Mesolithic Human Remains From The Gangetic Plain:

Sarai Nahar Rai

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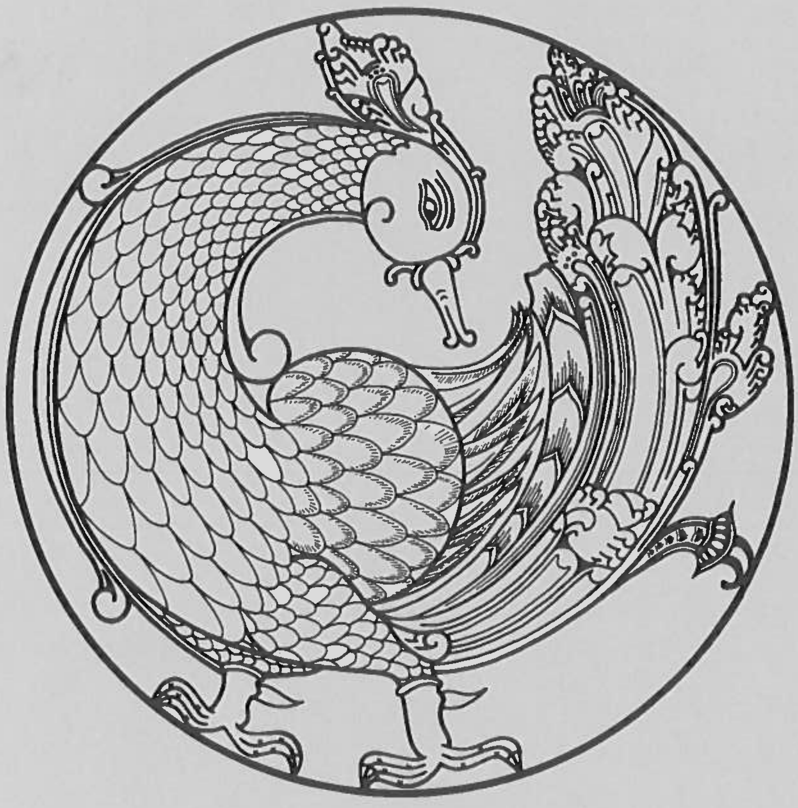

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This volume is dedicated to the memory of

Ron Patrick Laurin

1955 - 1985

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INTRODUCTION

Discovered in 1968, the site of Sarai Nahar Rai in the Gangetic Plain is important to palaeoanthropologists both for its archaeological record of Mesolithic artifacts and associated faunal remains, and for its mortuary series of fifteen human skeletons. This is one of the largest skeletal series of Mesolithic hominids from India discovered to date, and the condition of preservation of the remains is unusually good. Advanced mineralization of the bones, in undisturbed burial deposits, has allowed for the recovery of a number of relatively complete skulls and postcranial bones. All of the skeletal specimens are adults, thus permitting their morphometric analysis and comparison with other prehistoric skeletal series of adult specimens.

The excavation in 1978-1979 of thirty-five well-preserved fossil hominid skeletons from Mahadaha, a Mesolithic site 50 km from Sarai Nahar Rai, allows an unparalleled opportunity for morphometric and statistical studies of two adjacent, and perhaps contemporary, populations of the Mesolithic period in the valley of the Ganga. The site has faunal and cultural components similar to those found at Sarai Nahar Rai. The Mahadaha skeletal series has been examined by the senior author, and publication of results is now in progress. The authors welcome this opportunity to offer the results of research conducted in 1980 at the University of Allahabad.

HISTORICAL BACKGROUND OF RESEARCH

More than a century has passed since the initial discovery of human skeletal remains from Mesolithic cultural contexts in India. However, laboratory examinations and comparative morphometric analyses were never made on the skeletons observed by Carlleyle (1883, 1885; Allchin 1958) at Mahara Pahar, Uttar Pradesh, in 1880-1881, nor on a skull uncovered a decade later by Foote (1916) at Jalampura, Gujarat, nor on human remains collected by Hunter (1935, 1936), in the 1930s, from Pachmarhi, Madhya Pradesh.

Serious study of the skeletal biology of Mesolithic peoples in India did not get underway until forty-five years ago with the excavations at Langhnaj, Gujarat, by Sankalia and his associates (Ehrhardt and Kennedy 1965; Karve-Corvinus and Kennedy 1964; Sankalia and Karve 1949). Since 1941, additional Mesolithic skeletons have been recovered and examined, with important collections coming from Bagor, Rajasthan, in 1968-1970 (Lukacs et al. 1982; Misra 1976) and from Bhimbetka, Madhya Pradesh, since 1971 (Kennedy et al. MS, in press; Misra et al. 1977; Wakankar 1975). Especially significant are the discoveries made, since 1963, by archaeological teams directed by G. R. Sharma at Mesolithic sites of the Kaimur hills and Ganga valley in Uttar Pradesh. The Kaimur rockshelter of Lekhahia ki Pahari has yielded nineteen skeletons, and a single specimen found at Baghai Khor rockshelter has now been examined by Kennedy and Burrow (Sharma 1965, 1973). Other Mesolithic burials have been observed at Harli-Bhituli and Karka in the lake country of the Ganga valley.

Mesolithic sites with human skeletal remains extend into island Sri Lanka. In 1939, P. E. P. Deraniyagala excavated several specimens from the cave of Batadomba lena, Sabaragamuva Province, in an archaeological context that was called the Balagoda culture (the Bandarawelian culture of Noone and Noone 1940). Additional burials were recovered from the cave of Ravan Alla, Uva Province, in 1945, and from the cave of Alu Galge in the same province in 1954. Fifteen human skeletons were collected from the open-air site of Bellanbandi Palassa, Sabaragamuva, which was discovered in 1956 and excavated in 1957, 1961 and 1970. These Sri Lankan sites have been discussed in works by P. E. P. Deraniyagala (1963) and S. U. Deraniyagala (1981), and a description of the human skeletons from Bellanbandi Palassa has also been published (Kennedy 1965). Since 1978, S. U. Deraniyagala has recovered human skeletons in Mesolithic cultural contexts at the cave of Beli lena, Kitulgala, and at Batadomba lena. Radiocarbon dating of samples from the skeletal-bearing deposits are circa 16,000 years b.p. for Batadomba lena and circa 12,500 years b.p. for Beli lena. A description of the remains of twenty-seven individuals from the two sites has been published (Kennedy *et al.* 1985). Sri Lanka has provided palaeoanthropologists with the earliest fossils of *Homo sapiens sapiens* recovered thus far in South Asia, and these have significant implications for the later Mesolithic and skeletal deposits at Sarai Nahar Rai and Mahadaha.

Pakistan has not provided a human skeletal record of Mesolithic association, nor have human remains of this cultural horizon been recovered from archaeological sites in eastern and peninsular India. A catalogue of South Asian prehistoric human skeletal remains and burial practices, including Mesolithic specimens, is now available (Kennedy and Caldwell 1984), and a preliminary description of the Sarai Nahar Rai and Mahadaha specimens is already in print (Kennedy 1984a).

Although Sarai Nahar Rai was discovered in 1968, its excavation did not commence until four years later. Eight skeletons were removed, and, in 1973, six more skeletons were recovered. The significance of the human remains from Sarai Nahar Rai was appreciated immediately by Dr. P. C. Dutta and his affiliates of the Anthropological Survey of India, who removed one skeleton in 1970. Their published reports began to appear as early as 1971 (Dutta 1971, 1973; Dutta and Pal 1972; Dutta *et al.* 1971; Dutta *et al.* 1972), and a photograph of the cranium from the first excavated skeleton appeared in *Nature* that year (Dutta 1971). A recent re-study by Dutta (1984) of the Sarai Nahar Rai specimen retained at the Anthropological Survey of India, Calcutta, provides new morphometric data and collates valuable information on the geology, climate, fauna, vegetation and associated artifacts from the site. The earliest announcements of the Sarai Nahar Rai remains have engendered certain ideas about the nature and biological affinities of the population, ideas which must be reconsidered and evaluated in the light of the present study, which has incorporated most of the specimens removed from the site. This study favours a palaeodemographic orientation, rather than one focused upon racial palaeontology.

Apart from announcements in Indian Archaeology - A Review (1969-1970), and a more detailed study in the Journal of the Indian Archaeological Society (Dutta et al. 1971), archaeological reports of the site and its burials were not published until 1973 and 1975 (Sharma 1973, 1975). The 1973 summary report includes a discussion of preservation and completeness of the skeletons which had been recovered the previous year, along with a description of cultural materials found in the graves. In that report, the skeletons collected in 1972 are identified by the catalogue numbers I, II, III, IV, V, IX, X, and XIII. To this series was added the six additional skeletons collected during the 1973 excavation season. These bear Roman numeral catalogue numbers as well and are distinguished from the 1972 series by prefacing the specimen number with its appropriate date, e.g., Skeleton 1972-III and Skeleton 1973-III. Of this total of fourteen skeletons, nine are suitable for morphometric analysis. There is one additional skeleton which is suitable for morphological analysis only. The remaining four skeletons not included in this study were either absent from the existing Sarai Nahar Rai series at Allahabad University, or were too fragmentary to merit morphometric analysis. One of these, Skeleton 1973-IV, is still embedded in solidified soil matrix, and retained in this form as a display specimen in the museum of the Department of Ancient History, Culture and Archaeology at Allahabad University. The senior author, with the assistance of Mr. C. B. Burrow, studied the Sarai Nahar Rai skeletal series in the autumn of 1980 at the Department of Ancient History, Culture and Archaeology, Allahabad University. Two of the studied skeletons (1972-III, a male, and 1973-III, a female) are currently displayed in a glass case in the museum of this department, alongside two other adult skeletons and three skulls from Mahadaha. This exhibit, and a poster description of the major biological characteristics of the Sarai Nahar Rai and Mahadaha skeletal series, was prepared by the senior and second authors on the occasion of the Silver Jubilee Celebration of the department in November 1980, at the request of G. R. Sharma. The skeleton removed from Sarai Nahar Rai in 1970 is housed now at the headquarters of the Anthropological Survey of India, Calcutta, where it was examined by the senior and second authors upon completion of their research of the series retained in Allahabad. This specimen bears the catalogue number 1970-IV, and is included in the present study.

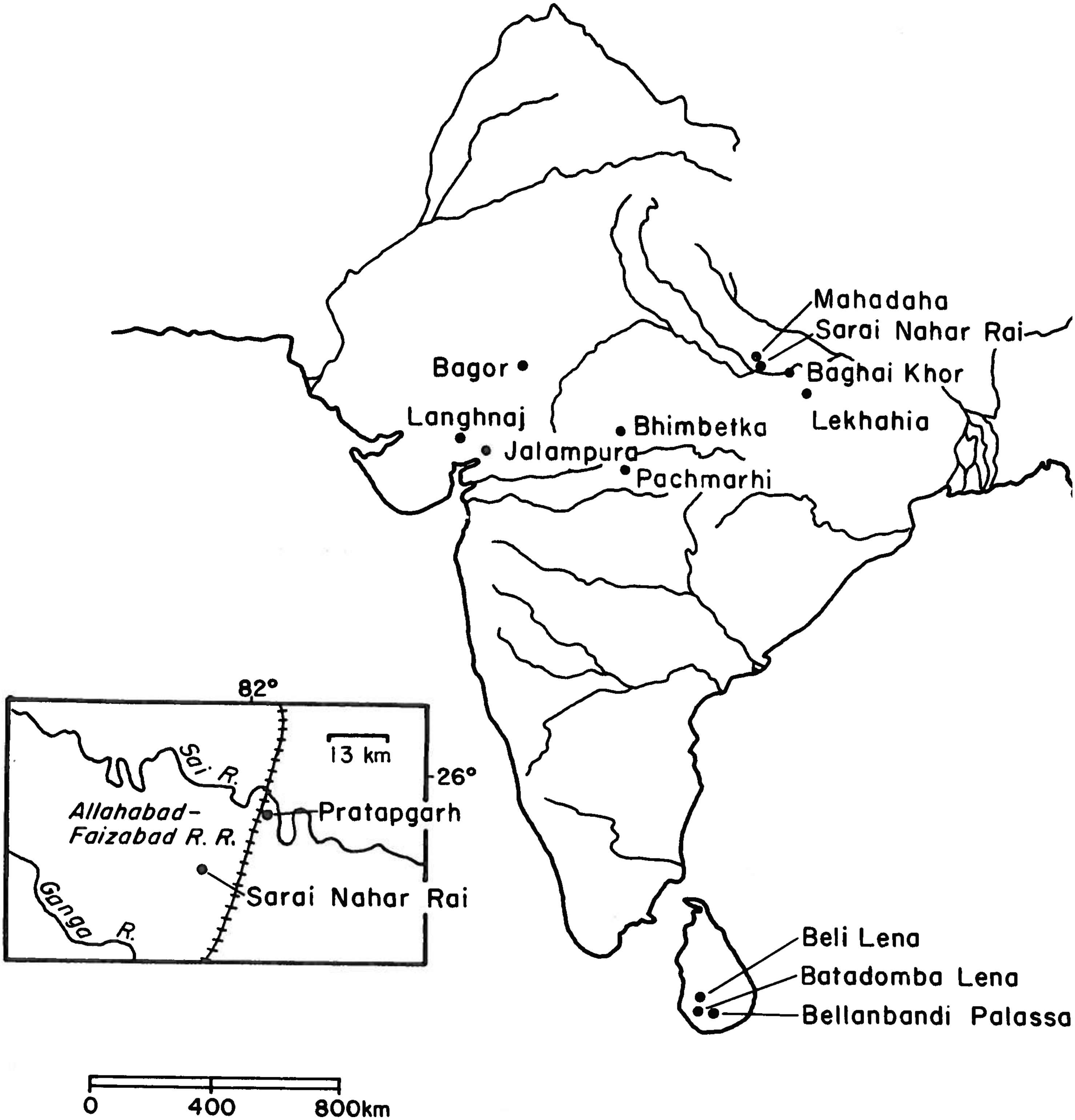
The problem of the chronology of the Mesolithic in India is a complex one. Consequently, in an attempt to facilitate the evaluation and comparison of radiocarbon dates for several sites, we have turned to the original publications of radiocarbon date lists, and have adopted current conventions in the report of these dates. All dates are reported in this paper in radiocarbon years b.p. (before present), present being defined as A.D. 1950. Since 1976, radiocarbon dates are no longer converted to B.C./A.D. calendar years simply by subtracting 1950 from the radiocarbon years. Instead, the radiocarbon year date, b.p., must first be converted to calendar years, B.P., by the application of a calibration curve, and then the 1950 may be subtracted. Conventional radiocarbon dates need to be calibrated because of temporal variations in the amount of radiocarbon in the atmosphere. Many different calibration curves have been produced over the years, and their diversity of results has resulted in a suspicion of calibration on the part of many archaeologists. However, a reasonable consensus of opinion has now been reached by many of the world's radiocarbon laboratories, and we recommend that readers adopt the calibration strategy advanced by Klein et al. (1982). Their published tables permit one to take a date in radiocarbon years, with its associated uncertainty, and obtain a 95% confidence interval containing the 'true' calendric date. Calibrations are included back more than 7,000 years, making them relevant for the Indian Mesolithic.

In the interests of ease of comparison, all dates reported here are uncalibrated. Readers should be aware, however, that other publications may report calibrated dates. These should cite the calibration curve used. If published prior to 1976, many publications gave uncalibrated dates, so care must be taken when comparing radiocarbon dates from different publications.

THE SITE OF SARAI NAHAR RAI

Sarai Nahar Rai (81 degrees 51 minutes East Long., 25 degrees 48 minutes North Lat.) is 15 km southwest of Pratapgarh town in Pratapgarh pargana, Uttar Pradesh (Line Drawing 1, Figure 1). This is within the central Ganga valley. This region is bounded on the south by the Ganga river and on the north by the Sarju river. The site is situated on the shore of an ancient oxbow lake, an isolated meander of the Ganga of terminal Pleistocene times. The river's present course is 55 km to the south. The lake is now dry, save for a small vestige 4.5 km to the west at Srinagar village where it is known as Khoalan jhil. However, when the lake bed held water for most of the year, its shore provided an open-air camp and burial ground used by nomadic hunter-gatherer bands of Mesolithic people. The total area which retains traces of their occupancy measures 2800 m^2 and is marked by microliths, hearths, faunal remains and burials which are exposed in the severely eroded eastern part of the site.

The soil of the region is saline, yellow or whitish in colour, with heavy calcium content (carbonate of lime nodules and black kankar), and includes a compact black soil which is the trace of the old lake deposit proper. The Gangetic alluvium forms a relatively flat topography with an average altitude of 915 m above sea level. Salt abounds in the area. In his geological and topographical description of Sarai Nahar Rai, Dutta (1984: 37-40) notes that the area of the site is well wooded and drained by the Sai river and its affluents. One of these, the Belkhari Nahar, flows within 1 km of the north-east limit of the ancient occupation area. Underlying the younger Gangetic alluvium of sand, silt, and clay is an older alluvium, rich in deposits of calcium carbonate in the form of kankars (nodules), particularly in the usar tracts. Reh, a saline product, also occurs in these soils. Interment of the skeletons in this hard pan of lime concretions explains certain factors of their condition of preservation and mineralization. The reader is urged to consult Dutta's valuable study for a more detailed account of the pedocalic soil horizon



Line Drawing 1

Map of Sarai Nahar Rai and Other Prehistoric Sites Mentioned in the Text

at Sarai Nahar Rai, and its context in the broader stratigraphic picture of this part of the Gangetic Plain.

Sharma (1973) classified the cultural associations of Sarai Nahar Rai as belonging to a geometric microlithic horizon of the early Mesolithic, a tradition characterized in this part of South Asia by small and finely retouched stone tools, such as symmetrical points, lunates, blunted-back blades, scrapers, and triangles. These were fabricated on chalcedony, carnelian, or other fine-grained stones. Large tools are essentially absent. Points and blades predominate over puncturing-boring tools and arrowhead. Nongeometric microliths are present in high frequency. Small clay vessels, made by hand with the coiling technique, were found in most of the graves.

Faunal remains are fragmentary, and are most often encountered in hearths, with microliths. Some of the bones are charred. Sharma (1975) has identified the mammals as Bos indicus, Bos bubulis, Ovis sp., Capra sp., and Elephas indicus. This represents a small proportion of the mammals living in the Ganga-Yumana region at the end of the Pleistocene, which included Equus onager khur, Elephas maximus, Bos gaurus, Gazella sp., Antelope sp., Cervus sp., Canis sp., Hystrix sp., and Mus (Dutta 1984: 39; Dassarma and Biswas 1976). Remains of fish and tortoise are also found. Pollen analysis, of a sample collected from a 3.30 m deep deposit from an oxbow lake in the vicinity of the site, was conducted by Gupta (1976). Results suggest the presence of open grasslands with low tree cover at the time of occupation of Sarai Nahar Rai, followed by a period of greater tree cover. These are conditions which characterize the onset of more arid conditions at the termination of the Pleistocene, as the Gangetic Plain gained pedocalic soil cover and greater salinity.

The human burials occurred in shallow oblong graves, which had been dug into the hard soil of the habitation area. Some specimens had been exposed by erosion before the discovery of the site. Skeletons were found in an extended supine position, and oriented east-west with the skulls to the west. Both single and multiple graves were found. One grave contained four individuals buried at the same time, with two males placed to the right side of two females. There were no infant, child, or early adolescent burials (Figures 2 and 3).

An uncalibrated radiocarbon date of 10,500 ± 110 years b.p. was obtained from a sample of unburnt, highly calcified, human bone (Agrawal and Kusumgar 1973). This date may be considered unreliable, since it was obtained on the inorganic matrix of unburnt bone. Although the issue is not settled, many researchers consider the inorganic carbon to be highly susceptible to contamination by carbon exchange with groundwater (Aitken 1974; Michels 1973; Tite 1972). It should also be noted that a much younger radiocarbon date of 2,860 ± 120 b.p. (Agrawal and Kusumgar 1975), made on charred bones, considered to be less susceptible to contamination of the inorganic matrix (Ralph 1971), has also been obtained. Currently, radiocarbon measurements made on the organic portions of bone (collagen) and shell (conchiolin) are viewed as the most reliable, since the covalent bonding of the organic matrix does not appear to permit carbon exchange with the burial environment.

The nearby Mesolithic site of Mahagara has rendered radiocarbon dates of 9,830 ± 160 b.p., and 11,550 ± 180 b.p. (Rajagopalan et al. 1982), and 10,980 ± 190 b.p. and $13{,}740\,^{+400}_{-380}$ b.p. (Agrawal et al. 1985). Unfortunately, these dates were made on the inorganic portion of shell, which is also susceptible to contamination. The lack of overlap between these dates, and a younger date of 3,330 ± 100 b.p. (Rajagopalan et al. 1982), obtained on usually reliable charcoal, reinforces the suggestion that those older dates may be unreliable. However, the type of pedocalic soil in which the skeletons of Sarai Nahar Rai were buried was developed at the onset of the Holocene, according to Dutta (1984: 49). Certainly, on the basis of Oakley's (1964: 4-5) Fourth Order Relative Dating procedures, the skeletal specimens are in harmony with what palaeoanthropologists expect to encounter, with respect to a suite of anatomical features, in terminal Pleistocene-Early Holocene deposits in other parts of the world. A comparison of radiocarbon dates for Sarai Nahar Rai and other Mesolithic sites with skeletons, such as Bagor in Rajasthan, Lekhahia ki Pahari in Uttar Pradesh, and Langhnaj in Gujarat, is presented in Table I. It is apparent from the great diversity of dates that the evidence for the antiquity of the Indian Mesolithic is presently inconclusive.

CONDITION OF PRESERVATION OF SKELETAL SPECIMENS

The condition of preservation and the number of identifiable human bones present at Sarai Nahar Rai in 1972 are among the data included in Sharma's (1973: 135-138) published account of the Mesolithic cultures of the Ganga valley. Individual bone identification in the field was made by V. D. Misra and A. Pal who supervised the lifting of the skeletons. Their report is confirmed by an extensive photographic record of the burials, *in situ* and during the process of excavation. These were examined by us at the time of our analysis of the skeletons, which had been transported in the interim to Allahabad University. With some minor exceptions, our osteological identifications correspond with those of the archaeological investigators, although certain bones had been removed, and the transport of skeletons from the site to the research institution resulted in some inevitable, but fortunately minimal, damage. Indeed, we were most favorably impressed with the care accorded these human remains with respect to the recording of data and the packing of bones for storage. The same high standards of curatorship were maintained in the 1973 excavation season at Sarai Nahar Rai.

Some cleaning and restoration of bones had been attempted at the site, but the initial task of the present investigators was the thorough cleaning and reconstruction of the bulk of the collection. Cleaning involved removal of loose soil, extraction of the hard calcareous matrix, and separation of bones adhering together with the soil or calcareous matrix serving as a bonding agent. Reconstruction involved mending bones, which had fractured before, during, or after excavation, where breaks had occurred with clean margins. No attempt was made to correct distortion such as warping of skull bones, caused by erosional forces. However, these modifications were given appropriate consideration in the secondary phase of laboratory analysis--the metrical and morphological examination.

Bones of the Sarai Nahar Rai skeletal series have undergone considerable fossilization. Most of the large bones are heavier than recently macerated bones, and have a metallic ring when tapped with a hard instrument. In addition to the high mineral component in the compact and cancellous bone tissues, there are varying degrees of mineral concretions deposited over the external surfaces of many bones. This form of preservation allowed the skeletons to remain relatively intact despite their exposure by erosion. Dentition, when present, is well preserved. Nitrogen and Fluorine assays, if conducted to determine the ratio of inorganic to organic constituents of the bones, as well as to establish the amount of Fluorine absorbed from groundwater, would provide a quantitative index of the degree of fossilization, as well as a measure of the degree of contamporaneity of the burials themselves and their temporal relationships to the associated faunal remains.

The degree of preservation and completeness of each part of the skeleton observed in the laboratory are summarized in Table II. The categories of Complete (C), Incomplete (I), and Fragmentary (F) are relative, but if a part of the skeleton of an individual is Missing (——), this denotes that the part was not observed in the laboratory. A missing bone may appear in a site record or photograph but not be available in the laboratory setting for any number of reasons. The category C is applied when a large number of metrical and morphological observations can be made because the major portion of a skeletal component is present. This symbol applies when a skeletal specimen has retained a complete skull or a complete femur. When a skeletal component yields relatively less quantitative and qualitative data because of postmortem damage, yet still allows for some significant analysis, it is identified as I. For example, a femur may have retained its diaphysis and proximal end but its distal end is missing: such a bone is classified as I in

Table II. This same category has been assigned to the bones of the hand and foot when some components of these members are missing or are severely damaged. Skeletal remains yielding minimal morphometric data because of postmortem damage are labelled F, and these may include splinters or small segments of bones.

MORPHOMETRIC ANALYSIS

Methodology

Calibrations are based upon methods described in the third edition of Martin and Saller's (1957) Lehrbuch fur Anthropologie. Each standard used in the present study is identified by its code number, which is placed adjacent to the name of the measurement in Tables III, IV and V. Measurements of Molar Tooth Row Length and Premolar-Tooth Row Length, for the maxillary and mandibular dentitions, are not accompanied by a Martin and Saller code number. These measurements are taken with the sliding caliper, graduated at 1 mm units, and are the straight-line distance measured from the mesial border of the first molar (or premolar) to the distal border of the third molar. Mid-shaft circumferences of the long bones are measured with a steel metric tape, which is placed against the bone at the middle portion of the diaphysis, pulled tight, and the reading taken at the point of intersection of the tape as it encircles the shaft.

Instruments used for quantitative data include the Seiber-Hegner/Gestetner sliding and spreading calipers graduated to 0.05 mm units, and the mandibular goniometer and palatometer graduated to 1.0 mm units. An osteometric board was constructed in the laboratory with graph paper lined in 1.0 mm units. All measurements are given to ± 1 mm. The manufacturer of the mandibular goniometer and palatometer is the Una Company. The authors' photographic record was taken with the Olympia camera, model OM-2, with 50 mm and macrolens attachments, and with film speed of 400 ASA for black and white exposures. All photographs of the specimens in situ from the archaeological site itself are the property of the Department of Ancient History, Culture and

Archaeology, Allahabad University. One procedure for age determination utilized the set of standard bone models of the pubic symphyses, as defined and classified by McKern and Stewart (1957), and Gilbert and McKern (1973). The Hanna and Washburn (1953) determination of sex of skeletons, by means of an Ischial-Pubic Index, has been used in this study along with other procedures for estimation of sex. Stature estimations were based upon calculations from lengths of long bones of the upper and lower extremities as formulated by Trotter (1970). For both age and stature estimations the tables for white (Caucasian) males and females were consulted.

DESCRIPTION OF SPECIMENS

Skeleton 1972-I

This very fragmentary specimen is represented entirely by postcranial bones. These are poorly preserved. Of the bones of the thorax, the sacrum is in three pieces, and, when articulated, these reveal a slight degree of concavity of the anterior surfaces of the sacral bodies. A right humerus fragment, found with the sacrum, is a non-human bone. Fragments of the right radius and right ulna show moderate degrees of muscular development of the interosseous lines. There is incomplete ossification of the proximal epiphysis of the third metacarpal bone with its diaphysis. A fragmented portion of the left innominate has a relatively narrow sciatic notch. The two femora have a moderate degree of robusticity. The angle of the collo-diaphysial junction of the right femur falls within the metrical value for males. From these data it is concluded that this is a male of 16 to 18 years of age at time of death. No pathological or anomalous features are observed.

Skeleton 1973-II (Figure 11)

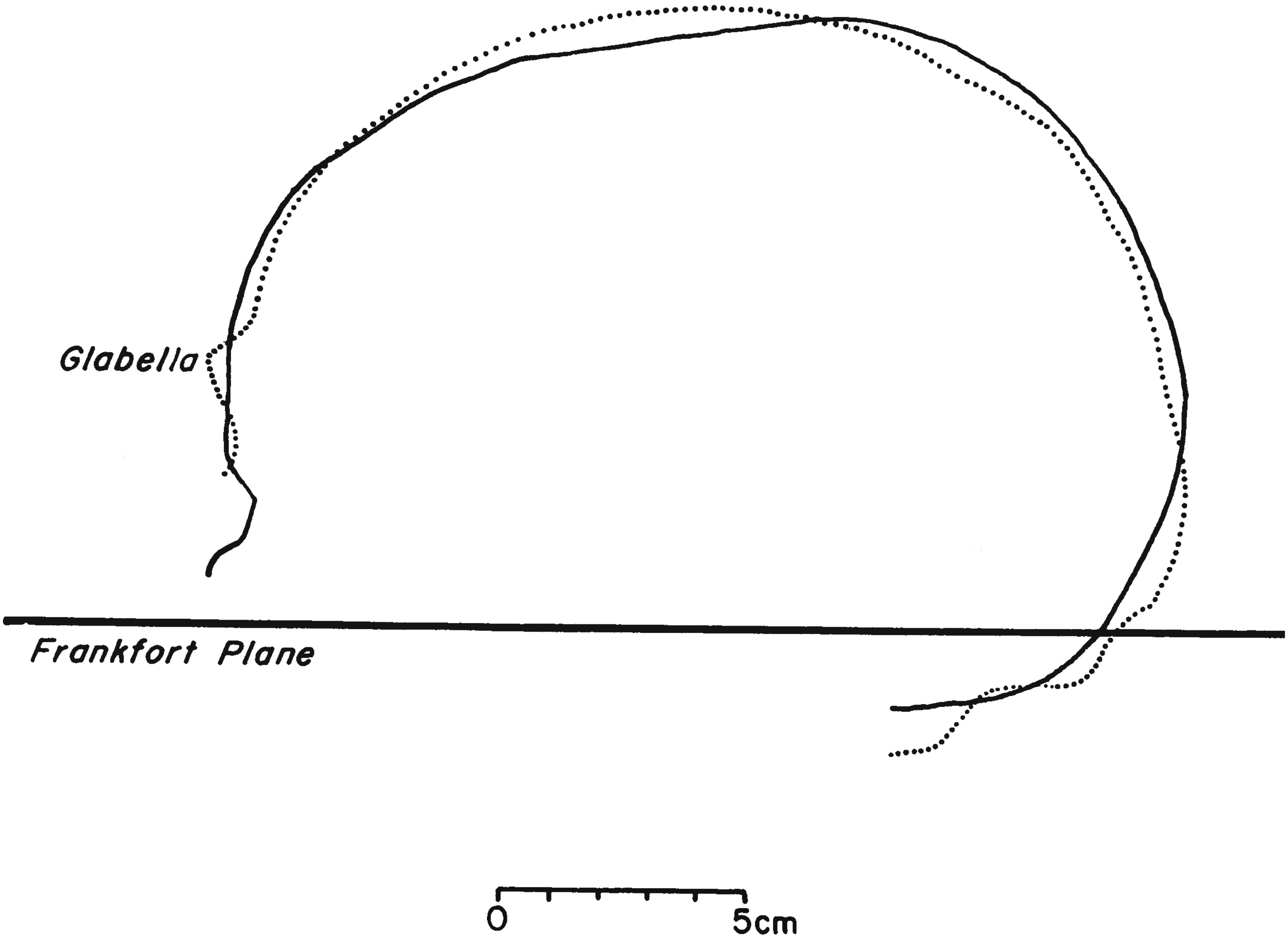
The mandible is represented by the right corpus and gonial portion of the ramus, but alveolar portions and dentition are missing. The gonium is sharply everted and supports prominent attachments for the right Pterygoid muscle. The mental eminence is bilateral in form.

Of the thoracic bones, the sternum has a manubrium of slight robusticity with a jugular notch of moderate depth, and an incompletely fused corpus of five segments. The sacrum is hyperbasal, and curvature of its anterior surface commences just inferior to the third sacral body. The first and second sacral bodies remain unfused. The lumbar and thoracic vertebrae exhibit slight lipping on the articular surfaces of the bodies, an interesting feature given the young age of this individual. Of the bones of the pectoral girdle, the clavicles are remarkable for their large size and pronounced muscular development, the right clavicle being the more robust of the pair. The scapulae are large and robust also, with massive acromial processes and the shallow glenoid cavities which are devoid of any lipping. Upper extremities are marked by large humeri, with a distinct bicipital groove on the right humerus. Radii are flat, rather than elevated, in the tuberosity for Deltoid attachment. Sharp interosseous lines appear on both ulnae. Both humeri and radii are slightly bowed. Hand bones are large, and their epiphysial union is complete. While fragmentary, the innominates have preserved their sciatic notches, which are intermediate in morphology to the norms for male and female pelvic bones. However, there are no preauricular sulci, and muscular development of the iliac crests indicate maleness. Arcuate lines are broad, dull and mound-shaped. Other male features are observed in the large and high linea aspera and pilasters of the right femur, and the pronounced development of the lesser trochanter. The tibiae have massive tuberosities, and, like the femur, are absolutely large in size. There is little retroversion of the proximal end of the tibiae, and the shafts are straight. Squatting facets are prominent on the distal ends of both tibiae. The fibulae are not especially robust or deeply fluted. These bones, and the bones of the foot, show completed epiphysial union. As noted above, there is some lipping of the vertebral bodies: a similar degree of lipping appears on the patellae, along the posterior surfaces of the lateral and inferior borders, and at the apex of the superior borders, where it is most pronounced. The condition is worse on the left knee and suggests a generalized exostosis, related perhaps to a chronic but low level inflammation of the joint.

The morphological features noted here support the decision that this is a male specimen. The estimate of age is based upon interpretation of the left pubic symphysis for which the sum of the three components is 6 on the McKern and Stewart (1957) models. This suggests an age of 20 to 24 years with a mean age of 22.42 $\pm$ 0.99 years.

Skeleton 1972-III (Figures 4-10)

The skull of this specimen is almost complete. However, the cranial vault has been crushed severely, resulting in some distortion to the right side. The face is also skewed to the right, and is slightly compressed. While these postmortem deformations preclude the taking of certain measurements, it is apparent from other measurements that the cranial vault is hyperdolichocranic and tapeinocranic. As a whole, the skull is large and robust, its muscularity appearing most obviously in the sharp temporal lines, deep digastric fossae of the mastoid region, and large supramastoid crests. The frontal bone supports a moderately pronounced supraorbital torus, which is of bilateral form, a large glabella, and a deep nasal notch. The forehead is low and steeply inclined with low frontal eminences (Line Drawing 2). The absolute length of the frontal bone, as measured by chord and arc distances from Nasion to Bregma, is greater than the norms for the length of the frontal bone in anatomically modern Homo sapiens. The parietal bones have large eminences, a striking feature of most of the Sarai Nahar Rai skeletons of both sexes. The occipital bone, while severely crushed, has preserved its pattern of a uniform and even curvature of the nuchal region. Nuchal crests are low. The temporal bones support mastoid processes of moderate size and of pyramidical form. There are large external auditory meati. There is no indication of temporal fullness. Coronal and sagittal sutures are clearly visible, but their patency is rendered more obvious by postmortem erosion of the bones of



Line Drawing 2

Comparative Craniograms of Crania of Skeletons 1970-IV (solid line) and 1972-III (dotted line)

the vault along articulating margins. The basi-occipital-sphenoidal suture has not fused. The face is hypereuryprosopic, and the nasal pattern is in the indicial category of low leptorrhiny. The nasal profile is concave, and nasal sills are oxycraspedotic. Orbital form is chamaeconchic and rhomboid, and orbital margins are dull. The malars are robust but not large, and they project anteriorly rather than laterally. Upper and total facial prognathism is moderate, but alveolar prognathism is pronounced. The palate is deep and brachystaphaline. As with other crania of this series, the intraorbital breadth is greater than is encountered in most skulls of anatomically modern <u>Homo sapiens</u> from South Asia.

The mandible, while of moderately large size, is not especially robust. The mylohyoid crests are low, gonia are straight, and Pterygoid muscular impressions are low. The mental eminence is large and bilateral in form. Genial tubercles are paired and low. The corpus-ramus angle is steep, as is most common in male specimens. The dentition is complete except for the postmortem loss of RIT. The third molars have erupted and are slightly worn; the LM$\overline{3}$ is worn to a somewhat greater degree than the RM$\overline{3}$. The pattern of wear is even across the occlusal surfaces of the teeth, but for the lower premolars the direction of wear is buccal. All anterior teeth show moderate wear, while posterior teeth have retained considerably more enamel on their occlusal surfaces. The cusp-groove patterns of lower second and third molars is +4 and Y5 respectively. The wear on the first molars is too severe to allow for determination of these features. Hypocone variation and cusp number of maxillary molars is 4 for RLM$\underline{1}$, 3 for RLM$\underline{2}$, and +3 for RLM$\underline{3}$. Molar occlusal form is round. The order of molar size for the lower dentition is M1 M3 M2; for the upper dentition this is M2 M1 M3. There is no evidence of caries, alveolar resorption is slight, and moderate enamel hypoplasia is evident on all upper and lower canines and incisors.

Of the postcranial bones, the vertebrae and ribs are large and indicative of a massive thoracic cage. However, the clavicle is not large or robust. Both acromial and sternal ends are completely fused with the diaphysis. Completion of epiphysial union of the acromial process commences at 18 years, and is completed by 21 years in males, providing a useful indicator of age at time of death for this specimen. The acromial end is rectangular in form. The scapula is a large bone, with prominent spine and robust axillary border. Of the bones of the upper extremity, the proximal end of the humerus exhibits an epiphysial line; fusion of this part of the humerus terminates at around 21 years for males. The humeral diaphysis is straight and moderately robust, with a well marked bicipital groove. There is a trace of an epiphysial line on the proximal end of the radius; ossification of this portion is completed by the 18th year. The radial tuberosity is small, but highly elevated. The ulna shows complete ossification of the proximal end of the shaft. On the lateral aspect of the proximal end of the ulna is a deep and short groove, marking the attachment of Anconeus, as well as a large Supinator crest, which extends distally from the apex of the radial facet for some 30 mm. These features of hypermuscular development of the forearm indicate some habitual activity associated with brachial hyperextension, as in spear-throwing or use of a sling (Kennedy 1983). Unfortunately, the absence of a left ulna for this skeleton does not allow determination of its bilaterality, but, as will be noted in descriptions of other skeletons in this series, this unique occupational marker appears most often in the right ulnae of males.

The sex of this specimen is determined to be male on the basis of the high degree of muscularity of the cranial and postcranial bones, and the high frequency of male features in the mandible. Age at time of death appears to be within the range of 17 to 19 years, an estimate based upon dental evidence of eruption and wear of the third molars, and the degree of suture closure and of epiphysial union of the long bones. No pathological conditions are observed in this skeleton.

Skeleton 1973-IV

The poorly preserved cranial vault exhibits well marked nuchal crests, and a very large and robust external occipital protuberance. The mastoid process of the preserved right temporal bones has a pronounced supramastoid crest. Occipital bone thickness is 5 to 6 mm. The mandible, which is limited to the inferior margin of the right corpus, has a gonium with some eversion and well-marked Pterygoid attachments. The mental eminence is missing, but the preserved corpus suggests that it was bilateral. Corpus length does not exceed 100 mm.

Of the bones of the axial skeleton, the sacrum is preserved as five unarticulated fragments. The curvature of the anterior surface of this bone takes its origin from the first sacral body. All vertebrae are present, and the lumbars and last three thoracics show pronounced arthritic lipping along the superior and inferior margins of their bodies, a condition which becomes most striking for the lumbar vertebrae 2 to 5 (Figure 15). The ribs have sharp crests and are fluted along their inferior margins. Clavicles are large with rectangular-shaped acromial ends. The scapulae are incomplete, but the glenoid cavities are preserved and are shallow and unlipped. Humeral diaphyses are large and straight. The right humerus has some normal cortical thickening at the proximal end of its diaphysis, a feature absent in the left humerus. Both humeri and radii have shafts which are straight and not particularly robust. The styloid process of the left ulna is large, but it is the right ulna which exhibits the greater degree of robusticity, particularly in the proximal area of the interosseous line and in the region of attachment of Anconeus and Supinator (Figure 17). The innominate bones are massive, with heavy and robust iliac crests, sharp arcuate lines, and large ischial tuberosities. The anterior iliac spines are well developed. Sciatic notches are deep and narrow, and there is no trace of a preauricular sulcus. Given these male features of the innominates, it is interesting that the Ischial-Pubic Index should fall between the male and female ranges. Of the lower extremities, the femora are straight and support large linea aspera with pronounced pilasters. The tibiae have large tuberosities, sharply defined and extensive Vastus lines, and large but single squatting facets. The fibulae are deeply fluted and exhibit considerable torsion. Foot bones are large. The right patella is larger than its left counterpart, and along its medial border are nodular excresences of secondary bone, which appear to be due to degenerative modifications, caused, perhaps, by arthritic inflammation of the joint of the right knee. The femoral morphology falls between the values for eurymeria and platymeria. The tibiae are mesocnemic.

On the basis of general skeletal robusticity, the sex of this specimen is defined as male. Only the Ischial-Pubic Index suggests femaleness, and this is due in part to the postmortem distortion and fracturing of the right innominate bone. Age at time of death is estimated as between 22 and 24 years, on the basis of modifications of the pubic symphysis. However, the degree of lipping of the lumbar vertebrae suggests that this individual might be somewhat older. All bones show complete epiphysial union, but cranial sutures remained patent at time of death. The most obvious pathological feature observed is an arthritic condition of the lumbar vertebrae and the right patella.

Skeleton 1972-IX

There is no skull associated with this specimen. Of the bones of the thorax, the sternum is represented by a complete manubrium, with a shallow jugular notch, and pronounced concavity of its anterior surface. The sacrum has six fused segments, and is of homobasal form. Anterior curvature of the sacrum is minimal, and is limited to the area of the first two sacral bodies. The thoracic vertebrae are severely damaged, but they do not appear to exhibit the pronounced degree of arthritic lipping which is present in the bodies of the lumbar vertebrae. The second lumbar vertebrae has considerable resorption of compact bone tissue, and the body is compressed. There is some porosity and striation on the corpus of this bone, which is suggestive of the degree of bone modification commonly seen in individuals in their late fourth decade of life or later. The first lumbar vertebra does not show any modification of a pathological nature. Ribs are large, and have sharp interosseous crests. The clavicles are fragmentary, but a preserved sternal end of a right clavicle indicates that the bone was large and robust. The fragment of right scapula is similarly distinctive for its muscular robusticity. The preserved right humerus shows a thickening of the proximal third of its straight diaphysis. The right ulna has some curvature of its proximal end, and its radial facet is 9 mm in length. The styloid process is large, and there is some arthritic lipping at the distal end. The radial tuberosity is very well developed on the right radius. The bones of the right hand are especially interesting, since the palmar surfaces of the proximal phalanges of digits 2, 3, and 4 show prominent tendinous development along their medial and lateral borders. This is less obvious on the proximal phalanx of digit 5. This degree of manual robusticity, not observed on the bones of the left hand, suggests the markings of an occupational stress where gripping and grasping functions were involved. The innominate bones and sacrum are embedded in a single piece of matrix, and only certain morphological features can be observed. However, it is possible to discern the iliac crest, which is broad and muscular, and the arcuate lines, which are dull. There is no sign of a preauricular sulcus on a fragment of one of the innominates. Bones of the lower extremity include femoral portions which indicate a massive and straight diaphysis, with a short but stout linea aspera mounted on a low pilaster. The transverse form of the femoral shaft is ovoid. Fovea of the caput is deep. The crista hypotrochanterica is pronounced, and is accompanied by a moderately deep fossa. The left femur is platymeric. The left tibia has a transverse form which is ellipsoid. The shaft is straight, retroversion of the head is moderate in degree, and the Vastus line is sharp. This tibia is leptocnemic. The left fibula is straight and moderately fluted. The patellae and bones of the feet are not present in the collection.

Although sex determination cannot be established from adequate observations of pelvic features, the high degree of muscularity of the other postcranial bones suggests that this specimen is male. He died between his 28th to 34th year, an estimate based upon the degree of ossification of all postcranial bones, and the advancing condition of arthritic modification of certain bones, especially in the lumbar vertebrae. No other pathological conditions were observed.

Skeleton 1972-X (Figure 13)

The skull is preserved as seven large cranial fragments, some small pieces of maxilla, and a complete mandible with dentition. Examination of the bones of the cranial vault reveal a stout and rectangular-shaped left mastoid process, with a low supramastoid crest and deep digastric fossa, an elipsoid-shaped external auditory meatus, which is 16 mm in height, and an occipital bone of 7 mm thickness, with low nuchal crests.

The most striking feature of the mandible is its large size. Its ramus is broad and low. Gonia are moderately everted, and have large impressions for the Pterygoid attachments. The mental eminence is prominent, bilateral, and extensive. Genial tubercles are paired and low. The mylohyoid crests are very high. The internal surfaces of the coronoid processes are sharp. There is a considerable space between the distal surface of the RLM3 and the ascending ramus. All teeth of the lower dentition are preserved in situ. Some loose teeth--RLPM2, RLM1, LM2 and LM3--represent the upper dentition. All teeth show extensive wear, with dentine exposed on all occlusal surfaces, thus obscuring the original cusp and groove patterns. The order of molar size is M1 M2 M3. Direction of wear is buccal for molars and premolars of the lower dentition. There is no evidence of caries, crowding, or malocclusion.

Of the thoracic bones, the sternum is represented by a well preserved manubrium, which is robust and moderately concave on its anterior surface. The sacrum is long and narrow with five completely fused sacral segments. Its form is hyperbasal. Sacral foramina are large. All vertebrae are preserved, and these show pronounced arthritic lipping of their bodies, especially for the cervicals and for the 4th and 5th lumbars. The bodies of these lumbar vertebrae are compressed. Interosseous crests are not particularly well defined on the ribs. Clavicles are robust with pronounced curvature, and their sternal ends are massive. This degree of muscularity is repeated in the scapulae, which have heavy axillary borders and deeply recessed dorsal surfaces. There is no evidence of a scapular notch or foramen along the superior scapular margin. The acromial process has the shape of a rectangle. Glenoid cavities are not lipped. The right humerus is more robust than the left humerus, especially in the area of the bicipital groove. There is perforation of the olecranon fossae of both humeri. The radii are straight with large tuberosities. There is a small exostosis at the distal end of the right radius, at a point just superior to the carpal facet. The ulnar diaphyses are straight save for some moderate retroversion at the proximal ends. The radial facets are large, and the styloid processes are long and massive. As in the case of Skeleton 1972-IX, the right hand exhibits robusticity of the palmar surfaces of the digits, which suggests a habitual grasping activity. This is not so apparent in the digits of the left hand, but both hands show advanced arthritic changes on the proximal and distal phalanges of the pollex, and on the medial phalanges of the other digits. This degree of bone modification would have been moderately incapacitating for an individual. There are no arthritic changes obvious on the carpal bones. The innominate bones are large, with thick iliac crests, sharp arcuate lines, and massive ischial tuberosities. The sciatic notches are deep and narrow. There is no preauricular sulcus on either innominate bone. The iliac spines are large and blunted. The Ischial-Pubic Index of 73.86 for the right innominate accords well with its estimation as a male pelvis on the basis of morphological observations. The left femur has a straight diaphysis with a high linea aspera and a pilaster which extends some 155 mm. The trochanters are not especially large, and the fossa of the hypotrochanteric region is shallow. The fovea of the femoral head is small and deep. The unusual femoral length of 512 mm is one of the striking features of this specimen. The femoral form is platymeric. The left tibia is also a large bone, with a massive tuberosity which extends some 49 mm along the straight shaft. There is no retroversion of the tibial head. There is a single elongated nutrient foramen. Squatting facets are of moderate size. The tibia is mesocnemic. The left fibula and both patellae are large, but without distinctive morphological features. The bones of the feet are well preserved. The right first metatarsal shows lipping at its proximal end, just inferior to the head, as well as along its plantar surface. This feature is less obvious on the other right metatarsals. The left first metatarsal shows the same kind of lipping, and, at the middle portion of its shaft, on the plantar surface, is a solitary osteocartilaginous exostosis (Figure 16). The apex of this bony spine has been broken off postmortem.

Estimation of age based upon the data of the pubic symphysis is 22 to 28 years for this individual, with a mean age of 24.14 $\pm$ 1.93 years. This estimation agrees with the dental evidence, as the RLM3 have erupted and exhibit severe wear. Enamel is removed from the occlusal surfaces of the other molars as well. The extreme degree of muscular robusticity, and large size of almost all of the bones of this skeleton, indicate that its sex is male. The most striking morphological features of maleness are the steep angle of the mandibular corpus and ramus, the bilateral chin, the deep and narrow sciatic notch, the Gothic-arch form of the subpubic angle, the absence of a preauricular sulcus, and the values for the Ischial-Pubic indices. The existence of arthritic modifications suggests an early onset of degenerative changes in this individual. The solitary osteocartilaginous exostosis (or osteochondroma) is a form of benign tumor that is often the consequence of trauma. The massive tibial tuberosity and the long spinous process on the left first metatarsal are other unusual features of this specimen. Excavators of this specimen report that a stone projectile point was embedded in the left traverse process of the fifth lumbar vertebra (G. R. Sharma, personal communication). This object was photographed while the skeleton rested <u>in situ</u> (Figure 14), but the reported stone artifact was <u>not</u> observed by the present writers at the time of the laboratory study.

<u>Skeleton 1973-III</u> (Figures 11-12)

The cranial vault is well preserved, but it has suffered postmortem distortion due to pressure on the left side. There is flattening of the left side of the vault, and displacement of vault and facial bones towards the right side of the skull. This is a large cranium. The frontal bone is not robust, and the supraorbital torus is low and median. Frontal eminences are pronounced in development, and the forehead is low with a vertical profile. The temporal lines are short and low. The parietal eminences are pronounced. The occipital bone has low nuchal crests, and the occipital profile is rounded. The mandibular fossae are deep and elongated. The temporal bones have large mastoid processes and moderately developed supramastoid crests. The external auditory meati are large and of oval form. All sutures remain clearly visible, the coronal suture being the most obviously patent. Facial bones show large and massive developments of the zygomae and maxilla. The orbital margins are dull. The canine fossae are low. There is a supraorbital foramen over the right orbit, but no foramen on the left side. The nasal profile is concave and the nasal sinus is broad. Nasal sills are orygmocraspedotic. There is some alveolar prognathism and total facial prognathism, but the upper portion of the face is not prognathic. The palate has a marked palatine torus. The face is very broad, but the degree of postmortem distortion precludes determination of the facial indices.

The partially preserved mandible shows prominently everted gonia, low impressions for the Pterygoid muscles, and an extensive but reduced mylohyoid ridge. There is a single low genial tubercle. Mental foramina are single on each side of the corpus. The chin is of bilateral form and moderately projecting. The angle of the corpus and ramus is steep and suggestive of the condition found most frequently in males. The dentition is complete except for the $LI\bar{1}$ and $LI\bar{2}$. All third molars have erupted, however the lower set has not yet attained full eruption to the occlusal level of the other mandibular molars. These third molars of both dentitions reveal no signs of wear, but other molars show slight wear, which is in a buccal direction. Premolars of the lower dentition show lingual wear to a greater degree. The most pronounced wear occurs on the anterior teeth, where dentine is exposed. Lingual pits and tubercles are on the upper lateral incisors, and all upper incisors show a shovel-shape pattern. Even the lower right lateral incisor has slight shovelling. The cusp and groove patterns of the lower molars are +5 for RLM3, +4 for the other molars. Hypocene variation for the RLM$\underline{3}$ is 3, for the RLM$\underline{2}$ is 3 and 3+ respectively, and for the RLM$\underline{1}$ it is 4-. The occlusal form of the lower molars is square for RLM$\bar{1}$ and RLM$\bar{2}$ and oval for RLM$\bar{1}$.

Of the bones of the axial skeleton, the sacrum is narrow with a low degree of anterior surface curvature along its course of five unfused segments. The sacral form is homobasal. All vertebrae are preserved, and are free of the arthritic lipping observed in other skeletons of the series. Ribs show moderate robusticity. Clavicles are large, with well formed acromial ends and prominent attachments for the Deltoid muscles. Axial borders of the scapulae are thick. The moderately robust humeri show recently completed ossification at their distal extremities. Epiphysial union is not complete on the radii. The degree of union cannot be determined on the ulnae. Metacarpal bones show advancing degrees of epiphysial fusion. The femoral head and diaphysis are in process of unification. The femora have a low degree of muscularity, an oval transverse pattern, and shallow foveae. The right femur shows high eurymeria. The tibiae are leptocnemic with low Vastus lines of elliptical transverse pattern. The left tibia is somewhat more robust than its right counterpart. Fibulae are incompletely fused at their diaphysial ends, and are only moderately fluted. Tarsal bones exhibit complete skeletal maturity.

The sex of this specimen is likely to be female on the basis of the gracility of all of the postcranial bones, and the specific female features of the skull, which include the large frontal and parietal bosses, low and median supraorbital torus, low nuchal crests and temporal lines, and the reduction in size of the mylohyoid ridges of the mandible. Age at time of death is estimated to be between the 17th and 20th year. Cranial sutures are patent, and many of the long bones have not completed their epiphysial union. However, the best determinant of age is the pelvic data, which yield a score of 3 for all components for females and give a range of 18 to 23 years with a mean age of 21.50 ± 3.10 years. This estimate, however, based upon methods proposed by Gilbert and McKern (1973) in their classification of aging changes of the pubic symphysis, seems a bit high when compared with the degree of epiphysial union of long bones. The distal epiphysis of the right ulna is united and this takes place most frequently between the 21st and 22nd year. There is incomplete ossification of the ilium and this is completed by 22 years. Epiphyseal lines appear on the humerus and suggest an age of 17 years, and the condition of the femoral head suggests an age closer to 18 to 19 years. The calcaneus has completed its growth, as it does after the 18th year. Thus the age range of 17 to 20 years seems most appropriate for this female specimen. Pathological lesions were not observed.

Skeleton 1972-V

At the time of its discovery, this skeleton was assumed to be a female of 23 to 24 years of age at time of death. Later it was estimated to have had a living stature of considerable height (Sharma et al. 1980). When the remains were collected, the skull was not included, and analysis is limited to rather poorly preserved postcranial bones. The sacrum is preserved as six large fragments, which are unsuitable for morphometric analysis. Of the vertebrae which were collected, the 4th lumbar vertebra exhibits pronounced arthritic lipping. Ribs are fragmentary. A right ulna shows completion of epiphysial union and moderate to well developed interosseous crests. These same features are recognized in the radial fragments. The phalanges of the right hand show considerable robusticity of their plantar surfaces, a feature not so pronounced in the bones of the left hand. Epiphysial union is complete for all hand bones. The innominate bones have broad and shallow sciatic notches, preauricular sulci, and complete ossification of the iliac crests. The femora appear to have well developed pilasters, and the left femur has a prominent linea aspera. The collodiaphysial angle is intermediate between values common to males and females. Tibiae are fragmentary, and the fibulae adhere to them by a bond of hard calcareous cement. This specimen is probably a female as the bones are generally gracile, compared to male specimens of this population which are hyper-robust. The pattern of the sciatic notch is most certainly female. The only clues to age at time of death are the completion of epiphysial union and the pronounced arthritic lipping of the lumbar vertebra. This appears to be an individual who died in the first half of the fourth decade of life. No anomalies of the skeleton were observed.

Skelton 1972-XIII

This specimen has been described as female, with a stature of 170 cm (Sharma 1973). There is a calvarium and maxilla which are preserved as separate and unarticulated portions of the cranium. There has been some lateral compression of the vault, so that the left side protrudes, and all sutures are open as a consequence of this degree of postmortem distortion. The bones of the vault are held in place by the endocranial matrix of hard earth. The frontal bone has a low and median supraorbital ridge, and is low to moderate in forehead elevation. The forehead is vertical in profile, and forms an even curve from Nasion to Bregma. There is no nasal notch. The temporal lines are sharp, but lose this pattern as they sweep posteriorly to the coronal suture. The superior orbital margin is sharp. Intraorbital breadth appears to be great, but damage to the specimen precludes a metrical assessment of this feature. Frontal eminences are low, but parietal eminences are very prominent. The occipital bone has an even curvature in the nuchal area, and is not surmounted by large nuchal crests. The superior nuchal crest is mound-shaped and low. Temporal bones are large with short but stout mastoid processes, medial to which are deep digastric fossae. Their supramastoid crests are low. The external auditory meati are of moderate size and ovoid in form. Mandibular fossae are deep and extensive. This feature and the low temporal lines suggest that the mandible must have been of moderate size and of a low degree of muscularity. The fragments of right nasal bone preserved indicate a slight concavity of the nasal profile at the root of the nose. The maxilla shows moderate robusticity. The palate is as deep as 13 mm. Unification of the interpalatine suture is nearing completion.

All teeth of the upper dentition are present, although the crown is missing from RT2. The RLM3 are fully erupted, with no visible signs of wear on the LM3, and a trace of wear on the RM3. Hypocone variation of the RLM3 is 4 and 3+ respectively, 4- for the LM2 and RM1, and 4 for the RM2 and LM1. The wear pattern is lingual for the molars and premolars, with greatest wear occurring on the anterior dentition. There is no marginal resorption nor any evidence of dental pathology. The RLM1 have a square occlusal pattern while the other molars are oval. The order of molar size is M1 M2 M3.

Of the bones of the axial skeleton, the sacrum is too incomplete to merit analysis of its number of segments or degree of curvature. Thoracic and lumbar vertebrae are present, but they are damaged. Ribs are large, and have marked interosseous crests. The scapulae are of moderate size, and the glenoid cavity of the right scapula does not reveal any lipping along its margins. The humeri show that the proximal epiphyses are in process of fusion, and, along the epiphysial line, the demarcation is deep and well defined. The distal ends of the bones show more advanced degrees of closure. Muscularity is low, and the bicipital grooves are shallow on these bones. The radii show unification of the proximal ends, but the distal epiphysis of the right radius is preserved as a separate piece of bone. The radial shafts are straight, rather gracile, with small and stout Deltoid tuberosities. Ulnar epiphyses are unfused, and the proximal caps are preserved as separate bones. There is pronounced curvature of the proximal half of the diaphysis. Proximal ends of the proximal phalanges of the hand are ununited and preserved as separate pieces of bone. The right innominate bone is present, and restored from several fragments. Its iliac crest has not completed ossification. The sciatic notch is broad and shallow. There is a single and low preauricular sulcus. The arcuate line is sharp, especially along its extension along the pubic bone. Muscularity is not pronounced on the iliac crest or ischial tuberosity. Anterior and posterior spines are sharp. The well preserved left femur is in process of epiphysial union, and has a low tuberosity and slight degree of muscularity. The left fibula is deeply fluted, and the interosseous crests are high. The fibular shaft is straight. Foot bones and patellae are present, and their states of development accord with the growth patterns of the other postcranial bones of this individual. The femur is eurymeric. The tibia is leptocnemic. The postcranial bones are large, but they are not especially robust, even granting the young skeletal age of this individual.

The sex of Skeleton 1972-XIII is assumed to be female on the basis of these observations, as well as upon the cranial evidence of gracility, form of the frontal bone, pronounced parietal bosses, low nuchal and temporal lines, and curvature of the occipital bone. The sciatic notch is very broad and characteristically female. The Ischial-Pubic Index of 83.00 is well within the range of modern white females. The pelvic evidence is equally convincing for age determination, as the score of 0 for all components suggests an age range of 14 to 18 years, with a mean age of 16 $\pm$ 2.82 years. Femoral age based upon epiphysial union suggests a period of life between 15 to 17 years. The age of beginning epiphysial union for the distal end of the femur is 17 to 18 years, and the latest age of incomplete epiphysial union is 20 years, therefore the age of the femur is closest to 17 years. However, for the greater trochanter, union begins at 14 to 15 years, being completed by 18 years. Hence the age of the femur on this criterion is closest to 15 years. Dental evidence indicates complete eruption of the third molars with minimal or no wear, suggesting a dental age of around 17 years or slightly earlier. Thus we have an estimated age, for this female specimen, of from 15 to 17 years. There were no pathological findings for this skeleton.

Skeleton 1970-IV

The first published description of this specimen appeared in Nature on 15 October 1971, along with a photograph of the frontal aspect of the cranium (Dutta 1971).

Subsequent references to the specimen appeared in publications authored by Dutta (1973, 1984) and his associates (Dutta et al. 1971; Dutta et al. 1972). The most detailed description of Skeleton 1972-IV appears in Dutta's paper of 1984. The morphometric analysis which follows is based upon the data presented in these sources, as well as upon observations made by the senior and second authors at the time of their visit to the Anthropological Survey of India.

The cranium is complete, save for some postmortem damage to the basalar aspect. The vault is large and its form is mesocranic, chamaecranic, and tapeinocranic. Inspection from the right or left lateral aspects reveals extreme flattening of the vault. This condition is reflected as well in the Cranial Auricular Height-Length Index of 59.89. Dutta's (1984: 41) estimation of cranial capacity is 1449.20 cm^3, based upon the Lee-Pearson (1901:247) formula for males. This value exceeds, by 112.68 cm^3, the estimate obtained by the present writers using the same formula. Observed vertically, the vault is of brisoid form with its maximum breadth across the plane of the parietal eminences. The forehead is broad, very low, and slightly inclined, with frontal eminences of moderate development. Glabella is pronounced, and the supraorbital tori, while bilateral, build to their greatest degree in the glabellar region. Supraorbital notches are moderately developed. The occipital region is slightly protruding with well marked nuchal crests and a prominent union. There is considerable bregmatic and lambdoid depression (Line Drawing 2). The mastoid processes are long, heavily muscled, and surmounted by large supramastoid crests. The external auditory meati are of oval form. Pterion is of sphenoparietal type. All sutures of the cranial vault are open, and a single wormian bone appears on the left occipital suture at pars asterica. The face is hypereuryne, with chamaeconchic and rectangular orbits and a chamaerrhine nasal form. The orbits are set widely apart. The nasal bridge is low, and the root is slightly depressed adjacent to a moderately deep nasal notch. There is a moderate degree of upper facial prognathism and somewhat more pronounced alveolar prognathism. The canine fossae are shallow, but there is some furrowing of the subnasal portion of the maxilla. The palate is brachystaphaline and of moderate depth.

The maxillary permanent dentition is well preserved and complete. The RLM3 have fully erupted, the LM3 revealing no sign of wear. Dutta et al. (1972: 121) suggests that this tooth erupted later than the RM3, which shows slight wear, but another possibility is that one side of the mouth was receiving greater attritional-abrasional stress. This could be due to any one of a variety of reasons, unrelated to dietary functions. Dentine is visible on the anterior teeth, second premolars, and second molars, but first premolars and first molars show only moderate wear. The wear pattern of the central incisors suggests an edge-to-edge bite. Hypocone variation is of the 4 pattern for RLM1 and 4- for RLM2 and RLM3. Incisors are shovel-shaped to a very slight degree, and the RLI2 have small lingual tubercles. The dentition is mesodont. There is no evidence of dental pathology.

All postcranial bones show robust features. The clavicles have well marked muscular impressions on their medial ends. The coronoid tubercle is well developed, but the attachment for Deltoid is not prominent. The subclavian groove is shallow. The right humerus has a prominent Deltoid tuberosity, and its bicipital groove is deep. Ulnar robusticity is exhibited by prominent Supinator ridges and interosseous crests. The right radius is larger and more developed than the left, but radial tuberosities are prominent on both bones. The Humerus-Radius Index is mesocercic. The innominates have deep and narrow sciatic notches and large acetabular cavities. Muscular features of the iliac crest are prominent, and the subpubic angle appears to have been less than 90 degrees. The robust femora are eurymeric, the right femur being somewhat larger than the left. The Humerus-Femur Index indicates a short femur relative to the upper arm. Patellae are broad. Tibiae have well marked Soleus lines and are mesocnemic. The left tibia is shorter than the right. The Tibia-Femur Index is brachycnemic. Squatting facets are present on the tibiae. Fibulae, while incomplete, have well defined interosseous crests.

This is a male specimen, as demonstrated by the marked robusticity of cranial and postcranial bones, blunt orbital margins, large mastoid processes, the form of the sciatic notch, and narrowness of the subpubic angle. The Ischial-Pubic Index falls within the values for males. The age of this specimen at time of death has been estimated as around 40 years by Dutta and his associates (Dutta et al. 1972: 117-118). Their aging criteria are a set of standards for dental wear proposed by Pal (1970, 1975) for modern Indian cranial remains. They dismissed suture closure as invalid for age determination, because another author (Brothwell 1963: 38) argued that this method had fallen into disfavour. They do note, however, that the sutures of the vault remain patent. Quite correctly, they note the late timing of the ossification of the medial end of the clavicle, claiming that this takes place by age 30. However, Stevenson (1924) gives a mean age of 27 years for the latest age of incomplete epiphysial union of the clavicle, as determined by gross anatomical observation. Furthermore, Stewart (1979) warns his readers to be aware of variation in the appearance of the sternal epiphysis of the clavicle towards the end of the third decade of life. The present authors suggest a younger age for this specimen, which they base upon the degree of cranial synostosis, absence of wear on the recently erupted LM_3, minimal wear of RM_3, and the degree of clavicular ossification. This new estimate would be an age range of 24 to 28 years for Skeleton 1970-IV.

PALAEODEMOGRAPHY

Sex and Age Distribution

The Sarai Nahar Rai skeletal series is composed of 15 specimens. Of the 10 described in this report, 7 are males and 3 are females. Children were not found at the site, although immature skeletons appear in the series from Mahadaha. The present sample is too small to suggest that Sarai Nahar Rai was predominantly a cemetery for males.

The extremes of the age range for males in the series is 16 to 34 years at time of death, with mean age ranges of 17 to 31 years. This has a cumulative mean of 23.28 years. This last figure is not statistically different from the cumulative mean of 22.33 years for females whose extremes of age range are 15 to 35 years with mean age ranges of 16 to 32.5 years. There is no reason to believe one sex had a significantly greater lifespan than the other sex. It is interesting to note that these sex and age ranges for Sarai Nahar Rai do not coincide with the ranges obtained from the considerably larger skeletal series from Mahadaha. Of the 26 specimens described from Mahadaha, 18 are identified as males, 6 as females, 1 is of uncertain sex, and there is a single child skeleton. The age range for Mahadaha males is 17 to 40 years, and from young adulthood to 60+ years for Mahadaha females. However, it appears that we are dealing with random samples for sex and age distributions at both sites, and the age range difference can probably be attributed to different sample sizes. Furthermore, the average ages at time of death for males and females at Sarai Nahar Rai agree well with death age means for Mesolithic populations elsewhere in India, in Sri Lanka and in Eurasia (Kennedy 1984b).

Pathological and Anomalous Features

With the exception of the osteocartilaginous exostoses (osteochondromae) observed on the right radius and left first metatarsal of Skeleton 1972-X (Figure 16), and the presence of dental enamel hypoplasia of the canine and incisor teeth of Skeleton 1972-III, other pathological features of the Sarai Nahar Rai series which were observed by the first and second authors are attributed to degenerative patterns of arthritic bone modification, or osteoarthritis (Table VII, Figure 15). What is most striking in this latter condition is the early age at which osteoarthritic changes are initiated in the Sarai Nahar Rai series, i.e., by the onset of the third decade of life. The apparent absence of dental problems, including caries, abscess, malocclusion, crowding, and high antemortem tooth loss, is another unusual feature of this Mesolithic collection, although other investigators (Lukacs

1981) have noted that, in Mesolithic series from India and Sri Lanka, a high frequency of severe dental wear is accompanied by a low incidence of caries and abscess. The single case of dental enamel hypoplasia among the Sarai Nahar Rai specimens may be attributed to any one of a wide variety of pathogenic agents, such as vitamin-D deficiency, exanthemateous fevers or hypoparathyroidism. Any of these or related pathological conditions may lead to interruption of dental development in the phase of active enamel formation. Dental enamel hypoplasia may be viewed as one stress marker of arrested ontogenetic development in the course of the attainment of full growth potential of the individual.

Some investigators, who had observed one or two of the Sarai Nahar Rai skeletons prior to the initiation of the present study, have suggested the presence of pathological conditions other than those just discussed. The investigators at the Anthropological Survey of India conclude that the flattening of the right frontal region of the skull, and the shortening of the limb bones on the left side of the body of Skeleton 1970-IV are diagnostic of a pathological condition defined as "left hemiperesis," i.e., this individual suffered from "a minor birth trauma leading to incomplete infantile hemiperesis. This condition might also occur due to congenital aplasia or hypoplasia of (the) right side of the frontal cortex extending on to the right parietal region. This change is likely to affect the normal development of the left side of the body in general" (Dutta et al. 1972: 119-120, 124). This is a most provocative speculation; however, a diagnosis of this order must be based upon accurate differentiation of bone shape modifications due to postmortem warping, from bone modeling which is the consequence of pathological malformation. It should also be noted that the differences in maximum lengths of long bones for the right and left sides of the body do not exceed 2 mm, nor do limbs of either side of the body exhibit marks of atrophy or neurological dysfunctions. Therefore, we do not concur with this diagnosis.

More recently, A. K. Sharma (1980) has described, under the rubrics of "palaeo-pathological observations" and "congenital perforation," the anomaly of olecranon fossa perforation of the humeri of Skeleton 1972-X. It is Sharma's understanding that "due to occupational hazards, work that requires constant vertical movement of the fore-arm, this thin bony membrane (in the olecranon fossa of the humerus) slowly gets rubbed, due to constant strokes of the olecranon of ulna, ultimately resulting in the creation of (a) perforation." If this explanation were correct, then the perforation is a marker of stress, and any "congenital" association it might have would be inherent in the capacity of some humeri to develop such perforations. The perforation per se is not a congenital or a pathological feature. However, the present authors do not see the matter in quite the same way that it is understood by Sharma, since it has never been demonstrated that the erratic frequencies in which this trait occurs in living primate populations (including orangutans and human beings from middle Europe, the Veddas of Sri Lanka, the Semang of Malaya, etc.) are related either to congenital determinants or to "occupational hazards." Current anthropological opinion is that perforation of the olecranon fossa is a marker of physiological stress, in a very broad sense, during the skeletal maturation of ontogenetic development, rather than a result of specific brachial activities of apes and men. We do agree with Sharma's analysis of the osteocartilaginous exostosis of the left first metatarsal of Skeleton 1972-X, which he ascribes to "some injury when the bony parts of the individual were still in process of growth." The extent of this bony spine is just under 9 mm in length (Table VII, Figure 16).

In the category of nonpathological anomalous features of the Sarai Nahar Rai skeletal series, we see three examples of squatting facets on the distal ends of male tibiae. More common, although not exclusively in males, is the hyperdevelopment of the attachments for the Anconeus and Supinator muscles in the region of the ulna, just inferior to the radial facet (Figure 17). When this stress marker is encountered, it is almost always more pronounced in the right ulna than in the left. Since the function of

Anconeus is hyperextension of the forearm, while the function of the Supinator muscle is supination, it is reasonable to surmise that this feature is an occupational, or habitual, stress indicator having to do with rigorous brachial activities, such as throwing a spear, using a slingshot or hurling stones. This feature of the right ulna has been observed by the present authors in Mesolithic skeletal series from Mahadaha and Bhimbetka. It is interesting that the skeletons which have this ulnar feature do not exhibit the other common anatomical stress marker of the upper extremity--the hyperdevelopment of the tendonous attachments along the palmar surfaces of the manual phalanges. This latter feature appears among both males and females, and indicates some habitual set of grasping movements, especially of the right hand. Speculations concerning the precise nature of these occupational features are legion, but we seem to have here something more specific than a marker of righthandedness.

In short, the dental and osteological health status of the Mesolithic population from Sarai Nahar Rai appears to have been unusually good from examination of this limited series, an impression that the authors have formed for the Mahadaha skeletal series as well.

Nutritional Status and Ontogenetic Growth

There are two features of the Sarai Nahar Rai skeletal specimens which are especially pertinent in determining their levels of attainment of full ontogenetic growth potential. One feature is the striking paucity of stress markers on bones and teeth, which are diagnostic of episodes of inhibition of normal skeletal development in many other prehistoric mortuary series, especially those from post-Mesolithic cultural contexts. The economic shift, from the nomadic hunting-gathering lifeway to the subsistence strategies based upon agriculture and herding practices, by Neolithic and more advanced food-producing communities, demanded a biological price which is manifested in reduced skeletal growth and by the high incidence of other markers of growth stress. These latter features include lines of arrested growth in the proximal and distal extremities of long bones (Harris lines), dental enamel hypoplasia, and excessive bowing or curvature of long bones which may be attributed to rickets among other conditions of malnutrition. Dental lesions such as caries and abscess become more frequent in early and contemporary food-producing populations. However, with the exception of Skeleton 1972-III, the Sarai Nahar Rai series does not exhibit these or other markers of arrested growth or inadequate nutritional resources. It must be emphasized that dental enamel hypoplasia is not always a direct consequence of periodic or chronic nutritional stress. The condition may reflect a wide range of abnormal health conditions suffered by an individual during the earlier period of life when enamel formation is taking place. However, all hazards to health have some bearing upon frequencies and qualities of food intake and upon the metabolic response of the individual to diet.

The second feature relating to ontogenetic development of Sarai Nahar Rai specimens has to do with their stature. All but one of the specimens described in this series have attained full skeletal maturity. As noted above, stature estimation for a skeletal specimen is based upon tables of regression statistics involving data obtained from the direct measurement of maximum lengths of long bones of the upper and lower extremities. To be sure, there are difficulties inherent in this method since tables of stature estimates for the long bones of one population may not be applicable to stature estimates of another population, especially when the populations are genetically distant from one another. Furthermore, different investigators have favoured the use of different methods for estimation of living stature from maximum lengths of long bones, and comparisons of their stature tables may show some incompatibility of results. Also, we must keep in mind that all of these standards for stature estimation are based upon studies of individuals from modern populations where an individual's record of body height when alive is correlated with the maximum lengths of his long bones after death. Consequently, when determining statures for members of an extinct population, the skeletal biologist is unable to establish precise standards which are specific for a prehistoric series. Rather, he has recourse only to estimations of stature which are already available and based upon data from relatively contemporary samples of individuals. Even when an investigator working with prehistoric human remains from India does make use of stature tables incorporating data for modern South Asians (Athawala 1964), these are of dubious value if applied to an extinct population such as Sarai Nahar Rai.

Admitting then that existing stature estimation tables have certain limitations when applied to prehistoric populations, they are, nevertheless, essential in providing the skeletal biologist with a relative picture of stature in the past. For this reason, the Trotter (1970) tables are consulted in the present study (Table VI). Earlier standards, proposed by Pearson (1899) as well as Dupertuis and Haddon (1951), have their uses, but the more recent Trotter study includes a larger number of individuals, and her standards for males and females of European descent are more appropriate in connection with the Sarai Nahar Rai specimens, than are tables for persons of African or Far Eastern descent.

In their study of Skeleton 1970-IV, the investigators from the Anthropological Survey of India measured the skeleton in situ and obtained a length of 165 cm. They justified this procedure by noting that the skeleton "was lying in a normal extended position on its back, and, there, the crown-heel measurement taken by a steel tape may be considered as representing the true length of the skeleton . . . . Even allowing some error on either side for the absence of superficial soft tissues and also for possible shrinkages . . .due to the drying up of the joint cartilages, we may say that the individual had a medium stature" (Dutta et al. 1972: 119). However, they found that this in situ stature measurement was not compatible with the estimates obtained from the methods of Pearson, and Dupertuis and Haddon:

By equation of	Equation in mm	Variation
Pearson	1680.406	+30.406
Dupertuis and Haddon	1749.033	+90.033
Trotter and Gleser	1740.300	+90.300
Measured skeletal length	1650.000	——

The Trotter and Gleser (1952, 1958) tables of 1952 and 1958, which were consulted in the present study, yield a stature estimate for Skeleton 1970-IV which is well above the ranges for medium height. Dutta and his colleagues did not indicate in their report which of the long bones were used in their estimations of stature for any of the three statistical procedures they cite. The stature estimates obtained by the present investigators, with reference to all long bones suitable for measurement of maximum length, afforded a considerable range of body heights, all within the category of tall stature:

Males	Females
173.93 - 192.08	174.89 - 187.68

However, if we take the femur as the best indicator of stature with respect to the Trotter (1970) tables, we obtain the following ranges:

Males	Females
175.65 - 183.26	(No femora measured)

While stature is only one criterion for ascertainment of an individual's growth potential, it is an important one. Although the sample is small, the Sarai Nahar Rai population appears to be composed of tall individuals, females as well as males, and in this respect they share a physical resemblance to the Upper Palaeolithic peoples of Europe and western Asia during terminal Pleistocene times. To the same degree they share stature norms with the South Asian Mesolithic population from Mahadaha, but later Mesolithic peoples from

Langhnaj, Bhimbetka, Bellanbandi Palassa and other sites in South Asia are characterized by somewhat shorter statures.

EVOLUTIONARY CONSIDERATIONS

The Mesolithic skeletal series from Sarai Nahar Rai represents a phenotypically distinctive population in South Asia. It is unlike other mortuary series hitherto discovered from this part of the world and submitted to morphometric analysis. Its unique place in the biological history of man in South Asia is especially significant in the light of its antiquity. Like their contemporaries in Europe, Africa and in other parts of Asia, the people of Sarai Nahar Rai were anatomically modern hominids, i.e., Homo sapiens sapiens. While bearing some physical resemblances to their sapient collaterals to the west of the Indus, the Sarai Nahar Rai population is characterized by a spectrum of phenotypic characteristics peculiar to itself.

With respect to cranial architecture, these ancient people of the Ganga valley have large and muscularly robust skulls, which range from low mesocrany to hyperdolichocrany. The cranial vaults are tapeinocranic, and, in the case of Skeleton 1970-IV, chamaecrany is present. Among the males, these long and moderately elevated vaults are surmounted by prominent supraorbital tori, moderately large to very large mastoid processes with prominent supramastoid crests, and sharp temporal lines. The development of the nuchal lines varies from slight to pronounced in development. Parietal eminences are very large for skulls of both sexes. The faces of both sexes are hypereuryprosopic and hypereuryne, with nasal forms ranging from low leptorrhiny to chamaerrhiny. Orbits are rectangular, chamaeconchic, and have dull margins. When the skulls are observed in Norma lateralis, the faces exhibit exceedingly low foreheads which are either slightly bulbous and vertical or inclined. Frontal bosses may be moderately developed. The nasal notches are deep, except in Skeleton 1972-XIII, and the profile of the nasal root is concave. Total facial prognathism is slight, but upper facial and alveolar prognathism is present to a pronounced degree in Skeleton 1973-III. The malars are robust, although their sizes vary. Canine fossae are shallow. Nasal sills are dull. The intraorbital distance is great for all specimens. Palates are deep and brachystaphaline. Mandibles are massive and have everted gonia on which Pterygoid muscular impressions are well marked. Some of these mandibles remind one of the Homo erectus mandibles from Ternifine in North Africa and of the Heidelberg mandible, although the Sarai Nahar Rai jaws have well formed mental eminences.

The dentitions are characterized by moderate to pronounced wear, especially along the occlusal surfaces of the anterior teeth, by apparent low incidence of the Y5 cusp and groove pattern for lower molars, and by the absence of caries, abscess, crowding, malocclusion, and other common dental abnormalities. The teeth are mesodont and megadont.

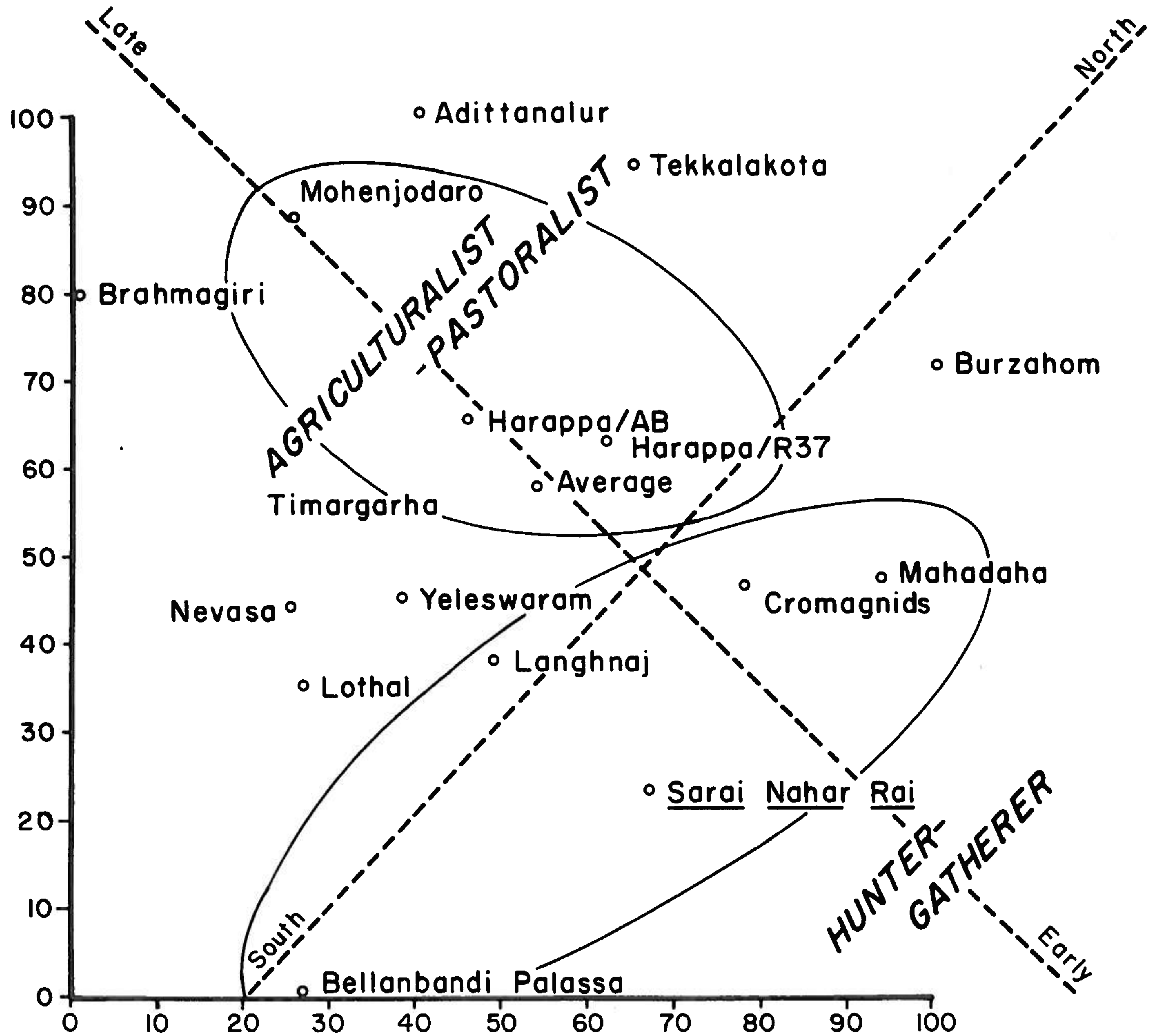
Postcranial bones are consistently massive and robust for males and females. Femora are eurymeric. Tibiae range from leptocnemia to mesocnemia. The single case of an articulated pelvic girdle, for Skeleton 1972-XIII, has an indicial value for the pelvic inlet which is platypellic. The Humerus-Radius Index for Skeleton 1970-IV is mesocercic. Living stature was tall for both males and females. The major pathological feature relates to osteoarthritic changes, but the overall health status of the population appears to have been good. However, there are no individuals in the series who survived beyond the fourth decade of life.

These morphometric data concerning the Sarai Nahar Rai series are relevant to two major considerations concerning the course of human biological evolution in South Asia. First, we recognize here an ancient population which was extremely successful in its adaptation to the hunting and gathering way of life carried out in an ecological setting of abundant food resources. Only in this way may we explain the physical responses of this population towards a high realization of their ontogenetic growth potentials and the low incidence of diseases related to nutritional stress. This pattern of adaptive success, or fitness, is not unique in prehistoric cultures antedating the invention of agriculture and pastoralism, as demonstrated by the skeletal and archaeological records from southern Europe and western Asia in terminal Pleistocene times. It occurs, too, in some populations of more recent times, such as the natives of the northwest coast of North America. But for every one of these instances of high adaptability among hunting and gathering peoples, there are myriad cases where this economic strategy has failed, has persisted as a marginal form of existence, or has undergone rapid acculturation to neighboring food-producing communities.

The evidence for successful biological adaptation to Mesolithic economic patterns is documented in South Asia by the rich archaeological record. This record attests to the attainment of some fairly sophisticated lifeways and socioeconomic strategies, well before the initiation of more advanced food-producing technologies and the shift from a nomadic to a sedentary existence. Surely the exploitation of new ecological settings by Mesolithic peoples, which allowed them to occupy a wide range of natural habitats and to pioneer areas only sparsely settled by their Palaeolithic forebears, is a significant expression of their cultural and social adaptability. The recently discovered cave paintings from Bhimbetka, and from other Mesolithic sites in India, and the lithic record of an advanced technology, established upon the manufacture of small precision tools, are other indicators that Mesolithic peoples were developing a man-made environment conducive to an enhancement of biological success for their communities of wandering bands. The Mesolithic lifeway of South Asia is coming to be recognized as a phase of high culture within the constrictions of the hunting and gathering economy, in the same way that the cave artists of prehistoric Europe achieved their unique cultural attainments and their success in adapting to their ecological settings in local areas of abundant resources.

The second evolutionary consideration is our need to appreciate the nature of the biological affinities of the Sarai Nahar Rai population with other Mesolithic populations in India and beyond. Some effort in this direction has been made by Dutta (1973), who compares the cranium of Skeleton 1970-IV with seven specimens from the Mesolithic site of Langhnaj, a locality in northern Gujarat. Dutta notes that there are similarities between these two populations with respect to cranial length, the form of the forehead, pronounced supraorbital tori, alveolar prognathism, chamaerrhine nasal form, and a few other features, while differences are in cranial and facial sizes and shapes, orbital forms, dental dimensions, and stature estimations.

Today, biological anthropologists have available, for comparative analyses, a broad spectrum of sophisticated statistical measures. These may be directed toward determination of degrees of biological distances among Mesolithic specimens from South Asia. One recently reported multivariate study is a principal-components analysis of 117 prehistoric South Asian crania from 15 prehistoric archaeological sites in India, Pakistan and Sri Lanka, to which were added data of 23 crania from Upper Palaeolithic sites in Europe (Kennedy et al. 1984). Specimens from Sarai Nahar Rai were included in the South Asian sample. Results indicated that their clustering with cranial series from Mahadaha, Langhnaj, Bellanbandi Palassa, and the Upper Palaeolithic series from Europe, was due to morphometric similarities of facial architecture. The variables which effected clustering of these specimens from prehistoric hunting-gathering populations include external and internal palatal breadths, bizygomatic breadth, intraorbital breadth, bifrontal breadth, and nasion-prosthion height. It was observed that these factors are different from those involved with clustering of post-Pleistocene food-producing populations of various degrees of technological development (Line Drawing 3). Interpretation of these data does not rest upon an hypothesis of racial affinity whereby the prehistoric people of Sarai Nahar Rai could claim close kindred among European Upper Paleolithic people. Rather, it is proposed that the positions of the South Asian and European series reflect real differences in craniofacial anatomy which set apart prehistoric hunting-gathering populations from the more recent food-producing populations. These trends toward decreased cranial robusticity find their parallels in the shift from pronounced skeletal robusticity and large



Line Drawing 3

Axes and Clusters of Selected South Asian Prehistoric Skulls Based upon Principal-Components Analysis

body size towards skeletal gracility and reduction of body size that has marked the course of hominid evolution over the course of the past 10,000 years (Wolpoff 1980). The evolutionary process behind this reduction of muscular-skeletal robusticity, with consequent reduction of sexual dimorphism, is natural selection, with smaller body size becoming adaptive for village and urban lifeways with their higher increments of carbohydrates and decreased availability of proteins. Another aspect of this trend is tooth size reduction which has been ably documented for prehistoric South Asians by Lukacs (1983, 1984). Based upon observations made by Brace and Mahler (1971), it can be demonstrated that the smallest teeth appear among South Asian populations living today in the northern and northwestern portions of the subcontinent, while larger (megadont) dentitions survive in peninsular India and in Sri Lanka. The Sarai Nahar Rai dentitions show high mesodonty, a feature which was of adaptive value for pre-agricultural, pre-pastoral populations of South Asia. Thus, the Upper Palaeolithic European series used in this multivariate analysis finds its place near the series from Sarai Nahar Rai since it exhibits a parallel morphological development of facial size and cranial robusticity, and the large tooth size which is characteristic of prehistoric populations of hunters and gatherers in widely separated regions.

The recovery of the human skeletal remains from Sarai Nahar Rai and from the nearby site of Mahadaha have brought Indian palaeoanthropology into the arena of prehistoric hominid studies which have been associated for so many years with other parts of Asia and with Europe and Africa. The recent discoveries in Sri Lanka of fossil hominids dating to 16,000 years b.p., of which the published report will soon be available, will provide invaluable comparative material for further study of the Gangetic hominid fossil record. It is anticipated that the publication of our analysis of the Mahadaha skeletal series will also contribute to our understanding of Sarai Nahar Rai and firmly establish India in the context of advances made by human palaeontologists in other parts of the world.

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TABLE I. RADIOCARBON DATES FOR SOME INDIAN MESOLITHIC SITES

Site name	Radiocarbon dates	Reference	Comments
Bagor	12450 $\pm^{220}_{210}$	Agrawal _et al_. 1985	Unburned bone, inorganic
	5620 ± 125	Agrawal _et al_. 1971a	Unburned bone, inorganic
	5090 ± 85	Agrawal _et al_. 1971b	Unburned bone, inorganic
	4585 ± 105	Agrawal _et al_. 1971b	Unburned bone, inorganic
	3945 ± 90	Agrawal _et al_. 1971b	Unburned bone, inorganic
	6245 ± 200	Agrawal _et al_. 1971b	Unburned bone, inorganic
	6460 ± 180	Agrawal _et al_. 1985	Charcoal
	8090 ± 220	Agrawal _et al_. 1985	Charcoal
Langhnaj	3875 ± 105	Agrawal & Kusumgar 1969	"Contamination is probably high"; mixed bones from different skeletons and levels
Lekhahia	3560 ± 105	Agrawal & Kusumgar 1969	Unburned bone, inorganic
	4240 ± 110	Agrawal & Kusumgar 1969	"Archaeological associations suggest these could be younger"
Mahadaha	4010 ± 120	Rajagopalan _et al_. 1982	Charred bone, inorganic
	2880 ± 250	Rajagopalan _et al_. 1982	Charred bone, inorganic
	3840 ± 130	Rajagopalan _et al_. 1982	Charred bone, inorganic
Mahagara	11550 ± 180	Rajagopalan _et al_. 1982	Shell, inorganic
	9830 ± 160	Rajagopalan _et al_. 1982	Shell, inorganic
	3330 ± 100	Rajagopalan _et al_. 1982	Charcoal
	10980 ± 190	Agrawal _et al_. 1985	Shell, inorganic
	13740 $\pm^{400}_{380}$	Agrawal _et al_. 1985	Shell, inorganic
Sarai Nahar Rai	10050 ± 110	Agrawal & Kusumgar 1973	Unburned bone, inorganic
	2860 ± 120	Agrawal & Kusumgar 1975	Charred bone, inorganic

TABLE II. CONDITION OF PRESERVATION OF SKELETONS*

Specimen No.	1972-I	1973-II	1972-III	1973-IV	1972-IX	1972-X	1970-IV	1973-III	1973-V	1973-XIII
Sex	M	M	M	M	M	M	M	F	F	F
Skull										
Cranium	-	-	C	I	-	I	C	I	-	C
Mandible	-	I	C	I	-	C	-	I	-	-
Dentition	-	-	C	-	-	C	C	C	-	C
Thorax										
Sternum	-	I	-	-	I	I	F	-	-	-
Sacrum	F	F	-	I	C	C	F	C	F	I
Vertebrae	-	C	I	C	C	C	F	C	F	I
Ribs-R	F	F	F	F	F	F	F	F	F	I
Ribs-L	F	F	F	F	F	F	F	F	F	I
Pectoral Girdle										
Clavicle-R	-	I	-	C	F	C	C	C	-	-
Clavicle-L	-	C	C	I	F	C	F	C	-	-
Scapula-R	-	I	-	I	F	C	F	I	-	-
Scapula-L	F	F	C	I	-	I	F	F	-	I
Upper Extremity										
Humerus-R	-	C	-	C	I	C	C	C	-	C
Humerus-L	-	I	C	C	F	I	C	C	-	I
Radius-R	F	I	I	C	C	C	C	C	F	C
Radius-L	-	C	-	C	-	C	C	I	F	C
Ulna-R	F	I	I	C	C	C	C	C	I	C
Ulna-L	-	C	-	I	F	C	C	C	-	C
Manus-R	I	I	-	I	I	C	F	I	I	I
Manus-L	-	I	-	C	C	C	F	I	I	C
Pelvic Girdle										
Innominate-R	-	I	-	C	I	C	C	I	I	C
Innominate-L	F	I	-	I	I	C	C	I	I	C

Table II, continued

Specimen No.	1972-I	1973-II	1972-III	1973-IV	1972-IX	1972-X	1970-IV	1973-III	1973-V	1973-XIII
Sex	M	M	M	M	M	M	M	F	F	F
<u>Lower Extremity</u>										
Femur-R	F	I	-	C	F	-	C	I	F	C
Femur-L	F	-	-	C	C	C	C	I	F	-
Tibia-R	F	I	-	I	-	-	C	I	F	C
Tibia-L	F	I	-	C	I	C	I	I	F	-
Fibula-R	F	C	-	I	-	-	I	C	F	C
Fibula-L	F	I	-	C	I	C	I	I	F	C
Pes-R	-	I	-	I	-	C	I	I	-	I
Pes-L	-	I	-	I	-	C	C	I	-	C
Patella-R	-	C	I	C	-	C	C	-	-	C
Patella-L	-	C	I	C	-	C	C	-	-	C

*C = complete; I = incomplete; F = fragmentary; - = missing

TABLE III. CRANIAL MEASUREMENTS (mm) AND INDICES*

Specimen No.	1972-III	1970-IV	1973-III	1972-XIII
Sex	M	M	F	F
Cranium:				
Glabella-Opistocranion length (1)	198	192		
Bieuryonic breadth (8)	135	146		
Basion-Bregma height (17)	153	124		
Bifrontotemporale breadth (9)	97	107	100	104
Bizygomatic breadth (45)		145		
Nasion-Prosthion height (48)	68	62.5		
Prosthion-Subnasale height (48-1)	19		19	
Nasal height (55)	48	48.5		
Nasal breadth (54)	23	26		
Orbital height - R (52)	31	30.5		
Orbital height - L (52)		31		
Orbital breadth - R (51)	39	40		
Orbital breadth - L (51)		41.5		
Interorbital breadth (50)	24	29.5		
Biorbital breadth (44)		113		
External Palate breadth (61)	58		64	
Internal Palate breadth (63)	37	44.5	38	
Internal Palate length (62)	54		62	
Palate depth (64)	13	14	13	
Molar Row length - R			30.5	31
Molar Row length - L			29	30
Premolar-Molar Row - R			43	45
Premolar-Molar Row - L			42	45
Nasion-Bregma chord (29-1)	123	116		115
Nasion-Bregma arc (25)	134	137		103
Bregma-Lambda chord (30)	137	117		133
Bregma-Lambda arc (27)	145	137		105.5
Cranial Capacity (Lee-Pearson 1901)		1449.20 cm^3	1515.65 cm^3	
		1336.52 cm^3		

Table III, continued

Specimen No.	1972-III	1970-IV	1973-III	1972-XIII
Sex	M	M	F	F
<u>Mandible</u>:				
Condylo-Symphyseal length (68)	122	114		96
Bigonial breadth (66)	90	118		
Bicondylar breadth (65)	112			
Corpus length - R (68-1)		86		89
Corpus length - L (69-1)	89	86		88
Corpus height at M_2 - R	29.5	37		29
Corpus height at M_2 - L	29.5	33		29
Corpus thickness at M_2 - R	17	22		19
Corpus thickness at M_2 - L	16	20		18
Ramus height - R (70)	59			54
Ramus height - L (70)	60	67		
Minimum Ramus breadth - R (71)		45		40
Minimum Ramus breadth - L (71)	34	44.5		
Maximum Ramus breadth - R (71-1)				50
Maximum Ramus breadth - L (71-1)	44	54.5		
Bimental breadth (67)	48.5	55		51
Molar Row length - R	31	32		
Molar Row length - L	32	34		
Premolar-Molar Row - R	44	48.5		
Premolar-Molar Row - L	44	47		
Symphyseal thickness	10	19		16
Corpus-Ramus angle - degrees (79)	125	115		115
Symphyseal height (69)	34	38.5		31
Cranial length-breadth index	68.18		76.04	
Cranial height-breadth index	88.23		84.93	
Cranial height-length index	77.27		64.58	
Upper Facial index			43.10	
Orbital index - R	79.48		76.25	
Orbital index - L			74.70	

Table III, continued

Specimen No.	1972-III	1970-IV	1973-III	1972-XIII
Sex	M	M	F	F
Nasal index	47.91		53.61	
Internal Palate index	68.51		89.00	61.29
Zygo-Frontal index			73.79	

*R = right side; L = left side; A-P = anterior-posterior; Lat. = lateral; I-S = inferior-superior. Measurements for skeleton 1970-IV are taken from Dutta (1984); numbers in parentheses refer to Martin and Saller (1957) code.

TABLE IV. DENTAL MEASUREMENTS (mm) AND INDICES*

Measurements (millimeters)	MD	BL	MD/BL	BL/MD	MD X BL	(MD + BL)/2
1972-III						
Maxilla						
RM3	8.7	9.6	90.63	110.34	83.52	9.15
RM2	10.1	10.0	101.00	99.01	101.00	10.05
RM1	9.8	9.8	100.00	100.00	96.04	9.80
RPM2	5.9	9.0	65.56	152.54	53.10	7.45
RPM1	6.0	9.2	62.22	153.33	55.20	7.60
RC	7.5					
RI2	7.0					
RI1	8.4					
LM3	8.1	9.4	86.12	116.04	76.14	8.75
LM2	9.8	10.1	97.03	103.06	98.98	9.95
LM1	10.4	10.3	100.97	99.03	107.12	10.35
LPM2	5.9	8.8	67.05	149.15	51.92	7.35
LPM1	6.4	8.7	94.12	134.39	55.04	7.50
LC	7.6					
LI2	7.2					
LI1	8.8					
Mandible						
RM3	10.0	9.2	108.70	92.00	92.00	9.60
RM2	9.8	9.0	108.89	91.83	88.20	9.40
RM1	10.3	10.0	103.00	97.08	103.00	10.15
RPM2	6.4	7.4	86.49	115.62	47.36	6.90
RPM1	6.6	5.8	113.79	87.87	38.28	6.20
RC	7.0					
RI2	6.5					
RI1	5.5					
LM3	10.5	9.5	110.53	90.47	99.75	10.00
LM2	10.0	9.1	109.89	91.00	91.00	9.55
LM1	10.3	10.0	103.00	97.08	103.00	10.15
LPM2	6.5	7.3	89.04	112.30	47.45	6.90
LPM1	6.8	5.8	117.24	85.29	39.44	6.30
LC	7.2					
LI2	5.5					
LI1						

Table IV, continued

Measurements (millimeters)	MD	BL	MD/BL	BL/MD	MD X BL	(MD + BL)/2
1973-III						
Maxilla						
RM3	8.8	9.4	93.62	82.72	9.10	
RM2	9.0	10.0	95.71	116.66	94.50	9.75
RM1	11.0	11.0	100.00	100.00	121.00	11.00
RPM2	6.5	8.4	77.38	129.23	54.60	7.45
RPM1	7.3	8.2	89.02	112.32	59.86	7.75
RC	8.1					
RI2	7.9					
RI1						
LM3	8.9	9.4	95.68	105.61	83.66	9.15
LM2	9.0	10.0	90.00	111.10	90.00	9.50
LM1	11.6	11.0	105.45	94.82	127.60	11.30
LPM2	6.1	8.1	75.31	132.78	49.41	7.10
LPM1	7.3	8.7	83.91	119.17	63.51	8.00
LC	8.3					
LI2	6.9					
LI1	7.9					
Mandible						
RM3	11.9	9.5	125.26	79.83	113.05	10.70
RM2	10.5	10.1	103.96	96.19	106.05	10.30
RM1	11.4	10.2	111.76	89.47	116.28	10.80
RPM2	6.4	7.5	85.33	117.18	48.00	6.95
RPM1	6.9	6.8	101.47	98.55	46.92	6.85
RC	6.5					
RI2	5.8					
RI1	5.1					
LM3	11.3	9.4	120.21	83.18	106.22	10.35
LM2	10.1	9.9	102.02	98.01	99.99	10.00
LM1	11.3	10.5	107.62	92.92	118.65	10.09
LPM2	6.5	7.0	92.86	107.69	45.50	6.75
LPM1	7.3	6.5	112.31	89.04	47.45	6.90
LC	7.0					
LI2						
LI1						

Table IV, continued

Measurements (millimeters)	MD	BL	MD/BL	BL/MD	MD X BL	(MD + BL)/2
1972-XIII						
Maxilla						
RM3	8.5	11.0	77.27	129.41	93.50	9.75
RM2	9.0	10.1	89.11	112.22	90.90	9.55
RM1	10.5	10.4	100.96	99.04	109.20	10.45
RPM2	7.2	8.8	81.82	122.22	63.36	8.00
RPM1	6.8	8.7	78.16	127.94	59.16	7.75
RC	7.8					
RI2						
RI1	9.0					
LM3	7.7	11.3	68.14	146.75	87.01	9.50
LM2	8.7	10.0	87.00	114.94	87.00	9.35
LM1	9.9	10.3	96.12	104.04	101.97	10.10
LPM2	7.2	9.2	78.26	127.77	66.24	8.20
LPM1	7.3	9.0	81.11	123.28	65.70	8.15
LC	7.2					
LI2	6.5					
LI1	9.0					
1970-IV						
Maxilla						
RM3	7.9	10.2	77.45	129.11	80.58	9.05
RM2	9.5	11.5	82.61	121.05	109.25	10.50
RM1	10.0	11.1	90.09	111.00	111.00	10.55
RPM2	6.6	10.0	66.00	151.52	66.00	8.30
RPM1	6.5	9.6	67.71	147.69	62.40	8.05
RC	8.0	9.3	86.02	116.25	74.40	8.65
RI2	7.0	7.0	100.00	100.00	49.00	7.00
RI1	8.7	8.5	102.35	97.70	73.95	8.60
LM3	8.0	10.4	76.92	130.00	83.20	9.20
LM2	9.2	11.5	80.00	125.00	105.80	10.35
LM1	10.2	11.2	91.07	109.80	114.24	10.70
LPM2	6.6	10.1	65.35	153.03	66.66	8.35
LPM1	7.0	10.0	70.00	142.86	70.00	8.50
LC	8.0	9.2	86.96	115.00	73.60	8.60
LI2	7.0	7.0	100.00	100.00	49.00	7.00
LI1	8.5	8.2	103.66	96.47	69.70	8.35

*MD = mesio-distal diameter; BL = bucco-lingual diameter; MD/BL and BL/MD = crown index; MD X BL = robustness or crown area index; MD + BL/2 = crown module; R = right; L = left.

TABLE V. POSTCRANIAL MEASUREMENTS (mm) AND INDICES

Specimen No.	1972-II	1973-II	1972-III	1973-IV	1972-IX	1972-X	1973-III	1972-XIII	1970-IV
Sex	M	M	M	M	M	M	F	F	M
Thorax									
Sternum:									
Manubrium height (2)					40	47			
Manubrium breadth (4)					53.5	57			
Manubrium height-breadth index					74.76	82.45			
Sacrum:									
Anterior height (2)					104	115	112		
Anterior breadth (5)					115	108	94.5		
Sacral height-breadth index					90.43	106.48	118.51		
Vertebrae:									
Vertical ventral height T9 (1)				21					
T10				26		21			
T11	19.5					20			
T12						23			
L1	23				24	22			
L2				26	25				
L3	24.5			24.5	26.5		21		
L4				24	26	26			
L5	28			24	24	24	22		

Table V, continued

Specimen No.	1972-II	1973-II	1972-III	1973-IV	1972-IX	1972-X	1973-III	1972-XIII	1970-IV
Sex	M	M	M	M	M	M	F	F	M
<u>Pectoral Girdle</u>									
<u>Clavicle</u>:									
Maximum length - R (1)						131			149
Maximum length - L		156	138.5	158		134	143		152
Mid-shaft diameter A-P - R (5)		15		14		15	14		
Mid-shaft diameter A-P - L		13	12	13		15	14		
Mid-shaft diameter I-S - R (4)		14		13		14	10		
Mid-shaft diameter I-S - L		11	9	12		13	9		
Mid-shaft circumference - R (6)		44		45		45.5	41		40
Mid-shaft circumference - L		38	38	44		45	38		40
Clavicle - Humeral Index - R						35.98			45.43
Clavicle - Humeral Index - L									
<u>Scapula</u>:									
Maximum length - R (2)									
Maximum length - L (2)			153						
Breadth - R (1)						109			
Breadth - L (1)			122						
Acromial Process length - R (10)									
Acromial Process length - L (10)				51		52			
Glenoid Cavity height - R (12)				38.5		42	43	38	
Glenoid Cavity height - L (12)			33	36		44		37	
Length-Breadth index			79.73						

Table V, continued

Specimen No.	1972-II	1973-II	1972-III	1973-IV	1972-IX	1972-X	1973-III	1972-XIII	1970-IV
Sex	M	M	M	M	M	M	F	F	M
<u>Upper Extremities</u>									
<u>Humerus:</u>									
Maximum length - R (1)				363		364	348	358	328
Maximum length - L (1)		357	336	361					
Head diameter A-P - R (9)				47		41		40	46.5
Head diameter A-P - L (9)			42	46		39			
Mid-shaft diameter A-P - R (6c)		22		23	22.5	22.5	22	19.5	
Mid-shaft diameter A-P - L (6c)		23	19	23		22	21	15	
Mid-shaft diameter Lat - R (6b)		26		25	18	23	21	20	
Mid-shaft diameter Lat - L (6b)		20	20	24		22	20	19	
Mid-shaft circumference - R (7a)		74		78	67	76	70	64.5	
Mid-shaft circumference - L		68	62	76		71	63	60	
Mid-shaft index - R		84.61		92.00	125.00	97.82	104.75	97.50	
Mid-shaft index - L		115.00	95.00	95.83		100.00	105.00	78.94	
Robusticity Index - R				21.48		20.87	20.11	18.01	
Robusticity Index - L				21.05					
Middle Index - R		118.18		100.68	80.00	102.22	94.45	102.56	
Middle Index - L		86.95	105.26	104.34		100.00	95.23	126.66	
Humero-Femoral Index - R									
Humero-Femoral Index - L				72.34					

Table V, continued

Specimen No.	1972-II	1973-II	1972-III	1973-IV	1972-IX	1972-X	1973-III	1972-XIII	1970-IV
Sex	M	M	M	M	M	M	F	F	M
<u>Radius:</u>									
Maximum length - R (1)				295	265	288	285		268
Maximum length - L		295				278			266
Head diameter Lat - R (4-1)		24	22	24	23	23	23		
Head diameter Lat - L		24		23		23	22		
Mid-shaft diameter A-P - R (5)		13		14	12	12.5	12	13	
Mid-shaft diameter A-P - L		13		13		13.5	12	14	
Mid-shaft diameter Lat - R (4)		15		18	15	15.5	16	11	17
Mid-shaft diameter Lat - L		16		15		16	15	11	17
Mid-shaft circumference - R		46		48	45.5	47	45	39	
Mid-shaft circumference - L		48		45		49	46	41	
Mid-shaft index - R		86.66		77.77	80.00	80.64	75.00	118.18	
Mid-shaft index - L		81.25		86.66		84.37	80.00	127.27	
Humeral-Radial index - R									77.13
Humeral-Radial index - L		82.63		81.26		79.12	82.75		
Middle index - R		115.38		128.57	125.00	124.00	133.33	84.61	
Middle index - L		123.07		115.38		118.51	125.00	78.57	

Table V, continued

Specimen No.	1973-II	1972-III	1973-IV	1972-IX	1972-X	1973-III	1972-V	1972-XIII	1970-IV
Sex	M	M	M	M	M	M	F	F	M
<u>Ulna:</u>									
Maximum length - R (1)			319	295	308	300			288
Maximum length - L (1)	312		316		307	295			
Semi-lunar notch height - R (8)	36	29	38	33	32	36			
Semi-lunar notch height - L (8)	36		38		33				
Mid-shaft diameter A-P - R (11)	14		17	13	17.5	15	17.5	12	
Mid-shaft diameter A-P - L (11)	13		17		18	19		13	
Mid-shaft diameter Lat - R (12)	17		14	14.5	13.5	12	14.5	15	
Mid-shaft diameter Lat - L (12)	14		12		14	12		15	
Mid-shaft circumference - R	52		52	58	52	45	53	45	
Mid-shaft circumference - L	47		53		50	42		46	
Mid-shaft index - R	82.35		121.42	89.65	129.62	125.00	120.68	80.00	
Mid-shaft index - L	92.85		141.66		128.57	158.33		86.00	
Middle Index - R	121.42		82.35	111.53	77.14	80.00	82.85	125.00	
Middle Index - L	107.69		70.58		77.77	63.15		115.38	

Table V, continued

Specimen No.	1973-II	1973-IV	1972-IX	1972-X	1973-III	1972-XIII	1970-IV
Sex	M	M	M	M	F	F	M
Pelvic Girdle							
Innominate:							
Maximum height - R (1)		222		223	131	203	210
Maximum height - L (1)				223	206	204	220
Breadth - R (6a)				155	210	126	138.0
Breadth - L (6a)	141	149		149		133	138.0
Acetabulum diameter I-S - R (22)		58		59	47	45	57.0
Acetabulum diameter I-S - L (22)			46.5	60		45	57.0
Sciatic Notch breadth - R (8)	50.5	38		42.5			
Sciatic Notch breadth - L (8)	51			42		41	
Pelvic Inlet diameter A-P (23)						97	
Pelvic Inlet diameter Lat (24)						120	
Innominate length-breadth index - R						62.06	65.71
Innominate length-breadth index - L						65.19	62.72
Pelvic Inlet index						80.83	
Lower Extremities							
Femur:							
Maximum length - R (1)							464
Maximum length - L (1)		499	480	512			462
Head diameter A-P - R (19)		49			47		45
Head diameter A-P - L (19)		49	44	46			45

Table V, continued

Specimen No.	1973-II	1973-IV	1972-IX	1972-X	1973-III	1972-XIII	1970-IV
Sex	M	M	M	M	F	F	M
<u>Femur</u>, continued							
Subtrochanteric dia. A-P - R (10)	26	29			32		
Subtrochanteric dia. AD-P - L (10)		28			32		
Subtrochanteric dia. Lat - R (9)	32	33			29.5		
Subtrochanteric dia. Lat - L (9)		34	32	34	29		
Mid-shaft diameter A-P - R (6)	34	34			29		33
Mid-shaft diameter A-P - L (6)		34	27	38	29	30	34
Mid-shaft diameter Lat - R (7)	29.5	28			24		26
Mid-shaft diameter Lat - L (7)		28	28.5	27.5	25	25	26
Mid-shaft circumference - R	101	97			87		
Mid-shaft circumference - L		97	90	103	86	87	
Bicondylar Breadth - R (21)							
Bicondylar Breadth - L (21)				80.5			71.5
Pilastric index - R							125.92
Pilastric index - L							130.77
Platymeric index - R	81.25	87.87					89.65
Platymeric index - L		82.35	90.62	76.47	108.47		89.65
Robusticity Index - R					110.34		12.88
Robusticity Index - L		12.50	11.70	12.94			13.11
Middle Index - R	86.76	82.35			82.75		78.78
Middle Index - L		82.35	105.55	72.36	86.20		76.47

Table V, continued

Specimen No.	1973-II	1973-IV	1972-IX	1972-X	1973-III	1972-XIII	1970-IV
Sex	M	M	M	M	F	F	M
<u>Tibia:</u>							
Maximum length - R (1)							391
Maximum length - L (1)		434		445		435	390.5
Mid-shaft diameter A-P - R (8)	29.5				29		38.5
Mid-shaft diameter A-P - L (8)	30	32	27	37	32	31	38.5
Mid-shaft diameter Lat - R (9)	24				20.5		25
Mid-shaft diameter Lat - L (9)	24	21	19	25	23	24	25
Mid-shaft circumference - R	90				83		89
Mid-shaft circumference - L	85	91	75	98	88	87	90
Platycnemic index - R	81.35				70.68		69.23
Platycnemic index - L	80.00	65.62	70.37	67.56	71.87	77.4	67.50
Tibia-Femoral index - R							80.52
Tibia-Femoral index - L		86.97		86.91			

Table V, continued

Specimen No.	1973-IV	1972-IX	1972-X	1973-III	1972-XIII	1970-IV
Sex	M	M	M	F	F	M
Fibula:						
Maximum length - R (1)						
Maximum length - L (1)	417		427			
Mid-shaft diameter A-P - R (3-2)				14		
Mid-shaft diameter A-P - L (3-2)	16	15	17	14.5	13	
Mid-shaft diameter Lat - R (3-1)				11.5		
Mid-shaft diameter Lat - L (3-1)	15	13	13.5	11	17	
Mid-shaft circumference - R				47		48
Mid-shaft circumference - L	53	50	48	43	50	48

Table V, continued

Specimen No.	1973-II	1972-III	1973-IV	1972-X	1973-III	1972-XIII	1970-IV
Sex		M	M	M	F	F	M
<u>Calcaneus:</u>							
Maximum length - R (1)	84			84	79	78	79
Maximum length - L (1)	85	39		85	87	78	
<u>Talus:</u>							
Maximum length - R (1)	55		54	63		53	54
Maximum length - L (1)	55	58.5	63	64	54	54	55
Breadth - R (2)	48.5		56	44		39	39
Breadth - L (2)	49	44	52	44	42	39	39
Height - R (3)	30		35	38		29	
Height - L (3)	32	32	34	38	30	32	
<u>Patella:</u>							
Height - R (1)	43		46	46			40
Height - L (1)	44		44.5	47		40.5	40
Breadth - R (2)	46		48	45			46
Breadth - L (2)	47		45	47		40	44

TABLE VI. ESTIMATION OF STATURE FROM LONG BONES

Specimen No.	Sex	Measurements of maximum lengths in mm		Stature estimate cm	Stature estimate inches
1973-II	M	Humerus-L	357	180.40	71.02
		Radius-L	295	190.52	75.00
		Ulna-L	312	189.49	74.60
1972-III	M	Humerus-L	336	173.73	68.47
1973-IV	M	Humerus-R	363	182.25	71.75
		Humerus-L	361	181.63	71.51
		Radius-R	295	190.52	75.00
		Ulna-R	319	192.08	75.62
		Ulna-R	316	190.97	75.18
		Femur-L	499	180.17	70.93
		Tibia-L	434	187.98	74.00
1972-IX	M	Radius-R	265	179.18	70.54
		Ulna-R	295	183.20	72.12
		Femur-L	480	175.65	69.15
1972-X	M	Humerus-R	364	182.56	71.87
		Ulna-R	308	187.96	74.00
		Ulna-L	307	187.64	73.87
		Femur-L	512	183.26	72.15
		Tibia-L	445	190.76	75.10
1970-IV*	M	Humerus-R	328	171.00	67.30
		Radius-R	268	180.00	70.10
		Radius-L	266	179.00	70.40
		Ulna-R	288	181.00	71.20
		Femur-R	464	172.00	67.60
		Femur-L	462	171.00	67.30
		Tibia-R	391	177.00	69.50
		Tibia-L	390.5	177.00	69.50
1973-III	F	Humerus-R	348	174.89	68.85
		Radius-R	285	190.02	74.81
		Ulna-R	300	185.86	73.17
		Ulna-L	295	183.72	72.33
1972-XIII	F	Humerus-R	358	178.25	70.18
		Tibia-L	435	187.68	73.88

*A stature of 174.03 cm (68.51 in) is estimated for this specimen by Dutta (1973; Dutta et al. 1972) with reference to Trotter's tables of 1952 and 1958, but Dutta does not indicate which of the long bones were used in this determination of stature. Stature estimates in centimenters and inches for each of the long bones of this specimen and others are calculated by the present writers using formulae favored by Trotter (1970). Standard errors for these formulae are given in Table XXVIII of Trotter (1970: 77). These are in the neighbourhood of ± 3 to ± 4 cm.

TABLE VII. SUMMARY OF PATHOLOGICAL AND ANOMALOUS FEATURES

Specimen No.	Osteological abnormality and diagnosis	Anomalous features and markers of habitual stress
1972-I	———	———
1973-II	Lipping on thoracic and lumbar bodies: osteoarthritis.	Squatting facets.
1972-II	Dental enamel hypoplasia on incisors and canines of upper and lower dentitions: marker of an episode of arrested growth.	Hyperdevelopment of muscular attachments for Anconeus and Supinator.
1973-IV	Lipping on thoracic and lumbar bodies: osteoarthritis. Lipping on right patella: local inflammation of knee joint.	Hyperdevelopment of muscular attachments for Anconeus and Supinator.
1972-X	Lipping on all vertebral bodies: osteoarthritis. Exostosis at distal end of right radius: osteochondroma. Exostosis of the left 1st metatarsal: osteochondroma.	Squatting facets. Hyperdevelopment of tendinous attachments to palmar surface of manual phalanges. Perforation of olecranon fossae of humerus. Hyperdevelopment of tibial tuberosity.
1970-IV	Depression of right frontal region: "left hemiperesis" (Dutta 1973; Dutta et al. 1972).	Squatting facets.
1973-III	———	Hyperdevelopment of muscular attachments for Anconeus and Supinator.
1972-V	Lipping of 4th lumbar body: osteoarthritis.	Hyperdevelopment of muscular attachments for Anconeus and Supinator.
1972-XIII	———	———

Figure 1. Site of Sarai Nahar Rai

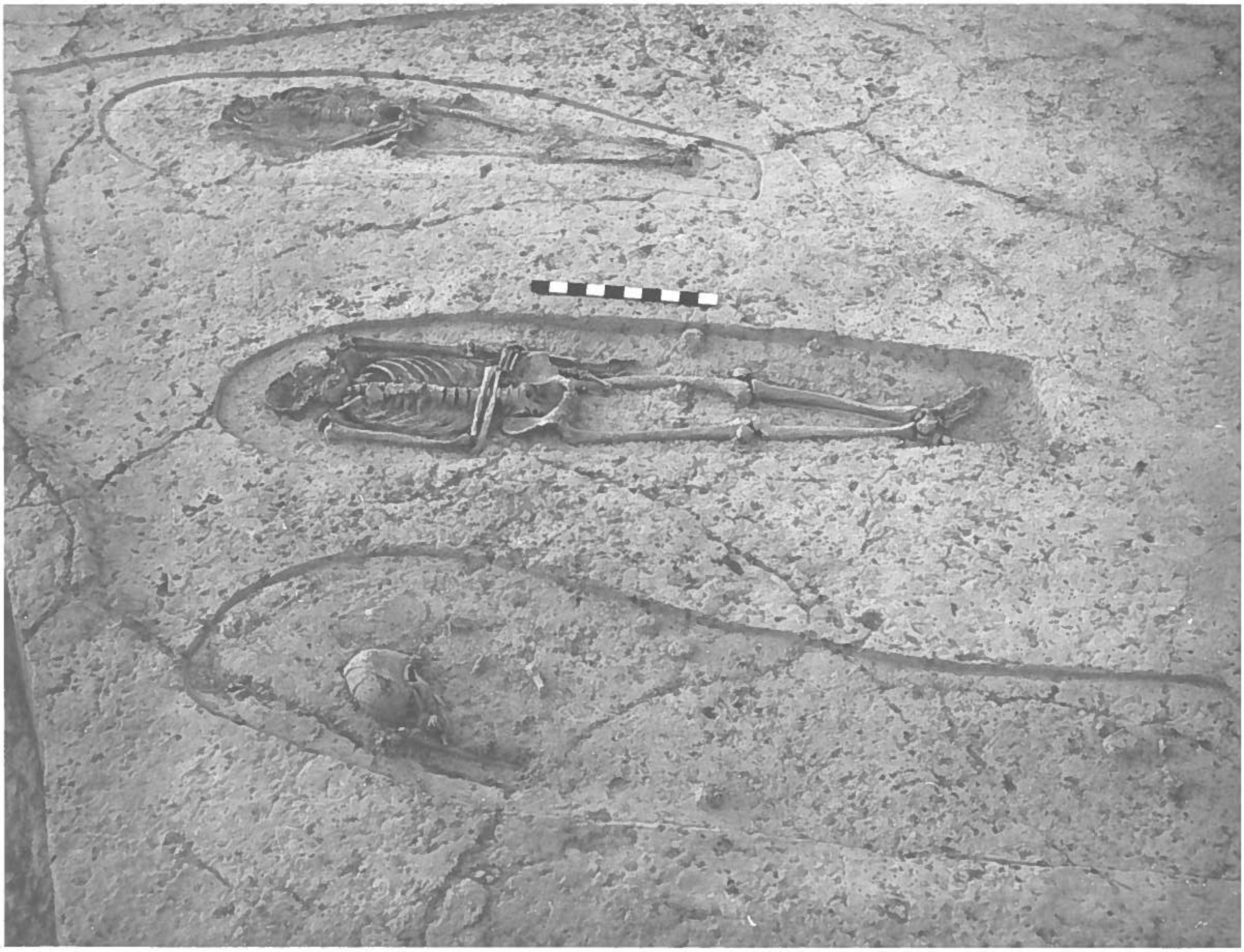
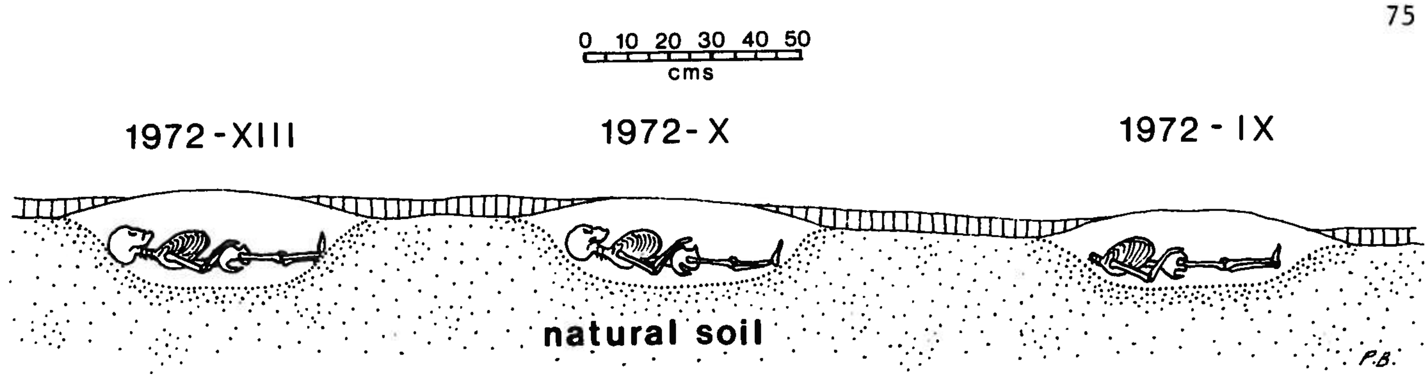


Figure 2. Skeletons 1972-XIII (lower), 1972-X (middle), and 1972-IX (upper), *in situ*



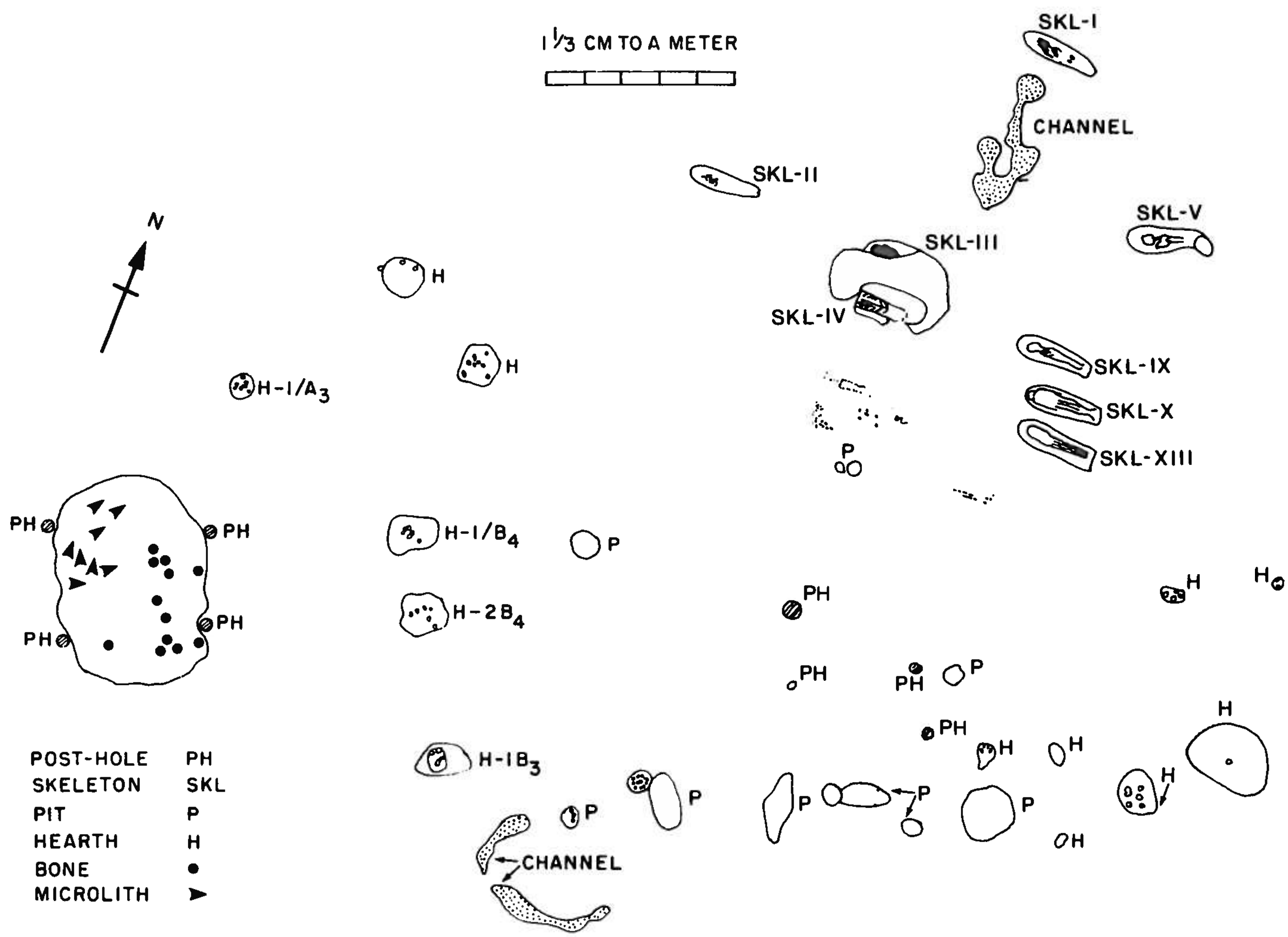


Figure 3. Section across graves of Skeletons 1972-IX, 1972-X and 1972-XIII

Figure 4. Skeleton 1972-III *in situ*

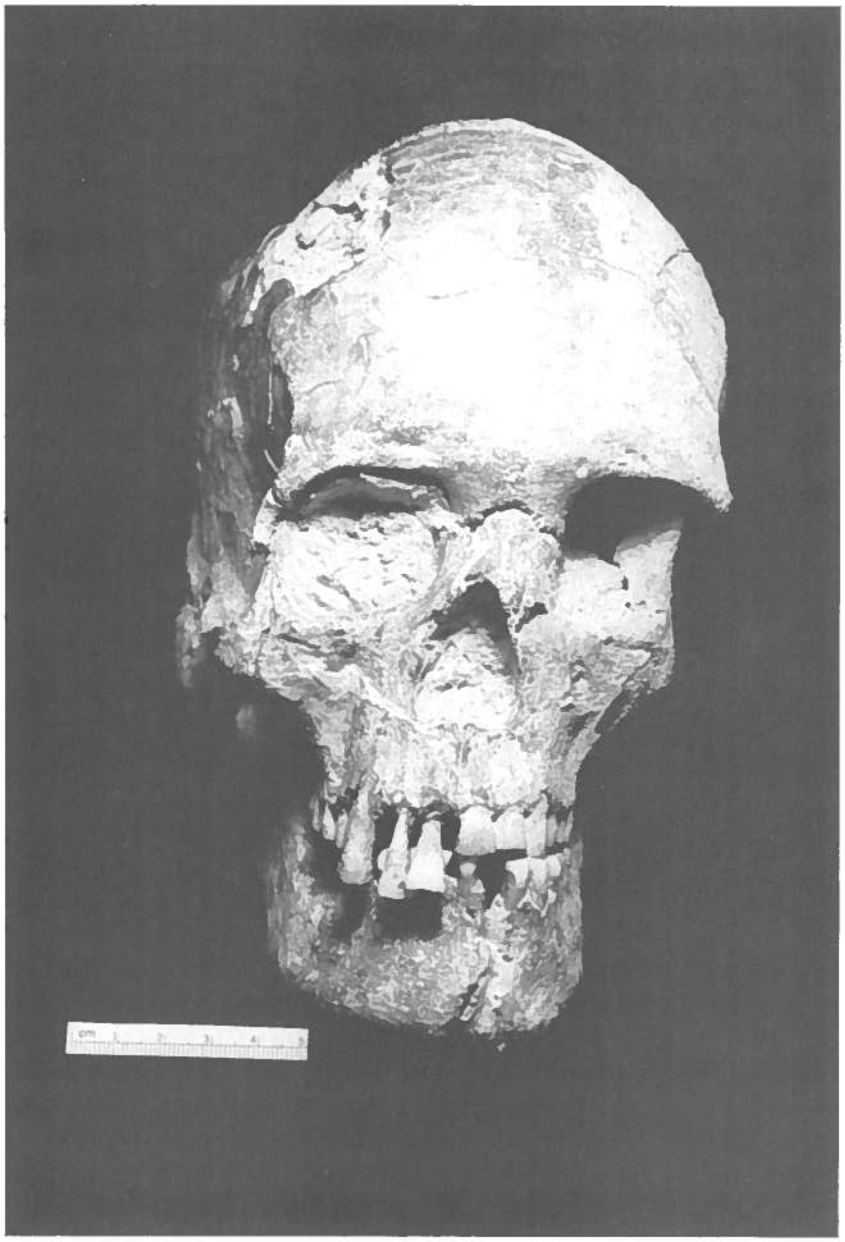


Figure 5. Skull of Skeleton 1972-III,
frontal aspect

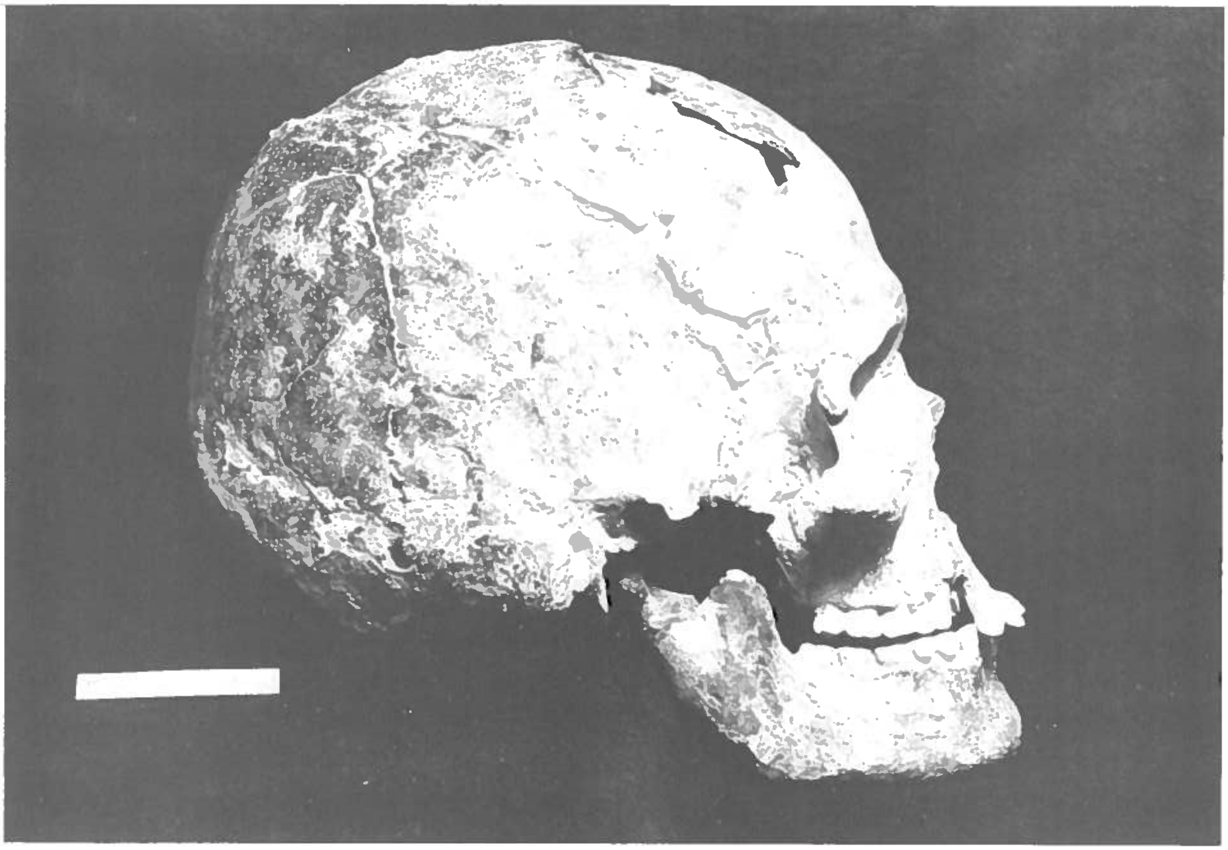


Figure 6. Skull of Skeleton 1972-III,
right lateral aspect

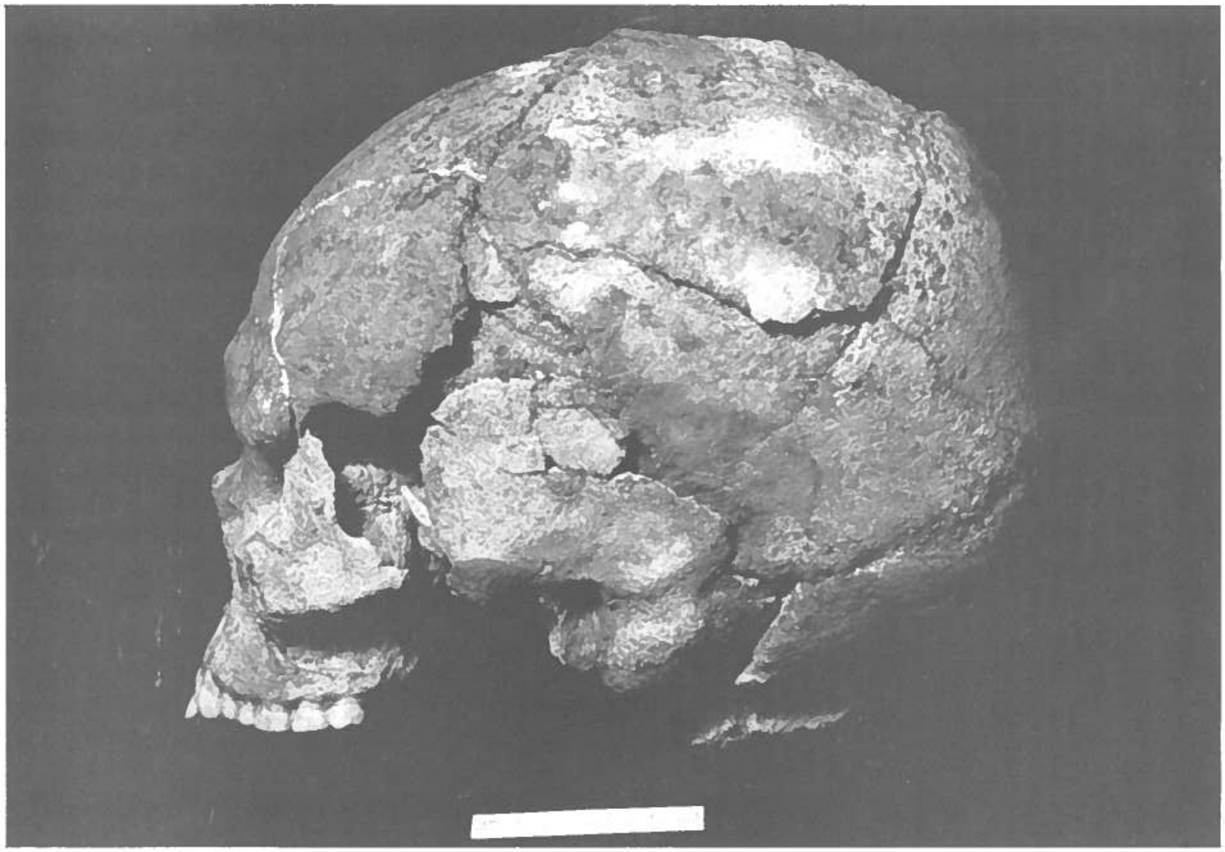


Figure 7. Cranium of Skeleton 1972-III, left lateral aspect

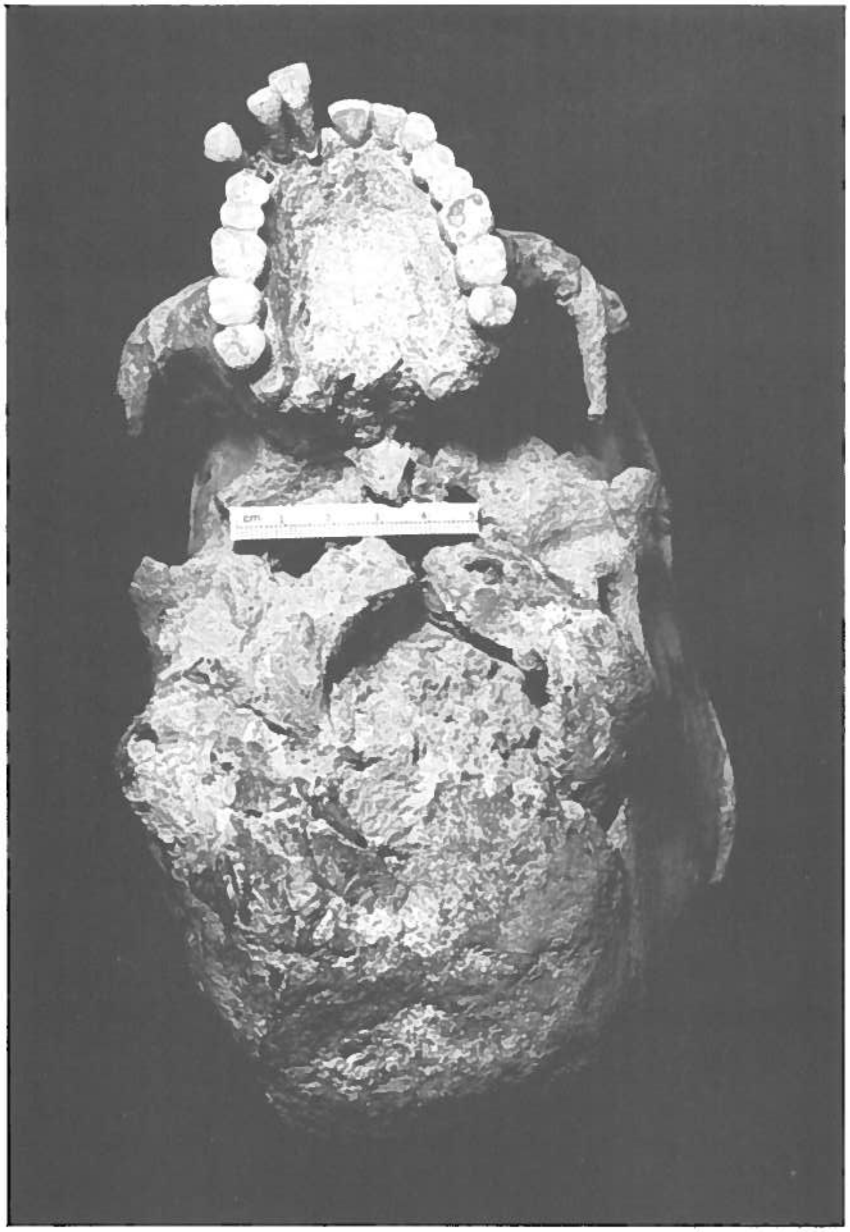


Figure 8. Cranium of Skeleton 1972-III, basalar aspect

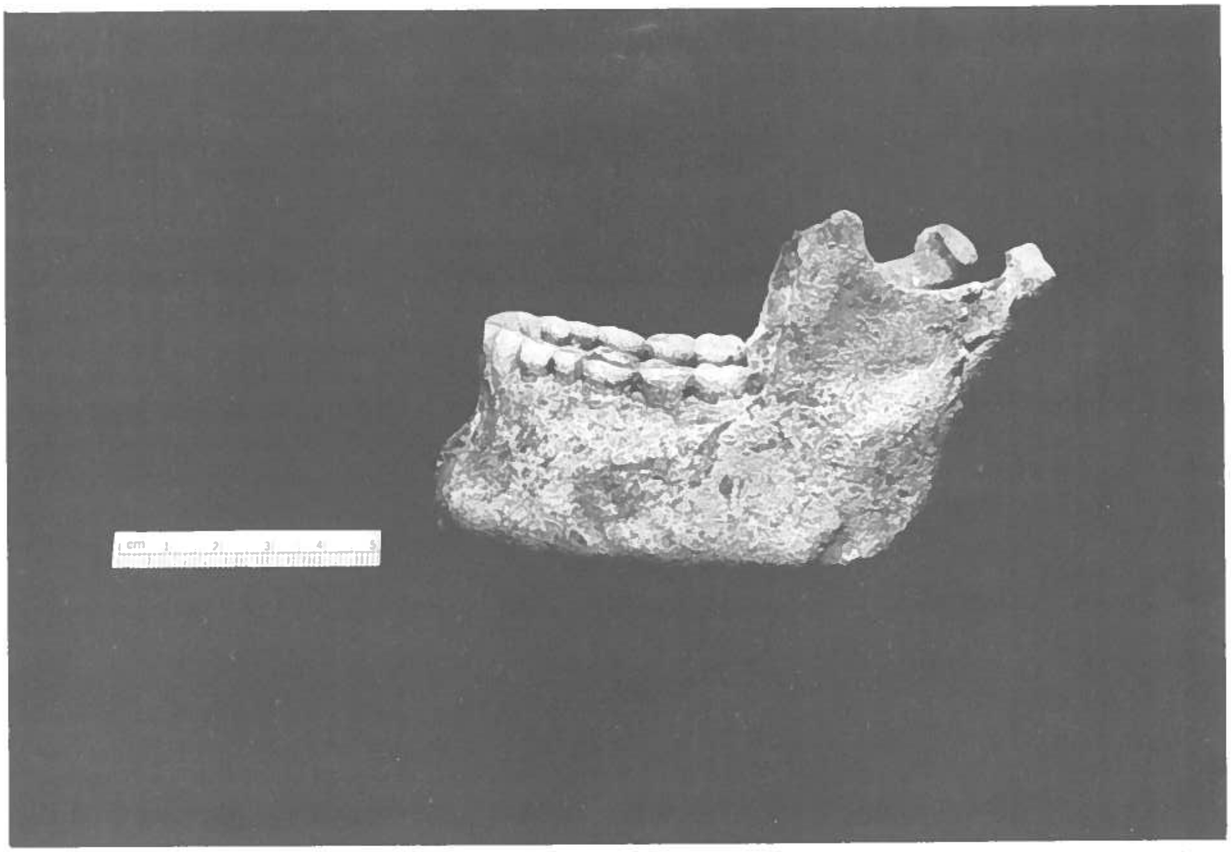


Figure 9. Mandible of Skeleton 1972-III
left lateral aspect

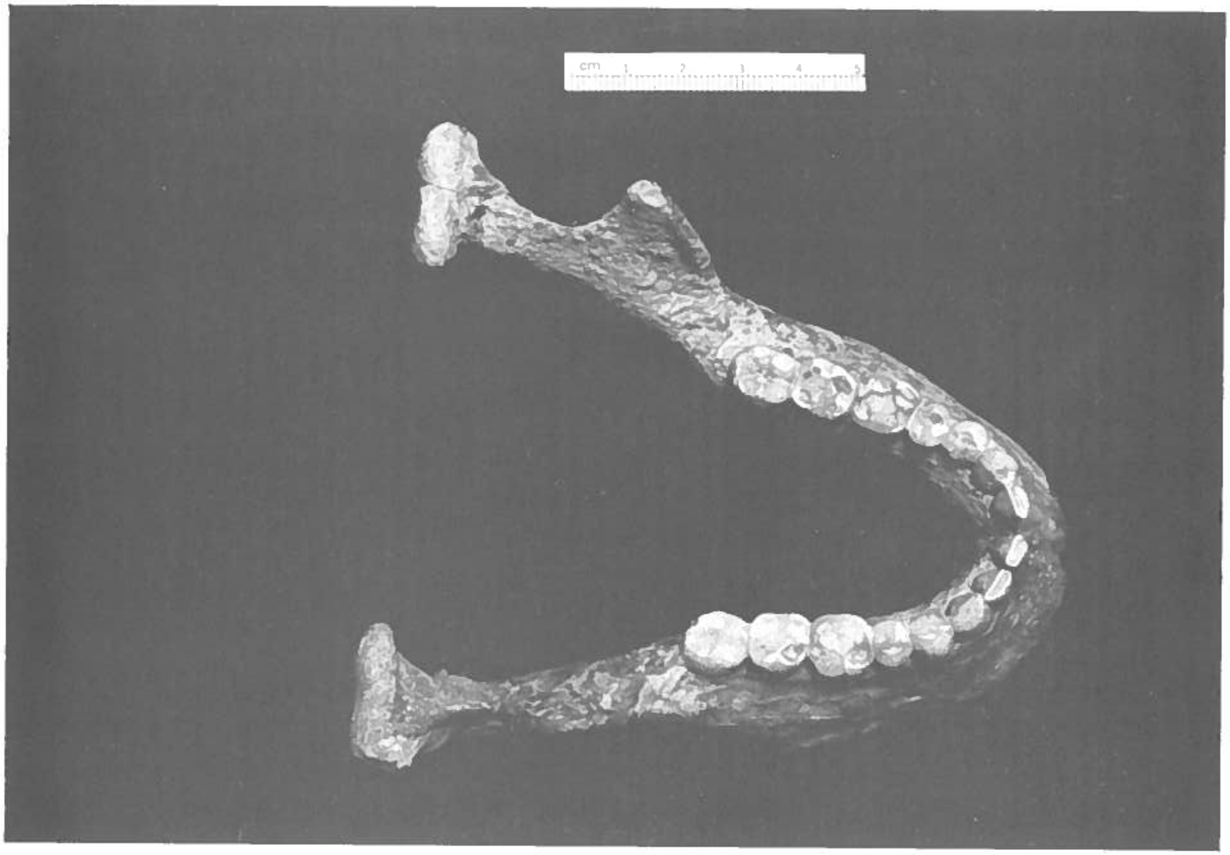


Figure 10. Mandible of Skeleton 1972-III, superior aspect

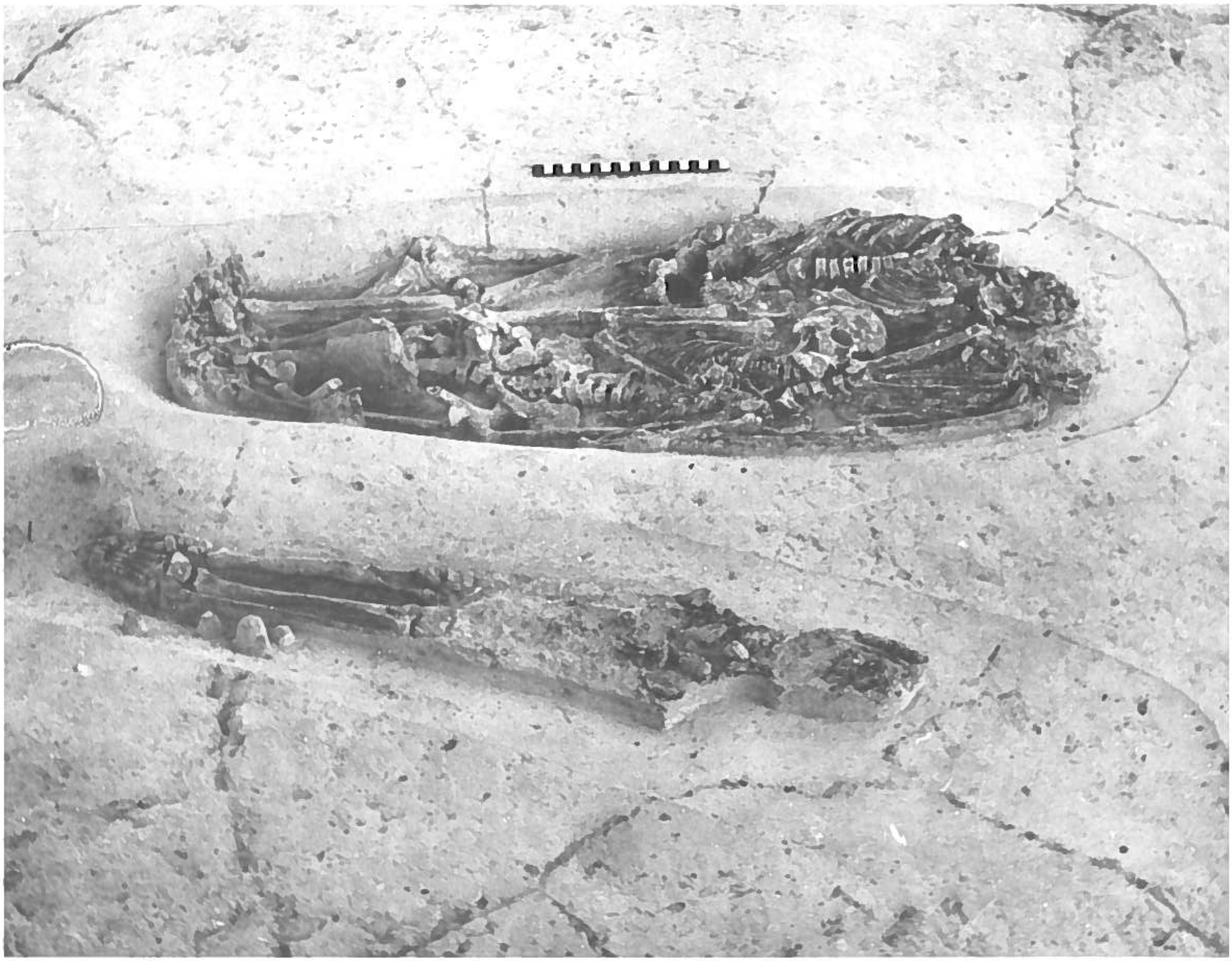


Figure 11. Skeletons 1973-II (lower) and 1973-III (upper), *in situ*

Figure 12. Skull of Skeleton 1973-III, *in situ*

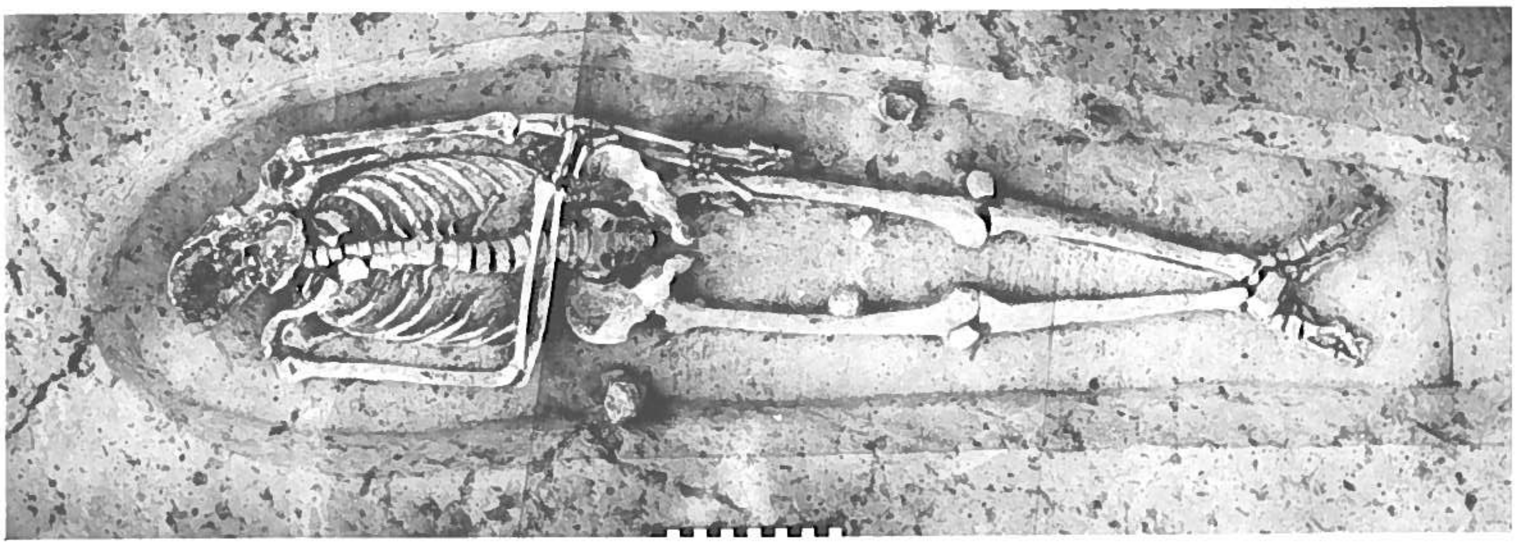


Figure 13. Skeleton 1972-X, *in situ*

Figure 14. Detail of Skeleton 1972-X, in situ. Note stone projectile point on left transverse process of the fifth lumbar vertebra

Figure 15. Osteoarthritic lipping of lumbar vertebrae of Skeleton 1973-IV

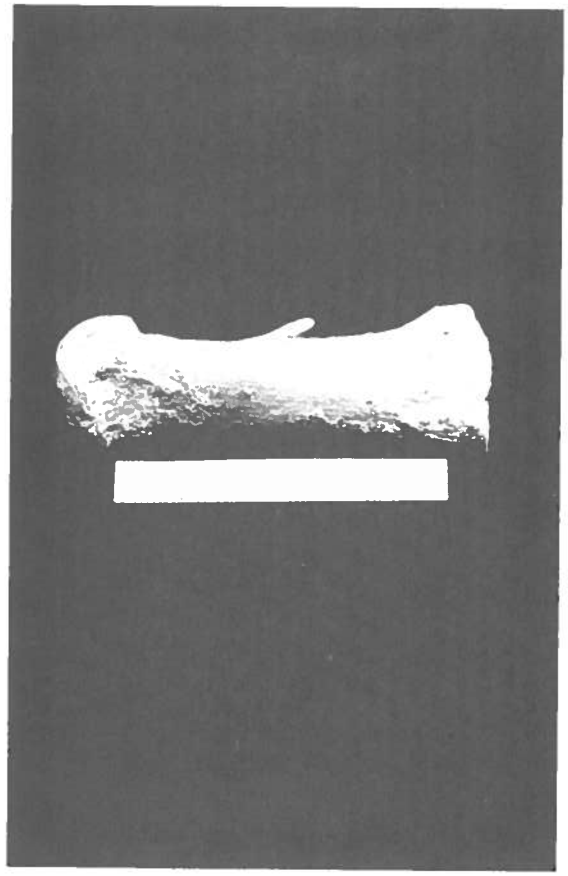


Figure 16. Exostosis on left first metatarsal of Skeleton 1972-X

Figure 17. Hypertrophy of Supinator crest on ulna of Skeleton 1973-IV