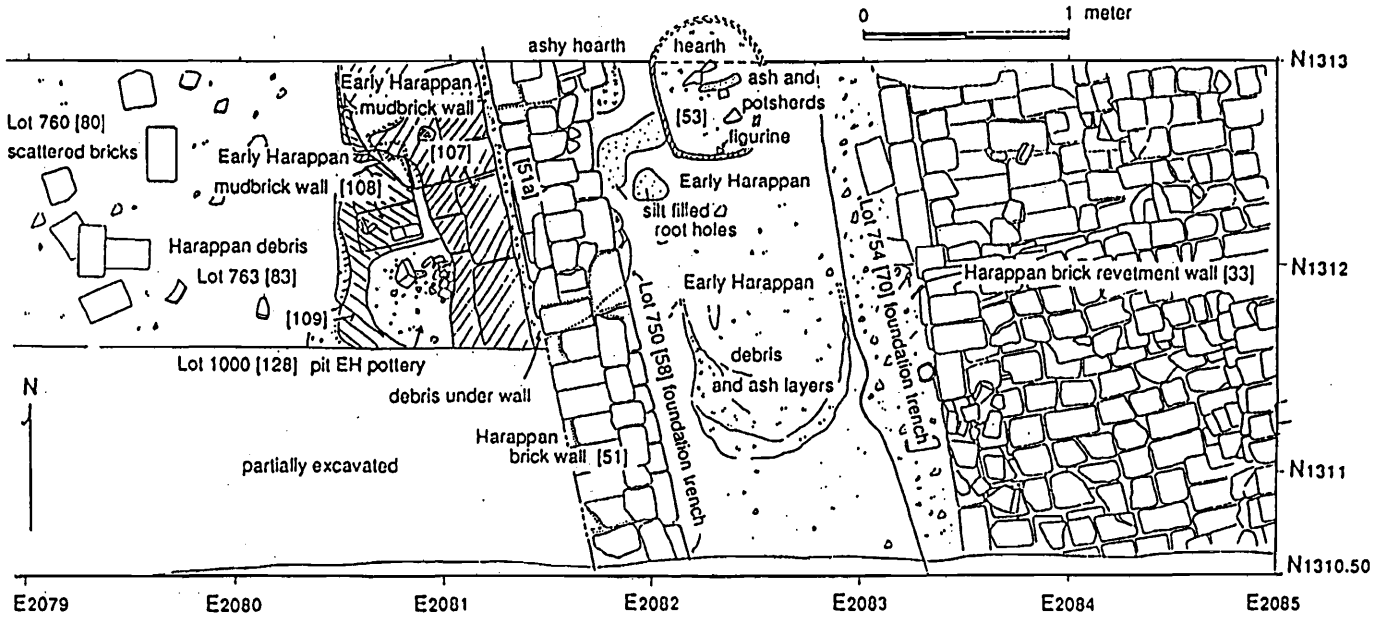



Fig: 38 B. Harappa: Mound E, North western slope plan of walls and revetment.

mound, right to the top. These mud brick structures were not built at one time, but are the result of many separate phases of construction (Fig. 36).

The latest platforms are at the top of the mound and are associated with Late Harappan, Cemetery H type pottery. These platforms overly Mature Harappan structures, that include habitation areas, kitchen areas, and domestic dump areas.

Beneath these latest Mature Harappan structures (preliminary definition based on ceramics and figurines) are earlier mud brick platforms that overly a series of eroded and reconstructed platforms. These platforms connect to a massive retaining wall (Feature 110 A and B) that appears to have formed a sheer face along one section of the mound (Fig. 37). This retaining structure however does not continue unbroken along the western face of the mound. It is interrupted by what appears to be an east-west road or alley way (Feature 137). The mud brick platforms and retaining wall may have been strengthened by a baked brick revetment or facing (Feature 33).

Traces of this baked brick revetment (Feature 33) have been found to the west of the mud brick revetment wall (Fig. 38). This structure was about 2 meters wide at the base, with a sloping exterior face. Based on calculations of toppled courses of brick it is estimated that this baked brick facing stood some 3 to 4 meters from natural soil to the crest of the mound. Similar structures found by Wheeler on Mound AB were interpreted as a defense wall. Further excavations will be conducted in 1989 to clarify the function of this massive brick structure. It will then be essential to make detailed comparisons with Mohenjo Daro where the German research team is suggesting that the construction of massive platforms was an intentional first stage in site construction.

An earlier north-south wall of baked brick (Feature 51) has been found approximately 75 cm further to the west of the large baked brick structure (Feature 33) (Fig. 38). This wall has been traced for some 25 meters and it too is oriented in correspondence with the structures exposed by Wheeler on Mound AB. The long wall appears

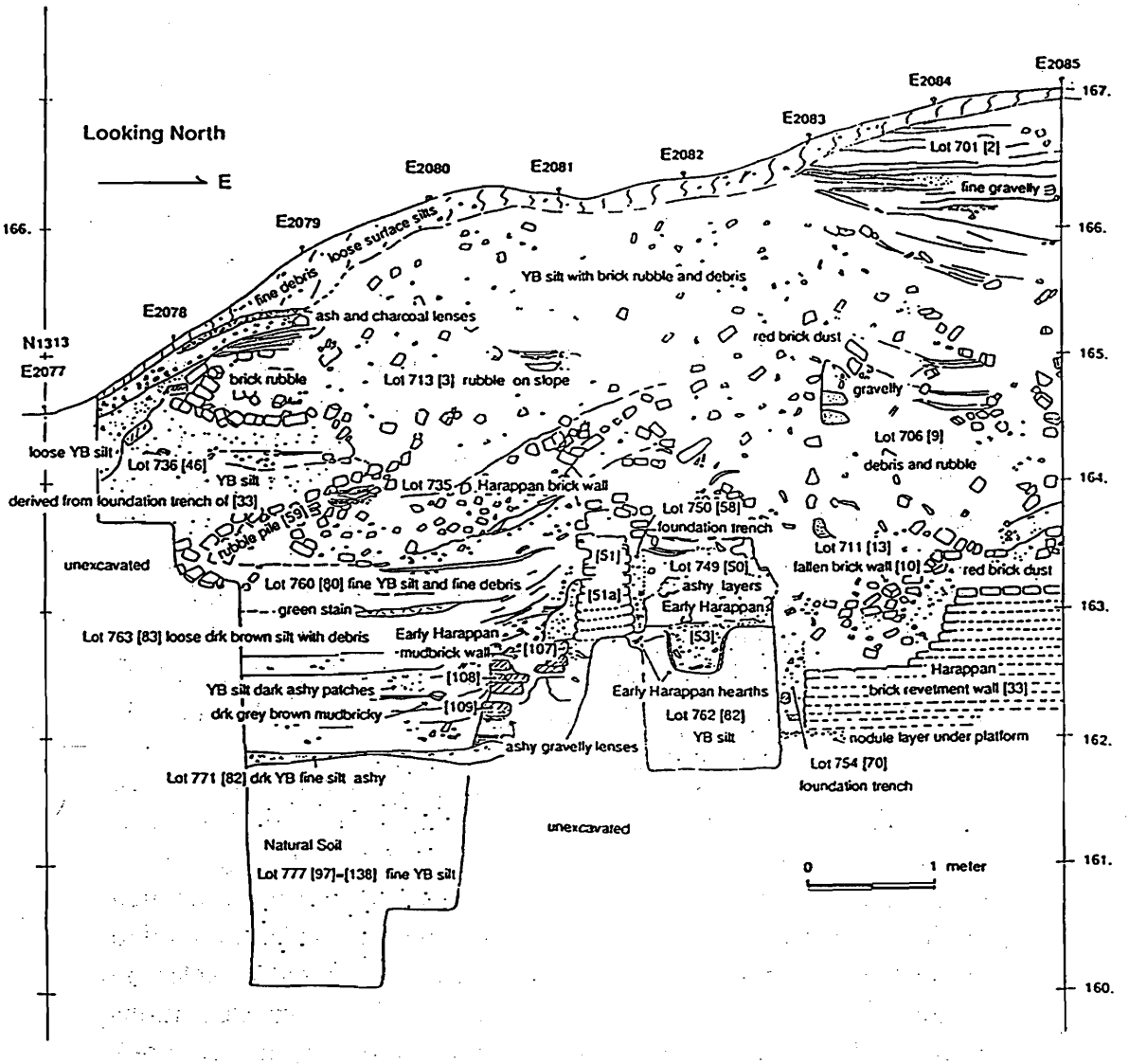



Fig: 39. Harappa: Mound E, North west section at edge of mound.

to have been rebuilt at least once, and the western face is badly eroded. This suggests that the eastern face was covered with earth, while the western face was exposed to water erosion and salt damage by seepage and evaporation. Similar types of erosion are commonly seen on baked brick revetment walls of contemporary and medieval cities in northern Pakistan.

Beneath this baked brick wall are earlier mud brick structures that were not completely exposed during the 1988 season (Fig. 39). They may represent earlier mud brick walls that were replaced by the baked brick wall or they could be unrelated structures that were demolished to build the long brick wall. The ceramics associated with these earlier mud brick structures are not Mature Harappan, but are characteristic of the Early Harappan period as defined by M.R. Mughal at Kot Diji and Jalilpur. There has been some ancient mixing of the strata due to the fact that the Harappans dug into these early levels to construct their baked brick structures, but we were able to locate some undisturbed Early Harappan strata associated with primary context hearths containing charcoal.

The early Harappan strata are lying directly on top of natural alluvium. Some of the Harappan structures that have cut entirely through the Early Harappan levels are also lying directly on top of natural soil (Fig. 39). Test pits were made one meter below the level of the natural soil and deeper corings were made to confirm the fact that this is natural soil.

In summary, the step trench on the northwestern face of Mound E provides a continuous sequence of habitation and construction from the Early Harappan occupations on natural soil to the Late Harappan occupations on the top of the massive mound. In addition to the masses of pottery, figurines, and terracotta bangle fragments and other artifacts, we have been able to collect a wide selection of faunal materials, soil samples for palaeobotanical studies, and most important, clusters of carbon samples for C14 dating.

**2. Pottery Kiln**

In addition to the large step trench, a 5 x 5 meter area associated with vitrified kiln wasters was excavated on the northwestern slope of Mound E (Fig. 40 & 41). The preliminary interpretation of this area is that it represents a specialized craft activity area that reflects one or more pyrotechnological activities dating to the Mature Harappan period. The latest strata contain Late Harappan and late Mature Harappan ceramics and structures.

The Mature Harappan strata are characterized by many sequential layers of floors with red burned patches and no ash. These are interpreted as working floors that have been periodically cleaned and flattened. The precise pyrotechnological activity has not yet been determined and will require some additional excavations in 1989.

Beneath these burned floors, are the remains of a large updraft kiln that appears to have been used to fire pottery and other ceramic objects (Fig. 41). It does not appear to have been used for metal smelting. The terracotta vessels, bangles and figurines found in association with the kiln have been collected very carefully, with detailed recording of provenience and micro-stratigraphy in order to reconstruct the process of site formation and erosion associated with the use and abandonment of the kiln.

In addition to the ceramic artifacts, these strata contain worked antler and bone, a mass of botanical information in plant impressions, charcoal pieces and ash. Soil samples for pollen analysis have also been collected from all major stratigraphic units, providing a continuous sequence from the construction of the kiln to the Late Harappan habitation of this area of the mound. Further excavations will be conducted in 1989 to expose mud brick architecture associated with the kiln and to further expand the excavations around and below the kiln.

This is the first pottery kiln that has been excavated in this manner at any of the major urban sites, and it will provide a unique glimpse of ceramic production inside the confines of the urban area. It is quite evident from the preliminary analysis of the other artifacts found in this area of the site, that the ceramic production was segregated from other production of stone tools, steatite, and faience.

### 3. Top of Mound E

The excavations on the top of the mound revealed that underneath the thick layer of disturbance left by the brick robbers, there are large, relatively undisturbed Harappan structures (Fig. 42a & b). Preliminary excavations begun in 1987 indicated the presence of

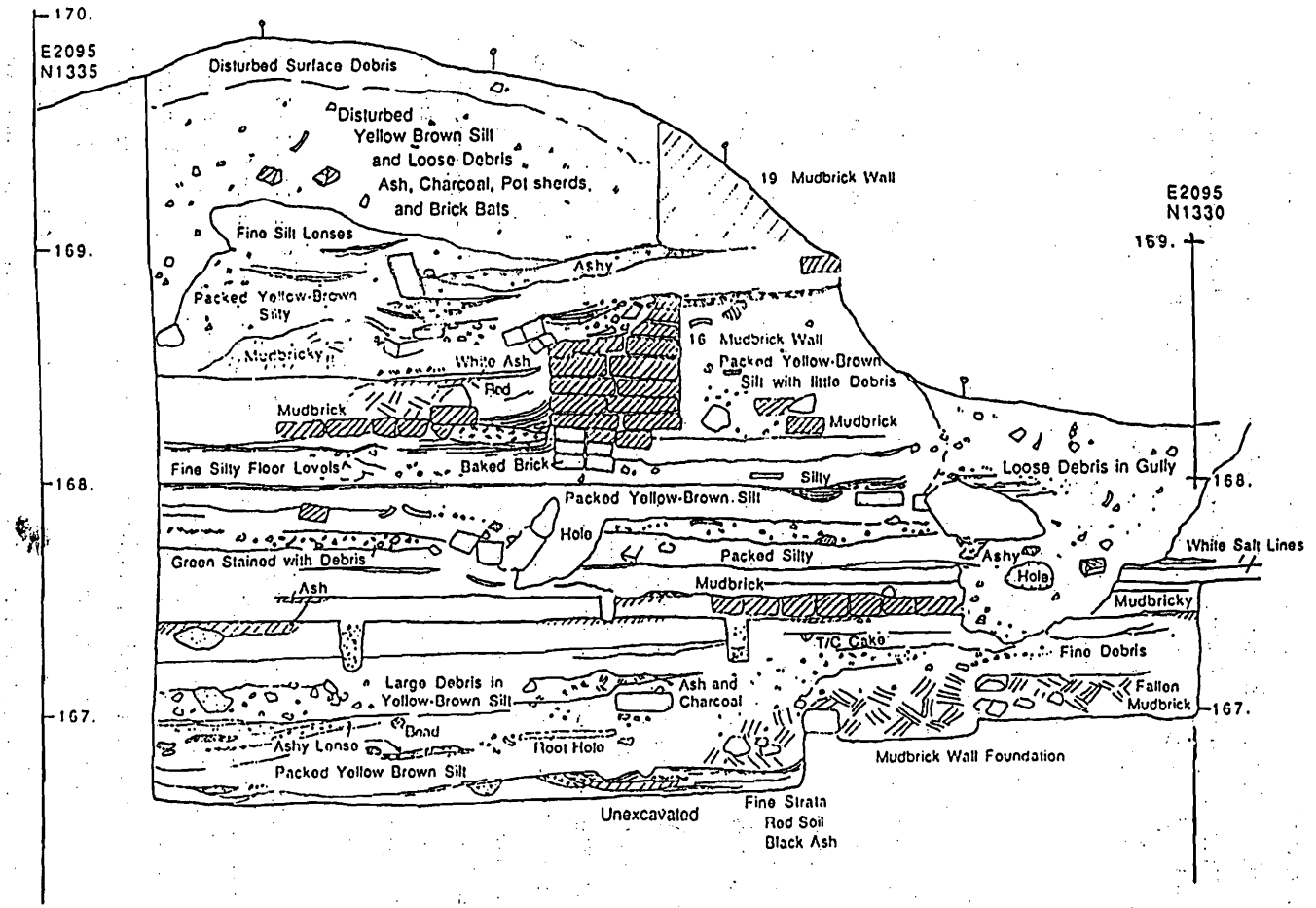



Fig: 40. Harappa: Mound E, North western slope above kiln, North South Section, facing east.

baked brick and mudbrick structures. In 1988, this area was expanded to include a large 10 x 8 meter area which was opened to obtain horizontal exposure of the uppermost preserved structures on the mound. The preliminary analysis of some of these areas suggests the presence of multiple levels of habitation units constructed of baked and mud bricks along an east-west street that was equipped with drains and sump pits. Many hearths and redeposited hearth material were found within and around the structures from which many carbon samples were taken for C14 dating. The types of artifacts recovered from the architectural contexts reveals the presence of domestic activities such as food processing and cooking, as well as craft activities. The range of craft activities includes chert tool manufacture and use,steatite working, bone working, and possibly the processing of agate and carnelian to make beads. At this stage of our analysis it is not possible to say if these craft activities are associated with domestic contexts or if they represent workshops or secondary dumps from workshops area. Further limited excavations in 1989 will help clarify these questions.

Other test pits also revealed fragmentary Harappan baked and mud brick structures. Within a 5 x 4.5m pit (E2110-2115, N1310.50-1315) along the western edge of the top surface of the mound were found multiple *in situ* habitation levels (Fig. 44). The upper layer contained mudbrick walls, a hearth, and a mortar and pestle still *in situ*. From the lower level a pyramidal gaming piece and a number of terracotta cakes were recovered. Further analysis will determine the possible activities of this area.

The presence of brick robbers and their disturbance of the mound is well documented in the excavations. Pockets of fine laminated silt bands were found throughout the excavations attesting to the historic pits from which bricks were removed and later filled with aeolian and water-washed sediments. Also, a 1/4 anna East India Company coin dating from 1835 was found at 1.3 meters below the surface amongst brick robber pit debris. In a 2 x 2.5 meter test pit (E2128-2130, N1310.50-1313) the east-facing section revealed the outline of a pit which apparently followed a baked brick wall to its foundation (Fig. 45).

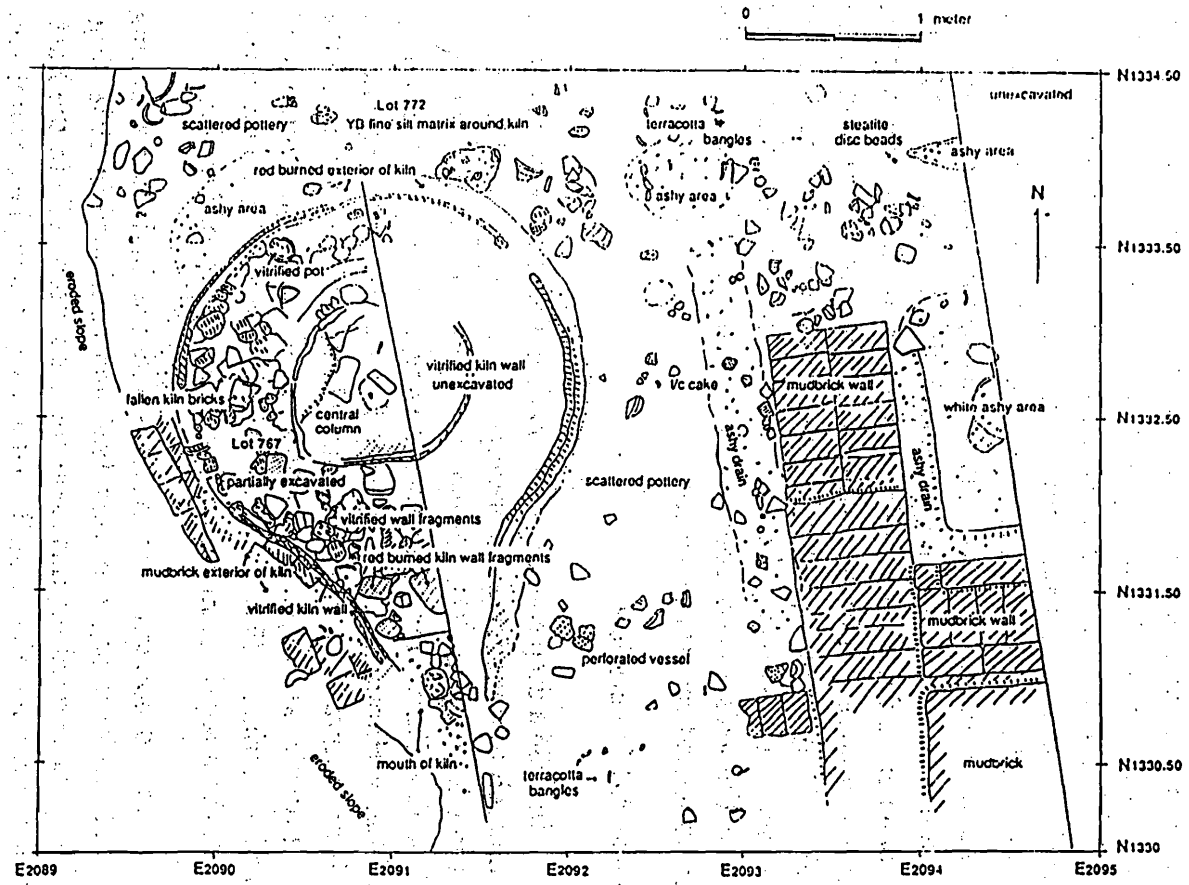



Fig: 41. Harappa: Mound E, North-western slope, plan of kiln area.

**4. Southwestern Slope of Mound E**

The small excavation on the southwestern slope was conducted to provide a comparison with the excavations on the northwestern slope of Mound E (Fig. 27, E2160-E2163, N1110.50-N1114.50). The area was selected because of the presence of what appeared to be *in situ* baked brick architecture that was oriented according to Mature Harappan conventions. Due to limited time and personnel we were only able to excavate this area for one week, but the excavations revealed fragmentary structures that confirmed the Mature Harappan period date. A significant find from the debris covering the structure is a large steatite seal with a bull motif and Harappan script (Fig. 59). Only six other seals with this animal motif have been found at Harappa. Its discovery in this portion of the site indicates that the use of steatite seals was not confined to Mound AB or Mound F as the earlier published reports suggested.

**E. Mound AB Excavations**

In 1986 a deep sounding was made in the southwestern corner of Mound AB to investigate the presumed presence of Early Harappan occupation levels (Fig. 27). Excavations reached natural soil, and though a few Early Harappan sherds were discovered, no primary context Early Harappan deposits were found. But, the sequence of strata from natural soil to the Mature Harappan occupation of the mound provide an important sequence of ceramics, faunal and botanical materials. This sequence will be used as a comparative sample in the analysis of materials from other areas of the site.

Limited horizontal excavations and a second deep sounding on Mound AB were begun during 1987 and continued in 1988 (Fig. 46). The area selected for this excavation is a deep gully in the East-center of the mound that would enable us to reach the natural soil without having to remove massive accumulations of Harappan habitation deposits. The original excavation area was 10 x 10 meters, but this was reduced when well preserved Harappan brick remains were encountered. In 1988 a finely preserved fired brick well was excavated in the center of the gully (Fig. 47). The well is constructed of specially

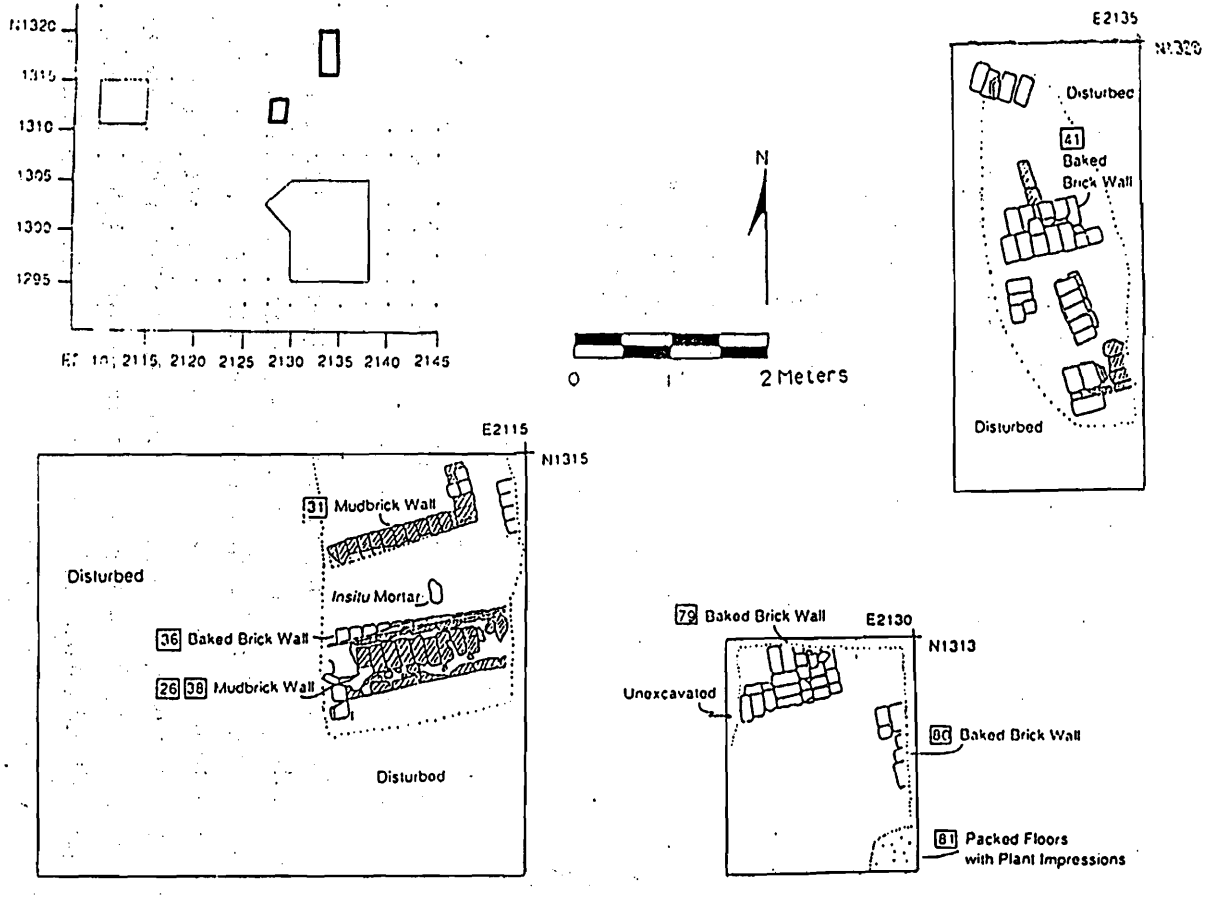



Fig: 42. A. Harappa: Mound E, North-western corner: Top surface and General plan of Harappan structures.

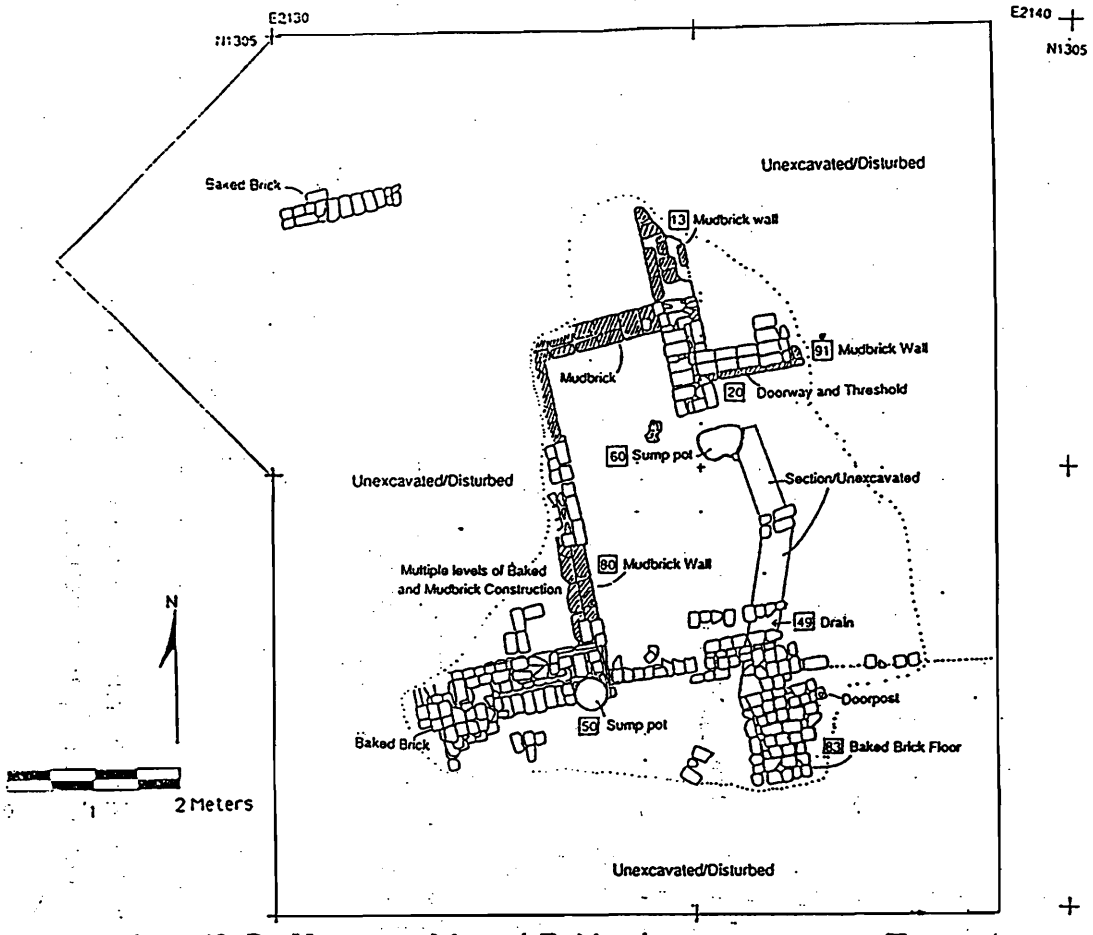



Fig: 42. B. Harappa: Mound E, North-western corner: Top surace and General plan of Harappan structures.

made wedge shaped bricks and the interior diameter is 1.20 meters. Its wall is 26 cm thick and each layer is made up of 36 bricks. The wedge shaped bricks are marked with a double incised line on the exterior edge. Since the markings do not correspond to any specific placement in the wall of the well, they probably indicate that the bricks were all made specifically for this well as opposed to any other well. No other wedge shaped bricks with double incised lines have been found in our excavations or reported from earlier excavations.

The interior of the well was excavated to a depth of 5.91 meters from the existing top layer of bricks (from 168.78 to 162.87 above mean sea level). The bottom of the well was not reached due to the fact that

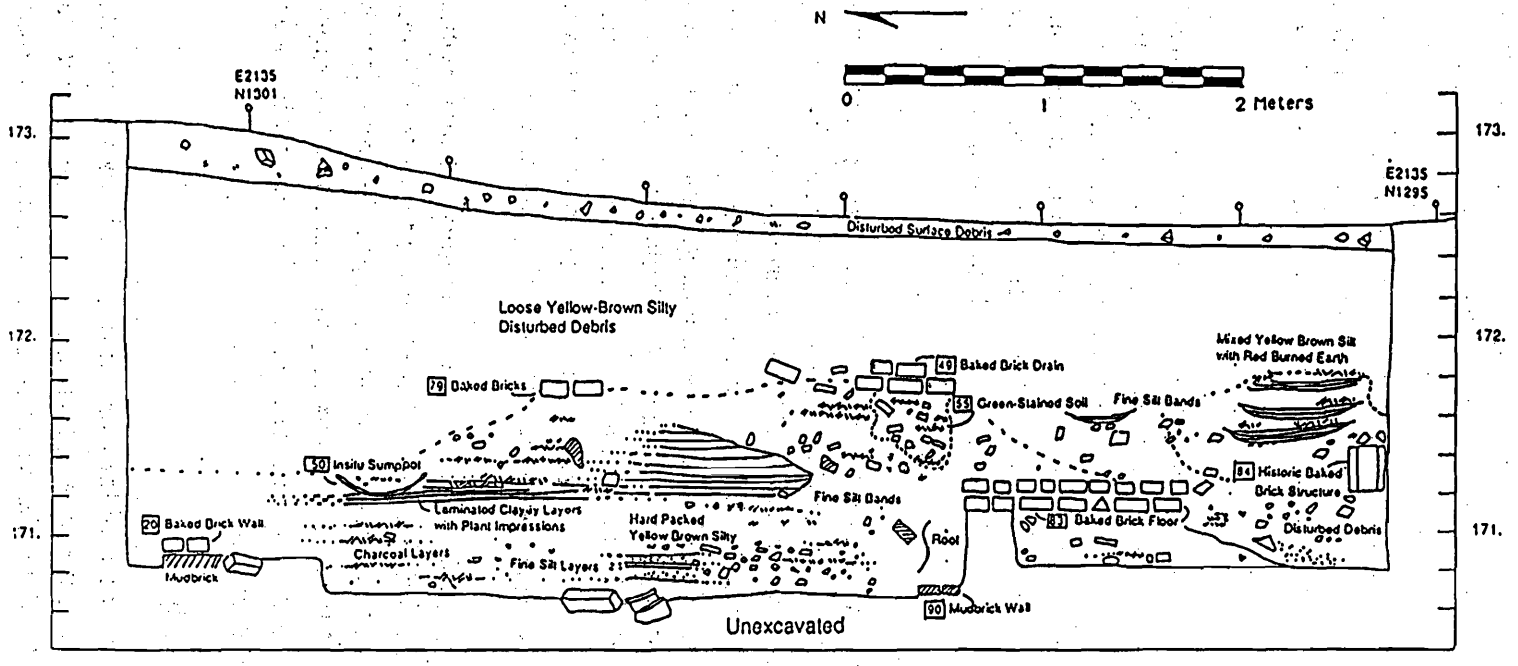



Fig: 43. Harappa: Mound E, Test pit on top of mound North-south section facing east.

the walls of the well began to crack under the new distribution of pressure. A limited area outside of the well was excavated to determine the techniques of construction. It appears that the well was constructed sometime late in the Harappan period after first excavating a large pit in the center of the mound, cutting through earlier habitation layers and domestic debris; but this requires further investigation in 1989.

During the 1988 season it was not possible to reach natural soil in this area of the mound. However, the excavations have revealed important architectural features, such as mud brick and baked brick structures, the well and numerous strata with distinct activity areas. The preliminary analysis of the artifacts and stratigraphy suggests that this portion of the site was a habitational area surrounding a well.

Although most of the artifacts found in the primary contexts around the well appear to reflect domestic activities, artifacts recovered from the debris above the well are quite different from those found in comparable contexts on Mound E. These preliminary impressions are based on the types of beads, faience artifacts, ground stone fragments and chert tools noted in the daily artifact tabulations. More detailed morphological and quantitative analysis of the artifacts from these two areas of the site should provide interesting new data about intra-site variation of artifact types and the activities they represent.

A considerable quantity of Cemetery H-like pottery is associated with the uppermost levels on both sides of the Mound AB gully. Mudbrick structures seen in section have different sized bricks than the standard Mature Harappan structures and it is likely that they may be architectural remains related to the otherwise unknown Cemetery H period occupation of the site.

**F. Samples for Dating**

One major focus of the excavations in all areas of the site has been the collection of carbon samples from primary contexts that can be used to accurately date the various cultural phases. During the

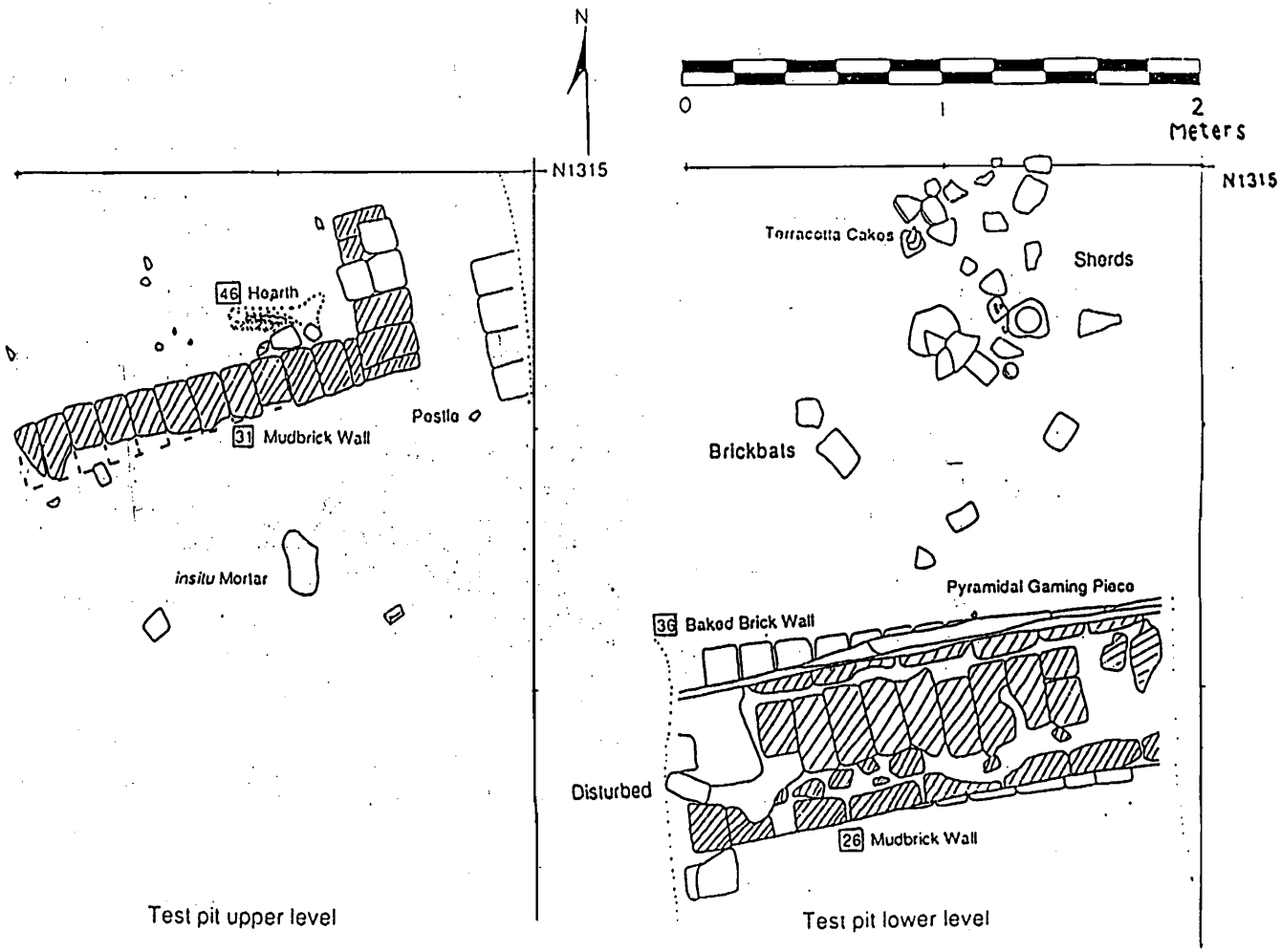



Fig: 44. Harappa: Mound E, Test pit on top of mound Multiple levels of Harappan structures.

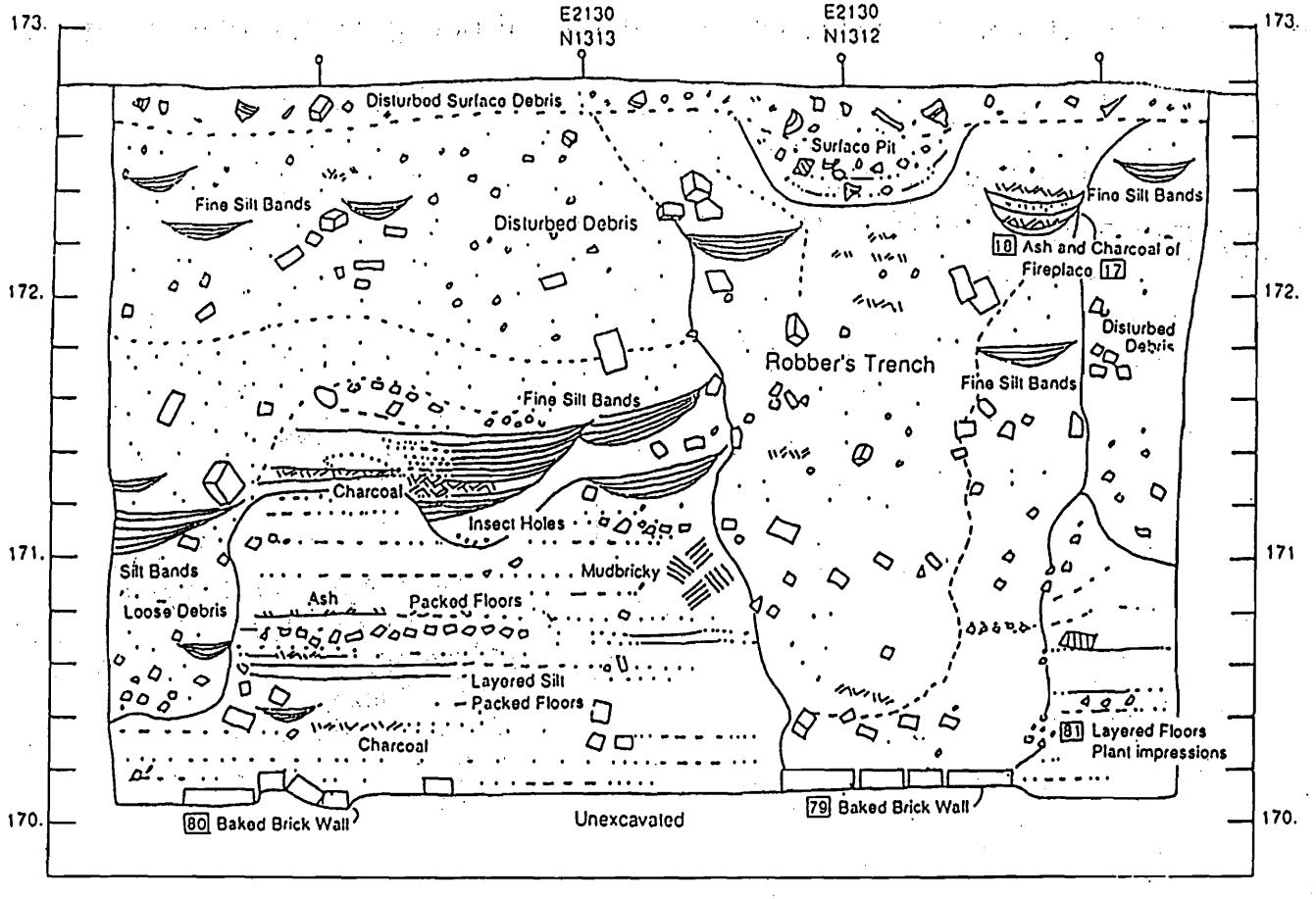



Fig: 45. Harappa: Mound E, Test pit on top of mound North south section facing east.

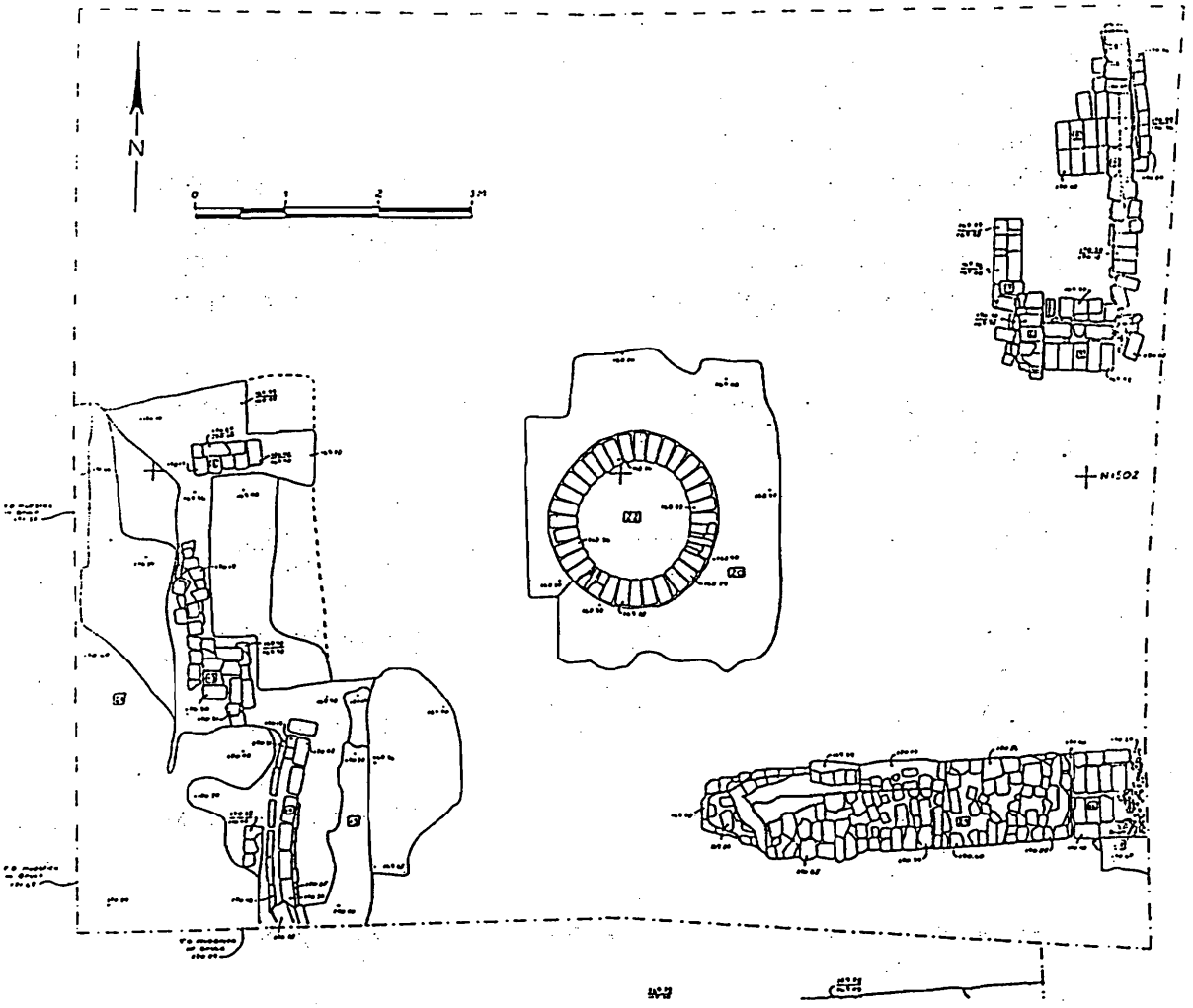



Fig: 46. Harappa: Mound A. B. Plan of excavations.

cemetery excavations, bone samples were collected from each primary context burial for possible AMS (Accelerator Mass Spectrometer) dating, but upon later analysis of them, it was found that there was not sufficient organic material for reliable dating. Considerable amounts of carbon have been found in the graves, but there is no method for determining their contemporaneity with the burials, since they could have been derived from earlier burials, dumps or forest fires, etc. There were some pieces of charcoal found inside the burial pottery and though these pieces have been collected for possible dating, the origin of these pieces is still uncertain.

In the other excavation areas we have been able to collect some sixty-three carbon samples from good stratified contexts. These include clusters of samples from the kiln area, from hearths in stratigraphically and spatially distinct domestic contexts on Mound E and Mound AB. These samples span the entire period of occupation at the site, from the Early Harappan to the Late and Post=Harappan occupations. They will provide the first series of dates from Harappa, and one of the most complete series from any excavated Harappan site.

At the present time four of the carbon samples submitted for dating have been returned with the following dates:

| | | |
|---|---|---|
| Sample # WIS 2043 | (5568 half life)<br>3770 ± 70 BP | (5730 half life)<br>1933 ± 70 BC |

Context: Lot 526, upper levels of Mature Harappan habitation, Mound AB,

| | | |
|---|---|---|
| Sample # WIS 2053. | 3920 ± 210 BP | 2088 ± 210 BC |

Context: Lot 309/311 Feature 11/14, upper levels of Mature Harappan habitation, Mound E.

| | | |
|---|---|---|
| Sample # WIS 2074 | 3700 ± 60 BP | 1861 ± 60 BC |

Context: Lot 798, hearth 7b, upper levels of Mature Harappan habitation on Mound E.

| | | |
|---|---|---|
| Sample # WIS 2075 | 3830 ± 60 | 1995 ± 60 BC |

Context: Lot 547, Mature Harappan habitation on Mound AB.

(Acknowledgement: Radiocarbon dates from the Radiocarbon Lab of the Centre for Climatic Research, University of Wisconsin-Madison, were supported by the Climate Dynamics Program, National Science Foundation under grant ATM86-03295).

**Table 2. HARAPPA 1988: Summary of Tabulation: Artifacts and Pottery**

| GENERAL ARTIFACT CATEGORY | EXCAVATION AREA CEMETERY | MOUND AB | MOUND E | TOTALS |
|---|---|---|---|---|
| T/C FIGURINES | 110 | 45 | 355 | 510 |
| T/C BANGLES | 855 | 3196 | 7161 | 11212 |
| T/C OBJECTS, VARIOUS | 72 | 254 | 720 | 1046 |
| FAIENCE, VARIOUS | 21 | 18 | 117 | 156 |
| BEADS, FINISHED | 585 | 58 | 560 | 1203 |
| BEADS, UNFINISHED | 1 | 1 | 18 | 20 |
| AMULETS/PENDANTS | 5 | 0 | 7 | 12 |
| SEALS & INSCRIBED OBJS | 3 | 0 | 8 | 11 |
| MISCELL OBJECTS | 3 | 12 | 45 | 60 |
| BONE/IVORY, VARIOUS | 2 | 2 | 20 | 24 |
| STONE, WORKED | 10 | 3 | 35 | 48 |
| BRICKS, UNIQUE | 0 | 1 | 9 | 10 |
| COPPER, VARIOUS | 11 | 10 | 108 | 129 |
| SHELL, VARIOUS | 80 | 102 | 197 | 379 |
| IRON | 1 | 0 | 0 | 1 |
| CHERT TOOLS | 52 | 147 | 476 | 675 |
| STONE FRAGS/MINERALS | 2 | 13 | 31 | 46 |
| GRINDSTONES & PESTLES | 1 | 5 | 44 | 50 |
| POTTERY VESSELS | 146 | 7 | 16 | 169 |
| POTTERY SHERDS | 36,699 | 28,894 | 115.931 | 181,524 |

## G. Artifacts

### 1. Craft Indicators

The excavations have produced a wide range of artifacts that will provide a new perspective on Harappan technology and stylistic preference and variation through time. During the third season, 653 complete and/or restored items were registered and deposited in the Reserve Collection of the Harappa Museum. Also, several thousand fragmentary and poorly preserved items were tabulated and are in the permanent study collection housed at the site. The preliminary tabulation of the total number of artifact categories with their distributions in the different excavation areas is given in Table 2. The range of different artifact categories is evident from the Table. A few categories are discussed in more detail below.

Manufacturing waste from many different industries has been recovered: stone bead production, shell working, faience manufacture, stoneware manufacture, bone and ivory working, antler working and

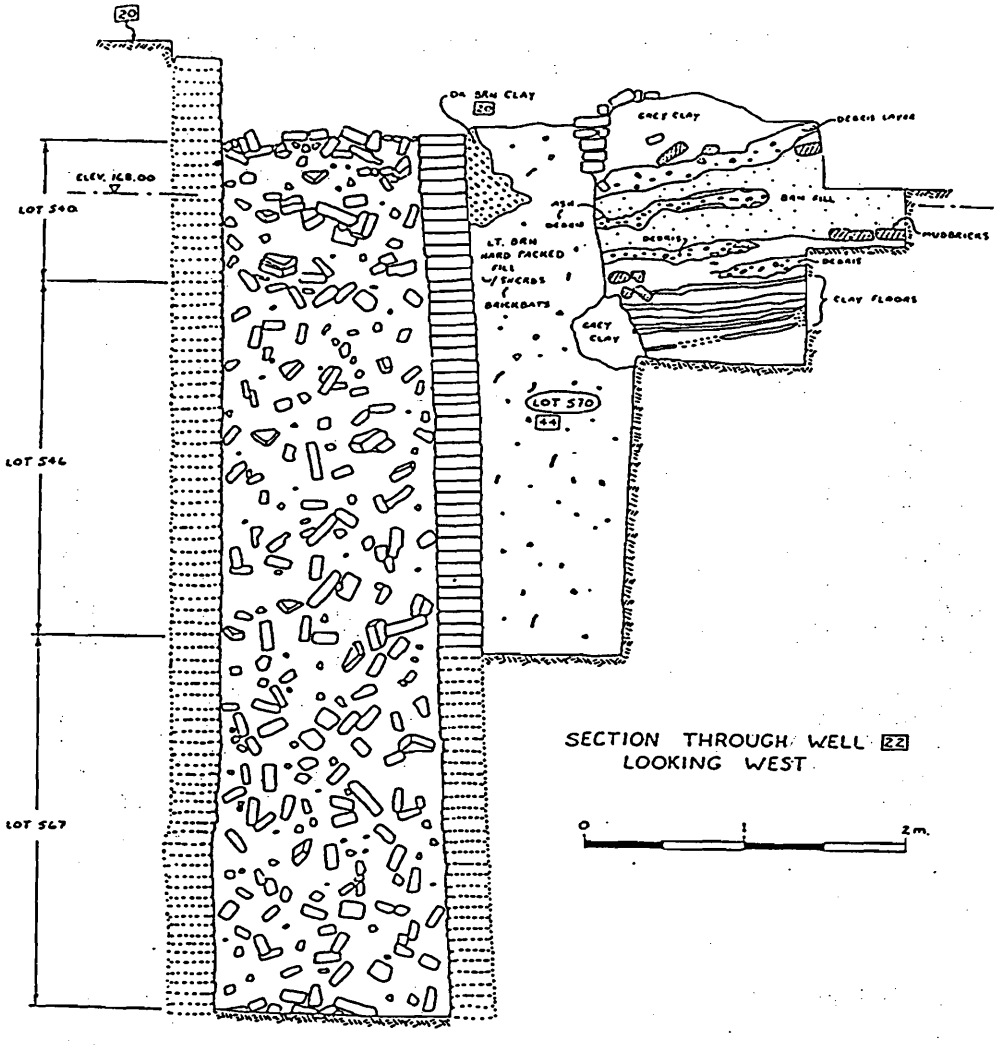



Fig: 47. Harappa: Mound A. B, Plan of wall.

chipped stone tool manufacture, and pottery production. The detailed distribution of these manufacturing indicators will provide new insight regarding the organization of these crafts in the urban context of the Harappan period.

## 2. Bangles

After pottery, the largest category of artifacts is that of terracotta bangle fragments. These bangles are found in a variety of styles and paste compositions, suggesting that there will be some interesting patterns over time and in spatial distributions. Bangles were also made of faience, stoneware and shell *(Turbinella pyrum* and *Chicoreus ramosus)* (Fig. 49 & 50).

### 3. Beads

A wide variety of beads (Fig. 51 and 52) was recovered in all of the excavation areas including certain types of beads that were not reported by earlier excavators. More important, we now have the opportunity to conduct detailed studies of the raw materials and the manufacturing technology on beads from known stratigraphic contexts. These studies will allow us to sort out some of the stylistic and technological developments of the Harappan and Late Harappan bead industries. The raw materials used include terracotta, faience, fired steatite paste and many different types of natural coloured stone, including steatite, serpentine, vesuvianite, agate, onyx, limestone, sandstone, basalt, quartz, lapis lazuli, turquoise, amazonite, and other raw materials that are still in the process of being identified. These stones came from source areas in the western highland regions of modern day Afghanistan and Baluchistan as well as the eastern regions of Sindh, Rajasthan, Kutch and Saurashtra. They reflect the wide ranging contacts of the Harappan internal and external trade/exchange networks.

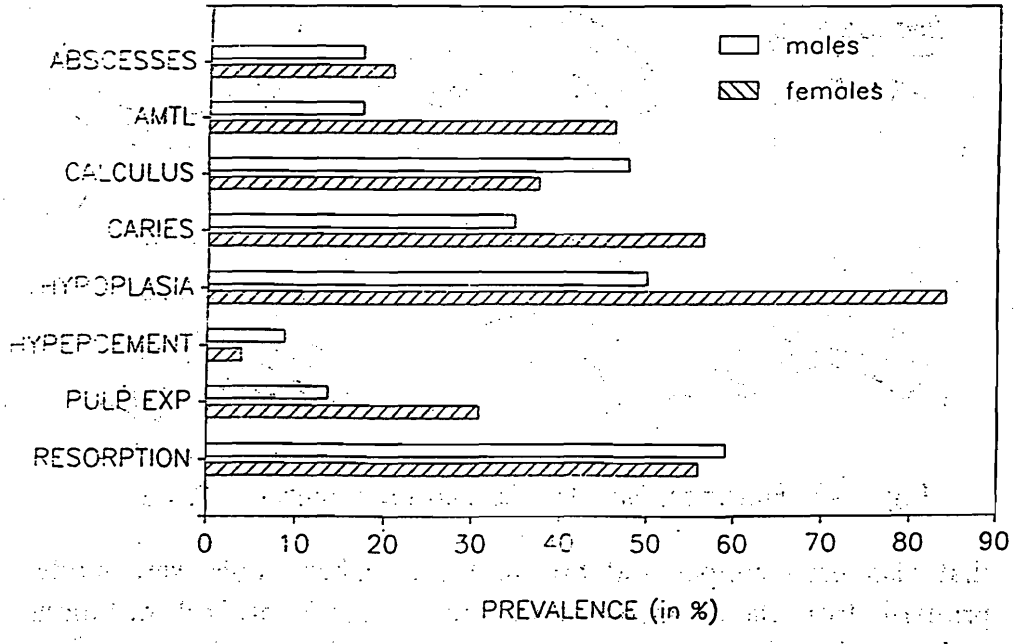



Fig. 48. Prevalence of Dental Diseases at Harappa.

### 4. Stone Tools

The specialized types of ground and chipped stone tools are an important new set of data for understanding the role of stone in a society

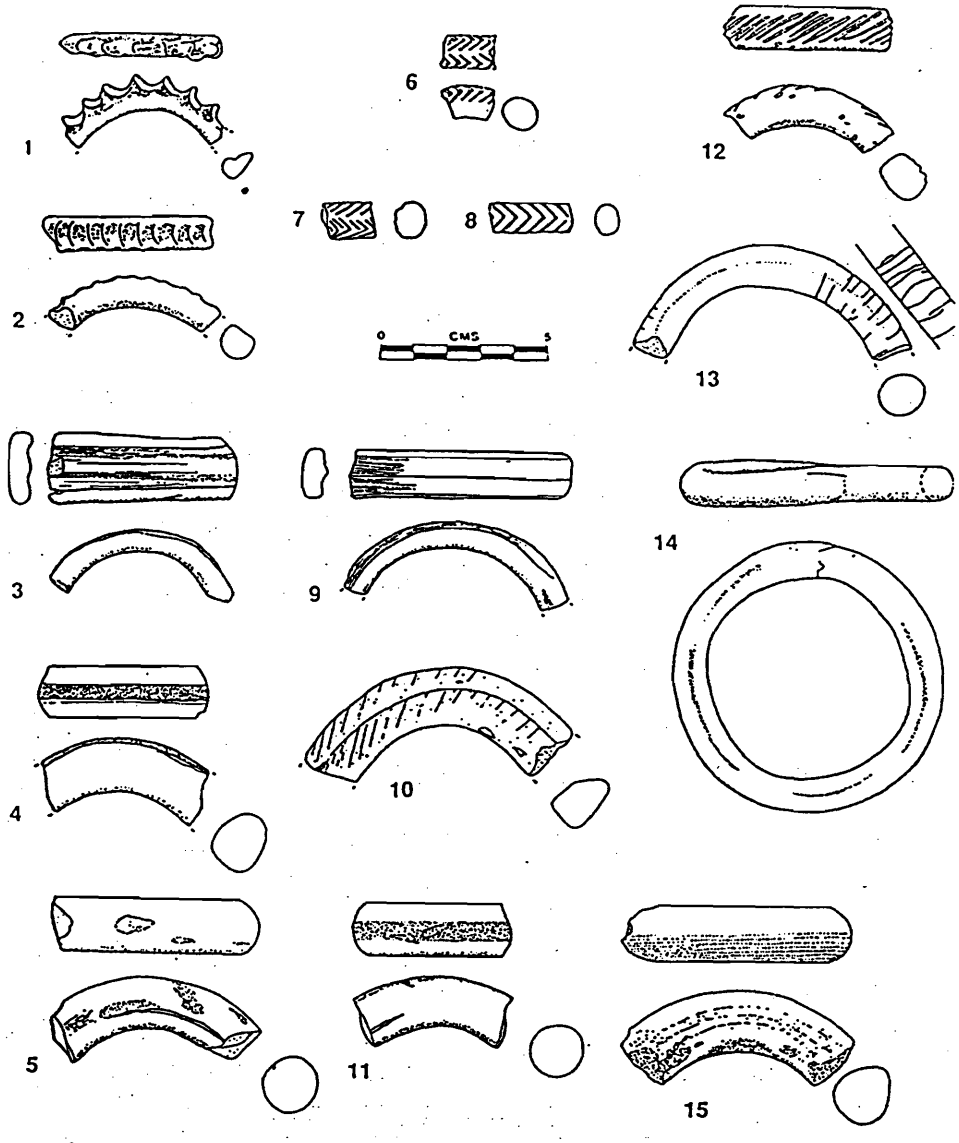



Fig: 49. Harappa: Bangles-Terracotta, stoneware, Paste.

that also used copper and bronze tools. Chert tools were made primarily from the distinctive stone found in the Rohri Hills of Sindh and include utilized truncated blades, retouched blades, percoirs, gravers, flake scrapers, and a variety of chert drills (Fig. 53 & 54). In addition to chipped stone artifacts we also have recovered a wide variety of ground and shaped stone objects such as hammer stones, pestles, grinding stones and small stone spheres or balls, whose precise function is still being studied (Fig. 55).

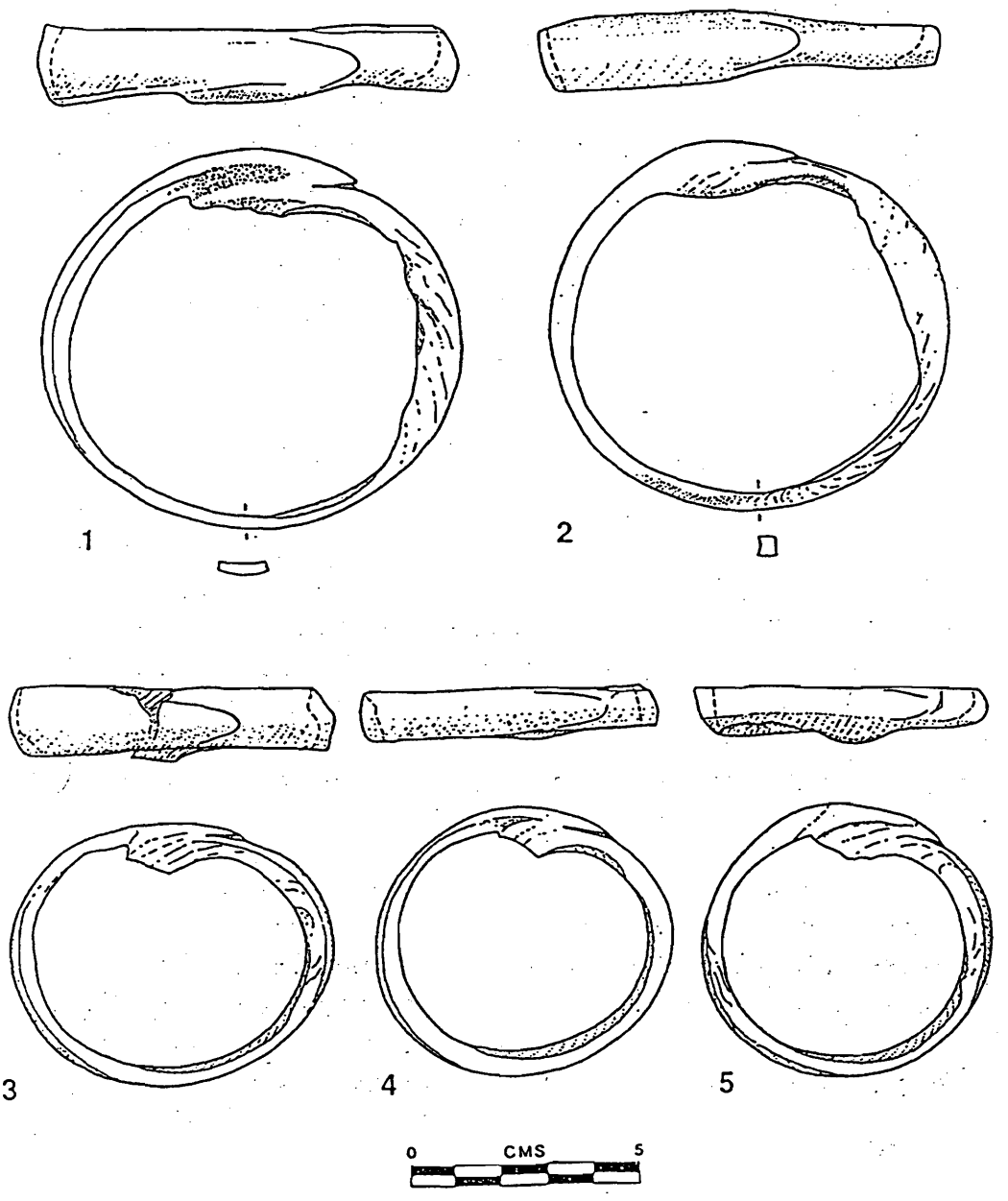



Fig: 50. Harappa: Bangles - shell.

## 5. Metal Objects

Many examples of copper/bronze objects were recovered in the excavations of the domestic areas on mound E and mound AB. The complete tools include typical Harappan arrow points, chisels, a spear and several blades (Fig. 56). Much of the copper was probably recycled to make new tools and in one case several small pieces of broken tools were found wrapped together with fibre possibly collected for reprocessing or remelting. Small circular mirrors were also found associated with burials.

## 6. Inscriptions

One of the most important categories of objects includes the inscribed seals, sealings and tokens. In the course of the first three years of excavation, two complete steatite intaglio seals have been recovered, along with several fragments (Fig. 59). Another type of steatite seal or token, with inscriptions on both faces was discovered on Mound E (Fig. 60a.4). Several examples of molded faience sealings, or tokens, were recovered in the excavations as well as in surface surveys (Fig. 60a). Although the inscriptions on these seals and sealings consist primarily of known signs, there are examples of new signs and new combinations of signs.

Besides seals and sealings,there are numerous other examples of inscriptions on bone objects, stoneware bangles and terracotta objects, such as a unique cone with an inscribed design (Fig. 60b.1). Inscriptions have also been found on pottery and potsherds (Fig. 61a, b & c). The complete study of these inscriptions is underway and a comprehensive article is being prepared for publication.

## 7. Figurines

Terracotta figurines, in human and animal forms, represent one of the many interesting categories of artifacts. During the first three seasons, 166 complete or well preserved partial figurines have been registered and deposited with the Harappa Museum. Hundreds of additional very fragmentary and poorly preserved figurines have been tabulated and are currently under study.

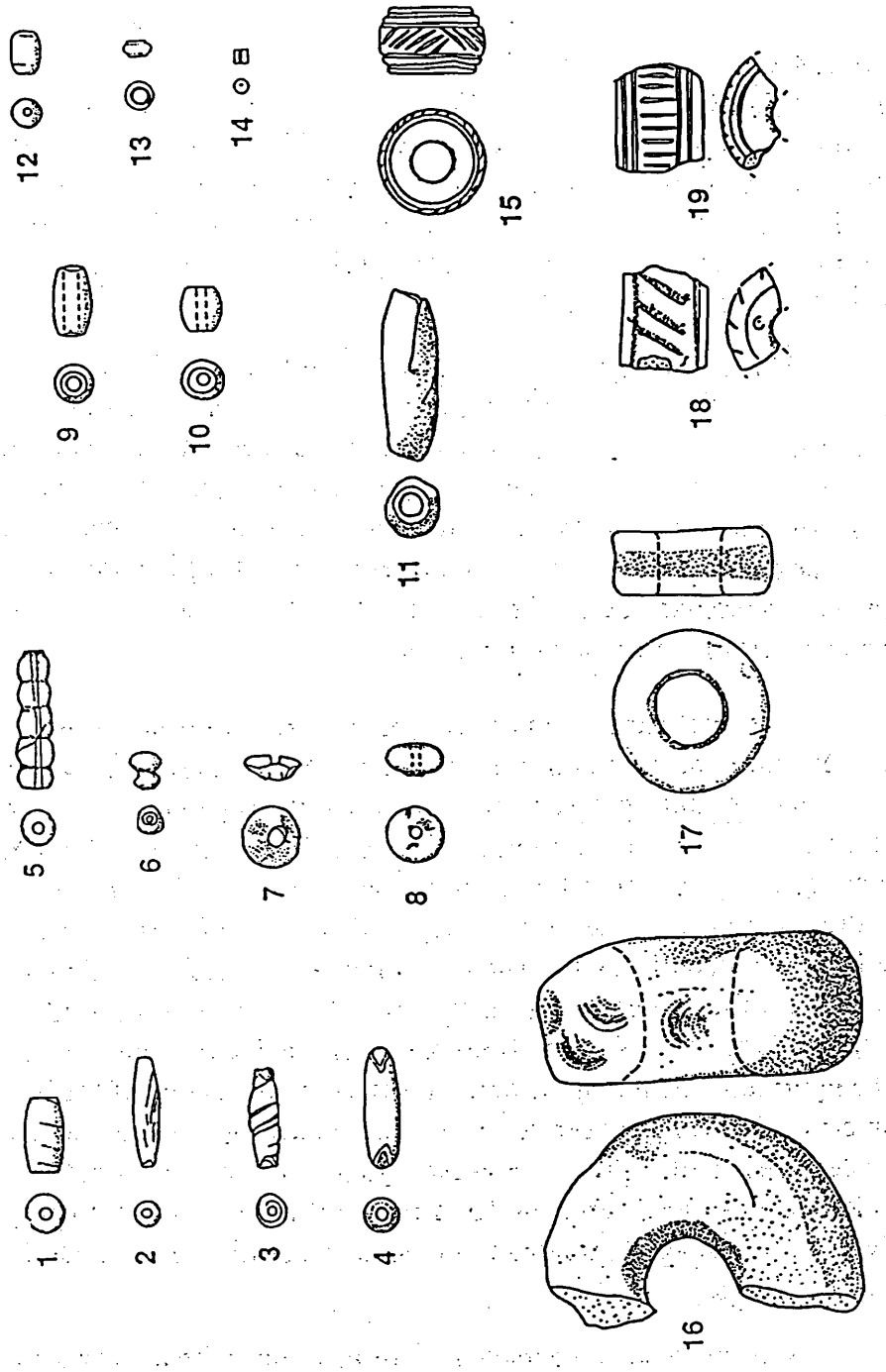



Fig: 51. Harappa: Beads - stone, Terracotta, Paste.

Of the figurines collected and tabulated during the third season, 54% are anthropomorphic and 46% are animal, with a few bird, forms. Table 3 shows that the majority—about 70%—of the figurines discovered during the third season came from Mound E. The second highest proportion—about 22%—from the cemetery (Operation 1) is deceiving. All these figurines came from the thick debris deposits covering the cemetery. Not a single figurine has been found to be positively associated with a burial.

The animal figurines are especially difficult to identify at the species level. The bodies and legs, and even the faces of non-humped cattle, buffalo, sheep, goats and even dogs are so stereotyped that they are often identical. It is usually other details such as distinctive horns—or the lack of them – that mark the specific species (Fig. 62). The detailed study of these figurines is being done in conjunction with our zooarchaeologist, Dr. Richard Meadow, who is setting up specific criteria for their identifications.

The preliminary study of the anthropomorphic figurines indicates that females are far more numerous than males varying from more than 4 to 1 during the first two seasons and more than 7 to 1 in the 1988 season. The standing female figures are characteristically nude except for a hip belt that hides the pubic area (Fig. 63). Elaborate headdresses and necklaces are usually added. It remains to be seen whether the different types of such ornamentations designate different functions for the individual figurines or whether they are simply ad hoc stylistic preferences. The questions of overall significance and function of the figurines—including the animal forms—remains one of the basic problems. None have been found yet in archaeological contexts that provide clues to their use. However, there are certain varieties of female figures—those depicting food preparation and other domestic activities—that suggest mundane functions rather than that of Mother Goddess figures.

Male figurines are depicted as entirely nude with an occasional simple necklace or headband (Fig. 63). A few examples are ithyphallic suggesting a fertility function but others are in poses that do not appear to be ritualistic. Currently the study of all the categories of figurines is

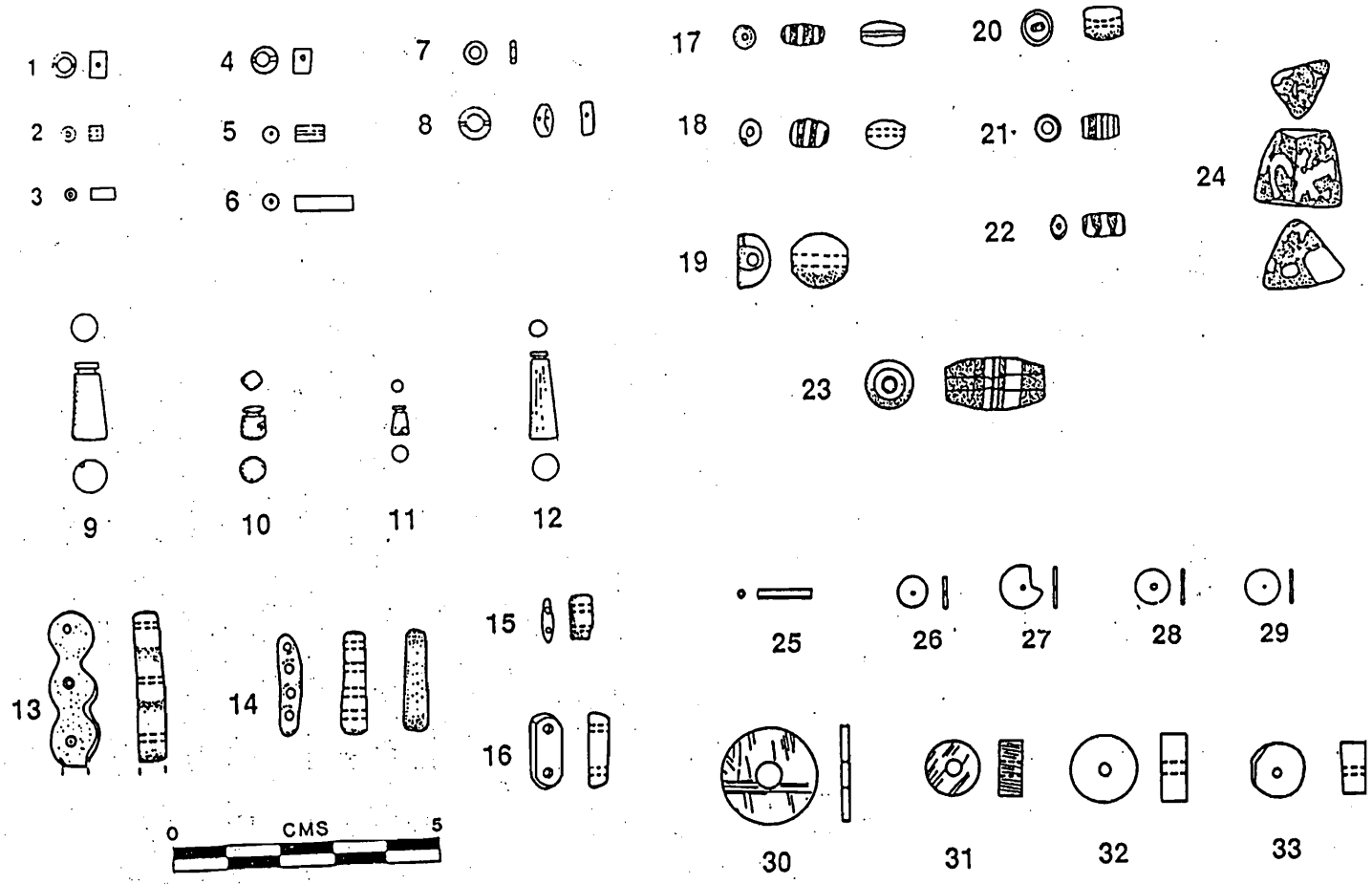



Fig: 52. Harappa: Beads stone, Terracotta, Paste.

focusing on the detailed description and analysis of typological and stylistic features and on the manufacturing techniques involved in their production.

**Table 3. Harappa 1988: Terracotta figurines**

| LOCATION | ANTHRO-POID | ANIMAL/ BIRD | TOTALS |
|---|---|---|---|
| OPERATION 1 CEMETERY | 70<br>25.40% | 40<br>17% | 110<br>21.60% |
| OPERATION 2 MOUND AB | 17<br>6.20% | 28<br>12% | 45<br>8.80% |
| OPERATION 3 MOUND E | 188<br>68.40% | 167<br>71% | 355<br>69.60% |
| TOTALS | 275 | 235 | 510 |

**8. Pottery**

Pottery is the single largest category of artifacts as it is at all sites of the Indus culture. The Harappan cemetery excavations have yielded a splendid collection of complete and or restorable vessels. During the 1988 season alone, 169 vessels were registered and added to the Reserve Collection of the Harappa Museum. The tens of thousands of individual sherds that have also been collected have been partially tabulated and classified but their complete study and analysis will require considerable more time. Technological studies of the pottery industry, including manufacturing and firing techniques, decorating procedures, and functional analysis, are being conducted by Rita Wright and J. Mark Kenoyer. Results of these studies will be made available in published articles as the work progresses.

The preliminary study of the burials shows that the number of vessels per burial varies from one or two to as many as 50. Statistical

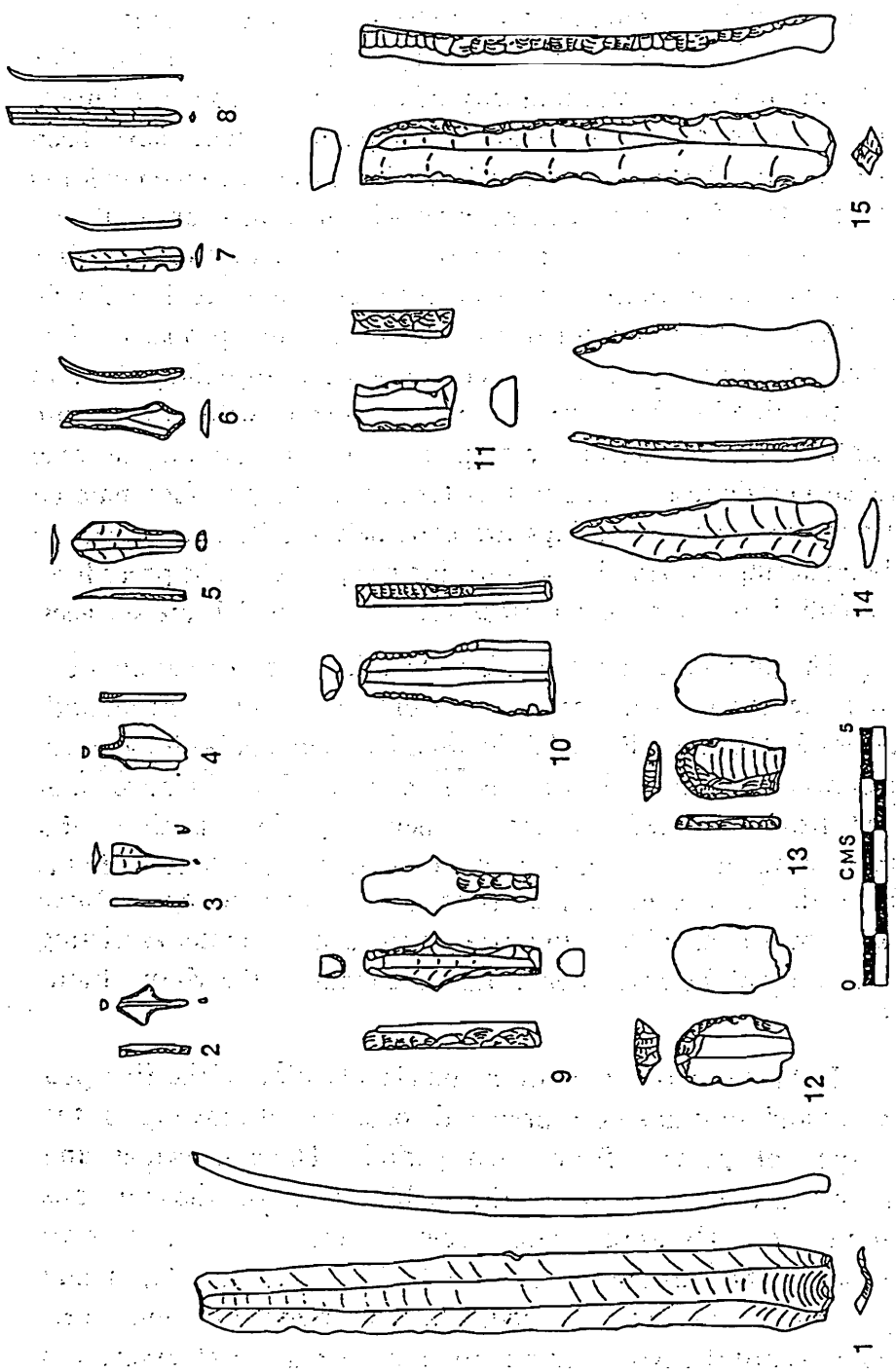



Fig: 53. Harappa Chipped stone tools.

and distributional studies of the specific types of vessels associated with different types of burials are expected to be completed during the fourth season. Several interesting details have, however, been noted. For example, although the vast majority of the pottery from the burials appears to have been unslipped and unpainted, there have been instances during the excavations when faint traces of applied colours have been detected on the surfaces of vessels but which vanish almost immediately after exposure to the drying effects of the air. Our conservation staff has been working on methods to preserve these fragile traces at least long enough for them to be documented properly. For example, during the third season, certain vessels—especially those in burial excavation Lot 219—were found to be covered with a thick white encrustation that appeared to be original decoration and not just some natural surface deposit. Laboratory tests showed the surface material to be gypsum. These coatings are extremely fragile and subject to dissolving during the vessel desalinization procedure. The procedures were modified to assure better preservation of these delicate surfaces.

The pottery and sherds from the other two excavation areas are providing new information of a very different nature. From both Operations 2 (Mound AB) and 3 (Mound E), sherds of both the Early Indus period and the Late or Post Cemetery H period have been collected from stratified contexts. They are being classified and described using the same basic methods used for the Mature Indus pottery so that consistent comparisons can be made among the three groups. This will provide an important corpus of new material relating to the questions of the antecedents and descendants of the Mature Indus period.

To facilitate the tabulation and classification of the Harappa pottery, a handbook has been prepared consisting of drawings of the known type of pottery from each period. These drawings and descriptions are derived from the publications of the previous excavations at Harappa plus new forms from our own excavations. The handbook is loose-leaf so that new types and significant variations can be added. Standardized tabulation sheets are used to record the types and quantities of sherds in each excavation lot. These records provide the basic information for conducting distribution and functional studies of all the excavated pottery.

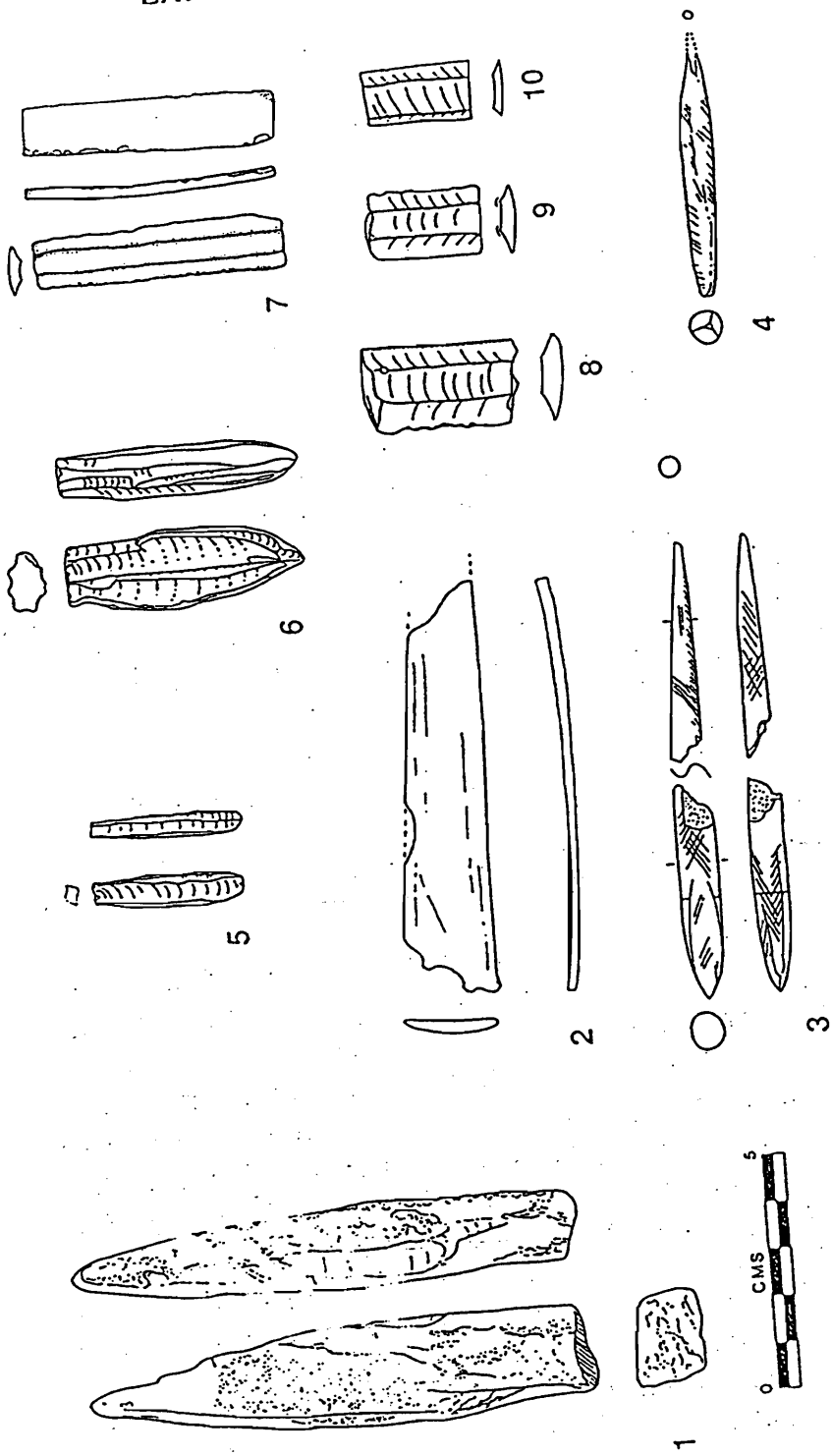



Fig. 54. Harappa: Chipped stone tools and Shaped Bone.

# PRELIMINARY REPORT ON SOIL AND ENVIRONMENTAL STUDIES CONDUCTED AT THE EXCAVATIONS OF HARAPPA, PAKISTAN

This report summarizes the findings of soils analysis from Harappa during the 1987 and 1988 field seasons. The objectives of the pedological study were: 1) to use soil data to assess the pre-settlement environmental setting; 2) to conduct a soil survey and use that information to understand the fluvial history of the Ravi River around the archaeological site, and 3) to perform chemical analyses of soil samples from within the archaeological site to help narrow the range of hypotheses regarding their origin and cultural association. In 1987, profiles of archaeological strata and natural soils within the excavations were described according to the Soil Survey Manual (Soil Survey Staff 1981). Approximately 80 samples were collected from nine profiles and analyzed in Berkeley for particle size, organic and inorganic carbon, major anions and cations, phosphorus, pH, alkalinity, and electrical conductivity. A study was performed on the stable isotope chemistry and morphology of calcium carbonate nodules found in a profile of natural soil in Cemetery R37. Results from all analyses are available upon request; only selected profiles are discussed in this report.

In 1988, Ms. Pendall assisted in excavation and in description of archaeological strata and undisturbed soil, as well as conducting analyses at the Harappa laboratory for phosphorus, nitrogen, sulfate, and particle size. A soil survey of an eight square kilometer area around the mound of Harappa was conducted by augering 1.5 to 3 meter deep soil cores on north-south and east-west transects (Fig. 71). Soil was described and classified according to USDA Soil Taxonomy (Soil Survey Staff 1987), and a soil map was prepared. Samples of each mapping unit were collected from various archaeological strata for a comparative study on the levels of nitrogen, phosphorus, and carbon in the different contexts. Field and laboratory results from the 1987 season are reasonably complete; however, samples collected in 1988 have yet to be analyzed.

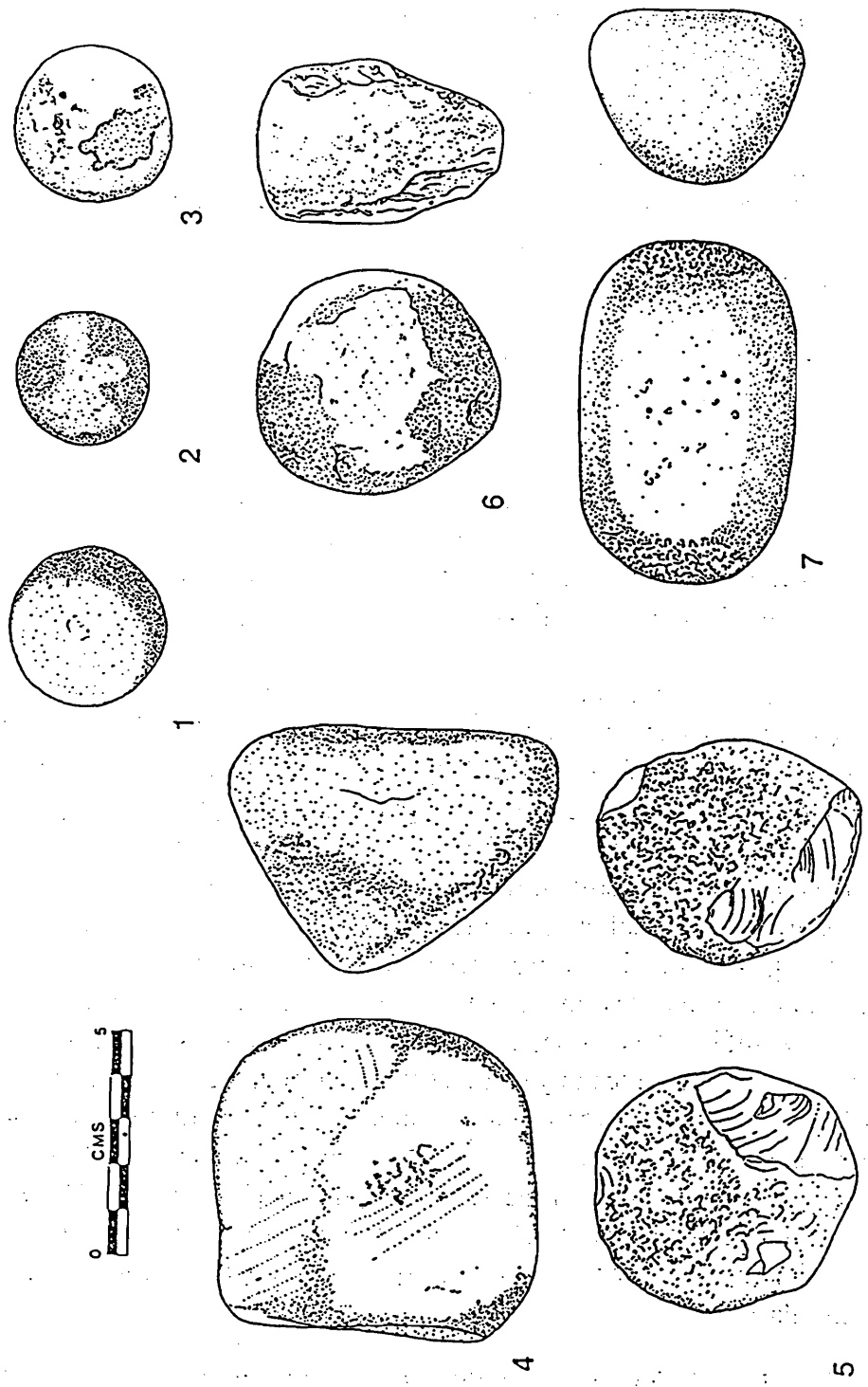



Fig: 55. Harappa: Ground and shaped stone.

## A. Role of Pedological studies in Archaeological Research

Chemical and physical analyses of soil samples in archaeological settings have added a new dimension to archaeological research. Nitrogen, phosphorus, and carbon concentrations in various types of cultural strata will help to test interpretations on the contexts of specific features. These elements are chosen because of their tendency to accumulate in settlement areas in proportions varying with the type and intensity of use. Soluble salts are important in most arid and semi-arid environments. The analysis of the anions and cations in soils helps in identifying particular salts and problems associated with those salts.

Particle size, or grain size analysis, is another important property of archaeological as well as natural sediments. It provides information on the environment of deposition, i.e. whether the sediment was deposited by still or quickly moving water, wind, or by humans.

Soil surveys of an area such as Harappa give insights into the local alluvial history and effects of human's land use. Because the Indus valley is so level, it is difficult to determine topographically where rivers have meandered, except for very recent entrenchments. The relative age of the deposit can be determined by morphologically and chemically examining soils and elucidating the 'chronosequence' of soils in the area. An ideal chronosequence contains soils of different ages beginning with a soil with no development (time=zero). Successively older soils are identified by increasing degrees of soil development. In this way, different geomorphic events, such as flooding and alluvial deposition, can be traced by changes in soil properties. In a situation, such as at Harappa, where human intervention has altered the landscape, soils may be disturbed to such an extent that soil development may have been set back to time=zero, and a new soil will form. Our soil survey at Harappa describes a chronosequence and suggests a relative time frame for events such as river meandering and cultural manipulation.

In well developed or older soils in the Punjab, calcium carbonate has accumulated in the form of nodules (kankar) (Pendall and

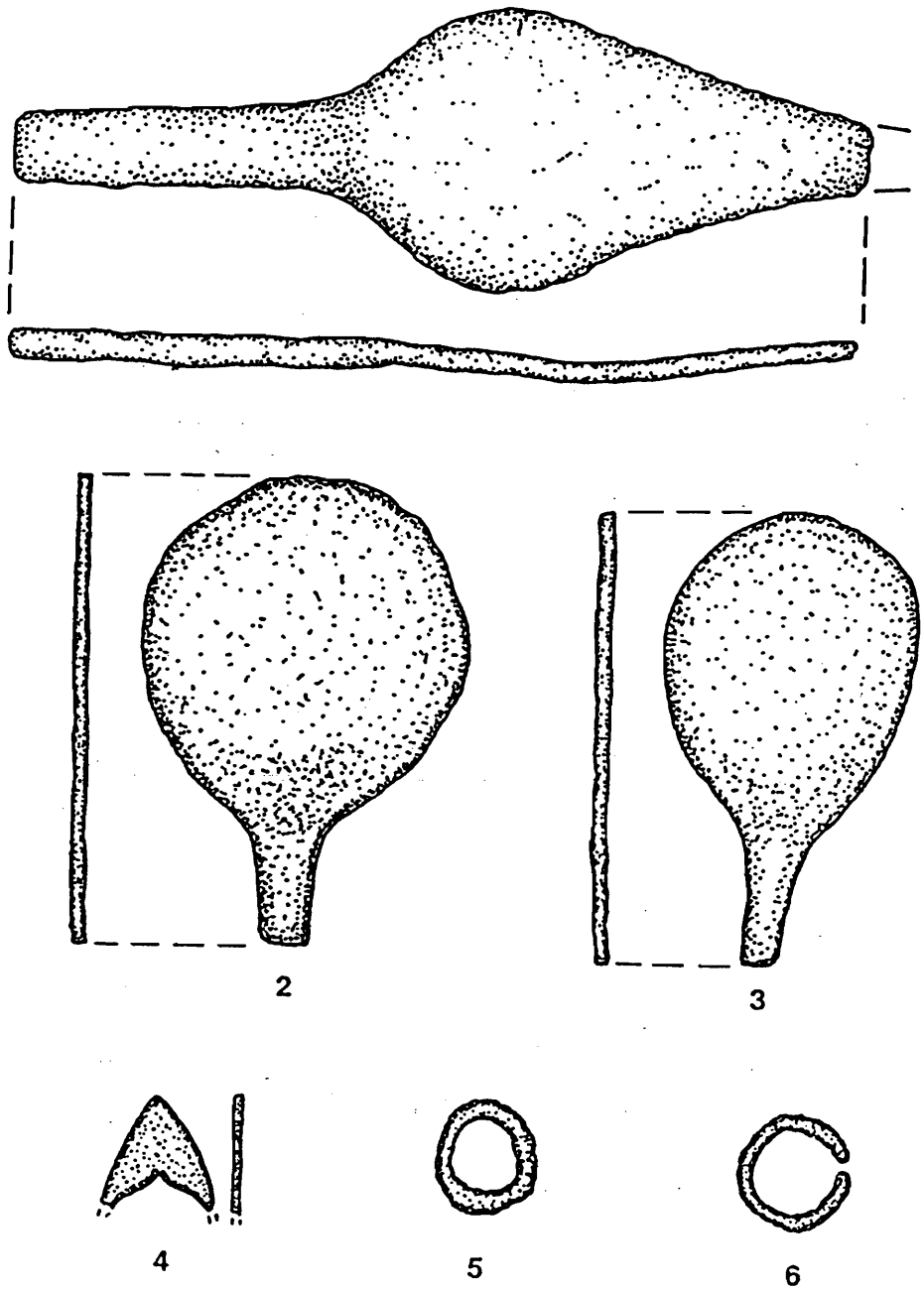



Fig: 56. Harappa: Metal objects.

Amundson, in review). The carbon and oxygen bound up in the nodules have information about certain environmental conditions that existed when the carbonate formed. The stable (i.e. nonradioactive) isotope ratio of carbon, $^{13}C/^{12}C$, is related to the amount of plant respiration and productivity at the site, and the stable isotope ratio of oxygen, $^{18}O/^{16}O$, is related to rainfall.

## B. Summary of Laboratory Methods

Soil samples from 1987 have been analyzed in the Pedology Laboratory at the University of California, Berkeley and selected samples from the 1988 season were analyzed semi-quantitatively in the field. Soils were air-dried and sieved to remove the particles greater than 2 mm in size. All analyses were preformed on the < 2 mm fraction. Particle size distribution was documented total phosphorus was extracted and analyzed colorimetrically on a Lachat autoanalyzer, organic carbon in soil was analyzed, water soluble anions and cations, pH, alkalinity, and electrical conductivity were analyzed from saturation extracts of the soil, etc. Details of these analyses are presented in an upcoming publication. Nitrogen was analyzed semi-quantitatively at Harappa on certain samples from archaeological contexts and total nitrogen will by analyzed at the lab in Berkeley. Radiocarbon dating of a composite sample of inner portions of calcite nodules from an undistrubed soil horizon (Ktk) was performed by Beta Analytic Laboratory. Stable C and O isoitope analyses were doen at the University of California, Riverside. Stable C isotope ratios in soil organic matter and stable O isotope ratios in rain and well water samples were determined at the University of California, Los Angels.

## C. Results of Chemical Analyses

### *1. SOILS AND CULTURAL STRATA OF HARAPPA EXCAVATIONS*

Archaeological and soil profiles examined and analyzed in 1987 were located in the Harappan Cemetery, in Test Pit # 14 on the Citadel Mound AB, and at a test pit north of the 'granary'. Laboratory results indicate that phosphorus and nitrogen contents are good

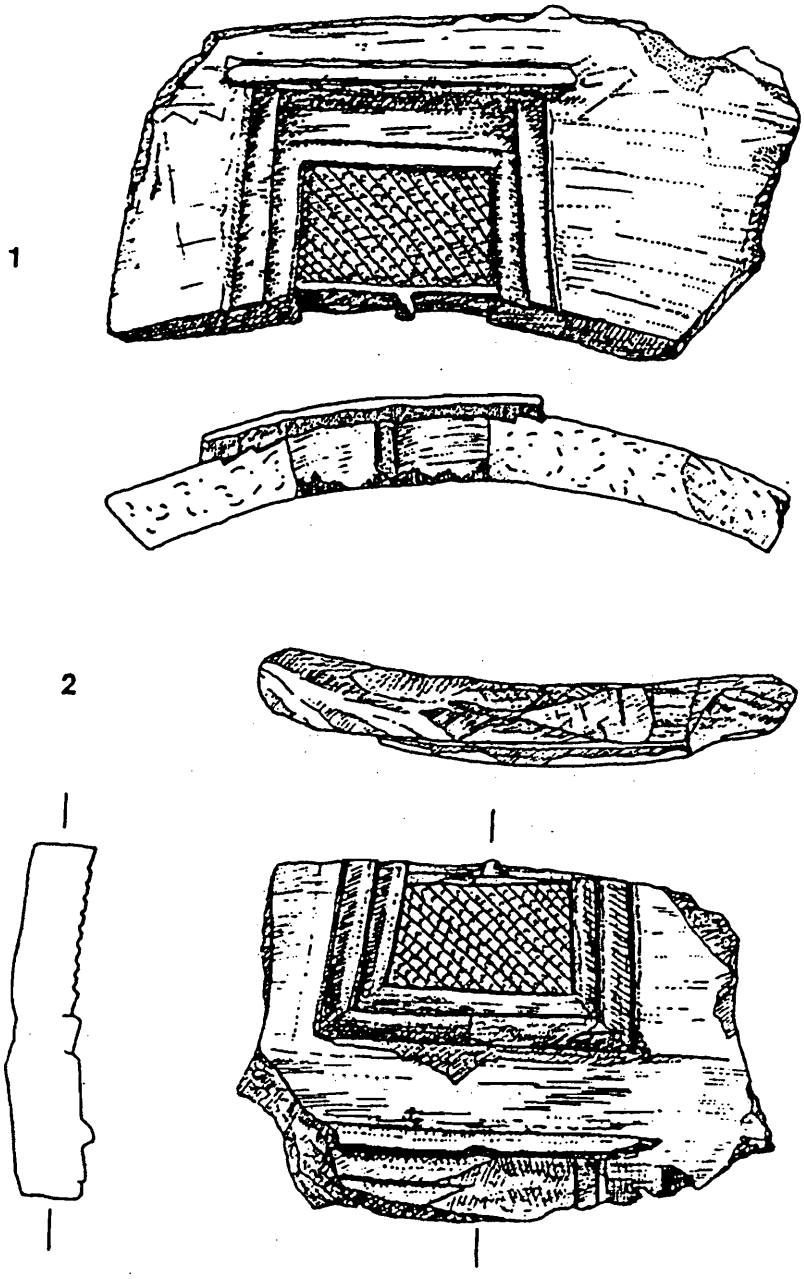



Fig: 57. Harappa: Unique terracotta objects.

indicators of human influence on soil or sediment. Phosphorus tends to be higher in strata with ash, bone, and charcoal debris. In the cemetery area, North Cemetery 1 profile (Fig. 67 & 68), surface debris layers ranged from 1800 to 3800 ppm P, more than 1000 ppm greater than values in undisturbed soil. At the profile exposed near the 'granary' (Fig. 69), total P ranged 1400 to 1800 ppm in upper, recently deposited Harappan debris layers. In the profile of Test Pit #14 (Fig. 70), the top 500 cm of debris were not analyzed. Total P was noticeably higher than natural levels in the strata containing cultural debris. In profile, South Cemetery 3, only a shallow cultural layer overlay the natural soil. Phosphorus content dropped quickly as depth increased to natural soil.

Nitrogen is higher in strata influenced by sewage or drainage, which are usually blue-green to gray in colour due to reducing conditions. This result is best demonstrated in Test Pit #14 where in a greenish layer, nitrate-N is significantly higher than background levels. This deposit was associated with a mudbrick wall and possibly consisted of waste runoff from floors or streets. Spot tests from the 1988 field season indicated high nitrogen levels in strata associated with Harappan drains in excavations, Operation 2, on AB mound. Phosphorus was also high in samples with more charcoal, ash, and visible debris.

Organic carbon is easily decomposed in warm areas such as the Punjab, and concentrations in archaeological contexts did not always differ significantly from those of natural soil. In the cemetery area and the "granary" profiles, some alluvial and cultural debris layers contained more carbon than natural soil. These differences are due to human inputs or organic materials, and would be greater if the method used for organic carbon analysis included charcoal carbon. More detailed study of samples from known contexts such as walls, floors, hearths, and bricks will be done on samples from 1988, to further elucidate the chemical differences between these contexts.

The reaction, or pH, and alkalinity of soils or sediments are important properties in relation to plant growth, and in archaeological contexts these properties are of interest if their values are extreme, for

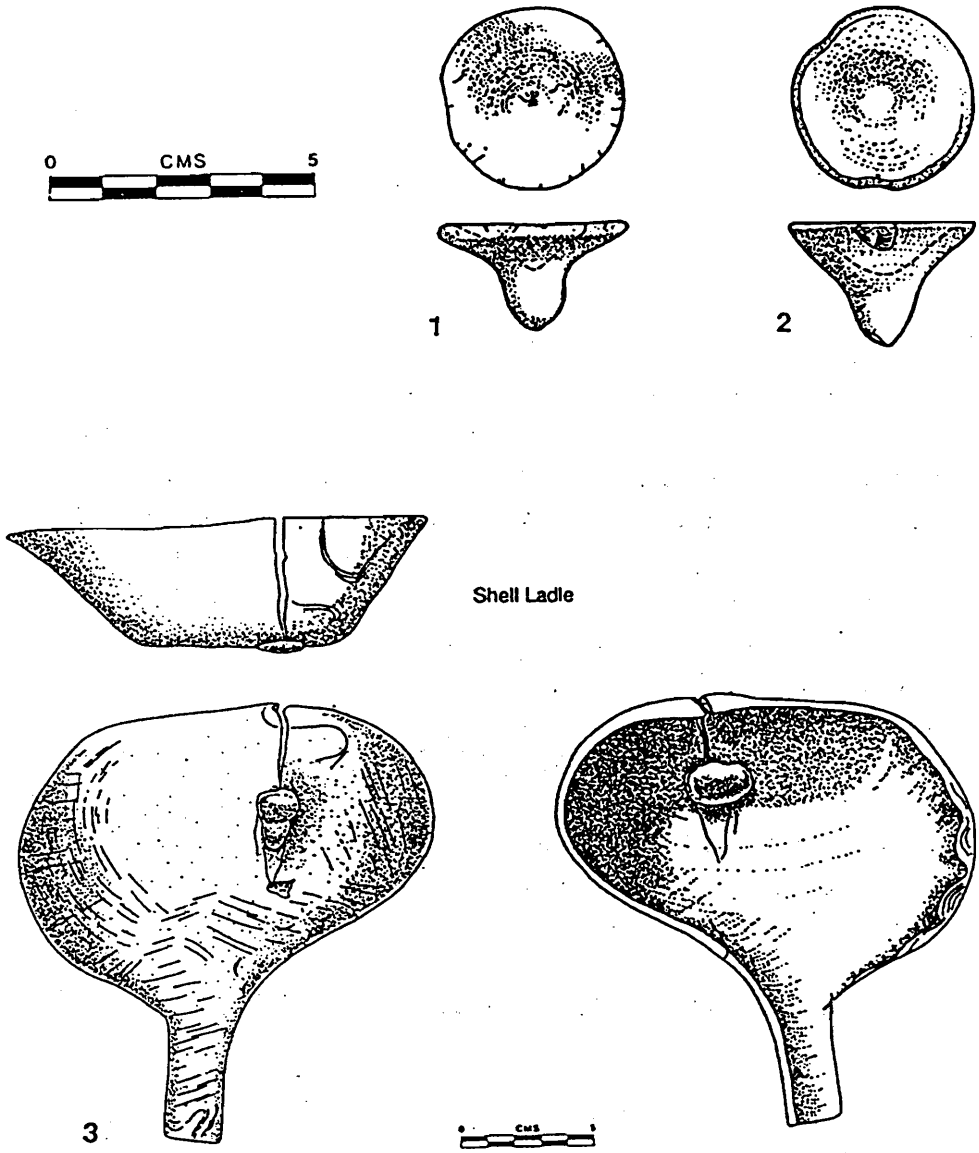



Fig: 58. Harappa: Shell ladle and terracotta tops.

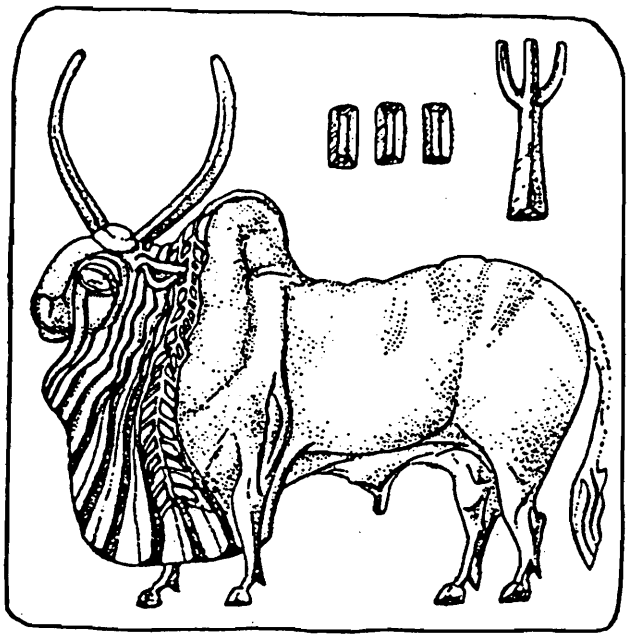
example, over 8.5 or under 5.0. In general, the soils of the Harappa excavations are between pH 6.5 and 8.9, indicating that calcium carbonate is controlling the chemical system. However, in some areas, extremely high pH and alkalinity values have been noted which may have a negative effect on preservation of artifacts and organic materials. The source of these high values is likely to be sodium carbonate, which is present in certain saline horizons.

Salt has accumulated in significant quantities in the archaeological strata at the site. It is also present in undisturbed, agricultural soils surrounding the site. Most of this salt has accumulated over geological time from the evaporation of groundwater which leads to the accumulation of soluble salts on the land surface. It is possible that these salts were present during the Harappan occupation. The types of salt at Harappa include sodium chloride, sodium carbonate, gypsum (calcium sulfate), sodium sulfate, and possible potassium chloride and sulfate. Water, and especially wind, have probably redistributed the salts, since the highest salt concentrations are at the surface of the mound, which is uneven and many meters above the capillary fringe of the current water table. Farmers have been leaching salts from soils in the area so that the soils can be used for agriculture. It is likely that the Harappans knew of the detrimental effects of salts on building materials and crops, and took advantage of less saline deposits for these activities.

## *2.1. STABLE ISOTOPE CHEMISTRY OF PEDOGENIC CARBONATES*

Calcite precipitated in soils of the Indo-Gangetic plains of India and Pakistan is know locally as "kankar" when it occurs in dense, hard, nodular form. It is most common on older stream or river terraces (early Holocene to late Pleistocene), where it precipitates in calcareous, silty soil.

Pedogenic carbonate nodules in soil at Harappa were recognized as a potential tool for interpreting environmental conditions prior to occupation, which began about 5000 years ago. The relationship of pedogenic carbonate to climate, particularly with respect



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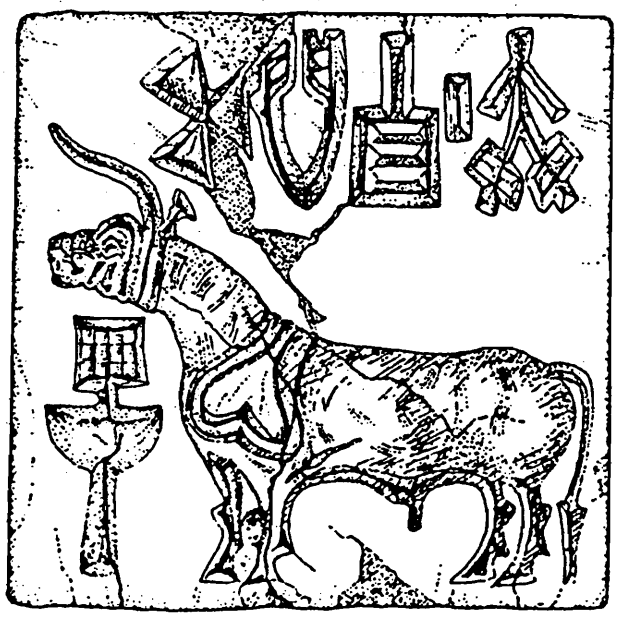

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Fig: 59. Harappa: Inscribed seals.

to annual rainfall or leaching, has been studied by many workers and more recently, a new generation of researchers has studied the stable isotope chemistry of carbon and oxygen in pedogenic calcite as a climatic or paleoclimatic indicator. Carbon isotopes in pedogenic carbonate have the potential to be used to identify the vegetation type and density that existed during calcite formation. Oxygen isotopes in carbonate of paleosols have been used to document regional warming trends, because the isotope composition of precipitation, which determines that of the carbonate, is strongly dependent on mean annual temperature. (Bibliographic details about these various studies are included in the full report submitted separately by Amundson and Pendall.)

This study was undertaken for two primary reasons. The morphology, mineralogy and stable isotope composition of the nodules were studied 1) to better understand the transformations that control their formation, and 2) to develop an assessment of the environmental conditions at Harappa that prevailed at the time they formed. The technical details involved will be found in the article recently submitted by Ms. Pendall to the journal *Soil Science*.

The basic conclusions are that the carbon isotope ratios of pedogenic carbonate in inner portions of nodules forming at Harappa reflect an arid climate with a very low soil respiration rate. Inner nodules are considered to represent pure pedogenic carbonate based on morphological evidence, and are early Holocene in age. Outer nodules isotope ratios are the result of an intermediate step in the pedogenic reprecipitation of calcite and/or represent more recent stages of deposition. These layers are most likely a mixture of pedogenic and detrital carbonate and cannot be used to compare in the bulk soil that has formed from pedogenesis and has been calculated to be a maximum of nearly 50% of the total carbonate in the Btk horizon.

Morphological evidence indicates the possibility of a change in the leaching environment at Harappa, from deep leaching with the development of an argillic horizon and deposition of dense calcite, followed by shallower penetration of water and deposition of porous carbonate on the nodules in the argillic. This apparent shift may have

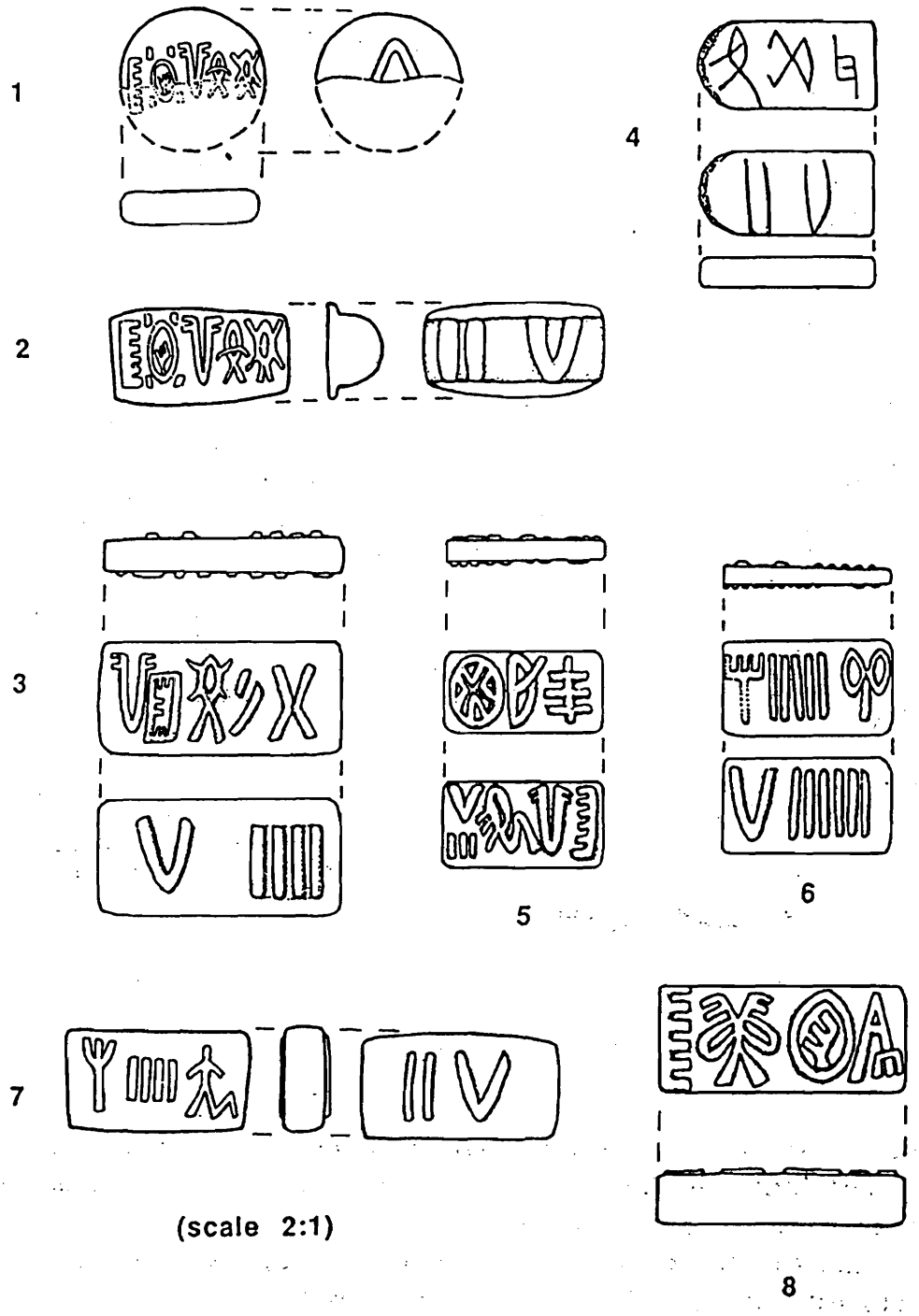



Fig: 60. A. Harappa: Inscribed objects.

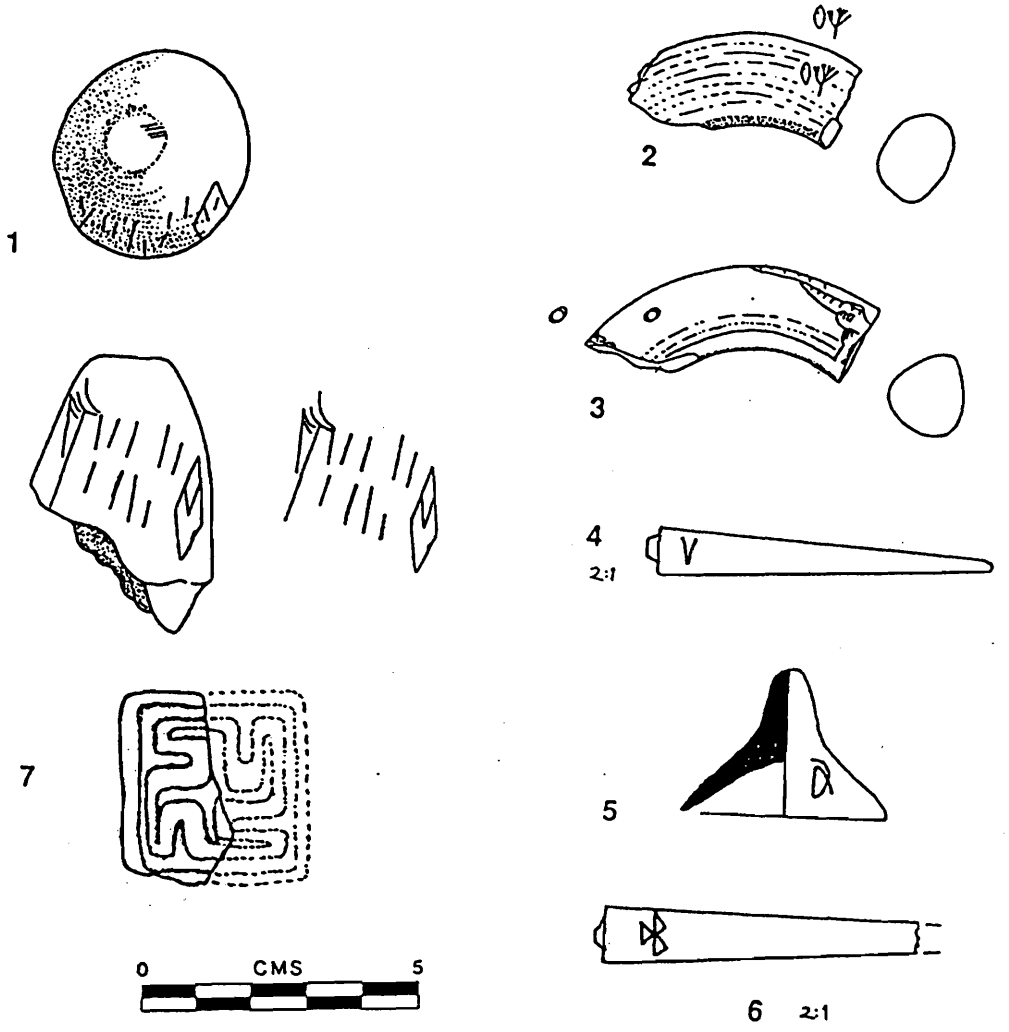



Fig: 60. B. Harappa: Inscribed objects.

been climatically induced or may have been caused by accretion of the ground surface by flooding or human occupation. However, the analysis of inner nodules suggests that sparsely vegetated conditions and an arid climate existed in early Holocene times when the oldest carbonate formed. Whether the past pedogenic environment suggested by this data differs significantly from present natural conditions is not known with certainty and indicates a need for further investigation.

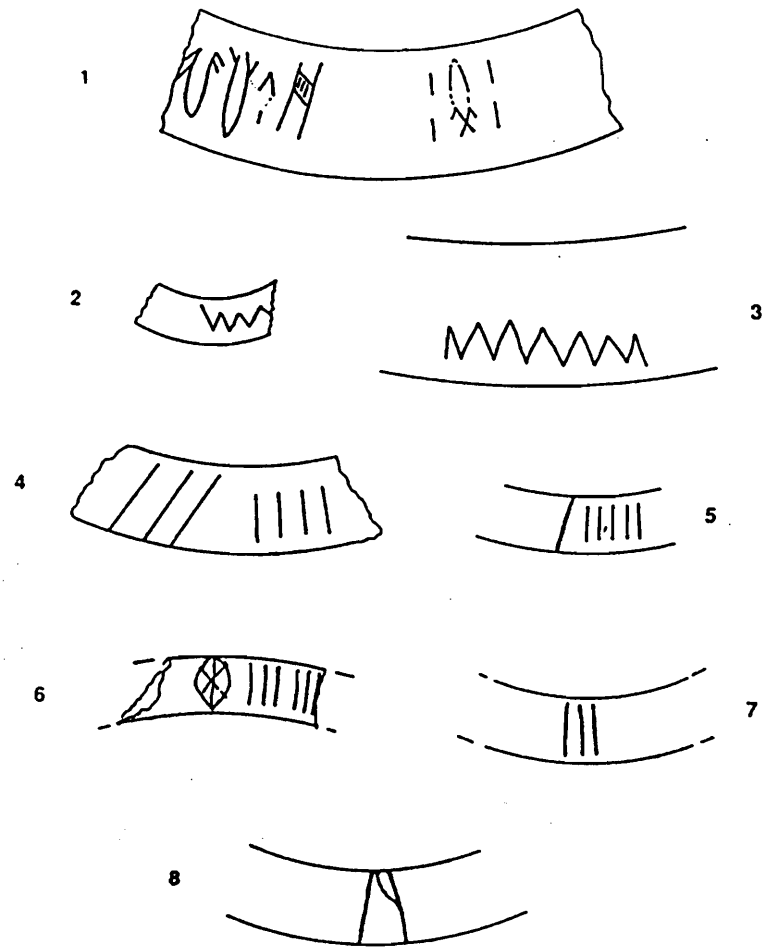



Fig: 61. A. Harappa: Inscribed pottery.

## D. Soil survey of the Vicinity of Harappa

### *METHODS*

A soil survey of an 8 square kilometer area around the archaeological site and modern town of Harappa was conducted (Fig. 71). Auger borings placed at 150 to 200 meter intervals along north-south and east-west transects were described in the field to a depth of 150 to 300 cm according to the Soil Survey Manual (Soil Survey Staff, 1981). The mound itself and habitated areas were not surveyed. The soil Munsell colour, texture, consistence, presence and description of

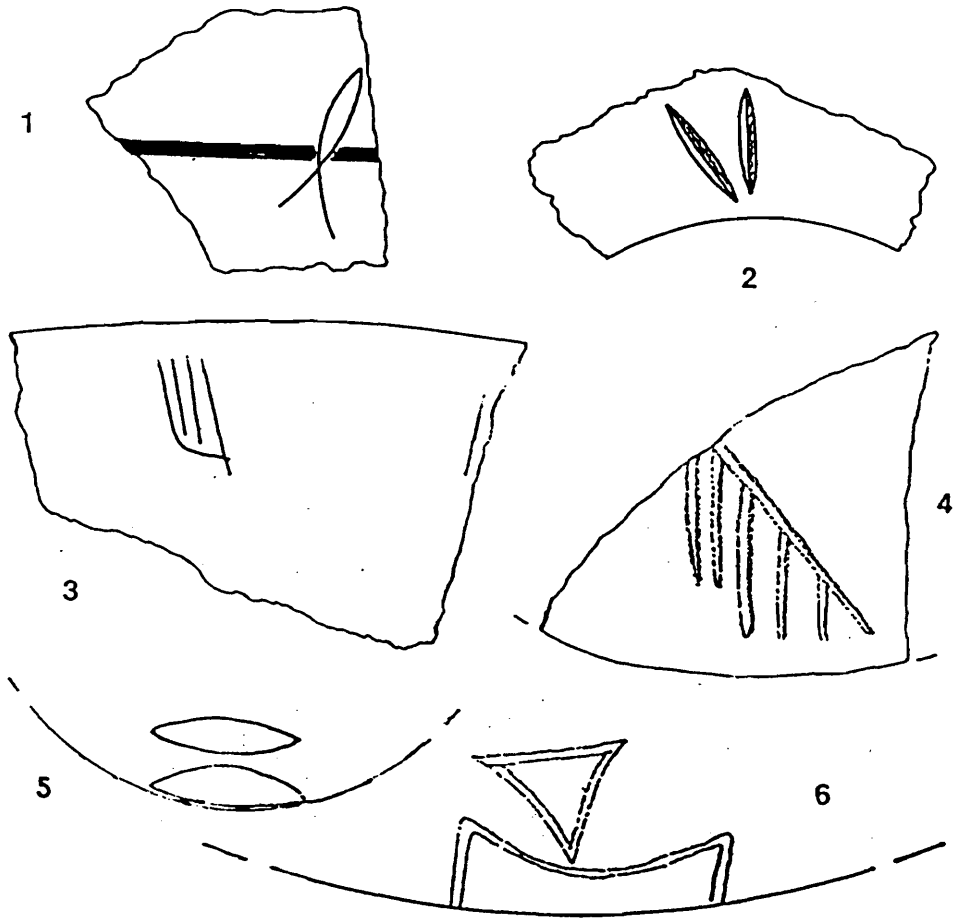



Fig: 61. B. Harappa: Pottery with script.

nodules or seams of calcite, gypsum and more soluble salts, and depth to parent material or water table were described. Soils with similar properties were grouped together as mapping units and classified according to the USDA Soil Taxonomy (Soil Survey Staff 1987) Series names were attached to these soils for completeness. In some cases, series names correspond to established soil series (e.g. Qadirabad), while in other cases, series names were merely taken from local geomorphic features. Series names do not necessarily correlate with established series of the Pakistan Soil Survey. Tests of pH and salt type were done in the Harappa laboratory. Samples of each mapping unit were collected and shipped to the USA for further analysis. A soil map was prepared using a topographic map of 1:50,000 scale as a base (Fig. 71).

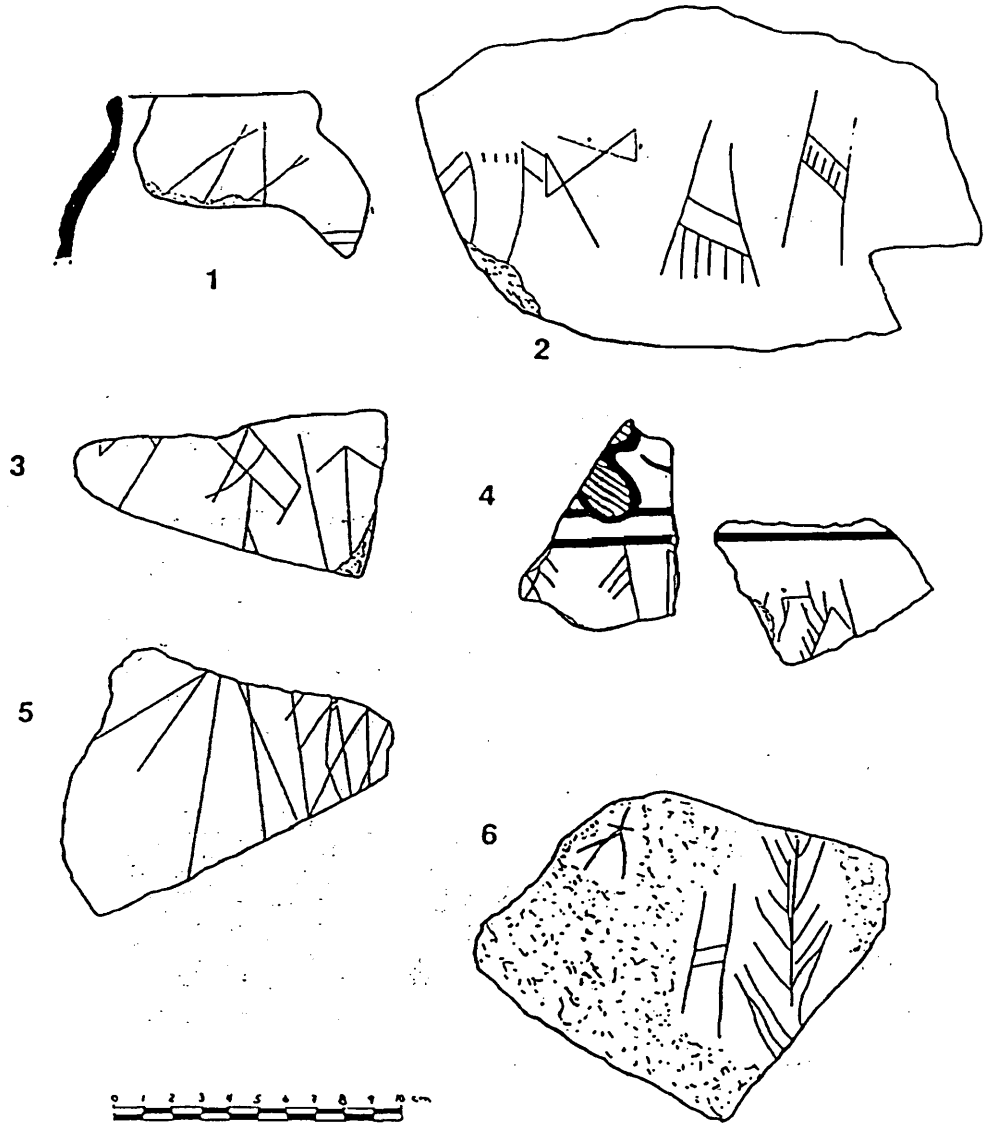



Fig: 61. C. Harappa: Inscribed pottery.

*RESULTS*

The major rivers of the Indo-Gangetic plains have been depositing tremendous quantities of alluvium since the uplift of the Himalayas began and, in the 50 to 60 million intervening years, up to 3 km of sediment has accumulated on the landscape south of the foothills (Marh 1986). Fast-moving, braided streams deposit coarse bed load materials in the mountains, but upon entering the low gradient plains,

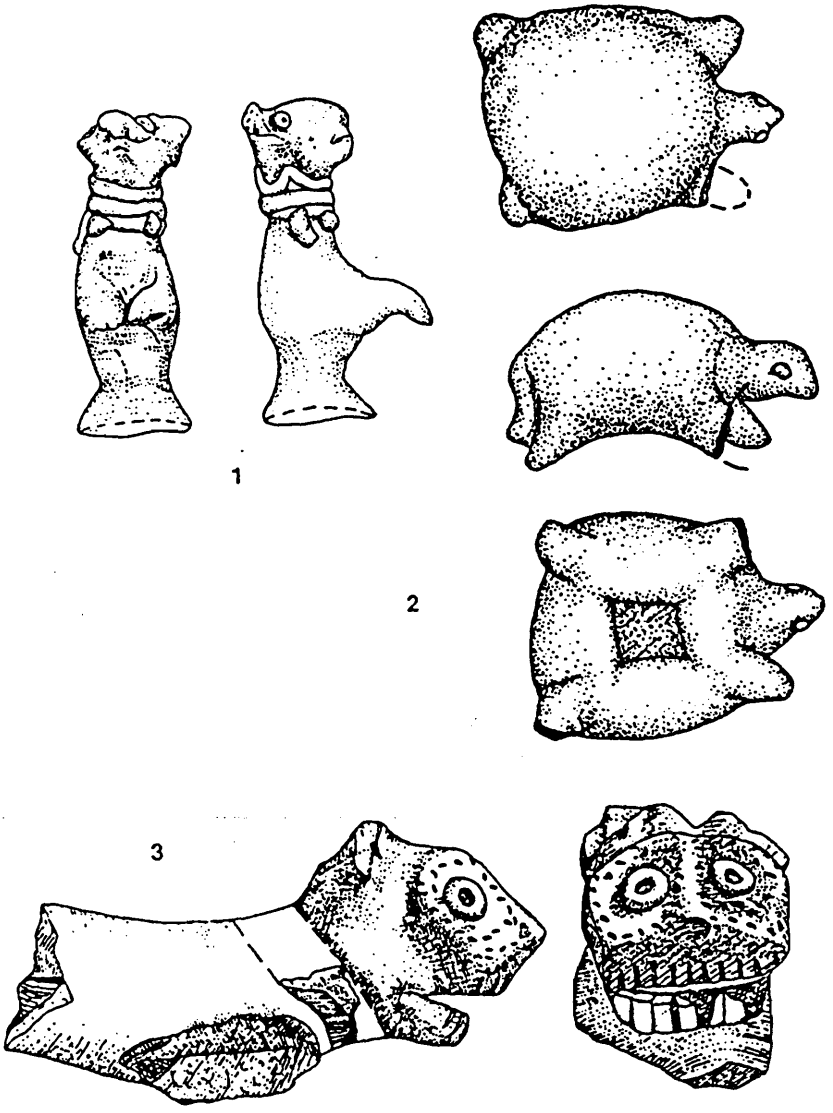



Fig: 62. Harappa: Terracotta animal figures.

they become meandering, slower moving rivers. In rivers flowing on the Indo-Gangetic plains, most of the coarse particles have been deposited or broken down, and only suspended silt and clay remains. These meandering rives tend to erode their silty banks only to deposit the material further downstream. In this way, silty flood plains can be self-perpetuating. Entrenchment (down cutting) occurs when the velocity or discharge of a stream increases, and the presence of high

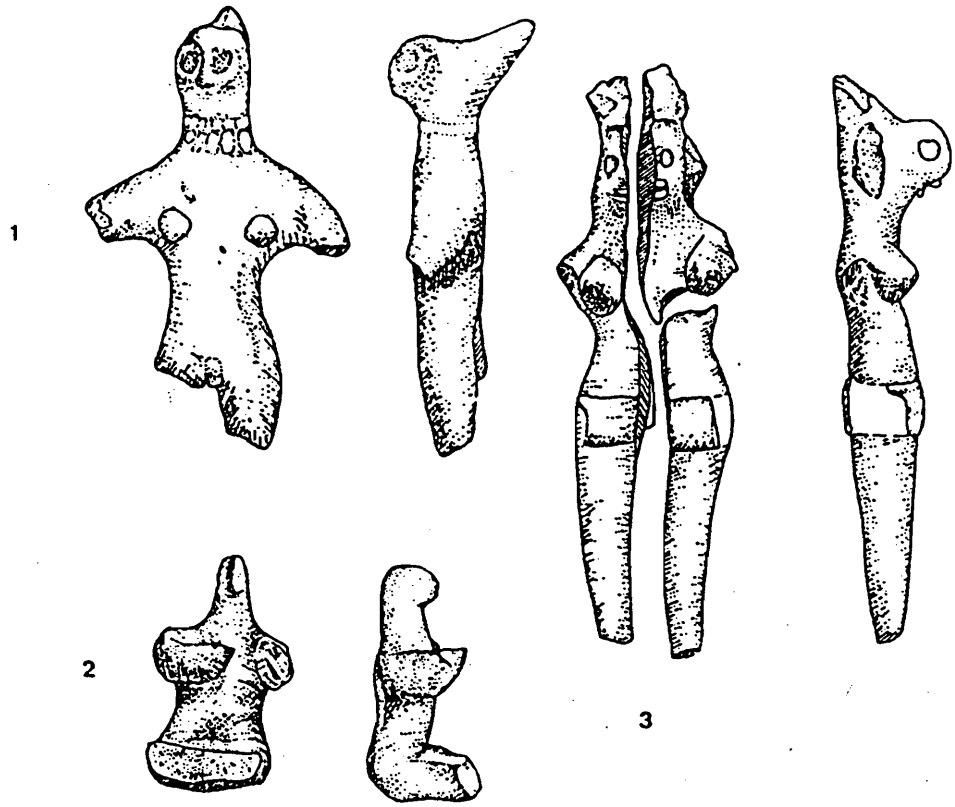



Fig: 63. Harappa: Terracotta figures, authropoid.

banks or other obstacles will not allow overbank flooding (Chorley et al. 1984). For example, local entrenchment in the vicinity of Harappa has occurred due to the presence of the old stable stream terrace of the late pleistocene adjacent to the former Ravi River bed.

At Harappa, most sediments are silt loam to very fine sandy loam in texture. Areas of silty clay loam to clay were deposited in slowly moving water or backswamps, while sandy loam to sand textures are typical of river channels. Within cultural strata, debris layers have sometimes been sorted by running water, and contain coarse (sand and gravel sized) particles of broken pottery and bricks. Cultural layers are dominated by silt loam textures, although silty clay loam textures can be found in some mud bricks. In the undisturbed soil of the Harappan cemetery, a silty clay loam horizon has formed by soil development.

The survey of the natural soil surrounding Harappa shows a dynamic and youthful environment, because the meandering of the Ravi River has caused aggradation of the floodplain. The youngest geomorphic surface in the area is the lowest channel north of Harappa city and mound. Flooding, possibly as recent as 20 years ago, has cut into banks creating terraces around the recent stream channel. Soils of the recent channel are composed of silty clay loam to sandy loam to sand, and may have a slight accumulation of organized matter in a surficial plowed horizon. No other diagnostic characteristics were observed. This soil represents time=zero in the chronosequence since it is minimally developed.

The next oldest geomorphic unit is loosely termed "Subrecent". The age of subrecent soils is difficult since no datable materials were recovered. However, judging from relative soil development we place this unit between 500 and less than 7000 years in age. It is found mainly north and east of the mound, as well as in a band to the south. This unit consists of floodplain and channel deposits and levee remnants. The soils exhibit varying degrees of development, depending on age and facies. In most soils, incipient calcite or gypsum accumulation is evident, and agricultural soils have surficial darkening from organic matter accumulation.

The oldest surface is late Pleistocene in age (Dr. Alim Mian, pers. comm., 1987), and was deposited by the Ravi River when rapid glacial melting and erosion of foothill soils was taking place. Soil formed in this deposit is relatively well developed. Its most noticeable feature is the presence of large and dense calcite nodules (kankar), which have formed over time by the downward movement of carbonate. The radiocarbon age of the single sample so far tested, of inner portions of these calcite nodules (7080 + /- 120 BP), indicates that the soil reflects environmental conditions which existed prior to Harappan occupation. A zone of clay accumulation may be present, but organic matter accumulation and intensive bioturbation are evident in the surface. This soil is found south and west of the mound area, and as remnant "islands" near the recent channel to the north and on the edge of the mound in the Harappan cemetery area.

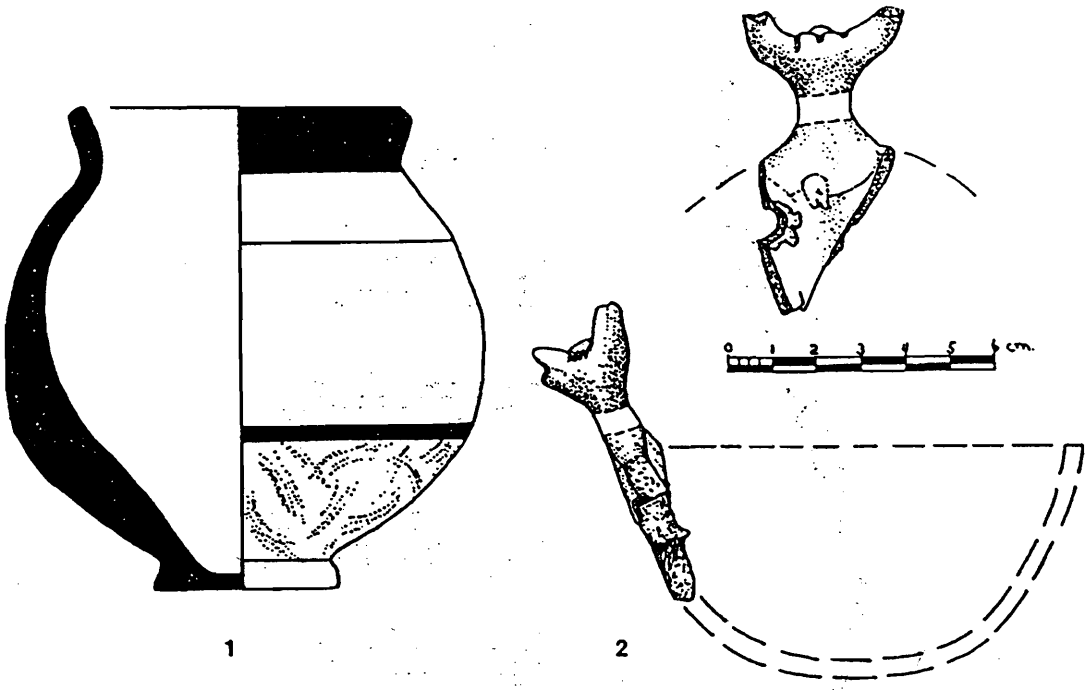



Fig: 64. Harappa: Unique Pottery.

Ancient Harappan debris covers the natural soil surface to varying depths from 0.5 to 1 km outward from the edge of the mound. This material may be associated with or buried by subrecent alluvium or may have gypsum accumulation within the profile. The surface is extremely salty and has sparse halophytic vegetation growing on it except where the debris has been scraped and the land reclaimed for agriculture. The presence of coarse rubble and other Harappan debris at depths to 3 meters, as far as one half kilometer from the site, may indicate locations of infilled Harappan borrow pits or rapid accretion of alluvium.

A summarized description of the soils of each mapping unit is presented in the separate more complete report by Amundson and Pendall and additional details will be supplied upon request.

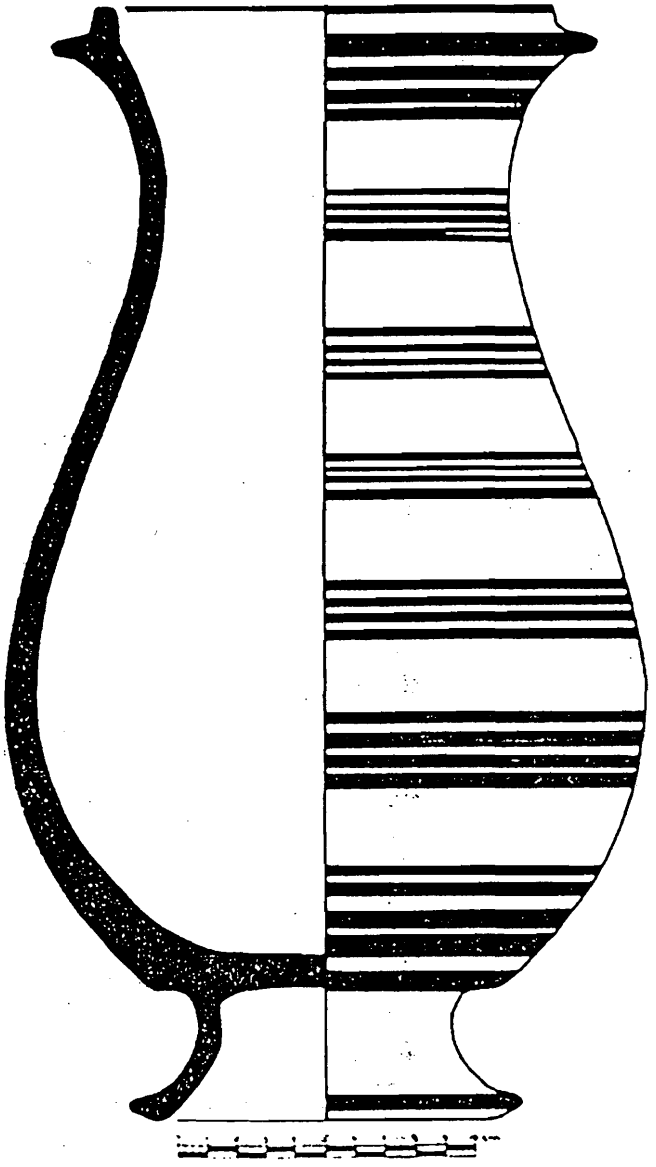


Fig: 65. A. Harappa: Pottery.

## E. Mapping Units of Soil Types

*Cultural material* (C. Cg) This mapping unit shows the extent of the eroded Harappan cultural debris (Fig. 71). It consists of silt loam to sandy loam matrix, with varying amounts of large to small fragments of potsherds, overfired nodules, brick bats, charcoal, etc.

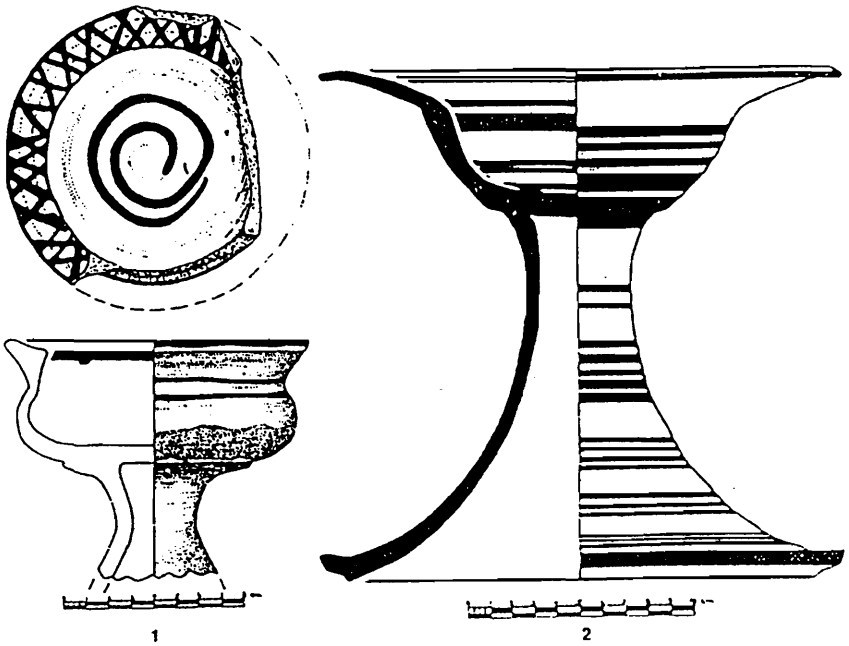



Fig: 65. B. Harappa: Pottery.

*Recent Channel* (Rc) This unit is found in the lowest landscape position near the Sukrawa drain. It has been an active, but not the primary, channel of the Ravi within the past 500 years and still occasionally receives flood waters. Minimal soil development is exhibited in the recent channel.

*Subrecent Channel* (Sc) This is a band of unweathered silt loam found west, south, and east of Harappa city and mound. It occurs on level ground or in slight depressions. Since it displays minimal soil development, it is considered one of the youngest members of the chronosequence. In some locations, it has buried cultural material, indicating that it was deposited since human occupation.

*Sultanpur Floodplain Association* (16) This unit is a group of soils found on the nearly level to gently sloping, subrecent floodplain of the Ravi River. The geomorphic unit is thought to be approximately 3000 to 7000 years old, based on soil development, and was the active floodplain of the Ravi River until migration of the Ravi to its current location 10 km north.

*Sultanpur Levee Remnant Association* (17.1) This is a group of soils occurring on the level, sloping, and slightly hummocky land northeast of Harappa city and adjacent to the Sukrawa drain. This unit is similar in age and relative degree of soil development to the Sultanpur floodplain association, but local topography and particle size are more variable.

*Gamber, gypsum phase* (18g) This unit is similar to a unit described by the Soil Survey of Pakistan, except it contains significant gypsum accumulation. It is found on the level, subrecent to old floodplain of the Ravi River, south and west of the Harappa mound. This soil is adjacent to the subrecent channel, and is thought to contain higher concentrations of salt and gypsum because of its slightly higher position relative to the channel.

*Lyallpur* (19 ) This mapping unit is found on the level, stable, old river terrace of the Ravi, though to be late Pleistocene in age. The soil contains well developed calcite nodules in silt loam alluvium.

*Qadirabad* (20 ) This unit is found on the old river terrace in areas where salts accumulated. The terrace is now among the highest positions on the landscape, although, due to the subdued topography, it is difficult to discern with the naked eye. The soil is found in Cemetery R37 and on a small "island" just northwest of the Granary. It is saline-sodic but in some areas has been leached and reclaimed for agriculture. Well developed calcite nodules and horizon of clay accumulation (argillic horizon) are present in otherwise silt loam alluvium.

## F. Discussion

General trends in soil development over time are suggested by the soils described in the soil survey. A deep, unweathered, and sometimes stratified profile of recently deposited alluvium is the starting point of soil development. If the deposit was from overbank flooding, the particle size distribution will be dominated by silt loam or very fine sandy loam. Channel deposits are primarily sandy loam, often with laminations of silty clay loam, indicating seasonal changes in river

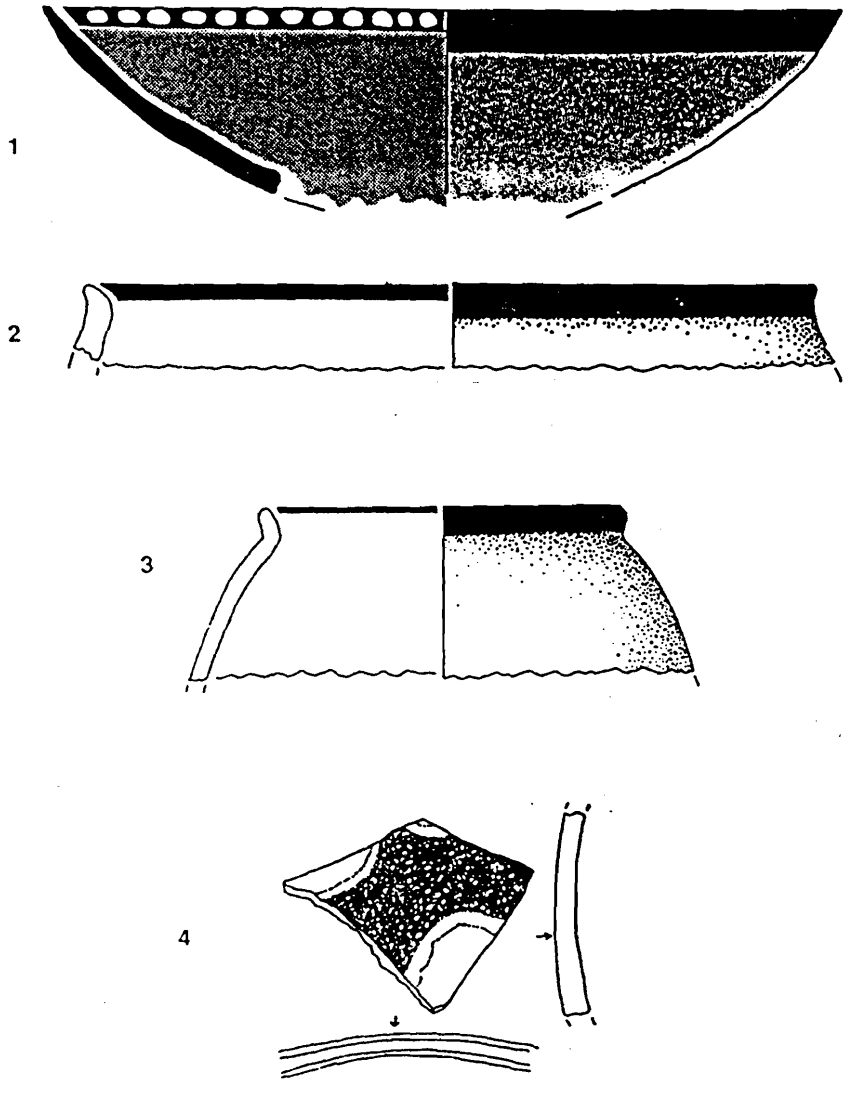
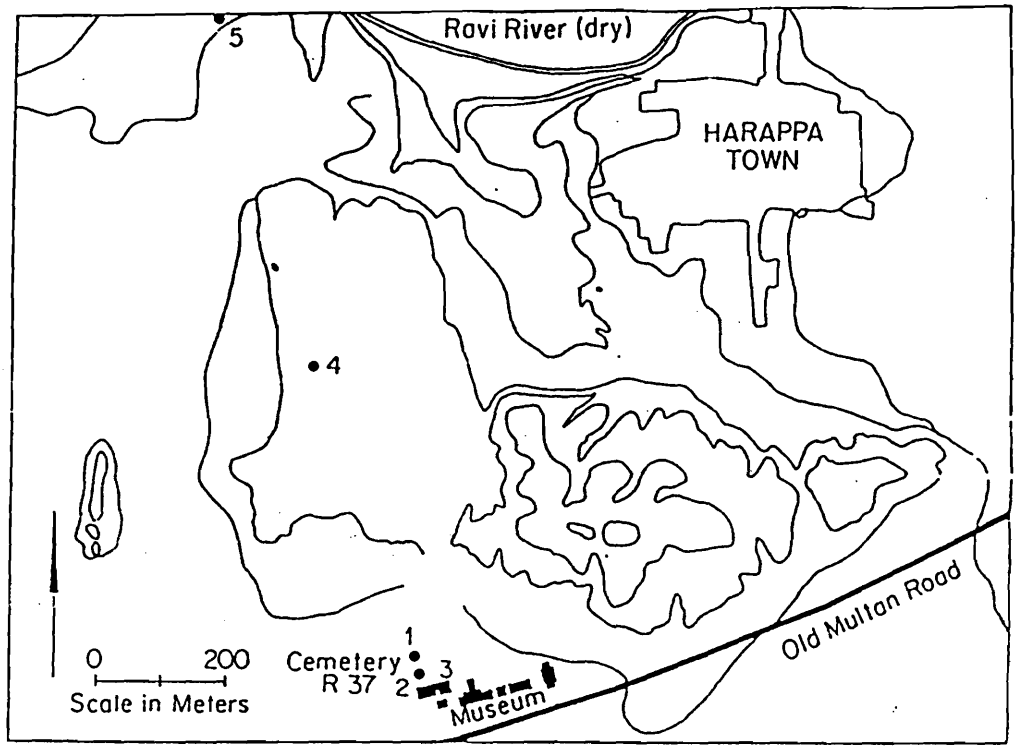



Fig: 66. Harappa: Early Harappan Pottery.

discharge and velocity. Backwater deposits are composed of silty clay loam and clay textured sediments. The texture or particle size of the initial "parent material" determines to a certain extent the degree of soil development possible within a given time.

Early in the development of a soil, organic matter from the breakdown of plants and animal wastes begins to accumulate in the surface. This is noticeable in the Recent Channel deposit. More rapid accumulation of organic matter can occur under cultivation,




Key

1. North Cemetery 1 Profile
2. South Cemetery 3 Profile
3. North Cemetery 2 Profile
4. Test Pit 14 Profile
5. Test pit North of Granary Profile

Fig: 67. Harappa: Test pits used in Pedological study.

especially in arid regions where irrigation increases the soil's productivity. Stratified layers will become less distinguishable as leaching water moves fine particles down, and therefore, the depth to stratification is an indicator of a soil's age.

Sediments deposited on the Indo-Gangetic plains tend to contain calcium carbonate disseminated in the form of microscopic particles. With continued leaching over time, the carbonate becomes dissolved and moves downward in the profile. In the semi-arid climate of Harappa, the carbonates are removed from the soil profile; rather, they accumulate at certain depth, depending on the soil particle size, as concretions or nodules. In the early phases of carbonate translocation, nodules are soft, small, and relatively impure, such as in the Sultanpur

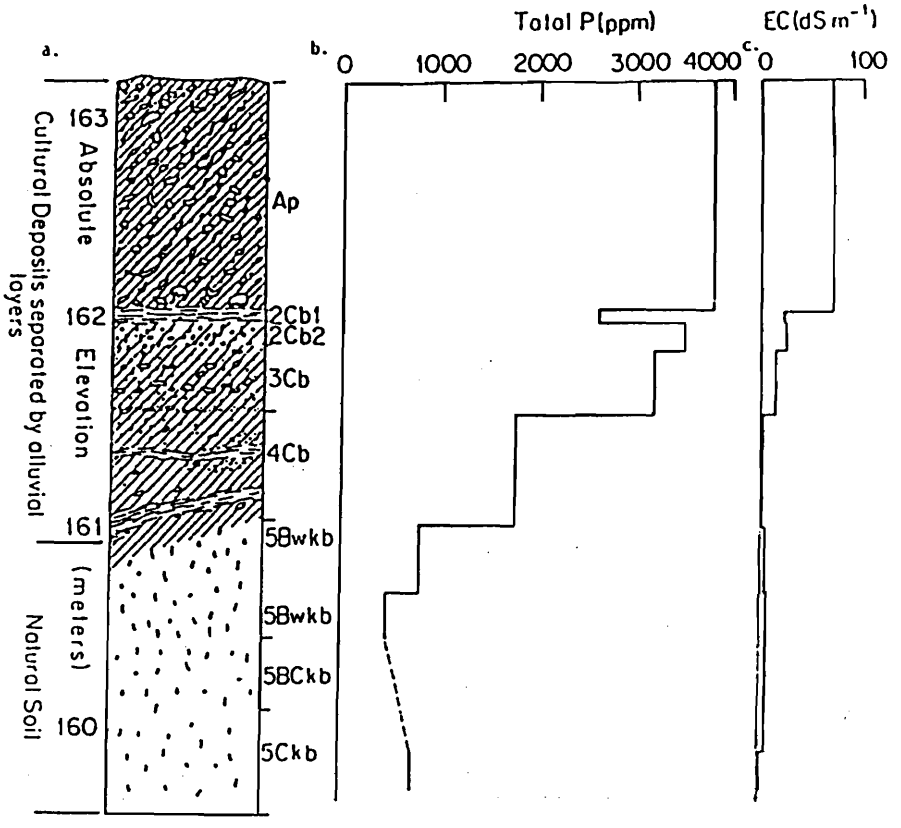



Fig: 68. Harappa: North Cemetery, Profile, Schematic Diagram, and Results of chemical Analysis.

floodplain association. With increasing time, calcite nodules become larger, irregularly shaped, and dense, and contain a high percentage of $CaCO_3$. The most advanced degree of calcite development was seen in Cemetery R37, in the Qadirabad soil. In finer textured soils (e.g. silty clay loam) more water is retained and pore diameters are smaller, so that nodules may become very dense but not as large as in silt loam soils. In sandy soils, calcium carbonate content in the parent material may be lower, and leaching is faster, so that nodule development is less prominent than in silt loams.

Gypsum ($CaSO_4$) and more soluble salts may be present in moderately well developed soils, and indicate proximity at some time in the past to a high water table or saline deposit. Crystallization of these salts can take place within 4000 years, as indicated by their presence in

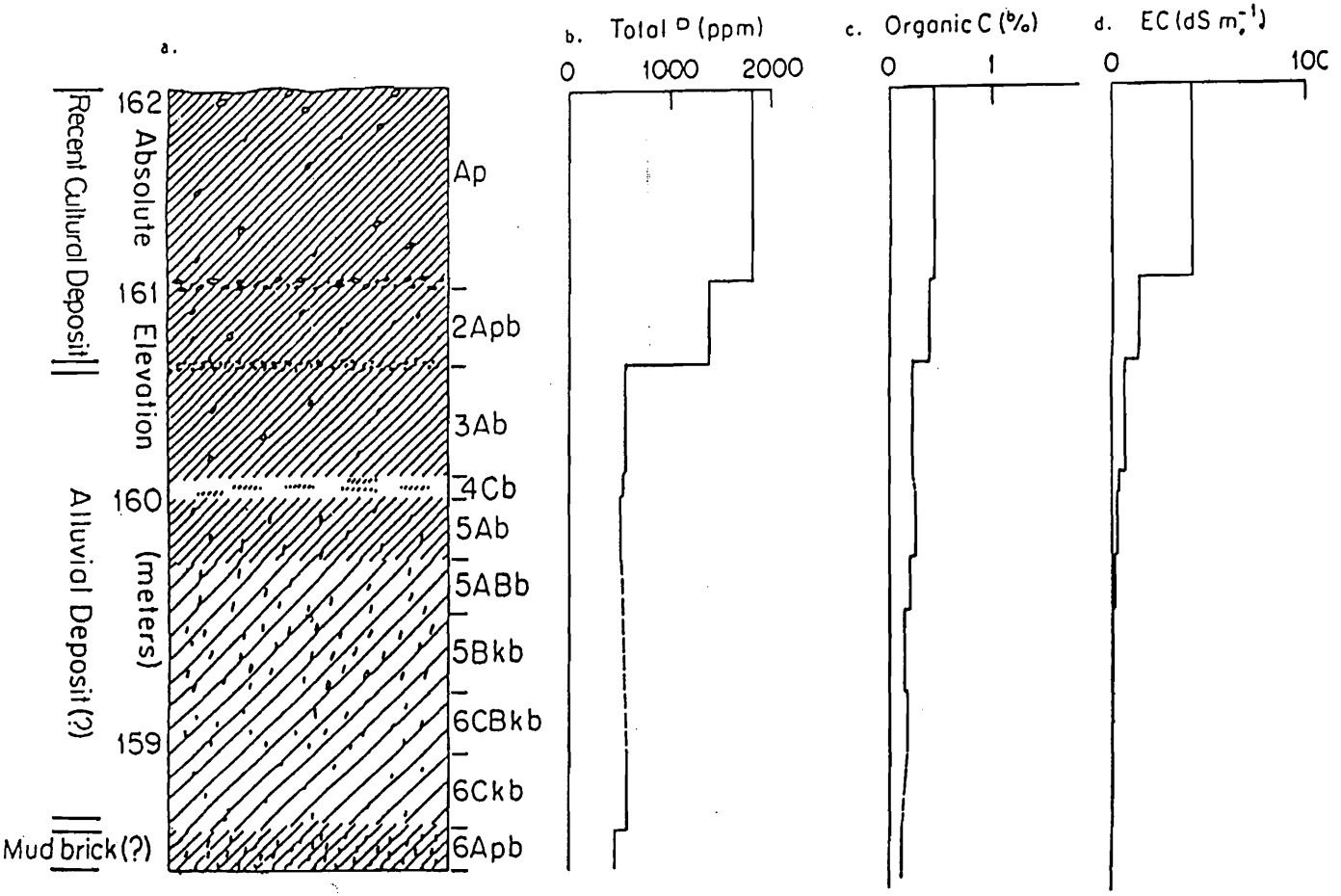



Fig: 69. Harappa: Test pit North of Granary, Schematic Diagram and Results of chemical Analysis.

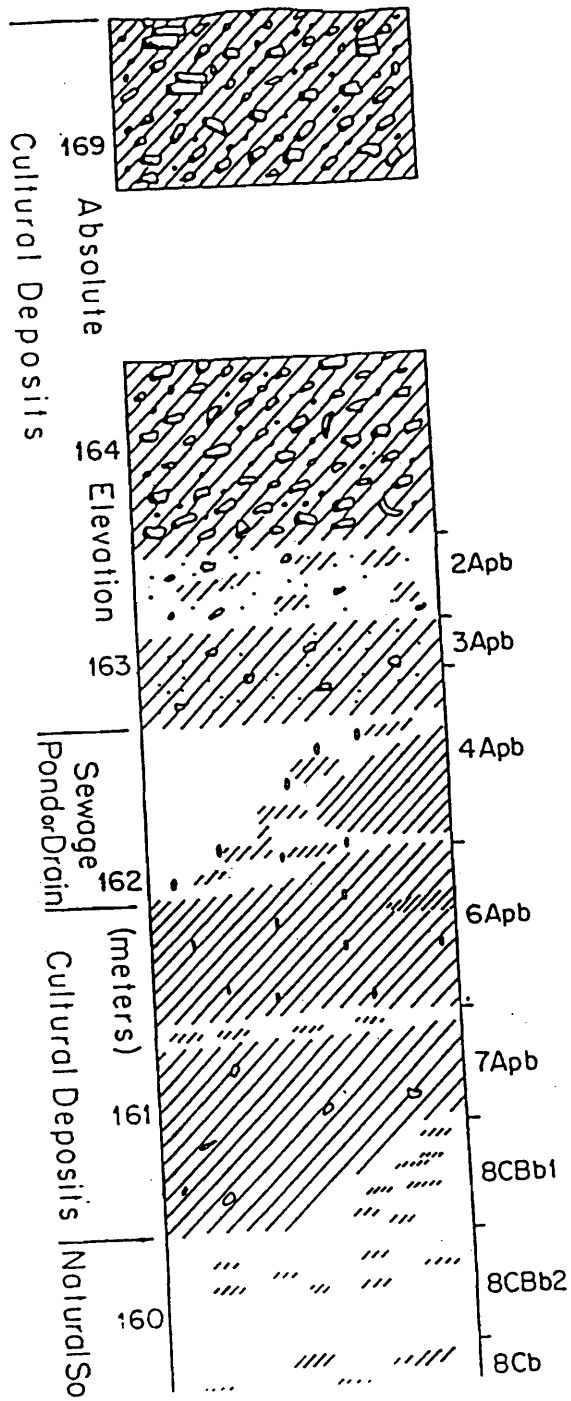



Fig: 70. Harappa: Test pit 14, Schematic Diagram of North face.

cultural deposits. Soil may accumulate gypsum more quickly than calcite if it contains high enough concentrations of Ca and $SO_4$. Gypsiferous soils are found adjacent to the Subrecent channel south of the Harappa mound, indicating that a relatively recent flood deposited sediment, and either raised the water table or deposited salts, including $CaSO_4$ nearby.

Continued leaching and weathering may eventually lead to the movement of clay-sized particles. An accumulation of clay (over a certain percentage) is termed an argillic horizon, and is an important indicator of relatively advanced soil development. Argillic horizons may take over 10,000 years to form, depending on soil texture and climate (Birkeland, 1984). In the vicinity of Harappa, only the Qadirabad soil has an appreciable clay accumulation. The cemetery R37 was built on this oldest and highest surface.

## FAUNAL STUDIES

The animal remains—bones and teeth—provide a major body of data for reconstructing the ancient environment–what animals,birds and reptiles were existing in the Harappa region. Equally important, faunal studies provide information on the human response to its environment–which fauna were domesticated and which were exploited for food and other raw materials. In other words, faunal studies provide a major body of data relating to ancient economics and human responses to its natural environment.

Large quantities of faunal remains have been collected during the first three years of the Harappa project. Dr. Richard Meadow has done preliminary tabulation and identification of limited parts of the collection each season. Because of the complexity of the identification procedures and the quantity of material to be analyzed, it is premature to present any results of his studies to date.

During the fourth season, he will have an experienced assistant who will work with him at the site for an extended period of time during which the tabulation and classifications are expected to be completed.

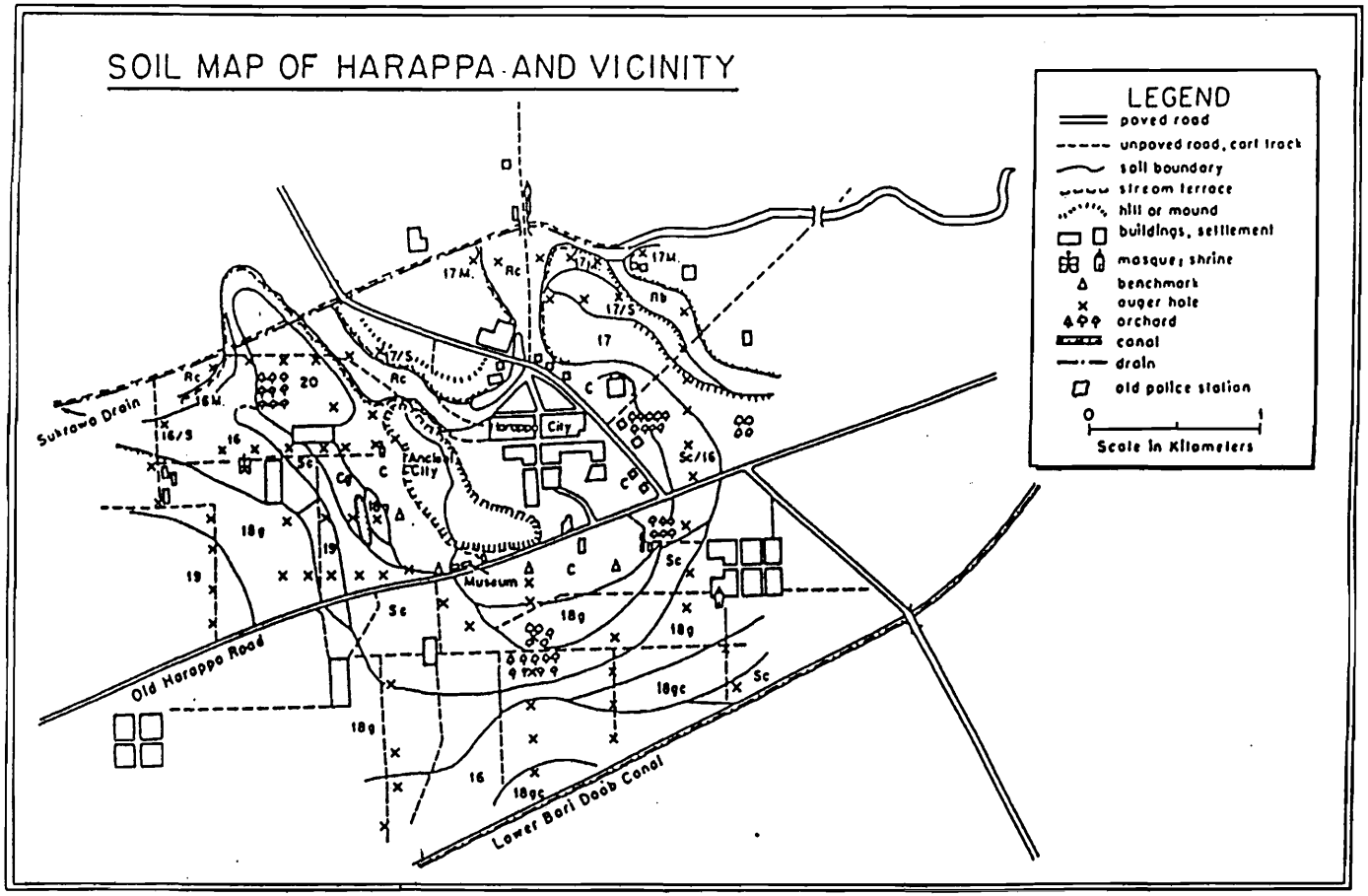



Fig: 71. Harappa: Soil map of Harappa and vicinity, showing location of auger holes of 1988 soil survey.

## CONSERVATION AND SITE/MUSEUM DEVELOPMENT

### A. The Conservation Laboratory

The laboratory was arranged physically in the same manner as the previous year: one side for the conservators, the other for the physical anthropologists, and the middle for the archaeologists. The open courtyard just outside the eastern door of the lab was used for the initial cleaning of objects and specimens, the desalinization soaking of the larger pottery, and for the sorting and initial reconstruction of vessels that had broken during their long burial.

The laboratory was under the direct supervision of Mrs. Donna Strahan who assisted in its original designing and outfitting. She was assisted in 1988 by Ms. Rae Beaubien of the Philadelphia Museum of Art who worked in the lab for the first month of the season; by Mr. Toseef-ul-Hassan of the Archaeology Conservation Laboratory, Lahore, who participated during the 1987 season and for two months in 1988; and by Mr. Waseem Ahmed, Senior Chemist at the Lahore Museum, who assisted in the lab for one month.

Because of the extreme salt problem at the site, desalinization was again a primary concern. The procedure was essentially the same as during the second season, namely, the initial washing of terracotta objects and pottery was performed in tap water. The interior of whole vessels was not cleaned well in hopes of preserving any microscopic remains of the original contents for future analysis. A LaMotte conductivity meter was used to monitor the salt levels of the soaking objects every twenty-four hours and a daily log was kept. Once the salt level reached the conductivity of the tap water, the object was moved to a soak consisting of roughly half tap water and half distilled water. Again it was monitored and the water changed to a lower conductivity of 100% distilled until the salt concentration leveled off around 100 ppm. The object was then removed and allowed to air dry slowly in the lab. The average soaking time for terracotta objects, sherds and vessels was from five to ten days.

As in the previous year, consolidation of friable terracotta objects was achieved with the application of 5% Acryloid B-72 in acetone after the object had air dried. Experiments are ongoing to improve the consolidation techniques.

Reconstruction of vessels was achieved through the use of the adhesive consisting of 50% B-72 in acetone. Losses or cracks were sealed with Acryloid B-72 and filled with plaster of Paris. The fills were inpainted a single background colour using Liquitex acrylic paints. Large complete vessels with long open cracks were reinforced on the interior with bandaids of Cerex (spun nylon) and Acryloid B-72.

Some materials required immediate consolidation treatment when they were exposed in the excavations. After the application of B-72, the artifact, or group of artifacts, was lifted with part of the underlying soil and taken to the laboratory for further treatment. The delicate lifting techniques utilized saran wrap or aluminium foil as a separator and plaster bandages as support around the dirt which contained the object. A board was slid under the wrapped block which was then carried to the lab.

A variety of other material was treated in the lab. For example, some of the copper alloy objects contained thread/string pseudomorphs on their surface. Mechanical removal of surface dirt was the only treatment performed on these objects. They were stored in air tight containers with dry silica gel.

A silicone rubber mold was made of the only complete inscribed seal found this season. Baked Fimo molding clay impressions were made of all sealings and inscribed sherds. Assistance was given to the physical anthropologists in consolidation and adhering bone and in gap filling bone with plaster.

**B. Museum Displays**

Delicate materials on display in museums require periodic cleaning and conservation attention. The expedition staff worked in coordination with the Museum Curator, M. Siddique, on several

displays during the third season. Most in need of attention was the human burial display from the 1966 excavations in Cemetery R37. Professor Kennedy was given permission to study the skeleton which was excavated from Cemetery R37 in 1966 and which is currently displayed in the Harappa Museum.

The skeleton had deteriorated since its post-excavation conservation, because humidity, heat, and levels of sunlight vary considerably over the course of the years, and can be very intense in the summer and rainy months. Dr. Kennedy, assisted by Dr. Nancy Lovell, cleaned the skeleton of the original preservative materials which had become discoloured and brittle. All the joints were found to have been glued together, to keep the skeleton in anatomical articulation. Unfortunately, the bones settled over time, and though in some cases the glue, perhaps softened by summer heat, accommodated the movement, in other cases, the glue maintained a bond that was stronger than the bones. Consequently, some of the bones that were not supported by the underlying cloth and straw in the display case, broke from the stress. Broken skeletal elements were therefore mended, and reconstructions with plaster were made where the ends of long bones had eroded. Bones which had been consolidated with their burial matrix, such as the feet hands, ribs, and vertebrae, were cleaned of as much matrix as possible, so they could be examined for morphometric and paleopathological analysis. Ribs remained in matrix, but vertebrae were separated and cleaned, and supported in the refurbished display by plastic tubing and surgical cotton. Hand and foot bones were separated and cleaned and placed, in anatomical position, on plaster supports. A new cloth was laid down in the display case, and the restored skeleton was placed back in the case in the same position as before.

Two new displays were installed in the museum. First is the elaborate and unique head-dress of microbeads discovered in a female burial during the 1987 season. Special authorization was received from the Ministry of Culture at the end of the 1987 season to export the head-dress for microexcavation and conservation. The work was done at the Conservation Analytical Laboratory of the Smithsonian Institution, Washington, D.C. by Mrs. Donna Strahan. The delicate

beads, preserved in their original position, are displayed in a special dustproof case in the jewelry section of the museum.

One of the best preserved of the skeletons excavated in the 1988 season was used to construct a display of a burial with a coffin and associated pottery. This display, enclosed in a specially constructed glass case was set up at the southern end of the Harappa Museum (Pl.XXII). A collection of burial pottery representing the typical assortment of vessels included in Harappan graves was arranged on the floor of the case on a layer of clean sand. Above the pottery, a reconstruction of a hand hewn wooden coffin was suspended on appropriate supports. One side and the top of the coffin were left open, and the skeleton was laid out on a molded clay support that was covered with soft cotton cloth. Photographs and explanatory lables in Urdu and English accompany the exhibit.

Such new displays with explanatory labels in Urdu and English, help visitors understand more about the ancient Harappans and also why the new excavations are being made.

## C. Site Improvements

In conjunction with the Site Curator, M. Siddique, the expedition staff contributes to efforts to improve educational facilities at the site for visiting tourists and scholars. During the second season, concrete and brick ramps and platforms and wire fencing were installed at two locations on AB Mound. Because the edges of the older excavations are severely eroded and undercut, they present a safety hazard for visitors. The platforms and fencing provide safe and optimum vantage points for visitors. These installations were found to be in excellent condition after the first year of use and the damage done by overzealous visitors climbing among the ruins has been reduced appreciably in these two areas. As for our new excavation areas, the deepest excavations were filled– incompletely or partially–at the end of the season and barbed wire fencing was installed around potentially dangerous excavated areas.

A long standing need at Harappa has been large maps and signs to guide visitors to the most important excavated areas and to provide written explanations of the excavated remains. One metal sign was installed in front of the Museum giving a map of the site with routes to follow. Also, in Urdu and English, is a basic description of the site and of the Indus civilization. Similar bilingual signs have been installed at Wheeler's 1946 Deep Trench and at both Cemetery R37 and Cemetery H.

**D. Training Programme**

*CONSERVATION AND MUSEUM PERSONNEL*

For the second year, Mr. Toseef-al-Hasan, of the Conservation Laboratory, Lahore Fort, has worked with the Project's conservators in the Harappa field laboratory. Participating in all aspects of the work–desalinization,cleaning repairing and restoring of artifacts—he has received practical training and experience in the basic techniques required in a modern field laboratory.

During the third season, two officers from Lahore Museum also participated in the laboratory and field training program. Mr. Waseem Ahmed worked in the Conservation Laboratory for one month. Mr. Shahbaz Khan worked with Dr. Kenoyer supervising excavations on Mound E and assisted in various aspects of the conservation activities, also for one month. Both men received training in some of the new techniques involved in excavation and conservation activities.

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