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Second Preliminary Report of the excavations at Lahuradewa District Sant Kabir Nagar, U.P. : 2002-2003-2004 & 2005-06

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1. Introduction and previous work

The second preliminary report is being brought forward on the results of excavations at an early lake-side settlement in the revenue limits of a Village Lahuradewa (also spelt as Lohradewa and Lahuradeva) (Lat. 26° 46' N; Long. 82° 57' E) in the region of Middle Ganga Plain (Figs.1, 2; Pls. 1, 2). It is in sequel to the earlier report which encompassed the results of initial excavation launched by the Directorate of Archaeology, Government of Uttar Pradesh, during 2001-2002[1]. Here we present additional information generated through the subsequent excavations during 2002-03, 2003-04 and 2005-06, which substantiate the first report.

The salient feature of archaeological investigations at Lahuradewa has been the involvement of specialists from the Birbal Sahni Institute of Palaeobotany and the Department of Geology, University of Lucknow with an objective to evolve an interdisciplinary approach relevant to the archaeological perspective. An archaeologically well expressed settled life at this site, has marked the beginning of a ceramic and non-metallic occupational phase of Early Farming tradition characterised by cereal cultivation, during seventh millennium BC in early post-glacial times, spanning for several thousand years up to about 2000 BC. It was succeeded by an Advanced Farming phase and a few confined phases of cultures in the Early Historic times.

1.2 The results in the first season's report had implications pertaining to the aspects of the commencement of early farming and the antiquity of the cultivation in this region; the interactions of the early farming cultures in the region with contemporaries in other areas; the time of the diffusion and bringing into use of the barley and wheat in the subsistence economy of cultural groups in the Sarayupar region, from north-western region of subcontinent where the important cereals were mainstay in the agriculture of still earlier farming cultures; and finally of the understanding the habitation patterns of early settlers in the region[2].

The continuing excavations during 2001-02 revealed the deposits of five-fold culture sequence as given below:

Period I	Early Farming Phase
Period II	Developed Farming Phase
Period III	Advanced Farming / Early Iron Age
Period IV	NBPW phase
Period V	Early Historic (Early centuries BC/AD)

The earliest Preriod I starting from the very opening of sedentary occupation at the site was subdivided into two sub-periods namely IA and IB. In first season's work, about 45-50 cm thick deposit of sub-period IA was distinguished on the grounds of physical nature. It is characterised by the presence

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of a coarse variety of handmade red ware and black-and-red ware industry often displaying cord-impressions on exterior surface. A few sherds also show decoration by incised patterns and fine red slip. Inclusion of black and grey ware in a meagre amount was noticed. Water vessels, pedestal and knobbed bowls, some of which decorated with applied rope-pattern, were the important shapes, in the ceramic assemblage. Solitary lithic component found, was a piece of stone of Himalayan region. Faunal remains included some bones and a tortoise shell. Plant material consisting of incidentally carbonised material included a few grains and glume pieces of rice, conforming morphological to those of domesticated form (*Oryza sativa),* in the assortment of the grains of some wildly or segetally growing rice (*Oryza cf. rufipogon*) and foxtail grass (*Setaria glauca*). On the basis of two conventional radiocarbon date determinations of wood charcoal from the lowermost deposits, carried out by the Radiocarbon Dating Laboratory at BSIP (BS - 1951: BP 5320 $\pm$ 90 yr; Cal. BC 4220, 4196, 4161 yr and BS - 1966: BP 6290 $\pm$ 160 yr; Cal. BC 5298 yr), the human activities and the agriculture practices during the early phase of occupation at the site, were ascribed to an early post-glacial times (early Holocene), during 6^{th}-5^{th} millennium BC (8^{th}-9^{th} millennium BP). However, the estimation of precise date of the cultivated rice remained unsettled, in want of direct AMS date of the material.

About 45 cm thick occupation deposit of sub-period IB was marked by the appearance of some new shapes in pottery such as beaker, perforated vessel, spouted vessel and dish or bowl-on-stand. Black-and-red ware continued in medium variety - sometimes comprising black or red slip on one side, and quite often, burnishing on one or both of the sides. The quality of pottery showed improvement over Period IA. A few painted potsherds, some terracotta and stone beads, and a few micro steatite beads were the noteworthy commodities in the cultural assemblage. Charred and un-charred bones showed cut-marks. Wattle-and-daub dwellings appeared in continuance, implied by the post-holes and burnt mud-clots with reed-marks. Culmination of this sub-period is dated by a radiocarbon date of charcoal from the upper level of a deposit in this occupational phase (BS-1950: BP 3750 $\pm$ 90 yr; Cal. BC 2135, 2079, 2056 yr).

Period II succession begining from about 2000 BC, was characterised by an acclaimed presence of copper artefacts at Lahuradewa. In continuation of ceramic industries of Period I, this period was marked by the appearance of plain and painted black slipped and black-and-red wares. The proportion of spouted and lipped vessel, bowl/dish-on-stand, pedestal bowl, disc based bowl increased many folds. Earthen storage bins, baked terracotta tiles, legs of some terracotta objects, steatite beads in fairly large numbers, some lithic artefacts, beads of semi-precious stones, socketed and tanged bone or antler arrowheads with ravishing micro encircled decorations, etc. indicate considerable spurt in the material prosperity. In addition to customary dwelling structures, rammed earthen floors, hearths and a mud-wall augment to improvement in settlement plan are present. Noteworthy is that the occupation area extended in this period, wherever excavations carried out during the first season, and surface finds indicated that whole of the mound including the eastern area, which is presently under cultivation, were under habitation during this period. Growth of population would have extended, plausibly due to increased sedentism and clustering of human groups, as to the need to exploit arable territories around the site for sufficient means of agriculture.

Period III was marked by the appearance of highly rusted iron artefacts. About 80 cm thick occupation deposit of this period comprised all types of ceramic industries of the earlier period. Important iron objects included sickles (?). Earthen floors, hearths burnt clay lumps with reed and straw impressions indicated the continuation of earlier structural traditions. Bone and antler arrowheads and awls were present in a good proportion, which show a considerable variation in shape and decoration. A radiocarbon date for a

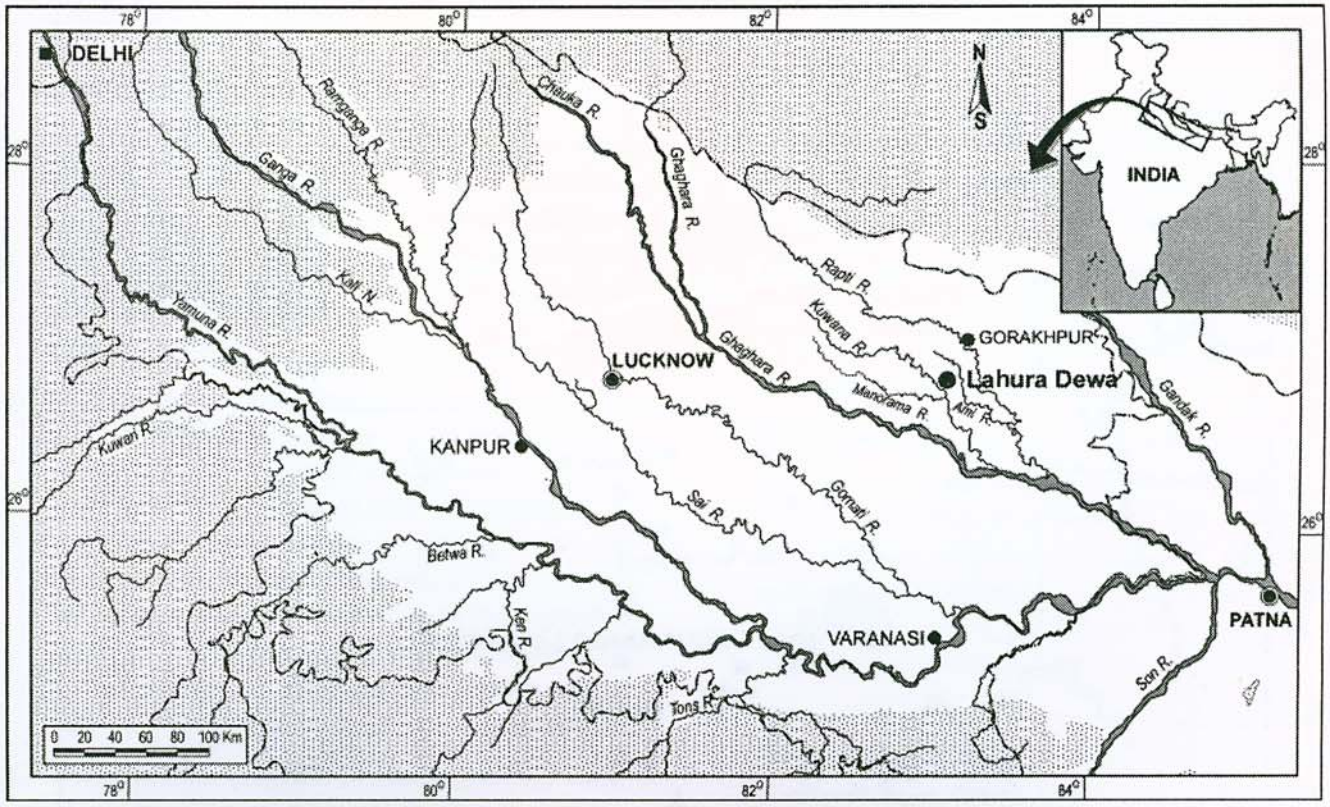

Fig.1. Map showing location of the concerned area of the Ganga Plain.

charcoal sample collected from the lowest iron yielding deposit of this period is 2940 ± 100 yr BP; Cal. BC 1205, 1205, 1188 yr (BS:1939).

Subsequent Period IV was characterised by well-known NBPW in an occupation deposit of about 1.20 m thickness. Painting tradition on pottery continued considerably even in this period. Some NBPW sherds of deluxe variety also exhibited painted decorations. The proportion of finely made black slipped, grey and red ware increased, while black-and-red ware and coarse variety of pottery declined in their proportion. Presence of iron slag was noted.

Some structures such as a brick paved well and remnants of some ground plan of a brick structure, comprising a few rooms and typical sherds in red ware known from the deposits of early centuries BC/ AD at various sites were represented in the deposits of Period V at Lahuradewa. Thickness of such deposits (about 70 cm) and area of occupation apparently appeared only in confinement.

1.3 In view of the outcome of the first season's work at Lahuradewa and the earlier archaeological evidence available from Koldihwa / Mahagara and Kunjhun etc. in the north Vindlyas and Jhunsi, Damdama, Imlidhih Khurd, Khairadih, Chirand and Senuwar etc. in the Ganga Plain, following important observations were underlined in the first preliminary report:

1. Rice based agriculture was prevailing at least in an area extended from the Himalayan *terai* to north Vindhyas during, circa 6th to 3rd millennium BC onwards. A diffusion of rice cultivation from the Ganga Plain to Harappan Zone was also suggested during the 3rd millennium BC, where the rice is documented on a number of sites in Haryana and Punjab datable from 2850 BC to

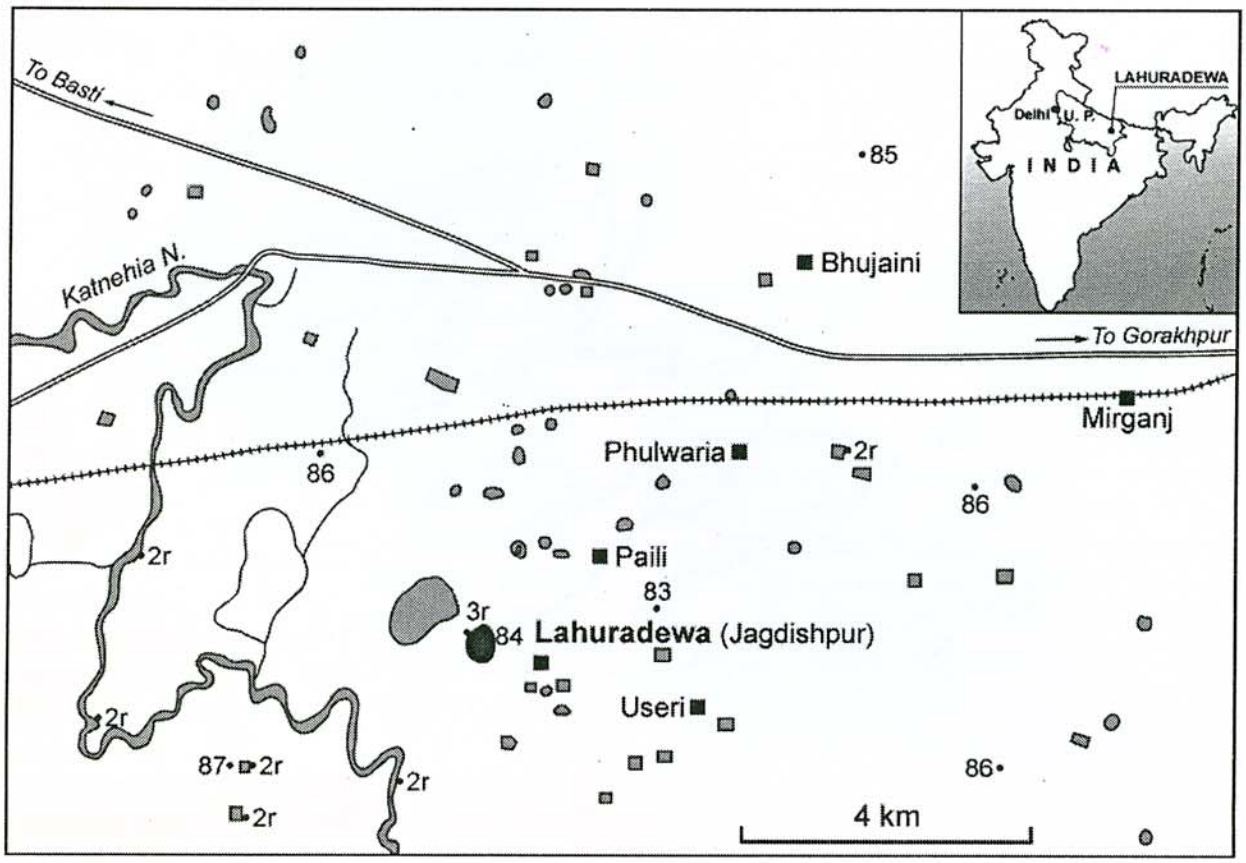

Fig.2. Map showing location of Lahuradewa.

the Early Historic times.

2. In view of conventional radiocarbon dates available for the deposits containing carbonised domesticated rice grains and early pottery comprising husk of domesticated rice in their matrix and available evidence from the other sites of the region, we were convinced about the cultivation/domestication of rice in at least 6th millennium BC at and around Lahuradewa. *However, more precision in this regard remained to be achieved by AMS dating of carbonised rice grain itself.*

3. Though no hiatus was found in lithology between the deposits of sub-periods IA and IB, there was a gap of about 2000 yr between the available radiocarbon dates for sub-periods IA and IB. The ^{14}C dates of calcrete collected from the deposits of sub-period IA (i.e. BS-1965: BP 4440 $\pm$ 140; cal. BC 3358-2902) were considered to be most probably related to ground water lowering in response to increased aridity, post dating the human settlement of the area in the 6th and 5th millennium BC. Further it was thought that the pulses of tectonics causing up-warping of landscape by few metres, would have lowered the groundwater and may have contributed to the formation of calcrete, and that virgin deposit of sand represents the deposit of a small water channel. Disruption of this channel and its filling could have taken place before the human settlement of the area. Aridity during 5000-4000 BP and warping of landscape may have plausibly led to temporary abandonment of the occupation site, as water in subsurface would have become deeper and adjacent lake may

have shrinked and dried up, causing water scarcity in the area.

The questions posed in this regard were left to be assessed precisely, on the basis of more ^{14}C dates for the deposits of sub-periods IA and IB; results of pollen analysis; archaeo-botanical studies; geo-morphological investigations; and the outcome of further excavations at Lahuradewa and other sites of the region in future.

4. An irregular channel (drain) running through three quadrants was exposed during the first season's work. On the basis of stratigraphic considerations it is associated with sub-period IA. It was traced for a length of about 12 m. Its average breadth varied between 23 and 53 cm. Some post-holes were found superimposing this channel. *The nature and context of this structure could not be ascertained and it was left to discernment during the subsequent excavations.*

5. The question of origin of Black-and-Red ware was raised and discussed in view of the presence of a coarse variety of black-and-red ware. This pottery is known in the ceramic industries of Koldihwa, Sohgaura, Imlidih Khurd and other early proto-historic sites in north Vindhyas and Middle Ganga Plain. However, it was generally placed in an ill-fired group of pottery. Since its thicker inner core and surface is black to greyish and upper thinner core and surface clearly distinguishable in section is red, we suggested 'coarse black-and-red ware' terminology for this particular pottery, which technologically fulfil the entire requirement in the identification of black-and-red ware. Considering the presence of this pottery in the 7^{th}-8^{th} millennia BC onwards in the context at Koldihwa/Lahuradewa, it was observed that *"If the earliest site comprising black-and-red ware is to be considered as the lineal progenitor of this pottery, may the region comprising north Vindhyas and central Ganga Plain be suggested as the source area for the origin of black-and-red ware technology? Consequently we may also assume that the technology of black-and-red ware and cultivation of rice were the two components contributed by the early farming communities of the central Ganga Plain and north Vindhyas to their western contemporaries at least as early as in 3rd millennium BC".*[3]

6. On the basis of the pottery comprising a fine red slip and incised decoration on exterior surface, in the lower levels at Lahuradewa, an earlier evolution of pottery was suggested.

7. The beginning of sub-period IB was marked on the basis of the presence of bowl or dish-on-stand, barley and wheat in the cultural assemblage. *In absence of any specific radiocarbon date from the corresponding layers, the lower limit of the antiquity of this sub-period, however, could not be ascertained precisely.*

8. Considering the provenance of a rock piece of Himalaya origin, black rock celt the artefacts of Vindhyan origin, beads of semi-precious stones and steatite (?) the direct or indirect long distance contacts of ancient Lahuradewa settlers with Himalayan foot-hills, Vindhyan hills and western India were surmised.

9. A good number of white or cream coloured micro - to medium-sized *steatite beads* found at Lahurdewa and other sites of the Middle Ganga Plain are comparable in size, shape and manufacturing technique with those of Harappan tradition. However, these beads appeared to be harder than talc or natural steatite stone. *Therefore a need of scientific examination of their material was underlined in the first preliminary report.*

10. The extent of settlements between 2000 and 1000 BC and their specific location alongwith rich cultural assemblage at Lahuradewa and other contemporary sites of the region was also pointed out, in view of ascertaining them as a village or larger than a village?

11. Mostly, more areas are seen occupied at many sites in the region during the early centuries of the Christian era, but at Lahuradewa the occupation appears to be considerably restricted during this period. What would have been the reason?

2. Further work during 2002-03, 2003-04 & 2005-06

2.1. Archaeological excavations at habitation mound:

The excavations carried out during 2002-03, 2003-04 & 2005-06 were aimed to find out convincing answers for the questions posed by the outcome of the first season's work briefed above, and to procure more source material for having a clear understanding of the different aspects regarding the respective cultural periods. In addition to first season's trenches, additional nine trenches YA1, YA2, YB1, ZA1, ZB1, YA3, ZA2, ZA3 and ZE1were laid down (Pl.3). Total area excavated till date covers 776.69 sq.m. Significant aspects revealed in these excavations are elaborated below:

2.1.1. Above excavations have revealed that the layer No. (11) in Trench YA1 Qdt.1 actually belongs to sub-period IB instead of Period II (Fig.3). This layer was mentioned in the first preliminary report[3] to be representing Period II. The thickness of the occupation deposit of sub-period IB including layer (11) stands amended around 50 cm. With this addition the total thickness for the deposit representing Period I would be around 1.20 m.

2.1.2. During the earlier excavation the number of charred rice grain was limited. Some more such evidence has been found during the subsequent work right from the lowest levels of layer (14) representing the earliest deposits of sub-period IA. These finds further corroborate the beginning of rice-based agriculture at the site in at least around middle of the seventh millennium BC.

2.1.3. Further excavations at Lahuradewa have provided more evidence regarding the earliest settlers in sub-period IA. We have been fortunate enough in getting the imprints of the earliest dwelling structures of the human occupants of this site in the form of postholes, in the lowest level of the habitation deposit just on the natural soil, in Trench No. YA3, Qdt.2. These holes would have supported the posts erected for making some kind of dwelling structures, which would have comprised of reed-screens or straw like material and plastered with clay, as attested by the presence of burnt clay-chunks bearing reed and straw like impressions. In addition to these pos-holes, one roughly circular earthen floor and several circumscribed postholes could also been observed in trench No. YA2, Qdt.3 (Pl. 4). Its radius is about 1.00 m. The cultural deposit of sub-period IA and IB, so far exposed in the excavations, covers an area extended over about 30 m in length and about 10-15 m in breadth. Taken together these evidences one could amply attest sedentary nature of the early farming community at Lahuradewa.

2.1.4. As detailed above the channel (drain) exposed in first season's work, belonging to sub period IA (c. 7^{th} – 6^{th} millennia BC), has been found connecting two large and deep depressions (ditches) during the subsequent excavations (Pls. 5-6). These depressions are on the locales in the central and peripheral areas of the habitation mound. It is to be noted that the central depression appears shallower than the peripheral one, which is towards the north close to lake. The cultural assemblage is largely found concentrated along this channel. This is indeed a rare and the only known example of a drainage system

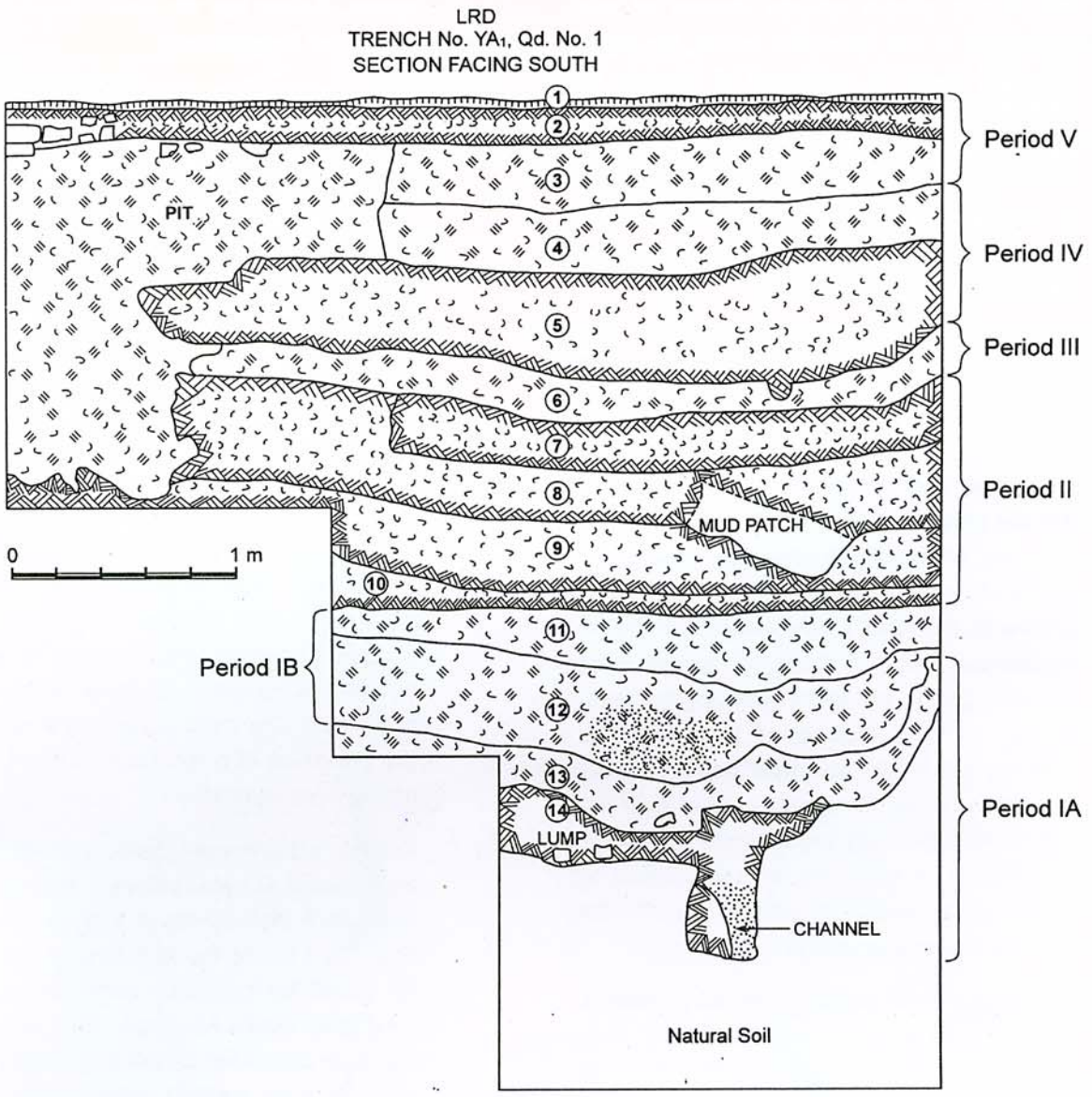

Fig.3. Lahuradewa, section facing south, Trench No. YA1, Qdt. No. 1. This section shows successive cultural deposits and respective cultural periods marked in upward order.

datable to such an early archaeological context in the Indian Subcontinent.

The subsequent excavations made it clear that the settlers, associated with layer No. (14), dug the channel (*nali*) through natural soil. Originally it was only 30-50 cm broad at upper level and about 50-60 cm deep. Subsequently, it became broader due to siltation and overflows. Finally the channel was filled up and became defunct towards the upper level of layer (13). Some post-holes have been found on the surface of the sealing level. When the surface became flat wattle and daub structures would have been erected on it. It is also notable that the area where this drain was cut was naturally a little

depressed which shows layers of silt embedded in the deposits below the layer No. (14). There is evidence of digging of natural deposit to channelize the flow. The gradient of the channel is from north to south (from lake-side towards the central part of the mound. The lower level of the channel at the cutting edges of YA2 and YA1 show a difference of about 25-30 cm.

2.1.5. The ceramic industries represented in IA and IB and their shapes remained almost the same as revealed in the first season's work (Figs. 4, 5, 6). However, more controlled excavation and closer observation showed that the grey ware sherds are not present in layer nos. (13) and (14) which are associated with sub-period IA. It seems that such potsherds found in a very limited number in first season's work in these layers were most probably due to intrusion from upper layers. As far as occurrence of potsherds is concerned their number considerably decreases below the upper levels of layer no. (13). Below that they are restricted to only a few sherds in each dig in association of mainly small charcoal pieces, burnt clay nodules and occasional charred bones.

Two examples of potsherd bearing cording, red slip and incised decoration on their exterior surface are also noteworthy (Pl.7). In earlier excavation at Lahuradewa such examples were restricted to sub-period IB and that too to its upper level. Later excavation show them from layer no. (13) of Period IA. Their stratigraphic context is carefully ascertained. These examples are broken parts of vessels of a coarse variety of black-and-red ware. Their upper shoulder comprises a fine red slip on exterior, which is further decorated with post firing incised parallel linear pattern and subsequently painted small vertical lines in creamish white colour. Below the shoulder, these potshers bear cord impressions.

2.1.6. The excavations of 2005-06 have also changed our earlier perception regarding the presence of beads in sub-periods IA and IB. Some beads were found during the earlier work from the upper levels of sub-period IB in trench no. YA2 Qdt. 3, 4, but below that not a single bead of any type was recovered. However, the excavations carried out during 2005-06, a good number of steatite beads (Pls. 8, 9) have been recovered in layer numbers (12) and (13) of the same trench which belong to lower and upper horizons of sub-periods IA and IB. A stone bead (possibly fiance) was found from layer (13). A carnelian bead recovered in flotation from layer (14) is also noteworthy (Pl. 12). Even if it would have belonged to layer (13) in which channel is sealed, its occurrence is very significant. The most surprising find for us is the presence of a tubular bead and steatite beads from layer (14).

2.1.7. Another achievement during the subsequent excavations at Lahuradewa is that the levels from which dish-on-stand and barley appears (Pls. 10, 11), for the first time in sub-period IB, could be precisely demarcated in the stratigraphical sequence. The associated charcoal and other carbonised remains were collected by water-floatation for further dating and archaeo-botanical studies.

2.1.8. The most important outcome of the sub-sequent excavations at Lahuradewa is the appearance of copper artefacts from the lower levels of sub-period IB. Amongst them a copper arrowhead (Pl. 14) and a copper fishing hook (Pl. 16) are most noteworthy. The arrowhead made on copper sheet measures 3.00 cm in length and 1.4 cm in breadth. Fishing hook is 1.5 cm long and 1.00 cm broad, and appears to be made of

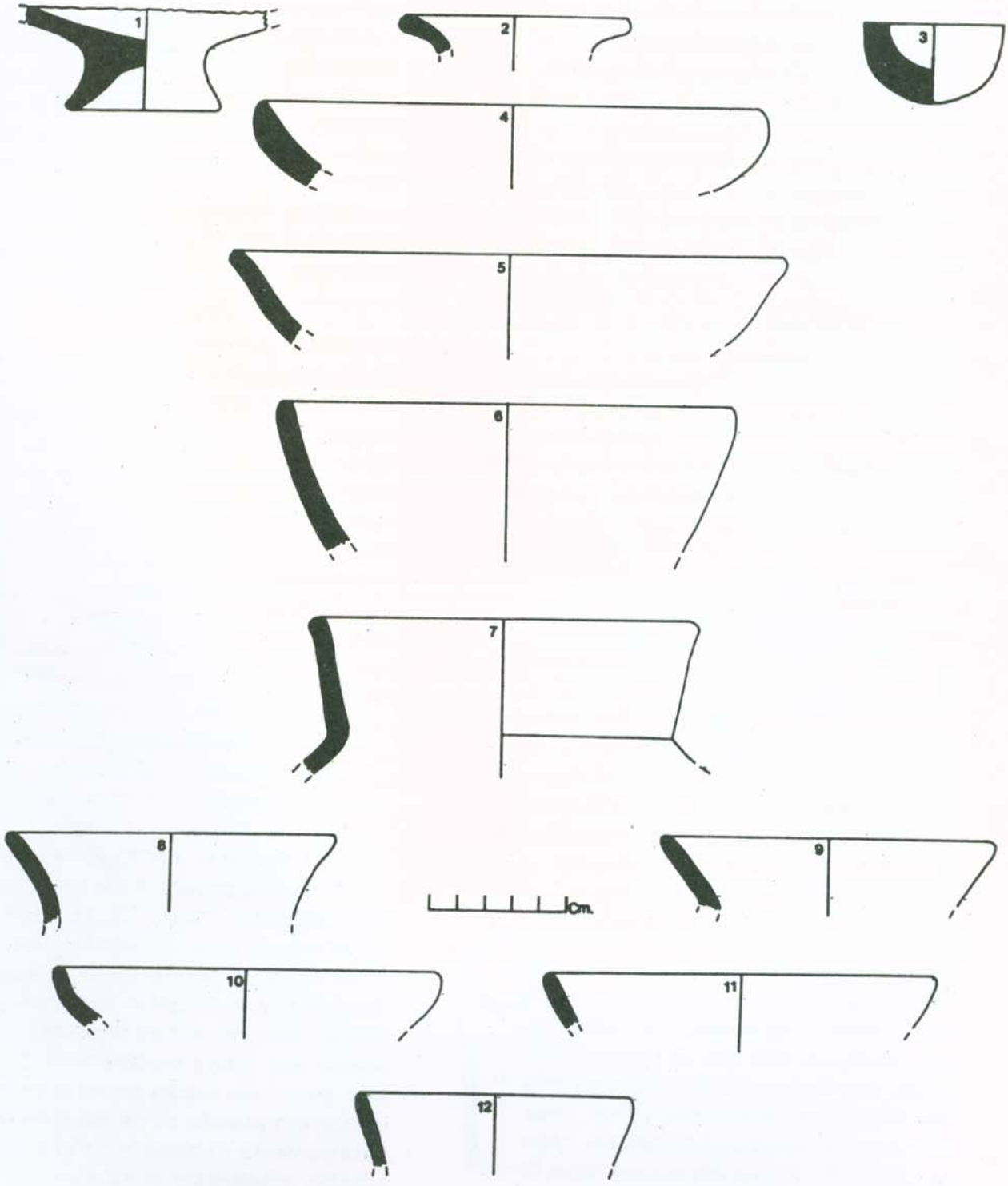

Fig.4. Important shapes in pottery, Period IA, Lahuradewa.

copper wire. On the basis of radiocarbon dates and on stratigraphic considerations these finds may be placed in early 3rd millennium BC. Since the oldest earlier copper finds have been found in *circa* 2000 BC context, the above mentioned copper artefacts of Lahuradewa are so far the earliest known representatives of this metal in the Ganga Plain. Third object of copper appears to be a small broken piece of a clamp (Pl.13).

2.1.9. Important amongst the associated culture material of sub-period IB, revealed during the subsequent excavations, includes beads made of steatite, carnelian and semiprecious stones, finely made small bone awl (Pl.15), a broken bone/antler bangle (Pl. 17), medium sized broken stone pieces, and a small stone scraper.

2.1.10. Earthen bins were found in the first year's excavations at Lahuradewa. Such structures have been revealed in a considerable number in almost all the areas subjected to excavation between 2001-02 and 2005-06. Their presence from lower to upper deposits in Period II is notable. Total number of bins recorded is over forty. Their structural features are elaborated elsewhere[4]. For making the bins, first of all a pit has been dug below the surface to provide required dimensions. On plan their shape is roughly oval to circular, while their elevation forms a cylindrical shape, with roughly conical base. The bins found in lower levels are unplastered, while some of them in upper levels are treated with clay-plaster on their interior surface, often mixed with *kankar* nodules. The base of a few bins is also treated with *kankar*. Their diameters fall approximately between 34cm to 130cm. The measurable average depth of these bins is from 24 to 92 cm. It is observed in a few cases that subsequent bins were laid above the earlier ones, within a short time duration. These bins may be termed as *Bakhāra* on the local analogy, which are presently used for storing the grains and fruits. Most probably, the un-plastered bins would have been used for the storage of fruits and such materials to be kept for a short duration, while plastered bins would have been used to store the grains and other material for a longer period. One of the large bins (diameter 1.00 m, depth 24 cm) has the capacity to store 50 kg of paddy grains in its half portion.

The number of bins in one area normally varies from one to two or three. However, a complex of a group of twelve bins found in an area of about 25 sq. m in trench No. ZA2 is worth mentioning. These bins include both plastered and unplastered types. Equally important in this area of noticeably upsurging concentration of bins in the form of a cluster, is the remarkably cumulative occurrence of primary and supporting postholes in the middle and peripheral precincts, in accompaniment of burnt clay lumps with impressions of straw contents and reed like plants. This evidence supports the contention that some massive wattle-and-daub cover was erected over this area having the cluster of bins. One may safely consider all the possible reasons to identify this structural complex as the granary, in the habitation of early occupants (Pls.18, 19). No traces of stored material, however, could be resoluted, in the batch of material so far examined. Considerably significant is that these pits indicate that the settlers depended upon reliable and readily storable surpluses of food grains. The staples stored in the bins undoubtedly played a crucial role in the rapid developments of some kind of socioeconomic organization in the early farming community at Lahuradewa.

The presence of a small circular posthole or

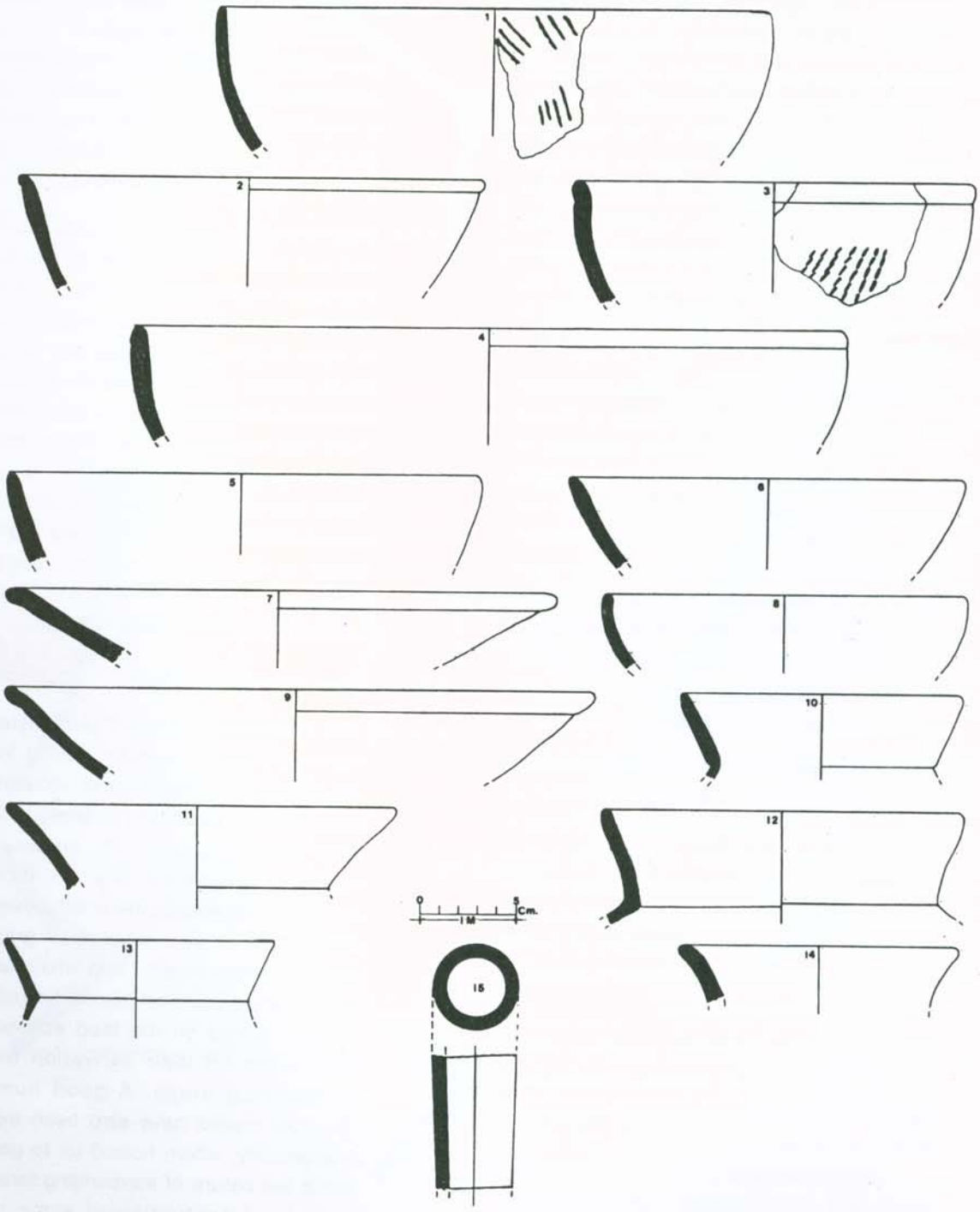

Fig.5. Important shapes in pottery, Period IB, Lahuradewa.

cavity like structure, along with the bins, also deserves special mention. An ethnographic parallels of such structure unearthed, can still be seen on clay-plastered working floors in the houses of Lahuradewa village. Locally, it is called *kāṅdi*, equating to the mortar in its functional approach. Plinth of cavity is subsequently concreted by crushing the *kankar* nodules. Locally, grains in this earthen-mortar (*kāṅdi*) are pounded with a wooden pestle (*mūsal*). It seems that the similar practice for pounding the grains in early times was prevalent.

The number of earthen bins in the excavated area, decreases in the upper levels of Period II. This observation may not be assumed to be representative of the whole site. Apart from that it indicates that subsequently this type of storage bins might have been replaced by alternative structures, most probably by well baked large sized earthen storage jars. Thick-sectioned potsherds present in considerable proportion in the pottery assemblage might be the representatives of such jars.

2.1.11. Though the lithic assemblage in the deposits of Period I contains a small number of artefacts, their number increases in Period II and III. Recovery of three stone celts, a ring stone and stone ball show their limited usage (Pls. 20, 21, 22). These artefacts are broken and bear use marks. Occurrence of a few stone artefacts from Lahuradewa is reported in the first preliminary report[5].

2.1.12. Some terracotta figurines made in single moulds, are found in trench number ZA3, Qdt.2, in association of some shapes in pottery such as incurved bowls and inkpot type lids of Kushana period. Straight sided bowls and short necked water vessels of Gupta period, on comparative considerations, also appear representing a period between 1st and 6th century AD and a little later.

2.1.13. A good quantity of faunal remains was collected during the excavations. The results of their study will appear in future publication. However, the occurrence of fish and turtle remains in a considerable number is notable in the deposits of sub-period IA and IB. The proportion of bones of bigger animals increases in the deposits of Period II.

2.1.14. Bone and antler remains bearing modification and cut marks were found during the first season's work at Lahuradewa from the deposits of Period II. These artefacts appear to have been used for various purposes. Many more such examples have been recovered in the subsequent work. Amongst them the noteworthy specimens, probably used as pick-axes, are illustrated here (Pl.23). These are made on bone and show carved socket-holes for hafting. Similar tools were found in the contemporary deposits at Chirand[6] (district Saran) and Chechar[7] Kutubpur (district Vaisali) in Bihar.

2.2. Other scientific studies

2.2.1.(a) The *systematic recovery* of plant material has been carried out by water sieving from the deposits of the beginning of occupation up to pre-NBPW deposits to understand the food from plant resources. The majority of the remains preserved due to incidental carbonisation reflect differential preservation, and turned to be a mixture of grains and seeds of domesticated and wild plants in a bulk of wood charcoal pieces. Domesticated species reflect on the food economy and wild forms on their derivation from the surrounding areas. A good number of charcoal pieces have also been examined anatomically, which helped us to generalise about the nature of surrounding forest type, and also introduction of some taxa by Lahuradewa settlers. It has remained elusive to assess how and through what sort of

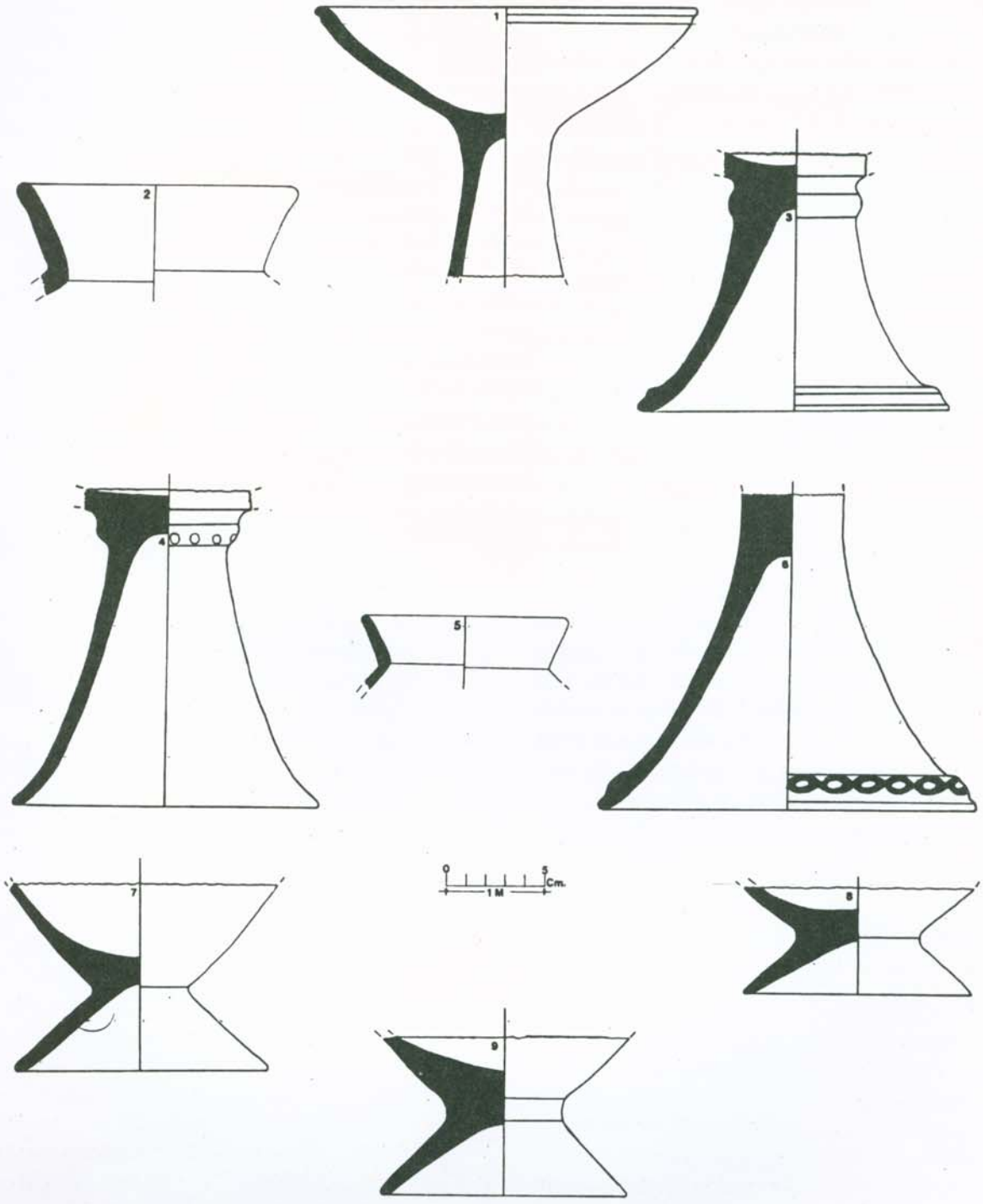

Fig.6. Important shapes in pottery, Period IB, Lahuradewa.

human activities the material came to the occupational deposits and got carbonised. The remains from such excavations cannot, however, be assumed to be representative of whole region.

(b) A *sediment trench profile* from the Lahuradewa Lake, has been studied for pollen analysis to acquire information on the vegetational history. A small trench measuring 1.00 x 1.00 m was laid down on the dried up lakebed of the Lahuradewa-lake, at a distance of about 75 m from the habitation mound by Chauhan and Pokharia. This trench was excavated to a depth of about 2.80 m. Twenty-eight soil samples were collected from the sediments at an interval of 20 cm. The pollen analysis, has thrown considerable light on the changing palaeo-environmental conditions in the region, and also on the human activities leading to agricultural practices. Data on the phytolith remains, diatoms and micro-charcoal contents in the lake deposits, in conjunction with pollen records, have also been found to add precision to the palaeoenvironmental studies and human activities. All these ventures in the Lahuradewa area are expected to add multidisciplinary results in archaeology, and are being regarded of considerable value.

(c) *Charcoal samples* and carbonised remains were collected from the respective deposits during the archaeological excavation at the Lahuradewa mound for radiocarbon dating, and other investigations.

2.2.2. The archaeological stratification has provided a relative sequence of cultures. It required *radiocarbon dating* to give a dependable chronological framework for them. Radiocarbon dating Laboratory, BSIP has carried out conventional radiocarbon date determinations of the charcoal samples collected from the deposits of IA, which range between 5000 and 3000 BC. A charcoal sample, comprising carbonised grains of barley in association of a dish-on-stand from a particular layer is dated to circa 2700 BC. Explicitness to the barley introduction is sought through AMS date determination of the grain itself (Pl. 25), which is comprehensible to 2345 - 2200 BC.

What is still more important that a husk-clot of domesticated rice (Pl. 24), in association of charcoal contents from deepest layer was conventionally dated to regard period IA from 6^{th}-5^{th} millennia BC. On being subjected to AMS radiocarbon determination has propelled the date back to 7^{th} millennia BC (6409 BC). In view of this, Period IA is regarded to span from about seventh millennium BC to 3000 yr BC.

All the conventional and AMS dates so far obtained from Lahuradewa are catalogued under Table 1.

2.2.3.(a) The preliminary studies of the *arcaheo-botanical remains* from bottom layers of two trenches revealed scant remains of rice and grain of foxtail-millet during the first season of excavations. In one trench a few fragments and clump of husk have been found (Pl. 29, 1), in the assortment of wood charcoal content dated by conventional radiocarbon determination to 5320 $\pm$ 90 yr BP: Cal BP 6110 yr and Cal. BC 4160 yr (BS - 1951). The husk-clump contained rachis (Pl. 29, Fig. 3) which got unfastened along with bits of husk during handling with a soft camel-hair brush. The break-up eventuated in opening the cavern of grain content encased by husk-cover, which was found disintegrated in the form of powdery charcoal. This worn-out content of charcoal left unfilled cavity beneath the husk, giving approximation to somewhat oblong and flattened shape of the lost grain. The husk piece (Pl. 29, Figs 4-5) from the carbonised lump seemed corres-ponding to that of domesticated form of rice

Table 1: Lahuradewa: radiocarbon ages

Cultural Period	Representative finds	Cal ^{14}C dates BC
Period V	RW, brick structures	-
Period IV	Painted NBPW etc.	-
Period III	Continuity of earlier cultural assemblage.	BS-1939: 1205, 1205, 1188
Period II	Painted and plain BSW, BRW, steatite beads, greater presence of dish-on-stand, bowl-on-stand, pedestal bowl.	BS-1938: 1519 (1435) 1399; BS-2150: 2012 (1884) 1750
Period I B	RW and BRW often bearing corded patterns a few paintings, incised designs, slipped pottery. Introduction of pedestal bowl, dish or bowl-on-stand, charcoal pieces, steatite bead. Cultivated *rice* and *barley*	BS-1950: 2135, 2078, 2056; BS-2274: 2919 (2700) 2570; ERL-6903 (AMS): 2345-2200
Period I A	RW and BRW often bearing corded patterns, charcoal pieces. Cultivated *rice*	BS-2145: 3090 (2916) 2879; BS-2148: 3363 (3328, 3223, 3174, 3159, 3119, 3106, 3105) 3020; BS-2151: 3654 (3635, 3553, 3542) 3382; BS-1951: 4220, 4196, 4161; BS-1967: 5298; ERL-6442 (AMS): 6442 - 6376
Natural soil	*Natural soil*	*Natural soil*

(*Oryza sativa*), as arrangement of granules of husk show regularly aligned and smoother profile (T.T. Chang and several others as discussed later). Charcoal pieces from other contemporaneous lowermost stratum in neighbouring trench, show of a elongate to oblongish, flattened and conspicuously ribbed rice grain akin to domesticated type (Pl. 29, Fig. 7), a slender and much narrow grain of wild or some weedy form of rice (comparable to *Oryza rufipogon*) and a grain of foxtail-millet (*Setaria* cf. *glauca*). Associated charcoal is dated by C14 method to 6290 $\pm$ 140 yr BP: Cal. BP 7247 yr and Cal BC 5298 yr (BS -1962). In addition to these scant remains in the opening phase of settlement, five grains congealed in a carbonised lump (Pl. 29, Fig. 6) and two individual grains (Pl. 30, Fig. 1) from the upper deposits in Period IA appear to be in

conformity to the domesticated types. In view of the dating of associated charcoal content, the dating of rice cultivation in the beginning phase of occupation at Lahuradewa appears to be in 7^{th} – 6^{th} millennia BC. Since the material recovery in the lowermost deposits was constrained, solitary grain of domesticated type of rice was saved and husk-clot was used for precise date determination by AMS radiocarbon method. Considerably startling has been the AMS date of rice-husk, ascribed to 7532 yr BP (Cal. BP 8359 yr), propelling back in time the inception of occupation and the cultivation of rice at Lahuradewa during 9^{th} millennium BP, in calibrated AMS radiocarbon terms[8].

(b) The remains of rice from archaeological sites always come out fragmentary, usually in the form of grains, husk fragments and impressions in pottery and burnt mud-clots. The criterion by which the distinction between the domesticated and wild forms of rice have been followed in a number of Indian sites, and also being pursued at Lahuradewa, need mention in brief. The information is sought on the morphological features, size and proportions of the grains and surface features of lemma and palea (husk). Both in India[9] and South-eastern regions[10], attempts have been made on these grounds to discriminate the domesticated species of rice. Elongate to somewhat oblongish, laterally flattened and prominently ribbed grains from sub-periods IA and IB have been ascribed to the domesticated form of *Oryza sativa*. They are similar to domesticated rice grains recovered from a large number of Chalcolithic and Iron Age settlements in India. Normally these rice grains show four ribs or ridges; out of which usually two (infrequently one also) occur on each flattened lateral sides, along with one or two grooves. A groove may also be present near the dorsal perimeter in some of the grains. On the other hand, slender or somewhat sylph-like grains, and also some broadly straightened ones, slightly flattened or roughly round in cross view, normally with two ridges – one on each lateral sides, are comparable to the forms of wild or weedy rice belonging to *Oryza rufipogon*. We have encountered a few somewhat-plumpy grains of rather smaller size, having prominent longitudinal linings and sharp furrows on lateral sides from the sub-period IB at Lahuradewa, which are akin to those of wild *Oryza officinalis* (treated under *Oryza perennis* complex by some workers).

Further, the tissue of lemma and palea in carbonised husk remains appear comparatively even and smoother in domesticated rice, contrasting to the relatively uneven husk surface in the wild forms. Somewhat cubicular granules, showing the tendency of alignment in horizontal wavy rows at places and accompanied by fine and sharp streaks or slits, show the tissue pattern of husk in domesticated rice. The dark areas become distinct at the union points of four granules. On the other hand, in wild forms the closely spaced rounded granules are protruded from the surface and aligned in straight rows with wider streaks between them. Further distinction between different species of wild rice can also be achieved within reasonable limits by statistical analysis of the number of granules per unit area and other minor features. Details are omitted here. While giving taxonomic treatment to the rice remains, one may also keep in mind that India is the centre of the greatest diversity of domesticated rice with over 20,000 (out of 50,000) identified varieties, and North-eastern Indian region is the most favourable single area of origin of domesticated rice in T.T. Chang's[11] model presented in this regard[12]. This area or that area in South-eastern area was the first for the rice domestication – such discussions based on regional

patriotism have been common in the literature, based on happenstances of archaeological discoveries. We expect that picture may be changed in future course of studies. Nevertheless, here is at least a good *prima facie* case for domesticated rice by the later half of 9th millennium BP, and constitutes the earliest evidence for *Oryza sativa* in India. The emerging evidence of the domestication of rice in the early Holocene time at Lahurdewa indicates to surmise that Middle Ganga Plain region may have been one of the independent areas for the origin of agriculture. Insofar as the thinking about the early agricultural developments are concerned, China, India and West Asia are the integral parts of the land in Asian context.

(c) Other than domesticated rice, remains of wild and weedy rice (*Oryza* cf. *rufipogon*), foxtail-millet (*Sataria* cf. *glauca*), goose-foot / bathua (*Chenopodium album*), job's tear (*Coix lachrymal-jobi*), Artemis (*Artemisia* sp.), flatsedge (*Cyperus* sp.) and catchfly (*Silene conoidea*) have also been recovered from Period IA. Gathering of wild rice, foxtail-millet, goose-foot and job's tear could well have fulfilled the role of carbohydrate staples in the dietary of inhabitants. Foxtail-millet and job's tear, almost forgotten cereals now, are thought to be early domesticates recorded to have been cultivated by tribals in India till the recent past. Mixed cultivation of rice in association of foxtail-millet and job's tear has also been proposed in the past since much ancient times in the region of South-eastern Asia, on ethnological grounds. Later with availability of more yielding cereals, the use of less efficient cereals for a given investment in labour was gradually dropped. Although the ideas are not archaeologically testable but for interpretation of data on plant use from Lahuradewa sub-period IA, these are meaningful, Gathering of foxtail-millet and job's tear has persisted commonly till now even by farming communities.

Some of more finds of seeds and grains of wild and segetal plants are as yet unidentifiable and not considered here. Full account of these and other finds from samples under study will follow in future publications.

(d) Similar finds of domesticated rice (*Oryza sativa*), wild or weedy rice (*Oryza* cf. *rufipogon* and *Oryza officinalis*), job's tear (*Coix lachrymal-jobi*), foxtail-millet (*Sataria* cf. *glauca*), goose-foot / bathua (*Chenopodium album*), job's tear (*Coix lachrymal-jobi*), Artemis/Mugwort (*Artemisia* sp.), flatsedge (*Cyperus* sp.) (Pls. 31, 32) and catchfly (*Silene conoidea*) have continued to come about from the deposits of subsequent sub-period IB, set down within the time-bracket of about 3000-2000 BC. Kodon-millet (*Paspalum scrobiculatum*) is, however, an additional find. Gesticulation of major change in the mainly rice based subsistence economy of Lahuradewa settlers in this phase, has strikingly become manifested by the sudden coming into view the inclusion of barley (*Hordeum vulgare*) in the early phase of this occupational period. Turning up of barley is equally important in association of an amazingly unprecedented springing-up of a dish-on-stand in a level dated by conventional radiocarbon determination of associated charcoal content, to 4170 ± 180 yr BP: Cal. BC 2700 Yr (BS – 2274). Precise AMS date of barley at this level, however, turned up to 2345 (2273) 2200 yr BC (ERL – 6903). So far, twenty-one intact barley grains have been recorded, in association of rice grains. Another evidence of early introduction of barley in the region of rice-growing Ganga Plain is secured at Damdama[13]. This was dated to 3984 ± 54 yr BP (Cal BC 2578-2458). Outset of barley introduction during the early

3rd millennium BC in this area of rice cultivation is worthwhile to draw meaningful conviction in terms of early direct or indirect interactions of farming communities at Lahuradewa and other settlements, with far distant Harappan or some other autochthonous cultures in north-western region. Inclusions of dwarf-wheat (*Triticum sphaerococcum*), bread-wheat (*Triticum aestivum*), lentil (*Lens culinaris*), etc. (Pl. 32, Figs. 1-5,7), further supports the diffusion of agricultural traits in strict cultural apprehension between north-western Harappan zone and the Early Farming zone of the Middle Ganga Plain. This is also supported, on the other hand, by the cultivation of rice by a wheat and barley growing Harappans in Haryana and Punjab, during 3rd millennium BC[14]. An increase in technological advancement, population density and the interactions of Lahuradewa inhabitants with distant communities, would possibly have led to exploit advanced agricultural resources.

(e) It is attempted to see plant economy as a spectrum of man and plant relationship through time, linked with the exploitation of shrubby and tree taxa by the Lahuradewa settlers from the surrounding forests, for the combustible and constructional necessities. Fragments of wood charcoals were the most abundant macro-remains recovered by floatation. It is important that the precision in identification of wood specimens reflected not only limitations imposed by innate structure of wood but also those resulting from carbonization of post-depositional changes. Careful sectioning over a thousand wood charcoal pieces and their studies have resulted in identification of 34 taxa (Table-2). Except Bhang (*Cannabis sativa*), which is Central Asian element and have been spread in the Indian region in wake of human preferential treatment, all the rest 33 taxa were a fraction of indigenous vegetation in the surrounding forested zones of Lahuradewa settlement. They represent only a sectional picture, reflecting on the springing-up of forest patches akin to the moist mixed-deciduous type. In view of the limited data, generated by incidentally carbonised remains, climatic interferences are not comprehensive. The information is relevant to the immediate surroundings of Lahuradewa settlement. The taxa identified, however, represent an important component of fundamental importance. Considering the habitats and associations of these taxa, sectional picture of forest can be envisaged.

Table-2: Wood charcoal remains identified from Lahuradewa excavations

S. No	Taxa	Period IA c 9000-5000 BP	Period IB c 5000-4000 BP	Period II c 4000-3200 BP
1.	*Acacia catechu / nilotica* (Khair,Babul)		*	*
2.	*Adhatada vesica* (Adusa)	*	*	*
3.	*Adina cordifolia* (Haldu)	*	*	*
4.	*Aegle marmelos* (Bel)	*	*	*

S. No	Taxa	Period IA c 9000-5000 BP	Period IB c 5000-4000 BP	Period II c 4000-3200 BP
5.	*Alangium salvifolium* (Akol)		*	*
6.	*Albizia* cf. *procera* (Siris)		*	*
7.	*Anthocephalus cadamba* (Kadamba)		*	*
8.	*Artocarpus* cf. *lakoocha* (Badahal)		*	*
9.	*Bambusa* sp. (Bamboo)		*	*
10.	*Bombax ceiba* (Semal)		*	*
11.	*Butea monosperma* (Palash)		*	*
12.	*Cannabis sativa* (Bhang)			*
13.	*Capparis sepiaria / horrida* (Heens/Jhiri)			*
14.	*Carissa opaca* / carandas (Karonda)			*
15.	*Clerodendrum viscosum* (Arni)			*
16.	*Dalbergia cf. sissoo* (Sheesham)		*	*
17.	*Diospyros montana* (Tendu, Bis Tendu)			*
18.	*Drypetes roxburghii* (Putranjeeva)		*	*
19.	*Emblica officinalis* (Anwala)	*	*	*
20.	*Erythrina* cf. *subarosa* (Panjira)		*	*
21.	*Ficus glomerata* (Gular)		*	*
22.	*Ficus religiosa* (Pipal)			*
23.	*Holoptelea integrifolia* (Chilbil)	*	*	*
24.	*Logerstroemia parviflora* (Dhaura)	*		*
25.	*Madhuca indica* (Mahua)		*	*
26.	*Mitragyana parviflora* (Keim)	*	*	*
27.	*Murraya koenigii* (Meetha-Neem)		*	

S. No	Taxa	Period IA c 9000-5000 BP	Period IB c 5000-4000 BP	Period II c 4000-3200 BP
28.	*Pongamia pinnata* (Karanj)		*	
29.	*Premna mucronata* (Bakar)			*
30.	*Pterospermum acerifolium* (Machakunda)	*	*	*
31.	*Shorea robusta* (Sal)			*
32.	*Srerculia villosa / urens* (Udal / Karrai)	*		
33.	*Syzygium cumini* (Jamun, Jambolana)	*	*	
34.	*Terminalia arjuna* (Arjuna)	*	*	*

(After K.S. Saraswat)

2.2.4. The need for climate reconstruction has been comprehended to conceive the background environment of the cultural developments at Lahuradewa, linked in some way to the ambience of ancient settlers. There is no doubt that certain conditions not now manifested may be found to have applied in the changing scenario of climatic conditions, during the stretch of about 10,000 yr. The 2.80 m thick deposit of Lahuradewa Lake (Pl. 27) comprised a succession of about 80 cm thick peat deposit followed by 2 m thick muddy sediments. Six radiocarbon dates of the successive sediments represent a time span of last 10,000 years (Holocene). A profile showing the successive sediments along with their radiocarbon dates measured for the samples containing rich organic material is illustrated here.

The pollen analysis[15] has reconstructed past vegetational history, establishing the probable factors, which determine the change in the former flora (Pl. 28). Grasses domi-nated in the open vegetation between about 9500 and 8700 yr BP, together with meagre trees, under cool and dry climate. Between circa 8700 and 5700 yr BP, the invasion of the open vegetation by a few more trees envisages an amelioration of the climate. Expansion of lake due to increase of monsoon rainfall is also suggested during this period. Appearance of cerealia pollen from about 7500 years BP has been suggested as an indication of the anthropogenic pursuits. On the basis of considerable enhancement of *Bambax*, advent of *Madhuca indica* as well as better representation of shrubby and certain other vegetation, open vegetation with patchy occurrence of forests and further increase in monsoon rainfall during circa 5700 to 2600 yr BP is suggested. Alternatively, increase in tree population around 5700 yr can be related to change in landform due to reduced rainfall. The time of 5000-4000 yrs is considered a period of reduced southwest monsoon. The reduced rainfall left lake margins dry to be occupied by trees in large numbers. The consistent presence of cerealia

pollen along with other cultural pollen taxa around 5000 yr BP is considered to be suggesting the expansion of agricultural practices in the area. Presence of *Cannabis sativa* has also consistently been noticed at this time. The presence of *Trapa* ('singhara') pollen in good numbers suggests that 'singhara' fruit would have also played its role in the subsistence, for the local inhabitants. Considering the increase in *Madhuca indica* together with other arboreal and swampy elements and a contemporary sharp decline of grasses implies that the area sustained localized grooves of dense deciduous forests in the period between *circa* 2600 and 1400 yr BP. The increasing diversity in the vegetation is further suggestive of rising rainfall. Increased frequencies of cerealia and other culture pollen taxa are considered as indicator of accelerated agricultural practice. Heightened sediment influx in the lake has been underlined as a prime contributor in the transformation of the lake into a swamp. Decrease in the frequency of trees particularly *Madhuca indica* and improvement in dry elements around 1400 BP onwards have been treated as indicators of sparse arboreal vegetation as a consequence of reduced rainfall due to which lake gradually shrunk and assumed almost its present small form. The agricultural activity has, however, been considered to be continued with more or less same pace since cerealia and other culture pollen taxa continue to turn up in the uniformly similar proportion.

2.2.5. Lithological succession of the lake profile shows about 80 cm thick peat deposit at the base representing a time span of 10000 to 5800 yr BP with rate of deposition of 1mm/100yr. The peat was formed under very humid condition in a lake with prominent swampy areas similar to present-day *Bils* (*Beels*) in Ganga delta region. During 5800 – 2188 yr BP lake accumulated sediments at a rate of 1.7mm/100 yr. Rate of sedimentation increased to 4 – 7 mm/100yr in the last about 2000 yr. Stable carbon isotope studies indicate that initially lake and surrounding area supported C-4 type grasses. Later C-3 type vegetation became prominent[16].

2.2.6. The study on fossil diatom assemblage from Lahuradewa Lake sediments[17] records rich and diverse forms in almost all the samples (Pl. 28). The enhancing presence of various euterrestrial diatom species present in the upper horizon of peat and mud sediments is considered indicators as of rice paddy fields in the vicinity of the lake since about 9720 Cal. yr BP. Benthic and tychoplanktomic diatoms of paddy fields bloom in summer with good amount of water and can survive dry period by forming resting spores.

2.2.7. Significance of phytolith analysis is in normal course well attested in archaeological studies as a compliment in the interpretation of plant remains from the archaeological sites. In geological deposits, phytolith data can be of aid to complement interpretations of data from pollen analysis, in the palaeoenvironmental reconstruction. The study on Phytoliths in Lahuradewa lake sediments throughout the lake-bed profile revealed pronounced variations in shape and size of phytoliths. Dominance of grass phytoliths is marked over non-grass phytoliths. Changes in grass phytoliths through time has been considered as related to the changing palaeovegetation, in response to the climatic shifts, especially the rainfall. Differentiation is established between the leaf-phytoliths of wild and domesticated forms of rice. In wild form of rice, number of scales on the edge of fan-shaped phytoliths is eight while in those of domesticated form it is nine and more (Pl. 26). The presence of wild-rice

phytoliths are observed since 10000 yr BP, while cultivated rice phytoliths appear in the deposits from 8300 yr BP and onwards[18]. Cultivated-rice phytoliths show a prominent increase in the last 3500 yr. On the contrary the decrease has been observed in the phytoliths of the wild-rice types (Pl. 27).

2.2.8. Micro charcoal fragments are present in all the 28 sediment samples of the Lahuradewa Lake[19], which indicate regular fire events caused by human activity in the catchment area of the lake since last 10,000 yr BP. The charcoal fragments in the bottom peat sediments of the succession occur in large proportion and almost all of them belong to grasses indicating thereby that open grass vegetation was well developed in region during about 10,000 – 7822 yr BP (Pl. 27).

2.2.9. The micro to medium sized disc beads sporadically found from the deposits of sub-periods IA and IB at Lahuradewa, are comparable to those already reported from early horizons at a number of sites in the Middle Ganga Plain and the Harappan settlements. Visual examination of the steatite beads of Lahuradewa, revealed that the material of these beads is much harder than the natural talc, which could be easily scratched by human nail because of its minimum hardness on the Moh's scale of hardness. The beads of Lahuradewa possessed hardness of 5-6.

The bead from Trench no.YA1, Qdt.-1, layer no.(9) at a depth of 2.32m was selected for detailed study. It belongs to the lower level of Period II and may date to about 3500 yr BP. Geochemical and mineralogical analyses of these micro-beads demonstrate that exceptionally pure talc was used to make them. The material was fired to a temperature of about 1100^{0}C. The microbeads were given shape before they were fired. Mineralogically they are made up of protoenstatite, cristabolite, and little quartz. Microprobe analysis of the bead shows that it is made up of 32% MgO and 68% SiO2. There was no indication of presence of original talc. The term 'fired steatite beads' is proposed for such micro-beads to differentiate them from soft natural steatite beads[20].

3. Discussion

3.1. The above description of the outcome of the palynological studies carried out on the Lahuradewa lake sediments show that the area around Lahuradewa was a largely grassland and there were a few thickets of trees, since beginning of Holocene. The proportion of trees and grasses, however, varied slightly with the increase and decrease in rainfall during the fluctuating climate phases. These conclusions are similar to studies on the sediments of Basaha Tal[21] in district Unnao, Sanai Tal[22] in district Rae Bareli, and Mahadaha[23] and Sarai Nahar Rai[24] in district Pratapgarh, which have shown that the concerned areas were dominated by savana type of landscapes with a few thickets of forests. Taken together the archaeological and other sources, these scientific evidences go against the prevailing view that the dense forests abonded the Ganga Plain, and these heavily wooded zones in the region required the efficacious from tools for clearance. This issue of Myth and Reality has already been dealt with[25].

3.2. Since the consistent presence of tiny charcoal pieces in the lake sediments is considered as an indicator of human activity in the vicinity of the concerned region[26], the occurrence of micro-charcoals in the Lahuradewa lake sediments since *circa* 10,000 yr BP denotes human activity. Sanai Tal, Rae Bareli has also yielded micro-charcoal pieces in the lake sediments dated

since 15,000 yr BP[27]. Cerealia and culture pollen have been found at Sanai Tal from the very beginning and at Lahuradewa since about 7500 yr BP. Hundreds of sites containing lithic artefacts are known from an area extended from Ghazipur in the east to Kanpur Dehat in the west with a concentration in district Pratapgarh. Some of these sites have been associated with the epi-palaeolithic and are considered to be datable around 19715 ± 340 yr BP[28]. Rest of these sites are associated to the Mesolithic culture. A number of conventional and AMS ^{14}C and T.L. dates available for charred and un-charred bones, carbonised grains, charcoal and archaeological soil and other materials from Sarai Nahar Rai, Mahadaha and Damdama in district Pratapgarh and Daulatpur in Kanpur Dehat range between circa 8000 and 2000 BC. Earlier to them are the evidences known from Kalpi (Middle Palaeolthic dated to circa 45,000 yr BP)[29] in district Jalaun, Bahadarabad (Middle Palaeolithic)[30] near Haridwar, Mau (Early Palaeolithic)[31] in district Banda and Nepalese Terai (from Early Palaeolithic to Chalcolithic)[32]. This data gives evidence to surmise that human activity was going on in the Ganga Plain since Early Palaeolthic times, and from about 15,000 yr BP its continuity is well recorded. These humans, living in a grass dominated landscape having some wooden thickets, must have exploited natural vegetation of the area, including the wild rices and other grasses for their edible grains. The phytoliths of wild rice are identified in the lowest lake sediments at Lahuradewa datable to *circa* 10,000 yr BP. We are presented with unknown vistas of time during which early man could have been exploiting the stands of wild rices for the subsistence, during the pre-agricultural and even in the following agricultural economies.

3.3. It would be worthwhile to consider some aspects regarding the burning activity evidenced through the presence of microcharcoal pieces in the lake sediments. Man since much ancient times was aware that fire was a very potential tool to make quantitative transition in his way of life; be it ecological or from the cultural point of view. In fact the hunters burn the brushwood to develop on a large-scale tender grasses, to attract herbivorous games. Analogously the gatherers burn the woodland to promote the herbivorous vegetation as opposed to arboreal. The man preferring one type of vegetation than another is obviously already operating as a cultivator; and has the mentality of the cultivator. Within the framework for one who practices a burning economy, to remain in the sphere of hunting/gathering, or to pass into the one of cultivation may also have been due to drastic change of climate. Burning the vegetation can also be supposed to have an environmental control in prehistory. Occurrence of microcharcoals in the Lahuradewa lake-bed, in all the levels, suggest that soils in some areas in the wide catchments would have had sufficiently dry patches of vegetation cover, suitable to burning culture. In fact, 'slashing' presupposes forested environment and the availability of cutting tools. When the evidence of grassy vegetation is being surmised with sparse forest patches in the area, "slash and burn" in all the likelihood may not have represented the sole kind of burning activities, and the evidence may reflect to some simple sort of igniculture being practiced in the Ganga Plain since the Palaeolithic times.

3.4. Remains of postholes, mud-clods with reed-impressions, suggestive of wattle-and-daub dwellings, and man made channel revealed in the lowest levels of sub-period IA, provide evidence for sedentary nature from the very beginning of the early settlers at

Table-3 : Seasonality of the species recovered from Lahuradewa IA indicating heeasons of their fruiting in relation to their incorporation in the settlement area
+ : Fruiting ; ++ : tentative assessment of usage; +++ : duration of rice cultivation

Taxa ↓ / Months →	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May	June
Domesticated rice (*Oryza sativa*)	+++	+++	+	+	++	++	++	++				
wild or weedy rice (*Oryza* cf. *rufipogon*)			+	+	++	++	++					
foxtail-millet (*Setaria* cf. *glauca*)		+	+									
job's tear (*Coix lachryma-jobi*)				+	+		+	+				
Goosefoot/ Bathua (*Chenopodium album*)						+	+	+				
Mugwort / Artemis (*Artemisia* sp.)					+	+	+	+	+			
catchfly (*Silene conoidea*								+	+	+		

Lahuradewa. Seasonality documentation of plant species recovered from sub-period IA (Table-3), also helps in assessing the situation. Domesticated rice (*Oryza sativa*), wild or weedy rice (*Oryza* cf. *rufipogon*) and foxtail-millet (*Setaria* cf. *glauca*) are the species of rainy season and their grains are seasoned to come up during the months of September - October. Grains of another rainy season grass belonging to job's tear (*Coix lachryma-jobi*), develop and mature in the region in the month of October, with furtherance to persist on the plants even up to the month of February. Goosefoot/ Bathua (*Chenopodium album*) is a common weed throughout the area in cultivated grounds and also in waste places. Flowering and fruiting in this plant go ahead from January to March. Mugwort / Artemis (*Artemisia* sp.) of common occurrence in

grassy patches is represented in the Middle Ganga Plain by two species, one flowering from September to November and fruiting in December-January, while another species fruits even up to March and April. Seeds of catchfly (*Silene conoidea*) have also been recorded in the deposits of sub-period IA. An annual herb of catchfly presently grows as a weed in winter crops. Fruiting takes place in this species from February to April. The grains and seeds of these seven species, incidentally recovered in sub-period IA, suggest their production in the surroundings of Lahuradewa from the months of September-October up to the months of March and April, and logically reason their incorporation in the settlement area almost all-the-year-round. In view of these facts the sedentary nature of the Lahuradewa settlers, during *circa* 7^{th}-6^{th} millennium BC, becomes apparent.

3.5. The question of a gap between sub-periods IA and IB was kept open in the first preliminary report to be settled after further investigations. Lithographic sequence uncovered during the succeeding excavations has attested continuity in the deposits of sub-periods IA and IB, indicating no hiatus between them.

Further a good number of conventional as well as AMS ^{14}C dates procured of the charcoal samples and carbonised husk-clot/ grain collected from these deposits have clearly filled up the suspected gap of about 2000 yr between IA and IB and shows uninterrupted human activities. Six consistent radiocarbon dates of the lake-bed sediments and the continued occurrence of cerealia pollen taxa and the micro-charcoal content further corroborate the uninterrupted human activity, throughout the time-span of past 10,000 years in the area.

3.6. Notably, two conventional radiocarbon dates for the charcoal samples from the lowermost layers were dated to 6^{th}-5^{th} millennium BC (BS-1951; BS-1967). The conventional radiocarbon dates measured for the charcoal samples collected from a deposit of about 5 cm, was indirect for the early agricultural activity at the site. The direct AMS date of husk-clot has now affirmed the antiquity of domesticated rice implied for some sort of agricultural activity at Lahuradea to cal. BC 6409 yr (cal. BP 8359). Phytolith of domesticated rice appear in the lake profile around the same time (8300 yr BP). On the other hand cerealia and cultural pollen appear in the lake sediments around 5000 yr BC (7500 yr BP).

The early beginning of agriculture during the later half of 7^{th} millennium BC has been determined essentially by the macro-remains recovered in the environment of settlement upported by phytolith studies in lake deposits. Determining whether vegetational changes in lake deposits are due to natural causes or due to human induced agricultural activities would remain difficult to determine. It is surmised that the rice in domesticated form would certainly have established in the region, much before than its present record at Lahuradewa, possibly in the latest Pleistocene/ earliest Holocene.

3.7. About three decades back, circa 7^{th}-6^{th} millennium BC was suggested for the beginning of agriculture of rice on the basis of evidence[33] from Koldihwa. This was, however, not supported by many scholars[34]. The Neolithic deposits containing domesticated rice at Kunjhun in Vidhyan plateau, Senuwar and Malhar in its foothills, Damdama, Khairadih, Chirand and other sites in Ganga Plain provided radiocarbon dates, which range between about 4^{th} and 2^{nd} millennium BC[35]. These evidences, taken together, show that the rice cultivation was

in practice in the vast region of Middle Ganga Plain extended roughly between Himalayan foothills and north Vindhyan Plateau region. More focussed archaeological and palyno-logical investigations at archaeological mounds and appropriate lacustrine cores would certainly provide elaborate evidence regarding the cultivation and domestication of rice, other cereals and plants in the region. Interactions between man and wild flora, during terminal Pleistocene and earliest Holocene with changing climatic conditions, is important period for such studies[36].

3.8. New evidences in the above context are coming from the recent excavations carried out by the Allahabad University at Jhusi and Heta Patti (Allahabad district) in the Ganga Plain and Tokwa (Mirzapur district) in Vindhyan plateau. A pre-chalcolithic deposit, containing pottery comparable to that of Lahuradewa IA and IB, has been recorded at these sites. Excavators have placed these deposits under Neolithic. Six conventional radiocarbon dates from Jhusi and Tokwa are also available for the charcoal samples (Table-4). These dates range between 7000 and 5000 BC (Personal communication from the excavators). This supports the contention of large-scale occupation of Ganga Plain during Neolithic period.

3.9. The nature and extent of the channel found in the first season's excavation in the deposits of Lahuradewa IA could be better understood during the subsequent excavations. It appears that this channel was dug deliberately to carry out water from one part of the mound to the other. In this context, another comparable evidence comes from the Central Highlands of New Guinea where we have both pollen cores and excavated agricultural features and tools. A significant number of palynological studies have been conducted in the New Guinea Highlands. Five different systems of drainage-ditches, which were constructed and abandoned during alternating periods have been found there. The greatest archaeo-logical surprise after discovery of these

Table -4: Radiocarbon dates from Tokwa and Jhusi

S. No.	Name of Site	Sample No.	Trench/Layer No.	C-14 Date	Cal BC
1.	Tokwa, district Mirzapur	BS - 2417	H-9 (Pit sealed by (4)	BP 7530 ± 230	6591 (6407) 6106
2.	-do-	BS - 2464	I-8 (6)	BP 5620 ± 310	4797 (4456) 4051
3.	-do-	BS - 2369	H-8 (14)	BP 6850 ± 200	5976 (5725) 5561
4.	Jhusi, district Allahabad	BS - 2526	SF-7 (47)	BP 8140 ± 220	7106, 7105, 7080
5.	-do-	BS - 2524	SF-7 (50)	BP 6760 ± 190	5660, 5649, 5612
6.	-do-	BS - 2525	SF-7 (51)	BP 7110 ± 170	5990, 5938, 5932

drainage system was the extremely early date for their first construction, which went back to about 7000 BC[37]. In almost the same time span, the Lahuradewa has evidence of the drainage system, solitary of its own kind, in the region of Indian Subcontinent.

3.10. The conventional radiocarbon date of circa 2700 BC is ascribed to the deposit in which first appearance of dish-on-stand and domesticated grains of barley is marked at Lahuradewa. An AMS ^{14}C date of circa 2345 (2273) 2200 BC of a carbonised grain of domesticated barley of the same site is also available. Carbonised grains of domesticated barley at Damdama[38] in district Pratapgarh are dated to around 2578 - 2458 BC on the basis of AMS dates. Since barley is known to be mainstay in the agriculture of Harappan Culture complex in north-westrn Indian region, it would have reached Ganga Valley from that area. Adaptation of a new crop in any area takes its own course of time. Similarly the presence of dish-on-stand a variation of Harappan ones indicates some interaction with Harappan Zone. Therefore the usage and agriculture of barley and use of new pottery types in this area must have preceded by a period of close contacts between Middle Ganga Plain and western part of the Indian subcontinent.

3.11. The white or cream coloured micro to medium sized disc beads are composed of steatite[39] or pure talc. The sources of natural talc are known from a wide area including Chota Nagpur and Vindhyan Plateau, Himalayan Region and Aravalli. However, so far known the nearest area where tradition of manufacture of comparable steatite beads was prevailing on in the contemporary period, is the Harappan Region. Considering this aspect, a strong possibility of borrowing of such beads from Harappans may be suggested. Recent find of a dish-on-stand intricately decorated with the disc shaped steatite beads, from a Harappan site at Sanauli[40], district Baghpat, western Uttar Pradesh, attests its usage in the Upper Ganga-Yamuna *doab*.

However, the presence of steatite beads in sub-period IA in pre-3000 BC occupation deposits, marked in the excavations during 2005-06 at Lahuradewa, has compelled us to rethink about their source and place of manufacture, and related aspects. These early dates make us hesitant to follow the earlier interpretation that the Middle Ganga Plain people procured them possibly from the western Indian sources during those early times. If it is not so, next obvious probability may be that the Ganga Plain people would have attained the required technological skills to make such beads? If so, how evolved their culture would have been? In either case, who were the people competent enough to purchase them, what was their status and what was the mode of exchange? These questions need further explanation.

3.12. Another aspect worthy of discussion here is the appearance of an arrowhead made on copper sheet and a fishing hook on wire from the lowest levels of IB. On the basis of stratigraphic and comparable considerations and radiocarbon dates we may safely place them in early 3rd millennium BC. The arrowhead from Lahuradewa compares with the copper arrowheads well known from Ganesvara[41] in Rajasthan, Dholavira[42], Lothal[43], Harappa[44], Mohanjodaro[45], Banawali[46], Baror[47], Bhirrana[48] and other sites in early and Mature Harappan contexts and datable to 3rd millennium BC. In Sarayupar region a copper arrowhead, typologically similar to the Lahuradewa find, is known from Imlidih Khurd[49]. Fishing hook may also be taken into the same category.

These finds additionally provide strong clues of long distance contacts of the Lahuradewa settlers. It is notable that in earlier excavations of the Ganga Plain sites the earliest copper artefacts were younger than 2000 BC. The copper artefacts of Lahurdewa IB are the so far known earliest representatives of this metal in the Ganga Plain.

3.13. The earthen bins, found in a considerable number at Lahuradewa since circa 2000 BC are also notable[50]. These structures are comparable with those earlier known from Chechar Kutubpur[51], Imlidih Khurd[52], Malhar[53] and Mahadaha[54] in the Ganga Plain; Banawali and Sanghol[55], etc. in Harappan Zone; and a number of sites such as Ahar[56], central Indian and west Bengal[57] chalcolithic cultures. In the middle Ganga Plain, such structures begin almost with the appearance of white painted black slipped and black-and-red wares. These circumstantial and comparable components also indicate probable interactions of the Ganga Plain inhabitants with the distant and culturally different areas.

4. Conclusions

There is good evidence to show that the human activity is going on in the Ganga Plain from Early Palaeolithic Period. The presence of micro-charcoal pieces in the lake-sediments of Sanai Tal and Lahuradewa-lake, from lower to upper levels, indicates human activity in their vicinity from circa 15000 and 10000 yr respectively. Obvious closeness and exploitation of wild flora by the foragers would have culminated in the plantation of certain plants. On the basis of the presence of domesticated rice grains from Lahuradewa datable to mid 9th millennium BP, it may be surmised that this process was probably initiated during latest Pleistocene/Early Holocene. Mostly coarse variety of hand made red and black-and-red wares appear along with such rice grains from the very beginning. The settlers, related with these finds, were making wattle-and-daub dwellings having mud plastered screens made of reed like material. Aquatic fauna formed a considerable proportion of their subsistence economy. These people were interacting directly or indirectly with distant regions to procure steatite/steatite beads and beads made of semiprecious stones. These interactions, particularly with the western part of the Indian Subcontinent, enhanced considerably since the early half of the 5th millennium BP onwards, which are evidenced by the appearance of copper arrowhead and fishing hook, dish-on-stand, barley, increased numbers of steatite and other beads, wheat and pulses, spouted and pedestal vessels, a few painted potsherds, improvement in pottery making, etc. Earlier ceramic industries, decorations on them and architectural tradition continued. Around 4000 yr BP some new cultural traits appeared, represented by thin sectioned plain and painted black slipped ware, plain and painted black-and-red ware, baked tiles, terracotta legs of an indeterminate object, and a good number of storage bins. Since the settlement extended in an area of about 500 x 200 m by this time, a considerable growth in demography is apparent. The presence of earthen bins of this time period at every location, which has been subjected to excavation, and a large granary show surplus agricultural production. However, baked clay tiles, earthen bins and terracotta legs did not continue for a longer time and are restricted to only in the lower phase of this period. Except for the appearance of iron artefacts around 3200 BP no major change appears in the cultural traits of the Lahuradewa settlers for the period of about early 3rd millennium BP. Next phase is marked by the appearance of the famous NBPW, which covers the pre and post Buddha periods. The significance of the Lahuradewa settlement markedly declined during the early centuries AD onwards.

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Note: This report deals with the details pertaining to the early settlers at Lahuradewa, their material culture, economy and environment, which rest on the composite evidence produced by archaeologists and collaborating experts of diverse scientific disciplines. The respective collaborators are responsible for the inferences drawn by them, regarding the human prehistory in the region with which archaeology is concerned.

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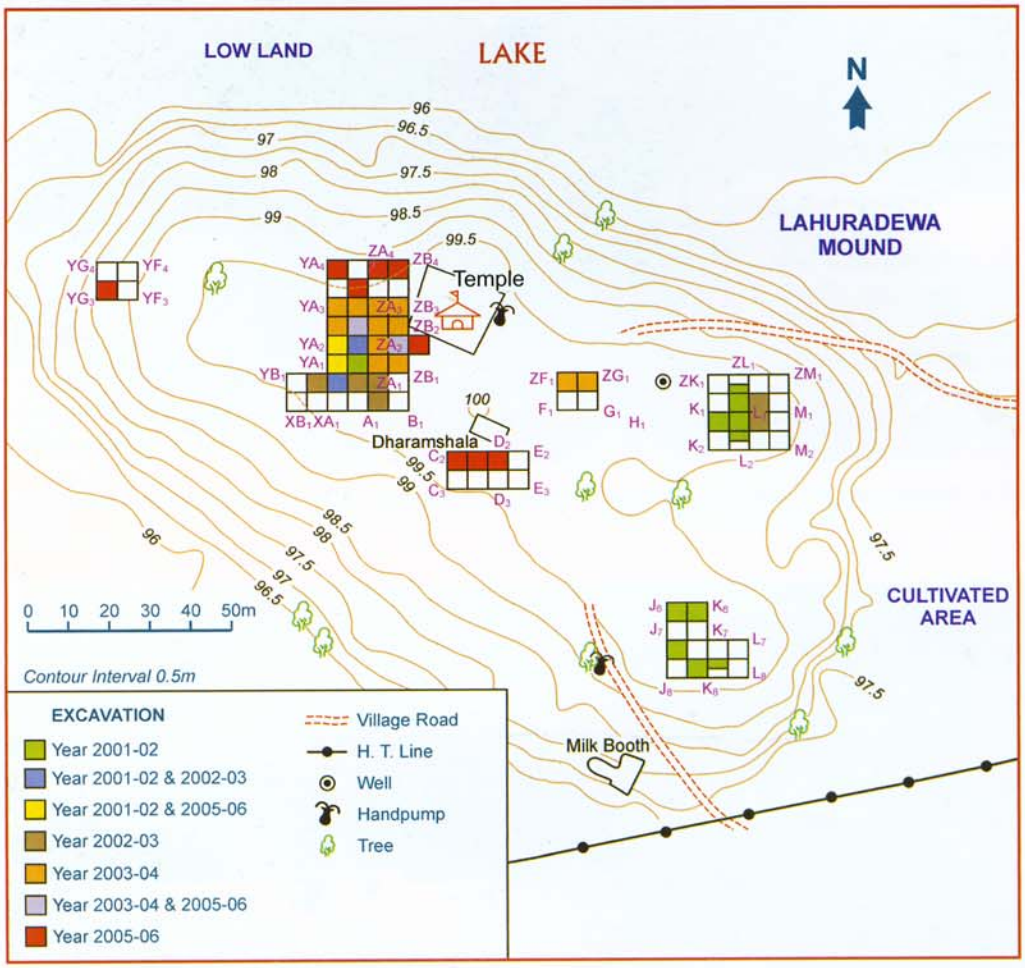
Pl. 1. General view of the ancient site of Lahuradewa, from the east, district Sant Kabirnagar (Tewari, *et al.*)

Pl. 2. General view of the ancient site of Lahuradewa, from southeast corner of the mound, district Sant Kabirnagar (Tewari, *et al.*)

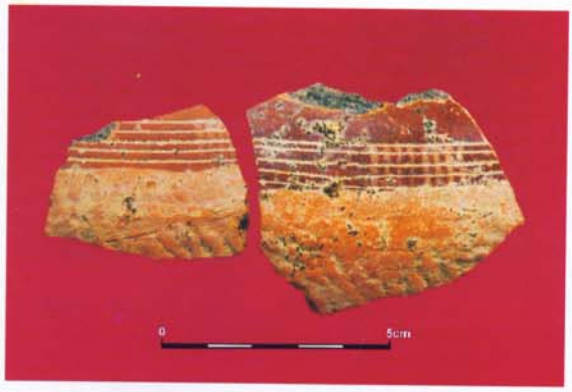


Pl.3. Contour plan of the ancient site of Lahuradewa showing layout of the trenches excavated in respective seasons, district Sant Kabirnagar (Tewari, *et al.*)

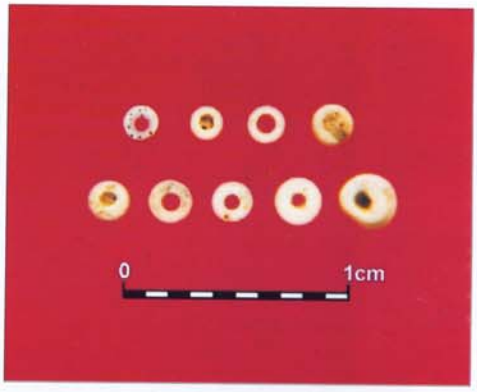
Pl.4. Plan of a circular hut-floor, sub-period IA, trench no. YA 2, Qdt.III, Lahuradewa, district Sant Kabirnagar (Tewari, *et al.*)

Pl.5. Alignment of the channel across the trenches YA 2, Qdts.I & IV and YA 1, Qdt.1, sub-period IA, Lahuradewa, district Sant Kabirnagar (Tewari, *et al.*)

Pl.6. Section facing south (trench no. YA 1 Qdt. I), showing successive deposits; channel is seen cut into layer number (14) and sealed by layer no. (13), Lahuradewa, district Sant Kabirnagar (Tewari, *et al.*)



Pl. 7. Broken sherds of black-and-red ware; showing corded, incised and painted decoration on their exterior surface, upper level of sub-period IA; Lahuradewa, district Sant Kabirnagar (Tewari, *et al.*)

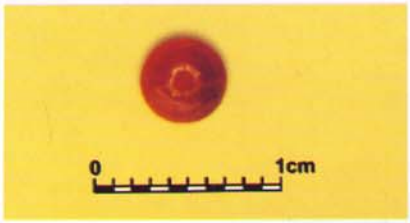


Pl.8. Micro to medium sized steatite disc beads, sub-period IA, Lahuradewa, district Sant Kabirnagar (Tewari, *et al.*)

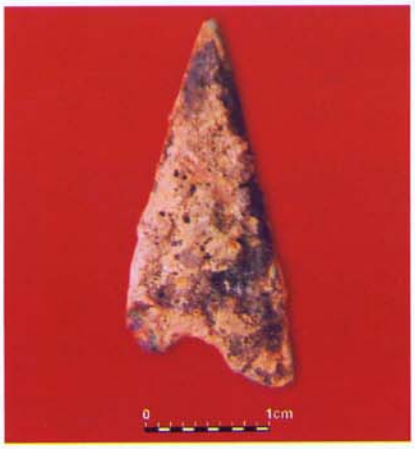
Pl.9. Micro to medium sized steatite disc beads, sub-period IB, Lahuradewa, district Sant Kabirnagar (Tewari, *et al.*)

Pl.10. Section facing west, trench no. YA 3, Qdt. II; dish-on-stand is shown *in situ* embedded in the lower deposit of layer no. (14); sub-period IB; Lahuradewa, district Sant Kabirnagar (Tewari, *et al.*)

Pl. 11. Dish-on-stand, shown *in situ* embedded in the lower deposit of layer no. (14); sub-period IB, Lahuradewa (Tewari, *et al.*)



Pl.12. A small bead; probably made of carnelian, sub-period IB, Lahuradewa (Tewari, *et al.*)



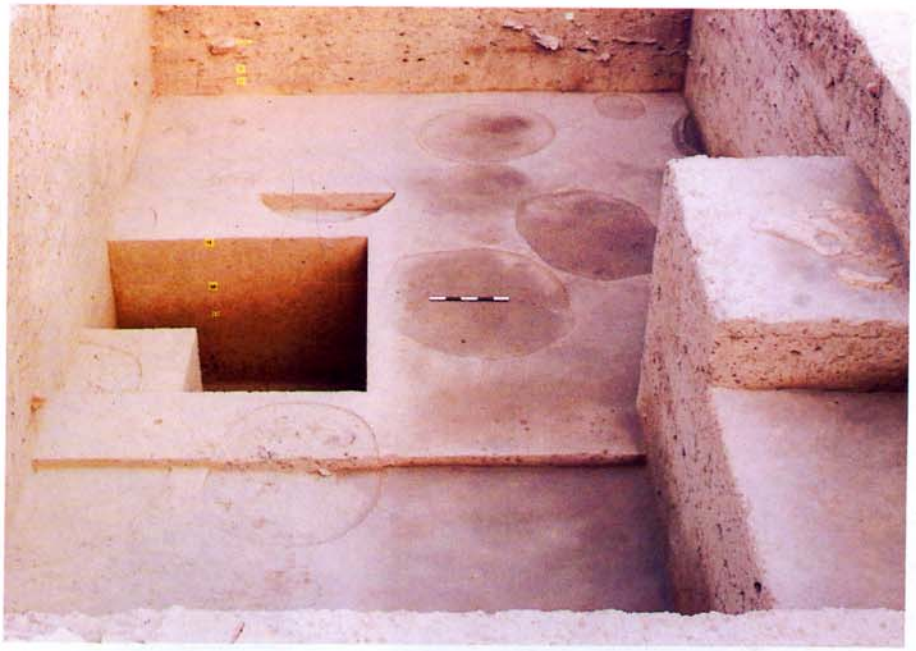
Pl.14. Arrowhead made of copper sheet, from lower level of sub-period IB, Lahuradewa (Tewari, *et al.*)

Pl.16. Fishing-hook made of copper wire, from lower level of sub-period IB, Lahuradewa (Tewari, *et al.*)

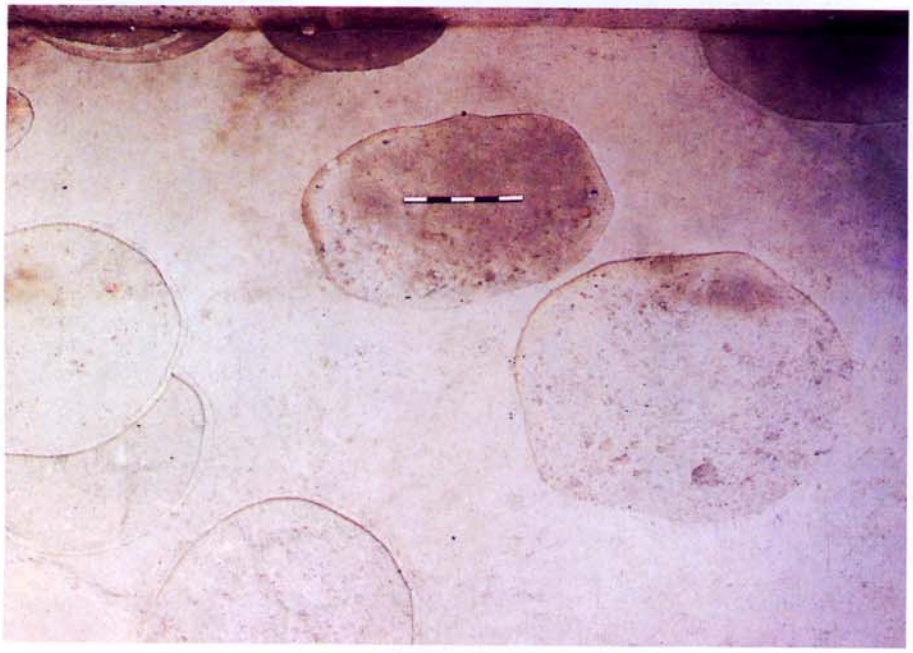
Pl.13. Broken copper object (clamp?), lower level of sub-period IB, Lahuradewa, district Sant Kabirnagar (Tewari, *et al.*)

Pl.15. Bone awl, from lower level of sub-period IB, Lahuradewa (Tewari, *et al.*)

Pl. 17. Bangle made of bone or antler, from lower level of sub-period IB, Lahuradewa, (Tewari, *et al.*)



Pl.18. Granary comprising earthen bins, trench no. ZA 2, lower level of Period II (Tewari, *et al.*)



Pl.19. Granary comprising earthen bins (close view), trench no. ZA 2, lower level of Period II, Lahuradewa (Tewari, *et al.*)

Pl. 20. Stone celts (broken and showing use marks), Period II and III, Lahuradewa (Tewari, *et al.*)

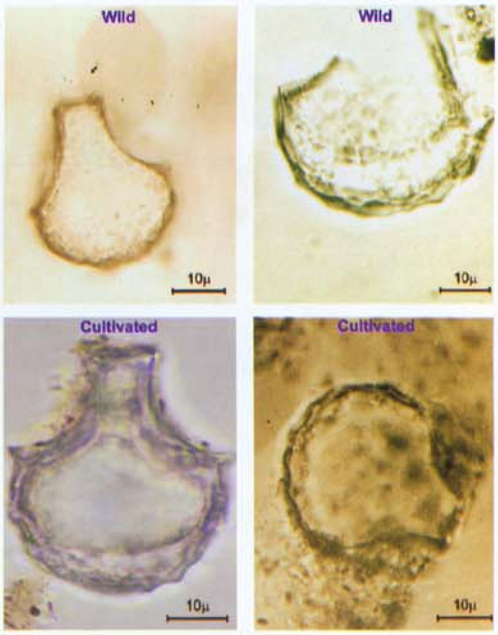
Pl. 21. Stone balls, Period II, Lahuradewa (Tewari, *et al*.)

Pl. 22. Finely made ring stone, Period II, Lahuradewa (Tewari, *et al.*)

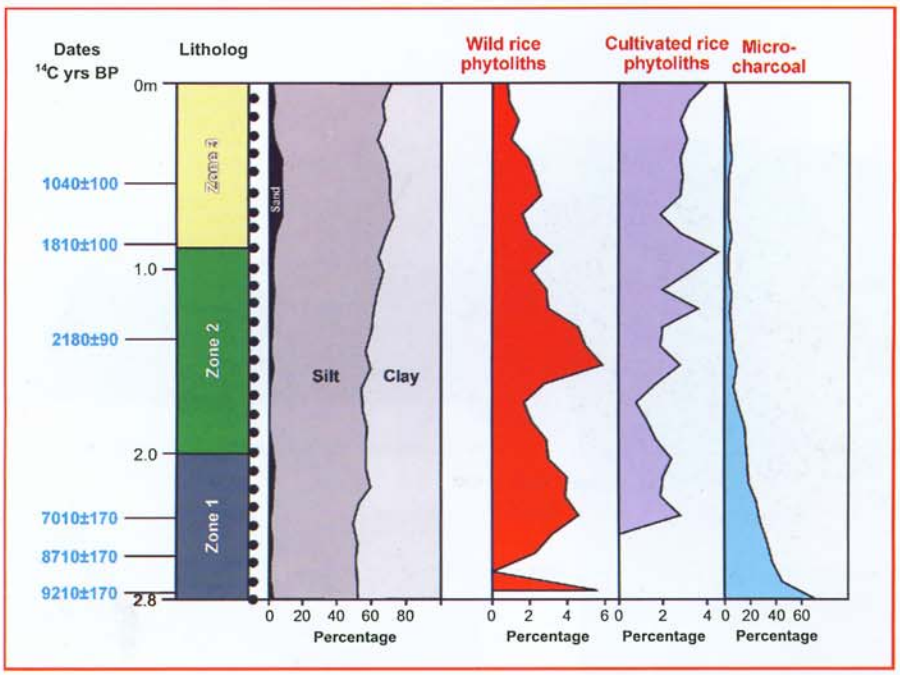
Pl. 23. Bone pick axes showing sockets made in the middle, Period II & III, Lahuradewa (Tewari, *et al.*)

Pl. 24. Rice husk clot, dated by AMS method, from lower level of Period IA, Lahuradewa (Tewari, *et al.*)

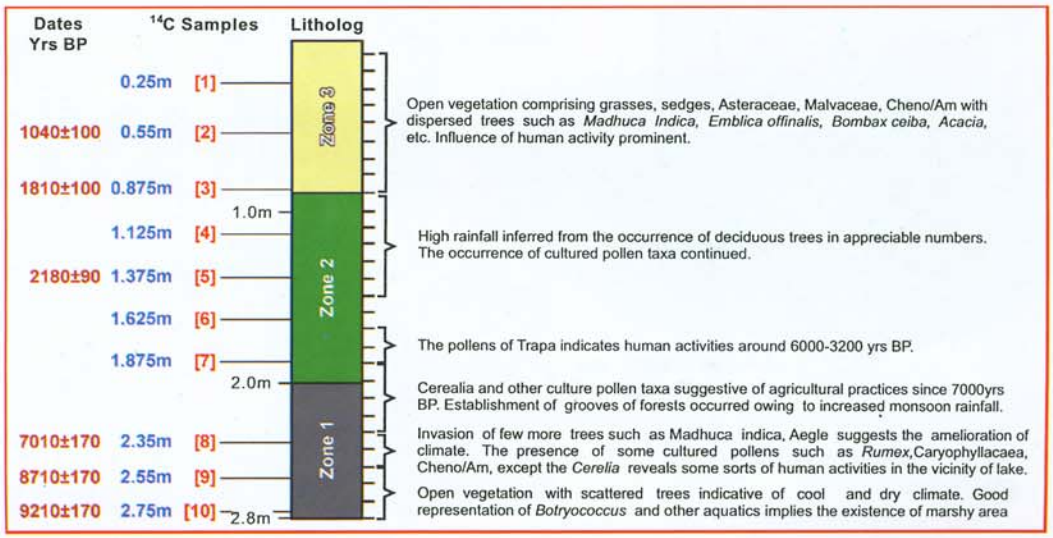
Pl. 25. Barley, dated by AMS method, Period II, Lahuradewa (Tewari, *et al.*)



Pl. 26. Plate showing wild and cultivated phytoliths, Lahuradewa lake-sediment (Tewari, *et al.*)

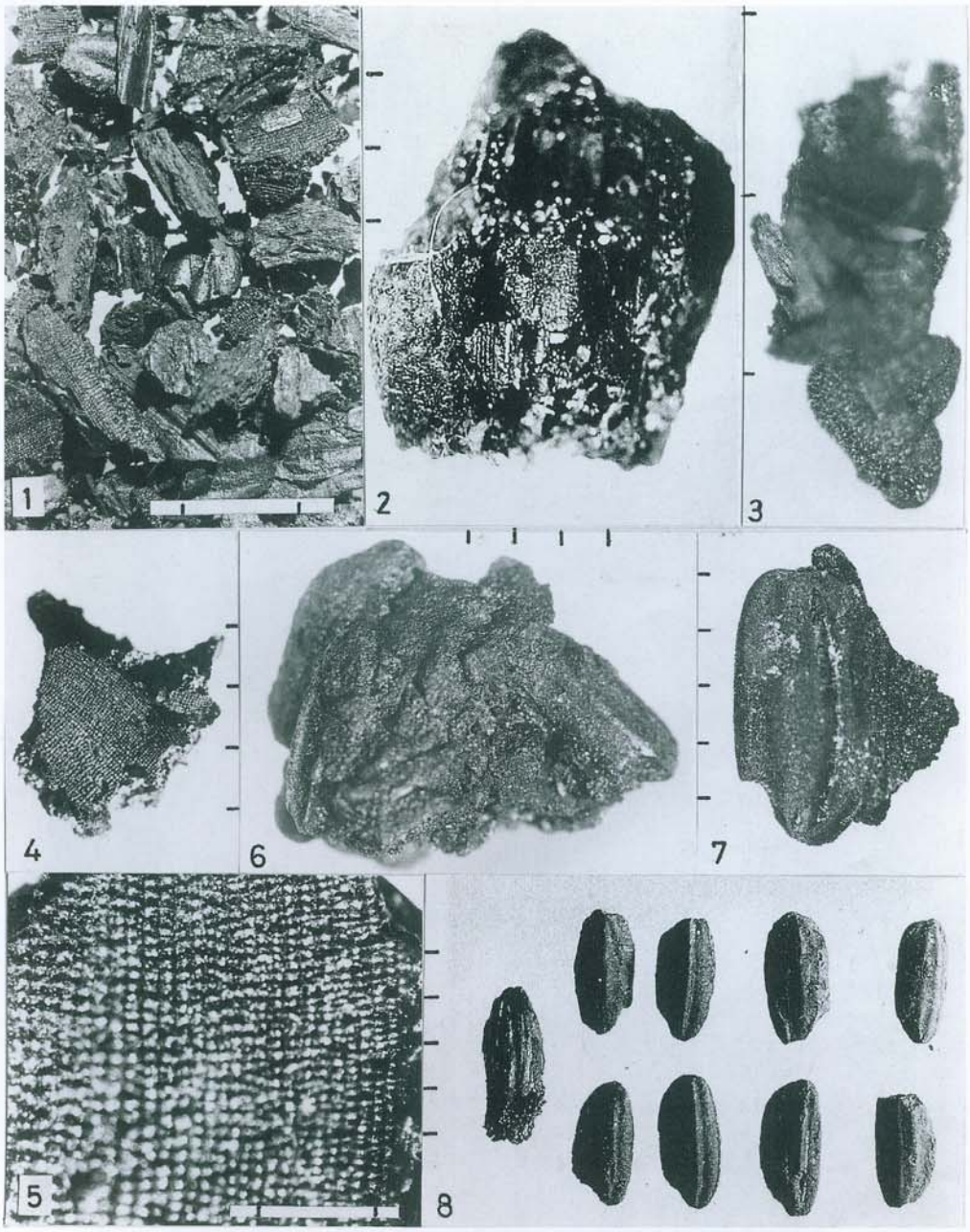


Pl. 27. Lahuradewa lake profile showing distribution of grain size, wild rice phytoliths, cultivated rice phytoliths and microcharcoal. The lake profile represents approximately 10 kyrs history (Tewari, *et al.*)



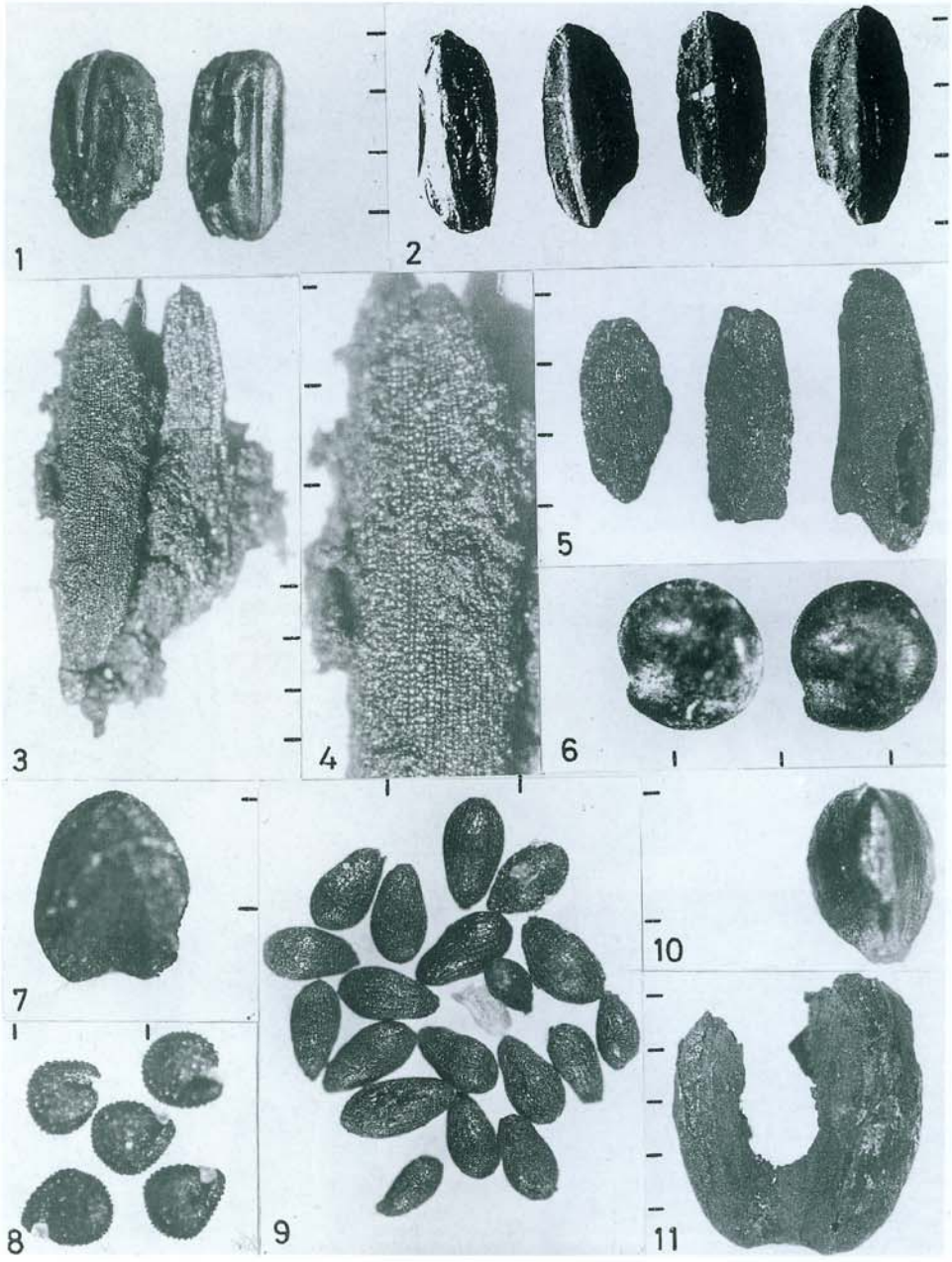
Pl. 28.Lahuradewa lake profile showing major palaeovegetation changes during last 10 kyrs (Tewari, *et al.*)

LRD-Subperiod IA



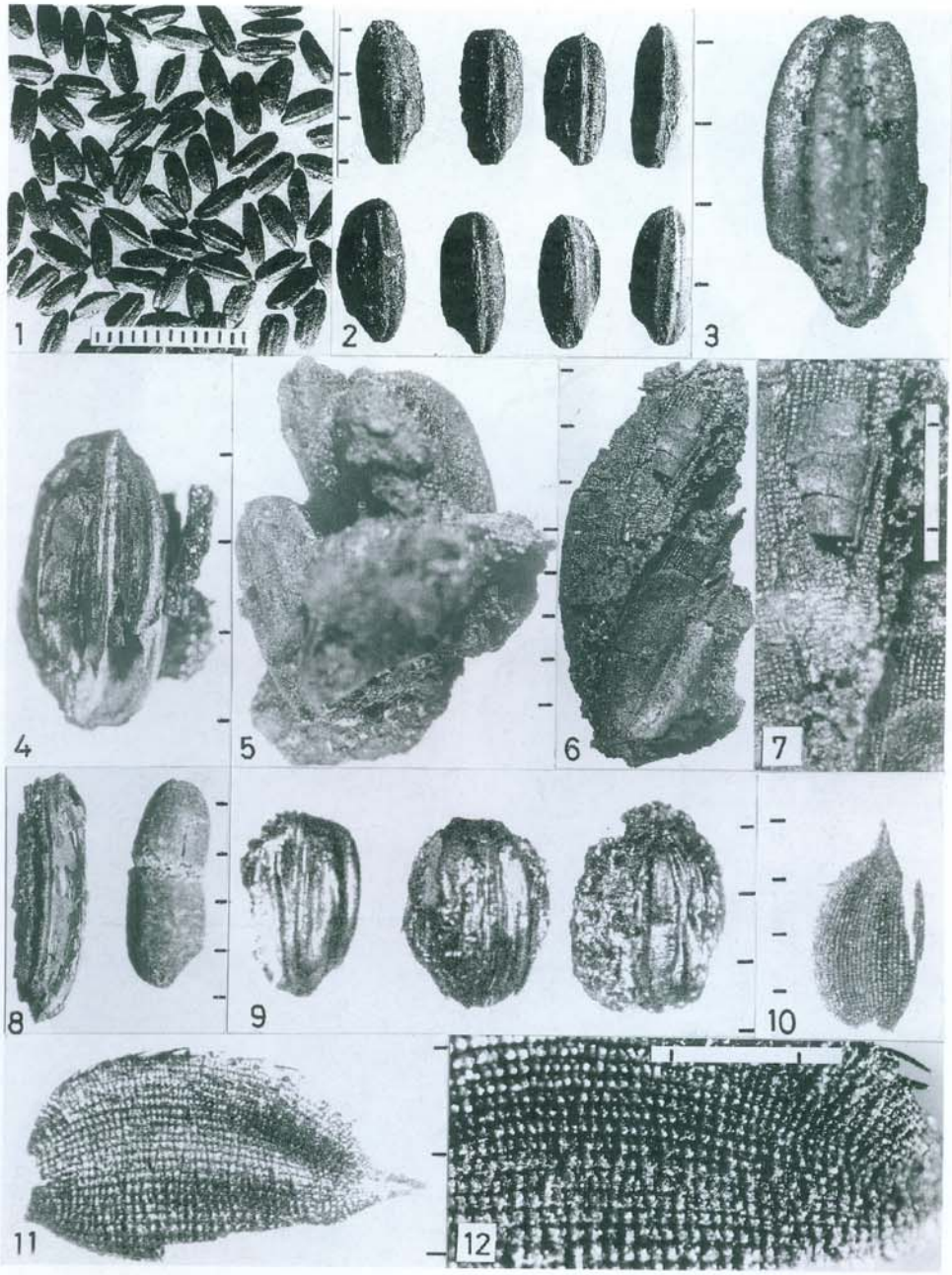
Pl. 29 1. Scant remains of rice-husk in the charcoal pieces from bottom layer; 2. A clot of husk comparable to that of domesticated rice (*Oryza sativa*); 3. Rachis unfastened from the rice-husk clot in Fig. 2; 4-5. Husk fragment showing surface-tissue ornamentation alike to domesticated rice; 6. Five grains of domesticated rice congealed in a carbonised lump; 7. A grain of domesticated rice from the deepest Layer in a trench; 8. Domesticated rice (*Oryza sativa*) grains. (Scale in mm). (Tewari, *et al.*)

LRD-Subperiod IA



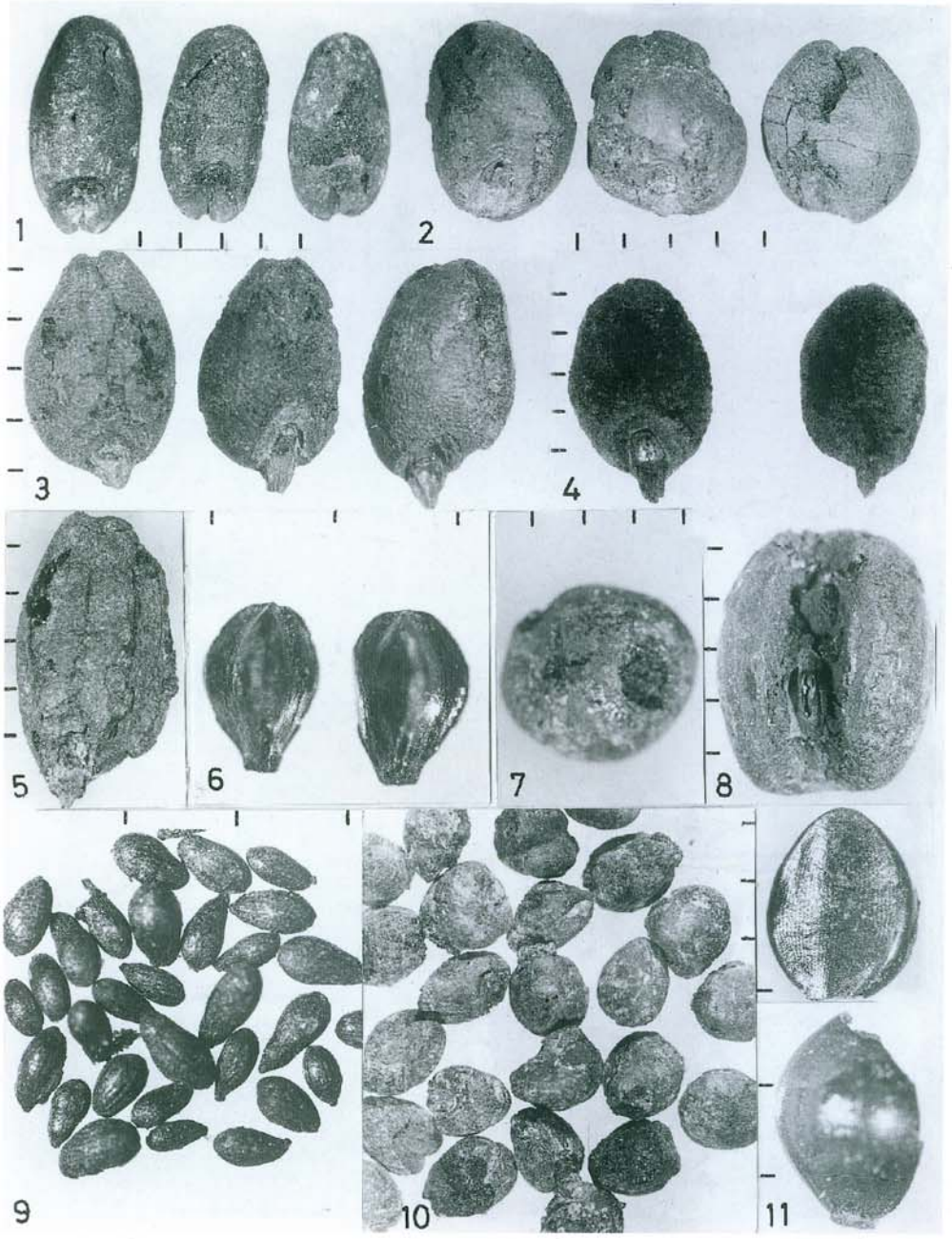
Pl. 30 1. Grains of domesticated rice with puffing during carbonization; 2. Domesticated-rice grains; 3. Caryposis of some wild or weedy *Oryza rufipogon*; 4. Husk-surface tissue of *Oryza rufipogon*; 5. Grains of *Oryza rufipogon*; 6. Goosefoot (*Chenopodium album*) seeds; 7. Grain of faxtail - millet (*Setaria* cf. *glauca*); 8. Seeds of catchfly (*Silene conoidea*); 9. Mugwart (*Artemisia* sp.) nuts; 10. Flatsedge (*Cyperus* sp.) nut; 11. Job's-tear (*Coix lachryma-jobi*) grain. (Scale in mm). (Tewari, *et al.*)

LRD-Subperiod IB



Pl. 31 1-2-3-4. Grains of domesticated rice (*Oryza sativa*); 5. Two grains of domesticated rice congealed in carbonised content; 6-7. Husk-remaims of domesticated rice, in carbonised matter; 8. Grains of *Oryza* cf. *rufipogon*; 9. Grains of wild rice (*Oryza officinalis*); 10-11. Husk of *Oryza officinalis*; 12. Surface tissue (enlarged) of *Oryza officinalis* husk. (Scale in mm). (Tewari, *et al.*)

LRD-Subperiod IB



Pl. 32.1. Bread-wheat (*Triticum aestivum*); 2. Dwarf-wheat (*Triticum sphaerococcum*); 3, 4 & 5. Barley (*Hordeum vulgare*); 6. Flatsedge (*Cyperus* sp.) nuts; 7. Lentil (*Lens culinaris*); 8. Job's tear (*Coix lachryma-jobi*) grain; 9. Nuts of mugwort (*Artemisia* sp.); 10. Foxtail-millet (*Setaria* cf.*glauca*) grains; 11. Husk pieces of kodon-millet (*Paspalum scrobiculatum*). (Scale in mm). (Tewari, *et al.*)